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INDEX

VOL. XXXIII, JANUARY-JUNE, 1910

GENERAL INDEX

A

Abutments Concrete, Cost 114, 354
Adverse Possession, Doctrine, Definition. 115
Aggregates (See Concretes) .....
Air Valves, Pipe Line, Water Works.... 203
Alkali, Active on Concrete 6, 539
Alvord, John W..... 51
American Society for Testing Materials.. 567
American Society of Civil Engineers.... 521
American Society of Engineering Contractors 208
American Society of Mechanical Engineers 486
American Water-Works Association..... 176
Aqueducts, Catskill, Pressure Tunnels... 122
Lining, Concrete 98
Los Angeles, Day Labor Work....443, 459
Structural Features 407
Arch Centers, Steel, Design for 150 ft. Span 120
Arches, Concrete .....
..72, 120, 234, 279, 332, 541, 476, 586
Crown Thickness, Formula 124
Groined Design in Concrete Reservoir Construction 311
Tests, New York Barge Canal..... 234
Asphalt Pavements (See Pavements)....
Asphalt Plants, Municipal.....80,157, 241
Auger, Hand for Test Borings..... 58
Automatic Regulating Dams.....278, 350
Automobiles, Roads, Effect on....17,289, 432

B

Barge Canal New York (See Canals)..
Barges, Concrete, Panama Canal..... 192
Base Plates, Formulas..... 254
Beams, Concrete, Continuity, Importance 173
Separately Molded, Various Spstems.. 304
Bearing Plates, Formulas..... 234
Bidding, Percentage .....
.....25, 119, 138, 139, 208, 281
Bids, Cost, Reimbursing Contractors.... 117
Bits, Drill, Shapes, Various in Use..... 266
Blanks, Bituminous Materials Test Record 385
Bridges, Concrete Cost Keeping..... 195
Concrete Tunnel Lining Report..... 358
Pavement Construction Record..... 79
Road Oiling Record..... 269
Strict Maintenance Record..... 17
Test Boring Record..... 9
Tunnel Cost Record..... 519
Tunnel Excavation Record.....219, 358
Wash Boring Record..... 277
Blasting, Cost.....60, 199, 307
Blasting Machines, Construction and Operation 13
Blasting Methods, Charging Drill Holes. 12
Detonators, Grades and Weights..... 11
Explosives (See Explosives).....
Firing by Electricity..... 12
Missfires, Handling 12
Moreno Dam, California..... 59
Pecos & Northern Texas Ry..... 307
Quarry, St. Helena, Ore..... 199
Shooting off the Solid..... 11
Tunneling and Loading, Large.60, 199, 307
Blasts, Large, Moreno Dam, California.. 59
Pecos & Northern Texas Ry..... 307
Quarry, St. Helena, Ore..... 199
Blow-Offs, Pine Line Water-Works.... 203
Bond, Concrete to Wood..... 163
Bonds, Pavement Work.....270, 351, 373
Borings, Diamond Drill, Cost Data, References to 23
Diamond Drill, Precautions in Making 585
Hand Auger Outfit and Operations... 58
Wash Recording Methods..... 277
Well Drill, Cost of..... 9
Boston Finance Commission, Permanent, Report 141
Boundary Monuments, Concrete..... 6
Breakwater, Colon, Rock Fill.....294, 432
Oneida Lake, Concrete..... 296
Brick Pavements (See Pavements).....
Bridge Design, Concrete Girder..... 97
Bridges, Abutments, Concrete.....314, 354
Concrete Arch, Bexar County, Texas.. 72
Centers for, Steel..... 190
Cost 98, 541
Lake Champlain & Moriah R. R..... 541
Medina New York Barge Canal.... 234
Cost Keeping System..... 194
Concrete Design, Present Methods Wasteful 279
Failures, Analysis of Causes..... 332
Girder, Advantages for Track Elevation 145, 166; 168
Cost 98
Florence, Ariz. 68, 117
Standard of Illinois Highway Commission 97, 121
Tests 121
Track Elevation Chicago, Burlington & Quincy R. R..... 168
Track Elevation Chicago, Milwaukee & St. Paul Ry..... 144
Track Elevation, Illinois Central R. R. 166
Floors, Concrete 335, 607
Foundations, McKinley, St. Louis..... 77
Maintenance by Day Labor, Chicago.. 600
Steel, Base Plate Formulas..... 254
Erection Methods 530
Erection Specifications 299
Track Elevation, Types, Cost Comparison 145, 168
Wooden Construction, New Brunswick 92
Buckets, Concrete Controllable Center Discharge 234
Track Elevation Work, Evanston, Ill. 150
Buildings, Concrete Cost.....55, 190, 304
Concrete Cost, Reduction by Working Rival Gangs 73
Separately Molded, Cost.....55, 304
Concrete Block, Cost..... 190
Cost, Diagrams for Estimating..... 184
Floors, Concrete.....283, 304, 335, 469
Foundations Caisson 440, 571
Foundations, Well 35
Girders, Long Span Concrete..... 191
Underpinning 10-Story 572
Bulkheads (See Sea Walls) .....
Business Failures, Causes..... 71

C

Caissons, Concrete, Construction, McKinley Bridge 77
Foundation Sinking Methods, Chicago 440, 571
Pneumatic, Sinking, Rate at McKinley Bridge 78
Camps, Contractors, Sanitation.....141, 153
Canal Lining, Concrete, Cost..... 398
Canals, Barge, New York, Arch Bridge, Concrete 234
Barge, New York, Cement Testing Methods 296
Dams, Concrete 295
Drag Line Excavator Work..... 383
Progress, 1909 109
Structures on 295
Calumet-Sag, Chicago Sanitary District 597
Georgian Bay Ship..... 393
Ill. & Miss. Aqueduct Construction.... 98
Lock Construction 380
Irrigation, Lining, Oil, Experience with Lining Plaster Methods..... 460
Lachine, Slope Paving Under Water.. 446
Locks, Concrete 89, 181, 204, 382, 516
North Shore Chicago Sanitary District 383, 449
Panama, Barges, Concrete..... 192
Contracts for Excavation.....111, 307
Excavation 111, 137, 213, 307
Lock Construction 181, 204, 516
Observations on 92, 163
Structural Features 462
Car, Power Required to Hoist Up Incline 279
Quarry, Electric 496
Cart, Concrete, Self Supporting..... 238
Transporting Forms 398
Cast Iron Pipe, Breakage..... 347
Catch Basins, Cleaning, Cost, Brooklyn, N. Y. 278
Cleaning, Cost, Cambridge, Mass..... 287
Cost, Day Labor *vs.* Contract..... 84
Objectionable Features of..... 17
Cement, Aerating, Compressed Air for.. 74
Bag, Volume of...1, 23, 47, 69, 91, 421, 584
Show, Chicago 29
Testing Methods, Barge Canal, New York 296
Louisville Sewer Work..... 543
Centers (See Arch Centers).....
Chicago Cement Show..... 29
Chimneys, Concrete, Construction Methods 352
Jacket, Reinforced Concrete..... 143
Chutes, Depositing Concrete by..... 286
Cisterns, Concrete, Cost..... 292
City Government, Commission Form..49, 421
Cost, Per Capita, Des Moines..... 187
Civil Service, Efficiency, How to Increase 95, 163, 257, 278
Cleaning Reservoir, Cost..... 307
Cleaning Sewers, Cost..... 106
Clearing Land, Bidding Prices..... 206
Cost 540
Cofferdam, Crib, Cost..... 88
Coloring Concrete, Directions..... 47
Columns, Concrete, Costs..... 213
Concrete, Economics 209, 210
Tests 210
Compressed Air, Consumption, Tunnel Work 219
Excavation, Wages and Working Hours 78
Concrete, Absorption, Reduction by Mixing with Mineral Oil..... 26
Abutments, Cost 114, 354
Aggregates, Grading, Value of.....50, 52
Selection and Proportion..... 52
Voids, Table of..... 53
Alkali, Effect on.....6, 539
Application in Electric Power Work... 587
Aqueduct Lining 98
Arches, Model for Testing..... 234
Barges, Panama Canal..... 192
Beams, Continuity 173
Separately Molded 304
Bituminous, Mixing 341
Bonding to Wood..... 163
Boundary Monuments 6
Breakwater 296
Bridges, Arch .....
.....72, 98, 120, 234, 279, 332, 541
Cost (See Costs).....
Girder.....68, 97, 117, 121, 144, 166
Buckets for Handling.....150, 234
Buildings 55, 73, 191, 304
Caissons 77
Canal Lining 78
Cart for Hauling..... 238
Chimneys 143, 352
Cisterns 292
Coloring, Directions for..... 47
Columns 209, 210
Contraction, Reduction by Mixing with Mineral Oil 26
Cooling, Rate Tests..... 426
Culverts 586
Curb 61, 177
Dams 110, 295
Density, Effect of Proportions of Aggregates 50, 52
Depositing by Chutes..... 286
With Tremie 196
Disintegration of by Alkali.....6, 539
Sewage and Sewage Gases.....470, 539
Drain Tile 167, 330
Drilling Outfit 434
Fence 282
Fence Posts 565
Finish, Sand Blast 421
Fireproofing Value 517
Flat Plates..... 258
Floors, Bridge 335, 607
Building 283, 304, 335, 469
Freezing Grout Wash Protection..443, 461
Girders, Long Span..... 191
Gutter 61, 177
Jacket for Chimney..... 143
Locks, Canal.....89, 181, 204, 382, 516
Mixing, Hand, Costs..... 571
Mixing, Water, Salts in, Effect..... 137
Pavement Foundations 244
Pavements 61, 201, 244, 551
Permeability, Tests of.....3, 516
Pile Protection, Efficiency..... 238
Piles 144, 355
Pipe 377
Preservation of Steel by..... 23
Proportions, Girder Bridges, Standard Highway, Illinois 97
Proportions, Sidewalks, Chicago..... 109
Reinforcing Bars, Specifications..... 493
Repairs to Wood Poles..... 588

Retaining Walls 149, 173, 328
Road Construction 16, 81, 457
Road Surfacing Blocks..... 201
Sea Walls 263
Sewers 121, 405, 553, 569, 595, 596
Shaft Lining 69, 193, 444
Slabs.....144, 148, 166, 171, 283, 304
Slide Rule for Computing..... 139
Slope Paving 446
Strength, Compressive, Washed and Unwashed Gravel 74
Compressive Waterproofing Compounds, Effect 6
Subaqueous, Depositing Methods..... 196
Testing, Compression Superior to Tensile 26
Trestles 377
Tunnel Lining..123, 245, 356, 398, 422, 505
Waterproofing Paint 584
Water Tower 224
Blocks, Buildings, Cost 190
Engine Foundations 387
Steam Curing Oven..... 284
Tests 458
Forms (See Forms).....
Models (See Forms).....
Conduits, Electrical, Construction Methods 19, 248, 400
Electrical, Costs.....19, 163, 401
Fiber with Bell Joints..... 482
Manholes 587
Connecticut Society of Civil Engineers.. 187
Construction Work, Costs, Day Labor and Contract Compared.....
.....83, 142, 443, 459, 600
Day Labor vs. Contract, Discussion of 397, 491
Outlook for, in 1910.....
Contract, Building Form for, Proposed Improved 37, 138
Contractors' Camps, Sanitation of..141, 153
Contractors' Plants (See Plants).....
Contracts, Cost, Plus a Fixed Sum..... 584
Contract vs. Day Labor Work.....
.....83, 142, 397, 443, 459, 491, 600
Convention for Standardizing Paving Specifications 200
Cost Analysis, Methods, Discussion..... 181
Cost Keeping, Blanks (See Blanks).....
Cost Keeping, Bridge Work, Concrete.. 194
Railroad Construction, Methods..... 176
Systems 184, 194, 278
Costs, Abutments, Concrete.....114, 354
Aqueduct, Los Angeles.....407, 459
Concrete Lined 100
Bituminous Concrete Mixing..... 341
Blasting 60, 199, 307
Borings, Well Drill..... 9
Boundary Monuments, Concrete..... 6
Brick Lining Concrete Sewer..... 571
Bridges, Concrete 98, 540
Track Elevation 145, 168
Buildings, Concrete 56, 190, 304
Concrete Block 190
Diagrams for Estimating..... 184
Canal Lining, Concrete..... 398
Catch Basins, Cleaning.....84, 278, 287
Cisterns, Concrete 292
City Government, Des Moines..... 187
Clearing Land 540
Cofferdam, Crib 88
Columns, Concrete 213
Concrete Blocks 190
Steam Curing 284
Concrete, Depositing by Chutes..... 286
Hand Mixing 571
Shaft Lining 194
Conduits, Electrical 19, 163, 401
Contract Sewers, Concrete..... 121
Contract *vs.* Day Labor.....
.....83, 95, 142, 443, 459, 600
Crib Timber 91, 113
Culverts, Cast Iron Pipe..... 586
Concrete 476, 586
Curb 61
Dams, Concrete 110
Crib 113
Ditch Maintenance 100
Drain Tile, Concrete 330
Drilling 215, 429
Drilling, Well 9, 402
Electricity for Lighting.....303, 319, 437
Excavation, Earth.....58, 80, 88, 113, 384
Excavation, Rock.....194, 360, 361, 544
Fence, Concrete 282
Fence Posts, Concrete..... 567
Filtering Materials, Washing..... 388
Filtering Water 163, 303
Filters, Sewage 134
Filters, Water 128, 306, 294
Floors, Concrete Arch and I-Beam.... 469
Forms 88
Knocking Down, Blaw..... 571
Foundations, Pavement 79
Timber Pile 113
Girders, Concrete, Long Span..... 191
Gutters, Concrete 61
Hauling and Loading Crushed Stone.. 80
Horses, Maintenance of..... 188
Hydraulic Filling 153
Installation, Water Meter..... 82
Lock, Concrete 88, 382
Lock Gates and Sills..... 90
Mechanical Haulage on Roads..... 594
Pavements in 1909 in American Cities 308
Pavements, Annual 31
Asphalt 31, 157
Asphalt Repair 80, 157, 242, 301
Bitulithic 61
Brick 106
Cobble Stone 61
Granite Block 61, 500, 563
Maintenance 30, 242
Wood Block Maintenance..... 592
Pipelaying 348
Pipe Lines 348
Submerged 525
Pipe, Water Intake 478
Plant, Machine Mixed Concrete..... 472
Power, Electric 303,
349, 391, 413, 414, 437, 534, 582, 583
Power for Various Industries..... 416
Power Plant Operation..... 487
Public Comfort Stations..... 537
Pumping 337
Railways, Electric 349
Electric Operating .....
349, 390, 391, 413, 414, 534, 582, 583
Elevated, Operation 369
Northern Pacific in Washington.... 44
Texas 370
Rations for Survey Parties..... 394
Reduction by Working Rival Gangs.. 73
Reforesting Reservoir Margin..... 277
Refuse Disposal 31, 326
Reservoir Cleaning 307
Reservoirs, Water-Works 110
Retaining Walls, Masonry..... 393
Revetment, Neat and Rip Rap..... 114
Road Maintenance 158, 442
Road Materials, Tests 80
Road Rollers 221
Road Rolling 221, 522
Roads, Bituminous Macadam..... 503
Concrete 81
Concrete Block 202
Grouted Macadam 376
Macadam 61, 79, 107
178, 241, 290, 338, 376, 500, 550, 563
Oiling 87
Rolling 221, 522, 563
Sand Clay 365, 457
Shell Macadam 241
Sea Walls 161
Sewage Disinfection 437
Sewage Purification 581
Sewage Purification Plants..... 136
Sewer Cleaning 106
Sewer Connections 401
Sewers 571
Shaft Excavation by Raising..... 544
Shut Piling 114
Sidewalks, Cement 109
Cinder 108
Slope Paving 354
Steam Curing Oven for Concrete Blocks 284
Stone Crushing 464
Street Cleaning, Hand Sweeping.23, 69, 221
Street Sprinkling 301
Stripping Earth 58
Subways, New York..... 348
Surveys, English Ordnance..... 394
Studia 419
Tank, Steel 226
Telephone Lines 111
Tie Preservation 253
Tie Protection 297
Timber Preservation 67
Tracklaying by Machine..... 559
Track, Street Railway.....370, 590
Transmission Line 473
Trenching, Potter Trench Machine.... 571
Trenching, Sewer 597
Trestles, Concrete 379
Tunnel Lining, Cast Iron, Calking.... 540
Tunnel Lining, Concrete.....400, 422
Tunnels, Rock.....215, 427, 475, 518
Tunnels, Los Angeles Aqueduct..... 504
Water Filtration 163, 203
Water Mains.....87, 337, 461
Water Meters, Removing and Testing 341
Water Pipes, Service..... 136
Water Purification Plants.....128, 306
Water Softening 435
Water Supply, Fire Service..... 481
Water Tower, Concrete..... 226
Crib, Timber Cost.....91, 113
Cross-Section Areas Computation, Criss-Cross Method Simplified..... 583
Cross-Ties (See Ties).....
Crown Thickness of Arches..... 124
Crushed Stone, Amount Required for Macadam 126
Cost, Day Labor *vs.* Contract 87
Cost, Hauling and Loading..... 80
Cost Hudson River Tunnels..... 464
Heating in Wagons..... 192
Plant, Dolere & Shepard..... 495
Testing Methods for Road Work..... 403
Washing, Plant 497
Crushers (See Stone Crushers).....
Culverts, Cast Iron Pipe..... 586
Concrete Arch 586
Concrete, Cost 476, 586
Corrugated Iron 576
Curb, Concrete, Cost..... 61
Specifications 177

D

Dams, Automatic Regulating.....278, 350
Concrete, Barge Canal, New York.... 295
Cost 110
Construction, Early, in Connecticut... 227
Crib, Construction Methods 113
Cost 113
Earth, Irrigation, Porto Rico.....57, 568
Failures, Dansville, Cause....117, 207, 256
Scioto River, Columbus Water-Works 110
Dansville Dam Failure.....117, 207, 256
Day Labor *vs.* Contract Work.....
.....83, 142, 397, 443, 459, 491, 256
Depreciation, Contractor's Plant..... 163
Crushed Stone Plant..... 497
Electrical Properties 487
Street Railway Properties..... 560
Water-Works 598
Derrick Boom, Attaching to Tower Leg. 471
Trench Excavation 606
Detonators, Electric, Grades and Weights of 11
Diamond Drill Borings (See Borings)..
Dikes, Construction for Tide Lands.... 181
Ditches, Design, Effect on Maintenance. 100
Maintenance Cost 100
Maintenance Methods 100
Drain Tile, Concrete, Cost..... 330
Concrete, Dissolution in Water, Tests 330
Specifications 167
Drawings, Filing Methods..... 205
Dredging Plants, Hydraulic Filling, Cairo, Ill. 151
Drill Bits, Shapes, Various in Use..... 266
Drill Holes, Charging, Directions..... 12
Drilling, Concrete, Outfit for..... 434
Cost 215, 429
Diamond, Cost Data, References to.... 23
Precautions in 585
Hand Auger Outfit and Operation ... 58
Methods, Concrete 434
Land Sections, Hudson River Tunnels 427
Terminal Station, Pennsylvania R. R 241
Tunnel, Bergen Hill 214
Tunnel, Water Supply, Ft. William, Ont. 474
Records 75, 214, 241, 429
Well, Cost of.....9, 402
Prospecting Methods 401
Records 497, 544
Drills, History of Percussion..... 518
Locomotive, Records of Work..... 75
Sharpening and Tempering..... 266
Driving Caps, Pneumatic, for Concrete Piles 144
Dryer, Portable, for Binder Stone..... 432
Dudley, Charles B..... 2
Dumpy Level, Improved Form..... 567
Dust Prevention on Roads.....500, 574

E

Earth Pressures 163, 507
Earthwork, Dam Embankments.....57, 568
Railway Specifications 175
Shrinkage, Amount 498
Efficiency, Principles, Fundamental..... 603
Electrical Conduits .....
.....19, 163, 248, 400, 482, 587
Electrical Properties, Depreciation and Reserve Funds 487
Electricity, Cost, Producing for Lighting 303, 319, 437
Firing Blasts by, Directions for..... 12
Electric Detonators 11
Electric Power, Costs.....303, 319
349, 390, 413, 414, 437, 534, 582, 583
Electric Quarry Car..... 496
Electric Railways (See Railways).....
Elevated Railways (See Railways).....
Embankments, Dam, Construction Methods 57, 568
Depositing from Wire Rope Trestle.. 494
Lever, Hydraulic Dredge Construction. 153
Engineering Colleges, Engineering-Contracting, Study in.....46, 165
ENGINEERING-CONTRACTING, Price, Reference Number 303, 319
Write-Ups, Practice Regarding..... 233
Engineering-Contracting, Study in Engineering Colleges 46, 165
Engineering Instruction, Co-operation Plan 521
Engineering, Road, Importance of..... 201
Engineer School, Army, Purposes of.... 112
Engineers, Civilian Assistant U. S. A., How to Secure Recognition.... 375
Commission Government, Opportunities 49, 421
Heads of Departments, New York... 25
Opportunities in South America..... 489
Titles, Meaning of Various..... 23
Engines, Foundations, Concrete Block... 387
Gasoline, Care in Freezing Weather.. 15
Traction, Design, Current Practice... 28
Horse-power, Formulas for Determining 28
Horse-power, Tables of..... 29
Ideal, Qualifications 28
Internal Combustion Compared with Steam 28
Operating, Directions for..... 155
English Ordnance Surveys..... 394
Evaporation from Water Surfaces, Formula for 31
Excavation, Earth, Basement by Steam Shovel 568
Canal, Drag Line Excavator..... 383
Canal, New York Barge.....265, 383
Compressed Air, Wages and Working Hours 78
Cost 58, 80, 88, 113, 384
Dam Abutment Foundation..... 113
Dam Construction, Porto Rico.....57, 568
Electrical Central Control Haulage System 449
Foundations, Deep Retaining Wall.... 329
Lock Foundation, Cost..... 88
Pavement Foundation, Cost..... 79
Sediment in Reservoir by Hose Streams 307
Specifications 175
Steam Shovel.....198, 200, 213, 361, 568
Stripping, Cost 58
Trenching.....198, 347, 569, 571, 596, 606
Two-Lift Steam Shovel, Cut in One Lift 200
Excavation, Panama Canal.111, 137, 213, 307
Excavation, Rock, Blasting Costs.60, 199, 307
Blasting Machines 13
Blasting Methods 11, 60, 199, 307
Cost 194, 360, 361, 544
Explosives (See Explosives) .....
Locomotive Percussion Drill Records. 75
Shaft 194, 544
Specifications 175
Trench Sewer 369
Terminal Station Pennsylvania R. R.. 239
Tunnels 60, 199, 215,
218, 307, 342, 427, 155, 473, 504, 518
Undermining Elevated Railway..... 239
Excavators, Scraper Bucket Records.265, 383

ncinnati, O..... 303
.....127, 294
lphia, Pa..... 306
psic, N. Y., Records..... 220
e Index to Cost of Water
.....563, 576
Methods, McKeesport, Pa.... 435
e Service, Cost..... 481
ents for Public..... 478
Evaporation from, Formula
..... 31
ncrete, Construction Methods 224
Costs 226
ducing, Methods 82
ng Compounds, Descriptions
Various 4
Compounds, Effect on Strength of Concrete 6, 93
Efficiency, Tests of.....3, 93, 516, 607
Methods, Bridge Floors 335
Tunnel Lining .....1..., 252, 357, 425
Paint for Concrete..... 584
Water-Works, Columbus, O., Dam and Reservoir 110
Dam, Columbus, O. 110
Depreciation, Uniform Accounting.... 598
Intake Crib, Construction Methods... 342
Pekin, China 8
Pipe Lines (See Pipe Lines).....
Reservoir, Cleaning Cost..... 307
Columbus, O..... 110
Reforesting Margin 275
Roofs, Groined Arch..... 311
Springfield, Ill., Statistics..... 227
Valuation 202, 577
Washington, D. C., Operating Results. 82
Well Drill Borings, Cost of..... 9
Wells, Artesian, Natural Gas From.... 137
Cast Iron in Waterworks Crib..... 342
Foundation Construction Methods.... 440
Lowering, Air Lift Pumps..... 226
Pollution of Shallow..... 388
Western Society of Engineers.....2, 67
Wood, Bonding Concrete to..... 163
Wood Stave Pipe.....92, 346
Workmen, Compensation of..... 605
Write-Ups, Practice of Engineering-Contracting 233

AUTHOR INDEX

A

Al-Theodore, 283; Allardice, E. R. B., lvord, John W., 577; Amos, J. J., nchutz, H. E., lv; Anderson, G. G., lrews, H. B., xxviii; Angier, F. J., ntonisen, J., 206; Armstrong, W. C., sh, John W., 190.

B

B., O., xix; Ballinger, W. F., x; Bam-Wm. B., 37; Beahan, Willard, lv.; sley, R. C., 208; Beatty, J. F., 523; am, C. A., 106; Black, R. P., 520; on, W. C., xix; Brooks, Benjamin, Brown, Geo. W., 411; Brown, Roy 92; Brown, W. L., 398, 422, 427, 449, 487, 545; Burdick, C. B., 388, 578.

C

(Florian, lv; Campbell, J. L., 346; er Frank H., 607; Cartlidge, C. H., 584; Chambers, Sidney H., 470; Chan-, C. E., 227; Chase, C. E., 77; Chase, vey S., 598; Chatley, Herbert, x; ds, O. W., 23; Clark, Geo. C., 328; ury, Jos. M., 163; Coe, C. S., 416; Cole-n, Clarence, 605; Cosgrove, J. J., xxviii; van, E. H., 100; Crane, C. A., 139; Cres-, B. F., 239; Curtis, D. C., 604; Curtis, W., 600.

D

W. H., 330; D'Rohan, W., 350, 460; ll, Edward A., 202; Dodge, G. F., xix.

E

y, Harrison P., 83; Edison, Wilfred, 524; glee, C. H., 490; Emerson, Harrington, 03; Espenshade, E. B., 498.

F

nn, Alfred D., 205; Ford, Frank R., 560; Frank. R. J., x; Frederick, F. F., xix; French, A. H., 535; French, Roger DeL., 277.

G

ant, H. L., 605; Gearhart, W. S., 457; Gilbreth, F. B., 75, 77, 517; Gillespie, Peter, 210; Goldingham, A. H., xxxviii; Goodrich, E. P., 371; Gray, Henry L., 482; Greeley, Samuel A., 32; Greenman, R. S., 295; Gregory, John H., 110, 127, 129; Greiner, J. C., 299; Griffith, Adam W., 47; Grunby, F. M., 416; Gustin, M. G., 279.

H

Hackett, E. A., 522; Hall, Clarence, 10; Hancock, H. Sidney, 461, 472, 525; Hansen, C. H., 608; Harris, H. T., 593; Harris, W. R., 46; Hauer, Daniel J., 76, 77; Hewitt, B. H. M., 398, 422, 427, 449, 464, 487; Heyny, Wm., x; Hoff, Olaf, 196; Hoenus, F. W., 354, 382, 586; Hoyt, Charles H., 81; Hutchins, M. E., 350.

I

Ingle, Jr., J. L., 494; Inskip, G. D., x.

J

Jackson, B., 487; Jacobs, Charles M., 101; Jarvis, Clarence S., 92; Johnson, A. N., 96; Jourdin, W. W., 187.

K

Kelley, William, 193; Kellog, Frank B., 23; Kempkey, A., 224; Kendrick, J. W., 297; Knight, P. C., 23; Konkle, A. H., 395; Kuichling, E., 579; Kulicka, O. C., 583.

L

Lance, John H., 163; Lavis, F., 214, 245, 282; Lippincott, J. B., 459; Lockwood, W. D., 76; Lordly, H. R., 446; Luten, Daniel B., 194.

M

Mabee, W. C., xxviii; McClelland, E. H., 23; McClure, A. G., 163; McCullough, F. M., 3; McCullough, J. S., 23; MacGregor, W. F., 28; McMath, Thos. B., 125; MacMillan, Angus, 258; Main, Chas. T., 416; Marble, Arthur B., 536; Marr, W. W., 106; Marshall, R., xix; Maury, Dabney H., 578; Mead, Daniel W., 576; Meem, J. C., 507; Menzies, Wm., 573; Moore, DeWitt V., 76, 77; Moyer, Albert, 26, 69, 564; Muenscher, E. W., 163; Muller, H. N., 587; Munroe, Charles E., 10; Murray, N. E., 108.

N

Nachod, J. F., 93; Nixon, F. P., 574.

O

Ogden, A. B., 387.

P

Pace, Fulton, 278; Page, H. D., 350; Page, Logan Waller, 16, 288; Pearce, Langdon, 207; Perkins Joseph, M., 69; Perrot, Emile G., 191, x; Phipps, F. S., 284; Pickering, J. S., 551; Pike, Geo. B., 79, 126; Pope, Thomas O., 163; Potter, Alexander, 435; Pratt, Jos. H., 201; Pratt, Mason D., 55; Prior, J. H., 530; Proske, T. H., 266.

R

Rathjens, George, 58; Raymond, R. R., 112; Raynes, F. W., x; Reece, O. T., 280; Reiner, A. A., 579; Richards, Frank, 75; Ricker, N. Clifford, 254; Ripley, John W., 163; Roberts, R. O. Wynne, 590; Roberts, S. S., 63, 256; Robinson, P. J., 9; Roden, C. B., 187; Rosamond, S. J., 578; Russell, L. K., 274; Ruttan, N. H., 481; Ryan, Richard R., 117.

S

Sang, Alfred, xxviii; Saunders, W. L., 518; Schmeer, Louis, xxviii; Sherman, L. K., 469; Shipley, G. B., 66; Smith, J. Walker, 479; Smith, Leonard S., 115; Smith, Vernon H., 92; Snow, Walter B., 73; Stephens, H. Morton, 200; Stewart, J. T., 438; Swain, Geo. F., 492.

T

Teeple, Geo. L., 115; Thomas, A., 23; Thomson, T. Kennard, 35; Travilla, Jas. C., 69; Turner, C. A. P., 302; Tyrrell, H. G., x.

U

Unwin, W. C., x.

W

Watson, Charles D., 304; Weatherford, J. H., 47, 91, 584; Weber, Wm. G., 401; Weber, Carl, 352; Wehr, A. H., 578; Wetmore, A. R., 92; Whinery, Samuel, 30; Wiggin, Thos. H., 311; Wilcox, W. F., 577; Willard, G. H., xxviii; Wood, H. S., 256; Wood, Stuart, 577; Woods, R. J., xix.

Y

bung, C. R., 332; Young, C. S., 307; Young, Henry A., 111.

BOOK REVIEW INDEX

Concrete Bridges and Culverts for Both Railroads and Highways, x; Concrete in Water-Works Construction, xxviii; Corrosion of Iron and Steel, xxviii; Cotton Mill Map of Alabama and Georgia, lv.——Diagrams for Designing Reinforced Concrete Structures, xix; Designers' Charts for Reinforced Concrete, xxviii; Domestic Sanitary Engineering and Plumbing, x.——Elements of Machine Design, x.——Field Practice of Railway Location, lv; Flow of Water, xxviii.——Handbook of Cost Data, liv; History of the Logarithmic Slide Rule, lv; How to Use Concrete, xix; Hydraulic Excavation Tables, lv.——Inspectors' Handbook of Reinforced Concrete, x.——Modern Lettering: Artistic and Practical, x.——Oil Engines, xxxviii.—Pattern Making, xxiii; Practical Talks on Contracting, xxviii.——Science of Organization and Business Development, x; Simplified Mechanical Perspective, xix; Squares and Logrithms, x; Stresses in Masonry, x.——Theory of Structures, xix; Treatise on Masonry Construction, xix.——Wrought Pipe Drainage Systems, xxviii.

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ALBERT P. GILLETTE
HAS. S. HILL
ERNEST McCULLOUGH
C. T. MURRAY
F. A. SMITH
} EDITORS

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CONTENTS.

	Page
EDITORIALS:	
The Outlook for 1910.	1
Further Light on the Size of 1 Cu. Ft. of Cement	1
Chas. B. Dudley	2
CONCRETE SECTION:	
Tests to Determine the Efficiency of Various Commercial Waterproofing Compounds for Concrete	3
Method and Cost of Constructing Concrete Boundary Monuments	6
Some Data and Records of Experience Regarding the Disintegration of Concrete by Alkali	6
EARTH AND ROCK SECTION:	
Cost of Boring Five Test Wells for a Double-track Railway Bridge in California	9
Data on the Storage and Handling of Explosives	9
ROADS AND STREETS SECTION:	
The Possibility of Portland Cement as a Road Material	16
Notes on Road and Street Work	17
WATER-WORKS AND SEWERS SECTION:	
Standards for Sewage Effluents	18
GENERAL SECTION:	
Comparative Methods and Costs of Underground Conduit Constructions	19
LETTERS TO THE EDITOR	22
COMING TECHNICAL MEETINGS	24
PERSONALS	24
CATALOGS WORTH HAVING	24

The Outlook for 1910.

Cause exists for hearty exchange of congratulations among engineers, contractors and manufacturers over the outlook for 1910. Never in the commercial history of America have there been so many evidences upon which to base predictions for "a banner year." Those who had shipments to make or to receive by rail in 1906 and 1907 will remember that freight congestions and lack of cars were a serious handicap to the progress of all construction. Such railway authorities as James J. Hill were then saying that the railways had fallen far behind the times in their building of additional facilities for handling traffic. Certain it was that the construction of new lines and the double tracking of old lines had not kept pace with the general growth of industry.

The panic that came in October, 1907, stopped much industrial growth, but it did not stop the growth of population, nor did it put a quietus on the efforts of the American farmer. Hence we find ourselves now facing even greater traffic congestions in 1910 than existed two or three years ago. Railway managers are preparing as fast as possible by orders for equipment, and the great steel mills have been unable to close down for the usual Christmas holiday season.

The construction of electric railways will proceed at a more rapid pace than ever, judging from applications for franchises and from the organization of new companies that have been reported in our news columns.

Road building has been given the greatest impetus in the world's history, first by the development of the automobile, second by the gradual abandonment of the old day labor system of road building in towns and counties and the adoption of the contract system under laws wherein "state aid" is given in financing road work. State after state has followed the original lead of New Jersey, until now there are few states without highway commissions in charge of the building of improved highways. The great prosperity of the farming classes has enabled them to buy auto cars and to join the general cry for more good roads. Even the railways themselves are awakening to a realization of the fact that good roads will solve many of their own problems by enabling farmers to get to the railway stations at all times of the year with produce, thus doing away with the present dearth of shipments during rainy weather and the consequent deluge of produce when the mud dries up. The Pennsylvania Railway is about to send a special car out along its lines carrying a road expert to lecture to farmers on the economic merits of good roads. This is sound business policy on the part of the Pennsylvania Railway, for everything that increases the prosperity of the farmers in the territory tributary to that railway also increases the prosperity of the railway.

The same force—the automobile—that has done so much to stimulate road improvement is also destined to work a great awakening in cities where the "dust nuisance" is becoming intolerable. New pavements will be built in the next few years at a rate hitherto undreamed of.

The knowledge that typhoid and other diseases are conveyed by water has already had its effect in leading large cities to build filtration plants and to go great distances to get pure water supplies. The smaller cities and towns are now awakened by the sight of these examples of activity in the great cities and will unquestionably expend sums very large in the aggregate to improve their water works.

The same considerations as to sanitary measures of precaution will stimulate the building of sewers.

The amazing development of the cement industry will continue to have its effect upon the reconstruction of bridges, buildings, etc.

Look where we may, there is work and lots of it in sight for manufacturers, contractors and engineers during this good year of 1910 and its immediate successors. We therefore extend hearty congratulations to all and wishes for the best of prosperity.

Further Light on the Size of One Cubic Foot of Cement.

The size of a barrel of cement has been for years a splendid subject on which to base a discussion, notwithstanding the fact that it is today almost an impossibility to purchase a barrel of cement, the bag now being the unit. It is one of the strange examples of how habits cling, to read specifications calling for the proportioning of concrete mixtures with the barrel as a unit, when only bags, four of which make one barrel, are used by the contractor. In 1896 the Boston Transit Commission had a number of measurements made of the capacity of Portland cement barrels and it was found that the capacities varied from 3.12 to 3.5 cu. ft., the mean volume being 3.29 cu. ft. These experiments are classic and no writer on concrete would have the courage to omit mention of them.

In the famous "Report on the Testing of Hydraulic Cements," made by a board of officers of the Corps of Engineers, United States Army, published June 6, 1901, a step was taken that effectually fixed the size of the unit of measurement of Portland cement. Section 5 of the Specifications for American Portland Cement reads as follows:

> Sec. 5. The average weight per barrel shall not be less than 375 lbs. net. Four sacks shall contain one barrel of cement. If the weight, as determined by test weighings, is found to be below 375 lbs. per barrel, the cement may be rejected, or, at the option of the engineer officer in charge, the contractor may be required to supply, free of cost, to the United States, an additional amount of cement equal to the shortage.

One of the editors of this paper, then in private practice, a year or two later prepared his specifications, omitting the barrel and using a bag as being equivalent to 1 cu. ft., which specifications were published in ENGINEERING-CONTRACTING Dec. 22, 1909. Instead, however, of using the "net weight" of the cement in a bag or sack his specifications called for a "gross weight" of not less than 95 lbs. per bag A comparison of those specifications with the Engineer Corps' specifications will show where he obtained his idea as to weights.

The idea of the bag being 1 cu. ft. was given to him by salesmen of the cement manufacturers. Shortly after the government report appeared the manufacturers got together and decided upon a bag size which would contain "94 lbs. net" of cement, and this is what every man obtains now who buys cement. The salesmen call one bag a cubic foot and it is convenient to so use it. The use is well nigh universal, except in a few isolated cases where some engineers have arbitrarily decided to use 100 lbs. as 1 cu. ft. and hold the contractors to it as well as they can. The bag being fixed in size by common agreement among manufacturers and it being unlikely that we will ever secure another agreement

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making it "100 lbs. net" instead of the present size, why should engineers stick to an imaginary quantity?

How did it ever come about that 100 lbs. was selected as an ideal weight for 1 cu. ft. of cement? In "A Treatise on Concrete, Plain and Reinforced," by Messrs. Taylor and Thompson, we read that the authors corresponded with or personally interviewed some fifty prominent engineers representing all sections of the United States, and asked them their opinion as to the proper weight of a cubic foot of cement. The units suggested varied, but—

> An approximate average of all the figures suggested was 3.8 cu. ft. to the barrel, corresponding to 100 lbs. per cubic foot. * * * Accordingly in cases where it is advisable to specify the proportions by parts, the authors have adopted this unit as being a standard.

This is the only record we have and it will be noticed that the weight selected was one that was merely an approximate average of weights suggested by fifty engineers selected from 25,000 or more practicing engineers in the United States and twice as many contractors, all of whom are obliged to take the unit given them by the cement manufacturers and who are not equipped with weighing machines or other apparatus to divide the bag into different units and whose time will not permit it. The easiest and most sensible plan is to do just what these practical constructors do; that is, follow the advice of the cement salesman and make their mixtures come out even with the bag assumed as being equal to 1 cu. ft. of cement.

We are not advocating any particular weight to be taken as that of a cubic foot of cement. It makes no difference to this paper or the editors whether the weight is 100 lbs. or 94 lbs. That is not the point. We simply advocate getting some definite standard fixed and as the bag has been fixed by the coming together of the manufacturers, then let the bag be the unit and call it 1 cu. ft. and thus fall in line with the majority of users and common custom among concrete men and cement salesmen. The experiments made for the Boston Transit Commission showed the weight of a packed cubic foot of cement might be anything from 112.8 lbs. to 123.2 lbs. The average was 118.8 lbs. A shaken foot varied from 102.3 lbs. to 109.4 lbs., the average being 105.1 lbs. A loose foot varied from 88.5 lbs. to 100.5 lbs., the average being 92.6 lbs. It may be seen from the foregoing that the cubic foot of cement is a decidedly variable quantity and unless some definite weight is fixed the amount a man puts into a batch depends upon how he deposits it. If he gently pours it from the bag he may get a cubic foot which weighs on an average only 85.4 lbs. It looks like common sense therefore to take a unit already provided by the cement mills and furnished with variations not exceeding one pound plus or minus, and call it 1 cu. ft.; *especially as it is now done by practically all the concrete workers in the country.* The only reason that weight is mentioned is to determine the size of the bag and it is most readily done by taking the accepted weight. It is a far more simple matter for a contractor to take one bag in forty or one bag in fifty and weigh them, than to weigh each lot of cement going into each batch of concrete. The reason for specifying a "gross weight" has been already stated.

Take for example batches wherein four bags will be the amount of cement used, and the mixture is 1:3:6. The contractor makes a box holding 12 cu. ft. and filling it once gets his sand; filling it twice gives him his stone. If he goes upon the theory that the cubic foot should weigh 100 lbs. and he is compelled to use the bag as a unit, something he cannot escape, he must make his measuring box 11.4 cu. ft. capacity and one who has seen the average man wrestle with fractions knows that the box is much more likely to be made actually 12 ft. to make it come out even and avoid "figgerin'." The cement barrel as a package was something that once existed. The cement barrel as a fixed quantity never existed until after the cement barrel as a package had disappeared. In spite of this it persists as a standard of measure and in the last proceedings of the National Association of Cement Users a committee solemnly proposed the following:

> Proportions of 1:1½:3, that is, one barrel (4 bags) packed Portland cement to 1½ barrels (5.7 cu. ft.) loose sand to 3 barrels (11.4 cu. ft.) loose gravel or broken stone. Proportions 1:2:4, that is, one barrel (4 bags) packed Portland cement to 2 barrels (7.6 cu. ft.) loose sand to 4 barrels (15.2 cu. ft.) loose gravel or broken stone. Proportions 1:2½:5, that is, one barrel (4 bags) packed Portland cement, to 2½ barrels (9.5 cu. ft.) loose sand to 5 barrels (19 cu. ft.) loose gravel or broken stone. Proportions 1:3:6, that is, one barrel (4 bags) packed Portland cement to 3 barrels (11.4 cu. ft.) loose sand to 6 barrels (22.8 cu. ft.) loose gravel or broken stone.

Here we find a committee recommending the barrel as the unit of measure and then defining the barrel in cubic feet and giving the contractor fractional parts of a foot for his measures. Since the size of the barrel has to be defined in cubic feet why mention the barrel? It should be enough to give the recommended proportions and then state that these proportions are by measure, the bag "having a gross weight of not less than 95 lbs. being considered as equivalent to 1 cu. ft. of cement."

The bag is now a fixed quantity according to an agreement between American Portland cement manufacturers. The 100-lb. cubic foot of cement is an ideal fixed "as an approximate average of all figures suggested by about fifty engineers," this average being settled upon after the cement manufacturers had fixed the size of the bag and their salesmen had commenced educating the ordinary user of cement in the use of a bag as a cubic foot. Until the size of the bag is changed by the manufacturers let us say a cubic foot weighs just what a bag now weighs. When the weight of the bag is changed, if it is ever changed, we can change our weight of a cubic foot of cement. It is after all only falling into line and following the procession. This is better than drawing specifications that involve trouble in enforcing and are generally unsatisfactory. The difference is about 6 per cent and cannot, we imagine, make very much difference in the strength of the concrete. We do not, however, want our readers to misunderstand us and think we are making suggestions that the cubic foot of cement be fixed at any definite weight. The weight is a minor consideration. A uniform standard is important.

Charles B. Dudley.

The death of Dr. Charles B. Dudley, chief chemist of the Pennsylvania R. R., on Dec. 21, 1909, deserves more than the passing notice given it in our last issue. This is true not merely because Dr. Dudley was a testing engineer of international fame or because he was a man of most lovable character but because of the work he did for the advancement of good construction. In his 34 years of professional labors, Charles B. Dudley did a paladan's service in advancing the character and quality of the structural materials used by railways. His belief was that no specification should be made for any material without exhaustive study and as full knowledge as possible of the conditions under which that material did its work. This belief he put into practice to the utmost of his powers. Every specification drawn by him for the great railway which he served was based on investigation and study of the most painstaking character. It was not unusual for him to devote two or three years of special investigation to his subject before the written specification appeared. The results of these labors were not of the kind that gets into the talk of the man on the street but they were of the kind that makes a man noted among his professional co-workers. Dr. Dudley's specifications for the Pennsylvania R. R. are to-day largely the standards for the railways of America.

To catalog Dr. Dudley's work is not our purpose. He was called upon to test and pass judgment upon the quality of nearly all the materials employed by a railway in its construction and maintenance work. His studies covered such various subjects as steel for rails; car lighting, heating and ventilating; cast iron car wheels; coal analyses; water purification; paints; bearing metals, and transportation of explosives. His work was not confined, however, to the services rendered to his employers. As president of the American Society of Testing Materials and as a member of a dozen American and foreign technical and scientific bodies he furnished papers and discussions that are reputed among chemists and engineers.

Dr. Dudley was what we like to think of as the typical American in his parentage, education and development to prominence. He was born at Oxford, Chenango county, New York, on July 14, 1842. His parents were New Englanders. As a lad he went to the village school and later to the local academy in winter, working on the farm in summer. In 1862 he enlisted as a private in the war of the Rebellion and served until the end of the war in 1865. Resuming his studies he entered Yale college in 1867, graduating in 1871. A year was then spent in newspaper work to earn money to pay off obligations incurred in his college course and to give him a start in the Sheffield Scientific School which he entered in 1872, graduating two years later. For a year after graduation he worked as assistant professor of physics at the University of Pennsylvania. On Nov. 10, 1875, he was made chemist of the Pennsylvania R. R. At that time there were few if any specifications; the study of the properties of materials was young; the study of materials from the standpoint of service had barely been born.

Concrete and Reinforced Concrete Section

Note: This section is devoted to methods and cost of constructing concrete and reinforced concrete structures. It will cover the selection, testing and proportioning of concrete materials; laboratory tests of concrete; concrete mixing, transportation and placing; fabrication and placing of reinforcement, and form construction and erection. It will also contain articles on new and interesting developments in the design of reinforced concrete.

Tests to Determine the Efficency of Various Commercial Waterproofing Compounds for Concrete.*

Introduction.—The object of these tests was to determine the efficiency of some of the commercial compounds used for the water proofing of concrete.

Tests were made on 14 compounds, each compound being subjected ordinarily to pressures of approximately 20 lbs. per sq. in. and 40 lbs. per sq. in. The duration of the test was usually three days, and a record was kept of the amount of water entering the concrete. In order to ascertain the effect on the strength of concrete of the compounds which are added to the body of the concrete, compression specimens were made. Three of the compounds were tested in this manner, the specimens being broken at the ages of approximately 1, 2 and 10 months. This work is a partial repetition and a continuation of a thesis completed by S. R. Hatch and H. E. Ketchum of the class of 1907.

Description of Apparatus and Material.—The apparatus which was designed for these tests consists essentially of 8 6-in. pipes filled with concrete and a pipe system connected with air and water reservoirs. Figure 1 is a general drawing of the pipe system for four specimens, the apparatus for the remaining four specimens being the same as shown.

The molds shown in Fig. 1 were 6-in. wrought iron pipe, 12½ in. long, with a cast iron flange screwed to the upper end. In order to prevent the passage of water between the pipe and the cement lining ten or twelve V-shaped grooves were cut in each pipe, each groove extending around the inner surface of the pipe.

This flanged pipe was attached to the casting by means of 6 eye-bolts. A ¾-in. pipe, 4 ft. 6 ins. long, was screwed into this casting. Each of these ¾-in. pipes was joined to the main pipe, which in turn connected with the water main and with the air reservoirs. The shut-off globe valves for water and air are shown on the pipes connecting the main pipe with the water main and with the air reservoirs. Two cast-iron cylinders, 6½ ins. in diameter and 4 ft. 8 ins. long, formed the air reservoirs. They were connected with a large air-tank, not shown, by means of the pipe shown in Fig. 1, a shut-off globe valve being placed between the air-tank and air-reservoirs.

A glass tube and attached scale graduated to hundredths of feet, were fastened to each ¾-in. pipe in order to obtain the water level in the pipe. The globe valve "V" was used to disconnect any specimen proving defective. The ¾-in. pipe and glass tube were drained by means of the needle valve. A gage registered the air pressure.

The proportions by volume of the concrete were 1:3:5, the required amount of the materials being weighed on a scale. No attempt was made to secure a waterproof concrete by proper proportioning. On the contrary, a lean mixture was desirable in order to bring out the waterproofing qualities of the compounds.

Local stone and sand and Atlas cement were used. The stone was a rather sandy lime-stone while the sand was of the fine bank variety.

The compounds tested, which were all secured through local dealers in order to obtain the ordinary commercial product, were Century Cement Fluid, Dehydratine No. 4, Des Moines Elaterite No. 60, Hydrex Waterproof Felt and Compound, Limate, Medusa Waterproof Compound, Siastex Waterproofing Fabric No. 2 and Pitch, Universal Damp-Proof Compound, Aquabar, Antihydro, Antihydrine, Wunner's Bitumen-Emulsion, Coatine, and Flexible Compound. In nearly all cases the manufacturers, at our request, gave special instructions in regard to methods of waterproofing against the pressures used, such instructions being usually followed in the tests. As the name indicates, Universal Damp-Proof Compound is used for damp proofing and not for waterproofing.

Method of Making the Specimens and of Performing the Tests.—Materials sufficient for two specimens were first weighed out. The sand was spread out evenly on the mixing floor and upon this was placed the cement in a thin layer. Two men with shovels mixed the sand and cement thoroughly to an even color when a crater was made in the center which was filled with water. After the water was absorbed the mass was turned several times until the mortar was in the form of a thick paste. The stone which had previously been dampened was now spread over the mortar and the whole turned by two men with shovels for five minutes, water being added at times with a sprinkler. The consistency of the concrete was such that it flowed readily from a pile on the floor. A quantity of neat cement was now mixed with sufficient water to form a thick paste.

The 6-in. pipe was placed on the floor with flanged-end up and a loose fitting wood disk

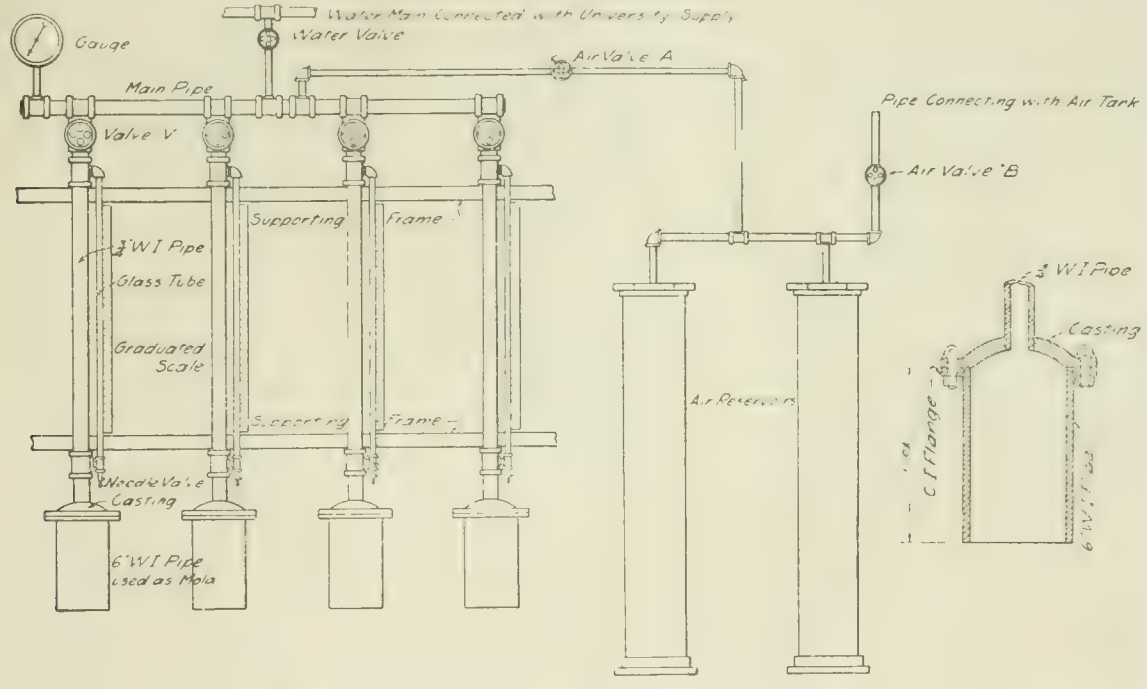


Fig. 1—Apparatus for Testing Permeability of Concrete and Details of Mold for Test Piece.

which had been turned on the outside to a taper, was centered on the wood disk. A lining of neat cement paste varying from 6/10 to 7/10 in. in thickness was now tamped into the annular space between the pipes, care being taken to fill the grooves in the outside pipe. This lining was carried up to within one inch of the top of the inner pipe, which was then filled with concrete to the level of the cement lining, the concrete being tamped well with a trowel meanwhile. The inner pipe was now carefully drawn about 3 ins., and the cement lining and concrete were deposited as before. This operation was continued until the specimen was completed, the depth of concrete being about 12 ins. The manner of finishing the upper surface varied for the different types of specimens and will be described later.

The cement lining and grooves were very effective in preventing water from seeping along the surface of the pipe. This was shown by chipping out the concrete and the lining of several specimens that had been subjected to pressure. While damp spots were found here and there in the pipe, in no case were

*Abstract of Bulletin No. 336, University of Wisconsin, by F. M. McCullough, Instructor in Mechanics.

they continuous. Neither was there any unusual flow between the concrete and the cement lining.

A set of 8 specimens was usually made for each kind of waterproofing, 4 of the specimens being tested at a pressure of 40 lbs. per sq. in. and 4 at a pressure of 20 lbs. per sq. in. All specimens were first tested at pressure of 40 lbs. per sq. in. and, if satisfactory, no other specimens were made. The duration of the tests was about 3 days, although the time was extended to 7 or 10 days in a few cases. In order to prevent shrinkage cracks, the specimens were covered with damp cloths for a few days after being made. The specimens were stored in air and were 35 days old when tested. The pressure was at all times applied to the upper or waterproofed surface of the concrete.

The specimens were securely bolted to the castings, an Eclipse rubber gasket being used between the finished faces of flange and casting. With the air valve *A* closed and the air valve *B* opened, air was admitted to the reservoirs until sufficient pressure was obtained. The water-valve was opened and water was allowed to fill the ¾-in. tubes. Care was taken that the pressure did not exceed that used in the test, this being regulated by opening the needle-valves. Air-valve *B* was closed and air-valve *A* connecting with the air reservoirs was opened, thus subjecting the specimens to pressure. Usually it was necessary to drain the ¾-in. pipes through the needle valves until the water level was visible in the glass tubes.

The rate of flow of the water through the concrete was obtained by noting the scale readings and the time. Pressures were also noted, but they showed very little decrease as the volume of the air-reservoirs was very large compared to the volume of the ¾-in. pipes. No readings were taken for five minutes after the pressure was on. As the rate of flow rapidly decreased readings were taken at intervals of 10 or 15 mins. for the first few hours and then at intervals gradually increasing from 2 to 8 hrs. The bottoms of the specimens were frequently examined and any dampness noted.

The threaded joint between the 6-in. pipe and the flange was the only unsatisfactory part of the apparatus. In some specimens considerable leakage was noticed at this joint, the cause no doubt being due to the springing of the joint when bolting the flange to the casting. When readings were taken these joints were always carefully examined and any leaks noted. The effect of this leakage has been eliminated as much as possible in reducing the data. Occasionally it has been necessary to throw out the entire set of readings on a specimen. This defect may doubtless be remedied by using a heavier flange.

Results of Experiments.—The compounds that were tested may be classified as follows according to the manner in which they were used:

(1) Compounds that were applied to the surface of the concrete. These may be subdivided into three classes: (a) Compounds which were applied as surface paints, as Century Cement Fluid, Des Moines Elaterite No. 60, Universal Damp-Proof Compound, Antihydrine, and Flexible Compound. (b) Compounds which were applied in layers of felt, burlap, or tarred paper with a cementing material, as Hydrex Waterproof Felt and Compound, Siastex Waterproofing Fabric No. 2 and Pitch, and Dehydratine No. 4 and common tarred roofing paper. (c) Coatine which is a surface coating used in the form of a thick layer.

(2) Foreign ingredients that were added to the body of the concrete as Limate, Medusa Water-Proof Compound, and Aquabar.

(3) Foreign ingredients that were added to a mortar coating as Medusa Water-Proof Compound, Aquabar, Antihydro and Wunner's Bitumen-Emulsion.

A set of specimens was made using for waterproofing an ordinary mortar coating and a neat cement wash, this method of waterproofing being frequently made use of in reservoirs under a low head. In order to determine the effectiveness of waterproofing materials in general, a set of specimens was made in which the concrete was not waterproofed.

Different methods, as illustrated in Fig. 2, were used in finishing the upper surface of the specimens, depending upon the kind of waterproofing compound used. As shown at *A* and *B* in Fig. 2 the concrete was finished flush with the top of the pipe, the upper surface of the concrete being well troweled. Before troweling, the specimens were allowed to stand a half hour in order that the free water on the concrete might be absorbed. The cement lining extends to the top of the concrete in *B*, while in *A* it is cut off ¼ in. below. In the specimens that were coated with mortar (see *C* and *D* of Fig. 2) the surface of the concrete was ¾ in. below the top of the pipe. After the concrete had absorbed the standing water the mortar top was added, the surface of the concrete and the mortar being thoroughly troweled.

The experiments will be discussed in the same order in which the waterproofing compounds have been considered. In applying all surface preparations care was taken to secure a dry, clean surface and to have the preparations well brushed in.

Century Cement Fluid.—This is a gray substance resembling caked putty, which was thinned with benzine to the consistency of a thick cream before being used. It is sold by the Century Cement Fluid Co., Madisonville, Ohio. The compound was applied in three coats with a brush at the ages of 14, 24 and 30 days. Only four specimens of the type shown at *B* in Fig. 2 were made because of a lack of time. These, were subjected to a pressure of approximately 20 lbs. per sq. in. for 263 hours and no appreciable flow was noted.

Des Moines Elaterite No. 60.—This is a black tar-like liquid furnished by the Elaterite Paint & Manufacturing Co., Des Moines, Ia. It is of the consistency of linseed oil and was applied cold. Eight specimens were made similar to that shown at *B* in Fig. 2. Three coats of the compound were applied at the ages of 15, 23 and 31 days for the specimens tested at 20 lbs. and at the ages of 10, 17 and 23 days for those at 40 lbs. The specimens subjected to a pressure of 201 lbs. showed no measurable flow during the 72 hrs. that they were under pressure. The flow of the specimens subjected to a pressure of 40 lbs. was quite variable. The duration of the test was 68 hrs. Specimen No. 53 was practically impermeable, the flow of No. 54 and No. 52 was moderate but No. 51 showed excessive flow. While considerable leakage was noted at flange joint of No. 51 and No. 52, this leakage would not account for the increased flow of No. 51. Furthermore, while the bottom of No. 53 and No. 54 were dry at the end of the test, the bottom of No. 51 was wet and that of No. 52 was damp.

Universal Damp-Proof Compound.—This is a heavy tar-like paint which was secured from the Universal Compound Co., No. 88 Maiden Lane, New York City. The 8 specimens were of the type sketched at *B* in Fig. 2. The compound was applied at the age of 15, 23 and 30 days for the pressure of 21 lbs. and at the age of 10, 16 and 26 days for the high pressure specimens. The results at the 20 lbs. pressure for a period of 251.5 hours were satisfactory but extremely variable. Specimens No. 127 and No. 130 were practically impermeable, while specimens No. 128 and No. 129 showed moderate flow. Three of the four specimens that were tested at a pressure varying from 35 lbs. to 37 lbs. showed excessive flow, while considerable water entered the fourth specimen. Moisture was noted on the bottom of No. 57 within 6 hrs. after the pressure was on, while No. 58 and No. 56 were wet within 16 hrs. Specimen No. 59 remained dry on the bottom during the test which continued for 69 hrs This compound was unsatisfactory at this high pressure.

Antihydrine.—This compound is manufactured by The Antihydrine Co., New Haven, Conn. It is thin tar-like liquid which is applied cold. Because of a lack of time only 4 specimens of the type shown at *B* in Fig 2 were made. Three coats of Antihydrine were applied at the age of 15, 23 and 31 days. Under a pressure of 20½ lbs. one of the specimens was impermeable, while the flow for the remaining three was moderate. All the specimens were dry on the bottom at the end of the test, which lasted about 168 hrs. These specimens were removed from the apparatus and stored for 26 days when they were tested at a pressure of 40 lbs. for 79 hrs. The flow for each of the specimens was very small.

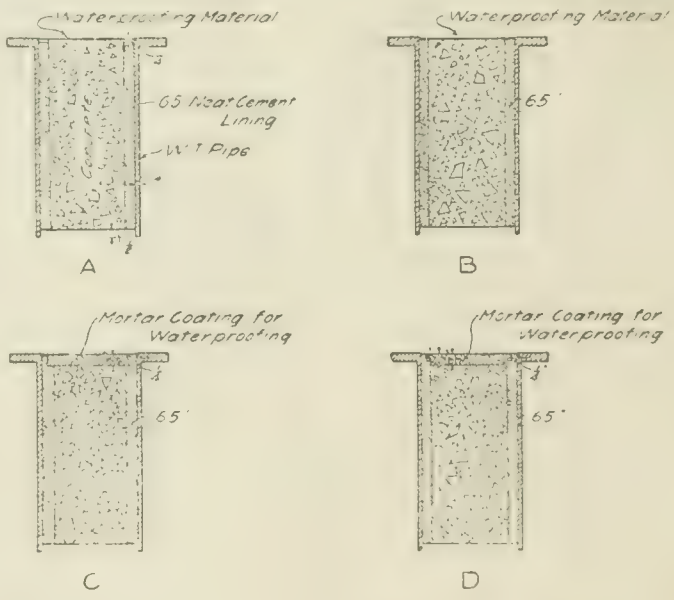


Fig. 2—Sketches Showing Method of Finishing Upper Surface of Concrete.

Flexible Compound.—This material, which resembles linseed oil in color and consistency, was secured from S. P. Holmes & Co., Chicago, Ill. Before applying the compound it was mixed with white lead, the proportions being 25 lbs. of lead to 1 gal. of the compound, the mixture being of a creamy consistency. A set of specimens was made similar to that shown in Fig. 2 at *B*. Three coats of the waterproofing were used; applied the age of 15, 23 and 30 days for the low and at 10, 16 and 26 days for the high pressure specimens. The results at each pressure were very satisfactory, the flow being small and uniform. The first set of specimens was tested at a pressure of approximately 21 lbs for 251.5 hrs., and the second set at a pressure varying from 35 lbs. to 37 lbs. for 69 hrs.

Hydrex Waterproof Felt and Compound.—These materials were purchased from the

Hydrex Felt & Engineering Co., New York City. Four specimens, similar to those shown in Fig. 2 at *A*, were treated with these compounds at the age of 19 days. The compound was heated so that it ran readily from a stick and was then quickly applied with a swab in an even layer to the upper surface of the concrete. A sheet of felt was now placed on the compound and well smoothed with a brush. Alternate layers of compound and felt were applied until the specimen was covered with three thicknesses of felt and four layers of the compound. The sheets of felt were of sufficient size to extend outside of the flange. This waterproofing gave excellent results, the specimens showing no flow whatever when subjected to a pressure of 40 lbs. for 163 hrs.

Siastex Waterproofing Fabric No. 2 and Pitch.—These materials were obtained from the Sicilian Asphalt Paving Co., New York City. The form of specimen used and the manner of applying the waterproofing were exactly the same as for Hydrex Waterproofing Felt and Compound. The specimens were treated at the age of 11 days. The test continued for 68 hrs. at a pressure of 39 lbs. and the specimens showed no permeability whatever.

Dehydratine No. 4 and Tarred Roofing Paper.—Dehydratine No. 4 is manufactured by the A. C. Horn Co., New York City. It is a black tar-like liquid of medium consistency which was applied cold. Tarred roofing paper similar to that found in ordinary building construction was used with this compound. The four specimens were of the type sketched at *A* in Fig. 2, and the materials were applied in the same manner as was the Hydrex Felt and Compound with this exception. Two coats of Dehydratine were applied to the surface of the specimens and to the upper sheet of roofing paper, the first coat being quite dry when the second coat was added. The flow at a pressure of 40 lbs. was practically zero for the 66 hrs. that the test continued.

Coatine.—This is a gray fibrous material resembling soft putty and was obtained from the H. B. Morgan Co., Grand Crossing, Chicago. It does not appear to harden and was still quite plastic 35 days after applying. Eight specimens were made of the form shown at *D* in Fig. 2 but with Coatine used in place of mortar. In order to secure adhesion between the Coatine and the concrete and cement lining, the surface of the latter was roughened with a trowel and allowed to set thoroughly before the Coatine was applied. The layer of Coatine was placed on the specimens at the age of 5 days, care being taken to secure a good joint by proper troweling. At a pressure of 20 lbs. for 74 hrs., specimen No. 193 was impermeable while No. 192 and No. 195 gave a very slight flow. At an average pressure of 38 lbs., specimen No. 200 was impermeable, No. 202 practically so, while No. 203 showed a slight flow and No. 201 a moderate flow. However, the needle valve of No. 201 leaked throughout the test, and this will account in part for the increased flow of the specimen.

Antihydro.—This is a thin liquid, greasy in consistency and containing a brown sediment. It was secured from the F. M. Hausling Co., New York City. Eight specimens were made of the type shown at *D* in Fig. 2. After the concrete had absorbed the water standing on its surface, the mortar coating was applied in three parts, the total thickness being ¾ in. The concrete was first covered with a slush coat or grout of neat cement to a thickness of ⅛ in. This was followed by a scratch coat of mortar ¼ to ⅜ in. thick, the proportions being 1 part of cement to 2 parts of sand. After the initial setting of the scratch coat, the finish coat of mortar was applied, its thickness being ¼ to ⅜ in. and the proportions 1 part of cement to 1 part of sand. Each coating was gaged with a mixture of water and Antihydro, the proportions by volume being 1 part of Antihydro to 10 parts of water. Care was taken to thoroughly trowel each coating. The results at a pressure of 40 lbs. was quite satisfactory. The flow was small and uniform for the different specimens. With the exception of specimen No. 190, which showed leakage at the flange joint, the specimens were practically impermeable for a pressure of 20 lbs. when continued for 141 hrs.

Plain Mortar.—Eight specimens were made similar to that sketched at *C* in Fig. 2. A ¾-in. mortar coat of the proportions, 1 part cement to 1½ parts sand, was applied to the concrete, the mortar being well troweled. At the age of 14 and 23 days the surface of each specimen was painted with a coating of neat cement of a creamy consistency. The cement and mixing water were not treated with any waterproofing compounds. Three of the specimens that were tested at a pressure of 39 lbs. gave satisfactory results. Specimen No. 66 showed excessive flow, dampness being noted on the bottom 24 hrs. after pressure was applied. The flow was moderate for the three specimens that were subjected to a pressure of 19½ lbs. Owing to defective apparatus it was not possible to test specimen No. 135.

Tests at pressures of 40 lbs. and 20 lbs. were also made on Medusa Water-Proof Compound, Limate, Aquabar, Wunner's Bitumen-Emulsion and plain concrete, but the results obtained were conflicting. Additional tests on these materials are desirable.

However, these two facts were brought out:

1. That when Medusa Water-Proof Compound, Limate and Aquabar were added to the body of the concrete and not in the form of a mortar coating, unsatisfactory results were obtained in 45 out of 48 specimens.

2. That all specimens of plain concrete were wet on the bottom either before or at the end of 3 days, thus showing the effectiveness of some of the waterproofings discussed in this bulletin.

Compression Tests on Concrete.—The proportions by volume of the concrete were 1:3:5. The cement, sand, and stone used were the same that were described under the permeability tests. The concrete was machine-mixed, the following method being used except in the case of Medusa Water-Proof Compound. Sufficient sand, cement, and stone were weighed on a scale to make 2½ cu. ft. of concrete. The sand and cement were thrown into the mixer in the order named. The mixer was run about one minute, sufficient water being slowly added to form a stiff mortar. The stone was now dumped into the mixer and the whole mass turned for 1½ minutes, the water being again gradually added until the concrete was of a wet consistency. The compounds tested were Limate, Medusa Water-Proof Compound, and Aquabar.

The compression specimens were of a cylindrical form, 6 ins. in diameter and 18 ins. high, cast iron molds being used. After the molds were set up on a horizontal plate, the concrete was deposited in them in layers, it being well stirred with a steel rod. Sufficient concrete was used so that after settling, its surface was slightly below the top of the cylinder. In a few days the upper surface of the concrete was plastered with 1:1 mortar, the surface of the mortar being finished flush with the top of the cylinder. Cylinders treated with each of the waterproofing compounds were made with 6 in each set, and 8 cylinders of plain concrete were made.

The cylinders were broken in a Riehlé Universal testing-machine of 100,000 lbs. capacity at the ages of 35, 62, and 292 days. Three sheets of blotting paper were used at the tops and bottoms of the specimens when tested.

In Table I are given the results of the tests which will now be considered.

(a) *Plain Concrete.*—For some unexplained reason the strength of the plain concrete specimens, marked P, is about 6 per cent less at 292 days than at 62 days.

(b) *Limate.*—This material is a hydrated lime obtained from the Western Lime and Cement Co., Milwaukee, Wis. Four sets of specimens were made, the ratio by weight of Limate to the cement for the different cylinders being 10 per cent, 14 per cent, 18 per cent and 22 per cent, respectively. In each case the Limate replaced an equal weight of the cement. The Limate and cement were first thoroughly mixed by hand. This mixture with the sand was then thrown into the mixer and the mixing process carried on as before described. The specimens marked L10, L14, etc. (see Table I) indicate those in which the Limate is equal to 10 per cent, 14 per cent, etc., of the weight of the cement. As shown in this table, the use of Limate usually increased the strength of the concrete, this effect being especially marked with the L10 and L14 specimens.

(c) *Medusa Water-Proof Compound.*—This is a dry powder furnished by the Sandusky Portland Cement Co. of Sandusky, Ohio. A quantity of the compound equal to 2 per cent of the weight of the cement was thoroughly mixed dry with the cement. Water was slowly added to this mixture while at the same time it was well troweled. The addition of water and the troweling were continued until the mixture was of a damp consistency. It was now thrown into the mixer with the sand, and the mixing completed as before outlined. By referring to Table I it will be seen that the cylinders (mark *M*) treated with this compound were stronger than those of plain concrete at corresponding ages. Furthermore, there is a decided increase in strength with age.

(d) *Aquabar.*—This compound was obtained from the Aquabar Co., Philadelphia, Pa. This is a material in gelatine form which, when properly diluted, is used to temper the mortar or concrete. The compound was thoroughly mixed with water in the proportions of 2 gals. of the compound to 48 gals of water. The concrete for these cylinders was mixed as before explained with this exception, that the Aquabar solution instead of water was used to temper the mortar and the concrete. The results (see Table I) were very unsatisfactory, the Aquabar specimens (mark *Aq*) showing from 46 per cent to 64 per cent of the strength of plain concrete at corresponding ages.

Conclusions.—The following conclusions are drawn as the result of the experiments:

(1) Unless extreme care is taken in proportioning, it is necessary that some form of water proofing be used for a 1:3:5 concrete for pressures from 20 lbs. per sq. in. to 40 lbs. per sq. in.

(2) For nearly all specimens the rate of flow decreased rapidly with time. This was especially marked in the case of the mortar coatings and was due in part to their dry condition.

(3) All of the surface paints were quite satisfactory at pressures of 20 lbs. per sq. in. When subjected to pressures of 40 lbs. per sq. in., Des Moines Elaterite No. 60 and Universal Damp-Proof Compound proved unreliable. The mixture of Flexible Compound and white lead gave good results at both pressures. Century Cement Fluid was not tested at the high pressure and while Antihydrine gave only a small flow at 40 lbs. per sq. in., the results can not be compared with those of the other compounds because the test was carried on under different conditions.

(4) Water proofing materials composed of layers of felt, burlap, or tarred paper, cemented together with a compound, gave excellent results at the high pressure. Not one of the specimens treated with Hydrex Felt and Compound, Siastex Fabric No. 2 and Pitch, and Dehydratine No. 4 and tarred roofing paper showed any appreciable flow.

(5) Coatine was practically impermeable at the two pressures.

(6) The mortar coatings in the case of Antihydro gave good results at both pressures, there being practically no flow after the first 24 hrs. It is possible, however, that its effectiveness was due partly to the method of applying the mortar. For waterproofing used in this manner, it would seem desirable to apply the mortar in two layers after first covering the concrete with a neat cement slush coat. The plain mortar with a neat cement wash was effective at a pressure of 20 lbs. per sq. in. but proved unreliable at 40 lbs. per sq. in. No doubt a plain mortar coating would prove satisfactory in water

proofing concrete at high pressures providing it be applied as just described.

(7) Water proofing compounds that are added to the body of the concrete are worthless at pressures from 20 lbs per sq. in. to 40 lbs. per sq. in. unless great care be used in proportioning.

(8) Limate, when replacing 10 per cent to 22 per cent of the weight of cement, and Medusa Water-proof Compound equal to 2 per cent of the weight of the cement do not impair the compressive strength of 1:3:5 concrete. On the other hand, Aquabar equal to 4⅛ per cent of the mixing water reduces the strength of 1:3:5 concrete by percentages varying from 36 per cent to 54 per cent.

TABLE 1 EFFECT OF WATERPROOFING COMPOUNDS ON THE COMPRESSIVE STRENGTH OF 1:3:5 CONCRETE

Ultimate Compressive Strength in Lbs./in.².

Specimens.	Age 7 days	Avge.	Age 62 days	Avge.	Age 270 days	Avge.
P ..	944		1110	.. .	1330	. . .
P	784		1160		880	. . .
P .			.		960	
P .		860	.	1145	1140	1041
Aq	70		1400		920	.
Aq	400	400	570	570	.	620
L10	1110		1260		1240	. . . .
L10	960	1035	1180	1190	1210	1225
L14	1130		1470	.	1170	
L14	1050	1090	1320	1395	1360	1265
L18	1040		1000	. . . .	1040	. . . .
L18	860	950	1190	1095	1020	1030
L22	1130		1250		1240	
L22	750	940	1000	1140	1140	1240
M	970		1090		1170	.
M	890	930	1160	1125	1120	1145

*Test specimens were broken in laboratory at age of 7 days.

Method and Cost of Constructing Concrete Boundary Monuments.

The accompanying sketch shows the construction of concrete monuments employed in marking the boundaries of the Kennebec Water District, Waterville, Me. These monuments were constructed as follows: A hole 5 ft. or so in depth was made with an 8-in. post hole auger and then the bottom portion of this hole was enlarged to about double this diameter with a spoon. The hole was then filled with concrete in which were embedded at each corner ¼-in. steel bars bent in U-form across the top of the monument. The excavation formed the mold for the concrete except for the top portion which was molded 6 ins. square, with chamfered corners, by means of wooden forms. In mowing fields or grass lands the top of the monument was made flush with the ground and the square top was 6 ins. in length; along fence and property lines the monuments extended 1 ft. above the ground surface and the square molded top was made 16 ins. long. The form used for molding the square top is shown by the illustration. In the top of the monument at the center there was embedded a cast iron mark plate shaped as shown by the sketch to hold it firmly. This plate bore the letters K. W. D. and the number of the monument, as K. W. D 27. The concrete used was a 1:2:4 ½-in. stone or gravel mixture.

The cost of these monuments was about $4.30 each, including materials, supplies, forms, teaming and supervision. The number of monuments constructed in three months and their costs were as follows:

Month.	No. built.	Total cost.	Cost per mat.
September			
October			
November	15	65.25	4.35
Total			

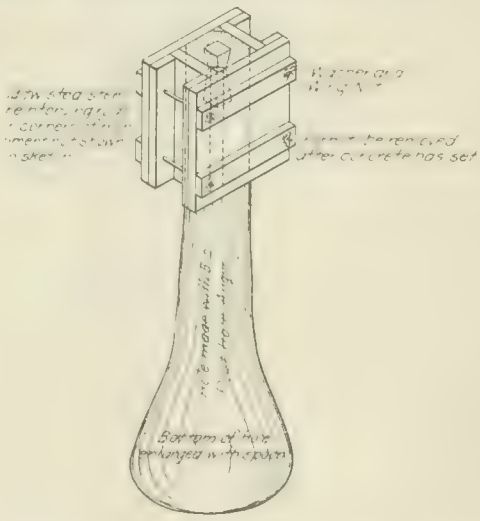
This includes $1 per day for district horses but does not include cost of forms which amounted to between $4 and $5, making the total average cost per monument in place $4.30. These figures are furnished by Mr. Leonard Metcalf, civil engineer, Boston, Mass., under whose direction the work was done which included this monument construction.

Some Data and Records of Experience Regarding the Disintegration of Concrete by Alkali.*

It is well known, of course, that alkali is present in greater or less amount in the soil of the arid regions. In the disintegration of the rocks, the minerals have been broken down into mineral salts which have remained in the soil as soluble salts. The rainfall and the drainage of the region are insufficient to carry these salts out of the soil through the subsoils and eventually into the streams and rivers, as is the case in the more humid regions.

A good many, if not all, of the projects of the Reclamation Service are located in alkali regions, and, thus far, the attention of the engineers has been directed to the failure of concrete structures on only two of these projects—one in Montana and one in Wyoming. These failures may indicate some special peculiarity of the local soil, and may be somewhat similar to the well-known fact that the action of sea water has been destructive to concrete in certain localities and not in others.

The Service has started an investigation, which is still continuing, and the chemist's report has not yet been published, but Mr



Concrete Monument for Marking Boundaries.

Jewett, the cement expert of the Service, in a paper before the American Society for Testing Materials, set forth some of the conditions, as will be shown by the following extracts:

On the Sun River project * * * its effect has been noted in the disintegration of a number of small structures, such as pipe culverts, which are partially submerged in the small streams carrying the drainage of the surrounding country. The effect of this water in causing the disintegration of the concrete is noticed, both in the softening of the material where constantly submerged for a period of three or four months, and also more particularly in the breaking up of the structure at the line where the water rises and falls, or, in other words, where there is a submersion followed by a drying out, followed by another submersion, etc. This process brings about a breaking up of the structure, similar in appearance to that of the effect of freezing, only much more severe. It is described by the engineer in charge of this work as follows:

"On examination of some of the concrete culverts which have been in place in alkali water for three or four months, the part under water is much softer than the part above water, but the greatest effect of the alkali seems to be at the water surface. Have examined pieces of these culverts taken from below water level and found, by microscopic examination, minute crystals which disintegrate on being exposed to the air and become a fine powder. This process of crystallization has an enormous expansive force, the same as freezing, and this undoubtedly has an enormous disintegrating effect. One culvert which had been in alkali water several months had no strength at all and was like so much sand and mud at the water level."

In studying the cause of this disintegration it seemed that a chemical analysis of the water producing these results would be the first step of importance to be taken. The results obtained from an analysis of this water are as follows:

	Milligrams per liter.
Calcium sulphate ($Ca\ SO_4$)	1 690
Magnesium sulphate ($Mg\ SO_4$)	6 870
Basic magnesium carbonate ($MgH_2\ CO_2$)	305
Magnesium chloride ($Mg\ Cl_2$)	192
Potassium chloride ($K\ Cl$)	20
Total solids	9 077
Weight after ignition	8 855
Loss on ignition	222

From this analysis it will be seen that the principal mineral ingredient of this water is magnesium sulphate, and this leads to the conclusion that the effect of this water in causing disintegration of concrete is similar in its action to that of sea water in which magnesium sulphate is stated to be the principal substance acting to bring about the disintegration of concrete with which it comes in contact.

Professor Headden, of the Colorado State Agricultural College, has at various times issued bulletins in reference to alkali in the soil and in the water, and has recently added to his publications Bulletin 132 on "The Destruction of Concrete by Alkali," in the course of which he gives an account of his investigation of cement tiling which had rapidly deteriorated. From that bulletin the following is quoted in order to convey clearly the conditions.

The following case of deterioration may be of some interest as it presents some new points. There were sent to me some months ago a number of fragments of tiling which had been laid but from eight to nine months. They had been disintegrated to such an extent that one of the samples was simply a white putty-like mass mixed with sand. There was nothing about this sample remotely suggestive of concrete. Another of the samples consisted of a fragment of the tile, the interior portions of which had been wholly decomposed, while there still remained an outer and inner portion in good condition, or comparatively so. Another sample had been attacked in the inner side, leaving the mass of the tile outside of the zone of decomposition apparently sound. The line of decomposition was sharply limited and showed distinctly, but even in this case there remained a thin layer of cement on the inside.

I do not know whether the tile were running full of water or not, probably not, as the fragments seem to be parts of 16 or 18-inch tile. The importance of this point is simply this, that it would answer any question in regard to the separation of solid "alkali" salts on that portion of tile above the water line. That such a separation of these salts should take place does not seem very probable in this case.

The point of attack, so far as the samples at my disposal indicate, is either in the center of the cement mass or near the inner surface. In either case we are almost compelled to assume the action of the water, i. e., of the salts held in solution. At the same time we see the resisting power of the outside and inside surfaces, which are evidently richer in cement than the inner portion of the mass of the tile.

The sand used in making the tile was quite fine. The proportion used was 5:1. We can readily see that the individual masses of cement in the interior mass of the tile must be small and readily attacked by solutions of salts capable of reacting with the cement.

It seems quite evident that the agents causing this disintegration of the cement must gain access to the interior portion of the mass of the tile in the form of a solution, but it is a question whether this solution is the same in strength and character as the water in the drain. I think that I have clearly shown in Bulletin 65 of the Colorado Experiment Station, page 34, that the water soluble portion of the

*Abstract of a paper by G. G. Anderson, Proceedings American Society of Civil Engineers, Vol. XXXV, p. 1352.

soil is different from the salts held in solution in the ground water. Further, in Bulletin 72, page 28 et seq., that the ground waters are different from the drain waters, and the action of these waters on the tile would vary somewhat according to the source of the solution which penetrated the mass of the tile.

The drain waters obtained, say at a depth of four feet, contain as a rule a smaller amount of salts in solution than the ground water. The salts present are the same, but their relative quantities vary. The usual salts present in the ground waters are, sodic sulfate, calcic sulfate, magnesic sulfate, sodic carbonate, and sodic chlorid, in some instances also magnesic chlorid. In the drain waters we have the same salts, but their relative quantities are different, the most notable feature being the relatively large amount of sodic carbonate.

The substances claimed to be the most active in effecting the disintegration of cement are the sulfates. In the case of sea water the explanation offered is that the lime of the cement decomposes the magnesic salts present in the water, whereby the lime goes into solution and the magnesia is deposited in its stead, causing a bulging and disintegration of the work owing to its greater bulk. The principal magnesian salt in sea water is the chlorid, the deleterious action of which on cement is not established, but it has been shown that magnesic sulfate acts energetically. The most active agent in decomposing concrete is the sulfuric acid of the sulfates carried in solution. Again, solutions of gypsum have been shown to act detrimentally on concrete by forming with the tri-calcic aluminate a sulfo-aluminate.

The water acting on these tiles, whether it be ground water or drain water, is very bad. One of the two small samples sent to me contained 1 252.6 grains per imperial gallon, of which 493.5 grains were sulfuric acid (SO_3) with an extremely large proportion of magnesia. The other contained 542.3 grains per imperial gallon, with 42.31 grains of magnesic oxid or 7.8 per cent of the total solids. I have examined a number of waters from this section, and find the ground water uniformly heavily laden with the sulfates of lime and soda, with comparatively large quantities of magnesia, especially if the water comes from near the surface, as it necessarily must in the case of drain waters. In addition to the above constituents, there is uniformly some carbonate present, which for the present purpose we may consider as sodic carbonate.

We have then an ample supply of these substances present which are known to act deleteriously upon cement, i. e., the sulfates, a portion of which is magnesic sulfate, and in addition there is so much sodic carbonate present that its action cannot be neglected.

Professor Headden, assuming that the cement used in the tiling was an average Portland cement, with not more than 2 per cent of calcic sulphate, then considers the action of the waters on the tile. The white decomposition product indicated the presence of a large quantity of water, also of considerable quantities of sulphuric and carbonic acids. The decomposed mass was washed with distilled water, and the wash-water showed that it had taken sulphuric acid, lime, and soda into solution.

An analysis of the Arkansas River water at Rocky Ford, which, Professor Headden remarks, is essentially a return water, is given, and the assumption is made that the composition of the water acting on the decomposed tiling was much the same, as are all waters in that district, varying in amounts of mineral matter, or total solids held in solution, as shown by the two samples of drain water accompanying the tiling—one having 1,252.6 grains, the other 542.3 grains.

The action on the tiling seems to be similar in Colorado and Montana. A comparison of the features of construction may not be possible.

In the Montana case, Mr. Jewett says:

Of course, in this case, as in any other case of concrete failure, the question of poor workmanship is one of the first to be considered and it should be noted that the work in question was carried on by force account under direct supervision of employes of the service and not by contract, and was done in the usual thorough and substantial manner, in which all of the construction work of the service is carried on. After taking all the evidence into account there seemed to be no other conclusion but that the action of the alkali water was directly responsible for the results noticed.

Professor Headden has not much information on the quality of the tiling examined by him. The sand used was quite fine, the proportion 5 to 1, and the individual masses of cement in the interior must have been small and readily attacked by solutions of salts capable of reacting with the cement.

Both Mr. Jewett and Professor Headden find the decomposing action, in the cases of these tilings, to be similar to that of sea water, in which magnesic sulphate is stated to be the principal agent. Professor Headden says, as already quoted.

The principal magnesian salt in sea water is the chlorid, the deleterious action of which on cement is not established, but it has been shown that magnesic sulfate acts energetically.

Reference to this similarity to the action of sea water will be made later; meantime, the following is a summary of Professor Headden's conclusions.

The analysis may be interpreted as indicating that the cement had been deprived of silicic acid and of a relatively large amount of lime. The amounts of the ferric and aluminic oxides have been reduced to about one-half as much in the decomposed cement as in the original. The sodic sulphate, more particularly the calcic and magnesic sulphates which are present in the ground-water, will at the same time act on the tri-calcic aluminate, forming the sulpho-aluminate, which crystallizes with 60 molecules of water and is soluble. The increase of sulphuric acid (more than 20 per cent), and also of carbonic acid (more than 12 per cent), in the water-free decomposition product is noted, as compared with only about 1 per cent each in the original product, while magnesic sulphate has also contributed to the result, being more than four times greater in the decomposed product than in the original; and there is the conclusion that:

The action of the ground waters seems to have been one of chemical change, converting the lime of the cement into a sulfate and carbonate accompanied by the removal of silicic acid, alumina, and lime, and totally destroying the cohesiveness of the concrete.

The case of the sewers at Great Falls, Mont., has been referred to frequently, and is probably the most striking illustration of deterioration yet considered. The city engineer, Mr. C. W. Swearingen, was so impressed by the conditions that he requested the authorities at the Montana State Agricultural College to investigate and report on it.

The preliminary conclusions of Mr. E. T. Tannatt, rural engineer, and Mr. Edmund Burke, chemist, are embodied in Bulletin No. 69 of the Montana Experiment Station, from which the following extracts give a very clear exposition of the conditions:

The Third Street main sewer was constructed in the year 1890, the material used being Portland cement pipe of home manufacture, made in moulds and put in place after the cement had hardened. Sewer is oval in shape, dimensions 26x32 inches. This sewer, after a comparatively short term of service, showed defects of so serious a character as to necessitate rebuilding portions of the same. The remaining portion of this sewer has disintegrated in many places and occasionally portions of the pipe are gone; the cement in places has the appearance and consistency of fresh lime mortar.

The Sixth Street main was constructed in the year 1892, the material being the best grade of common brick of home manufacture. Sewer is circular in form, four feet inside diameter, two rings of brick laid on edge in imported Portland cement mortar, outside plaster coat one-half inch thick, not plastered on inside; all cement mortar one part cement and three parts sand. The masonry in the invert in this sewer is disintegrating throughout its entire length, the defects being confined almost entirely to the invert and lower sections of the manholes; the arch is in apparent good condition.

There is no sub-drain under, nor on the sides of the sewer. As stated before, the disintegration in the Third Street main, where cement pipe was used, commenced soon after its construction, whereas the Sixth Street main gave no evidences of defect for about seven years after its construction, and it is only during the past four years that decomposition has been rapid.

The examiners found (a) that the disintegration and destructive action of the cement did not come from adulteration nor from the quality of the materials used; (b) that though a limited chemical or physical action of the alkali salts may be a partial cause of the breaking down of the brck, yet the principal cause was the fact that the bricks were too soft and not fit for sewer construction; and (c) that the action on the cement was chemical, that the destructive agent came from the outside of the sewer, and that the disintegration of the cement cannot be charged to any action of the sewage or gases from the same.

They found that certain portions of the sewers showed the presence of external moisture to a more marked degree than other sections, and that, contiguous to it, were various depressions in which water collected and gradually seeped into the soil, thereby affording means for the leaching out of the alkali from the gumbo, through the sand and other more permeable formations, into the back-filling adjoining the sewer, there depositing against the structure. The soil samples showing the highest percentages of alkali were taken immediately at the back of the cylinder of the sewer.

Soil samples were analyzed in order to ascertain the amount of alkali salts, whether these were being leached out and lodged against the sewer, and the amounts at various depths, but there is no chemical investigation of the action on the cement and its alteration, which it is understood will form the subject of a later bulletin.

The analyses embodied in the report, however, show that the maximum disintegration of the sewer occurred where the greatest percentage of alkali showed in the soil, and that the ground waters were leaching the alkali from the soils and depositing the salts along the sewer.

Messrs. Tannatt and Burke consider that the use of cement for sewers and other structures in alkali soil is inadvisable in cases where it is not possible to drain all ground waters from the exterior of the sewer, and they recommend that drain tile be placed in the bottom of the trench, covered with clean gravel or crushed stone, and that similar drains be placed around the barrel of the sewer to provide effective drainage of the ground waters, in order that it will not be possible for them to come into contact with the structure itself, and where these precautions cannot be taken they "unhesitatingly recommend that cement pipe be not used."

The writer had some experience with a construction somewhat similar to the Great Falls sewer, and in similar, though not such aggravated, conditions, but with entirely different results.

Lake Loveland was constructed under the writer's supervision in 1894. The outlet is a tunnel about ¾ mile long, nearly all of which is in stratified shale. The rock was of such a character that it would have decomposed under the action of passing waters at a high velocity, and therefore the tunnel was lined. The interior diameter of the tube was 5 ft. The invert was built of two rings of well burned brick, and the arch was of concrete.

In the excavation, large volumes of water were developed, ultimately giving a flow of about 2 cu. ft. per second. The water undoubtedly was impregnated heavily with alkali, but the writer did not obtain a chemical analysis of it, as at that time he did not suspect that any deleterious action might be caused by the character of the water itself; but apart from the fact that it was "return water"—the drainage of a large section of

irrigated country lying west of the reservoir—there were constant physical evidences that it contained salts, if one might judge from the action on the human system caused by drinking it in moderate quantities.

Through the whole length of the tunnel a sub-drain was channeled out in the rock bottom, and wooden boxes were placed to convey these waters. Side drains were also placed at frequent intervals throughout the whole length, and mostly where the volume was largest, always connected with the under drains. These were carried up as high as the drainage showed, usually to the spring of the arch. In short, every precaution was taken to prevent the water from coming in contact with the concrete, certainly until it had set thoroughly, and solely for the purpose of securing good results and without thought of any ultimate chemical reaction.

The work was done practically by force account. The materials were supplied, the labor was done under contract, and the work was in charge of a competent concrete worker and under a thoroughly able inspector.

As far as the writer knows, the concrete and the cement mortar in the brickwork are in thoroughly good condition today. It is nearly 8 years since he examined the work, and then it was found to be without any apparent defect. The superintendent informed the writer recently that he had not been in the tunnel for 2 years, but had then found it in perfect condition, and was of the opinion that it still is so.

One other structure may be mentioned, a reservoir spillway in the Arkansas Valley, or the Bob Creek Reservoir, constructed and owned by Mr. W. C. Bradbury. The writer's attention was attracted to it in September, 1909, when passing near it on other business. He first noticed and examined a small division head gate about ½ mile below the reservoir. It was stated that these works had been built less than 2 years before that time. The writer had no means of knowing the proportions used in the work, but this head gate seemed to have been fairly well built, and its upper portion was in fair condition. The floor had evidently been about 6 ins. in thickness, but it was entirely decomposed and could be crushed readily in the hand. The uprights, up to about the normal height of the water, showed disintegration. At the outlet from the reservoir the apron was disintegrated in the same way. It had been reinforced and the reinforcing material was exposed and bright, while the concrete mass was almost completely pulverized.

The spillway to the reservoir was of considerable length and height, of ogee overfall, and had the same appearance of fairly good construction. Prior to the writer's visit there had never been any water flowing over it from the reservoir. Its lower portion, for a height of about 10 ft. above the apron level, was markedly discolored, and on breaking the surface crust it was found that the interior mass of the concrete could easily be removed and pulverized in the hand.

About a month later water passed over the spillway and washed out the lower section of the fall to the height already indicated. The concrete had been placed on a foundation of shale, from which the alkali water oozed. No provision had been made for the under drainage of this water, and the conclusion is inevitable that the destruction of the concrete was the result of the chemical action of the alkali in the water draining from the shale.

From these various instances it would seem that somewhat new problems are presented to the constructing engineer, or if they are not new they are old problems under new conditions, and engineers have been prone to overlook their significance until serious consequences have forced them directly on their attention.

It is very likely true that the effects of alkali on concrete are similar to those of sea water, with some differences, as these in themselves differ in various localities. Means of overcoming the sea water action are fairly well outlined, though as competent an authority as Feret says:

> No cement or other hydraulic product has yet been found which presents absolute security against the decomposing action of sea water.

Michaelis, on the other hand, long ago made certain recommendations which may be summarized briefly here: From the physical point of view a dense concrete surrounded with an impermeable layer composed of 1 part of cement and 2 or 2½ parts of sand of mixed grains, of which at least one-third must be very fine, and the whole mass made if possible in one operation; from the chemical point of view the use of cement rich in silica and as poor as possible in alumina and ferric oxide and the use of substances which render the mortar, at any rate in its external layers, denser and more capable of resistance.

The solution of the problem, from the chemical point of view, will be the care of the chemists and the cement manufacturers. The problem for them is as new—or as old under new conditions—as it is for the engineer, and conceding the general proposition that the solution lies in good construction, which the engineer must realize and will provide, there is, it would seem, the larger problem of a coating which, adding impermeability, shall also resist the chemical reactions between the soil and water and the cement.

What is good construction under these conditions?

It seems to the writer that the engineer, under these conditions, first has to extend materially the field of his investigations before outlining plans. The character of the soil and of the water passing over the soil and to be transported over the structure must be thoroughly analyzed. Then to the physical problem similar analytic consideration must be taken of the materials used as concrete aggregates—the sand, the gravel, and the water.

On that feature the following is quoted from Mr. Jewett's paper:

> In the case of the sand used on the Reclamation Service project above mentioned, the engineers reported that there were evidences that this sand, which was the only supply readily available, contained alkali or some substance making it chemically active and assisting in the disintegration of the concrete. A chemical analysis of this sand was therefore obtained and resulted as follows:

	Per Cent.
Silica ($Si O_2$)	67.03
Alumina ($Al_2 O_3$)	6.85
Ferric oxide ($Fe_2 O_3$)	2.50
Manganese oxide (Mn O)	.02
Lime (Ca O)	10.72
Magnesia (Mg O)	1.72
Sulphuric anhydride (SO_3)	Trace
Alkalies—	
Soda ($Na_2 O$)	1.74
Potassa ($K_2 O$)	1.51
Water at 100° C.	.14
Ignition loss	8.16
Total	100.39

> This sand gives excellent results from physical tests, but since, as will be seen from the above analysis, the alkali content is about 3 per cent, which would correspond to about 15 to 20 per cent of feldspathic material, and that it also contains a considerable percentage of limestone, it is altogether possible that this sand would be more readily acted on by the influences tending to disintegrate the concrete than a sand of a more highly silicious nature.

It is extremely likely that similar conditions will be found in most of the sands and gravels available in the arid regions where alkali is known to exist.

There is no occasion for elaboration on the care required in the selection of water for use in mixing concrete. It is quite well known that the ground and drain waters in most of these districts are largely impregnated with alkali; that is discernible without chemical analysis, and is particularly true in the lower reaches of irrigated valleys, where most of the waters are drain waters, consisting of the concentrated essence of alkali from the irrigation and drainage of the upper valleys. Prior to the introduction of the gravity system at Greeley, for instance, the domestic supply from underground galleries contained as much as 1,800 parts of hardness and, it may be added, the water used in mixing the concrete at the Loveland work referred to was obtained not from the drainage of the tunnel but from the town supply withdrawn from the river inside the foot-hills.

If the action of the alkali salts in the water surrounding a concrete mass can have the destructive effect shown in the various instances quoted, it is certain that the incorporation of such water in the aggregate cannot be other than injurious.

Beyond extra care in the materials and the production of a dense mass, there is no room to doubt the advisability of effective drainage around the structure.

Professor Headden, in Bulletin 72*, speaking of the alkali lands in the Poudre Valley, said:

> I am convinced that the only question of alkali that we have resolves itself into one of drainage, and beyond this, there is no alkali question for us.

It would be too much to hope that the drainage around structures would as effectively solve the difficulty of alkali in contact with concrete, but it will aid in resisting the action of the agencies at operation.

It is not possible, however, in all cases to provide such drainage as would be effective, and beyond all that—beyond the external application and the possible incorporation of an impervious coating in the mass itself—it seems to the writer that there must be added to it or in it, in some form, agencies which will counteract the effect of these apparently well recognized chemical elements which bring destruction, and that must be left to the chemist, on whose province the writer has probably encroached too far, and apparently with only a speaking acquaintance with that science.

Waterworks in Peking, China.—The new waterworks in Peking, China, have been completed in a trifle less than one year by a German company. The contract price is said to have been $1,000,000.

The resident area to be supplied by the waterworks contains a population of about 700,000 (128,000 families), among which cholera, smallpox, typhus, and other contagious diseases have been more or less prevalent. The use of pure water, together with the benefits of the system of removal of garbage and cleansing the streets initiated by the city police department, will tend greatly to reduce, if in time not entirely to eradicate, these diseases. Peking is situated in one of the most healthful climatic zones in China, and with proper sanitary precautions should show as low a death rate as the average American and European cities.

The waterworks are to be administered solely by Chinese. The cost of water to consumers will, it is said, be less than 40 cents per 1,000 gallons.

The water is taken from the Shaho River, which rises in the hills west of Peking and is an unusually clear water stream. It passes through no villages. The pumping plant consists of two centrifugal pumps having a combined capacity of about 5,000 gallons per minute, or about 10 gals. per capita, a decided contrast to Chicago and New York with over 200 gallons per capita.

The settling tanks were furnished by the Riter-Conley Company, of Pittsburg, Pa. Patented steel mains have been used, and the Ludlow Valve Manufacturing Company, of Troy, N. Y., has furnished the valves, hydrants, water gates, etc., for the system

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The total original supply of coal in Arkansas is estimated by M. R. Campbell, of the United States Geological Survey, at 1,887,000,000 short tons, of which 1,797,000,000 were lignite. The lignite areas have not been developed and no production has been reported from them. From the bituminous and semi-anthracite areas there has been mined, to the close of 1908, a total of 25,834,758 short tons, representing an exhaustion, including waste, of approximately 39,000,000 tons, or a little more than 2 per cent of the estimated original contents of the Arkansas fields.

*Montana Agricultural Experiment Station

Earth and Rock Section

Note: This section is devoted to methods and costs of excavating earth and rock and building embankments. It will cover the grading of roads and railroads, diking and canal work, dredging, building reservoirs and earth dams, sewer and water pipe trenching, quarrying, etc.

Cost of Boring Five Test Wells for a Double Track Railway Bridge in California.

BY P. J. ROBINSON *

The American River of California is a harmless stream during the summer or dry period, but as soon as the winter rains set in, it assumes proportions creditable to much larger rivers, and has been known to rise 15 ft. in less than 24 hours.

During January, 1909, an unprecedented rise occurred, which left destruction in its wake on every hand, and undermined one of the concrete piers of a large railroad bridge near Sacramento, carrying away two deck plate girders spans of 100 ft. each. In view of increased traffic conditions, improvements had been contemplated before the disaster, but now it was decided to take immediate steps towards the construction of a double-track structure, a short distance down stream from the old bridge, thus effecting a reduction in curvature on the approaches at either end. Accordingly test wells were bored to determine the nature of the foundation for the new piers. The original plans called for 6 wells, but only five were bored. Stagings were erected from the side of the old bridge, and the equipment used, which consisted of a gasoline hoist and drill machine, was rented from a local well borer, who also supervised the work. Three crews prosecuted the work at the start, ending with one, with wages as follows:

Engineer	$4.75
Foreman	4.00
Sub-foreman	3.75
Sub-foreman	3.50
Sub-foreman	3.25
Laborers	3.00
Laborers	2.75
Laborers	2.50
Laborers	2.25

A suction sand pump, a design of the local shops, was used through the gravel and cobbles and an earth auger in the clay. The wells were encased with sheet iron and when possible the pipe was pulled and used again. The prices charged for this material are shown in the cost statement and the wide range in cost of the different sizes is due to the fact that the 14-in. and 12-in. pipe were new, while the 10-in. and 8-in. were second hand.

The work was twice interrupted by high water, necessitating the dismantling of the equipment, and thereby adding quite materially to the cost.

The method of recording the progress of the work is shown on the accompanying diagram and is unique in that it furnishes a complete record of all the details and is a permanent part of the records for future reference. The cost of this work was as follows

Labor:		
Loading and unloading material, 63½ days	$	197.00
Hauling material, 2 days		6.50
Boring well No. 1, 107 days		324.25
Boring well No. 2, 52 days		165.75
Boring well No. 3, 131½ days		417.62
Boring well No. 4, 51½ days		171.50
Boring well No. 6, 117½ days		360.00
Erecting staging, 68½ days		236.81
Repairing derrick, 2 days		7.00
Making boxes of test well soils, 4 days		15.00
Rental of well boring apparatus		118.00
	$	2,019.43
Material:		
Lumber, 9,073 ft. B.M. at $13.83 per M	$	125.47
Sheet iron casing, 14-in., new, 52 lin. ft. at $2.75		143.00
Sheet iron casing, 12-in., new, 172 lin. ft. at $2.25		387.00
Sheet iron casing, 10-in., second-hand, 49 lin. ft. at $0.60		29.40
Sheet iron casing, 8-in., second-hand, 36 lin. ft. at $0.51		18.36
Store department expense		40.55
2% of labor for use of tools		40.40
		784.18
Total	$	2,803.61

No. lin. ft. bored, 534.5—cost per ft., $5.25.

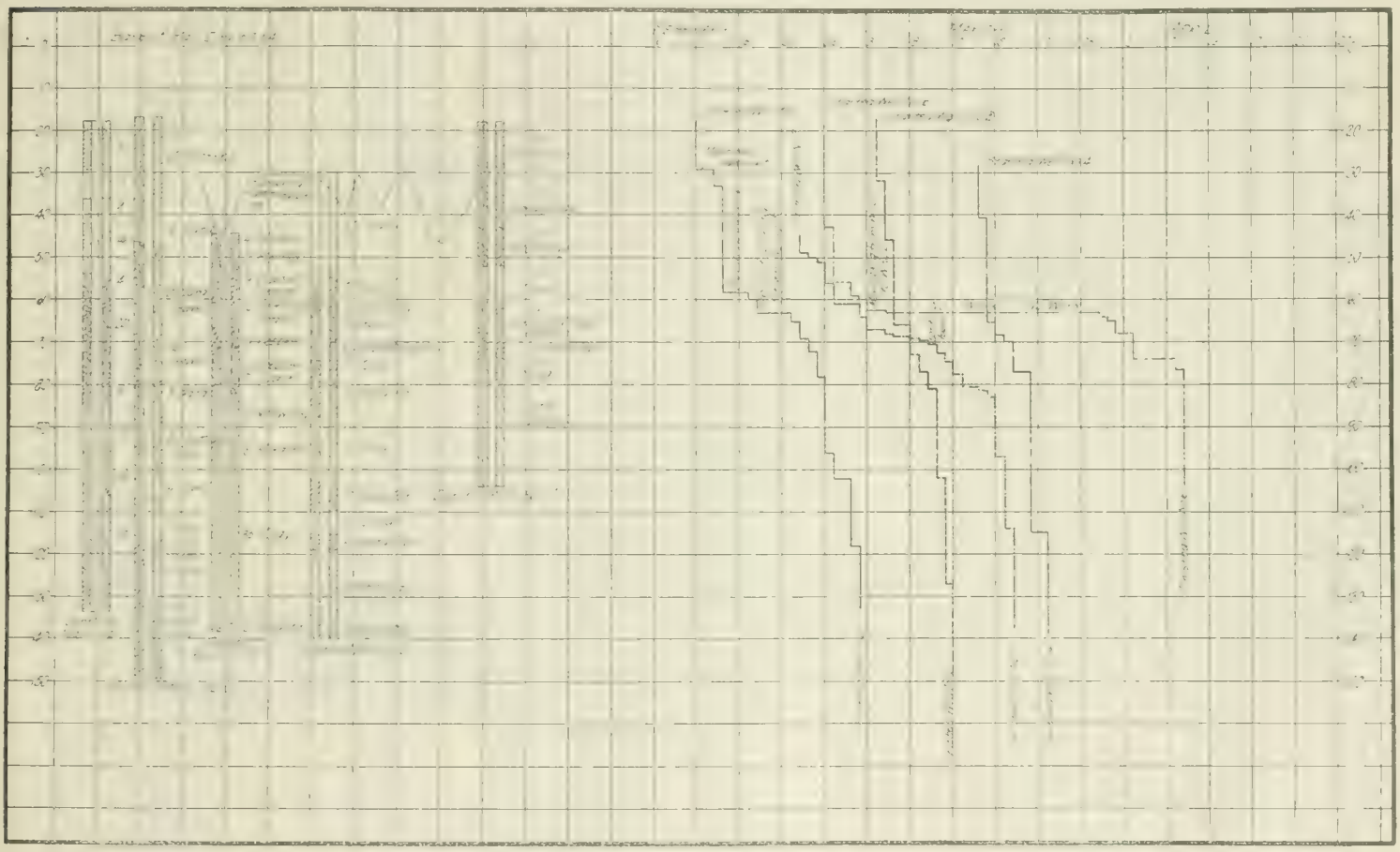

Diagram for Recording Progress and Character of Test Borings.

Of the five wells bored, No. 1 and No. 6 were on the bank and Nos. 2, 3 and 4 were located in the channel of the stream. It is noted that well No. 3 was the most expensive to bore, due to the nature of the substance penetrated.

"We adopted meters at Wellesley in a small way from the opening of the works in 1885. In 1893 we had 560 in use, as against 164 in the previous year. In 1891 we pumped 92,400,000 gals. On the introduction of meters our consumption began to decrease and although takers steadily increased we did not reach a consumption of 93,800,000 until 1902, eleven years later. At the present our consumption is 45 gals. per day to each consumer and 44 to each inhabitant."—Extract from the report of Mr. Frank L. Fuller, C. E., of Boston, Mass.

*Assistant Engineer Southern Pacific Co., Sacramento, Cal.

Data on the Storage and Handling of Explosives.*

In open air quarrying an explosive may be employed that produces a long flame or gives off poisonous gases or shatters the material, whereas in coal mines these are all points to be guarded against. Flames may ignite gases present in coal seams, poisonous gases in the confined tunnels are dangerous to workmen, and undue shattering of coal wastes it and means misdirected labor.

Explosives commonly used for blasting purposes, containing nitroglycerine, should be kept frozen until required. The temperature should be kept constantly close to 35° F. To keep nitroglycerine explosives permanently thawed the temperature should not go below 52° F. A

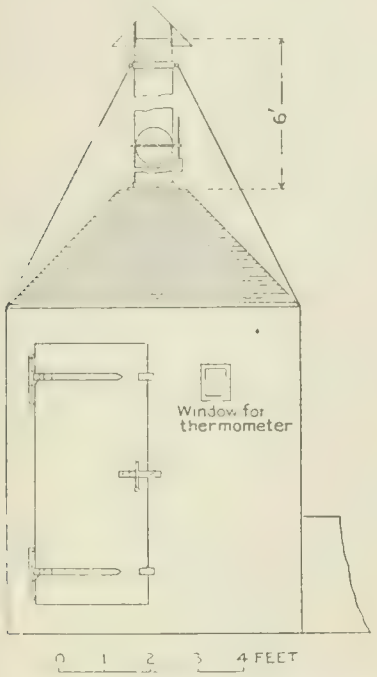

Fig. 1—Elevation of Thaw House for Frozen Explosives.

high temperature renders them more sensitive to explosion and some decompose at high temperatures, so it is best that the temperature in magazines in which they are stored should never rise above 90° F.

Explosives should not be exposed for any length of time to direct sunlight, because this may lead to decomposition in those containing nitroglycerine, nitrocellulose, nitrostarch, or substances of that kind. Explosives should be stored in a dry place, for many of them contain considerable quantities of ammonium nitrate or of sodium nitrate and so will take up moisture from damp air and become damp. Too great dampness makes the explosive not only harder to fire but weaker when fired. Besides, if the explosive is damp the nature of the gases produced will be different. Moreover as bodies like dynamite become moist, the nitroglycerine contained in them tends to run out; that is, what is called exudation takes place, and all the dangers follow that belong to liquid nitroglycerine.

On the other hand, explosives should not be kept in an extremely dry place, for all of them as made contain some moisture and if the place of storage is very dry the explosive may lose this moisture. Such a change in composition will affect the explosive so as to change the speed with which the explosive reaction takes place within it, and therefore the character of the work which it does when exploded. Naturally the longer an explosive is kept in storage the greater are the chances that change will take place in it, and therefore the explosive should be obtained in as fresh a condition as possible and should be used as soon as possible after it is received. Also it should be kept stored in its original packages in the magazine until wanted for immediate use, and then used promptly.

The paraffine wrapper used in making the dynamite up in sticks is to keep the moisture from the contents of the cartridges. As rough handling readily breaks the folded edges, cartridges should be handled with great care. The necessity for handling cartridges with care to prevent an explosion is pretty well understood, but it is also necessary to handle them carefuly to prevent them being spoiled by moisture. They are best carried to the place where they are to be used in the cartons in which they are bought.

Dynamite sticks should never be thrown or dropped and portions of powder falling from the cartridges must be carefully guarded against friction, blows or fire. It is best that only one kind of explosive be kept in any one magazine. If more than one kind of explosive should be kept in the same magazine, it should be divided into rooms and the different explosives kept in the different rooms. All firing devices should be kept in a dry place by themselves.

The greatest care must be taken to prevent packages of explosives from falling or getting shocks. They must not be thrown, dropped, nor rolled. Wooden boxes containing explosives should be opened with extreme care, so as to avoid friction and blows as much as possible. They should never be opened within the magazine, but in a properly sheltered place outside of the magazine and at a distance from it. They should be opened only by the use of a wooden mallet and a hardwood wedge.

The thawing of frozen explosives requires extreme care, and doing it improperly has frequently led to most serious accidents. No attempt should ever be made to thaw a frozen explosive by placing the cartridge before a fire, or near a boiler, or on steam pipes, or putting it in hot water, or by placing it in the sun. While thawing, nitroglycerine explosives are extremely sensitive and should be handled with great care. During the thawing the nitroglycerine tends to separate from the dope and run out from the cartridge and this is a source of danger.

When but a small amount of the explosive is required, it may be thawed in the thawers that are furnished by all the manufacturers of explosives and have been found safe for use as directed. The thawer consists of a water-jacketed tin vessel, in which the cartridges are placed and which is closed with a tin cover. Before the water is placed in the vessel it is warmed up to a temperature not uncomfortable to the hand put into it, and the cartridges are allowed to remain in the thawer until it is found, by gently pressing them, that they are completely thawed throughout. When thawed, the material will feel plastic between the fingers. When frozen or partly frozen the stick will feel more or less rigid and hard. It is necessary that the stick should be thawed completely, because dynamite when frozen can be detonated only with great difficulty and any part that is frozen will be but imperfectly detonated in the hole; hence not only may such partly frozen powder fail to give its full effect as an explosive, but there is danger of a serious accident where such powder is used.

Where large quantities of explosives are used daily, a small thaw house should be provided. Figures 1 and 2 illustrate a satisfactory thaw house and the Chicago specifications for a contractor's thaw house are given in ENGINEERING-CONTRACTING for Dec. 29, 1909. All powder manufacturers will furnish on application plans and specifications, together with a bill of material, for a thaw house which should be large enough to hold all the explosives used in one day's work. It should be heated by a small hot water heater, placed at least 4 yards from the house, the hot water being passed into the house through iron pipes at such a rate that the temperature in the house will not at any time be above 90° F.

Thaw houses are intended only for the treatment of explosives for immediate use and not for the storage of explosives, for if powders or dynamites are left in this high temperature and dry air for a considerable time the moisture that is a proper part of them will be driven off and, as stated before, this will markedly alter the character of the powder or dynamite and may lead to accidents in its use.

By the use of electric detonators (also

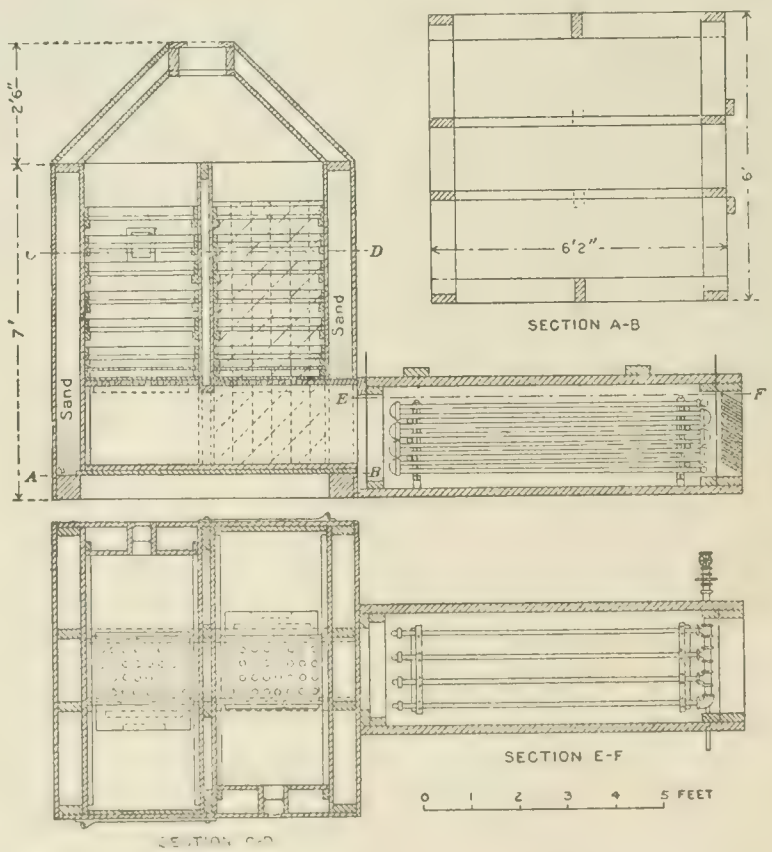

Fig. 2—Section of Thaw House for Frozen Explosives.

*Abstracts from "A Primer on Explosives," by Charles E. Munroe and Clarence Hall; being Bulletin 423, U. S. Geol. Survey.

called electric fuses) the dangers that are common in the use of squibs or fuse in gaseous coal mines are avoided. These electric detonators (see Fig. 3) are simply ordinary detonators that have been fitted with a means of firing them by the electric current. This is done by inserting within them two copper wires, joined at the inner ends by an extremely fine platinum or other high resistance wire, which, like the carbon filament in the ordinary incandescent lamp, becomes heated till it glows when an electric current is passed through it. This wire, known as the bridge, is placed above the detonating compo-

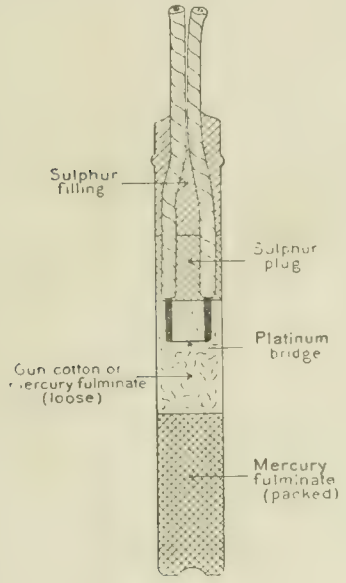

Fig. 3—Electric Detonator.

sition and is surrounded by gun cotton or loose fulminate. The space above it and the mouth of the capsule are then filled and closed by means of a plug of sulphur or other water proof composition, which is poured in while soft. The copper wires pass through the plug and are long enough to extend outside the capsule. These outer ends are called the legs or wires of the electric detonator. Although the copper wires are bare within the electric detonator, the legs outside are covered with an insulating wrapping. These legs are made of different lengths in order to suit different depths of bore holes. The charge of detonating composition differs in the different grades of electric detonators so as to give different strengths.

The following table gives the grade and weight of charge for the more common electric detonators:

Testing-station grades	Commercial grades.	Wght. of charge in grams.	Wght. of charge in grains
No. 5.....	Single strength.. .	0.80	12.3
No. 6.....	Double strength...	1.00	15.4
No. 7.....	Triple strength....	1.50	23.1
No. 8.....	Quadruple strength	2.00	30.9

In loading bore holes electric detonators are placed in the charge just as detonators

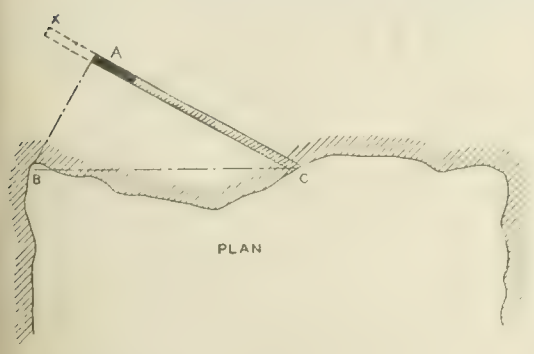

Fig. 4—Shooting Off the Solid.

with fuse are, and the bore holes are tamped in a similar manner. To fire the charge, the legs of the detonator are connected by leading wires to an electric device at a safe distance, and from it the current is sent to fire the blast. No flame can escape from the bore hole during the firing, for the tamping fills the hole completely, and hence blasting in gaseous mines is made much safer.

Only electric detonators are used at the Pittsburg testing station in the tests of explosives for use in mines.

What are called delay action electric "exploders" or detonators are now being offered for use where a number of holes are to be fired at once, but so that the charges may explode one after another. This is done by placing a piece of fuse or other device in the electric detonator between the detonating composition and the bridge and inclosing the whole so that the flame may not escape from the blast hole. In the present state of knowledge this practice is not commended for use in coal mines.

Fulminate of mercury is extremely sensitive to heat, friction or blows and to the extreme violence of the explosion which it undergoes. All these properties therefore belong to detonators and electric detonators, and these little devices should be treated with the utmost respect. Never attempt to pick out any of the composition. Do not drop them or strike them violently against any hard body. Do not lay them on the ground where they may be stepped on. Do not step on them. Use the utmost care when crimping and never crimp with the teeth. They should be stored in a dry place in buildings apart from explosives. They should never be carried with other explosives nor placed near other explosives except in bore holes. When carried or shipped they should be packed with a quantity of elastic material.

Figure 4 illustrates a method of blasting in coal mines termed "shooting off the solid."

A hole is bored or drilled in the face at or near the middle of the seam, at such a slant as to make a small angle with the face. If an imaginary line (*AB* in Fig. 4) drawn from the back of the drill hole at right angles to the hole passes out of the open face, and if that distance is not too great, the hole is rated as "safe" by those who use the method. If, however, the hole extends beyond *A* to *X* (Fig. 4), the extended part is said to be "dead" and the hole is considered "unsafe." A hole is also considered "unsafe" if the angle *ACB* is greater than 35°. In the softer coals and where the joints or cleavage planes (cleat) are favorable a greater angle is used, but no drill hole, even under such favorable conditions, is bored at an angle greater than 45°.

In shooting off the solid only one face of the coal to be thrown off is exposed. It must be torn off along the line *AB* and *AC* and in addition must be forced out along the bedding planes at top and bottom. Where such bedding planes are smooth this is not difficult, but generally they are irregular, and a strong shearing force must be exerted parallel to the bedding planes, both at the top and bottom. This method to be effective requires a slow-acting explosive, and black blasting powder has been much used in the work.

A second hole and even a third one are sometimes drilled and charged before the first one is fired, and these are called "dependent" shots. The fuses are sometimes made of different lengths and lighted at the same time, with the expectation that the shots will go off in the proper order. Such practice is now generally held to be very wrong even in "solid shooting" districts. The second and third holes should not be drilled until after the first shot has been made, so that the location of each shot can be properly judged.

The size or weight of the charge in shooting off the solid varies much in different coals. In fact it is extremely difficult, even in the same coal, to judge the amount correctly

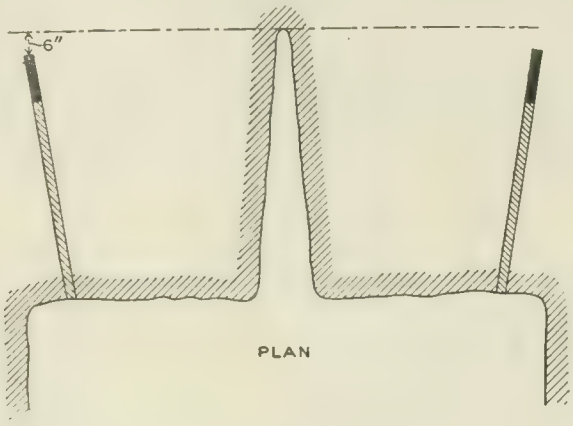

Fig. 5—Shearing.

each time. If undercharged, the hole is likely to "blow out"; hence it follows that holes are almost invariably overcharged, and in some districts all sense of right proportion has been lost by the miners.

Aside from the dangers in the use of black powder, the uncertainties in proportioning the charge to the work are such that the method of shooting off the solid can not be approved as either precise or safe. Many of the great mine disasters of this country have undoubtedly started from misjudged or overcharged shots off the solid.

The other method of bringing down the coal, in which the explosive is assisted by undercutting or shearing beforehand and which was early used in this country, is now being

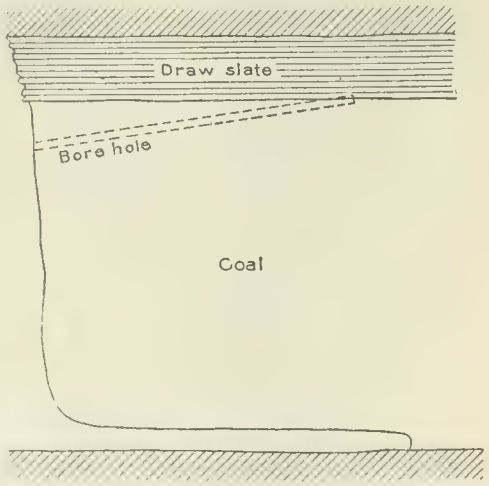

Fig. 6—Bore Hole for Permissible Explosives.

readopted in most parts of the country. The object of undercutting or shearing is to expose two faces of the mass of the coal to be brought down, and as coal generally tends to break along vertical planes, to permit the explosive to exert a wedging effect, rather than to shear or tear off the mass as it must in shooting off the solid.

There are two ways of applying this method—shearing and undercutting. Occasionally where the coal is hard to shoot down, both shearing and undercutting are done so that a less amount of explosive is needed; in fact, in some places none is required, as the coal can be wedged down.

Where the cutting is by hand and the top

and bottom part "freely," shearing is the easier, and is usually employed in entry or narrow work. In some cases the shear or vertical cut is made on but one rib, but generally it is made in the center of the narrow face and the shot is so placed as to throw the coal toward the shear.

Where the coal is all alike in character and parts equally well at top and bottom the hole is started at or near the middle of the seam and drilled nearly parallel with the shearing, slanting a little upward to cross the bedding planes, and also to clear itself of dust as it is being drilled. The hole should never go

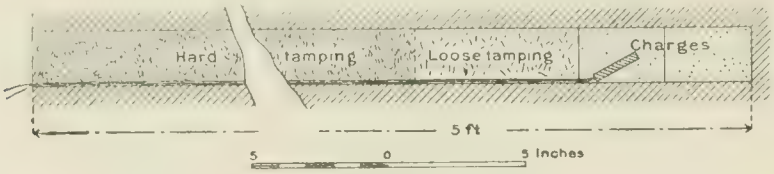

Fig. 7—Bore Hole Ready for Firing.

deeper than the cutting, and it is better for it not to go as deep by at least 6 inches as the cutting. In Fig. 5 the back of the bore hole is shown as reaching the projected line of the rib, but in softer coals the backs of the bore holes are usually at least 6 inches from the projected line of the rib.

With permissible explosives the mouth and back of the drill hole should be nearer the roof and the hole should slant upward in order that the back of the drill hole may reach the top bedding plane (Fig. 6). The break will then be clean and a wedging action will be exerted along the top bedding plane.

In the use of permissible explosives, special care should be taken that each bore hole has the same width throughout and is wide enough to permit the cartridges to pass through it without too hard ramming. Too small a hole may cause the cartridge to stick, and nitroglycerine explosives or even black powder may be exploded by the friction of the tamping bar against the sides of the hole. Daily attention should be given to the drills that are used in drilling the bore holes, and the points of the bits when being sharpened should be made to a standard size.

In blasting, any explosive gives the greatest disruptive effect when the charge most completely fills the bore hole from side to side. If the explosives are supplied in cartridge form this condition can often be obtained in the bore hole by splitting the wrapper, gently pushing a cartridge down into place in the bore hole with a tamping stick, gently squeezing it so that it spreads out to fill the entire width of the hole, and repeating this with each cartridge until the charge has all been put in. Finally the detonator is placed in the last cartridge put in, and this cartridge is known as the primer. The primer is gently pushed down into place in firm contact with the remainder of the charge, and the hole is tamped (Fig. 9).

If the same weights of different explosives are of equal strength, the one that takes up least space—that is, the densest—will have the greatest effect in breaking coal or rock. Of two cartridges of equal size containing different explosives the heavier cartridge is said to have the greater density.

With certain explosives, which are somewhat largely used, the cartridge case may be split and the charge rammed firmly into place. This is not the universal practice and should not be done with all the ammonium-nitrate class of explosives nor with some of the nitro-substitution explosives, for if they are tightly rammed in the bore hole, it is difficult or even almost impossible to explode them.

After the priming charge with its fuse and detonator or its electric detonator has been inserted in the bore hole, the hole should be tamped with clay or with other material that can not burn. It should never be tamped with coal dust (either wet or dry) or with machine cuttings, known as "bug dust." The tamping should be done by means of a wooden tamping stick. The pressure in tamping should be very gentle on the first tamping material put in, particularly if detonators are used in the primers, and great care should be taken at this time not to disturb the position of the detonator in the primer. Special care should be taken not to draw the detonator out from the primer or the fuse out from the detonator. When fuse is used, care should also be taken not to rub the surface off of it.

After the first 6 inches of the tamping material has been pressed down, greater force may be used in ramming the rest, because the firmer the tamping is the better is the work of the explosive and the less is the chance of a blown-out shot. The tamping should be continued quite up to the mouth of the bore hole. If fuse has been used, the upper side of it near the end may now be cut into on a slant, with a sharp knife, and the outer part bent way so as to form a notch in which the powder from the core gathers and to which the igniter is applied. This cutting prevents the loss of powder from the fuse and makes it easier to light.

The shattering effect of high explosives may be lessened in loading simply by pushing the cartridges into place without splitting or afterward squeezing them, so that an air space will be left about the cartridges in the bore hole, and then proceeding with the priming and tamping. This air space notably lessens the shattering effect of the explosive (Fig. 8).

Where it is desired to use black blasting powder, electric black powder igniters, sometimes called electric safety fuses or squibs, are recommended for setting off shots. They are made in a general way like electric detonators, but gun powder or other slow-burning composition is used in them instead of detonating composition. They are much safer for use in coal mines than ordinary squibs or fuse, both because they do not throw fire into the mine air and because they permit better tamping of the bore holes. It sometimes happens that it is desired to fire a number of charges at the same instant. This is readily done with electric detonators by coupling them up in series from hole to hole and firing by one discharge from the machine.

Premature explosions, misfires, and hang fires are most likely to happen when squibs and fuses are used to set off charges, owing to defects that may be in them from the first, or may be caused in the handling, carrying, or loading of them. Miners are especially warned in case of a hang fire to avoid returning to the breast until half an hour has passed. Hang fires rarely happen with electric detonators, but it is possible that they may happen more often with delay-action detonators.

Incomplete explosions may result from several causes. They may be due to failure to push in all the cartridges of a charge till they touch one another, thus leaving an air space between them, or else a mass of coal dust or dirt, which breaks the path of the detonation from cartridge to cartridge. They may be due to the pulling out, even but a little way, of the detonator from the primer or of the fuse from the detonator. In the use of nitrate of ammonia or nitro-substitution powders, incomplete explosions may be due to too tight packing and compressing in the bore hole. In any case, a partial explosion is a marked source of danger, first, because it may have the effects of an underloaded charge; second because the unexploded part of the charge may burn and throw out flame and sparks into the mine, and also give out poisonous gases and fumes; third, because the unexploded part of the charge, if it is not burned up, may be brought down with the coal and give rise to an accident in the breaker, or, if it passes the breaker, to an accident in the transportation or the use of the coal. Whenever there is a partial explosion, if coal has been brought down, careful search should be made in the coal for the remainder of the charge.

In case of a misfire no attempt should be made to draw the charge, but a new bore hole should be placed at least 2 feet away from the first one and fired, and after the coal has been brought down it should be carefully looked over to find any unexploded material that may have come from the hole that misfired. When a hole charged with black blasting powder has misfired the tamping and charge may be withdrawn, drenching them with water while withdrawing them. After the hole has been dried out it may be reloaded.

An electric igniter or an electric detonator should be so loaded into a bore hole that while it is in perfect contact with the charge the legs of it reach at least 6 inches out of the completely tamped hole. Both legs should be bared of their insulation for about 2 inches from their ends, and the wires scraped bright so that a good electrical contact can be made with them. Each leg is then firmly connected with one of the leading wires by about five turns. It is bad practice to have the two splices directly opposite each other, because when the leading wires are pulled the splices may touch one another and thus make a short circuit, which will prevent the electric igniter or electric detonator from being exploded. A better plan is to wrap the bare wire splices with tape made for the purpose, which will completely insulate them.

After the legs are spliced to the leading wires (and only after), the wires are connected to the firing machine from which the electric current is to be obtained. This last connection should never be made until all the men are at a safe distance from the place where the blast is to be fired. The rule should be made and never broken that when bore holes are charged the connecting up shall move from the bore hole back to the firing machine. The work in the face should be so organized that it can never be possible for the leading wires to be coupled up to the firing machine while any one is about the place where the holes are being charged and where the blast is to be fired. In heavy blasts in development work, two or more electric detonators may be used to good advantage in the same bore hole. For this purpose they are connected up in series, which means, for two detonators, that a leg of each is bared and the two legs twisted together and wrapped with insulating tape, and that then the two free legs are attached to the leading wires just as where but a single detonator is used. In coal mining the charge used should never be so large as to require the use of more than one detonator in the same hole.

When it is desired to fire two or more holes at the same time the detonators for these holes should also be connected up in series, and to bridge the space between the holes a cheap insulated wire, known as connecting

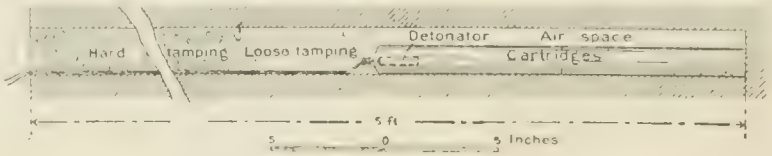

Fig. 8—Loaded Bore Hole Showing Air Space About the Charge.

wire, which is not as heavy as the leading wires, may be used. In coupling up a series of holes for this purpose, one leg of a detonator is connected to one leg of the detonator in the next hole, and so on to the last hole. There is then left one free leg in the first hole and one free leg in the last hole, and these are spliced to the leading wires. The usual precautions should be taken to wrap all the splices with insulating tape, so as to completely insulate them, and thereby insure a good circuit through which the current may pass. It should be borne in mind that the greater the number of holes to be fired in a single blast the greater is the necessity for making sure that the circuit is complete throughout, because if there is a break or a short circuit at any point, the blast will probably fail to fire. The delay, expense, and danger caused by such a failure can be prevented by giving careful attention in the first place to the charging and the wiring.

The electric current for use in firing electric igniters or electric detonators may be obtained either from primary batteries, such as dry cell batteries, or from secondary batteries, such as storage batteries, or from electric lighting circuits, or from generators known as electric firing machines.

Firing charges of explosives by means of ordinary dry cells has been prohibited in foreign countries, because premature firing of detonators, and sometimes of the charge, has been caused by the wires coming into contact with the poles of the batteries. Safety contact dry cell batteries have lately been introduced abroad and in this country. These are made with a spring key contact, or with two safety spring contact buttons, which are the poles of the battery. The two leading wires are laid on the buttons, which are at the same time pushed downward. When the pressure of the thumbs is released the contact is broken. If the wires of a detonator accidentally come into contact with the poles of the battery, the current can not be discharged unless both poles are pushed downward.

Dry cells, small batteries, and some firing machines can be carried about by the miner who is to act as shot firer, and this is an advantage that insures him against premature firing by any other person. Such small devices can at best be used with only a few shots in one circuit. The number of shots to be fired and the length of leading wires and other conductors through which the firing is to be done must be known beforehand, so that a battery of sufficient capacity can be selected. Batteries often fail to fire blasts because they can not send such a current as will fire through the great length of leading wires, connectors, and detonator legs that is used for the blast. A simple way to test the strength of the batteries is to pass the current through a small electric lamp of known capacity and note the brightness of the light given by the lamp. Another way is to pass the current from the battery through a testing circuit whose resistance is equal to that of the circuit of a blast and which has in it one electric detonator. If the battery fires this detonator (which should be put in a safe place) it is strong enough and in good condition.

When the electric current for firing is obtained from an electric lighting circuit the connections are usually made in parallel; that is, one leg of every detonator is connected to one of the leading wires and all the other legs to the other leading wire. Care must be taken, by the use of insulating tape, that there shall be no short circuiting in these connections. This method has the advantage that if there is a defective electric igniter or electric detonator in the circuit its failure will not prevent the rest of the blast from being fired; but, on the other hand, this method is objectionable because at any time after the explosion of the good igniters or detonators the unexploded charge with the defective igniter or detonator may be blown out and scattered in the coal, or it may even be set afire or perhaps exploded in the air of the mine by shock or friction. Furthermore, in this and other methods of electric firing an accidental premature blast may possibly be caused by leakage from the electric main to the earth and through the leading wires or connections, which may have become bared by rough handling or may not have been properly covered by the insulating tape. Premature explosions have been known to occur that were caused by leakage due to defective insulation.

Firing machines, sometimes called blasting machines, generate the electric current to be used in firing by mechanical means. A variety of such machines has been invented, but the two best known classes are the dynamo-electric machines and the magnetos. The dynamo-electric machines are made like ordinary dynamos used for generating electric currents, differing only in that they are worked by hand. They contain a coil-wound armature which is rotated between the poles of an electromagnet. This armature can be made to revolve by means of a crank or a vertical ratchet geared direct to the spindle of the armature. The machines with ratchet bars are made so as to take up the current during a stroke, until just as the stroke is ended the entire current that has gathered is discharged through the leading wires.

These machines are built in different sizes and are rated according to the number of electric detonators they can fire. Thus a "50-hole" machine will, when properly worked, fire 50 detonators at one discharge. The machines usually built for use in coal mines are rated as "4-hole" machines; and such a machine can be conveniently carried about by the miner or shot firer.

The magneto machines consist mainly of an armature revolving between the poles of a set of permanent magnets. They look much like the dynamo-electric machines that are worked by cranks, and they are used in much the same way. These magneto machines are used to a considerable extent in foreign countries, but the "push down" dynamo-electric machine is the one most commonly used in the United States.

The leading wires that carry the current from the blasting machine to the blast hole are of insulated copper wire, copper being used because it is one of the best conductors of electricity known and has the further advantage of being but little corroded in damp mines. These leading wires or firing lines are insulated with a braided covering, which is better if made water proof. In some instances the two wires are twisted together and wrapped with an additional coating of braid, making them into one cable, which has the advantage of being more easily handled than two separate leading wires, and has also

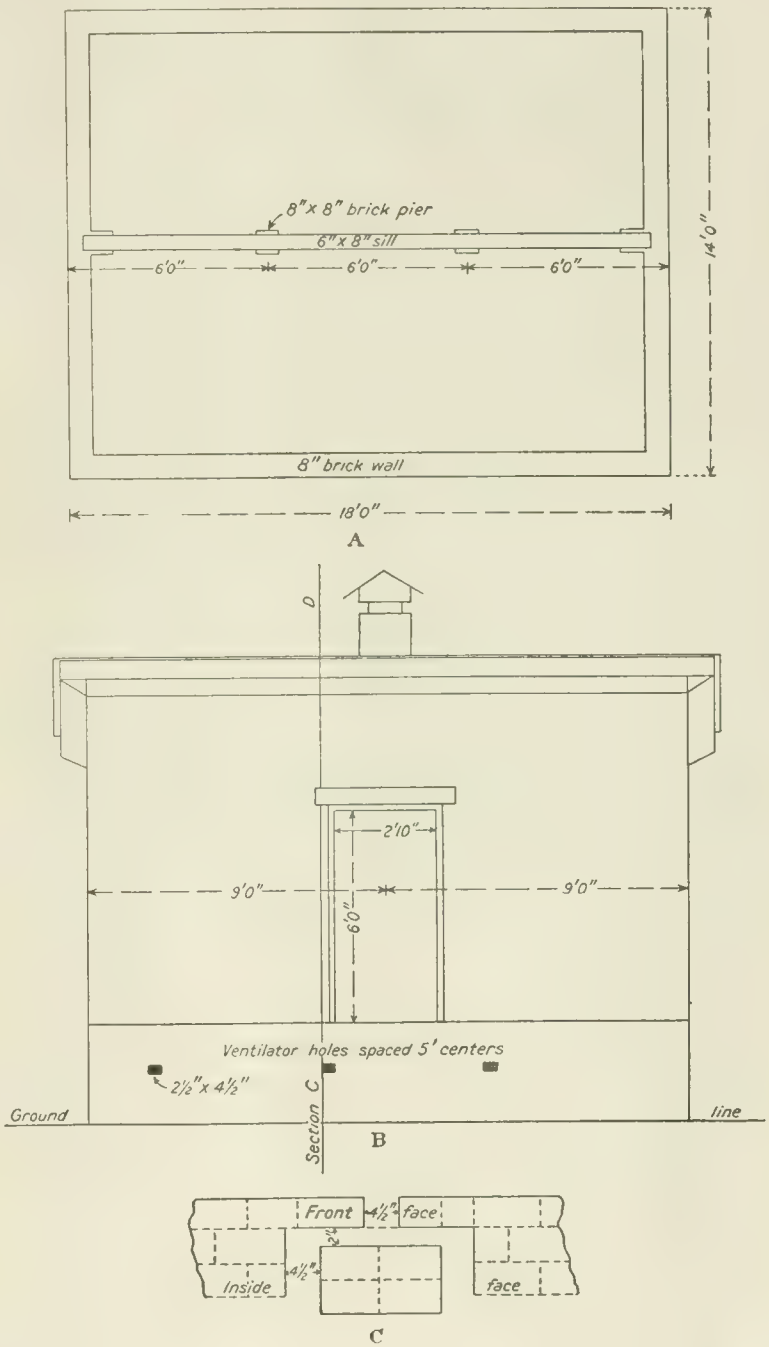

Fig. 9—Foundation Plan, Front Elevation and Plan of Ventilation of Brick Magazine.

the advantage of the added protection given by the additional braiding.

After the blast has been fired, the ends of the leading wires should be immediately disconnected from the posts of the firing machine, and the lines should be examined for their whole length in order to see that the insulation has not been broken by coal or rock thrown against it, nor been stripped by the force of the blast. Where such defects or injuries are found, they should at once be repaired with insulating tape, and then the leading wires should be placed where they are not liable to injury until they are again needed.

For testing the line after it is connected up and before the firing, in order to show that the circuit is complete and that there is no leakage in the wires, a special galvanometer may be used, together with a battery such as many of the manufacturers of explosives now sell. This galvanometer, like others, bears upon its face a needle, which is turned or deflected if an electric current is present. By noting whether this needle is deflected or not one can tell whether the circuit is closed or open, and the extent of the deflection shows just how little resistance there is in the circuit. To use the galvanometer, the wires leading from it are connected to the two binding posts of the firing machine, to which the wires leading to the charge have already been connected. The deflection may then be noted. The current generated by the very weak battery cell attached to the galvanometer should not be strong enough to fire the electric detonators used in the bore holes, but is enough to deflect the galvanometer needle. This testing galvanometer, with its attached battery, should never be applied directly to the fuse to be blasted, even when it is being used to find out, when the test has shown no current, which of the electric igniters or electric detonators are defective. The tests for the separate detonators or igniters should always be made through leading wires long enough to let the person making the test stand where he would be perfectly safe if the blast should be fired; and on no account should this testing of the igniters or detonators be made while any person is so near that he may be in danger from the blast.

In the sinking of shafts or in the removal of rock or dirt by means of explosives, the methods to be followed in loading, tamping, and firing the charges of explosives are similar to those described for use in blasting coal.

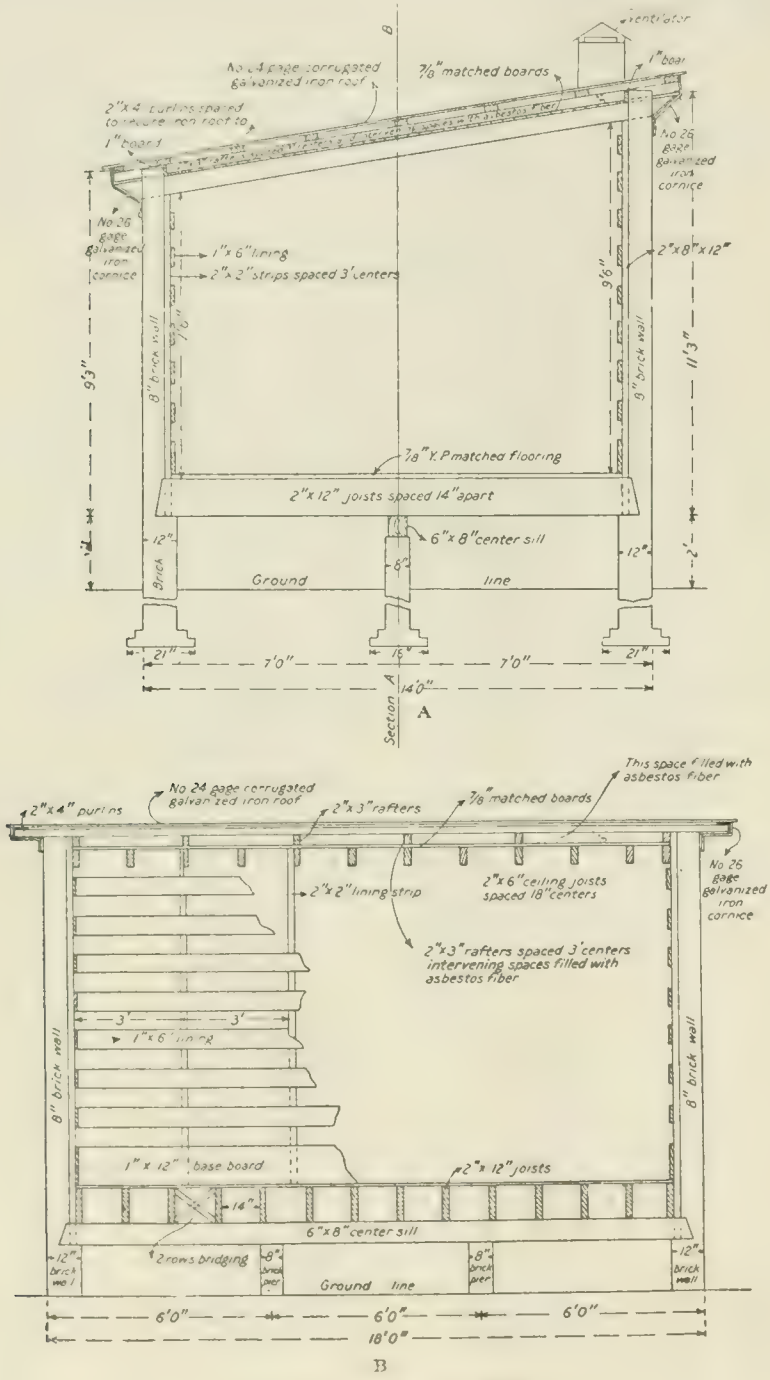

Fig. 10—Sections of Magazine.

In this as in other work electric firing will be found to be the safest means of shot firing, and in the long run the cheapest.

It is not uncommon to hear the statement that high explosives, because they are quicker in action than low explosives, need not be tamped. This is a serious error. The fallacy of it has been repeatedly proved in the tests of many different explosives made at the Pittsburg testing station. It has there been clearly shown that the highest pressure an explosive can give, and therefore the greatest amount of energy it can set free, will be developed only when the explosive is confined in the smallest possible space. Hence after the charges have been loaded into the bore holes they should be tamped with such materials (the best being damp clay) as confine the charges most closely, and this material should be rammed in firmly, with the precautions already set forth, quite to the mouth of the bore hole.

Electric or other detonators containing not less than 1 gram of the fulminating composition should be used in firing the charges. For use with high explosives in rock blasting, detonators of that strength are also best. Under no circumstances should an electric or other detonator be used of less strength than No. 5, containing 0.8 gram of the fulminating composition. The greater efficiency and certainty of the stronger detonator more than make up for its slightly greater cost.

In the sinking of shafts, after the soil has been removed and the overlying layers of shale and rock are uncovered, it becomes necessary to use explosives; and because in such a place the ventilation is always poor and the miner must wait for the fumes and smoke to clear away after each blast before he can safely return to his work, time can usually be saved by firing shots in groups instead of singly. Dynamite, or, when the shaft is wet, gelatine dynamite, may be used for these shots, which should always be fired after the men are out of the shaft. The most economical and safest way of firing a number of shots at one time is by means of the electric current, with electric detonators. The older method of firing by fuse is dangerous and wasteful. Where fuse is used, there is always danger that a seeming misfire may prove to be a hang fire—that is, the smoldering fuse may cause the charge to explode unexpectedly; also, if by any chance there is any irregularity in the burning of the fuse, the miner can not properly judge the time necessary to get out of the shaft and out of danger after having lighted the fuse.

In shafts that run through rock, as most shafts do, there is no objection to the shattering effect of firing several shots at the same instant, and this method is recommended; but when it happens that in shaft sinking the shattering effect would be harmful, and successive shots are therefore used, it is still advised that they be fired by electricity. For such shots, however, a less violent explosive may be employed, and the delay-action electric detonator may be used to good advantage.

The following explosives may be recommended, in a general way, for use when the size and condition of the material resulting from the blast is not important, for example, in the sinking of shafts or the driving of entries through rock:

For use where the texture of the material is very tough and hard, as in tough granite, hard boulders, and the like, 60 per cent straight nitroglycerine dynamite is recommended. Where the material is of moderate toughness and somewhat brittle, 50 per cent straight nitroglycerine dynamite is recommended. In material such as limestone and sandstone, 40 per cent straight nitroglycerine dynamite is recommended. In hard earth or compact sand, a 30 to 20 per cent straight nitroglycerine dynamite is recommended. In material such as a soft crumbly or seamy rock that requires a stronger explosive than black blasting powder, but a slower explosive than dynamite, a granulated powder containing 5 per cent of nitroglycerine is recommended. This should always be fired with a priming stick of dynamite. With this exception, dif-

ferent kinds of explosives should never be used in the same bore hole.

For very soft work in cuts and fills, or for quarry work when dimension stone is sought, black blasting powder is recommended. In grading work the blast hole may be bottomed out with dynamite before charging with granulated powder or with black blasting powder, but before it is charged care should be taken to see that the dynamite charge has not left any fire in the hole. In plastering or adobe work on boulders and spawls, or in block holing, a strong dynamite should be used. Block holing is the more effective and economical method for use with boulders.

If the straight nitroglycerine dynamites, as recommended above, are found to be too quick or too violent for use, and the results obtained are not as desired under the given circumstances, ammonia dynamites, which give a more heaving and rending action, are recommended. They are made in several grades and are rated as of a certain percentage of strength, but this rating is not always made in a scientific way. The following composition is an example of that which is generally offered in this country as a 40 per cent strength ammonia dynamite:

	Per cent.
Nitroglycerine	[illegible]
Ammonium nitrate	[illegible]
Dope	[illegible]

This composition does not contain so large a percentage of nitroglycerine as the straight 40 per cent dynamite, and as tested at the Pittsburg testing station it is not found to produce the same results as the latter. Nevertheless the ammonia dynamites are often found to be more economical and more efficient for certain classes of work than the straight dynamites of the same commercial rating. The ammonia dynamites are less readily set off and are safer to handle, transport, and store than the straight dynamites are, but they all require stronger detonators than the straight dynamites to insure a complete and rapid detonation. They have the disadvantage, compared with the straight dynamites, of taking up moisture very readily, and great care should be used in storing them or in using them in wet holes.

For use in very wet blasting and in places where there is poor ventilation the gelatine dynamites are recommended. Water has but little effect on them, and on complete explosion they yield only a small quantity of fumes and bad gases. Like ammonia dynamites, gelatine dynamites are less sensitive than straight nitroglycerine dynamites, and they therefore require stronger detonators to cause their complete explosion. They become less sensitive during long storage and they have been known after long storage in tropical countries to become so insensitive that they could not be detonated by means of the devices ordinarily used in firing them. Gelatine dynamite is likely to decompose during storage in very hot places.

Like the ammonia dynamites, the gelatine dynamites are sold in several grades and are given a somewhat unscientific rating in commerce. The grade known as 40 per cent strength gelatine dynamite, as generally offered in this country, has the following composition:

	Per cent.
Nitroglycerine	32
Soluble nitrocellulose	1
Dope	67

As tested at the Pittsburg testing station, gelatine dynamites have not been found to be equivalent in every respect to straight nitroglycerine dynamites of the same commercial rating, and as regards economy they should seldom be used as equivalent; but they are superior for some uses, as mentioned above.

There is no standard type of storage magazine in use in this country, and the laws and regulations in foreign countries applicable to the construction of magazines differ materially. In Austria, for example, they are required to be of light construction, while in England they must have walls at least 18 inches thick. In Chicago they are made of wooden studding frame work covered on both sides with wood and the space filled with dry sand. This applies as well to the roof as to the sides. The exterior of the building must be covered with No. 26 or No. 28 sheet iron. Proper ventilation must be supplied in the roof. No lights permitted.

Explosives should be protected as far as practicable during storage against heat, moisture, fire, lightning, projectiles, and theft. The buildings should therefore be weatherproof, covered by fire-proof and bullet-proof material, well ventilated, in secluded locations, and not beside grass or underbrush subject to fire risk. Lightning protection is best placed on a line of supports encircling the building and 20 to 30 feet distant from it. Figures 9 and 10 shows plans of an approved type of magazine.

It is difficult to state definitely safe distances to separate magazines from dwellings, highways, railroads, etc. The proper distance must vary evidently with the amount of explosives stored and the degree of natural protection afforded by the slope of the ground and of artificial protection, such as barricades or mounds of earth.

The distances prescribed by the English law have been adopted by the state of Massachusetts. They are materially greater for large quantities of explosives than those prescribed in other countries. For example, the distances from a railway or public highway prescribed for a magazine containing explosives without natural or artificial protection are: For 1,000 pounds—England, 630 feet; Prussia, 984; Austria, 984; Italy, 244; for 10,000 pounds—England, 795 feet; Prussia, 1,968; Austria, 1,640; Italy, 328; for 80,000 pounds—England, 2,160 feet; Prussia, 1,968; Austria, 984; Italy, 574.

These distances may be materially reduced, in some places to one-half or even to one-quarter, where there is good natural or artificial protection.

Magazines should be kept clean and in thorough repair. Grounds around them should be kept clear of leaves, grass, or other materials that might feed a fire. These words should be conspicuously posted on them: "Explosives dangerous. No shooting allowed." The floors must be swept regularly and kept clean. The sweepings should be thrown in water or taken to a safe distance and destroyed.

In case floors become stained with nitroglycerine, cover the stains with dry sawdust, sweep up, and remove the sawdust. Then scrub the stains thoroughly with a hard brush and a solution of one-half pound of sulphide of sodium or sulphide of potassium in one-half gallon of wood alcohol.

Do not allow in the magazine any tools other than a wooden mallet and wooden wedge, or a phosphor-bronze chisel, and a screw driver to be used only for removing screws.

Do not open dynamite boxes with a nail puller or powder cans with pickaxes.

Remove all explosives before repairing a magazine.

Do not store detonators with explosives, especially high explosives.

Do not open packages of explosives in a magazine.

Issue first the oldest explosives on hand.

Do not store dynamite boxes on end, as this increases the danger of nitroglycerine leaking from the cartridges.

Pocket Edition of Geologic Folios.—The U. S. Geological Survey has just adopted an octavo field or "pocket" edition for its geologic folio publications. The results of the detailed geologic surveys necessary to the preparation of the geologic map of the United States have heretofore been published by the Survey in folio form, 168 such folios having been already printed. Each folio contains the topographic base map of the quadrangle under consideration and maps showing the areal and structural geology, while in some folios are maps showing the economic geology and in others the underground water resources of the region. The map sheets are of the standard size—about 18 by 21 ins.—and are accompanied by brief descriptive texts printed on sheets of corresponding size, making the folios extremely cumbersome for field use.

While the folio form has given general satisfaction for office and library use, it has been recognized for some time that a more convenient and if possible a "pocket" edition would add greatly to the value of the publication for field work. The Survey therefore sent a circular request to the principal geologists, civil and mining engineers, teachers and librarians requesting their opinion as to the desirability of a change in form and inviting suggestions. The consensus of opinion was that there ought to be two styles, some copies to be in folio form as heretofore and some in octavo. Many librarians and most instructors prefer the unfolded maps, while on the other hand most mining men desire a pocket edition with loose folded maps for field work, but wish also the unfolded map for office and wall use.

It has therefore been determined to continue the folio form of this publication and also to print a field edition of these folios in octavo size—about 6 by 9 ins.—in which the maps are folded and inclosed in a pocket.

Although the folios of the geologic atlas are prepared primarily for educational and technical purposes, they have also been of interest to many non-technical people who have desired to obtain some knowledge of the geology of the areas in which they live, but the large size of the folios has served to keep them out of the book case. The folios in the new form can easily be preserved on ordinary shelves with other books.

Five folios in this form have been printed by the Survey and are now ready for distribution—namely: the Belle Fourche (South Dakota), the Aberdeen-Redfield (South Dakota), the El Paso (Texas), the Trenton (New Jersey), and the Jamestown Tower (North Dakota), numbered respectively 164, 165, 166, 167 and 168. They are bound in substantial covers provided with pockets that hold securely the accompanying maps. The maps are printed on a special paper that will bear refolding and handling and the books will slip into a good sized coat pocket.

Another slight departure in connection with the publication of the geologic atlas, beginning with the above four numbers, is the printing of separate maps (unfolded) showing the areal geology of the quadrangle.

Care of Gasoline Engines in Freezing Weather by Use of Anti-Freezing Mixtures.—The following are rules for avoiding freezing of water in the cylinders, pipes, radiators, etc., of the cooling system of water-cooled automobile engines and stationary explosive engines. As soon as freezing weather approaches or when the temperature drops as low as 40 degrees F. all water should be drained from the radiator, cylinders and pump, says Gas Review, and the radiator filled with one of the solutions given.

1. A mixture of glycerine and water in the proportion, by weight of 25 per cent of the former and 70 per cent of the latter, to which is added 2 per cent of sodium carbonate.

2. Chemically pure calcium chloride dissolved in hot water in the proportion of 4 pounds to one gallon of water.

3. Sodium chloride (common salt) or magnesium chloride dissolved in water in the proportion of 1½ to 2 pounds to the gallon.

4. Wood alcohol in the proportion of 20 per cent alcohol to 80 per cent of water. This solution has the advantage of being sufficient for average winter weather, and it has no ill effect of any kind on metals nor does it leave any sediment.

Should the thermometer reach as low as 15 degrees F., a solution of about 25 per cent alcohol and 75 per cent water should be used. For temperatures below zero, use 30 per cent alcohol and 70 per cent water.

Roads and Streets Section

Note: This section is devoted to methods and costs of road and street construction. It will cover road building in all its details, the construction of pavements, sidewalks and gutters, the testing and use of paving materials and the machinery and tools used in road building and paving.

The Possibilities of Portland Cement as a Road Material.*

BY LOGAN WALLER PAGE.†

Lime-cement concrete is the oldest road material of which we have any record. The Roman roads, which were of this type of construction, are the only ones which have endured for any great length of time. The Appian Way, which is undoubtedly the best type of Roman road, was begun by Appius Claudius 312 years B. C. and parts of it are in a remarkably good state of preservation to-day. We know perfectly well that any of our modern Portland cements are far superior in strength and durability to the lime mortar used by the Romans, and yet I have never seen a road built of Portland cement concrete that I considered altogether a success. There are two characteristics of Portland cement concrete which, in my opinion, bring about the failure of roads constructed of it. They are, first, the tendency of concrete, where exposed as in a road surface, to develop shrinkage cracks. These cracks are generally parallel to the road and increase in size as time goes on. The second characteristic which brings about failure is the ease which concrete spalls along the margins of cracks. I have never seen a concrete road fail through what I thought was expansion, but it is the general practice to place expansion joints at right angles to the line of concrete roads at frequent intervals, and the road suffers much from spalling at these joints.

It is perfectly apparent to any one who has made a study of the subject, that there could be no better form of road construction, at so low a cost, to meet only automobile traffic conditions than a cement macadam road. The most durable types of rock could be used as an aggregate, which would give maximum life to the road, and it would be practically dustless. So apparent is this, that in the endeavor to use Portland cement in road construction much ingenuity and refinement has been resorted to, but with the exception of a few isolated cases, real success has not been attained.

It might be appropriately asked, Why have the Roman roads stood varying conditions for so many centuries? I believe that a consideration of this point might be helpful in meeting our present conditions.

In the construction of Roman roads of the best type, a trench about 3 ft. deep was excavated the entire width of the road, and wherever poor material was present it was removed and replaced by suitable material, and the whole subgrade was thoroughly compacted by ramming. Generally four distinct layers were placed in these roads. The bottom course, or *statumen,* was composed of two courses of stones placed in lime mortar. On top of this was placed the *rudus,* or rubble, which consisted either of broken stone, or when available, broken bricks, potsherds, etc. When the latter composed the aggregate, more lime was used in the proportion of 2 to 5. This course was very thoroughly rammed, and was usually about 9 ins. thick. The third course, or *nucleus,* was composed of old building material such as brickbats, broken tiles, etc., mixed with lime in proportion of 1 to 3. This course was not rammed and the lime was mixed hot. Above this course came the top or wearing surface called the *summam crustam,* which was made of blocks of flat stone set in mortar and fitted together with great refinement. It can be seen that the third layer, or *nucleus,* was much soften than any of the others, and was placed purposely below the top layer which was designed to take the wear of traffic.

This type of road was undoubtedly the result of much experience. There are four distinct features which I consider worthy of the fullest consideration. First, an absolutely secure foundation was always obtained; second, a resilient or cushion layer was placed just beneath the wearing surface; third, the four layers composing the road had different coefficients of expansion which would probably preclude the development of definite lines of stress brought about by contraction; fourth, the exposed or wearing surface was composed of a material which would not only withstand the wear of traffic, but atmospheric conditions as well.

We frequently hear the statement that the Roman method of road building is a lost art, and that we cannot build roads to-day of a similar character. This is altogether a mistake. We could not only build similar roads, but roads which under the same conditions would be more durable. A road of the Roman type under modern city traffic conditions would last only a few years, and would probably cost $250,000 a mile to build. The traffic they were subjected to consisted of light vehicles and unshod horses, and the fact that unshod horses were used leads one to believe that an earth cushion was probably maintained on the surface of these roads as otherwise a horse would go lame after 50 or 60 miles of travel. The portions of Roman roads that we find intact to-day are those which have either been subjected to very light traffic or have been completely covered up with earth for long periods of time. In most cases we find only portions of the foundations.

The nearest approach we have to the Roman road to-day is the best type of paving brick, laid on a concrete foundation with a 2-in. sand cushion, and this type of road suits automobile traffic admirably, but is very hard on the feet of horses. As far as I have observed the concrete foundations both for brick pavements and asphalt streets rarely crack except from faulty foundations. The contraction cracks, therefore, I believe are due to no fault in the cement, but to the great range of temperature to which the road surface is subjected, and the fact that it is generally laid during the warmest season of the year, when expansion is greatest. This view is further upheld when one considers that concrete floors and pavements laid on earth foundations inside of buildings rarely crack.

Whether this view of the matter is correct or not, we know that concrete roads at present are not satisfactory, and our next consideration is whether they can be made so. Concrete has been almost universally adopted as a foundation for almost all types of heavy traffic pavements. It gives perfect satisfaction when protected from direct exposure, and whether methods of construction, or treatment, can be devised by which concrete can be used as a wearing surface for roads is a matter for investigation.

It is my belief that in most concrete roads the concrete is too uniformly mixed and too homogeneous in composition. This may account, in a measure, for the development of shrinkage cracks, where the surface is exposed to a great range of temperature. Concrete is also too unyielding to the blows of traffic and too brittle, both of which characteristics facilitate spalling. It seems to me that a pavement can be made which, to some extent, will obviate these undesirable characteristics, and I would suggest the following general specifications:

About 6 ins. of number one broken stone mixed with the screenings below ½-in., thoroughly rolled with a steam roller as a foundation course. On top of this, spread a uniform layer about 1 in. in thickness of rather dry cement sand mortar. Over this course of mortar at once spread about 3 ins. of No. 2 stone, which should immediately be rolled with a steam roller until the cement sand mortar rises flush with the surface. Such a road as this, I believe, would have many advantages. It could be opened to traffic within a short time after completion; it would not be as rigid as an ordinarily mixed concrete road. I do not believe it would be as likely to crack as ordinary concrete, as the stones forming the aggregate would rest firmly upon each other, receiving the blows of traffic, and the cement mortar only acting as a binding matrix. Further than this, there would be a minimum amount of cement used, and no two horizontal sections of such a road would have the same coefficient of expansion. Rock of the very highest resistance to wear could be used without any consideration of its natural binding power, which is so important in the ordinary macadam road. Another most important feature of this type of construction would be the absence of dust on the surface, which is so much sought after by highway engineers at the present time It would also give an excellent surface, not too slippery nor too noisy. Most important of all, however, such a road would not cost more than 10 or 15 cts. per sq. yd. more than ordinary macadam, which extra amount is about the annual cost of spreading bituminous dust preventives.

I have mentioned this type of construction as a possible cheap method of using concrete in road building. Another way of approaching the problem is to treat Portland cement so that its brittleness will be reduced and its resilience increased. This I believe, would be of great advantage, even if in so doing the tensile strength was greatly lessened. It can be seen that a material like asphalt, which meets so successfully the wear of traffic, is of a semi-plastic nature, with very low tensile strength and no elastic limit. Alone, a slight blow will permanently deform it. Its adhesiveness to mineral matter, however, permits its being tempered by a mineral aggregate to the desired consistency. It is also known that the addition of Portland cement to asphalt surface mixtures is very desirable With these points in view, the Office of Public Roads has begun an investigation to ascertain the practicability of mixing semi-asphaltic base oils with Portland cement concrete, with the object of obtaining the desirable properties of both the cement and asphalt. Up to the present time, our results have been somewhat encouraging. We have succeeded in making mixtures of as high as 20 per cent of oil, and both the 7 and 28-day tests for toughness and tensile strength showed a regular increase. Briquettes with 5 per cent additions of oil broke in tension at 230 lbs. after 7 days in soak, and 296 lbs. after 28 days; with 10 per cent oil, 228 lbs.; with 15 per cent, 246 lbs.; and with 20 per cent, 203 lbs., all after 28 days. The results obtained under impact were practically parallel with those under tension. Increased proportions of oil retarded both the initial and final set in increasing amounts; the tensile strength and toughness were also reduced, but not in like proportions. It has been shown that concrete immersed or mixed with animal and vegetable oils disintegrates and, of course, this may be the case with petroleum. It is my intention to continue this investigation until the several points under consideration have definitely been settled. I might mention further that parallel tests were made with tar and cement, but the results were practically all negative.

If it is found that cement can be mixed with asphaltic base oils, and increased toughness obtained, I believe that the value of cement as a road building material will be very much increased. The matter of mixing the oil is very simple, and can be conducted

*A paper read before the Association of American Portland Cement Manufacturers Dec. 15, 1909.

†Director U. S. Office of Public Roads.

in an ordinary concrete mixer. All that is necessary is that the cement be thoroughly wet before the oil is added. On account of the lime present the oil quickly emulsifies and is evenly distributed. Mr. Moyer has suggested that the addition of hydrated lime would permit of larger proportions of oil, which I believe will prove to be the case. I further believe that concrete mixed in this way will be impervious to water.

While a laboratory investigation of this nature is very interesting and instructive, yet no final results can be obtained until an actual service test is made, and it is my earnest hope that in the near future I may be able to make satisfactory arrangements for one or more cooperative service tests, as the appropriation for the Office of Public Roads cannot be used for the purchase of material and labor for road building.

Notes on Road and Street Work.

Effect of Automobile Traffic on Road Surfaces.—As the result of some tests on the effect of automobiles on road surfaces, conducted last fall by Mr. James Owen, Engineer of Essex County, New Jersey, the following conclusions were reached: automobile travel at low speeds is not detrimental to the macadam surface, the tires of the wheels acting merely compressively. The limit of this low speed is somewhere between 20 and 25 miles. At higher speeds stripping action begins and with the continual stripping, the loosening tendency is inevitable and dust raising follows. The stripping effect is reduced if a clay-packing surface is used, but the dust raised is still objectionable. A surface oil treatment practically eliminates dust and a continually good surface is maintained. The extra wear and shattering of a macadam road surface is due to a combination of self propelled and horse-drawn traffic. The tests from which the above deductions were drawn were conducted on a mile stretch of county road at Glen Ellen, N. J. The road as originally built was of the telford macadam type, the telford foundation being 8 ins. thick and the surface coat 3 ins. thick. For the past three or four years, during which time no attempt had been made to repair the road or prevent dust on it, the road had been used almost exclusively by high speed motor cars. As a result the surface coat of the road was reduced to about 2 ins., and the center of the road was completely bare of dust covering. The smaller stones in the surface had become loosened, but few of the larger ones appeared to have been displaced. In fact the road showed only slight abrasion. For the purpose of the test one portion of the road was left in its original condition, another portion was given a light coating of oil, and a third portion, about two months prior to the test, was covered with a surface coating of clay. Before the tests were started the conditions of the different test sections were carefully noted. The section having the surface coating of clay was found to be in far better condition than the untreated road for it showed only slight abrasions exposing small stones. The surface coated with oil was in an entirely satisfactory condition the only roughness being caused by projecting knobs of the bedded stone. For the tests automobiles, weighing from 2,000 lbs. to 3,800 lbs. were driven at speeds ranging from 10 miles to 60 miles an hour, in the center of the road and on the sides of the road. The effects of the various speeds on the different road surfaces were as follows:

BARE STONE SURFACE.

10 miles per hour: No trace in center, compression of dust at side.

20 miles per hour: Surface dust spread sideways, but no stripping.

30 miles per hour: Surface dust begins to strip.

40 miles per hour: Surface under tire swept bare.

45 miles per hour: Dust lifted, surface stripped, but no breaking.

55 miles per hour: Road stripped bare, but no breaking.

60 miles per hour: Road stripped bare, but no breaking.

OILED ROAD.

30 miles per hour: Heavy oiled dust raised 1 ft.

40 miles per hour: Same as for 30 miles per hour.

60 miles per hour: Strips dust.

High speed on the oiled road had no effect on the surface, other than loosening it or scattering the particles sideways.

ROAD SURFACED WITH CLAY.

15 miles per hour: Compression only.

20 miles per hour: Dust raised.

35 miles per hour: Heavy dust raised: no breaking.

44 miles per hour: Heavy dust raised; no breaking.

52 miles per hour: Heavy dust raised; no breaking.

There was no tendency for the clay packed surface to break up under high speed, but merely to raise dust and scatter it according to the wind.

Supplemented experiments were made by driving five heavy coal wagons over the road. The results, showed that with the hammering of the caulked shoes of the heavy horses, followed by the wide iron tired wheels, a tendency toward complete breaking up began. It was stated that large stones which were undisturbed by the automobiles were moved by the coal wagons and horses.

A Card for Recording Street Maintenance Work.—In our last issue we gave a system for recording and accounting for supplies and labor in the paving division of a street department. This system was given by Mr. Samuel Whinery, consulting engineer, New York city, in his report to the Finance Commission of Boston. Mr. Whinery also suggested the accompanying card for use in recording street maintenance work. Its details may of course be varied to suit special conditions.

RECORD OF STREET MAINTENANCE

Street, from ..... to .....

Length.....ft. Width bet. curbs.....ft. Roadway paved with ..... ft wide.

..... Gutters.....ft. wide. ..... Sidewalks, ... ft. wide.

Repairs made between ..... 190 .... and ..... 190.....

Character of Repairs made.....

MATERIALS USED AND COST OF WORK

	Roadway Found'n			Roadway Surface			Gutters			Sidewalks			Edgestone		
	Qty.	Price	Cost	Qty.	Price	Cost	Qty.	Price	Cost	Qty.	Price	Cost	Qty.	Price	Cost
Crushed stone.....tons															
" " screenings "															
Gravel and sand....cu. yds.															
Cement, hydraulic.....bbls.															
Granite blocks (new) ....No.															
" " (old) .... "															
Wood blocks ..... "															
Pitch .....bbls															
Asph. mixt're, binder cu.ft.															
" " surface "															
Bricks .....No.															
Edgestone (new).....lin. ft.															
" (old reset) "															
Rolling .....hours															
Labor .....days															
For man..... "															
Hauling ..... "															
Sundries															
Total															

Catch Basins in Sewer Systems.

I am opposed to the ordinary construction prevalent in the city of catch basins, which are simply a series of cess pools, waiting to be cleaned by rain storms. The refuse of the street goes into them. It dissolves and it remains there. It is not a septic tank because it does not get time to form a scum on top and create septic action, so it is nothing more or less than a cess pool on every corner of the street. Created for what? It may be excusable to have something of that kind in an extremely flat section of country where a large amount of sand is continuously finding its way to the street, and to allow that sand and that kind of material to get into the sewer would cause decomposition and ultimate destruction of the pipes of which the sewer is built. In a great majority of towns where they have good grades, such, for instance, as we have here and in Kansas City, there is no excuse for a basin.

Omaha is perhaps the only city of over one hundred thousand population which has had in successful operation for many years a system of untrapped connections from the roof to the sewer and from the sewer inlets at the street corner to the sewer, upon the broad theory that thorough aeration of the sewer through the constant unbroken air currents will give more satisfactory results from a sanitary standpoint.

Now around here in this city, if the weather permits, you can walk along our numerous inlets at every corner. You may find evaporation and vapor coming up because of high winds and extreme difference of temperature, but you will not experience any odors. But you can go to Kansas City and that is the universal complaint there, that there are strong odors at every street corner. They can be avoided provided they just stop these catch basins and convert them into inlets. In other words, slope the bottom of the catch basin towards the pipe connection leading to the sewer, so that when the sewer is free there is nothing left to decompose and give off odors. Where sewers are thoroughly ventilated from the man holes you will not find any offensive odor in going through them. I have walked through many miles of our sewers wearing a pair of rubber boots and could scarcely notice the odor because of the aeration, and if any foul matter stuck to the side of the sewer and decomposed to any extent, the enormous amount of aeration that took place so diluted the atmosphere of gases as to render it harmless and innocuous, with an odor hardly noticeable.—From an address of Andrew Rosewater, city engineer of Omaha, Neb., at the fourth annual convention of the American Society of Inspectors of Plumbing and Sanitary Engineers, February, 1909, a few weeks before his death.

Our water system was installed 22 years ago with two pumps, having a capacity of 1,250,000 gallons each per day. With a population of 7,500 we had 120 meters installed and the use of water was decreased to 1,125,000 gallons for each pump. In 1905, with a population of not less than 45,000, we had 3,200 meters in use and the system was operated with the same pumps delivering 1,250,000 gallons each. This is about 35 gallons per capital. The patrons are satisfied with the operation of the system, which we would have been compelled to enlarge several years ago only for the meters.—Report of Superintendent of Water Works of Sioux City, Ia.

Water-works and Sewer Section

Note: This section is devoted to methods and costs of constructing sewers and water-works. It will cover the construction work for all details of water supply and sewerage, including sewage purification and water filtration.

Standards for Sewage Effluents.

Dr. John C. Thresh, the eminent authority on sewage disposal, read a paper with the above title at the annual meeting, Dec. 9, 1909, of the Association of Managers of Sewage Disposal Works (England) from which the following abstracts have been made.

Dr. Thresh stated that the manager is responsible for the proper treatment of the sewage in the works entrusted to his care and whether he is successfully treating the sewage or not can only be determined by the examination of the effluents produced. It is necessary therefore for the effluents to be examined at frequent intervals, and it is imperative that some standard should be fixed which he can reasonably be expected to attain. If this standard is one which can be ascertained approximately by the manager, so much the better, since where, as in the majority of cases, a chemist is not employed, the manager himself can determine whether his effluent is satisfactory, and can examine the effluents from different beds or different parts of his works, and ascertain whether they are giving satisfactory results. From time to time only will it be necessary to have his results independently checked by a more complete examination.

Standards whether necessary or not, are desirable. Experience has proven this and everyone who expresses an opinion on an effluent has a standard in mind. The same standard may not be desirable in every district, but in the great majority of districts the sewage to be treated is practically domestic in character, and contains so little manufacturing refuse that its character is not appreciably affected. The great majority of works have to discharge their effluent into non-tidal streams, so that the standard for any one of these may be accepted as the standard for all.

After a few remarks on attempts to settle upon standards he states that all authorities regard non-putrescibility as necessary in any standard, though they differ in their views as to how the putrescibility is to be determined. Many are in favor of a standard based upon the oxygen which the effluent will destroy or combine within a given time, but opinions differ widely as to how this oxygen destroying power is to be determined. The standard of the Mersey and Irwell Joint Committee quoted by a number of authorities is as follows:

The oxygen absorbed from an acid solution of permanganate of potash in three minutes should not exceed [illegible] grain per gallon.

The oxygen absorbed from the same solution in four hours at 80° F. should not exceed 1.00 grain per gallon.

The ammonia yielded by the albuminoid matter [illegible]

The chief difference between a good and bad effluent is in the amount of oxygen which it would require to oxidize the constituents of the effluent, the oxygen being obtained from the air. A good effluent absorbs or destroys very little oxygen, a bad effluent absorbs or destroys a relatively large amount of oxygen. The amount absorbed, however, varies much with the amount of suspended matter present; consequently the Royal Commission put their conclusions in the following way:

(1) That it should not contain more than 3 parts per 100,000 of suspended matter.

(2) That after being filtered through filter [illegible] should not absorb more than—

(a) 0.5 part by water per 100,000 of dissolved or atmospheric oxygen in 24 hours;

(b) 1.0 part by weight per 100,000 of dissolved or atmospheric oxygen in 48 hours; or

(c) 1.5 parts by weight per 100,000 of dissolved or atmospheric oxygen in 5 days.

The foregoing is a fairly definite standard but no hint is given as to methods of determination. There are two tests to make, one for turbidity, the other for oxygen absorption. An unfiltered effluent may be non-putrescible and yet absorb more than the amount of oxygen mentioned. When this is the case it is almost invariably due to its containing more than 3 parts of suspended matter per 100,000.

If a sample of unfiltered effluent does not absorb more than 0.5 parts of oxygen per 100,000 it will be very satisfactory, and if it does not absorb more than 0.55 it will be passable. In such cases the one test might be made to suffice, but it could be supplemented by a simple turbidity test which would enable the experimenter to decide, in a case where the oxygen absorbed was too high, whether this was due to an excess of organic matter in suspension or in solution.

A fully oxygenated sewage effluent will contain about 1 part of oxygen in solution in 100,000, and if it does contain nearly this amount, then, the sewage will prove to be non-putrescible, so that it is probable that the mere examination of an effluent to determine its turbidity and to ascertain that it is well oxygenated would answer every purpose. Tests of this kind are easily applied, and give in two or three minutes a very good idea of the quality of the effluent.

In the United States great stress is being laid upon the ratio of available oxygen in the effluent to the total amount of oxygen which the effluent is capable of absorbing, and in a paper just published, a simple test has been given whereby the sewage works manager can determine this ratio, but unfortunately, although it requires no skill, it takes four days to obtain decisive results if the effluent is good.

The paper mentioned is by Prof. Phelps, and is contained in a report entitled "Contributions from the Sanitary Research Laboratory and Sewage Experiment Station, Massachusetts Institute of Technology." The paper itself is entitled "Putrescibility and Stability of Sewage Effluents."

Referring to modern methods of sewage purification he says: "Suspended solids, available oxygen, and the character of the effluent in reference to its stability now demands first consideration"; and "As the production of a stable effluent is the primary function of such filters, the determination of such stability becomes the most important method of filter control." Later he describes a method of determining this stability which he has used for three years, and which enables him to express his results numerically.

We may take it that by a stable effluent is meant an effluent in which the dissolved oxygen and the nitrates present in it are sufficient to oxidize all the organic matter, and thus prevent putrefaction. In other words, a stable effluent is one which, if kept for a lengthened period in a closed air-free vessel, will not give rise to an offensive odor. Such an effluent is said to have a relative stability of 100. If the available oxygen is not sufficient then the relative stability is below 100. When the available oxygen in an effluent is not sufficient to secure proper stability, it is only a question of time for putrefaction to occur if the effluent is kept out of contact with air. The time, however, will vary with the temperature, the putrefactive bacteria developing more rapidly at a temperature approaching blood heat than at a lower temperature. The exact estimation of the time occupied by the organic matter to take up all the available oxygen in a filter-bed effluent is a tedious matter, requiring up to twenty-one days or more at room temperature and ten days or over at blood heat.

However, Prof. Phelps finds that in actual practice he can determine the relative stability with sufficient exactness for practical sewage work purposes in four days. His method is very simple. He completely fills small stoppered bottles of about ¼-pint capacity with the effluents, then tints each of them with a solution of methylene blue and places them in a cupboard kept approximately at a temperature of 68° F., and examines them daily for four days. So long as there is any available oxygen in the effluent the blue color is maintained, but as soon as it is all used the blue color disappears. The relative stability of each sample is then taken from the following table, which has been calculated from the results of numerous experiments.

RELATION BETWEEN RELATIVE STABILITY AND TIME REQUIRED AT 20 DEG. C. TO DECOLORIZE THE METHYLENE BLUE

Time.	Relative Stability.	Time.	Relative Stability.
12 hours	11	8 days	84
24 hours	21	9 days	87
36 hours	30	10 days	90
48 hours	37	11 days	92
60 hours	44	12 days	94
3 days	50	13 days	95
4 days	60	14 days	96
5 days	68	16 days	97
6 days	75	18 days	98
7 days	80	20 days	99

As a result also of the experiments made with filter-bed effluents at the works he finds that the average "relative stability" of an effluent which does not decolorize the blue in four days is 95. This figure may not be correct for any single effluent, but it will be very nearly correct on the average for a number of samples, and therefore a works which uniformly produces an effluent which does not decolorize methylene blue may be regarded as giving satisfactory results. A relative stability figure as high as 95 is never required under ordinary conditions to prevent putrescence, since the effluent must be discharged into some stream where it becomes diluted with water containing available oxygen, and as it is in contact with air it is continuously taking up oxygen. For these reasons an effluent which is putrescent when kept in an air-free sealed vessel may not putrefy or cause putrefaction when discharged into a stream.

This simple test is probably the best yet devised for the use of the sewage works manager, as it enables him with the minimum of trouble to test the effluent of individual beds. It merely requires a stock of stoppered bottles (size immaterial), a little solution of methylene blue, and a cupboard or incubator which can be maintained at a temperature of about 68° F.

If an effluent contains an excess of organic matter or a deficiency of dissolved oxygen and of nitrates, it will have a low relative stability, but it is almost invariably found that when there is little available oxygen there is an excess of organic matter in solution, or in suspension, or in both.

The standard suggested by the Royal Commission is more scientific than that of Prof. Phelps, but the former is intended for the use of skilled chemists and the latter for use by works foremen or others only desiring approximate results. An objection to Prof. Phelps' test is that it takes four days to discover whether an effluent comes up to the desired standard or not; meanwhile a bed or beds may be continuously discharging an unsatisfactory effluent. Dr. Thresh is inclined to prefer his own method, which he should like some of the members of the association to give a systematic trial, keeping records of the results.

It consists in determining the relative turbidity of each sample and the relative oxygenation. The relative turbidity is estimated in a graduated cylinder standing on a white disc bearing black squares. The effluent is shaken and then poured carefully into the cylinder until the individual black squares can no longer be identified. The length of the column should not exceed 100 mm. (4 ins.). The number of millimetres divided into 1,000 gives the relative turbidity figure. Thus if the col-

umn of effluent is 125 mm. long, the relative turbidity is 8; if it is 80 mm. long, the relative turbidity is 12½. The scale, however, can be made to give the relative turbidity without calculation.

To determine the relative oxygenation one portion of the effluent has to be saturated with air by thorough agitation; this gives the standard oxygenation, which he takes as 10.

With this a small stoppered bottle of about 150 c. c. capacity is filled, while a second and exactly similar bottle is filled with the effluent to be examined. Into each is dropped a pellet or soloid of caustic soda, or a few drops of solution of caustic soda and one of pyrogallic acid, or about ½ grain of the crystals. The stoppers are inserted so as to exclude any bubble of air, and the bottles are well shaken until the soloids or crystals have dissolved. A red brown color will develop, the depth of tint depending upon the amount of oxygen in the solution. By comparing the two it will be seen at a glance whether the effluent is well oxygenated or not. With a little practice one can give a relative figure which is sufficiently near for the purpose. A dilute solution of burnt sugar gives a very similar tint, and a set of solutions varying in tint from 1 to 10 may be kept for reference. For all practical purposes it is sufficient to find that the effluent is well oxygenated—i. e., that its relative oxygenation is above 7. If below 5 the effluent would not be regarded as satisfactory. This refers to effluents freshly taken. If they have been kept more than a few hours much of the oxygen may have disappeared. This fact suggests a variation of the test. A good effluent will retain some free oxygen after being kept in a full well stoppered bottle for twenty-four hours. If thoroughly saturated with air, it ought at the end of twenty-four hours, if kept at about 68 deg. Fahr., to still have a relative oxygenation figure of 5. To translate this into the words of the Royal Commission, the effluent would not have absorbed more than 5 parts of oxygen in twenty-four hours.

Dr. Thresh said he only recommends these tests as rough and ready tests for guidance of the sewage works manager and not as substitute for more scientific tests which can only be employed by an analyst. He does not wish to deprive any analyst of fees, and while recommending that the sewage works manager should make frequent and approximate tests, he also recommends that he should, as frequently as his authority will permit, have his results checked by complete analyses of typical samples. Without some tests for his guidance the sewage works manager is working more or less in the dark, and it is quite certain that if he can be persuaded to test his results daily or at frequent intervals it will be of advantage to himself and to the authority he serves.

In the discussion it developed that the possibility of a bacteriological standard being some day adopted was not pleasing. It would bring up the question of the condition of the stream above and below the discharge and complicate the manager's responsibilities. The problem of the manager now is to produce a non-putrescible effluent and the tests here given will enable him to judge his work. It was agreed that the sterilization of sewage does not remove the necessity for filtering before passing it to the stream. We are indebted to the Surveyor, London, for the opportunity to give the foregoing abstracts of the paper and discussion.

It is stated that the Department of Public Works in the Province of New Brunswick, Canada, has gone back to wooden bridges for spans between 50 and 180 ft. on highways. These wooden bridges are not painted and hot tar and lime are placed in all joints. After construction the bridges are completely housed in and roofed over. Some engineers place the life of a well designed and well built, housed in wooden bridge at 100 years. Protected by a tight roof it is believed the floors will wear out whereas now wooden floors generally fail by rotting.

Unclassified and General Articles

Note: This section is devoted to methods and cost articles on construction work not properly coming under any of the preceding classifications.

Comparative Methods and Costs of Underground Conduit Construction.

BY CLARENCE MAYER*

As the purpose of this article is to compare methods and cost of constructing underground conduits for electric transmission lines and railway signal lines, the construction of manholes, while strictly a part of underground conduit work, will not be treated on account of the great variety of design, materials, and methods requiring a separate article for their description. Besides no true comparison of manhole construction methods and cost could be made, as manholes of different designs and sizes are required for street railway, electric light and power, telephone, telegraph, and railway signal conduits. This does not hold true of conduit itself, for a conduit which is free from deterioration, electrolysis proof, fire proof, has a smooth bore, and is quickly and cheaply laid, is practical for all classes of underground transmission.

Fig. 1 — Use of Iron Pipe Conduit on a Bridge.

In the brief scope of this article the writer gives in a few words the result of his experience in the actual construction of several million duct feet of underground conduit. In this work careful cost data were collected on the installation of more than 600,000 trench feet of city and country conduit work, large and small jobs, and on many kinds of conduit construction.

For the information of those who have never given underground conduit work much thought, a brief description of the most prominent kinds of duct now installed may be pertinent. These may be roughly divided into three classes: (1) Conduits of metal material; (2) conduits of vegetable material; (3) conduits of silicious material.

In the first class are: Wrought-iron pipe and cement line wrought-iron pipe.

In the second class are: Paper or fibre conduit and creosoted pump log.

In the third class are: Cement or stone conduit; single and multiple vitrified clay conduit, and monolithic concrete or cement conduit.

Conduit of metal material is rarely used except for continuing conduit over a bridge or trestle, or for terminating a lateral or for a short subsidiary conduit. Its cost and corrosiveness makes its use almost prohibitive. (Fig. 1.)

Although several types of monolithic conduit have been installed in recent years, mostly in St. Louis, this kind of conduit is not very practical on account of the length of time required for its installation, the difficulty of breaking into it without injuring cable where repairs are to be made due to a bad burnout, or an additional manhole or service box is required, the difficulty in securing the experienced labor required in monolithic construction, the expense of such labor and the liability of heterogeneous and defective construction incident to all molded concrete and cement work which must be done quickly and underground.

The length of time required to install conduit is important not only from a standpoint of cost and utility, but also because work in city streets must be quickly completed to avoid interruption of traffic and complaint of property owners.

In practical conduit work it rarely happens that the cement or concrete work is without defects, except, perhaps, where the work is very carefully done by experienced and skilled men, which means additional time and cost.

It is the teaching of experience that different batches of concrete are not always uniform in composition or consistency. It is therefore obvious that any conduit which is built entirely of this material is very liable to be defective. Another negative feature of monolithic concrete conduit is that it is by no means electrolysis-proof.

This latter objection is also made against cement or stone conduit and it is a very important objection. For the great demage done to cable by the ravages of electrolysis, annually amounts to a large sum of money, irrespective of the losses through interruption of service incident to such cable injury.

All concrete is porous enough to allow saturation of the mass by the acid and alkali solutions constantly present under streets. And though the mass itself may not be materially weakened by this process, the eroding solutions are allowed to seep quite freely through to attach the cable sheath. The concrete surface lying next to the cable becomes softened, scales off and distributes its debris through the duct so that in time the duct is of no more use for exchange and repulling of cables than the disqualified iron pipe.

Another detrimental feature of cement or stone conduit is its brittleness. It is rarely that a load is hauled from cars or storehouse to the work with a breakage of less than 6 or 7 per cent.

Cement or stone conduit is of circular shape and usually made in 3 or 6-ft. lengths with slip joints on either end. It is usually laid in an envelope of concrete 3 in. in thickness; the lengths are butted together within the aligning collar of iron which fits over the slip joints. In multiple conduit construction the ducts are built up in tiers, the formation being retained in place by clamps or by stakes driven into the bottom of the trench and removed upon completion of the side walls. Cement or concrete is placed and flushed between the layers of ducts so as to make a solid construction. Where two or more ducts are laid side by side all joints are staggered.

Most of the underground conduits installed today are either single or multiple clay duct, fibre, or creosoted wood. The preference is often caused by the market price of conduit materials and freight from factory to point of installation. In too many instances the first cost is the main item of consideration. There are, however, some conditions besides cost of material and installation that should dictate the kind of conduit to be laid.

For example, in localities where much water has to be contended with or where conduit is subject to constant and severe shocks as in the yards of great steel plants and the like, creosoted pump log is most practical. In streets crowded with underground pipes or

*Author of "Telephone Construction: Methods and Cost," Chicago, Ill.

where it is desired that ducts be isolated from each other in order that ground currents may be equally distributed over the greatest possible area of cable sheath, to minimize the local electrolysis, such as in street railway conduits, single duct tile should be laid.

Creosoted pump log, though most practical under certain rare conditions, for general conduit construction cannot be said to compare with either fibre or vitrified clay conduits in durability or insulating qualities, and its cost is greater than either fibre conduit or vitrified clay conduit as the ducts cost more and the creosoted stakes, cleats and protecting plank cost more than concrete and labor in mixing and placing.

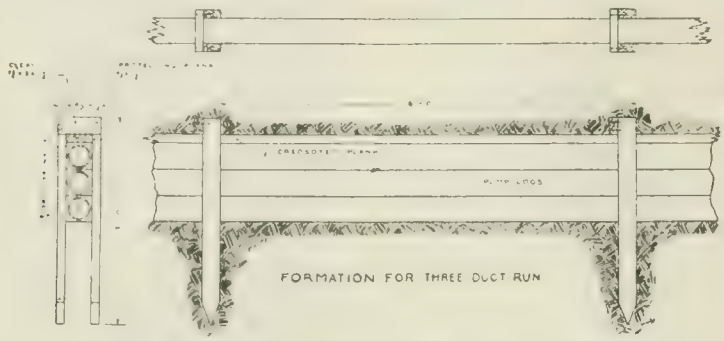

Fig. 2—Sectional Views of Pump Log Construction.

Creosoted pump log is generally laid without any special foundation. Where two or more ducts are required they are laid so as to break joints. Each duct is provided with mortise and tenon which simplifies alinement. When the pump log is laid and settled in position, a creosoted plank usually 1½ ins. thick and of width of the conduit is laid on top of the ducts. Stakes are then driven, one on either side, 3x1½ ins. x 3 ft, of creosoted lumber. These stakes are driven at intervals of 6 ft., are sharpened to a point and are driven with the 3-in. face parallel to the line of conduit. The tops of the stakes are bound together by a cleat, of the same size lumber as the stakes. The method of installing pump log is shown by Fig. 2.

There are other and cheaper methods of installing permanent and solid construction. Were either stakes or creosoted plank to be omitted, the formation would have no protection from foreign excavations which experience has shown to be imperative.

In a comparison of the cost of installing the two kinds of conduit which this article has narrowed to—fibre conduit and vitrified clay conduit—only the most economical and serviceable methods of construction are described. These methods have been standardized by the great public utility companies on the basis of their experience and the investigation of their engineers and the methods have stood the test of time.

Fibre conduit is usually laid in a 3-in. envelope of concrete. Where two or more ducts are required the ducts are laid so as to leave an interstice between the ducts of 1 in. Ducts are alined by means of male and female slip joints with which each length is provided and in laying the joints of each length are dipped in a liquid compound which seals the joint. Where the conduit cross section is large it is built up in tiers and the formation is held in place by stakes driven into the bottom of the trench or by removable guide racks at intervals of 6 ft. As each tier is laid concrete is flushed into the interstices between ducts and to a thickness of 1 in. on top of the ducts. The next tier is then laid and similarly concreted (Fig. 3). Where, as in railway signal conduit construction, ducts are laid between rails or tracks, and it is desired to concrete the entire formation in a single operation in order not to impede traffic or in order to cheapen construction cost, 1-in. duct supports or guide racks are placed at intervals betweens tiers of ducts both horizontally and vertically and the whole formation is held in place by stakes driven into the bottom of the trench on either side of the conduit formation. With this method the concrete although mixed in a semi-fluid condition will not always fill the interstices between ducts, especially in the lower tiers. See Fig. 4 and 5. Other objections to this method are the cost of supports or guides which must be left in the concrete and the weakening of the construction by the presence of these wood supports or guides.

Fibre conduit while generally considered a good insulator, is by no means fire-proof nor has it the durability of vitrified clay conduit. This is well shown by the data computed by a special commission, consisting of Prof. Dugald C. Jackson, Dr. George W. Wilder and William H. Crumb, appointed to investigate matters pertaining to the telephone situation in the city of Chicago. In connection with its report the commission gave the following data as to the life and depreciation of conduit:

	Life in years.	Per cent to depreciation account.	Per cent salvage.	Per cent to reconstruction and insurance
Underground conduit, main, clay in concrete.....	50	.89	0	1½
Underground conduit, main, fibre in concrete....	20	3.72	0	1½

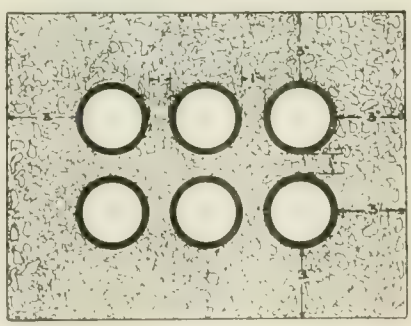

Fig. 3—Fiber Conduit with Concrete Encasement.

A vitrified clay conduit line when composed of a single duct is laid in a matrix of 3 ins. of concrete. Where multiple duct tile is laid, the trench is prepared with a foundation of 3 ins. of concrete. (Figs. 6 and 7). Upon this the tile is laid, and if multiple ducts are used, the ducts are centered by means of dowel pins which preserve alinement. The top and slides of each tile joint are covered with a strip of burlap 6 ins. wide to prevent the entrance of concrete, and all joints are staggered. The formation is then enclosed at the sides and top with a wall of concrete 3 ins. thick. Another and more economical method of installing vitrified clay tile which has been adopted by the Chicago Telephone Co. in most of their work, except in congested districts, and by other large companies, after a series of experiments covering several years, is to lay the tile on a 4-in. concrete foundation which is wide enough to extend 3 ins. beyond the outer walls of the conduit formation. On this foundation the tile is laid as already described, except that the tile joints are protected by strips of muslin or burlap dipped in neat cement paste extending smoothly over the end of each section of conduit at least 3 ins. on each side of the joints. After the joint has been made the entire surface of the muslin or burlap is covered with a ⅜-in. layer of 1:1 mortar. The sides of the trench are then filled with earth to a height level with the top of the ducts and a layer of concrete 3 ins. in thickness is placed over the ducts, extending 3 ins. on each side beyond the outside line of the ducts. This method of construction is shown by Fig. 8.

The cost of underground conduit construction while variable and depending on the location of work, size of job, rates of wages, price of material and competency of foremen, may still be figured with accuracy provided the data used are based on average cost of work done under average conditions.

It is often assumed that cost data to be of any value for comparative purposes must be based on work done under approximately similar conditions. Of course, to secure such data is obviously impracticable, as it does not often occur that two conduit lines are built under similar conditions, of the two kinds of duct which it is desired to compare. However, this is by no means necessary, for where distance of haul, character of soil and pavement, rates of wages and price of material are known and the cost data are carefully and systematically collected they may serve as accurate bases for comparing or estimating.

This is now generally recognized by most statisticians and the writer's personal experience has proven this beyond question. As an instance of this, the writer, when cost statistician for the Chicago Telephone Co., estimated the cost of installing a multiple duct conduit from 48th Ave. in the city of Chicago to LaGrange, Ill.—a distance of approximately 38,000 ft., and he came within less than $100 of the actual cost. This is not an isolated instance. Similarly close estimates have been

Fig. 4—Wooden Racks for Fiber Conduit Line Showing Holding Stakes.

made by the writer and others where based on actual cost records.

COST DATA.

The comparative cost table (Table I) is based on average costs collected by specially trained men using an identical system. They are not averaged from timing a few feet of work but from complete jobs, small and large, done in both city and country districts. On one job alone 824,862 duct feet of conduit were installed. This work was done by the Chicago Telephone Co. in combination with the American Telephone & Telegraph Co. to extend their conduit from Chicago, Ill. to Kenosha, Wis., and is one of the longest underground conduit lines ever built. The writer personally superintended the collection of cost data on this work and daily detail records of cost were kept. (For further details of this work the reader is referred to the author's "Telephone Construction: Methods and Cost." Chapter VI.—Myron C. Clark Publishing Co., Chicago.) These data together with those collected on many other conduit jobs are used as a basis for averaging the costs given in Table I.

Fig. 5—Wooden Racks and Concrete Encasement for Fiber Conduit Line.

Rate of Wages.—The following were the rates of wages paid for a nine-hour day:

Foreman	$3.50 to $4.00
Assistant foremen	2.50 to 3.00
Timekeepers	2.00 to 2.50
Watchmen	2.00
Waterboys	1.00
Laborers	2.00
Teams with drivers	5.00

Concrete.—Concrete is based on cement at $1.65 per bbl., sand and gravel at $1.90 per yard delivered on the ground, mixed in proportion of 1 part cement, 4 parts sand and 8 parts stone. Concrete was mixed by machine where possible. A considerable section of trench was excavated and graded and then the mixer was drawn along the side of the trench and an entire section of trench bottomed. The ducts were then laid and concreted on sides and top in one operation. In the case of fibre conduit, the bottom was placed as described for vitrified clay conduit, and as each tier of ducts was laid, concrete was placed and tamped in order that no interstices might be left between ducts.

Laying Conduit.—Conduit was laid by unskilled labor. Two men were used in the trench and one handing conduit, dowel pins, and preparing burlap or compound for joints as the case might be. The conduit layers were usually picked men and were kept continually on this work.

Resurfacing.—All pavements except in unimproved and macadamized streets and roads were repaired by contractors. In the cost table the resurfacing is not shown because there are many kinds of pavements, varying in cost in different localities, and whether the trench is a few inches wider for one construction than another makes no difference in cost of resurfacing as paving contractors charge the same yardage. This is proven by the experience of everyone who has ever installed a conduit line.

Trenching.—The cost of trenching is based on average clay soil which is the most usual soil encountered in this country. In trenching, any conduit requiring less than a 15-in. trench, costs practically the same to excavate as a 15-in. trench. The reason for this is that a trench less than 15 ins. wide impedes the free working of the men, where a trench is deep enough to permit the top of the conduit formation to be 2 ft. below street level as is generally required. Then, again, experience has shown that it is almost impossible to get men to dig a trench less than this width unless a foreman is placed over each man.

Unloading and Distributing.—Unloading and distributing conduit is based on an average load over overage distances and road conditions being $.0023 per duct foot for vitrified clay conduit and $.0016 per foot for fibre conduit, with 2-horse trucks costing $5 per day with driver, carrying 5 loads per day.

Conclusion.—As will be seen by the Cost Table the cost of installing fibre conduit is considerably more than for vitrified clay conduit and when we take into consideration the fact that vitrified clay will last over two and one-half times as long as fibre conduit, it is obvious that from a standpoint of either first cost or final cost, vitrified clay conduit is much cheaper to install though the vitrified clay conduit itself may be more expensive.

There are many points which lead inexperienced men to believe the cost of laying vitrified clay conduit to be higher than it actually is. For example, it is often thought that a mandrel is required in laying multiple tile and that skilled men are needed to lay the tile. Of course a mandrel may be used as may skilled men, but neither is used by competent conduit men. If vitrified clay tile be laid as described in this article, it would be only necessary to run a cleaner through the ducts when rodding to remove any concrete which may have entered through joints and this operation would add nothing to the cost of rodding.

Vitrified clay tile are superior to any other kind of ducts because they form a solid and permanent conduit, irrespective of the concrete envelope which only adds a secure foundation and protection from foreign excavations. As has already been pointed out concrete on the sides of vitrified clay tile is more or less superfluous. With fibre or any other ducts laid in concrete, the concrete is indispensable and the important part of the construction. This is especially true of fibre conduit, for on account of its composition it is useless unless encased in concrete as the fibre simply acts as a mold forming ducts in the concrete. It is therefore clear that while the concrete may be a very cheap mixture and imperfectly placed without seriously affecting

Fig. 7—Single Duct Clay Conduit Construction with Complete Concrete Encasement.

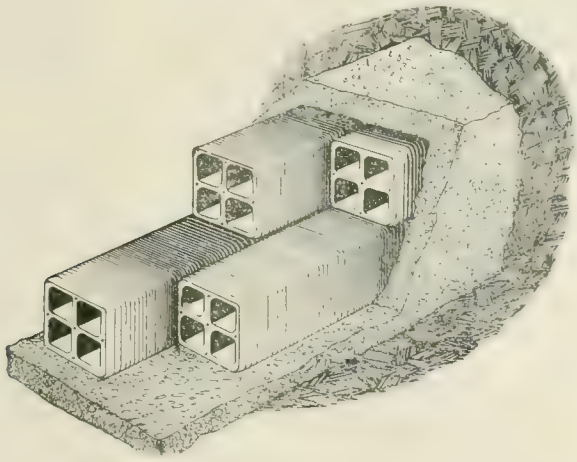

Fig. 6—Standard Multiple Duct Clay Conduit Construction with Complete Concrete Encasement.

TABLE I.—COMPARATIVE COST OF 4-DUCT VITRIFIED CLAY CONDUIT AND FIBRE CONDUIT.

	Single duct tile [illegible]	Multiple duct tile enclosed in concrete.	Multiple duct tile concrete top and bottom.	Fibre.
Costs of ducts at factory	[illegible]	$0.1600	$0.1600	$0.1800
Concrete	[illegible]	.1463	.0915	.1950
Burlaps for joints (no burlap used for single tile)	[illegible]	[illegible]	.0043	.....
Mortar for joints	.....	.....	.0051	.....
Lumber for [illegible]	.....	.....	.....	.0107
Breaking [illegible]	.0040	.0040	.0040	.0014
Trenching	[illegible]	.1252	.1252	.1404
[illegible]	[illegible]	.0256	.0269	.0461
Backfilling	.....	.....	.....	.....
Unloading and distributing conduit	.0096	.0091	.0091	.0064
Laying ducts	.0111	.0093	.0093	.0082
Placing concrete	[illegible]	.0068	.0042	.0264
Mixing concrete	.0230	.0222	.0076	.0336
Disposal of surplus earth	.0336	.0321	.0167	.0392
Supervision 5% of total	.0286	.0279	.0232	.0344
Total cost per trench ft.	[illegible]	$0.5848	[illegible]	$0.7218
Total cost per duct ft.	[illegible]	$0.1462	[illegible]	$0.1805

the permanency or value of a vitrified clay conduit, in the case of fibre conduit, the concrete unless rich, and well placed and tamped will soon deteriorate.

Another serious objection to fibre conduit is that when subjected to heat of a summer day such as is encountered in Southern states, most of the year, it will soften and lose its shape so that in laying the concrete will flatten or partially flatten the ducts. The experience

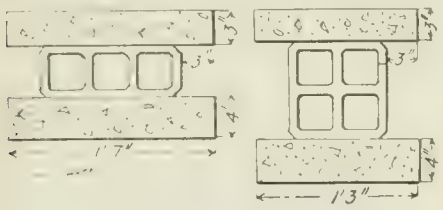

Fig. 8. Multiple Duct Clay Conduit with Partial Concrete Encasement.

of any conduit contractor in the south has proven this.

While it is claimed that fibre conduit is a good insulator, vitrified clay conduit being virtually cheap glass is practically a perfect insulator where as the vegetable nature of fibre conduit would leave some doubt as to its insulating qualities.

In the case of electric light conduit built with fibre ducts, experience has shown that at certain hours of the day where the load is heavy such as at hours when stores, offices, sign and street lights are all in use, overload sometimes occurs, causing the cable to become hot, which in turn heats and softens the fibre conduit. In the course of time this causes the cable to sink into the conduit, making it impossible to remove.

In a discussion before the Transvaal Institute of Mining Engineers Mr. H. Kerseur says: In this connection I have noticed that several mines on the Rand are installing electrically-driven air compressors, and as air compression has a certain fascination for me I tried to investigate the reasons for this method of driving. I think electrically-driven compressors are only adopted because the mines believe that method is more economical I beg to state, however, that electrically-driven compressors are about 25 to 50 per cent less in economical working than steam driven —especially for the larger units. As it would make this contribution too lengthy, I refrain from giving you the reasons and figures hereon, but I intend to come back to this subject in the near future and prove to you my above assertion. In my opinion it is only justifiable to adopt an electrical drive for compressors if there is some surplus electric power which could not be used in some other way.

The Kenefick-Quigley-Russell Construction Co. of Denver, Colo., and Kansas City, Mo., has been awarded an additional contract by the Denver Reservoir Irrigation (Strandley) Co. for the construction of a large canal from Barr lake to a point 18 miles east of Hudson. The canal will be an enlargement and extension of the Neres canal, branching from it at Hudson, and will cost $500,000.

LETTERS TO THE EDITOR.

A Design for a Stadia Rod.

Sirs: A design shown in the issue of Engineering-Contracting for Nov. 17, 1909, prompts me to send a description of a stadia rod which I have designed and given a thorough trial. It is made to be seen. I use rods about 3 ins. wide. As will be seen from the drawing, it is graduated to 0.05 ft., leaving the intermediate points to be estimated with the eye. Having the graduations for alternate feet on alternate

Design for a Stadia Rod.

[illegible] the rod enables one to see them a long [illegible] off and there is also plenty of white background at all points on the rod.

Yours truly,

F. O. NELSON.

Estherville, Ia., Dec. 18, 1909.

Contract Labor Compared with Day Labor and Rate vs. Amount of Wages.

Sirs: A letter from Thomas Flynn in the Dec. 29 issue on the subject of wages was interesting to me. Mr. Flynn [illegible] read more political than economic literature and his epistle is a very pretty plea along the lines of protection to home industry. Now my experience has proven to me that a contractor does not always pay less than the city. My experience and a very careful study, as the result of which a new book on economics may appear, prove that the rate of wages is independent of the amount of wages. The cost of a highway per mile, to choose a familiar example, is about the same in every country of the world under the same specifications, yet the rate of wages may be as low as 2 cents per hour in one country and as high as 30 cents per hour in another As you stated in your reply to Mr. Flynn, "The cheapest labor in the world is the most economic."

In municipalities there are favored employes. Civil War veterans must be employed whether fit or not in a great many places. If the youngest soldier in that war was 20 years old on the day of his discharge he must now be at least 64 years old, yet the writer within the past three years had to employ four veterans under an old ordinance. No one grudged the old men their jobs and no one objected to paying them $2 per day of eight hours. The effect, however, on a gang of men working alongside unfit men, was so bad that the writer finally carried them on the payroll at full pay so long as they kept away and permitted him to drive the other laborers. It happens often that councilmen and politicians have certain friends, relatives or family connections who must be employed. The writer has been a city engineer for years and knows whereof he speaks. In one city the council wanted to adopt the policy of doing all work by day labor and the writer protested. Finally a test was made on two identically similar pieces of street work, the specifications being the same and length and width identical, therefore the estimates of cost being alike. One piece was let by contract and the other was done by day labor under charge of the chairman of the street committee, the man who favored the day labor idea. In his early years he had been a contractor, and it was feared the writer, being opposed to day labor work, would not push things properly, so he was relieved from his duties and another engineer engaged.

The writer preserved a perfectly neutral attitude and watched the work closely. The contractor put in a lump sum bid for his job, which was [illegible] per cent below the estimates of the writer. The organization and carrying out of both pieces of work were excellent and the chairman of the street committee was all right as a boss. The spirit on the two jobs was different and the difference was noticeable. The contractor was free to employ whom he chose and kept only the men who worked. Naturally he paid much higher wages than were paid on the city job, which was considered a snap. He infused spirit into his men and claimed to have made a good profit, which nobody doubted The superintendent on the city job had little choice in the selection of his men. The first men employed were put on the payroll to favor his colleagues on the council and certain friends and interests. This gave him a nucleus with whom good men did not care to work. The men he secured later were those fired by the contractor. His job cost 20 per cent more than the contract job and was no better done.

To answer another part of Mr. Flynn's letter in which reference is made to traits in human nature. A man can be proof against financial bribery when a hard luck story will touch his heart and make him untrue to his employer. If the man in charge of day labor work can steel his heart there are men higher up who can make him less exacting if they are annoyed by the importunities of the friends of the men who believe themselves oppressed. On contract work the contractor is moved entirely by personal interest and so are his men. To hold their jobs they must be guided by him whose sole motive is financial profit. On day labor work all men are swayed by personal interest. To hold their jobs they must be guided by the man above whose interest is personal ambition and seldom financial profit. Votes, not dollars, measure his profit, and each laborer is a voter. The city engineer as a superintendent must not lose votes, precisely as the superintendent for the contractor must not lose dollars.

D. H.

Chicago, Ill., Dec. 28, 1909.

The Use of Oils for Lining Irrigation Canals.

Sirs: Being greatly interested in an important subject relating to the building and main-

tenance of irrigation canals, and having the privilege of being a subscriber to your valuable paper, I have not hesitated to address you, respectfully asking for some information about that matter.

I am now charged with very important works in this district, tending to the improvement of a large and costly irrigation canal. This latter is built through very soft soil and the greater part of it runs on embankment, thus endangering its preservation and causing big losses through seepage. I am now making designs to deepen the canal, the slope of the ground making it possible in long tracts, and studying the means of preventing, as far as it is practicable, the great losses from seepage.

I have read in an American technical paper about some successful experiments made in lining irrigation ditches with crude petroleum, and should like to have more detailed data on this important subject. It would be specially interesting for me to know if that process of lining canals has left the experimental stage and is being practically applied in some parts of the United States, and if so, where and to what extent, as I might take a trip and study such works personally.

Very truly, V. S.

Sacramento, Mexico, Dec. 20, 1909.

(The best information perhaps which our correspondent can easily obtain regarding the use of asphaltic oils for irrigation canal lining is contained in a bulletin published by the Agricultural Experiment Station of the University of California, Berkeley, Cal. This bulletin describes a series of tests made to determine the effectiveness of various linings for irrigation canals and was abstracted in some detail in ENGINEERING-CONTRACTING for Dec. 2, 1908. Oil for lining irrigation ditches has been used only in California, so far as we know, and, according to reports, with varying degrees of success.—Editors.)

Cost of Cleaning Streets with Hand Brooms.

Sirs: We read with much interest the report of Mr. Samuel Whinery, Consulting Engineer, New York City, in regard to street cleaning in Boston, Mass.

Have you any data on file as to the average cost per thousand yards of cleaning with hand brooms in some of the larger cities. If we are not presuming too much, we would appreciate any information you can give us.

Yours truly, C. F. R.

South Bend, Ind., Dec. 22, 1909.

(The editors have at the moment no data on costs of cleaning streets with hand brooms and a search of the literature immediately at hand gives no very satisfactory information. We shall be glad to hear from our readers on this matter.—Editors.)

Roughening the Surface of Old Cement Walks.

Sirs: We have in this city a number of walks on which apparently too much steel trowelling was done at the time they were built and the surface is so smooth and slippery that in wet or frosty weather they are dangerous to pedestrians. I would like to inquire from you, or through the correspondence columns of your paper, whether anyone has tried acid on old walks to produce a rough surface. Any information about any approved method of obtaining this result will be appreciated.

J. S. McCULLOUGH.

Fond-du-Lac, Wis. City Engineer.

(Acid wash was tried on two sidewalks of which the editors know and was successful enough but the work was done in midsummer. The walks were three years old. Muriatic acid 1 part and water 2 parts was the wash used. It was done a number of years ago and the costs are not available. Some of the wash got into expansion joints and caused some trouble. A good way to roughen the walk is by bush hammering. This work costs from 1½ cts. to 2½ cts. per sq. ft. Hand hammers may be used or pneumatic hammers with portable compressor operated by gasoline engine. A small hand hammer operated by electricity has lately been put on the market. We hope our readers can give some data on the acid etching.—Editors.)

A Bag of Cement and One Cubic Foot.

Sirs: In your editorial of Dec. 22 you suggest that a bag of cement weighing 95 lbs. be accepted as a unit and nearly equivalent to 1 cu. ft. Why not make the bags weigh 100 lbs. and therefore more nearly equal to 1 cu. ft.? It would be well if we used 100 lbs. as a unit for nearly everything used by weight.

P. C. KNIGHT.

Pontiac, Ill., Dec. 24, 1909.

Sirs: All practicing engineers will thank you for a move in the right direction of considering a bag of cement as one-quarter barrel. Your move for 95 lbs. as a bag weight is nearly the same as accepting the "sack weight" of cement stipulated or specified Aug. 15, 1908, by Article 7, that is, "net 94 lbs." for Portland cement. (The writer does not say where the Article 7 belongs.—Editors.) This was the correct move at that date to establish uniformity for a barrel weight, the net contents being thus made 376 lbs. The quarter of that is 94 lbs., the "net weight" of a sack.

FRANK P. KELLOGG.

Chicago, Ill., Dec. 24, 1909.

Sirs: Your editorial advocating a "bag" of cement as a unit instead of a barrel is not a satisfactory solution of the problem, as it simply substitutes another indefinite and irrational unit for the one now existing.

A barrel of cement is a unit of measure by custom only and has no definite weight. The usual weight is 380 lbs. for Portland cement and about 265 lbs. for natural. The U. S. Army Engineers' specifications say 375 lbs. of cement is a barrel. Other published information gives other weights as being correct for a barrel of cement.

One of the greatest nuisances engineers have to deal with is the tendency of manufacturers and dealers in nearly all classes of supplies to establish standards and measures peculiar to their products. Cement is in reality all sold and transported by weight and mixed by volume, so why should we not use the ordinary legal measures of weight and volume? That is, buy the cement by the hundred pounds net, and the manufacturers would soon discover that it was convenient to put 100 lbs. of Portland cement into a sack instead of 94 to 96 pounds as at present. In order to simplify the proportioning, specifications should state that 100 lbs. of cement will be considered to be 1 cu. ft., or 1.1 cu. ft., whatever is correct in the judgment of the engineer. Let us drop the use of the term barrel as a measure of cement, but do not adopt another unit which is peculiar to the one industry, but rather adopt a unit which has a definite legal value and is understood by anyone who knows the usual weights and measures.

Yours truly,

O. W. CHILDS.

St. Louis, Mo., Dec. 27, 1909.

(The above letters are given as a sample of the comments received on the editorial about what constitutes 1 cu. ft. of cement. We ask our readers kindly to bear in mind that we made no recommendations as to the weight of 1 cu. ft. of cement. We simply suggested that engineers fall into line with the manufacturers who now have a standard size bag into which is placed as near as may be, 94 lbs. net of cement. We suggested that this bag be assumed as being equal to 1 cu. ft. of cement and as a contractor has no means of emptying and weighing the contents to determine the "net weight," that the specifications call for a "gross weight" of not less than 95 lbs. We are not suggesting anything new. On this point a further discussion will be found in the editorial pages.—Editors.)

Diamond Drilling Records and Costs.

Sirs: I would like to get a line on diamond drill records and costs in different parts of the western country, including Mexico, British Columbia and Alaska; also a system of cost keeping for diamond drill work.

Yours very truly, H. D. S.

Portland, Ore., Dec. 22, 1909.

(Costs of diamond drill borings in Colorado were given in our issue of March 13, 1907; costs of diamond drill borings in Mexico were given in our issue of April 29, 1908, and costs of diamond drill borings in British Columbia were given in our issue of May 6, 1908. Other useful articles on diamond drill costs will be found in ENGINEERING-CONTRACTING for Jan. 9 and March 13, 1907, April 21, July 28 and Sept. 8, 1909. Cost-keeping systems and blanks for diamond drill work will be found described in "Cost Keeping and Management Engineering" by Gillette and Dana.—Editors.)

A Definition of Terms Used to Designate Engineers.

Sirs: Do you know of any book, either legal or engineering, that defines the different qualities of Consulting, Constructing, Contracting, etc., Engineers and their duties? These different prefixes are used extensively and many people are liable to take one for the other.

A. THOMAS.

Detroit, Mich., Dec. 24, 1909.

(We are not acquainted with any book or books, giving the desired information. A consulting engineer should be a man, who, because of study added to wide experience, is qualified to give advice on engineering work to men less well informed. It was formerly a title of high distinction but is now meaningless because every man assumes it who goes into private practice. A consulting engineer in common opinion is an engineer not steadily employed on a salary and when a salaried engineer is consulted on special work he is, for the time being, a consulting engineer. A constructing engineer is a man educated as an engineer—or who assumes the title—and is placed in charge of construction work. He is compensated by a salary, fee or percentage of cost or profits. When such a man contracts to do the work he is a contracting engineer. Contractors in charge of work involving something more than the problems connected with ordinary small building operations are today generally termed engineering-contractors. The engineer himself is "the ingenious man," the name having the same root form as the word "ingenuity." The modern engineer must assist his native ingenuity by adding to it a good education in mathematics, applied science and a knowledge of costs and methods of construction work.—Editors.)

Corrosion of Steel in Concrete Sea Walls.

Sirs: I note with interest the query on page 552 of Engineering-Contracting for Dec. 22, in regard to corrosion of concrete reinforcement by salt water. Am sending you under separate cover a bibliography which may be of interest to you along this line. Concrete protection is treated on page 44.

Very truly yours,

E. H. McClelland,

Technology Librarian Carnegie Library.

Pittsburg, Pa., Dec. 24, 1909.

(The bibliography referred to is entitled "Metal Corrosion and Protection. References to Books and Magazine Articles." Second Edition. Revised and Enlarged, 1909. It contains 64 pp., 6 x 9 ins. and will be mailed for 10 cts. About 4½ pages contain references to articles on metal encased in or protected by concrete. The Society of Scandinavian Portland Cement Manufacturers presented a report on Cement in Sea Water to the International Association for Testing Materials in 1909. The report deals with experiments made in Denmark, Sweden and Norway but no mention is made of reinforced concrete. This

report can be had for $1.25 printed in English. Prof. M. Möller presented a paper at the same convention entitled "The Use of Reinforced Concrete Beside the Sea." This paper has also been printed in English.—Editors.)

Technical Society Meetings.

The list following names those technical societies in which engineers and contractors are most interested, whose meetings are to be held within three months of the date of this issue. There are given for each society listed the date and place of meeting and the name and address of the secretary, to whom all communications and inquiries should be addressed.

American Society of Civil Engineers.
Jan. 19-20, 1910. Annual meeting at New York City. Secy., Chas. Warren Hunt, 220 W. 57th street, New York, N. Y.

Canadian Society of Civil Engineers.
Jan. 25-27, 1910 Annual meeting at Ottawa, Ont. Secy., C. H. McLeod, 413 Dorchester St., West, Montreal, Que.

American Society of Engineering Contractors.
Feb. 24-26, 1910. Annual convention at Chicago, Ill. Secy., Daniel J. Hauer, Park Row Building, New York, N. Y.

American Society of Heating and Ventilating Engineers.
Jan. 18-20, 1910. Annual meeting at New York City. Secy., W. M. Mackay, P. O. Box 1818, New York, N. Y.

American Society of Inspectors of Plumbing and Sanitary Engineers.
Jan. 20-22, 1910. Annual Convention at Trenton, N. J. Secy., C. S. McCosker, Mobile, Ala.

Canadian Society of Civil Engineers.
Jan. 25-27, 1910. Annual meeting at Ottawa, Ont. Secy., C. H. McLeod, 413 Dorchester street west, Montreal, Que.

Connecticut Society of Civil Engineers.
Feb. 8, 1910. Annual meeting at New Haven, Conn. Secy., J. Frederick Jackson, Box 1304, New Haven, Conn.

Illinois Association of Municipal Contractors.
Feb. 24-26. Annual meeting at Chicago, Ill. Secy., Orie T. Dunlap, Edwardsville, Ill.

Illinois Lumber Dealers' Association.
Feb. 16-18. Annual meeting at Chicago, Ill. Secy., Geo. K. Hotchkiss, 315 Dearborn St., Chicago.

Illinois Masons' Supply Association.
Feb. 16-18. Annual meeting at Chicago, Ill. Secy., Geo. K. Hotchkiss, 315 Dearborn street, Chicago.

Illinois Society of Engineers and Surveyors.
Jan. 26-28, 1910. Annual meeting at Cairo, Ill. Secy., E. E. R. Tratman, 1636 Monadnock Block, Chicago, Ill.

Indiana Engineering Society.
Jan. 14-16, 1910. Annual convention at Indianapolis, Ind. Secy., Chas. Brossman, Union Trust Bldg., Indianapolis, Ind.

Interstate Mantle and Tile Dealers' Association.
Feb. 15-19. Annual meeting at Chicago, Ill. Pres., Joseph W. Lantry, Wm. H. Jackson Co., Union Square, New York City.

Iowa Association of Cement Users.
March 9-11, 1910. Annual meeting in Cedar Rapids, Ia. Secy., Ira A. Williams, Iowa State College, Ames, Iowa.

Iowa Engineering Society.
Feb. 16-17, 1910. Annual convention at Cedar Rapids, Ia. Secy., A. H. Ford, Iowa City, Ia.

Michigan Engineering Society.
Jan. 12-14, 1910. Annual meting at Lansing, Mich. Secy., Alba L. Holmes, 574 Wealthy Ave., Grand Rapds, Mich.

Montana Society of Engineers.
Jan. 6-8, 1910. Annual meeting at Butte, Mont. Secy., Clinton H. Moore, Butte, Mont.

National Association of Cement Users.
Feb. 21-25, 1910. Annual meeting at Chicago, Ill. Secy., Geo. C. Wright. Address all communications to Edw. E. Krause, Asst. to the President, Harrison Bldg., Philadelphia, Pa.

National Builders' Supply Association.
Feb. 23-24. Annual meeting at Chicago, Ill. Secy., James W. Wardrop, Frick Building, Pittsburg, Pa.

National Brick Manufacturers' Association.
Feb. 7-12, 1910. Annual Convention at Pittsburg, Pa. Secy., T. A. Randall, Indianapolis, Ind.

Northwestern Cement Products Association.
March 1-5, 1910. Annual meeting in St. Paul, Minn. Secy., A. E. Pfiffner; Pres., Martin T. Roche, Pioneer Press Building, St. Paul, Minn.

Ohio Engineering Society.
Feb. 15-17, 1910. Annual meeting at Columbus, Ohio. Secy., C. J. Knisley, New Philadelphia, Ohio.

Personals.

Mr. Walter Loring Webb, M. Am. Soc. C. E., has become associated with the Roberts & Abbott Co., Consulting, Supervising and Operating Engineers, of Cleveland, O., and will represent that company at Philadelphia, Pa., and vicinity. Mr. Webb's office will be as heretofore at 1026 Real Estate Trust Bldg., Philadelphia, Pa.

Mayor Gaynor of New York City has made the following appointments: Commissioner of Docks, Calvin Tomkins, Assoc. M. Am. Soc. C. E.; Commissioner of Bridges, Kingsley Martin, M. Am. Soc. C. E., heretofore Chief Engineer Department of Bridges; Commissioner of Water, Gas and Electricity, Henry S. Thompson. Prof. Edward Bemis, at present head of the Water Department of Cleveland, O., has been appointed First Deputy Commissioner under Mr. Thompson.

Mr. Harry C. Hill, heretofore Assistant State Engineer of New Hampshire, has been appointed State Engineer, succeeding Mr. Arthur W. Dean, who has become Chief Engineer of the Massachusetts Highway Commission, as noted in our last issue. Mr. Hill was graduated from the Thayer School of Engineering at Dartmouth College in 1903, and served for some time as a transitman and assistant engineer for the New York Central & Hudson River R. R., near Corning, N. Y., and at New York City.

Mr. C. H. West, Chief Engineer of the Mississippi River Levee District, of Greenville, Miss., has been appointed a member of the board of Mississippi River Levee Commissioners. Mr. West was educated in the University of Illinois and first engaged in railroad surveying, which he followed until 1893. In that year he was appointed an engineer of the federal government on the Mississippi River and continued in this capacity until 1898, when he was elected chief engineer of the board of levee commissioners.

Mr. John T. Featherson, of New York City, as the result of the recent civil service examination held by the city of Chicago, will probably be the next superintendent of streets of that city. The results of the examination were posted on Dec. 31, and it was found that Mr. Featherson lead the list with a mark of 92.8 per cent. The list of the 16 men who averaged above the passing grade of 70 is as follows: John T. Fetherston, New Brighton, N. Y., 92.80; John B. Hittle, 832 Leland Ave., 84.15; Cicero D. Hill, 1722 West 101st St., 83.90; John H. Moore, Evanston, 82.63; Parke G. Anderson, Moline, Ill., 81.36; Frank T. Fowler, 915 Lakeside Pl., 80.06; Charles B. Ball, 4347 Hazel Ave., 80.02; Jean B. Balcomb, 5208 Lyon St., 78.23; Michael English, 3951 West Harvard St., 76.27; Abraham M. Milner, 649 East 37th St., 74.40; Michael E. Murray, 120 North Park Ave., 73.49; Walter G. Leininger, 125 South Prairie Ave., 73.10; Thomas F. McGrath, 110 South Hamlin Ave., 72.62; William J. Higgins, 1633 Francisco St., 72.52; Edward D. Very, Brooklyn, N. Y., 71.56; Daniel W. Maher, 5001 Greenwood Ave., 71.16. Mr. Fetherston is 35 years old, and was graduated from the University of New York in 1897, with a degree of civil engineer. At present he is Superintendent of Street Cleaning for the borough of Richmond. He installed the English method of garbage reduction in Brooklyn and under Col. Waring made a thorough study of European methods of street care. The position carries a salary of $5,500 per year

Catalogs Worth Having.

Engineers and contractors should have on file the latest catalogs of machines, tools and supplies that they use. In sending for catalogs reviewed or advertised in this paper, you will confer a favor on us if you will write directly to the advertisers and state that you saw the catalog mentioned in ENGINEERING-CONTRACTING. If you are in the market for tools, machinery or supplies, tell us and we will notify promptly the leading manufacturers.

Steam Specialties.—Cloth, 6x9 ins., 186 pp Albert Schade Co., Philadelphia, Pa.
This is a very complete catalog describing all of the appliances and tools required by steam users, plumbers and stationary engineers.

The Use of Meters. — Pittsburg Meter Co., East Pittsburg, Pa.
This company sends in a number of circulars giving statistics of water consumption and reports from a number of cities where meters have been installed.

Hauling Machinery.—Paper, 8½x11½ ins., 64 pp. The Avery Co., Peoria, Ill.
This is a very complete catalog for the use of contractors and other men using traction engines. Special attachments for the Avery Double Mounted engine consist of steam cranes and rollers, so that the engine may be used as a scraper-excavator, as a hoisting engine and as a road roller, as well as being used for hauling trains of wagons.

Road Machinery Catalog.—Paper, 4x9 ins., 44 pp. Petrolithic Pavement Co., Los Angeles, Cal.
This catalog describes machinery for roughing the surface of roads and also describes the petrolithic rolling tamper and a machine for oiling roads. It also contains specifications for petrolithic macadam roads as constructed in Los Angeles, Cal., with tables giving quantities of oil and broken stone for roads of different widths.

Special Hauling Machinery.—Paper, 9x12 ins., 36 pp. Buffalo Pitts Co., Buffalo, N. Y.
The use of road engines to haul trains of wagons is becoming common. This catalog contains a description of the Buffalo road engine for such purposes and gives dimensions of wagons used in connection with these engines; illustrated with views from many parts of the United States.

Office and Field Instruments.—Cloth, 6x9 ins., 543 pp. Keuffel & Esser Co., 111 E. Madison St., Chicago, Ill.
This is the thirty-third edition of the catalog of this firm now so well known to draftsmen, surveyors and engineers that it hardly requires a special notice. Every tool, instrument or article required in the office or field by the engineering profession is here illustrated and priced Two new slide rules are illustrated.

Boiler Tests.—Heine Safety Boiler Co., New York City.
This firm sends in a number of pamphlets containing records of tests made on boilers of the Heine type.

Water Filters.—The Moore & White Co., Philadelphia, Pa.
This circular describes the Fullner Filter for removing suspended matter from water, used especially in paper mills.

Wood Pipe.—National Wood Pipe Co., San Francisco, Cal.
This circular is an envelope size folder describing the manufacture of continuous woodstave pipe to be used in city water works, irrigation systems, power plants, etc.

Contractors' Machinery.—Paper, 5x8 ins., 56 pp. Cropp Concrete Machinery Co., 84 LaSalle St., Chicago, Ill.
This catalog describes the Cropp concrete mixer and a line of engines, boilers, hoisting engines and rock crushers.

Metal Cutting and Welding.—Paper; 6x9 ins., 24 pp. The American Oxhydric Co., Milwaukee, Wis.
The oxy-hydrogen process of cutting iron and other metals is coming into use generally by contractors and this catalog gives about all the information a contractor needs to enable him to cut and weld metals by this process.

Contract News Section

of

ENGINEERING-CONTRACTING

A Consolidation of ENGINEERING-CONTRACTING—CONTRACT NEWS—ENGINEERING WORLD—THE DIRT MOVER.

Containing Items of Interest to Railroad, Public Works and Other Contractors.

The Doings of the Week.

Several large contracts on the New York State Barge Canal were awarded the last of the year. The largest of these contracts called for the construction of a little over seven miles of canal west of Rome, the work being secured by Scott Bros., Baldwinsville, N. Y., at $1,748,679.——The Elmore & Hamilton Contracting Co., Albany, N. Y., was on Dec. 24 awarded the contract for constructing the Grassy Sprain cut and cover, Platt Ave. siphons and portions of the Ardsley cut and cover for the Board of Water Supply of New York city.——One of the largest railroad contracts of the week was secured by the James McGraw Co., Philadelphia, Pa. This contract calls for the construction of the new Pennsylvania line through Bristol, Pa., and involves a considerable amount of grading and concrete masonry. Another large railroad contract was secured by the Miller Construction Co. of Lock Haven, Pa. This contract calls for nine miles of double track, grade and line revision between Newton, Pa., and Mt. Jewett, Pa., for the Buffalo, Rochester & Pittsburg Ry. The work will cost about $800,000. Still another good sized railroad construction contract was received by Willett & Burr, San Francico. This contract calls for the extension of the Northwestern Pacific R. R. from Willitts to Shirley, and the work includes grading, tunnelling and masonry.——One of the largest ditch contracts of the week was secured by G. A. McWilliams, Walnut, Ill. This contract was for the construction of the Knox ditch in Fremont County, Ia., and calls for about 807,600 cu. yds. of dredge work.——A large levee and ditch job is to be let at Carrollton, Ill., on Jan. 20 by the Eldred Drainage and Levee District, the work calling for the construction of a levee containing 1,492,759 cu. yds. and a drainage ditch requiring 192,730 cu. yds. of excavation.——The Kenefick-Quigley-Russell Construction Co. of Denver, Colo., and Kansas City, Mo., has been awarded an additional contract by the Denver Reservoir Irrigation (Standley) Co. for the construction of a large canal from Barr lake to a point 18 miles east of Hudson. The canal will be an enlargement and extension of the Neres canal, branching from it at Hudson, and will cost $500,000.——It is strongly believed in Denver and Salt Lake City that the Denver, Northwestern & Pacific Ry. (Moffatt line) is to be built to Salt Lake City this year. At present the road is completed for several miles beyond Steamboat Springs, Colo.——The El Paso & Southwestern system has announced that there is no work contemplated on an extension of its lines to the A., T. & S. F. Ry. in New Mexico.——The rumored intention of the Baltimore & Ohio to construct a third track between Pittsburg, Pa., and New Castle, Pa., seems also to have originated from shanty house talk, for we are advised that nothing is to be done in that locality.——The Canadian Northern Ry. has taken over the charter and interests of the Victoria & Barclay Sound Ry. Co. of Victoria, B. C., thus greatly expediting preliminary arrangements for the construction of the Vancouver Island portion of the C. N.

Some Early Railroad Records.

The present day methods of railroad construction are a great advance over the methods of the early days. And yet those old time contractors were no slouches in stringing rails across a continent, as witness the records made on the Canadian Pacific Ry. by D. C. Shepherd in the early '80s. Mr. Shepherd, by the way, is still living, and in a few days will be 82 years old. He retired from contracting work in 1894. His history may be said to be the history of railroad building in the northwest for that period, for in the 24 years of his activity as a contractor, the company of which he was a member, built 6,666 miles of railroad in that section of the country. Another distinction of which Mr. Shepherd is rather proud is that of being the builder of the first railroad in Minnesota. He came to St. Paul in 1857, when that city was a village and Minnesota itself a territory, and in that same year made a survey for a railway from Stillwater by way of St. Paul and Minneapolis to Breckenridge and from Minneapolis up to the old Indian trading post of Crow Wing. In the spring of 1858 with two other men he drove out to break the ground for this railroad. The dedication ceremonies were simple, consisting merely of turning over a shovelful of dirt and breaking the top of a bottle of champagne. The ceremonies took place at a point just south of what is now Calvary cemetery, on the Como line, at St. Paul, at a spot where the old kind of wheelbarrow grading could be done. This railroad was not actually completed for many years, part of it never. In 1863 Mr. Shepherd became chief engineer for the Minnesota Central Ry. Co., which was then running lines into southern Minnesota and Iowa. He remained with the company until the spring of 1870, when he became a member of the Northwestern Construction Co., and his active life as a contractor began and continued uninterruptedly until he retired in 1894. In the period from 1870 to 1894 the firm of which Mr. Shepherd was a member built 7,026 miles of railroad. In 1882 his crews working on the Canadian Pacific built 675 miles of line in 15 months; in one day the crew covered 6 miles and 600 ft. Five years later Mr. Shepherd bettered this record, constructing 8 miles and 60 ft. of track in one day during the daylight hours. It is stated that an additional half mile of track would have been laid that day had not the cars used in hauling rails broken down. This record was made on the Great Northern system between Minot and Helena. The trackage between Minot and Helena of 643 miles was constructed in 7½ months. For a distance of 200 miles, from Milk River to Grant Falls, the grading progressed at the rate of seven miles a day. On this work the average force employed was 8,000 men and 6,600 horses on the grading and 650 men and 450 horses on the track laying, surfacing and timber work. The men were housed and boarded in 3-story box cars, built for the purpose, and so high that they had to be guyed with ropes during high winds to prevent their toppling over. How well the work was done is shown by the fact that the first trains over the line made the run at an average speed of 30 miles per hour, and reached a speed of 50 miles per hour part of the way. In April, 1887, Shepherd's firm became the contractor for the extension of the Great Northern system to the Pacific coast, and from that time until the close of 1893 did much work for that railway. In 1894 Mr. Shepherd retired at the age of 66.

A One-Man Railroad.

Hodgeman County, Kas., is to have a one-man railroad if truthful press reports are to be believed. It seems that about two years ago a man named Myers arrived in Jetmore, Kas., with four mules, a wagon and an ordinary scraper. He immediately announced his intention of building a railroad from Jetmore to Garden City, and began seeking leases and right of way He asked no bonuses, sought no free right of way, or offered no stock for sale, but quietly went on securing the necessary land. He is already said to have purchased four miles of right of way, paying $40 an acre, and has also leased other land for the right of way. The distance between Jetmore and Garden City is 54 miles, and Myers set about building all of this line himself. With his four mules and the scraper he began constructing the road bed and is now said to have over 1½ miles of it graded and surfaced ready for ties and rails. All that his neighbors have been able to worm out of him is that he is building the line as he can in the belief that some time a big railroad will come along and buy his right of way and grades. He wants to get the grade started and is purchasing and leasing right of way as he goes along. It should be added that he expects to find a purchaser before the line is finished.

Confirmed Reports by Engineers and Contractors

RAILROADS, POWER DEVELOPMENTS, LEVEES, DRAINAGE AND IRRIGATION WORKS.

Railroads—Steam and Electric.

CALIFORNIA.

We are advised that the Sacramento & Sierra Ry. is at present doing some grading by day labor, but has no present intention of letting any contract soon. J. M. Graham, 5th and K Sts., Sacramento, Cal., is chief engineer.

Willett & Burr, 133 First St., San Francisco, have secured the contract for the construction of that portion of the Northwestern Pacific Ry. 10 miles northerly from Willits and about 16 miles southerly from Shiverly, leaving a gap of about 90 miles. Considerable of the work has been sublet, such as could be economically worked until the late spring. The country through which this road traverses is one where even for a wet country the rainfall is excessive. According to one rain gage during the preceding rainy season, which is about from the first of October to the last of April, 106 ins. of rain fell. Willett & Burr have sublet on the southerly end, or what is known northerly from Willits, portions of the work to Clark & Welles, the Damascus Railroad & Contracting Co., Graham, Nicholson & Arnold Co., and the Van Hees Contracting Co. On the northerly end it is more than likely that Willett & Burr will perform all of the work themselves. The work includes five tunnels, all in rock, and they will aggregate about 4,500 ft. There are about 16 bridges, one 65 ft. in height and one 45 ft., the others running from 25 to 30 ft. in height, all to be of steel or concrete piers with concrete abutments. There will be about a dozen ballasted trestles. The amount of masonry has not been definitely settled, and as the country through which the road traverses is a deep, narrow ravine, with high, precipitous sides, the amount of yardage to be removed will depend on how the slopes stand. It is hoped to finish this work by the latter part of next fall.

ILLINOIS.

The Springfield & Jacksonville Interurban Ry. Co. has completed surveys for the first 33-mile section of its projected 102-mile line and contracts for this section have been let. O. J. Lucas, Latham, Ill., is president and T. S. Davy, Springfield, Ill., is chief engineer.

IOWA.

The Atlantic Northern & Southern Ry. Co. has raised 50 per cent of the actual cost of the road in the cities along the route. The company now wants to exchange first mortgage bonds for material, grading, etc., for the balance. H. S. Rattenborg, Atlantic, Ia., is president.

KANSAS.

The Central Kansas Interurban Ry. Co., recently organized at Abilene, Kan., projects the construction of an 80 mile line, passing through Newton, Canton, Roxberry, Gypsum City, Abilene and Salina. O. Moorshead, Newton, Kan., is chief engineer, John C. Nicholson, Newton, Kan., is president and C. B. Kirtland, Salina, Kan., is treasurer.

The Kansas City, Lawrence & Topeka Ry. has completed surveys for its projected 55-mile electric railway. The capital for the construction of the line has not been secured as yet and date for awarding contracts has not been decided upon. The line is to extend from Monrovia to Lawrence, Kan., passing through De Soto and Eudora, Kan. James G. Hughes is chief engineer, and Willard E. Winner, 424 Realto Bldg., St. Louis, Mo., is president.

MISSOURI.

The Mexico, Santa Fe & Perry Traction Co. has completed surveys for the construction of its 100 mile line from Mexico, Mo., to Fulton, Mo., and Columbia and from Mexico via Perry to Hannibal. The contract has been let to Burns & Co., 705 Isabella Bldg., Chicago, Ill. M. Crum, Mexico, Mo., is president of the traction company.

NEBRASKA.

The Nebraska Traction & Power Co. has awarded a general contract to the General Construction Co., Omaha, Neb., for constructing a 3½-mile extension from its present terminal at Ralston. The General Construction Co. will sublet the grading and bridging. The extension is to be built partly over private right of way and partly over highways. B. H. Oliver, Box 1057, Omaha, Neb., is chief engineer, and Mel Uhl, 17th and Jackson Sts., Omaha, Neb., is president.

NEW YORK.

The Rockland R. R. has completed surveys and has secured the capital for the construction of its projected 50-mile electric railway. Construction contracts are to be let within three months. The road is to extend from Englewood, N. J., through Nyack to Haverstraw, N. Y., and is to have a branch to Suffern, N. Y. B. A. Hegeman, Jr., 165 Broadway, New York, is president, and W. H. Coverdale & Co., 66 Broadway, New York, are the engineers.

NORTH CAROLINA.

The North Carolina Traction Co. has completed surveys for its projected 80 miles line and will let contracts within two months. The road is to extend from Winston-Salem, N. C., to Stuart, Va., and its construction will involve the erection of three bridges—one 100 ft. long and two 80 ft. long. E. Hillman, Aberdeen, N. C., is president and Dr. H. P. MacKnight, South Paris, N. C., is chief engineer.

OHIO.

The Cincinnati, Portsmouth, Pomeroy & Pittsburg Traction Co. has partially completed surveys for its projected electric line. Capital for the construction has been secured and contracts will be let in the early spring. The projected length of this road is 438 miles and it is to extend from Cincinnati, O., to Pittsburg, Pa., the route being along the Ohio River. A. E. Cox, Huntington, W. Va., is president, and C. Parsons Sanborn, Huntington, W. Va., is chief engineer. A. M. Frick, Portsmouth, O., is also interested.

OREGON.

We are advised that the Oregon Electric Ry. Co. has not as yet made any definite plans for future extensions. It was reported that the company plans to build about 50 miles of track work this year. G. W. Talbot, Portland, Ore., is vice president and general manager.

The Oregon Eastern Ry. has completed surveys for its projected 287 mile line from Vale, Malheur County, Oregon, to Odell, Klamath County, Oregon. The capital for the construction of the line has not been secured as yet and date for awarding contracts is indefinite. This is an Oregon Short Line project. C. G. Sutherland, Portland, Ore., is president and Geo. W. Boschke, Portland, Ore., is chief engineer.

PENNSYLVANIA.

The Buffalo, Rochester & Pittsburg Ry., E. F. Robinson, chief engineer, Rochester, N. Y., will soon commence the construction of a storage reservoir, with earth fill dam and concrete core wall, on Kyle Run, near Du Bois, Pa., for the purpose of furnishing the Du Bois terminal with a continuous gravity supply of pure boiler water. The dam will be 35 ft. in height, 1,000 ft. in length, and the reservoir will have a capacity of 500,000,000 gals. The feed line will be 12-in. cast iron pipe, four miles in length. The railroad has just completed a similar reservoir, with a capacity of 100,000,000 gals., for supplying the engine terminal at Punxsutawney, Pa., with pure boiler water.

The Buffalo, Rochester & Pittsburg Ry., E. F. Robinson, chief engineer, Rochester, N. Y., has closed a contract with the Miller Construction Co., of Lock Haven, Pa., covering grading for nine miles of double track, grade and line revision between Newton, Pa., and Mt. Jewett, Pa. This improvement involves very heavy work, costing approximately $800,000.00, and will eliminate the last link of single track in the main line between Ashford, N. Y., and Punxsutawney, Pa.

The James McGraw Construction Co., Arcade Bldg., Philadelphia, has been awarded the contract for the new Pennsylvania R. R. line through Bristol, Pa. As stated in our last issue the work will include nine bridges to be built over streets and public roads, one bridge to be built over the Pennsylvania Canal, and three over streams. To do this will require the grading of 550,000 cu. yds. of earth, the building of 5,000 cu. yds. of arch masonry, and 12,000 cu. yds. of bridge masonry. All the bridges will be built of concrete and they will be reinforced over all streets to provide solid floors for tracks.

WASHINGTON.

The Mount Adams Electric R. R. Co. has partly completed its preliminary surveys for its projected 60 mile line via White Salmon, Snowden and Glenwood, Wash., and possibly may let contracts by May 1. C. L. Colburn, White Salmon, Wash., is acting president and H. S. Hall, White Salmon, is engineer in charge.

WISCONSIN.

At a mass meeting of farmers and business men held Dec. 29 at Prairie Farm, Wis., a corporation was organized for the purpose of constructing and operating a railroad from Prairie Farm, Wis., to a point on the Chicago division of the Soo between Downing, Dunn County, Wis., and Emerald, St. Croix County, Wis. In less than one hour $25,000 was subscribed. The directors chosen for the ensuing years are G. E. Scott, W. A. Reque, J. DeWilde, J. M. Rassbach, R. A. Cleveland, C. B. Thatcher and A. A. Hovda. The officers elected are as follows: G. E. Scott, Prairie Farm, president; C. B. Thatcher, vice president; J. DeWilde, secretary and treasurer.

Power Developments, Levees, Drainage and Irrigation Works.

COLORADO.

Bids are asked by the Holbrook Irrigation District, J. E. Lewis, secretary, La Junta, Colo., until 11 a. m., Jan. 10, for building dam, outlet ditch and all structures to fully complete Reservoir No. 1 of the district. Bids are also asked for building dam, outlet tunnel or conduit, outlet gates and outlet ditch to the

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Arkansas River, as well as all structures necessary to fully complete the Dye Reservoir. Plans, etc., are on file at the office of J. E. Lewis, at La Junta. The official advertisement for this work will be found elsewhere in this issue.

ILLINOIS.

The commissioners of the Eldred Drainage and Levee District will receive bids until 2 p. m., Jan. 20, at Carrollton, Ill., for the construction of a levee containing 1,492,759 cu. yds., a muck ditch requiring 42,220 cu. yds. excavation and a drainage ditch requiring 192,730 cu. yds. excavation. The work is divided into nine sections and bids will be considered upon each section or collectively. The Harman Engineering Co., Peoria, Ill., is the engineer. Plans, etc., are on file at the office of the county clerk at Carrollton, at the office of the Harman Engineering Co. and at the office of Boyle, Mott & Haight, 218 La Salle St., Chicago, Ill. The official advertisement will be found elsewhere in this issue.

IOWA.

G. A. McWilliams, Walnut, Ill., has been awarded the contract for constructing the Knox Ditch, near Hamburg, Fremont County, Ia., for the Knox Drainage District. The contract price was 5.89 cts. per cu. yd. and the work includes the cutting of a new ditch about 12 miles long with a bottom width of 34 and 40 ft. The estimated amount of excavation is 807,600 cu. yds. Above is dredge work; bids for it were opened Dec. 30.

NEW YORK.

Henry Du Bois' Sons Co., 17 State St., New York city, was the low bidder Dec. 30, at 13¾ cts. per cu. yd., for dredging in the North River for the borough of Manhattan. The work includes dredging about 200,000 cu. yds. mud, etc.

The Board of Water Supply of New York city on Dec. 24 awarded Contract 53 for the construction of Grassy Sprain cut and cover, Platt Ave. siphon and portions of Ardsley cut and cover, bids for which were opened on Dec. 16, to the Elmore & Hamilton Contracting Co., Tweddle Bldg., Albany, N. Y.

The State Superintendent of Public Works, Albany, N. Y., has awarded the following barge canal contracts, bids for which were opened Dec. 28: Contract 33, for constructing lock gates, needle beams, guard and sluice gates at various points on the new canal, Penn Bridge Co., Beaver Falls, Pa., $199,640; contract 44, for constructing a little over seven miles of canal just west of Rome, Scott Bros., Baldwinsville, N. Y., $1,748,679; contract 70, for dredging the channel of the Hudson river from Waterford northerly, a distance of 3½ miles, Shanley-Morrissey, Inc., 527 Fifth Ave. New York city, $779,636.

TEXAS.

The Beaumont Navigation District has voted $498,000 in bonds and the bonds have been approved by the attorney general for the purpose of opening the Sabine-Neches channel to a depth of 25 ft. These bonds have not yet been sold, it being the present intention of the commissioners to await an additional appropriation from the present congress. It is therefore not likely that any contract will be attempted until probably August or September. Jas. F. Weed, Beaumont, Tex., is the engineer.

The town council of Piedmont, W. Va., has voted to extend the franchise granted to the Potomac Valley Ry. The company laid a short piece of track about a year ago in the town.

The Ponemale Co., manufacturer of cotton goods, of Norwich, Conn., has begun work on the reservoir which it is to build at Taftville. The dam will have a length of 300 ft. and a height of 34 ft., with a core of concrete, and the reservoir will have a storage capacity of 50,000,000 gallons.

A route is being laid out for the projected line of the Hudson, Center & New Salem Electric Ry. The proposed line is to parallel at some distance the extension the Northern Pacific is building north from Mandan, N. D. It is planned to build a large power house at Center, N. D., and make the place a division point.

Surveys have been started for the Clarksdale & Mississippi River R. R., which projects a line from Clarksville, Miss., to Friars Point. The necessary capital for building the road has been secured. H. T. Adams, Memphis, Tenn., is chief engineer.

Plans are stated to have been decided upon by the Pennsylvania R. R. for a new branch line to extend from Newark to Harrison, N. J. It is said that the tracks from Harrison to Jersey City will be electrified, and direct track connection made with the Hudson and Manhattan railroad in Jersey City. The construction and electrification of this new line will provide a new electric train service from Newark into Jersey City and a direct route into the Church and Courtlandt St. (New York) terminals of the Hudson & Manhattan R. R.

A resolution has been before the city council of Phœnix, Ariz., instructing the city attorney to take steps toward obtaining permission from Congress for the city to bond itself for $300,000 for the construction of a municipal lighting plant.

The city council of Paris, Ky., has granted a 20 year franchise to the Paris & Cynthiana interurban electric railroad for building and operating an electric line between these points. Work is to begin immediately, it is said.

The National Railways of Mexico, James M. Reid, chief engineer, city of Mexico, has awarded the contract for the Pasedon cut off to E. M. Griffith. The cut off will be six kilometers in length and is built primarily to reduce operating expenses, affording a short haul from the coal fields tributary to the Mexican International to Monterey and thence to Saltillo and Mexico.

Provision has been made by Col. Lansing H. Beach, U. S. engineer, New Orleans, La., to lease a dredge boat to replace the one which burned last June, and work will be rushed vigorously in carrying on the dredging in connection with the work of digging the intercoastal canal. Thus far nearly all the digging has been done in Louisiana, under the personal direction of Colonel Beach, who has been assisted by Lieutenant R. R. Ralstow. With regard to the progress made in Louisiana in the digging of the intercoastal canal, it is reported that five miles have already been cut through from the western end of Vermillion bay to Schooner bayou. The engineers are now at work digging through the marsh. Thus far they have dug about 1,500 ft. through the marsh and will continue to dig until White lake is reached. The engineers are now preparing to take up the digging in another section; that is, beginning at Grand lake and working east to Vermillion bay, the connecting point. It is expected that the new dip dredge now being built at Mermentau will be ready for use by the first of the year.

The National Government of Mexico is stated to have plans in preparation for harbor improvements at Tuxpam, Mexico, including deepening of the entrance at the bar and the building of new wharf and warehouse. This work is to begin early in 1910.

Andy Scott, of Douglas, Ariz., is working an outfit near Sasco, Ariz., on work for the Santa Cruz Reservoir Co. This company has built more than 200 miles of irrigating canals and laterals have been run throughout the immense acreage acquired by the company and many more miles of such canals will be laid before the work is completed. The reservoir, when completed, will have a capacity of 190,000 cu. ft.

The Atlantic Coast Line Ry. Co. has decided to construct a line from Wadesboro to Charlotte, N. C., and surveys are to be started at once. E. B. Pleasants, Wilmington, N. C., is chief engineer of the company.

The Atlantic City Co. has been incorporated in Delaware with a capital stock of $6,000,000 to manufacture and deal in gas and electricity. It is believed in Atlantic City, N. J., that the incorporators of the company are Clarence Giest and other Philadelphians who recently purchased and merged the Atlantic City Water Co. and the Consumers' Gas & Fuel Co. of Atlantic City.

Advices from Missoula, Mont., state that C. F. Allen, district engineer of the Blackfoot Ry. Co., has a large force of men at work clearing the right of way so that grading and rock blasting can be started at once. The contract for constructing two bridges over the Blackfoot River for the railway has been let to O. E. Peppard, Missoula, Mont.

The Mexican government has agreed to spend $6,000,000 and a Mexican capitalist $4,000,000 on irrigation projects in northern Mexico along the line of the International road. Millions of acres there will be transferred into truck beds.

The Vera Cruz & Isthmus R. R., Thos. Milan president, Vera Cruz, V. C., Mexico, is stated to have let the contract for the construction of a branch line from Tierra Blanca to San Andres Tuxta, a distance of about 60 miles. The route is through a rich agricultural section of southeastern Mexico.

The Vancouver Island Power Co., Ltd., of Vancouver, B. C., has applied for permission to build a dam and storage reservoir on Bear Creek and Alligator Creek, tributaries to the Jordan River.

Davis, Marshall & Macneill, attorneys, Victoria, B. C., have applied for incorporation for a company to build a proposed line commencing near where the Salmon River crosses the international boundary line between British Columbia and Alaska, thence following the Salmon River to its source.

Items Concerning Contractors and Their Work

RAILROADS, POWER DEVELOPMENTS, LEVEES, DRAINAGE AND IRRIGATION WORKS.

Alabama Notes.

FROM CORRESPONDENTS AND OTHER SOURCES.

Land agents of the Southern Ry. are reported to be securing a right of way between Birmingham and Parrish, Walker county, for a new line that will be constructed within the next six months. The purpose of the new line is to facilitate business between the coal fields to Birmingham, and to ultimately supplant the roadway which is now arranged over the line of the Western Alabama.

The Birmingham Railway, Light & Power Co. of Birmingham, which is now laying its tracks on 19th St. at Bessemer, is said to have asked the city council of that city for a franchise to run a car line on 20th St. from 1st Ave. to 4th Ave.

Arkansas Notes.

FROM CORRESPONDENTS AND OTHER SOURCES.

The Fort Smith & Van Buren Interurban Light & Traction Co. has been organized at Van Buren with a capital stock of $100,000 and proposes to build a traction line through Crawford, Franklin, Johnson, Madison, Newton, Boone and Searcy counties. T. A. Bayley, C. E., is one of the principal promoters of the company and has already made the preliminary surveys from Van Buren to Mulberry. He has secured seven miles of the right of way, beginning at the eastern limits of Van Buren and he anticipates no trouble in securing the right of way through Crawford County. The officers of the company are as follows: W. F. Keller, president; L. W. Burgett, vice president; T. A. Bayley, secretary; S. A. Pernot, treasurer; and S. R. Chew, attorney. The other incorporators are J. L. Rea, W. F. Blocker of Fort Smith, Frank Woclum, L. F. Sherwood, R. A. Clarkson of Fort Smith, Henry Kibler, J. H. Keller, John Kibler, J. W. Keller and N. E. Waite.

Roach & Stansell, Memphis, Tenn., have been awarded the contract by Maj. M. L. Walker, U. S. Engineers, for building 61,000 cu. yds. of levee near Wilson, Ark., in the St. Francis Basin. This levee will be a very difficult one to build, according to engineers who have gone over the country through which it will go. Before the levee can be started, the land will have to be cleared, which is through a dense swamp. The contractors have one year in which to complete the work.

California Notes.

FROM CORRESPONDENTS AND OTHER SOURCES.

The Los Angeles Ry. Co. of Los Angeles is to construct an extension of the West Adams car line between Arlington and West Adams, the present terminus, and Eleventh Ave. and West Adams St. The extension will be two-thirds of a mile long.

The Southern Pacific Co. has placed an order with the Folsom Rock Co. of Folsom for 200,000 tons of crushed rock to be used for ballast on the Sacramento division.

The Southern Pacific Co. has applied to the city council of Alameda for a franchise for a line running from the High St. bridge across the Cohen property to the new loop right of way. If the company is given this franchise it will be enabled to run electric trains from Melrose and adjacent territory to the Alameda mole, via Lincoln Ave.

The San Jose Railroads Co. has been incorporated with a capital stock of $5,000,000 for the purpose of taking over the First St. railway line in San Jose and operating it in connection with the Santa Clara St. line. The company also proposes to construct other local lines. The men interested are L. E. Hanchett, president; W. R. Lawson, manager, and E. M. Rea, secretary and attorney of the Santa Clara St. line, and F. E. Fitzpatrick, who is associated with John Martin of San Francisco.

The Southern Pacific Ry., W. Hood chief engineer, San Francisco, is planning to relay its track between Bakersfield and Mohave with 90 lb. steel at an approximate cost of $300,000. Another improvement will be the relaying with 90 lb. rails of the Imperial valley branch, a trifle over 40 miles, reballasting, reconstruction of bridges and other improvements, at an expenditure of $450,000.

The Feather River Dredging Co. has been organized at Kingman, Ariz., with offices at Pueblo and Denver, Colo. The company has been incorporated in Arizona with a capital stock of $2,500,000 for the purpose of dredging 24 miles of the channel of the Feather River from Yuba City to a point below Nicolaus. The company will extract the gold contained in the sand and gravel of the river bed and deposit the sand along the banks of the river for levees or for filling the low lands, doing this under an arrangement with the reclamation districts along the river. These operations will remove a large amount of debris that now choke the channel of the river, and will make it navigable, at the same time permanently reclaiming many thousands of acres of agricultural lands. The incorporators are George S. Cowdery, M. R. Carpenter and W. H. Cole. They have filed placer mining claims along the river where they intend to operate. Several suction dredges will be employed in the dredging operations.

E. E. Shafer, Los Angeles, has been awarded the contract for constructing the Newhall tunnel for the county supervisors, the contract price being $63,364. The tunnel arch is to be lined with concrete.

A hearing was held Dec. 28 at the U. S. engineer's office in Los Angeles on the petition of the Pacific Electric Co., for permission to build a bridge across Los Cerritos slough for a line from Long Beach to San Pedro by way of Wilmington.

The Southern Pacific Co. is stated to have awarded the contract for grading for the extension of the 7th St. line at Melrose to San Leandro, via Melrose Heights. It is believed that though the road will be built for electric trains a steam service will first be used until the electrization of the suburban lines is completed.

Final arrangements are reported to have been made for the proposed Fresno-Hanford interurban line and it is believed that actual construction work will be started early this month. The project has been promoted by F. S. Granger of Fresno as previously noted in this paper. W. G. Luce, Chicago, Ill., is reported to be interested.

Surveyors for the Southern Pacific Co. have established headquarters at Redding, and have begun surveys for the Pit River branch of the Goose Lake Southern. This road is to connect Alturas, Klamath Falls and other points in the Pit River territory with Redding or some other point on the main line in Shasta County.

It is believed here in San Bernardino that the Western Pacific Ry. is planning to begin construction work on its line through San Bernardino. It is said that the contract for the work has already been let to the Western Construction Co., of Los Angeles.

Work on the Sacramento-Sierra R. R., now building a line from Sacramento to Lake Tahoe by way of Georgetown, is to be continued all the winter. Work has been stopped temporarily in the adobe soil in the valley lands, because it is impossible to work in that kind of soil in winter. In districts where the soil is such that it can be worked no stop will be made. In some of the hilly districts much more progress can be made in winter than in summer because the soil can be more easily handled when it is wet. Large forces of men have been at work clearing the right of way above Orangevale Bluffs, where grading will begin in January.

Work has been started at Walnut Creek near Oakland on the new electric railway in Contra Costa County in order to hold the franchise. It is stated, however, that more men will be put at work shortly and the line finished within a year or so. The line is ultimately to connect Oakland with Walnut Creek, Martinez, Antioch, all the towns and villages of the San Ramon valley and the growing electric system of the San Joaquin country. The first section of the road that will be built will be that connecting Oakland, through the tunnel under the range in the Claremont district with the Walnut Creek section. A. W. Maltby and R. L. Napthali have the franchise.

Grant Bros. Construction Co., Trust Bldg., Los Angeles, Cal., has been awarded the contract for grading the line of the Phoenix & Eastern R. R. from Winkelman to San Carlos, Ariz. The work includes the boring of two 1,800-ft. tunnels through solid rock which will require about one year's time.

Construction work will probably be started this month on an extension of the Holton Interuban R. R. from El Centro westerly to New River. It is believed that this extension will form the valley end of the San Diego and Arizona railroad, now building from San Diego. This road is not expected to get into Imperial Valley for eight months or a year, and in the meantime it is the general supposition that the extensions now planned from El Centro will be operated as a portion of the railroad controlled by the W. F. Holt interests.

The Southern California Edison Co. has filed with the county clerk at San Bernardino a $30,000,000 trust deed, which represents a general mortgage on all the company's property in California secured by 5 per cent 30-year gold bonds dated November 1, 1909. The company is to use the money to carry out extensive improvements.

The Southern Pacific has made plans for the extensive improvement to its railroad property at El Centro.

William Williamson, a subcontractor on the Parker cut off, who shot and killed Dan O'Donnell, has been acquitted as far as the coroner's jury is concerned. The jury which investigated the shooting found that William son had shot in self defense.

Colorado Notes.

FROM CORRESPONDENTS AND OTHER SOURCES.

The recent inspection of the Denver, North western & Pacific Ry. by J. B. Berry, chief engineer of the Rock Island, has given rise to the report in this city that the latter road has furnished the necessary financial backing so that the D., N. & P. Ry. can be built to Salt Lake City next year. It is said that the line will be built over the original survey entering Salt Lake City by way of Provo. It is further said that construction work will be started early in the spring. The Denver, Northwestern & Pacific is now completed to a point several miles beyond Steamboat Springs, Colo. The route is over exceedingly rough country, making the cost of construction much more than it was at first estimated. The survey for the road runs in a line almost directly west from Denver to Provo, Utah. The line goes over the mountains where possible, but the higher points are crossed by means of tunnels. H. A. Sumner, Denver, Colo., is chief engineer.

The Kiowa Reservoir & Irrigation Co. has sold a bond issue of $801,000 and is said to be planning to have work started in the spring on its irrigation project, covering 20,000 acres in Kiowa and Arapahoe counties. The land in the project lies south and east of Denver, and will be irrigated by three large reservoirs, to

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contain a total of 51,074.8 acre feet. Senator C. D. Griffith, Lee S. Reynolds, H. S. Covey, Arthur Keenan and E. W. Jackson are the promoters. E. W. Jackson, Chicago, Ill., is the engineer.

The Silverton Northern R. R., which operates a 15-mile line in Colorado, is making surveys for an extension from Animas forks to Mineral point, about four miles. J. P. Pitcher, Jr., Silverton, Colo., is general manager.

The Nevada United Mines Co., Denver, Colo., has completed plans for building 18 miles of railroad to connect its mine at Ward, Nev., with the Nevada Northern R. R., near Ely, Nev.

The stockholders of the Juana Justo Power & Electric Co., at a meeting at Colorado Springs, took action on increasing the capital stock from $3,000,000 to $5,000,000. The company plans extensive additions to its equipment and big development work for the new year. Leonard E. Curtis and Henry Hine of the Central Colorado Power Co. are leading stockholders of the company, which has large holdings at Guana Juato, Mexico.

According to reports from Grand Junction the Denver & Rio Grande railroad is making a survey from Cisco into the Paradox country. The route taken by the surveyors is directly southeast from Cisco to the Rio Dolores River and then follows the river to Hydraulic and on to Bedrock. From that point the proposed line is to extend to Naturia and Norwood and connect with the Rio Grande Southern at Placerville. It is said that this route offers a 1 per cent grade into the Paradox valley, as against a 3 per cent grade by the way of Unaweep. The plan of the Rio Grande, it is said, is to run a direct train connection between Grand Junction and the Paradox, the trains leaving the main line near Cisco. The survey has been pushed to the Dolores River and will go on as fast as possible.

Dr. J. A. Lewis, former mayor of Manitou, has filed on all unappropriated water rights on West Sutherland creek, a mile and a half west of Colorado City, and with associates has started preliminary work on three reservoirs capable of developing 15,000 hp. They will invest $125,000 and plan to eventually furnish Colorado City with water and power.

J. C. Ford, of Lamar, has a subcontract on the Two-Buttes Canal work, his contract being mostly rock work.

Dr. Newton N. Brumbach, of Colorado Springs, president of the Manitou Incline Ry. Co., has completed the purchase of a tract of 160 acres, adjoining the forest reserve on Pike's peak, in order to perfect the title to his right-of-way. The consideration was $3,000.

The Colorado Railway, Light & Power Co. has filed articles of incorporation with the county clerk at Pueblo. The company will operate in Denver, Huerfano, Las Anamas, Fremont and Pueblo counties and has a capitalization of $5,000,000. The new company is the successor to the Southern Power Co., which will go out of existence this month. It will take over the power plant at Trinidad and will enlarge it.

The Whedbee St. extension of the Fort Collins electric line was put in operation on Dec. 23. The line is a mile in length, running from the center of the city to the limits on the southeast. The Denver & Interurban, a company controlled by the Colorado & Southern, now has seven miles of line in operation at Fort Collins.

P. J. Franklin of Colorado Springs will shortly have construction work started on an irrigation system to water 23,000 acres of land in the Santa Fe valley, 12 miles west of Santa Fe, N. M. The company in which Mr. Franklin is interested secured control of 3,200 acres and the remaining tract adjoins. The main canal of the irrigation will carry water from the Santa Fe River and several laterals have been completed.

The Guanajuato Power & Electric Co., Giddings Bldg., Colorado Springs, Colo., has ratified plans involving the expenditure of something over a million dollars. According to Henry Hine, president of the company, the increase in the capital stock from $3,500,000 to $5,000,000 will be used in taking over numerous electric, power and light concerns in Mexico, and in greatly enlarging the present extensive system of the company in the state of Guanajuato.

The plant, franchises, etc., of the Southern Colorado Light & Power Co., has been sold to the Northern Securities Co. of Denver for the Colorado Light & Power Co. for $50,000. The new company is financed by Brown Bros. of New York and they plan improving the plant to supply power to many mines in southern Colorado and northern New Mexico. It is planned to increase the capacity from 1,500 to 15,000 hp.

Idaho Notes.

FROM CORRESPONDENTS AND OTHER SOURCES.

The engineers of the Northern Pacific Ry., who have been at work on the Missoula cutoff, are now said to be concentrating their work on the survey of a tunnel at Kooskia. The tunnel will pierce the hill near Kooskia and afford a more convenient entrance from the middle fork to the main stream at the junction. It is reported that the cutoff survey will be abandoned and a three mile tunnel driven, which will reduce the elevation of the summit climb 500 ft. at the divide.

The Pacific & Idaho Northern Ry. is said to be making good progress with its plans for extending its line from Evergreen to the heavy timber belt. E. M. Heigho, Weiser, Idaho, is general manager.

Grading work on the Aberdeen-Moreland branch of the Oregon Short Line R. R. in Idaho has been completed and eight miles of street have been laid. The branch, which will be 29 miles long, leaves the Mackay branch at Moreland, about 9 miles from Blackfoot. The line will end at Aberdeen, but it is believed that in the spring surveys will be made west from that town to Minidoka.

The Northwestern Lumber Co. has completed surveys for its projected 12 mile line from Vollmer, Idaho, to Forest, Idaho, and is planning to commence construction work in the spring. Ties and bridge timber are to be cut this winter. The maximum grade according to the survey of W. P. Wood, chief engineer, is 1½ per cent.

The Boise Valley Electric Ry. of Boise is planning to begin active construction work in the spring on the loop connecting the South Basin and Morris Hill cemetary branches. Robert Noble is president.

The Northern Pacific engineers have completed the revision work on the survey from Kooskia to the summit of the Bitter Root mountains and the last of the parties returned to Kooskia Dec. 20. During the past 10 months the Northern Pacific has maintained an average force of 200 men on the survey between Kooskia and Lolo Junction and every feature of the engineering work is now in readiness for the contractors. During the past four months the railroad company has expended a large sum of money in the construction of a trail up the middle fork, and with the surveying work practically completed at that time this work can only be construed as being preparations for construction camps. W. L. Darling, St. Paul, Minn., is chief engineer.

The Idaho & Western Ry. Co. has been incorporated at Couer d'Alene as a subsidiary company of the Chicago, Milwaukee & Puget Sound Ry., to construct the latter company's branch from Plumer, Idaho, to Spokane. The principal place of business is Coeur d'Alene and the road will consist of 75 miles, from a point near Plummer to Spokane, with a stub into Coeur d'Alene. Surveys for this road are practically completed and options have been secured through Coeur d'Alene from the "made" ground in front of the Hotel Idaho to the northern limits of the city. The road will run along the west side of the lake to Mica bay, thence through the Coeur d'Alene reservation to Plummer. From Coeur d'Alene the road will follow down the Spokane river, paralleling the electric line. The capital stock, aggregating $3,000,000, is all held by the Chicago, Milwaukee & Puget Sound Railroad Company excepting one share each by J. L. McLear of Coeur d'Alene, E. D. Sewell, H. R. Williams, E. W. Coole and H. H. Fields, all of Seattle.

Advices from Grangeville state that the Hummer Mining & Milling Co., which owns property about 3,000 ft. north of the town of Calendar, has made arrangements for starting work on the claims. Work will shortly begin on a tunnel which is to be driven 3000 ft. and will tap the main ledge at a depth of approximately 1700 ft. Six other ledges will be cut by this tunnel.

Location work for the new Harriman line to connect with the Illinois Central at Sioux City, Ia., has been made 180 miles west of that point, west to Bijou Hills in South Dakota. The line is to be extended to Pocatello, Idaho, where it strikes the Oregon Short Line, and to Idaho Falls. It will be a connecting link which will give the Harriman system a northern through route from Chicago to Seattle; also to Salt Lake City and San Francisco. The new line is through a fertile country, largely devoted to cattle and sheep raising. In many places it will be 150 miles from any other railroad. The location work has been under way for five months and will be rapidly pushed as soon as the engineers find the weather again endurable up there. It is expected that the line will be completed in about two years. Capt. C. J. Dubois, Macon, Mo., is chief locating engineer.

Illinois Notes.

FROM CORRESPONDENTS AND OTHER SOURCES.

The Galesburg & Rock Island Traction Co of Rock Island, which projects a 41-mile interurban line, has filed a mortgage and trust deed for $1,500,000 at Aledo. This gives some color to the report that construction work is to be begun on the line next spring. The line will pass through Knox, Warren, Mercer and Rock Island counties and will touch Alexis, Viola and Preemption, and enter Rock Island over the proposed belt line in that city.

The People's Traction Co. is said to be planning to begin work in the spring on its interurban line from Galva to Galesburg. L. T. Edwards is chief promoter.

John Murphy, Eldorado, Ill., is promoting the construction of an electric railway to connect Marion, Eldorado and New Haven, Ill., with Mt. Vernon, Ind., and Evansville.

Indiana Notes.

FROM CORRESPONDENTS AND OTHER SOURCES.

The Winona Interurban Ry. Co. has just leased the Winona & Warsaw Traction Co.'s line for a term of ninety-nine years the lease taking effect on Jan. 1. The new line, which is operated between Warsaw and Winona, will be used as a separate division.

The Kokomo Western Traction Co. has been incorporated with a capital stock of $10,000 and proposes to maintain a street car line in Kokomo connecting with an interurban line from that city to Young America and to points in Carroll county. O. C. Guard, Young America, is one of the incorporators.

The project to build a traction line from New Castle to Richmond via Hagerstown has been revived. John M. Lontz, a manufacturer of Richmond, and who was one of the promoters of the line between Indianapolis and Richmond, has become interested in the proposed line. It is said that work will begin in the spring. The route has been surveyed several times

The Winona Interurban Co. is rushing its construction work so as to complete its line through from Mentone to Peru by Feb. 1. A large quantity of steel has been received for the line and two additional steam shovels have been placed at work.

The Logansport-South Bend Traction Co. has been granted a franchise at South Bend. The cars will enter that city over the Chicago, South Bend & Northern traction line.

Iowa Notes.

FROM CORRESPONDENTS AND OTHER SOURCES.

The city of Clarinda has voted a 5 per cent tax to aid the projected Iowa & Southwestern Ry. This makes it probable that work on the new road will begin not later than April 1 next and the line from Clarinda through College Springs to Blanchard will be completed and cars running thereon by Dec. 21, 1911.

F. J. Cross, Monticello, Ia., is reported to have been awarded the contract for constructing the Davenport & Manchester Interurban Co.'s line from Manchester to Davenport.

Messrs. Smith and Johnston of the Leon Electric Co. of Leon, Ia., are promoting a project for building an electric railway in that city from the C., B. & Q. depot to the business section of the city and from there to be extended as needed.

The Chicago & Northwestern Ry. is planning a number of improvements at Belle Plaine for this spring. The proposed improvements, which may be begun as soon as the frost is out of the ground in the spring, include about ten or twelve miles more of side tracks, for which land has been bought; a new and enlarged pumping station at Salt creek to replace the present pumping plant there, and with double its capacity, and a new round house near the "Y" to the south yards.

The Iowa & Illinois R. R. of Clinton, Ia., has been incorporated with a capital stock of $25,000, the incorporators being F. W. Ellis, G. E. Lamb and R. B. McCoy.

The directors of the Atlantic Northern & Southern Ry. have decided to ballast the entire line and reduce the present grade in a number of places. The work is estimated to require an expenditure of $20,000. C. B. Judd, Atlantic, Ia., is chief engineer.

The city council of Davenport has approved the ordinance granting a 25-year franchise to the Davenport Water Power Co. This will mean the securing to Davenport of an industry assuring the expenditure of at least $2,000,000 for a water power developing plant.

The city of Pocahontas will vote Jan. 14 on incurring an indebtedness of $14,000 for the construction of a lighting and heating plant.

Engineers of the Chicago, Milwaukee & St. Paul Ry. have started surveys over the Milwaukee east of Charles City with a view of relocating the road bed in some places along the line. The object of the survey is to level up several grades so that the Pacific coast traffic can be handled easier. With this end in view the hill at Doubleday is to be avoided.

Kansas Notes.

FROM CORRESPONDENTS AND OTHER SOURCES.

The Kansas Northwestern R. R., which projects a 300 mile line from the northern border of the state to Wichita, is reported to have financed the northern part of its line and is now proceeding to secure the necessary public subscriptions for the southern section. Great Bend and vicinity have raised $132,000 for the line and Hoisington has raised $50,000. The estimated cost of the road is $21,000 per mile. It is expected that work on the Great Bend end of the line will be commenced soon. E. W. Moses, Great Bend, Kan., is president.

The Wichita Terminal Association, which is controlled by the Santa Fe, Rock Island, Frisco and Missouri Pacific Rys., is to expend $168,000 in building new tracks, coal chutes, and the purchase of engines for its switching railway at Wichita.

The Interstate Construction Co. has been organized at Salina, Kan., for the purpose of building the Salina, Winnipeg & Gulf R. R. J. W. Wegner, Milwaukee, Wis., is president and H. J. Wilson, Chicago, Ill., is secretary.

Mount Pleasant, Elm Grove and Howard township, in Labette county, have voted bonds to the amount of $31,500 to take stock in the Kansas Union Traction Co., a corporation headed by William J. Jones of Labette county, which proposes to build an interurban railway from Parsons to Coffeyville, a distance of 35 miles passing through the townships which voted aid to it.

Practically all preliminaries have been completed for the Motor Grand Traction Co.'s line from Chester, Neb., to Wichita, Kas. As proposed the road will run from Chester to Wichita, connecting at Belleville, Concordia, Minneapolis, Salina, Canton, Newton and Wichita with all the east and west lines. E. S. Alnutt, Belleville, Kas., is the promoter.

The belt line railway company recently chartered to build a belt line at Wichita is said to be planning to go ahead with its project and build an entirely new set of tracks and switches to compete with the present belt line. The Cudahy Packing Co. is said to be the principal stockholder in the new company.

Michigan Notes.

FROM CORRESPONDENTS AND OTHER SOURCES.

The Duluth, South Shore & Atlantic Ry. has put in about 15 miles of new track during the present season, most of it in territory where much filling was required. The last jobs to be completed were the new tracks put in to Palmer and to the Davis and Milwaukee mines at Negaunee, and the filling of the hole caused by the cave-inat the Lake Angeline mine immediately east of the Oliver Iron Mining Company's Section 16 property.

The Michigan United Rys. has been granted the right to extend its lines on Saginaw, and Sheridan Sts., at Lansing.

Residents of Hope, Edenville and vicinity northeast of Midland are endeavoring to secure the construction of a railroad into the latter place.

The St. Joseph-Benton Harbor Interurban Ry., supposed to be headed for Paw Paw Lake and various other points not yet announced, has completed its line to the Watervliet road across from the old Teeter Hotel, Coloma, and is building a waiting room at this point. With this accomplished, construction work will probably be discontinued until spring.

It is believed that the Grand Trunk Ry. will complete its branch from the south to Kalamazoo by next summer, following which it is expected that active steps will be at once taken to continue the line to Grand Rapids, making the railroad a competing line with the Lake Shore, the G. R. & I. and the Pere Marquette between Grand Rapids and Chicago.

Minnesota Notes.

FROM CORRESPONDENTS AND OTHER SOURCES.

The Minneapolis, St. Paul & Sault Ste. Marie Ry. is said to be considering building a branch line from Thief River Falls northward. No preliminary surveys have been made as yet, although steps have been taken to ascertain the topography of the country to be traversed. The line will pass east of Thief Lake and enter Roseau County near the west township line of Golden Valley and run northeasterly into Warroad.

A committee of the city council of Duluth has been in conference with the officials of the Canadian Northern Ry. Co. in an effort to prepare a franchise granting an ordinance covering the route which the company has selected through the residence section of West Duluth, which will protect the city's interests and at the same time be fair to the company.

The houses located on the Soo right of way in Bemidji are being vacated so that the contractors can begin the grading work in the residence portion of the city. John Moberg, Bemidji, has the grading contract.

The work of clearing the right of way and starting grading operations on the Soo railway east of Bemidji to Cass Lake and for some distance east towards the Leech Lake Dam is progressing very satisfactory. George Lydick of Cass Lake, who is clearing a considerable portion of the right of way, has contracted to clear 17 miles of the right of way east of Cass Lake and the 16 miles from Cass Lake to Bemidji. The latter part of December he had four miles of the right of way westward from Cass Lake ready for the shovels, and eight miles of the right of way had been cleared east of Cass Lake. Mr. Lydick has four crews at work on the clearing, and he is rushing the work as rapidly as possible. Richard Evans, Minneapolis, has two big steam shovels at work on the grade west of Cass Lake towards Bemidji, and the dirt is flying in big chunks over Cass Lake way. He states that the first 10 miles of the right of way from Cass Lake towards Bemidji furnishes the finest grounds to grade that he has ever worked on. F. J. Mann has a contract to grade 17 miles of the right of way east of Cass Lake.

St. Louis Items.

BY A. B. KOENIG.

The Illinois Traction System will not be able to complete the McKinley bridge at St. Louis and inaugurate service over the St. Louis, Venice, Granite City and Madison suburban lines until July. The bridge and the St. Louis lines were, according to ordinance, to be in commission by April, but General Manager H. E. Chubbuck is now convinced that the requirement cannot be fulfilled and he is preparing to request the municipal assembly for an extension of time. The installation of service on the McKinley lines and bridge at St. Louis is delayed by three causes. The commercial depression following the panic of 1907 affected the Illinois Traction Company to some extent and work did not progress as rapidly as had been planned. Weather conditions next interfered with operations. One of the worst obstacles, and this remains unsettled, was the opposition on the part of the Wabash and the Terminal Railroad Association to the building of the bridge approach over their tracks in St. Louis. Further delay will be caused by the present inclement weather, which will prohibit work on the superstructure of the bridge for at least several weeks and probably months. All arrangements for opening the bridge and line at St. Louis have been made. Coaches for the through service between St. Louis and Springfield, Peoria and Danville have been constructed. Pay as you enter cars for the suburban service between St. Louis, Venice, Granite City and Madison are nearing completion. Track laying on the local line from the McKinley bridge at Salisbury street to Twelfth street and Lucas avenue is done. Contracts have been awarded for the construction of a passenger station at Broadway and Salisbury street and plans have been drawn for a station at Twelfth, Thirteenth, Gay and Linden streets. Although the Illinois Traction System could if urged operate cars in St. Louis it will not be in position to open the McKinley bridge until July. And the suburban service between St. Louis and the Illinois suburbs cannot be inaugurated until the bridge is in commission.

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In all probability the St. Louis local line will not be put in operation until the bridge is opened. The report that Mr. Chubbuck would resign as general manager originated, it is believed, through his election as president of the Cairo-St. Louis and the Cairo local properties. Mr. Chubbuck will take charge of the Cairo project, but he will continue to act, for several years at least, as general manager of the Illinois Traction Company. Mr. Chubbuck said that extensions from Morris, Ill., to Joliet and from Streator to Bloomington will be completed at a comparatively early date next year. Then the Illinois Traction Company will have an interurban electric railway system between St. Louis and Chicago, as it has trackage rights from Joliet into Chicago. Another project, the Danville-Southeastern, has been launched by the Illinois Traction Company. Surveys have been made and considerable right of way secured for this new line, which will be constructed from Cairo northeast to Danville. Work is now in progress on the proposed line from Cairo to St. Louis. Operations on the Cairo-Danville and the Cairo-St. Louis lines will be carried on northwardly from Cairo. W. B. McKinley, president of the Illinois Traction Company, has a plan for the building of a line from Staunton eastwardly to Sullivan, Ind. Consideration of plans for the establishment of a Missouri traction system, based on a trunk line between St. Louis and Kansas City will be delayed until the work at St. Louis is done and the St. Louis-Chicago line is completed.

Pat Hickey spent the holidays here with his folks and returned to New York.

The warranty deed to the strip of ground on the Illinois side of the Mississippi River upon which the eastern pier of the municipal bridge is to be constructed, was received last Thursday by Comptroller Taussig, who paid the Southern Railway Company $100. Although there is a mortgage on the property the Southern Railway Company has guaranteed the transfer according to the city hall officials and there need be no alarm as to the right of the city to proceed with the work. Already the bridge builders are at work on the caisson, but it will not be sunk until the weather improves, as it would not be safe to mix the concrete before the frost has disappeared.

Opinions upholding the levee and drainage laws of Missouri, enacted in 1899 and amended in 1905, were given recently in the supreme court in Jefferson City. These opinions will now remove all obstructions towards the reclaiming of overflowed and swamp lands in the state. As long as the laws relating to the validity of such orders by county courts were in question as to their legality, many counties held back, awaiting a final decision by the supreme court.

Mike Tansey has finished his work on the Kansas City Southern R. R. and moved his outfit to Paris, Texas.

The Walsh-Kahl Construction Co. got in on several new pieces of steam shovel work on the Illinois division of the Iron Mountain R. R. last week.

List & Gifford report their work on the Illinois division on the Iron Mountain R. R. as getting along nicely. They will finish in a short time.

T. L. Smith secured a piece of Mulvill's work on the Rock Island R. R. at Villa Ridge. Smith will move onto this work as soon as he gets his job on the Santa Fe near Menocia, Ill., completed.

T. H. Nichols, who is going to superintend Lorrimer, Gallagher & Co.'s extensive sewer job in East St. Louis, is making preparations to begin work. Nichols says he is going to push this work for all it is worth and try and complete it in record time. Lorrimer, Gallagher & Co. have opened an office at 1417 Broadway, East St. Louis, Ill.

Preparations are already under way to begin anew the three months labor required to build the false work structure of the McKinley bridge, which was swept away, endangering the lives of a hundred men, by the rush of an ice pack down the river shortly after 4 p. m. Friday. As soon as the river has cleared sufficiently to make the resumption of the work free from danger, the rebuilding of the superstructure will begin. It took three months of hard labor and from $100,000 to $150,000 to bring the work to the stage it had reached. In fifteen minutes the result of this labor and financial expenditure was swept away. The work must necessarily be done again. Machinery valued at $25,000 went down into the river with the falling structure. It is possible some of this may be hoisted, but the probabilities are it will be a total loss. Seventy men were at work in the wooden structure and nearly 30 more were operating engines above them, when the creaking of the timbers told that the feared ice jam was sweeping down stream. The 70 men were rescued after a wild scramble to the tug Jos. Rogers, fixed in the ice near the bridge. The ones above clambered to safety on the steel structure. After the 70 men reached the tug their lives were still in danger and were saved only after a desperate battle with the ice by Capt. Jas. S. Short, master of the boat. The disaster was not wholly unexpected. For several days past the ice gorge above the bridge had extended as far south as North Market St., and north almost to the Chain of Rocks. Engineer F. E. Washburn, representing the McKinley system, known officially as the Illinois Traction Co., and J. J. Kelly, superintendent of the work, representing the Missouri Valley Bridge & Iron Co. of Leavenworth, Kan., the contractor, had been constantly on the watch, hoping against hope that the danger might pass, but fearing that the ice might move at any moment and crush the temporary structure to splinters. Both Washburn and Kelly were on the works directing the crew of 140 or more men employed and had just begun to feel that possibly the danger point had passed when the ominous rumble of moving slush ice portending disaster was heard. Seventy men were in the false work at the time. Twenty others were at work on its top, running a large traveling derrick, three "dinky" engines and a small traveling derrick. Alongside the false work, which is erected preliminary to putting the steel of the permanent bridge in place, lay the tug Jos. Rogers, a barge pile driver, a derrick barge and four other barges. Notwithstanding the tug as well as all the barges were helpless frozen in, the tug had steam up when the first intimation of the disaster came. The value of the machinery and the money and toil which had been put into this part of the bridge were instantly forgotten when Frank Walsh, standing 500 ft. from where the men were working, saw the rails on the bridge bulge and looking up beheld the long feared movement of the ice down the river. Throwing his hands to his mouth to form a megaphone, Walsh yelled at the top of his voice to the men in the structure. Almost at the same instant the cracking of the timbers began. Seventy faces turned up stream and 140 bulging eyes saw the ice had broken from the banks and the river wide sheet was moving down upon them. Then men on top of the span scurried back to the steel structure which has been laid between pier No. 1 and pier No. 2. They were safe within a few seconds after the first warning was received. The men in the false work were less fortunate. Each man knew exactly what it meant for the ice pack to be coming down against the structure which supported them. Some of them had lain awake at night thinking of what would happen to them if they were caught unaware. Some had dreamed of the very crash which confronted them and had started in terror from their sleep. When the reality was upon them the men were anything but transfixed by fright. Each man jack of them scampered from his dangerous perch to the nearest point of safety. Only one of them took the desperate chance of climbing from the quivering structure to the steel between the other piers. This man, Fred Thompson, one of the workmen, left the false work just as it plunged to the ice covered river 100 ft. below. Long before Thompson reached safety his 69 fellow laborers had run across the derrick barge to the deck of the Jos. Rogers, commanded by Capt. Short.

Montana Notes.

FROM CORRESPONDENTS AND OTHER SOURCES.

The Montana, Wyoming & Southern R. R. Co., recently organized to build from Miles City, Mont., to Sheridan, Wyo., has acquired control of the Yellowstone Park R. R., a 30-mile strip of track extending from Bridger, Mont., on the Northern Pacific to Clark's ford. The road acquired gives the company a part of the mileage contemplated and it is expected that the work will be pushed forward rapidly to make a connection with the Colorado & Southern. M. W. Maguire, Belfry, Mont., is general manager.

Nevada Notes.

FROM CORRESPONDENTS AND OTHER SOURCES.

The Southern Pacific Co. is stated to have arranged to begin work early this year on the construction of a feeder line from Fernley, skirting Pyramid Lake and making northward across the plains.

The Tonopah & Goldfield R. R. is stated to be planning to remove its shops and general offices to Goldfield, and as a result, it is said that the Las Vegas and Tonopah line, or Clark railway, will be extended to Tonopah as rapidly as it can be graded and rails and ties laid.

Neil McLean, Tonopah, Nev., is reported to have secured the contract for grading 50 miles of the projected Ely-Goldfield R. R., beginning at Goldfield.

New York Notes.

FROM CORRESPONDENTS AND OTHER SOURCES.

The State Public Service Commission has authorized the Hornell & Bath Interurban Ry. Co. to build an electric road from Hornell to Bath, 24 miles in length. The new road is to pass through the towns of Hornell, Howard, Fremont, Avoca and Bath.

Bids were opened Dec. 28 at Albany by F. C. Stevens, State Superintendent of Public Works, for four contracts for work on the New York State Barge Canal, the low bidders being as follows: Contract 33, for constructing lock gates, needle beams, guard and sluice gates at various points on the new canal. Penn Bridge Co., Beaver Falls, Pa., $199,640; state engineer's estimate was $183,619. Contract 44, for constructing a little over seven miles of canal just west of Rome. Scott Bros., Baldwinsville, N. Y., $1,748,679; state engineer's estimate was $1,926,093. Contract 70, for dredging the channel of the Hudson river from Waterford northerly, a distance of 3½ miles. Shanley-Morrissey, Inc., New

York City, $779,636; state engineer's estimate was $749,300. Contract 71, for constructing dam No. 1, above Waterford, and dredging a distance of upwards of four miles. Shanley-Morrissey, Inc., New York City, $1,615,519; state engineer's estimate was $1,502,100.

Ohio Notes.

FROM CORRESPONDENTS AND OTHER SOURCES.

The Mahoning & Shenango Valley Street Ry. Co., of Youngstown, has decided to begin work as soon as the weather will permit on the double tracking of the Park & Falls line at Youngstown from Central Sq. along Market St. to Warren Ave., the double track to extend across the Market St. viaduct, the company having the franchise right for crossing the bridge with double tracks.

The Toledo, Napoleon & Lima R. R. Co. has been chartered with a capital stock of $100,000 and proposes to build an electric railway from Toledo to Lima, passing through Lucas, Henry, Defiance and Allen counties. The incorporators are M. M. Dailey, A. D. Bishop, M. E. Donaldson and N. W. Gillette.

The Mt. Vernon Street Railway & Light Co., is taking steps to secure permission to extend its system in Mt. Vernon, O.

Surveyors are reported to be establishing the grade for the double tracking of the Cincinnati, Hamilton & Dayton Ry. between Lima and Pittsburg, Pa. F. H. Alfred, Cincinnati, O., is chief engineer of the company.

Announcement has been made that Receiver C. F. M. Niles, of the Toledo & Indiana Electric Railway Co., will again attempt to sell the property at auction at Toledo on Jan. 18, the upset price to be two-thirds of the appraised value, or about $614,000.

Oklahoma Notes.

FROM CORRESPONDENTS AND OTHER SOURCES.

The Washita Electric Power Co. has brought suit at Ardmore to condemn lands in Carter and Murray counties on the Washita river for the purpose of building a water power plant.

C. G. Jones of Oklahoma City and Geo. B. Herron, of Tulsa, who propose to finance a line connecting Lawton, Okla., with Wichita Falls, Tex., have been over the route from Randlett, Okla., to Wichita Falls.

C. T. Edwards of the Citizens' Traction Co., Oklahoma City, Okla., has announced that the company has secured right of way and capital and that grading for the proposed line from Oklahoma City, to Shawnee, Okla., will be started at once.

The Lawton & Fort Sill Electric Ry. Co., has decided to issue bonds amounting to $150,000 for the construction of its proposed system of electric railways in Lawton and the line connecting Lawton, Fort Sill and Medicine Park, Okla.

Nowata, Okla., has raised a $50,000 bonus for the Osage & Western R. R., chartered a short time ago, and that road will be built from Vinita westward through Nowata and Bartlesville. From Bartlesville the road will run westward through Pawhuska and Ponca City to Enid. It will be the first east and west line across the Osage Indian country. The Osage & Western is believed to be a Katy extension.

The Utility Gas & Electric Co. of El Reno has been chartered with a capital stock of $1,000,000 for the purpose of furnishing electric power to the El Reno-Oklahoma City electric railway now in course of construction between the two cities. Grading on this line has been completed to Yukon. The incorporators of the electric company are H. H. Stevens, W. H. Crilley, C. C. McVay, F. W. Van Ness and Lydia McBride, all of El Reno.

The citizens of Altus have accepted the proposition of Messrs. Kemp and Kell of Wichita Falls, Tex., to extend the line of the Altus, Roswell & El Paso railroad from Altus to Wellington, Texas. Kemp and Kell secured an option from Ed Kennedy, the promoter, for that much of the line, and will begin construction immediately upon the signing up for the bonus money by the towns interested. They are now building the Wichita Falls & Northwestern Ry. north through western Oklahoma.

Announcement has been made that the Midland Valley, now in operation from Fort Smith, Ark., to Arkansas City, Kas., through northern Oklahoma, will soon build a branch line from Warner to Webber Falls in Muskogee county. This short line, if constructed, will tap a very valuable territory in the Arkansas river valley. C. Kaighn, Muskogee, Okla., is engineer.

A contract has been signed in New York city between the Shawnee Electric Co. and a bond company, financing an electric interurban from Shawnee through McCloud to Oklahoma City. C. T. Edwards, president of the company, who has been engineering the deal in New York, is the man who built the electric interurban between Dallas and Fort Worth, Texas. Permanent survey of the Shawnee-Oklahoma City line will start in a few days.

Oregon Notes.

FROM CORRESPONDENTS AND OTHER SOURCES

The Washington-Oregon Traction Co. is stated to have effected final arrangements with the business men of Pendleton, whereby it will commence construction on six miles of line in Pendleton. The line is to be operated with gasoline motors at first, but is to be electrified later on. D. Fitzgerald, Pendleton, is interested.

The Nevada-California-Oregon R. R., Geo. S. Oliver, chief engineer, Reno, Nev., is reported to have awarded the contract for grading the extension to Lakeview to Nugent & Richardson, who have been engaged for several months constructing the Oregon Valley Land Co.'s canal in Goose Lake Valley, near Lakeview. Nugent & Richardson will finish their work on the canal in January and will then commence work for the N.-C.-O. A large number of men and horses will be employed and the work will be pushed as fast as the weather will permit.

The Portland Railway, Light & Power Co. is to at once extend its Broadway street car line to 24th St.

The Pacific Engineering Co., Portland, has been awarded the contract for building the foundation for the steam power plant of the Portland Railway, Light & Power Co., to be erected on the river front at East Lincoln St., Portland. The contract calls for the driving of 4,000 piles, the building of a timber bulkhead to protect the pile foundation and the covering of the entire foundation with a 3-ft. concrete mat. After the piles are driven, a steam dredge will pump sand and gravel from the bottom of the Willamette river, covering the entire area of piling, and on this will be laid a concrete mat and the whole surrounded by a heavy bulkhead.

The following bids were received Dec. 22 at the U. S. Engineer's Office, Portland, for repairs to the government dredge Chinook: Marine Iron Works, St. Johns, Portland, $132,000, not including new boilers. Willamette Iron & Steel Works, $162,500, with repairs to the old boilers, and $182,500 if new boilers were to be installed. Heffernan Drydock Co., $171,000, or $189,340 with new boilers. Union Iron Works, $175,000, or $195,000 with new boilers. Moore & Scott Iron Works, $176,000, or $196,000 with new boilers. Risdon Locomotive & Iron Works, $183,400, with no bid on new boilers. Repairs on the Chinook will include the removal of the upper deck between points about 59 ft. aft of the stem, and about 70 ft. forward of the stern, the removal of the sides of the vessel down to a point 8 ins. above the main deck, and the lowering of all davits and other attachments to the sides of the vessel about 8 ft. between the above mentioned points. It will include the repairing of the boilers and the furnishing and installing of new oil tanks.

The Corvallis & Eastern R. R. Co., has surveys under way for the construction of its proposed line from Yaquina to Newport, Ore., and construction work will be started soon. G. W. Boschke is chief engineer of the company at Portland, Ore.

Pennsylvania Notes.

FROM CORRESPONDENTS AND OTHER SOURCES.

The Pittsburg & Great Lakes Connecting R. R. has been chartered and will build a 12 mile line connecting the Pittsburg & Western R. R. and the Western Allegheny R. R. The line is to run from Ellwood City, on the Pittsburg & Western, to a point near Portersville, Butler county, on the Western Allegheny road. The incorporators are: President, J. Rush Snyder, Pittsburg; directors, C. J. Boak, G. T. Snyder, I. Boak, Pittsburg; C. F. Armour, Girard; W. H. Evans, Baltimore; R. G. Boak, C. H. Akens, New Castle, and P. H Sechler, Butler.

The W. S. P. Shields Construction Co. has commenced work on its contract for constructing the substructure for the $700,000 municipal pier at Vine St., Philadelphia. The contract amounts to about $300,000. The substructure will be of concrete 1 ft. above the low water line, and will be of arched construction from low water line to the roof of the floor, so that the under section may be examined from time to time by means of the use of a small boat. The supports will be of pilings. The superstructure will be of steel and concrete and will be fire proof all through. It will be two stories for its entire length, but the substructure will be strong enough to bear three stories if at any future time it is decided to put on the extra story.

The construction of a trolley line from Central Valley to Blue Church, Steinsburg, East Greenville and Pennsburg is projected. This is a well populated territory and would make a valuable link between the Saucon and Perkiomen Valleys.

D. J. Carson, Du Bois, Pa., who has the contract for constructing two mine branches for the Buffalo, Rochester & Pittsburg Ry., as noted in our Dec. 22 issue, has commenced the grading work. The operations are in Indiana County. The Nesbit Run branch, with headquarters at Clarksburg, is about two miles long, and contains the excavation of about 30,000 cu. yds. of material. John Hennessey, of East Branch, Delaware County, New York, is superintendent or "walking boss" on this operation, and E. W. Read, of Lancaster, Pa., is one of the grading foremen. Harry E. Faust, of Du Bois, Pa., is timekeeper. Two or three months will be required on this operation. The Jacksonville branch is four miles distant, with headquarters at Parkwood, and embraces 200,000 cu yds. of excavation. The length of the line is about four miles. R. K. Woodson, of Lyndora, Pa., is superintendent or "walking boss" on this operation, with Paul Carson, of Du Bois, Pa., as assistant superintendent.

Tennessee Notes.

FROM CORRESPONDENTS AND OTHER SOURCES.

The Lakeview Traction Co., W. W. Hayden, chief engineer, Memphis, Tenn., opened bids Jan. 5 for track laying on 12 miles of railroad, Memphis, Tenn., to Lakeview, Miss.; also for 1,025 lin. ft. of pile trestle.

The Clarksdale, Covington & Collierville Interurban R. R. Co., has applied for an amendment to its original charter authorizing it to run four lines through Memphis, two north and south and two east and west.

Texas Notes.

FROM CORRESPONDENTS AND OTHER SOURCES.

Right of way is being secured for the Waco, Belton & Georgetown Ry., and it is announced that surveys were to be started shortly. It now looks as though the road, which will be nearly an air line between Waco, Belton, Cornhill and Georgetown, will be built and in operation by next fall. George M Feltz, Belton, Tex., and Judge George W Tyler, Belton, are interested.

E. S. White, Fort Worth, engineer for the Levee Commission, which is to build levees along the Trinity River, as stated in our last issue, has completed final surveys and estimates and announces that the $250,000 bond issue voted for the district last August will be sufficient to construct the levees. Nearly half

of the money, it is estimated, will be required to purchase the right of way for the levees, to remove the trees and prepare the ground. The balance will be required for the actual construction. The contract for the work will be let in a short time.

The Cotton Belt R. R. is said to have purchased extensive gravel beds on the White Rock Creek, about six miles north of Waco. The company will build a spur to connect the gravel purchased with the main line, a distance of four or five miles. This gravel will be used in permanent improvement of the roadbed.

Citizens of Eldorado have purchased $100,000 of bonds of the Kansas City, Mexico & Orient Ry., thus assuring the extension of the line to that city, which is 45 miles from San Angelo. Work on the extension is to be commenced in January and the line completed by July, 1911. C. H. Webster, Sweetwater, Tex., is chief engineer.

Work is under way from Dalhart on the construction of the Enid, Ochiltree & Western R. R. The line is projected from Dalhart west to Ochiltree, a distance of 113 miles, and 30 miles have already been graded. The Panhandle Construction Co., F. L. Bryant, general manager, Dalhart, has the contract.

Preliminary surveys for the new railroad from Laredo to Brownsville have been started. C. M. Fish, Laredo, is reported to be interested.

The railroad committee of Terrell has secured $60,000 on the bonus to secure the Memphis, Paris & Gulf Railroad for that city. It is expected that the entire amount of $100,000 will be raised in the near future.

The sum of $400,000 is to be expended for ballasting and other improvements to the St. Louis, Brownsville & Mexico, R. R. C. B. Rodgers, Kingsville, Tex., is general manager.

Surveys are to be made for an extension of the Marshall & East Texas R. R., a Frisco line. The Marshall & East Texas R. R. at present extends from Winnsboro to Marshall, and, it is said, an extension is planned to connect it with the Frisco at Paris. R. J. Lockwood, Marshall, is chief engineer.

According to reports from Temple, Tex., surveyors are at work on the proposed line of the Temple & Northwestern from Temple north toward Hamilton, and grading will be started soon. Promoters of the line are at Temple, Tex.

It is reported that R. H. Baker of Austin will sever his connection with the Trinity & Brazos Valley Ry. as president about Feb. 1 and will engage in the construction of a new railroad in Texas.

Utah Notes.

FROM CORRESPONDENTS AND OTHER SOURCES.

Frank L. Capening of Provo has applied to the State Engineer for 5,000 acre feet of water in order to raise the height of the Gunnison reservoir dam 10 ft. It is proposed to store all the surplus and unappropriated waters of the Sanpete River.

The irrigation company at Kanab has awarded a contract to Cramm Brothers & Adams for drilling a 425 ft. tunnel. The contract price is $3.12½ per foot and the work is to be completed by Jan. 24.

The Belknap Power Co. of which James Long, former state representative, is president, is planning a $300,000 waterpower project near Marysvale, in Piute County, in the Sevier river country. The project involves the building of a big plant capable of generating from 6,000 to 7,000 h.p., which will be used for generating electricity to light the homes of settlers and the towns in the valleys, besides furnishing power to run the machinery in mines in the Gold Mountain and Marysvale district.

Preliminary surveys for three extensions of the Harriman lines in Utah are being made and the construction of these lines will be started next year. The new lines extend from Salt Lake through Emigration canyon to Evanston, from Salt Lake paralleling the Western Pacific to connect with the Southern Pacific between Cobre and Elko, and from a point on the Lucin cut off to connect with the main line of the Oregon Short Line to the northwest. The Utah Construction Co. of Ogden, Utah, is reported to have secured the contracts for a large part of the grading on the extensions of the Harriman lines in Utah and it is said that the forces of this company which have been at work on the Western Pacific for the last three years will be started on the new lines early next spring.

Virginia Notes.

FROM CORRESPONDENTS AND OTHER SOURCES.

The Roanoke Electric Co. is said to be planning to begin work in the early spring on its hydro electric development on the Staunton River near Brookneal. The site of the proposed dam is a mile above Brookneal, on the Staunton River. It is 26 miles from Lynchburg, 80 from Roanoke and 50 from Danville, while Altavista, the new town at the junction of the Virginia and Southern railways, is 28 miles away. The dam required for this purpose would be 1,300 ft. long, including the power house, and the height will be 25 ft. The water there is sufficient to deliver 2,000 hp. into Lynchburg 24 hours a day. The entire plant, including the cost of lines to deliver the power to a storage station in South Lynchburg, would be $750,000. Judge E. D. Newman, Woodstock, Va., is reported to be interested.

Surveys have been started near Ashland for a line for a railway, which will be a continuation of the Richmond & Chesapeake Bay R. R., into Washington. After the route has been established from Ashland to the national capital; a second line will be laid off at right angles and running eastward to the Chesapeake bay. From Richmond to Washington the line will be about 115 miles long, the new road practically paralleling the Richmond, Fredericksburg. Actual construction will probably begin early next spring, it being believed that the engineers' estimates will be completed by that time.

Washington Notes.

FROM CORRESPONDENTS AND OTHER SOURCES.

The Vance Lumber Co. of Elma, Wash., has applied to the state land office to purchase a right of way across section 16, township 17, range 5, west in Chehalis County.

All but two miles of the right of way has been secured for the Northern Pacific's new water grade line out of Tacoma via Point Defiance and the Narrows. Announcement of the beginning of construction work on the new line is expected early in 1910 and it is likely that spring will see work under way.

Press reports from Walla Walla state that the North Coast R. R. has definitely located its route from Walla Walla east through the mountains, over the Snake River and up through the mountains to Landor, Wyo. According to the reports the route is east from Walla Walla, first going toward the north fork of the river, tunneling through a hill to get into the canyon of this stream, which it hits several feet above the bed of the creek. Taking a 3 per cent grade up the river, it finally runs down to the bottom of the canyon, where there is a bridge, and the road winds back in the other direction, still going up grade, but down the river. It then goes toward the south fork, making another tunnel and hitting the canyon of that stream some 1,200 ft. above the water. Again the road hits upstream, on a 3 per cent grade, until the bed of the river is reached. Here another tunnel is made, coming out on the Looking Glass, from where the line goes to the Grande Ronde, thence down that stream to the Snake and Salmon and then east across the mountains to Landor, Wyo.

A line on the definite location of the Toppenish, Simcoe & Western R. R. (a Northern Pacific feeder) has been given out through a condemnation suit filed in the superior court at North Yakima. Instead of running south of Mt. Adams and joining the Vancouver spur at Yacolt, as was at first supposed, or of joining the spur from Lyle at Goldendale, the Toppenish road will run to Fort Simcoe and thence south direct to Lyle. The new road will give the Yakima valley a direct outlet to Portland and will be on a down grade, except for a short distance in getting over the Simcoe hills.

An agreement has been reached between representatives of Stone & Webster, Boston, Mass., and the citizens' committee of Bellingham for the construction of 32 miles of interurban road. According to the agreement citizens of Bellingham are to subscribe for $400,000 of stock of the Whatcom County Railway & Light Co., which is to control the road.

The Grays Harbor Interurban Co., mentioned in our last issue, has had surveys started on its projected line between Hoquiam and Tacoma, via Olympia, and it is announced that construction work will be started as soon as the right of way can be secured. Eldridge Wheeler, Montesano, Wash., is the chief promoter.

Capitalists of Seattle and Portland, Ore., have had preliminary lines run in the South Bay country for the proposed canal between Grays Harbor and the Columbia River. According to the plan outlined the canal will be 30 ft. in width, having a mean depth of 12 ft. It is estimated that there are between 10 and 20 miles of excavation between South Bay and Willapa Harbor. Much of this is easy to excavate, and a chain of small lakes will be utilized. From the southern shore of Shoalwater Bay the canal eventually will find its way into the Columbia River a few miles east of Oneida. It is the intention of the promoters to use the canal for freight and passenger service and serve a large section of country now isolated. The Inland Waterways & Canal Co. has been organized at South Bend, Wash., as a holding company for the project. The work will cost about $60,000, it is thought. Special dredges will be constructed at South Bend this winter and construction work started in the spring. Charles N. Hudson is the engineer.

Swansen Bros. have removed their outfit from Montana to Okanogan, Wash., and have begun work on the subcontract on the Oroville-Paternos branch of the Great Northern Ry. Several other outfits are located between Pateros and Brewster on this work.

The Seattle-Tacoma Short Line Electric Co., which proposes the construction of a new interurban line between Seattle and Tacoma, has filed a mortgage for $3,500,000, indicating that arrangements have been made for securing funds to build the line. Surveys for the line have been completed and a private way for practically all the distance has been secured. E. J. Felt, Tacoma, is interested.

The city council of Seattle has passed over the mayor's veto three bills giving the Northern Pacific Ry. permanent franchises around the Lake Union Basin. The franchise granted gives the Northern Pacific access to a large manufacturing district which will have a fresh-water harbor when the Lake Washington Canal project is completed.

Residents in the Yakima valley have formed an association and have raised money for a survey to be submitted to the U. S. Reclamation Service of an extension of the ditch already proposed in Kittitas County some 200 miles, bringing the water from the lakes in the Cascades along the highest ridges possible to the Columbia. The water would reach North Yakima, it is estimated at an altitude of 2,000 ft., which would mean the reclamation of all the bare ridges surrounding the city and long considered worthless. Lee A. Johnson of Sunnyside is president of the association and H. W. Goff of Colfax. W. W. Robinson of Seattle and ranchers of the upper and lower valleys are among the promoters of the project.

Olsen & Anderson, sub-contractors on the Bovill branch of the Chicago, Milwaukee & Puget Sound Ry., have moved their outfit to Mount Hope on the North Coast, seven miles from Fairfield.

Reports from Colfax, Wash., state that W. C. Buck, assistant engineer of the Oregon Ry. & Navigation Co., has started surveys for the construction of a line from Lacrosse to Pullman. As proposed the line will pass

through Dusty and Wilcox, Wash. G. W. Boschke, Portland, Ore., is chief engineer of the railroad company.

Active work will soon commence on the erection of the large new cement dam at the head of the Hatt slough, one mile east of Florena. The former dam, built by the government last year, is stated to have proved inadequate, and on account of its present construction has been a constant menace to the neighboring farmers. The present plans for the new dam call for an entirely different manner of construction, and when completed will add an immense business to the shipping interests of the lower river valley, as well as to the east and north sides of Camano island. The length of the proposed dam will be about 900 ft. by 6 to 18 ft. high, and will be of re-enforced concrete. The estimated cost is $30,000.

The St. Helena Public Service Co., of which Dr. Henry Waldo Coe, Portland, Ore., is the principal stockholder, is planning to begin work this year at Castle Rock, Wash., on its projected railroad and hopes to have 15 miles completed during the year. The railroad as projected is to be about 200 miles long, extending from Vancouver to the copper districts in the vicinity of Mount St. Helena, Wash. Surveys have been made and right of way for practically the entire distance has been secured.

Wisconsin Notes.

FROM CORRESPONDENTS AND OTHER SOURCES.

Isham Randolph, consulting engineer, Chicago, Ill., has submitted plans to the city council of Milwaukee for the proposed new harbor for that city. The plans contemplate the expenditure of $6,000,000, $4,000,000 by the city and the rest by the government.

Business men of Sheboygan are trying to get the Milwaukee road to extend its line from Plymouth to Sheboygan in order that a competing line may be had with the Northwestern road. If the Milwaukee road will not build it is likely several Sheboygan business men will build the line as a business enterprise.

Advices from Manitowoc state that Dr. J. S. Pritchard, who has been identified with the Wisconsin Central and the Chicago & Northwestern roads for many years, is at the head of a company which has secured an option on the mill and site at Rapids, on the Manitowoc River, two miles west of Manitowoc, and has employed hydraulic engineers and is making a survey of the property. It is expected that from 2,000 to 3,000 hp. will be developed and the power will be carried by cables to the city limits and sold to Manitowoc manufacturing establishments. It is expected the plant will be in operation early next year.

The State Railroad Commission has been holding hearings at Madison on the application of the Milwaukee & Fox River Valley R. R., which intends to build an electric line to Fond du Lac.

Canadian Notes.

FROM CORRESPONDENTS AND OTHER SOURCES

The Canadian Northern Ry. has taken over the charter and interests of the Victoria & Barkley Sound Ry. Co. of Victoria, B. C. The latter railway has completed surveys for some 50 miles out of Victoria, and these being taken over by the C. N. R. will greatly expedite preliminary arrangements for construction of the Vancouver Island portion of the third Canadian transcontinental line. The Victoria & Barkley Sound Railway Co. depended upon obtaining provincial aid for its undertaking and tentative arrangements were made with British financiers to provide $5,000,000 for construction of 100 miles of road projected. The Victoria & Barkley Sound division of the C. N. R. will open up 100 miles of southern Vancouver Island.

Wade, Whealler & McQuarrie, attorneys, Victoria, B. C., are to apply for incorporation for a company with power to build and operate a railway, commencing at Port Moody, for 20 miles.

The Southwestern Traction Co. of London, Ont., is planning to extend its line from Brantford to London in the spring, involving construction of the line from Brantford to Woodstock. At the latter place the Woodstock to Ingersoll line will be taken over, and the line from London to Ingersoll will be projected. Other lines are in contemplation. S. B. Mower is manager.

The Kettle Valley Lines, F. M. Holland, general manager, Republic, Wash., proposes to extend the system west via the west fork of the Kettle River, through the Okanogan and Similkameen districts and over the Hope Mountains to Hope. Legislation granting a subsidy of $5,000 a mile from Midway to Nicola, a distance of 150 miles, will be introduced at the coming session of parliament.

The Winnipeg Electric Ry. Co. has submitted a plan to the board of control of Winnipeg, showing a conduit to be constructed in Portage Ave. east from the corner of Main and Portage to its Mill St. substation to carry return feed wires.

The Montreal Street Ry. Co. of Montreal, Que., has asked the city council of that city for a number of franchises for new lines, extensions and for double tracking. An important franchise in the business district is the double tracking of St. Joseph St. to the city limits to enable the St. Denis cars to go out and back on St. James St. instead of on Craig St. as now. The company wants either Lagauchetiere St. or Vitre St. widened in order to have a parallel line with Craig. It is also suggested that Craig St. be widened possibly to Vitre St., the houses razed, and Craig St. made a boulevard. A new line through the western and river front part of the city, William St. throughout, down McCord, along Ottawa, down Shannon, Wellington to McGill St., is also asked. The city council of St. Louis, a suburb of Montreal, has already granted franchise to the Montreal Street Ry. Co. for a number of new streets.

The British Columbia Electric Ry. Co. is to expend $500,000 in New Westminster this year. A large part of the $500,000 to be spent in New Westminster will go into the extension of the present car shops and the remainder into rolling stock. One hundred freight cars, four locomotives and 100 passenger cars are to be built during 1910 at the Westminster shops.

The Grand Trunk Pacific Ry. is completing preparations for active construction of branch lines during 1910. It is the intention to open for development a large, new territory in the wheat belt. In the planning of the branch lines the G. T. P. aims at avoiding sections only cultivatable by irrigation. It plans to open up country where there has always been an abundance of moisture and where crop failure is unknown.

The Couteau Power Co. is understood to have financed to the extent of $2,000,000 its scheme for installing a network of rural tramlines in the Okanogan district.

Track laying on the western end of the Grand Trunk Pacific Ry. has been continued despite the cold weather and a track layer with a big force of men has been making rapid progress laying steel. Since the completion of the Pembina River bridge steel has been laid down at the rate of two miles a day and the line is now finished for 84 miles to the west of Edmonton. A section of this line was completed early in the fall and fully ballasted. Tracklaying will be continued throughout the winter to the termination of the grade on McLeod River. As soon as that point is reached, material and supplies will be rushed in to make ready for an early start on grading work on the next 150 miles. The contracts for this work will bring the line to Fete Jeune Cache in the heart of the Rocky Mountains, and it is confidently expected that the grading will be sufficiently advanced to allow steel to be laid on the greater portion of these contracts in 1910. Excellent progress is being made from Prince Rupert east on the Pacific Coast side. By this time next year 250 miles or more should be in operation under construction, leaving about 400 miles to connect up.

BIDS ASKED.

Bridges.

Bids are asked on following work, the notes being arranged alphabetically by states:

Indianapolis, Ind.—Until Jan. 15, by B. H. Miller, City Engineer, for the construction of a stone and concrete bridge over Pogues run at Commerce Ave.

Cincinnati, O.—Until noon, Jan. 7, by Board of County Commissioners, for the repairing the east abutment of the bridge over the Little Miami River on the New Richmond Pike in Anderson Township.

Columbus, O.—Until noon, Jan. 28, by County Commissioners, for constructing a new floor system on the Decker bridge, over Little Walnut Creek, on the Groveport and Lithopolis Pike, about one mile southeast of Groveport, in Madison Township, and on the Grand View Ave. bridge over the Scioto River, in Franklin Township.

Fremont, O.—Until 10:30 a. m., Jan. 24, by County Auditor, for the construction of a wagon bridge on the Monroeville Road. The structure will be of steel, having two 62-ft. spans and one 80-ft. span with 20-ft. roadway.

Norwalk, O.—Until 10:30 a. m., standard time, Jan. 24, by the Board of County Commissioners of Huron County, O., Norwalk, O., for the furnishing and erecting of a steel riveted truss bridge over Huron River at Monroeville, O., known as Main St. bridge. Length of bridge, 204 ft., consisting of two spans each 62 ft., and one span 80 ft. Width of roadway, 20 ft., with sidewalk on one side 4 ft. wide. Certified check for $300 must accompany each bid. Jay E. Smith, County Auditor.

Wagoner, Okla.—Until Jan. 18, by County Commissioners, for the construction of a steel bridge over Verdigris River at Mingo Ferry. The structure will be about 300 ft. in length on tubular foundations. J. E. Hildt is County Clerk.

Buildings.

Bids are asked on following work, the notes being arranged alphabetically by states:

Hot Springs, Ark.—Until 3 p. m., March 1 by James Knox Taylor, Supervising Architect, Treasury Department, Washington, D. C., for the construction including plumbing, gas piping, heating apparatus, electric conduits and wiring of an extension to the U. S. Post Office at Hot Springs, Ark.

Denver, Colo.—Until 3 p. m., Feb. 17, by James Knox Taylor, Supervising Architect, Treasury Department, Washington, D. C., for the construction, including plumbing and draining of the U. S. Post Office and Court House at Denver, Colo.

Fort Barrancas, Fla.—Until 11 a. m., Jan. 28, by Constructing Quartermaster, for the construction, including plumbing, heating and electric lighting, of one double set of non-commissioned officers' quarters and one kitchen at Fort Barrancas and one double set of civil engineer's quarters at Fort Pickens, Fla.

Chicago, Ill.—Until 4 p. m., Jan. 5, by Directors of the Chicago Public Library for structural alterations, ornamental iron work and electric elevator. H. G. Wilson is Secretary of the Board of Directors.

Rock Island, Ill.—Until 3 p. m., Feb. 21, by James Knox Taylor, Supervising Architect, Treasury Department, Washington, D. C., for the construction, including plumbing, heating, wiring, and standard clock systems, of the extension to the U. S. Post Office at Rock Island, Ill.

Ames, Ia.—Until 2 p. m., Jan. 20, by D. A. Emery, Secretary State Board of Education, Des Moines, Ia., for the construction of a domestic technology building for the Iowa State College of Agriculture and Mechanic Arts at Ames, Ia.

Jena, La.—Until Jan. 3, by H. C. Hartner, President Police Jury, for the construction of a county court house and jail. Emile Weil, New Orleans, La., is the architect.

Meridian, Miss.—Until 3 p. m., Feb. 8, by James Knox Taylor, Supervising Architect, Treasury Department, Washington, D. C., for the extension, remodeling, etc., including plumbing, gas piping, heating apparatus, electric conduits and wiring and standard clock system, of the U. S. Post Office and Court House at Meridian, Miss.

Fort Omaha, Neb.—Until 11 a. m., Jan. 19, by Capt. George S. Gibbs, Constructing Quartermaster, for the construction of one oil house, one combined hay shed and granary and for the construction, plumbing and electric wiring of one stable.

Goldsboro, N. C.—Until 3 p. m., Jan. 31, by James Knox Taylor, Supervising Architect, Treasury Department, Washington, D. C., for the construction, including plumbing, gas piping, heating apparatus, electric conduits and wiring, of an extension, remodeling, etc., to the U. S. Post Office at Goldsboro.

Tower City, N. Dak.—Until 1 p. m., Jan. 10, by S. F. Sherman, Clerk, Board of Education, for the erection of a high school building.

Fort Bayard, N. M.—Until 11 a. m., Feb. 15, by Capt. F. P. Vestal, Constructing Quarter-

master, for the construction, plumbing, heating, electric lighting and fixtures of one double set of hospital sergeants' quarters and one power plant with machinery for refrigerating and electric lighting systems.

New York, N. Y.—Until 2:30 p. m., Jan. 11, by Department of Public Charities, E. 26th St., New York, for furnishing all necessary labor and material for the construction of a dormitory for female inmates at the New York City Farm Colony.

Fort Hancock, N. J.—Until noon, Jan. 15, by C. J. Goodier, Constructing Quartermaster, for the construction, plumbing, heating, electric wiring and fixtures of one double set N. C. O. quarters (stucco); one double set of firemen's quarters (brick); and construction of second story (brick) to quartermaster's storehouse at Fort Hancock, N. J.

Columbus Barracks, O.—Until 10 a. m. Jan. 24, by Capt. H. J. Hirsch, Constructing Quartermaster, for the construction of an isolation hospital. The work includes plumbing, heating, electric light wiring and fixtures.

Franklin, Pa.—Until 2 p. m., Jan. 11 by E. K. Smiley, Clerk, Board County Commissioners, for the construction of a county jail estimated to cost $50,000.

Houston, Tex.—Until noon, Jan. 11, by Commissioners' Court of Harris County, for furnishing electrical fixtures for Harris County Court House. A. E. Amerman is County Judge, Houston, Tex.

Thorndale, Tex.—Until 2 p. m., Jan. 10, by C. D. Hill & Co., Wilson Bldg., Dallas, Tex., for the construction of a 2-story bank building for the First National Bank of Thorndale, Tex. A certified check for $500 must accompany each bid.

Fort Monroe, Va.—Until 10 a. m., Jan. 26, by Capt. Ernest R. Tilton, Constructing Quartermaster, for the alterations and repairs to old artillery school building at Fort Monroe, Va., the work including electric lighting, wiring, heating and plumbing.

Spokane, Wash.—Until 3 p. m., Feb. 9, by James Knox Taylor, Supervising Architect, Treasury Department, Washington, D. C., for the installation of a vacum cleaning system in the United States Post Office, Court House and Custom House at Spokane, Wash.

Vancouver Barracks, Wash.—Until 11 a. m., Jan. 26, by Constructing Quartermaster, for the construction of an artillery stable of brick with slate roof, for 138 animals at the Vancouver Barracks.

Cassville, Wis.—Until 8 p. m., Jan. 18, by Walter Kleinpell, Clerk of School District at Cassville, Wis., for the construction and heating of a school building at Cassville, Wis. A certified check for $300 must be filed with each bid.

Winnipeg, Man.—Until 11 a. m., Feb. 15, by the Chairman of the Board of Control, Winnipeg, Can., for the supply and erection of the various portions of the equipment for the Terminal Station at Winnipeg and for the turbine governors and gate valves for the generating station. M. Peterson, Secretary Board of Control.

Roads and Streets.

Bids are asked on following work, the notes being arranged alphabetically by states:

Fort Mason, San Francisco, Cal.—Until 11 a. m., Jan. 6, by Maj. George McK. Williamson, Constructing Quartermaster, for the construction of a supply road to pumping station, Presidio, of San Francisco, Cal.

Palatka, Fla.—Until 2 p. m., Jan. 6, by Henry Hutchison, Clerk of Circuit Court, for the construction of a hard road from Palatka to Rice Creek.

Lewiston, Ida.—Until Jan. 16, by City Council for the construction of pavement on Main St., east of the Union Depot.

Vicksburg, Miss.—Until 8 p. m., Jan. 17, by Mayor and Aldermen, for paving Veto St., between Washington and Monroe Sts., and Drummond St., between Harris St. and Bowman Ave., with granitoid, brick, bitulithic, asphalt, creosoted wooden blocks and mineral rubber. J. J. Hayes is Mayor.

New York, N. Y.—Until 2.30 p. m., Jan. 14, by the Department of Public Charities, foot of East 26th St., New York, for furnishing all labor and material required for macadam roadways, brick gutters, cement walks, curbs, catch basins and drainage pipes at Coney Island Hospital site on Ocean Parkway, Borough of Brooklyn. Robert W. Hebberd, Commissioner.

Cincinnati, O.—Until noon, Jan. 7, by Board of County Commissioners, for improving the Stone Mill Road from Colerain Pike at Dunlap to County line Colerain Township. Stanley Struble is President of the Board.

Cincinnati, O.—Until noon, Jan. 21, by County Commissioners, for the construction of improvements to Congress Ave. through the village of Glendale. Fred Dreihs is Clerk of the Board of County Commissioners.

Columbus, O.—Until noon, Jan. 28, by County Commissioners, for grading, graveling, etc., the Stygler hill on the Stygler road, about one and one-half miles northwest of Gahanna, in Mifflin Township.

Fort Worth, Tex.—Until Jan. 5, by City Council for paving Lipscomb St., from Terrell Ave., to Capps St.

Sewers.

Bids are asked on following work, the notes being arranged alphabetically by states:

Quincy, Fla.—Until 6 p. m., Jan. 12, by George H. Palmer, City Engineer, for the construction of sewer system. The work includes approximately 7½ miles of 8, 12, 15 and 18-in. pipe sewers from 4 to 25 ft.; 70 manholes, 20 flush tanks, and one septic tank.

Fort Dodge, Ia.—Until 5 p. m., Jan. 10, by City Council, for furnishing all material and labor for the construction of a 10-in. storm sewer with four catch basins. W. L. Tang is City Clerk.

Holton, Kan.—Until noon, Jan. 12, by Board of Sewer Commissioners, for the installation of a sewer system and the construction of a disposal plant. The work includes 45,000 ft. of 8-in. sewer, 64 manholes, 35 flush tanks, 14,000 ft. of 10, 12 and 15-in. pipe 41 manholes.

Hebron, Neb.—Until 2 p. m., Jan. 12, by C. P. Hess, City Clerk, for the construction of 13,000 ft. of 8-in. vitrified pipe, 12 flush tanks, 25 manholes, 1,300 ft. of 15-in. pipe, 1,760 ft. of 10-in. vitrified clay pipe, etc. C. H. Meeker, McCook, Neb., is Engineer.

Oklahoma City, Okla.—Until 5 p. m., Jan. 10, by Robert Parman, City Clerk, for the construction of a lateral sewer in certain streets portions of Putnams Heights, Military Park, Epworth View, Lawndale, Adams Sub., Anderson's, Wahl's & S. J. Young's Addition.

Lawton, Okla.—Until 2 p. m., Feb. 16, by Department of the Interior, Washington, D. C., for the construction of a sanitary sewer system for the north addition to the city of Lawton, Okla. John D. Kennard, Lawton, Okla., is Engineer.

Water Supply.

Bids are asked on following work, the notes being arranged alphabetically by states:

Fort Mason, San Francisco, Cal.—Until 11 a. m., Jan. 21, by George McK. Williamson, Constructing Quartermaster, for the construction of a pumping station, smoke stack, boilers, pumps, reservoir, flume and pipe at Presidio, of San Francisco, Cal.

Cawker City, Kan.—Until Jan. 11, by G. B. McKinley, City Clerk, for furnishing all necessary material and labor for the installation of a water works system. The work includes the following approximate quantities: 7,050 ft. of 6-in. and 14,580 ft. of 4-in. cast iron pipe; 2,250 ft. of 2-in. galv. iron pipe; 28 hydrants, etc. one 75,000-gal.-tank on 125 tower, foundation, triplex pump and powerhead, etc.

Macon, Miss.—Until 7 p. m., Jan. 17, by the Board of Mayor and Aldermen, for furnishing machinery and supplies only in connection with the improvement of the city light and water plant. The work includes the following: Compound high-speed engine, two 2,300 v. 3-phase generators and exciters, three 2,300 v. 3-phase vertical motors, one three panel switchboard and instruments, series street lights, three vertical turbine pumps, feed water pump, closed feed water heater, ejector condenser and check valve, vacuum release and back pressure valve, vacuum oil separator and trap, steam separators and traps, smoke stack pipe, valves and fittings, pipe covering and miscellaneous supplies. G. B. Baskerville, Jr., Engineer.

New York, N. Y.—Until 2 p. m., Jan. 12, by John H. O'Brien, Commissioner of Water Supply, Gas and Electricity, 1536 Park Row Bldg., New York, for the following work in the borough of Richmond; furnishing, delivering and laying water mains and appurtenances and removing existing water mains and appurtenances in Westervelt, Beechwood, Bismark, Madison, Monroe, Tompkins, Hamilton, Second, Third, Fourth, Fifth, Sixth, Seventh, Crescent and St. Pauls avenues; Jersey, Henry, Belmont, Church, Nicholas, Vine, Fifth and Wall streets; Carroll, St. Marks, Egmont, Holland (Curtis) and Fort Places; Richmond road, Daniel Low terrace, Daniel Low circle and Richmond turnpike.

New York, N. Y.—Until 2 p. m., Jan. 12, by the Commissioner of Water Supply, Gas and Electricity, Room 1536, Nos. 13 to 21 Park Row, Borough of Manhattan, New York, for furnishing and delivering and laying a trunk distribution main and appurtenances in Glenmore, Pennsylvania and Bushwick Aves. and in Madison St.

Mount Pleasant, Tenn.—Until 8 p. m., Feb. 1, by Mayor and Board of Aldermen, for the purchase of $55,000 36-year 6% water works bonds for the construction of a gravity system of water works for the town of Mt. Pleasant. W. H. Long is Mayor and F. M. Ricketts is Recorder. Official advertisement will be found elsewhere in this issue.

Petersburg, Va.—Pumping Plant.—Until Jan. 10, by Water Committee of Petersburg, Va. for the complete installation of a pumping plant of 1,800-gal. capacity per minute. R. D. Budd is City Engineer.

Miscellaneous.

Bids are asked on following work, the notes being arranged alphabetically by states:

Washington, D. C.—Electric Lighting System.—Until noon, Jan. 29, by Constructing Quartermaster, Capt. H. L. Pettus, for the extension of the electric lighting system at the Walter Reed Army General Hospital, Washington, D. C.

National Soldiers Home, Va.—Electric Plant.—Until Jan. 11, by John T. Hume, Treasurer, Southern Branch, N. H. D. V. S., National Soldiers Home, Va., for furnishing all necessary labor and material for remodeling electric plant, poles, wires, etc.

Richmond, Va.—Transmission Line. — Until Jan. 14, by Committee of Water, Room 103, City Hall, Richmond, Va., for furnishing material and labor for the construction of electric transmission lines. E. E. Davis is Superintendent of the Water Department.

Dodgeville, Wis.—Steel and Cypress Tanks.—Until Jan. 11, (extended from Jan. 4) by City Council for furnishing steel and cypress tanks. W. G. Kirchoffer, 31 Vroman Bldg., Madison, Wis. is Engineer.

Winnipeg, Man.—Power Station.—Until Feb. 15, by the Board of Control, for the construction and equipment of the terminal station at Winnipeg for the municipal power system. Estimated cost of the building and equipment is about $300,000. H. N. Ruttan is City Engineer.

Excavation, Earth and Rock.

Bids are asked on following work, the notes being arranged alphabetically by states:

La Junta, Col.—Dam, Tunnel, Etc.—Until 11 a. m., Jan. 10, by J. E. Lewis, Secretary Holbrook Irrigation District, for constructing dams, outlet tunnels and ditches for the district. The official advertisement will be found elsewhere in this issue and the work is also noted under Confirmed Reports.

Carrollton, Ill.—Levees and Ditches.—Until 2 p. m., Jan. 20, by Commissioners Eldred Drainage and Levee District, Edward Boyle, Commissioner, for constructing a levee (1,493,759 cu. yds.), a muck ditch (42,220 cu. yds.), and a drainage ditch (192,730 cu. yds.). Also noted in Confirmed Reports. The official advertisement will be found elsewhere in this issue.

Crawfordsville, Ind.—Drain.—Until 11 a. m., Jan. 8, by M. L. Nees, Drainage Commissioner, for the construction of a drain in Montgomery County.

Boone, Ia.—Drain.—Until 1 p. m., Jan. 21, by Board of County Supervisors, for the construction of county drain No. 62. The work includes the following approximate quantities: Main Line, Sec. 1, 3,150 ft. 32-in. tile; Sec. 2, 2,100 ft. of 26-in. tile; Sec. 3, 1,400 ft. of 10-in. tile. Branch A, Sec. 4, 1,600 ft. of 16-in. tile; Sec. 5, 600 ft. of 15-in. tile. Branch B, 800 ft. of 14-in. tile; Sec. 7, 1,700 ft. of 12-in. tile; Sec. 8, 1,104 ft. of 10-in. tile. Branch C, Sec. 9, 649 ft. of 8-in. tile. Branch D, 535 ft. of 8-in. tile.

Geneva, Neb.—Bridge Fills and Grading.—Until noon, Jan. 11, by Uriah F. Stanard, County Clark, for the construction of bridge fills and doing grading work in Fillmore County for the year of 1910.

Materials, Machines, Supplies, Etc.

Bids are asked on following work, the notes being arranged alphabetically by states:

Washington, D. C.—Steel Rail Sections, Steel Shafts, Etc.—Until 10:30, Jan. 24, by Capt. F. C. Boggs, General Purchasing Officer, Isthmian Canal Commission, Washington, D. C., for furnishing under Canal Circular 551 steel rail sections, steel shafts, manganese steel chute for rock crushing plant, steel cable, pulsometer pumps, liquid compasses, etc.

Chicago, Ill.—Seats and Desks.—Until noon, Jan. 19, by Board of Education, 730 Tribune Bldg., for furnishing 5,000 seats and desks for the Chicago Public Schools.

Napanoch, N. Y.—Structural Steel. — Until noon, Jan. 15, by Joseph F. Scott, Superintendent of Reformatories, New York State Reformatory, Elmira, N. Y., for the structural steel and iron work, exclusive of erection, for the hospital building for the New York State Reformatory at Elmira, N. Y., and for the structural steel and iron work, exclusive of erection, for the mess hall and kitchen at the Eastern New York Reformatory, Napanoch, N. Y.

Fort Sam Houston, Tex.—Sink, Pipe, Etc.—Until 11 a. m., Jan. 10, by Capt. Fred H. Gallup, at the office of the Constructing Quartermaster, for furnishing 6 kitchen sinks, type H-4; four type H-5; 8 brass ferrules; 24 ft. 2-in. lead pipe; 24 ft. of 1½-in. lead pipe; 20 lbs. metal wiping.

CONTRACTS LET.

The following contracts have been let recently:

BRIDGES.

New Orleans, La.—Bridge—Penn Bridge Co., at $14,980, for repairing the draw bridge over New Basin Canal at Galvez St.

Littlefork, Minn.—Bridge—Hennepin Bridge Co., Minneapolis, Minn., at $6,700, for the construction of a wagon bridge over the Big Fork river in Lindford township. The work is to be completed by March 20.

Missoula, Mont.—Bridge—O. E. Peppard, of this city, at $12,000, for the construction of

two bridges over the Blackfoot river, one three miles above Bonner and the other six miles above Bonner. The structures are to be of a combination type, of wood and steel. For the necessary approaches $5.45 per lin. ft., is to be allowed.

Chambersburg, Pa.—Bridge—J. S. McIlvaine and Co., of this city, at $1,666, for the construction of a bridge over Big Elk Creek, two miles north of Elkton.

Goliad, Tex.—Bridge—J. J. Greathouse, at $3,559, for the construction of a bridge across Blanco creek between Goliad and Bee counties.

Colfax, Wash.—Bridges—J. W. Janey, Colfax, at $9,300, for the construction of two full steel bridges, each 130 ft., long, one across Pine creek at Pine City and the other across the Palouse river at Matlock. The work includes furnishing material and erecting the two bridges without approaches. Bids were opened Dec. 20.

ROADS AND STREETS.

Jacksonville, Fla.—Paving—Peninsular Engineering Co., Jacksonville, Fla., for grading, curbing and laying of two and a quarter miles of vitrified block or concrete pavement on the new country road from South Jacksonville to Pablo Beach, at the following price: Grading the roadbed per cu. yd., $.15; brick paving per sq. yd., $1.54½; vitrified curb per lin. ft., $.18.

Morton, Ill.—Grading—E. R. Neville, Hopedale, for grading the approaches to the new bridge across the Mackinaw in Dillon township, known as the Cedar Bluff bridge.

Naperville, Ill.—Grading and Paving—John Hapes Sons Co., at $62,593, for grading, paving, curbing and draining. The work includes 31,000 sq. yds. of brick pavement on concrete foundation, 9,200 cu. yds. of grading, 8,380 lin. ft. of curbing with sundry drains, inlets and gutter crossings.

Rock Island, Ill.—Paving—Tri-City Construction Co., $14,643, for paving Ninth Ave., from 27th to 30th Sts.

Kendallville, Ind.—Paving—Fred Hoffman, Rochester, at $41,500, for paving portions of three streets with Athens block. The streets to be paved are Mitchell St., from East St., to Lincoln St.; Rush St., from State to the G. R. & I. railway; Maine St., from the south end of the present pavement to Diamond St. The work is to be commenced by May 1.

Ligonier, Ind.—Paving—Trippier & Son, Peru, Ind., at $13,220, for the construction of 7,400 sq. yds., of pavement. The work includes brick pavement, cement filler, cement curb, 8 ft., 12 ft., and 18 ft., sewer pipe, and iron inlets. Bids were opened Dec. 9.

Casco, Me.—Road—F. E. Tenney, at $1,219, for the construction of a state road in this town. The work is principally grading and stone culverts.

Poland, Me.—Road—E. A. Libby, at $1,473, for the construction of 5,362 ft. of state road in this city. The work is principally grading and stone culverts.

Buffalo, N. Y.—Paving—F. V. E. Bardol, at $21,500, for paving Jefferson St., with brick from Ferry to Main St.

Buffalo, N. Y.—Paving—Following contracts have been awarded by the council: German Rock Asphalt and Cement Co., at $22,380, for paving Main St., from the Erie tracks to the city line; for repaving Kehr St., from the north curb line of Genesee St., to Urban St., and Alwin St.; Barber Asphalt Co., for paving Hedley St., from Meech St., to Oak Grove Ave.; L. H. Gipp Contracting Co., for repaving Royal Ave., from Tonawanda St., to Ontario St.

Rochester, N. Y.—Grading and Paving—Whitmore, Rauber & Vicinus, at $2,013, for grading Carter St.; at $1,364, for paving Schlitzer St.

Bellaire, O.—Road.—Rosser & Maloney, Bellaire, O., at $16,250, for improving the Woodsfield Western road. The road is to be paved one and three-quarters miles and 14 ft. wide.

Cleveland, O.—Grading.—Nickel Plate Railroad, at $6,300, for the grading of the subway and its approaches at the Mayfield road, S. E. crossing. Bids were opened Dec. 24.

Woodsfield, O.—Paving—Rosser & Maloney, Bellaire, O., at $16,250, for the construction of 1.02 miles of brick paving, 14 ft., wide; roadway, 22 ft., wide; concrete curb. The work includes 6,650 cu. yds. excavation, 8,380 sq. yds., sandstone foundation, filler and sand cushion, 8,380 sq. yds., No. 1 vitrified brick paving and 10,774 lin. ft., concrete curb. Bids were opened Dec. 28.

Winston, N. C.—Pavement.—Atlantic Bitulithic Co., for the construction of 6,700 sq. yds. of bitulithic pavement in this city.

Chandler, Okla.—Highway—Petrolithic Construction Co., Chandler, Okla., for constructing 30.51 miles of hard surface highway in Road District No. 1.

Portland, Ore.—Paving.—Warren Construction Co., for the construction of 28,000 sq. yds. of bitulithic pavement in this city.

Houston, Tex.—Paving—A. F. Lucas, for the construction of pavement on San Jacinto St., from Leeland Ave. to McGowan Ave.; Travis St., from Dallas to Leeland Ave.; Main St., from present terminus of paving to city limits; Washington Ave., from Glenwood cemetery to Southern Pacific R. R. crossing. Brick will be used for the work.

El Paso, Tex.—Paving.—Texas Bitulithic Co., for the construction of 9,170 sq. yds. of bitulithic pavement on South Oregon St.

Fort Worth, Tex.—Paving.—Texas Bitulithic Co., for the construction of bitulithic pavement on portions of Missouri Ave. and College Ave.

Salt Lake City, Utah.—Paving—P. J. Moran, at $151,475, for the paving of Ninth East St., from South Temple St., to the city limits to the south; at $70,594, for the paving of First Ave., from J St., to Virginia St.

Puyallup, Wash.—Paving.—Warren Construction Co., for the construction of 19,000 sq. yds. of bitulithic pavement in this city.

SEWERS AND WATER SUPPLY.

Payette, Ida.—Sewer.—R. M. Bardsen & Co., Butte, Mont., at $28,825, for the construction of a sewer in improvement district No. 1.

Louisville, Ky.—Sewer—Guild and Co., Chattanooga, Tenn., for the construction of 21st St. Sewer, Contract No. 58. The work includes the following approximate quantities: 2,180 ft. of 60-in. reinforced concrete sewer; 1,566 ft. of 48 and 39-in. unreinforced concrete sewer; 3,746 ft. of earth excavation, 7 to 30 ft. deep; 970 cu. yds. of reinforced concrete; 520 cu. yds. of unreinforced concrete; 60,000 lbs. of steel reinforcement.

Lincoln, Neb.—Sewers—C. D. Campbell, at $10,226, for the construction of a storm sewer on B St., from Eighth to Third; at $3,091, for the construction of a storm sewer on North 27th St., from Holdredge to Potter.

Gloversville, N. J.—Sewage Plant—Albert L. Willey, Binghamton, N. Y., at $92,410, for the construction of a sewage disposal plant and for excavations connected therewith.

Roselle, N. J.—Sewers—Following contracts were awarded by the borough council; DeRosa and Jaques, at $3,781, for the construction of lateral sewers on Fifth Ave.; Harrison Construction Co., at $1,037, for the construction of lateral sewers in Vine St.

Sea Girt, N. J.—Sewage Disposal System.—B. F. Sweeteu & Son, Camden, N. J., at $11,337, for the construction of a sewage disposal system at the State Camp Grounds. The work includes 2,700 cast iron pipe, 8 in.; 1,680 vitrified pipe, 8 in.; intercepting and ejector chambers; 2 shone ejectors, 100 gals.; 13 manholes, and special connections. Bids were opened Dec. 28.

Sebring, O.—Sewers—John Skeele, Canton, O., at $11,059, for the construction of the sewage disposal works in this city.

Dayton, O.—Sanitary Sewer and By-Pass.—Backus Construction Co., 950 Reibold Bldg., Dayton, O., at $1,817, for the construction of a 36-in. reinforced concrete by-pass sewer, from the east side drain along the north side of the levee to the Longworth St. pumping station. The work includes the following: 390 lin. ft. of 36-in. reinforced concrete sewer (7-in. shell). Bids were opened Dec. 30.

Oklahoma City, Okla.—Sewers—Stokes & McCredie, Oklahoma City, Okla., for the construction of a lateral sewer in Bellemonde addition and blocks 1 to 14 inc. and 20 of Epworth View addition, and blocks 2, 4, 11, 12, 17, 18, 26, and east 195 ft. of block 25. Bids were opened Dec. 13.

Oklahoma City, Okla.—Sewers.—J. O. Stevens and F. R. Stone, for the construction of a sanitary lateral sewer in blocks 1 to 8, inclusive, of Brauer Heights Addition to Oklahoma City, Okla.

Ogden, Utah.—Sewer.—J. P. O'Neil Construction Co., at $624, for the construction of a sewer in Sewer District No. 101. Bids were opened Dec. 20.

Vancouver, Wash.—Sewers—Cascades Contract Co., at $17,151, for the construction of sewers on Grant, Harney, Ingalls and Jefferson Sts.

Kenosha, Wis.—Sewer—Fred Cate, for the construction of a sewer on Edwards St.

EXCAVATION, MISCELLANEOUS, MATERIALS.

Marion, Kan.—Waterworks and Electric Light Plant—Squire Electric & Construction Co., Kansas City, Mo., at $60,000, for the construction of a waterworks and electric light plant. The plant is to be finished within four months.

Baltimore, Md.—Timber Scow.—Oliver Reeder & Sons, Covington St., Baltimore, Md., at $2,246, for furnishing the Harbor Board with a timber scow, the dimensions of which will be 80 ft. by 24 ft. by 7 ft.

Pontiac, Mich.—Water Pipe—United States Cast Iron Foundry Co., Chicago, Ill., for furnishing the city with water pipe to be used for the water extensions, at the following prices: Four in. pipe, $26 per ton, and for all sizes over four in., $25.50 per ton.

Rochester, N. Y.—Fire Hose—Eureka Fire Hose Co., at $1 per ft., for furnishing the city with 5,000 ft. of fire hose.

Rochester, N. Y.—Armored Cable—Standard Underground Cable Co., at $.13 7-10, per ft. for furnishing the city with 10,000 ft., of armored cable.

Rochester, N. Y.—Elevator—Otis Elevator Co., for installing a passenger elevator at police headquarters.

Cincinnati, O.—Retaining Wall—E. M. Tompkins, at $2,050, for the construction of a concrete retaining wall on the Princeton pike, near Glendale.

Cleveland, O.—Pig Lead.—Illinois Smelting & Refining Co., at $4,790, for supplying the water works department with pig lead. Bids were opened Dec. 24.

Zanesville, O.—Pump House and Well.—J. A. Swingle & Co., Zanesville, O., at $89,316, for the construction of a pump house and well in this city. The building must be completed by June 1, and the new pump must be in operation by Sept. 1.

Providence, R. I.—Sewer Materials.—W. M. Harris, Jr., and Chas. M. Kelly, Providence, R. I., for furnishing and delivering to South Providence sewer material as follows: 1,200 ft. of 12x6-in., 75 ft. of 12x8-in. branch pipe; 26,000 12, 8 and 6-in. straight pipe; 100 pieces of 6x6x6-in. V pipe. Bids were opened Dec. 21.

Charleston, S. C.—Concrete Piles—Raymond Concrete Pile Co., 90 West St., New York, N. Y., and 135 Adams St., Chicago, Ill., for the placing of concrete piles in the foundations of the Peoples National Bank building in this city. Thompson and Frohling, New York, architects; Hedden Construction Co., general contractors.

Roanoke, Va.—Building—Virginia Bridge and Iron Co., at $225,000, for the construction of the steel structural work of a 23 story building to be erected by the Memphis Cotton Exchange. The building will cost $1,000,000.

Tacoma, Wash.—Fire Engines.—American La France Fire Engine Co., A. G. Long, general agent, Portland, Ore., at $12,370, for furnishing this city with two steam fire engines. Bids were opened Dec. 20.

PROJECTED WORK.

Bridges.

Items Arranged Alphabetically by States.

Globe, Ariz.—City Council is soon to call for bids for the construction of a bridge over Pinal Creek on North Broad St.

Pittsfield, Ill.—Advices from this place state that the Wabash R. R. Co., is to construct three new bridges on its Springfield Division over the sloughs of the Illinois River. The structures will be of concrete and stone.

Fort Scott, Kan.—County Commissioners are to hold a meeting to consider the construction of a bridge over the river at Woodland Ford, 6 miles northwest of the city.

Hutchinson, Kan.—City Commissioners have decided to construct a single, reinforced concrete arch with a 50 ft. clear span over Cow Creek at the intersection of Main St., and Ave. "A." City Engineer G. L. McLane reports that it will be possible to span the creek with a single arch, as a rise of 6 to 7 ft. may be secured. The structure will cover the creek for a distance of over 300 ft, with an area of about 16,000 sq. ft. City Engineer is to prepare plans, which, after approval by the Commissioners will be submitted to contractors for bids. This will be the first structure of the kind in the city, and the commissioners have by their decision, fixed the policy of replacing the 12 or 15 wooden bridges now spanning the creek with permanent bridges when renewals are required.

Westmoreland, Kan.—County Commissioners have agreed to appropriate $4,000 if Blue Township would vote $7,000 of bonds for the construction of an $11,000 bridge over the river in that township. The structure as proposed will be 400 ft. long and will be of steel.

Shreveport, La.—Plans have been approved by Capt. C. S. Smith, U. S. Engineer, Vicksburg, Miss., for the construction of a bridge across the Red River at the foot of Texas St., and city council will soon hold a meeting to authorize the construction of the structure.

Torras, La.—The Mississippi River Commission is to call a meeting at the office of Maj. H. Burgess, 2335 St. Charles Ave., New Orleans, La., for repairing the bridge over Old River in Torras, La. The improvements contemplated will require an expenditure of $9,000.

Lansing, Mich.—Plans and specifications have been prepared for the construction of a foot bridge over the Grand River at South St. The structure is estimated to cost about $1,300.

Duluth, Minn.—A petition has been filed with the City Council asking for the construction of a steel foot bridge on Twelfth Ave., from Michigan St., to Railroad St.

Springfield, Mo.—City Engineer Horton is preparing plans and making preliminary surveys for the construction of the proposed viaduct across the Jordan Valley on Grant St.

Schuyler, Neb.—Business Men of this city are to take steps toward securing the construction of a new bridge over the Platte River in the Spring.

Newark, N. J.—River and Navigation Committee of the Board of Trade is to hold a meeting to discuss the addition of facilities for pedestrian and vehicular traffic over the new Center St. bridge which is to be built by the Pennsylvania R. R.

Niagara Falls, N. Y.—Grade Crossing Commission approved plans and specifications prepared by the City Engineer, for the construction of a bridge over the New York Central tracks at the North End. The structure will be of steel and will have a 28 ft. road way. The estimated cost of the work is $75,000.

Rensselaer, N. Y.—Board of Aldermen are to consider plans for the construction of the new highway bridge over the Columbia Turnpike to be built by the New York Central R. R.

Springfield, O.—City is taking steps toward having the Cleveland, Cincinnati, Chicago &

St. Louis R. R. Co., repair the present structure or build a new bridge over its tracks at East High St. M. J. Bahin is City Engineer.

Toledo, O.—According to every indication the Pneumatic Caisson Co., Troy, N. Y., will be awarded the contract for the construction of the new $777,777 lift bridge over the river at Cherry St. The Board of Public Service and the Board of Control favor bid of the above company.

Youngstown, O.—Plans have been completed for the proposed overhead bridge at Holmes St. and will be submitted to the West End and North Side Improvement Clubs for approval.

Portland, Ore.—Bids are to be received sometime during January by the Oregon R. R. & Navigation Co., for the construction of a new railroad bridge at Oregon St. over the river. As proposed the structure will have two decks and a lower and upper draw, and is estimated to cost $1,300,000.

Scranton, Pa.—Resolution has been passed by the City Council and signed by the mayor providing for the construction of a viaduct over the Lackawanna R. R. in Keyser Valley at Washburn St. Plans and specifications will be prepared for the structure at once.

Chattanooga, Tenn.—City Council has made an appropriation for repairing the viaduct in that city.

Dallas, Tex.—Specifications have been approved by the County Commissioners for the construction of a $90,000 bridge to be erected at Miller's Ferry, between this city and Hutchins.

Laredo, Tex.—A bill has been introduced into the Congress at Washington, D. C., authorizing the National Mexican Ry. Co., to construct a bridge over the Rio Grande River connecting Nuevo Laredo, Mexico and Laredo, Tex.

San Antonio, Tex.—According to reports the San Antonio & Aransas Pass Ry., has announced that it will construct a steel bridge across the Colorado River between Altair and Eagle Lake. The structure is estimated to cost $70,000. J. S. Peter, San Antonio, Tex., is General Manager of the railroad.

Seattle, Wash.—Surveys and plans have been completed by G. F. Cotterill, Surveyor and F. W. Bowerman, Construction Engineer, for the new Railroad Avenue viaduct. The structure as planned will be 2 miles in length, straight across the Bay from Railroad Ave., in line with Alki Point and about 30 or 40 ft. above high tide.

Tacoma, Wash.—Resolution is to come before the city council providing for the construction of a wooden bridge over the gulch on Fairbanks St.

Milwaukee, Wis.—Resolution is to be introduced to the city council providing for an issue of $200,000 worth of bonds for the construction of a new bridge over the Milwaukee River at Buffalo St.

Cameron, Wis.—Citizens recently voted to rebuild the bridge over the Menomonie River in the town of Stanley.

Neillsville, Wis.—County Commissioners have decided to construct a steel bridge over Eau Claire River near Tioga.

St. John, N. B.—Council is considering the proposition to construct a bridge over the Harbor at a cost of $750,000, the cost being paid by the city, province and Dominion.

Sherbrooke, Que.—City Aldermen are in favor of replacing the Aylmer bridge across the St. Francos River, and a committee to investigate the matter was appointed.

Ottawa, Ont.—All bids recently received for removing the wreckage of the Quebec Bridge have been rejected and the work which is estimated to cost $50,000 will be let by private contract.

Roads and Streets.

Items Arranged Alphabetically by States.

Little Rock, Ark.—Petition is being circulated for the purpose of organizing a new paving district to include East Second St., from Olive to Smothers, Magnolia from Washington Ave., north to Ninth St., and Olive between Ninth St., and Washington Ave. It is planned to disburse between $15,000 and $18,000 for paving.

Phoenix, Ariz.—City is contemplating on paving the streets of the downtown district before constructing the sewers.

Jonesboro, Ark.—The street paving commission, improvement district No. 4 has rejected all bids for paving work to be done in this city. They will soon make an inspection tour of other cities after which the commission will again advertise for bids.

Pasadena, Cal.—City Council has decided to widen Broadway.

San Jose, Cal.—Board of public improvements has been asked to lay out, open and maintain a public Road District No. 5, commencing at the southwest corner of S. J. Brun's ranch on Hawthorne Ave., and running to San Antonio Ave.

San Diego, Cal.—City Council has instructed the city engineer to prepare plans, drawings, specifications and cross sections for the repaving of M St., from Sixth to 16th Sts., with asphalt laid on a concrete base; also for the construction of necessary culverts.

Stockton, Cal.—Board of Supervisors recently received the following bids for the construction of 13.8 miles of macadam roadway in the Manteca section of the county: Clark and Henery Construction Co., of this city, at $97,846; Cotton Bros. and Co., Oakland, Cal., at $88,826. Both bids were rejected.

Colorado Springs, Colo.—A meeting was recently held by the property owners included in the proposed paving districts to discuss the various paving materials and the relative cost of each.

Denver, Colo.—Denver Motor club, C. P. Allen, chairman, has perfected plans for a vigorous campaign for better roads throughout the entire state. The state will be asked for an appropriation of $500,000.

Denver, Colo.—The highway between Colorado Springs and Denver may soon be constructed, as the state has offered to do $5,000 worth of work on the boulevard if the county commissioners of El Paso county will advance a like amount.

Savannah, Ga.—An ordinance will probably be presented to the city council soon providing for the paving of Estill Ave., from Bull St., to the Waters Road. The paving of Whitaker and Drayton Sts., is also under consideration. Asphalt block will likely be used.

Bloomington, Ill.—City Engineer has submitted to the board of local improvements estimate of cost for the laying of an asphalt resurface on West Washington St., between Madison and Roosevelt Ave. The engineer is at present making calculations for the brick pavement for the remainder of the street to the C. & A.

Chicago, Ill.—Property owners of the city have petitioned the board of local improvements to pave 200 miles of streets this year.

Elkhart, Ind.—Marion St., of this city is to be paved with asphalt at a cost of about $23,000.

Wichita, Kan.—Petition has been presented to the city commissioners for the paving of Pattie Ave., from Douglas to Kellogg with asphalt.

Wichita, Kan.—Petitions are now before the board of city commissioners for approximately 10 miles of paving at a cost of nearly $500,000. The contracts for the work will be awarded this winter and the work pushed to completion at the earliest possible date.

Winfield, Kan.—Petitions for the paving of East Ninth St., with brick; curbing, guttering and macadamizing Gary St., and the opening of the north end of Bliss St., were received by the city council recently.

New Orleans, La.—City Engineer Hardee has been instructed to prepare new plans and specifications for the paving of St. Charles Ave., from Louisiana Ave., to Carrollton Ave., with bitulithic. The new specifications will call for both paving and subsurface drainage.

New Orleans, La.—The protest against the paving of North Prieur St., from Marigny to Press Sts., has been allowed by the committee on streets and landings.

Flemington, N. J.—Petitions have been presented to the Hunterdon County Board of Freeholders asking for a macadamized road from Milford to Flemington by the way of Mount Pleasant, Everittstown, Pittstown, Quakertown and Cherryville.

Trenton, N. J.—State Highway Commissioner will recommend to the next legislature the building of about 800 miles of state roads. The commissioner is already planning on the construction of an ocean boulevard from Atlantic Highlands to Cape May.

Buffalo, N. Y.—Property owners have filed a remonstrance with the common council against the repaving of Eagle St., between Union and Michigan Sts., on the grounds that the work is not needed.

Williamsville, N. Y.—Williamsville and Amherst Business Men's Association have taken steps to convince the state highway commission that the proposition of a 16 ft., road for Williamsville road is not wide enough. They ask that the road be built 25 ft. wide.

Alliance, O.—Plans have been completed for macadamizing the Patterson St., road from Alliance to Sebring, including the paving of about half mile of the road across the lowlands adjacent to the Mahoning river. A meeting will be held by the Smith Township trustees and the Mahoning county commissioners to discuss some plan whereby the road can be improved the entire length with brick.

Cincinnati, O.—County Commissioners have approved the plans and specifications for the improvement of Congress Ave., through the village of Glendale. This improvement will cost $10,891. The board also ordered plans and specifications for the improvement of Short Ave., in Fernbank. This improvement will cost $6,315.

Cleveland, O.—Park Engineer Stinchcomb in his estimate of the cost on park maintenance and necessary improvements for 1910 has included $100,000 for the extension of Edgewater boulevard from its present easterly terminus at W. 45th St., to W. 25th St. The engineer has also recommended the expenditure of $50,000 for the grading of the new speedway.

East Palestine, O.—City Council has passed ordinances providing for the paving of Clark and Martin Sts., with brick or block. The work includes about 11,400 ft. Contract will be let early in the spring. C. E. Vaughn, of this city is engineer.

Sandusky, O.—City Engineer has estimated the cost of paving Franklin St., between Water and Monroe Sts., with brick at $28,000.

Youngstown, O.—City Council has passed resolutions to pave the following streets: South Ave.; Poland Ave., from South Ave., to Lansingville school; Foster St.; Scott St.; and Thomas St.; Mahoning Ave., between West Ave., and Mahoning Ave., viaduct; Duquesne St., between Edwards St., and Oak Hill Ave.

Altus, Okla.—City will soon hold an election to vote on the issuance of $20,000 worth of municipal improvement bonds.

Ardmore, Okla.—City is planning on doing about $350,000 worth of paving during the year. Commissioner W. R. Burnitt already has plans for 225,000 sq. yds. of asphalt.

Chandler, Okla.—City Council is contemplating on paving the new four mile Linwood boulevard with a combination of macadam and asphalt.

Chandler, Okla.—City Council has decided to construct lateral storm sewers in the following streets: Fifth St., from the east side of Manvel Ave., to the east side of Blaine Ave.; Ninth St., from the west side of Price Ave., to the west side of Cleveland Ave.

Hobart, Okla.—City will soon hold an election to vote on the issuance of $90,000 worth of public improvement bonds.

Oklahoma City, Okla.—City Council has declared it necessary to grade Kelham Ave., from a point 144 ft. north of the north line of Granger St., to the north line of Alice St.; Granger St., 11th St., and Park Place from the east line of Kelham Ave., to the west line of Clark St., and Alice St., from the west line of Clark St., to the west line of Delaware Ave.

Oklahoma City, Okla.—City Council has declared it necessary to pave the East and West alley in block 47.

Albany, Ore.—The project to park several of the leading streets in the residence district of the city, preparatory to paving next summer was defeated in the city council. Plans are underway for the paving of Ferry, Broadalbin and Ellsworth St.; Third and Fourth are under consideration.

Portland, Ore.—Plans have partly been made for the construction of 75 miles of bitulithic, asphalt, Hassam and stone block pavement. The work is to be done on a concrete foundation; cement gravel will be used as a filler and concrete curb built. Contracts will probably be let during this winter. J. W. Morris, city hall, is engineer. T. M. Hurlburt, city hall is the official in charge.

Scranton, Pa.—Resolution has been introduced in the city council for the laying of an asphalt pavement on Sanderson Ave., from Market St., to Race St. From Race St., the proposed paving will go to Shawnee Ave., thence to Pond St., from Pond to Dean, and thence to North Main Ave.

Woonsocket, R. I.—City Council has passed a resolution to construct a highway from River St., to the Blackstone River.

Cookeville, Tenn.—City recently held an election to vote on the issuance of $30,000 worth of municipal bonds.

Denison, Tex.—City has voted the issuance of $260,000 worth of good roads bonds.

Alexandria, Va.—The county of Alexandria will soon pave four squares on King St., at a cost of about $18,000.

Leesburg, Va.—The Leesburg-Washington Turnpike Co., is to be incorporated with a capital stock of $150,000. The object is to macadamize the old Georgetown-Leesburg turnpike and maintain it by a system of tolls. John G. Hopkins, Ashburn, is president; E. R. White, vice president, and Westmoreland Davis, Morven Park, is secretary.

Norfolk, Va.—Board of Control has announced that estimates are in preparation for a new pavement on Granby St.

Norfolk, Va.—Ordinance appropriating $5,925 for the paving of Main St., has received the Mayor's veto, because it would leave less than $10,000 as a public improvement fund for Berkley ward.

Spokane, Wash.—Following paving contracts will be let this spring providing the ordinance for the changing of the period of maintenance bonds to be furnished by street-paving contractors from 10 to five years is passed: A mile of paving on Broadway west of Monroe St.; Grand St., from Ninth Ave., to 29th Ave.; seven blocks on North Monroe St., to Division St., and avenues in Browne's addition, and the paving of Perry St., on Cannon Hill.

Spokane, Wash.—City Council has passed a new ordinance to pave Howard St., from the Spokane river to Spofford Ave.

Tacoma, Wash.—City Engineer Raleigh has had a gang of surveyors at South Tacoma running lines for the proposed pavement of Union Ave. The avenue is to be 75 ft. wide.

Grafton, W. Va.—City will soon hold an election to vote on the issuance of $110,000 worth of municipal improvement bonds.

Sewers.

Items Arranged Alphabetically by States.

East San Jose, Cal.—Board of Trustees has accepted the plans and specifications prepared by town engineer J. E. Fisher for the proposed sewer system.

Los Angeles, Cal.—City Engineer is busy with plans for extending the sewer system to sev-

eral sections of the new territory in the Wilshire and Sunset boulevard districts.

Greeley, Colo.—City Council has ordered the extension of the sewer system in this city.

Canton, Ill.—Drawings and specifications for the rebuilding and enlarging of the sewer system for this city are being made by A. T. Maltby of Chicago, Ill. Mr. Rudolph Meisinger of Pekin, Ill., will probably superintend the construction work.

Sterling, Ill.—City Engineer J. D. Arey has been instructed to prepare plans and the estimate of the cost of the proposed extension of the sewer system on Dixon Ave.

Grinnell, Ia.—Guy E. Smith of Indianola was low bidder for the construction of the storm sewer in North Grinnell. The sewer is to be 5,530 ft. long, with 15 manholes. Mr. Smith's bid was $4,662. The contract was not awarded on account of a technicality which will soon be complied with.

Missouri Valley, Ia.—Plans and specifications for the proposed sewerage system for this city are being prepared by the Iowa Engineering Co., of Clinton, Ia.

Webster, Ia.—City Council is planning on constructing a sewer along the alley of Second St., from Third St., to the river for the purpose of draining the business district of the city.

Louisville, Ky.—C. T. McCracken & Co., Columbus, O., was the lowest bidder for the construction of the Jane St., sewer, Sewer Contract No. 59, of the comprehensive system of sewerage for this city. The work will include the following approximate quantities: 3,460 ft. of 8 to 33-in. sewer and drain from 4 to 17 ft. deep; 1,300 cu. yds. of rock excavation; 700 cu. yds. of concrete; 5,700 ft. of vitrified pipe from 8 to 24-in. J. B. F. Breed is Chief Engineer.

Greenfield, Mass.—Preliminary plans are being made for the proposed new intercepting sewer at an estimated cost of from $40,000 to $50,000. At present it is thought that the construction will not include a disposal plant. William S. Johnson, 101 Tremont St., Boston, Mass., is consulting engineer; George F. Merrill, Greenfield, Mass., is the chairman of the committee appointed to investigate sewage disposal.

Sedalia, Mo.—Plans and specifications for the construction of a sewage purification plant at this city are being prepared by Burns & McDonnell, Scarritt Bldg., Kansas City, Mo.

New Brunswick, N. J.—The mayor has named an advisory sewage disposal commission to consider the problem of changing the sewage system of this city to avoid pollution of the Raritan river.

Paterson, N. J.—An estimate of the cost of the proposed sewer system for the Lakeview section of the city has been prepared by Engineer Harder. The board of public works is in favor of the construction of the sewer.

North Tonawanda, N. Y.—Board of Public Works accompanied by City Engineer A. P. Smith, visited Ithica for the purpose of obtaining information and a demonstration of both the centrifugal and Shone systems of lift pumps. It is planned to install one of these systems in this city.

Waterville, N. Y.—C. A. Holquit, chief engineer of the State Health Department, has investigated the sanitary conditions in this city, and states that unless the city prevents the pollution of the stream which runs through the village, they will have to build a public system of sewers.

Grand Forks, N. Dak. — A tunnel will be built under the Great Northern right of way for a distance of 250 ft., for the DeMers Ave., sewer main so that the sewer may be perfectly safe and not subject to danger of being crushed by the weight of heavy trains above. The tunnel will be about seven ft., in diameter and the sewer main will be 23 ft., beneath the surface.

Cincinnati, O.—County Commissioners have been petitioned to build a trunk sewer in Millcreek, from Glendale to the Ohio River.

Greenville, O.—City Council has authorized the board of control to employ an engineer to prepare plans and specifications for a sanitary sewer disposal plant for this city.

Hamilton, O.—An ordinance has been presented to the city council for the construction of certain sanitary sewers in the Third ward.

Sandusky, O.—City Council has been asked to construct a 15-in. tile sewer on McKelvey St., instead of the old 9-in. tile sewer now there.

Steubenville, O.—City Council has decided to construct a sewer in Edgar Ave., for a distance of 250 ft., and in Spring Ave., from South and Spring Ave., to Elm St.

Youngstown, O.—City Council has passed the following resolutions: To sewer and build outlet in Frederick Ave.; to sewer Buckeye St., between Hillman and Garlick Sts.; to sewer Garlick St., between Tremont and Weldo Sts.; to sewer Cypress St.

Cherokee, Okla.—City Attorney Sam Halstead has asked the government for permission to run the sewer mains of this city to the great Salt Plains and use a portion of them as an outlet. The piping to the plains will be commenced as soon as the permission is obtained.

Oklahoma City, Okla.—City Council has declared it necessary to construct manholes and catch basins and to put in inlet pipes, lateral storm sewers, curbs and reset curbs in East and West alley in block 47.

McKeesport, Pa.—City Council has decided to appropriate $4,000 for the city engineer to employ assistants in preparing sewer plans for the city as demanded by the state board of health. J. Munroe Smith is city engineer.

Columbia, S. C.—The street committee of the city council has authorized the construction of a storm sewer on Cherokee St., to Weston and Booker at an estimated cost of $2,661.

Austin, Tex.—A report will soon be submitted to the city council estimating the value of the property of the Austin Sewerage Co., with a view to its purchase by the city.

Richmond, Va.—Following construction work has been authorized by the city council: Sewer, in alley between Leigh and M Sts., at $593; sewers in 33rd and other streets, amounting to $26,989; sewer in 31st St., from M to P to cost $1,500; sewer in Winder St., to cost $800; and a number of sewers in Fulton to cost $22,657.

Richmond, Va.—City Council has approved the plans and ordered the construction of the first section of the Dooley Ravine sewer, from James River, under the Chesapeake and Ohio Ry., and under the James River and Kanawha canal; estimated cost $60,000.

Water Supply.

Items Arranged Alphabetically by States.

Aplington, Ia.—Citizens of this place are agitating the installation of a water works system for the city.

Corydon, Ia.—The installation of a complete water works and sewerage system for this city is being agitated.

Delmar, Ia.—A petition is being circulated asking the town Council to call a special election for the purpose of voting bonds for the extension and improvement of the water works system.

Grinnell, Ia.—City Council is to be petitioned to hold a special election for the purpose of voting a bond issue of $15,000 for the improvement of the water works plant.

Leon, Ia.—City has voted to install a system of water works.

Boise Barracks, Ida.—An appropriation of $40,000 has been granted by the War Department, Washington, D. C., to Captain Ryan, Constructing Quartermaster, for securing additional water supply.

Bloomington, Ill.—City Water Board has decided to readvertise for bids for the enlargement and improvement of the water works station. Bids were formerly advertised for on Dec. 28.

Rockford, Ill.—City Water Works Committee is now considering the installation of larger water mains throughout the city.

Vermont, Ill.—Town has issued bonds for the purpose of installing a water works system.

Canton, Kan.—A movement is on foot in this town leading toward the installation of a water works and electric light system.

Wichita, Kan.—City has under consideration a plan to purchase the present water works system at a cost of approximately $1,000,000.

Saginaw, Mich.—City Council has passed a resolution calling for a new water plant in Saginaw and an election is soon to be held to vote on issuing $500,000 worth of bonds for the purpose.

Hibbing, Minn.—Water and Light Commission has decided to improve the water works system, which at present is inadequate.

Chouteau, Mont.—Steps are being taken providing for the construction of a water works system. Carl Tschepen, Havre, Mont., is seeking a water franchise.

Manchester, N. Y.—Citizens are anxious that a system of water works be installed and a proposition to bond the village for $25,000 for that purpose is to be submitted to the voters.

New York, N. Y.—The State Water Board is to hold a meeting Jan. 11 at New York, for the purpose of considering the plan for constructing a tunnel under Manhattan for the Catskill System as proposed by the New York Water Board. The estimated cost of the work is $25,000,000.

Morehead City, N. C.—W. J. Hales, Secretary, will sell bonds amounting to $20,000 for water works on Jan. 17, 1910.

Altus, Okla.—City Council has decided to hold a special election to vote on issuing bonds amounting to $200,000 for the purpose of extending the municipal water and electric plant and the sewer system.

Foss, Okla.—The proposition to issue $29,000 worth of bonds for the construction of a water works system was carried.

Davis, S. Dak.—City has under consideration the matter of installing a municipal water works system and it will probably be submitted to the voters at the early Spring election.

Dallas, Tex.—Plans and specifications have been approved by the Consulting Engineer, for the White Rock Reservoir, dam and pumping station and Board of Municipal Commissioners will probably call for bids for the work in the near future.

Merkel, Tex.—Preliminary surveys have been completed for the city water works system and construction work will be started soon.

Sherman, Tex.—City voted at a special election to the issuance of bonds amounting to $12,000 for the extension of the water works system.

Vernal City, Utah.—Contracts are to be let within 60 days for the installation of a new water works system, estimated to cost $24,500. The canal will be used as a source of supply. Gray & Grosh, Salt Lake City, Utah, are the Engineers. Benjamin Kelly is City Recorder.

Martinsburg, W. Va.—City recently voted to issue bonds amounting to $40,000 for the purpose of extending the present water works system.

Oshkosh, Wis.—Resolution has been adopted instructing the mayor to appoint a committee to outline a plan for the construction of a new water works plant for the city.

Racine, Wis.—City has under consideration the matter of installing a municipal water works system.

TRADE NOTES.

Mr. Warren Wood, proprietor of the Wood Drill Works of Paterson, N. J., is in Chicago, and can be found at the company's offices, 5108-5110 West Lake St., Chicago, Ill.

The Arthur Koppel Co. has been consolidated with the Orenstein & Koppel Co., and the new corporation will be known in the future as the Orenstein-Arthur Koppel Co. The combined corporation has a capital of $6,500,000, with a surplus of $2,000,000, and is said to be the largest company in the world for designing, installing and manufacturing of narrow gage railways, viz: Portable railways, industrial railways, narrow gage sidings, narrow gage public railways and railway equipments of all kinds. One of the specialties of the company is the study of the individual transportation problem. They also act as consulting engineers to render their customers all the assistance required. The capacity of the plant built a few years ago at Koppel, Pa., has been enlarged in order to meet the increased demand of the products.

The Strauss Bascule & Concrete Bridge Co., Chicago, Ill., report the following orders taken during the past year: Railway Bridges—Florida East Coast Ry., at Ft. Lauderdale, Fla., over New River, 63 ft. 6 ins., single leaf, single track. National Transcontinental Ry., at Winnipeg, Man,. over Red River, 129 ft. 6 ins., single leaf, double track. Peoria & Pekin Union Ry., at Peoria, Ill., over Illinois River, 160 ft., single leaf, double track. Erie R. R. Co. (New York Division), over Hackensack River, 152 ft., single leaf, double track. Cape Cod Construction Co. (for N. Y., N. H. & H. R. R.), over Cape Cod Canal, 160 ft., single leaf, double track. Erie R. R. Co. (N. Y. S. & W. R. R.), over Overpeck Creek, at Little Ferry, N. J., 55 ft. 5 ins., single leaf, double track. C. & W. I. R. R., at Chicago, Ill., over Calumet River, 186 ft., single leaf, double track. Canadian Northern Ry., at Winnipeg, Man., over Assiniboine River, 92 ft., single leaf, double track. Niagara St. Catharines & Toronto Ry., over Welland Canal Feeder, 46 ft. single leaf, single track. Northern Pacific Ry., over Duwamish River, at Seattle, Wash., 160 ft., single leaf, double track. Highway Bridges—City of Ottawa, Ill., over Illinois River, 118 ft. single leaf. Cape Cod Construction Co., at Buzzards Bay, Mass., over Cape Cod Canal, 160 ft., single leaf. Department of Rys. & Canals, Canada, over Trent Canal, at Lindsay, Ont., 73 ft., single leaf. City of St. Petersburg, Russia, over Neva River, 200 ft., clear span bascule, double leaf. The Palace Bridge at St. Petersburg will require a number of years in its construction, being an unusually monumental work. The remaining bridges will probably all be in service by next spring, including the C. & W. I. R. R. bridge across the Calumet River, which will be a single leaf structure of unusual proportions. There are also now nearing completion the Polk Street bridge for the city of Chicago, the Walnut Street bridge for the city of Green Bay, Wis., and the Illinois River bridge for the city of Ottawa, Ill., which will make the total number of Strauss Trunnion bridges in active service 13. Of these the 170-ft. double track, single leaf bridge for the C. & N. W. Ry. at Kinzie St., Chicago, which was put in service during the month of September, 1908, has an average record of 1,000 bridge movements per month and of 1,100 train movements per day. Since this bridge was put into service at a moment's notice and without any preliminary trying out, this is evidence of extreme efficiency. In a recent test it was found that the average horsepower required for the operation of this structure was 30, with a minimum of 14 and a maximum of 78.

CONTENTS OF DECEMBER 29, ISSUE OF ENGINEERING-CONTRACTING.

EDITORIAL:

Boston's $1,000,000 Experience in the Municipal Operation of Stone Crushing Plants 555

CONCRETE SECTION:

Some Retaining Wall Construction in Connection With the Chicago & Northwestern Railway Track Elevation Work in Chicago 556

Moulding Concrete Piles With Enlarged Bases for Posttoffice Building Foundation at Paris, Ill. 557

Specifications for Concrete Sewers at Richmond, Ind. 558

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CONTENTS.

EDITORIALS:
- Percentage Bidding as Viewed by the Contractor and the Engineer 25
- Engineer Department Heads for New York City 25

CONCRETE SECTION:
- Reducing Contraction and Absorption of Concrete by Mixing It with Mineral Oil .. 26
- The Disposal of Sewage Sludge 27
- Election of Officers for 1910 of the Western Society of Engineers 27

EARTH AND ROCK SECTION:
- Suggestions on the Design and Selection of Traction Engines 28

ROADS AND STREETS SECTION:
- Economics of Street Pavements 30

WATER-WORKS AND SEWER SECTION:
- Formulas for the Capacity of Tile Drains .. 32
- Refuse Disposal and the New Refuse Incineration Plant for Milwaukee 32

BRIDGES, BUILDINGS AND FOUNDATIONS:
- A New Method of Sinking Cylinder Foundations in Underpinning the Cambridge Building, New York City 35
- A Suggested Form of Building Contract Designed to Secure Justice and Equity to Both Owner and Contractor 37

RAILWAY SECTION:
- Original Cost and Cost of Reproduction of the Northern Pacific Railway (1,645 Miles) in the State of Washington 44
- The Study of Engineering Contracting in Engineering Colleges 46

LETTERS TO THE EDITOR 47

COMING TECHNICAL MEETINGS 48

PERSONALS 48

CATALOGS WORTH HAVING 48

Percentage Bidding as Viewed by the Contractor and the Engineer.

The evils of unbalanced bids have been a fruitful source of discussion. Many suggestions have been made to overcome or minimize the dissatisfaction invariably consequent upon the discovery that a contractor has so unbalanced a certain bid that his resulting profit has been more than the other party to the contract deemed proper. What has seemed to many engineers of experience a good method to enable an analysis of bids to be made, has been the percentage method now used in a number of cities.

The percentage system calls for more care in the preparation of estimates on the part of the engineer than is customary before its introduction. It reduces to a minimum the office work involved in the comparison of bids received and each bid is subjected to a careful analysis. Briefly, the engineer prepares careful detailed estimates with 100 per cent unit, item, or total costs. Before the present era of the study of methods and costs by engineers such estimates would have been of little value, for engineers were then chiefly concerned with design. The present day engineer is a technically trained business man, whereas in former years he was a technically educated scientist. Instead of the contractors submitting unit or item bids for work, they bid, under the percentage system, a plus or minus per cent of the engineer's estimated 100 per cent costs.

The percentage system of bidding has become popular with engineers. It is claimed by many that it is a good system and has enabled engineers in the necessarily hurried study of bids before award of contracts, to protect themselves against overlooking many apparently unimportant items. Some contractors claim it has eliminated an undesirable class of guessers and is thus good for the contractors as a whole, while other experienced contractors claim it has led many to go into contracting who rely entirely upon the engineer's estimates and bid accordingly. This last objection has from time immemorial been urged against preliminary estimates.

The General Contractors' Association of New York city has recently issued a brief embodying suggestions for changes in sewer specifications from which the following section relating to percentage bids has been taken:

Seventh—We would ask that the percentage system of bidding on work be abolished for the following reasons:

It does not insure an unbalanced bid unless it could be assumed that the estimate of quantities as made up by the engineer, together with his estimated cost, were absolute and accurate. We feel that a contractor of experience is better enabled to estimate the cost of work than the engineer, whose ideas of cost must be largely a matter of conjecture. It would permit of irregularity in unbalancing the estimated quantities by the engineer preparing the estimate (should he be unscrupulous) and enable him to work in collusion with a favored bidder. By the ordinary system of bidding item by item it is possible, where such a condition of unbalanced quantities exists, to so arrange the prices on the various items—reducing that on an overbalanced item and increasing the price on some other item which will cover it in accordance with the original quantities—as to reimburse the bidder for the loss which he will sustain on the overbalanced item. With the percentage system, however, the bidder has no opportunity along that line, as his average percentage price is applied uniformly to the engineer's 100 per cent standard, and if that standard be too low or too high in any particular item or items the bidder has no recourse but to follow the ratio designated by the engineer and must make his percentage sufficiently high to safeguard himself, which course makes his bid higher than it would be were the quantities properly stated by the engineer. It is claimed that the percentage system of bidding prevents unbalancing by the contractor; but it would seem possible for the engineer to detect an unbalanced bid quite as readily by the system of item bidding, as he could apply his uniform standard in comparison with the contractor's scale of prices and satisfy himself whether the latter were unbalanced. The fact that the engineer has established the 100 per cent basis for bidding might be assumed by the uninformed that such standard was sufficient and that prices should never exceed the engineer's limit. We submit that the engineer is not in a position to make the careful estimate of cost that the contractor must make in submitting his bid for the work. The engineer is apt to assume that certain fixed standards will meet all conditions, which is not true in all cases, and may result in an unbalanced estimate as the standard. The contractor in estimating a piece of work would figure it item by item and compare his total cost with the engineer's 100 per cent allowance regardless of the fact that his scale of cost may not correspond in ratio in every respect with those given by the engineer. It is impossible, therefore, to tell whether on the completion of the work the quantities will have been justified, and as a matter of prudence he will be inclined to increase his figures to cover the contingency.

Without taking sides we incline to the belief that the arguments presented by the contractors are not cogent. The admission is made that the engineer will likely employ his 100 per cent standard in comparing bids; it is also admitted that contractors will compare bids before submission, with the engineers' 100 per cent standard. The argument against the percentage method is, therefore, resolved into little more than a mere statement that the contractors do not like it.

As in all such protests some ground exists for the protest and in this one the men making it have failed to present some essential fact on which they apparently agree but cannot adequately present.

Engineer Department Heads in New York City.

The new city administration of New York headed by the Hon. William J. Gaynor as mayor has signalized the inauguration of its work by the appointment of engineers as heads of several of the most important city departments. It is worth while to note the list. As head of the Department of Docks is Mr. Calvin Tomkins, an Associate of the American Society of Civil Engineers and a man prominent in the engineering industries. The new Commissioner of Water and Gas Supply is Mr. Henry S. Thompson for many years the head of the well known building contracting firm of Thompson-Starrett Co. As head of the Bureau of Buildings of Manhattan is Mr. Rudolph P. Miller, M. Am. Soc. C. E., a man unusually well qualified by experience and in technical attainments for the position. The great Department of Bridges with its unusual demands for technical and executive ability is placed under the direction of Mr. Kingsley L. Martin, M. Am. Soc. C. E. This engineer who entered the department a dozen years ago in a subordinate position has earned promotion step by step until now he is made its head.

It is so rare that even a single city department in New York or in any large American city has an engineer head that this list of appointments from the engineering field is notable. The question naturally arises, is it of any general significance? In a word, does it signify merely the individual notion of the new mayor of the great eastern metropolis as to the kind of training that best fits men to direct city public works or is it evidence of a growing public opinion? We cannot feel altogether confident that the last alternative is the true answer, but recent events are not without evidence that it may be.

The city of Boston, as we noted in our issue of Nov. 24, 1909, has by popular vote revolu-

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tionized its city government largely because of the disclosures that have been made of the inefficiency of its politician department heads. Just now the city of Chicago is in the midst of a public investigation which is every day adding fact upon fact proving the gross incompetence, if no worse, of its politician heads of departments. Engineers know, largely through our columns alone we may remark incidentally, what conditions of incompetency, carelessness, extravagance and veniality were disclosed in Boston. The Chicago investigations have not progressed so far, only fragments of the Merriam commission's discoveries have found their way outside of the committee rooms, but the little that is known indicates a condition of affairs no whit better than that disclosed by the Boston Finance Commission.

The important fact of these investigations in Boston and in Chicago is not wholly that incompetency and extravagance has been proved—both these and a certain measure of rascality were long ago known to exist; it is that the people have put their city servants on trial. Incidentally, whenever this trial has been pushed to a decision the politician heads of departments have been convicted. It is not perhaps without significance too that the evidence which secured conviction was evidence collected, analyzed and presented by engineers. This was the case in Boston as we have demonstrated in many pages of text and cost data published during the last few months. It will be found to have been the case in Chicago, also, when the work of the engineers of the Merriam commission comes to be made public. We shall go even further and say that no one but engineers could have searched out so wisely and presented so forcibly this evidence. These things are the business of the engineer, just as much as are the computation of strains and the marking of lines and levels with which alone he is associated in the public mind. Indeed, they are even more his business.

This journal has advocated the appointment of engineers to direct, as responsible heads, the public works departments of our cities. It has further advocated that in every large city at least there should be a review board composed largely of engineers to review, to criticise and to suggest improvements in the work of these department heads. The direction of a city's street department, or sewer department, or water supply department, or bridge department is a work of management engineering. The engineer fitted to be at the head of great works is to-day a management engineer, something more than a technician but none the less a man of technical attainments. There are such engineers, scores of them, and it is they who should handle our city public works.

The city of New York has begun a regime of engineer management of public works. Several of its most important bureau heads are men who have gained prominence in the engineering field. Their success or failure in their work will signify much to engineers. Engineers the country over can but be gratified that their profession has been so generously recognized. It is our belief that this recognition will have been proved justified when the time comes to take account of work done.

Concrete and Reinforced Concrete Section

Note: This section is devoted to methods and cost of constructing concrete and reinforced concrete structures. It will cover the selection, testing and proportioning of concrete materials; laboratory tests of concrete; concrete mixing, transportation and placing; fabrication and placing of reinforcement, and form construction and erection. It will also contain articles on new and interesting developments in the design of reinforced concrete.

Reducing Contraction and Absorption of Concrete by Mixing it with Mineral Oil.

BY ALBERT MOYER.*

The mixing of oil (mineral) with concrete is very simple. The oil, alkalies and water will form an emulsion becoming thoroughly incorporated in the concrete. If the concrete is to be mixed by hand, proceed as usual and after the water has been added and the resulting mass turned and raked, add non-volatile mineral oil in proportion of 10 to 15 per cent of oil to the weight of the cement. Turn the concrete with shovels two or three times, raking while turning; the oil will quickly emulsify and become thoroughly mixed in the concrete. If machine mixing is employed, use a batch mixer, turning a sufficient number of times thoroughly to mix the cement, sand, crushed stone or gravel and water. Then add 10 to 15 per cent of non-volatile mineral oil and turn again the same number of times as it required to mix the concrete. The oil will quickly emulsify and become thoroughly incorporated in the concrete.

Oils added to concrete in proportion of from 5 to 15 per cent will slightly delay the initial and final set. Increasing the proportions of oil will further retard both the initial and final set and hardening, but up to 15 per cent from experiments so far made, it would seem that the retarding of hardening will not be sufficient to cause the work to be uneconomical. The tensile strength will necessarily be reduced, and with the increasing percentage of oil toughness will be slightly diminished but not in proportion to the increase in the percentage of oil used.

An extremely interesting paper (Eng.-Contg., Jan. 5, 1910) was read at the meeting of the Association of American Portland Cement Manufacturers, New York, Dec. 15, 1909, by Logan Waller Page, Director Office of Public Roads, Agricultural Department, Washington, D. C., on the subject of the "Possibilities of Portland Cement as a Road Material," in which he described some investigations being carried on by Dr. Allerton S. Cushman in the Laboratory of the Office of Public Roads to ascertain the practicability of mixing semi-asphaltic base oils with Portland cement concrete, with the object of obtaining the desirable properties of both Portland cement and asphaltum. So far only pats and briquettes have been made; the results so far obtained show ample strength for ordinary work; 6-in. cubes will be tested later. It is believed that compression tests will show greater strength than the usual relation of compression to tension. This is a matter for further investigation, and it is to be hoped that chemists and cement testers will actively take up this work and carry on investigations covering long time periods.

Tensile strain tests should be discarded. Such tests have now been discovered by the German Portland Cement Manufacturers and compression tests substituted. With the increased scientific knowledge and the consequent better material produced by Portland cement manufacturers, tensile strain tests have become obsolete, and owing to the brittleness and extreme sensitiveness of neat Portland cement, the unscientific methods employed in tensile strain tests, the personal equasion involved, tensile strain tests do not indicate the possible load which Portland cement concrete may carry.

I, therefore, would earnestly advocate compression tests on cylinders of a size which will cause the area to equal 6-in. cubes. In order that such tests may be standardized and relative, standard sand should be used, and if possible a standardization of gravel or crushed stone. If crushed stone, trap rock should be used, all passing through a ¾-in. mesh and all collected on a ¼-in. mesh. Mix up cylinders which will theoretically figure maximum density, add varying proportions of oil from 5 to 20 per cent. Also make up another set of cylinders adding proportions of hydrated lime, from 10 to 30 per cent, increasing the percentage of oil with the increase of hydrated lime. The addition of hydrated lime theoretically should permit the addition of a larger percentage of oil, as we thus have a greater emulsifying material. Varying percentages of Portland cement may be used, always keeping the relation between the sand and stone the same, maximum density having been figured. The amount of Portland cement to be increased above that which is required to fill the voids in the sand.

Two months ago the writer made some briquettes and pats with the object in view of ascertaining, if the mixture of oil with wet neat cement and mortar would have the tendency of keeping all but the excess water from leaving the wet neat cement of mortar. Briquettes were made, neat cement mixed with water, the water slightly in excess of that usually required, after which 10 per cent of oil petrole was added. (Oil Petrole is a white non-volatile petroleum product of about the consistency of melted vaseline). Pats were made of 1 part cement and 3 parts sand, mixed with water a little in excess of what would ordinarily be used, after which 10 per cent of the same oil was added. These pats are about 2½-ins. in diameter and a ¼-in. thick.

As soon as made the pats were left in dry air. The initial and final set was found to be normal. They were never immersed in water but remained in dry air for several weeks. No cracks occurred and they became so hard and strong that they were very difficult to break by the use of the fingers and thumbs. After remaining in dry air for three weeks, they were put out in freezing temperature for three days, and again placed in dry air over the radiator. No cracks or checks have occurred.

After remaining in dry air for a month, a test for absorption was made. A broken pat was weighed dry and found to weigh 94-64 oz. It was then immersed in water for several hours. Upon removal from the water, the surface was quickly removed with blotting paper, the pat immediately weighed and found to weigh 99-64 oz. Only 5-64 oz. of water was absorbed.

The fact that the pats were never immersed in water and showed no evidence of checking or cracking, and became hard, would indicate that the emulsified oil had held the water in the mortar and that such mortar was, therefore, both non-evaporative and non-absorbent, which would tend to show that concrete in which mineral oil has been mixed would not be likely to contract and therefore contraction cracks would be avoided.

Under the theory of Prof. Bauschinger, which has been demonstrated by Prof. Swain in the laboratory of the Massachusetts Institute of Technology, neat cement when set and hardened in air contracts and this con-

*Fifth Avenue Bldg., Madison Square, New York.

traction increases with age up to a certain period, possibly six months or a year. A mortar of 1 part Portland cement and 3 parts sand, hardened in air, shows contraction but less in proportion than neat cement. The results also prove that neat cement when hardened under water shows a slight expansion, while mortar composed of 1 part Portland cement and 3 parts sand, hardened under water, shows expansion but less in proportion than the neat cement. Reducing these conclusions to figures and taking the average results obtained by various authorities, figuring the expansion and contraction by percentage the following are the results:

Neat Portland cement hardened in air at the end of 16 weeks shows 0.15 per cent contraction.
1 to 3 mortar hardened in air at the end of 16 weeks shows 0.05 per cent contraction.
Neat Portland cement hardened under water at the end of 15 weeks shows 0.05 per cent expansion.
1 to 3 mortar hardened under water at the end of 16 weeks shows a 0.015 per cent expansion.

Mixing oil with concrete, judging from the meager tests so far made, would seem to indicate that the oil held the water in the mortar keeping the cement particles wet and thus furnishing the same conditions as if set under water, hence very materially assisting, if not altogether obviating contraction cracks and hair cracks or crazing. Furthermore, the resulting mortar appears to be far less brittle and therefore such treatment should admirably serve the purposes required of concrete retaining walls, foundations enclosing cellars, tanks, cisterns, etc.

Exhaustive tests have been made by a number of authorities on the action of oils on concrete. The effect of oil on concrete and the effect of oil emulsified in concrete are two separate and distinct subjects.

We are informed by reliable authorities that concrete immersed in animal or vegetable oils will in time disintegrate and that concrete immersed in mineral oils is unaffected. In the first instance there was no chance for the oil to emulsify, in the latter the oil is separated into minute globules. A large field of usefulness is ready for oil mixed and emulsified in concrete. The emulsion takes place after the oil is mixed with the wet concrete and not before as has been done in a patented article.

A mere casual glance at the uses of Portland cement concrete would indicate that oil mixed with the concrete would prove very desirable for dustless waterproof floors for office buildings, for slaughter house non-absorbent floors, impervious concrete drain tile and sewers. If the experiments to be carried on in the future prove that mineral oils in the course of time are not disadvantageous, the drain tile problem has been solved, for there can be no action of the alkalies or other injurious elements to non-absorbent, dense and impervious concrete.

Such concrete will be particularly desirable for silos. Some of the acids formed by the silage in the bottom of the silo would probably not attack a dense, non-absorbent, impervious concrete.

Contraction cracks will be eliminated in cisterns, drinking troughs, live stock feeding floors and platforms. Some objection may be raised to the use of oil mixed concrete from the standpoint of its liability to flavor the water or the food. If we stop to consider that the oil is divided into minute globules, thoroughly emulsified, we will see that while there may be some odor there is not likely to be any taste after the drinking trough, feeding floor or cistern has been in use for a few days.

Such oil mixed concrete will be effective for liquid manure cisterns for the reason above described. It will also be particularly adapted to terrazzo floors, the great objection at present being due to contraction cracks. A white oil may be mixed with Portland cement, white sand and water and used for the purpose of setting brick and stone; it being non-evaporative and non-absorbent no efflorescence or stains can occur. In fact, such concrete can be used in any work not requiring extraordinary compression strength, and in which the concrete does not come in contact with heat.

One of the particular advantages will be for stucco work, and exterior plasters. It would seem that this idea of mixing oil with wet mortar was novel and new, but like many discoveries it only proves to be a rediscovery. In the first century A. D., Marcus Vitruvius Pollio, the famous Roman architect, gives the following detailed specification for stucco. "A mixture of well hydrated lime, marble dust and white sand mixed with water, to which mixture is added either hogs lard, curdled milk or blood." In A. D. 1280 at Rockingham Castle, England, melted wax was mixed with the mortar. In A. D. 1324 in the work of King Edward II. at Westminster pitch was mixed with mortar.

The permanency of the Roman stuccoes may be partially accounted for by the use of oil mixed with mortar. Although Vitruvius used hogs' lard, an animal oil, the mortars have withstood the action of the centuries, and in places where freezing temperature occurs in winter and great heat in summer. However, the hogs' lard must have been very thoroughly emulsified by the action of the hydrated lime. Portland cement was unknown at that period. In this connection, I would like to suggest the following specification for stucco, the third or finish coat:

Use 1 part Portland cement, 20 per cent (volume of cement) of hydrated lime and 3 parts coarse white sand. First dry mix the sand and cement and with this mix dry hydrated lime turning each three times with shovels, rake while shoveling. Add water, turning and raking until the desired consistency is obtained. Then add 15 to 20 per cent of white oil petrole (Chesebrough Mfg. Co., New York), the oil to be by weight in percentage to the weight of the cement. A gallon of oil petrole weighs 7½ lbs. Apply this mortar while the scratch coat is damp and as soon as scratch coat is firm enough to stand the pressure or plastering. If it be desirable to tint the stucco color the oil with any lime-proof coloring matter, in proportion which by experiment with small samples is necessary to give the desired tint.

A white non-volatile mineral oil is suggested for stucco and for mortar to be used in setting white marble or light colored brick, on account of the color possibilities. For concrete where the color is not essential the heavy black bituminous oils to the light non-volatile petroleum oils are successful. They are cheap and their name is legion. Do not use oils containing organic matter and positively avoid, at least for the present and until further experiements have been made, vegetable or animal oils as they are liable to form an acid which in turn may disintegrate the concrete.

Lime, and animal oils have stood the test of centuries; Portland cement and animal oils have not yet had this opportunity. It is within the range of possibility that the test of time may prove contrary to the theory and animal oils emulsified be found not dangerous.

The Disposal of Sewage Sludge.

Mr. W. C. Easdale at a recent meeting in London, of the Institution of Civil Engineers made the following comments on the disposal of sewage sludge. The conversion of sludge into a marketable manure is a genuine disposal, in that the products are actually taken away and got rid of. The cost of the process is high and not entirely repaid by sale of the product. A general adoption of this process will lower the market price.

Depositing at sea is also a real disposal. It is only economical when handled in large volumes and at places where the sewage works are convenient to wharves. Pressing into cakes is not a real method of disposal. It can be done only with chemically treated sludge and is simply a method to facilitate transportation to lands wanting manure. If not quickly sold it becomes offensive and it has proven to be a difficult product to sell. Shallow burial in light porous soil is a cheap and effective method when the soil is dry. In wet weather this method may easily prove to be a nuisance.

Air drying, is also not a real method of disposal, but rather a preparation for disposal by spreading on land, either at the works or by the neighboring farmers. It consists of running the sludge on to draining beds and allowing it to remain there until it becomes dry enough to be removed by a spade. With drying beds of large area, suitably constructed, the author considers this method very satisfactory. Placing the sludge in thick layers in lagoons or over land not suitably prepared he considers unsatisfactory.

Running of sludge is a real method of disposal. It however involves pressing before mixing with house refuse and is only available where a refuse incinerator is in operation. Another fairly satisfactory method is that of mixing sludge with house refuse. The mixture dries at a fairly rapid rate, there is very little, if any, nuisance from smell, and the result is a good manure, easily handled, and suitable for sale to farmers.

In discussing the paper Mr. R. H. Jeffes gives as his opinion from actual experience, that land burial is the most efficient method of disposal, under proper conditions. His experience in pressing sludge and selling it has not been satisfactory. Mr. Henry C. Adams condemned the spreading of wet sludge on land unless all conditions were perfect. Mr. L. A. Dibdni believed the main efforts of sanitary engineers should be directed towards processes of sewage disposal which will produce no sludge or such small amounts that the disposal will be no problem. Mr. J. E. Farmer has to dispose of 33,000 tons of sludge each year and has found in his own experience that spreading on and ploughing into land is cheapest and best. Burning had been abandoned as too costly. Spreading 3 ins. thick on land was best. Mr. H. C. H. Sheriton believed with Mr. Dibdni that it is by no means necessary to have sludge. Mr. E. E. Ryder obtained the best results by shallow trenching. The discussion is to be continued in the Journal of the Institution of Municipal Engineers.

Election of Officers for 1910 of the Western Society of Engineers.

The ballots for the election of officers for the Western Society of Engineers for 1910, were canvassed on January 7, and the following officers were found elected: President, J. W. Alvord; first vice president, O. P. Chamberlain; second vice president, A. Bement; third vice president, W. K. Hatt; treasurer, A. Reichmann, and trustee for three years, W. W. Curtis.

During the year we have pumped 269,675,185 gallons of water; of this amount but 53,440,424 gallons, or twenty per cent, were metered or measured, leaving 216,234,761 gallons used under our guess work system. For the fifty-three million (in round numbers) gallons metered, we received $15,606, or twenty-nine cents per 1,000 gallons; for the 216 millions (in round numbers) gallons unmetered, we received $18,110, or eight cents per 1,000 gallons. This is a case where the economical man pays for the waste of his neighbor.—Extract from Annual Report of the Water Commissioners of the City of Dover, N. H.

We are well pleased with results since putting all consumers on meters. We have no trouble to furnish water and run our north pumping plant but half the time to keep our storage reservoir full all the time. This time last February it was impossible, with the amount of wells we had, to furnish water. The first month we put in our meters, most of our consumers used five times as much water as they have any month since. Meters have already been worth to the city all they cost.—C. V. Porter, Supt. of Water Works, Enid, Okla.

In 1903 Thomasville had about 250 consumers—125 of this number were metered. They pumped about 200,000 gallons per day. They now have 500 consumers, all of which are metered. They now pump about 200,000 gallons per day. They are selling water at 15 cents per 1,000 gallons, but the minimum charge is only 25 cents per month. The plant is on a good paying basis.—J. A. Epply, Supt. Water Dept., Thomasville, Ga.

Earth and Rock Section

Note: This section is devoted to methods and costs of excavating earth and rock and building embankments. It will cover the grading of roads and railroads, diking and canal work, dredging, building reservoirs and earth dams, sewer and water pipe trenching, quarrying, etc.

Suggestions on the Design and Selection of Traction Engines.

At the annual meeting of the American Society of Agricultural Engineers, at Ames, Ia., on Dec. 27-28, 1909, Mr. W. F. MacGregor,* M. E., read a paper on traction engines from which the following points have been taken as of especial interest to engineers and contractors.

The author dwelt first upon the history of traction engines and then took up points of design and considered the elements entering into the ideal tractor. He believes these features might be about as follows:

(1) In the ideal traction engine the fuel cost must be low, and the fuel should be easily obtainable at any time in the local market.

(2) The ideal traction engine must be simple and reliable—that is, it must be always capable of delivering the required power.

(3) The ideal traction engine must be durable, for maintenance and depreciation must be counted in the cost of power delivered.

(4) The ideal traction engine would be safe against the danger of injury to life and property from explosion or fire.

(5) The ideal traction engine would be able to travel over anything in the way of roads or ground that it would meet. It would be able to negotiate steep hills, sand, gravel, soft ground, sloughs, wet clay, mud, snow, ice, etc., and also travel on pavements without injuring them. It would have wheels that would not slip on any surface and the engine would always be able to furnish whatever power was required to turn them.

(6) The ideal traction engine would be well balanced and would run steadily; that is, it would be able to maintain a constant speed whether running empty or under full load. This is necessary because the separators and some other machinery which it is required to drive can only do good work when run at an unvarying speed.

(7) The ideal traction engine would require only such attention from the operator as would be required to make it conform to the requirements. It would be easily steered and would turn as short as desired.

(8) The ideal traction engine for all localities should not require a great amount of water, for although this is usually plentiful, there are localities where it costs considerable to furnish it, and this cost must be counted in the cost of power delivered.

(9) In the ideal traction engine the cost of lubricants and miscellaneous supplies would be low.

(10) The ideal traction engine would be noiseless in operation.

(11) The ideal traction engine would be simple in construction, so that any one could easily learn to operate it.

(12) The ideal traction engine would be constructed so that the operator could easily manipulate it, and be protected from dust and weather.

When several manufacturers build a machine for a certain purpose year after year, they are obliged to a great extent to follow the demands of the purchasers and operators, who are naturally most intimately affected by the state of perfection of the machine. It is in short in the end simply a matter of the "survival of the fittest."

In the case of the steam tractor we may now begin to see some tendency toward a common type. The internal combustion tractors, on the other hand, being of more recent origin, naturally show greater variation in design and construction.

*Engineer for the J. I. Case Threshing Machine Co.

Today most of the leading builders of both steam and gasoline engines mount the engine on four wheels, the rear two of which are the drive or traction wheels, while the front ones are used to steer the engine. In a few cases a single front wheel is used. The weight is usually distributed so that from two-thirds to three-quarters of it is carried by the traction wheels. A certain amount of weight is necessary on the front wheels so that the engine may be steered when pulling, for the gearing then tends to lift the front wheels from the ground. Four wheel drive engines have been often proposed and sometimes built, one firm having manufactured them successfully for a number of years.

The "live" axle—that is, the system of mounting whereby the traction wheels are placed on an axle that turns—is gaining ground and we now find more manufacturers using it, for at least their larger engines, than ever before.

The throttling governor is universally used, and every close speed regulation has been obtained with it. The ideal speed regulation for driving a separator or other belted machine is to have a slight increase in speed with full load in order to make up for the slippage of the belts. Throttling governors are now made which will give ideal results in this respect, the speed increasing gradually with increase of load until at full load it is about 2 per cent faster than at no load. The automatic cut-off governor has been used on agricultural engines more or less in Europe, but very rarely in this country. The throttling governor dries and superheats the steam, and, used in connection with a valve gear which admits of "hooking up" to vary the point of cut-off according to the load requirements, gives good results in economy of steam consumption.

Table I gives some data of current practice in steam traction engines by leading manufacturers in the United States:

TABLE I. SHOWING RATIO OF STROKE TO BORE, NORMAL ENGINE SPEED, PISTON SPEED AND RATE OF TRAVEL OF 118 ENGINES OF THE DIFFERENT SIZES BUILT BY FIFTEEN LEADING MANUFACTURERS.

Make of engines	Average for different sizes of each make.	Ratio of stroke to bore.	Normal engine speed R.P.M.	Piston speed feet per min.	Rate of travel, miles per hour.
1	6	1.352	257.0	462.0	2.205
2	9	1.190	241.4	402.6	2.313
3	6	1.231	223.3	390.5	.....
4	12	1.410	236.6	412.4	2.152
5	7	1.215	251.4	405.9	.....
6	12	1.403	247.0	456.3	.....
7	2	1.250	220.0	366.0	2.100
8	9	1.373	256.4	474.3	.....
9	6	1.363	227.5	441.7	.....
10	6	1.285	232.5	406.2	2.170
11	10	1.288	247.5	461.5	.....
12	7	1.236	240.7	412.4	.....
13	6	1.117	246.7	431.0	2.498
14	5	1.108	240.0	416.0	.....
15	5	1.718	238.0	414.2	.....
Total ...	118				
Minimum		1.00	200	246	1.67
Maximum		2.18	300	537	2.63
Average		1.313	240.6	423.5	2.239

The figures in the columns of the table are obtained by averaging the various sizes of engines built by each of the 15 manufacturers. The minimum and maximum given at the bottom of each column, however, in each case show the extreme of any one size, while the averages at the bottom are the averages of all sizes and all makes represented, and consequently are not necessarily the same as any figure in the column above. These figures are given not only as illustrating the general practice along certain lines, but also because some of the figures are interesting in connection with the points brought up later on.

There are a few traction engines which differ quite widely from the accepted type, but these have as a rule been built from some particular class of work and are not usually conceded to be suitable for general use in various localities. Among these are the Best and Holt engines, which are built on the Pacific coast, primarily for hauling combined harvesters, but are also used to some extent for plowing, working the soil, and for hauling logs, ore, etc. These engines are quite large, some being rated as high as 110 horse power. When required, the boilers furnish steam for an auxiliary engine to drive the header and traveling thresher. Although built for similar purposes, these two makes differ considerably in construction, as one has an upright boiler, while the other has a horizontal boiler, one has a single engine, while the other has a double engine, and one is chain driven, while the other is gear driven. Both ordinarily use crude oil for fuel. Both use a single front wheel, having traction wheels of large diameter (7 to 9 feet), and have wide tires, widths of 4 or 5 feet being common. One of these manufacturers has built special engines with the traction wheel tires 13 and even 16 feet wide.

A discussion of the traction engine at the present time is not possible without some reference to the relative merits of the steam and internal combustion engines, but it is not the purpose of this paper to attempt to show which of the two is more nearly ideal. In such a comparison, all of the factors which go to make up the ideal engine as outlined must be taken into account and this is difficult, for the experience of one operator varies widely from that of another. In fact, the personal element of the operator enters so largely into the question that in many cases it is the deciding factor in determining the reliability, the durability, the cost of attendance, the cost of maintenance, and it usually determines to a more or less extent its ability to travel over bad ground or difficult places, its safety and the amount of lubricants required.

The fuel cost is always an important item, except when it is straw that is otherwise of no value, and it is sometimes the deciding element. It is well known among engineers that the internal combustion engine is capable of, and in fact gives, a higher thermal efficiency than the steam engine, but this is ordinarily of little interest to the purchaser. What is of vital importance to him is the actual cost of the fuel per unit of power delivered at the belt or at the draw bar. It should not be difficult to obtain this, but one obstacle in the way of so doing is the lack of a uniform unit of power, or rather the lack of uniformity in the popular conception of the unit of power among users.

In obtaining fuel costs and in selecting an engine for a given purpose, the intending purchaser of a traction engine is confronted by a very confusing problem on account of the differences in the methods of rating by the various manufacturers. Steam traction engines have been rated at from a half to a quarter of their actual horse-power, while internal combustion engines have been rated at figures more closely approximating their actual horse-power. Most manufacturers publish only the rated or nominal horse-power, although several now publish both rated and brake horse-power, and a few publish only the brake horse-power.

The actual horse-power as determined by the Prony brake-test is becoming better known, but ordinarily the purchaser has no means of applying this test. Consequently an uniform system of rating, based on the cylinder dimensions, pressure and piston speed is very desirable. It would not be a difficult thing to arrive at and it seems that the necessity for it is becoming more apparent each season.

As practice among builders of traction engines is not so uniform as automobile motor construction we cannot use the simple formula used by the Association of Licensed Automobile Manufacturers.

However, we may find comparatively simple

formulae which can be applied by most of the buyers or operators of these engines, which will give reasonably accurate results.

We will take the usual formula for indicated horse-power as determined by the indicator,

$$HP = \frac{P L A N}{33{,}000}$$

where

P = mean effective pressure,
L = length of stroke in feet,
A = area of piston in sq. in.,
N = number of power strokes per minute.

The "number of power strokes per minute" is twice the number of revolutions in the steam engine, and one half the number of revolutions per minute in the four-cycle internal-combustion engine. The area of the piston-rod of the steam engine is neglected in these calculations, but this does not materially affect the results. Practically all steam traction engines have the point of cut-off such that the mean-effective-pressure may be as much as one-half the boiler pressure. Now, we ordinarily have the boiler pressure expressed in pounds per square inch, the cylinder bore and stroke in inches and speed in revolutions per minute, so for simplicity we can write our formula in these terms and combine all of the constants. For indicated horse-power it then becomes practically as follows:

$$IHP = \frac{2 P L D^2 N}{1{,}000{,}000}$$

in which

P = boiler pressure,
L = length of stroke in inches,
D = diameter of cylinder in inches,

and

N = revolutions per minute.

In these engines the mechanical efficiency should be (and is under proper conditions) about ninety per cent., so we may write our formula for *brake* horse-power as follows:

$$BHP = \frac{18 P L D^2 N}{10{,}000{,}000} \qquad (A)$$

the characters denoting the same thing as before. This is for one cylinder and of course with double engines the result must be multiplied by two.

To show the way this formula applies to the engines as built by the various manufacturers, Table II is given. This table represents 17 different makes of engines, no one make appearing more than twice in the table. The "brake horse-power in public test" is given in a few cases taken from the Winnipeg and Brandon tests and is not necessarily the maximum power of the engine, as these tests were made principally to determine the fuel consumption, and in this case the load selected was naturally less than the maximum.

TABLE II.—HORSEPOWER OF STEAM ENGINES; TWENTY-FIVE EXAMPLES COMPUTED BY FORMULA COMPARED WITH HORSEPOWER BY OTHER METHODS.

Eng.	Rated H. P.	Cyl. bore (inches).	Stroke (inches).	No. of cylinders.	Steam pressure (lbs. per sq. in.).	Rev. per min.	Brake H. P. claimed.	Brake H. P. in public test.	Brake H. P. by formula.
1	..	6	8	1	125	300	20.6	.....	19.4
2	10	7	9	1	120	240	.....	.....	22.9
3	10	7¼	10	1	150	325	.....	.....	31.9
4	12	8	8	1	125	250	28	.....	28.8
5	..	8	10	1	125	250	.....	.....	36.
6	13	8	10	1	130	252	.....	.....	37.7
7	14	7½	10	1	175	220	42	.....	39.
8	14	6	10	2	150	260	42	.....	50.5
9	15	7¾	10	1	150	225	.....	.....	36.5
10	16	8½	10¼	1	135	240	48	.....	43.2
11	18	8	11	1	135	250	.....	.....	42.8
12	18	8½	12	1	150	260	54	.....	60.9
13	19	6&7	10	2	125	230	45	.....	44.
14	20	8¾	10	1	125	250	.....	.....	43.
15	20	10	10	1	130	250	60	62.9	58.5
16	22	9	11	1	150	220	.....	.....	52.9
17	25	9¼	12	1	150	230	60	.....	63.8
18	25	7	11	2	160	257	76	76	79.8
19	30	11	12	1	135	240	116	.....	84.7
20	30	7	10	2	145	300	90	73.6	76.7
21	32	7⅝	14	3	125	230	.....	.....	84.2
22	32	12	12	1	160	230	110	97.5	114.5
23	35	7⅞	11	2	150	225	..	.....	82.6
24	35	7¾	12	2	135	250	.....	.....	87.6
25	36	7¾	14	2	165	235	120	105.5	117.4

We can use a formula similar to the one given for steam engines for internal-combustion engines, assuming as before an approximation for the mean-effective-pressure and mechanical efficiency. We may take these the same as in the A. L. A. M. formula for those figures approximate the actual conditions in well designed vertical engines in good order. However, we cannot eliminate the piston speed as was done in the A. L. A. M. formula for this varies considerably in the internal combustion motors of traction engines. Our formula is then (for one cylinder)

$$BHP = \frac{66 L D^2 N}{1{,}000{,}000} \qquad (B)$$

in which

L = length of stroke in inches,
D = diameter of cylinders in inches,

and

N = number of revolutions per minute (4 cycle).

For multiple cylinder engines, multiply the result obtained by the number of cylinders. To show the ways this formula applies to engines built by various manufacturers, Table III is given for vertical gasoline engines.

TABLE III. — HORSEPOWER OF VERTICAL GASOLINE ENGINES; SEVEN EXAMPLES COMPUTED BY FORMULA COMPARED WITH HORSEPOWER BY OTHER METHODS.

Eng.	Cyl. bore (ins.).	Stroke (ins.).	No. of cylinders.	Rated horsepower.	R. P. M. rated.	Brake H. P. claimed.	H. P. by formula, Av. stated speed.	R. P. M. in public test	Brake H. P. in public test.	H. P. by formula at speed in public test.
1	4.75	5	4	12	1000 to 1500	36	36.5	865	17.9	25.7
2	7.0	7	2	12	700 800	30	34.	...	....	....
3	6.25	7	4	30	650	45	45.	520	29.7	37.4
4	6.0	8	4	25	500 to 800	35	49.4	...	...	....
5	7.0	7	4	25	700 to 800	60	68.	730	58.5	66.0
6	7.5	8	4	40	500	60	59.2	468	45.6	55.4
7	8.0	10	3	20	350	44	44.3	311	26.2	39.3

The current practise, with horizontal gasoline engines is to make the stroke longer in proportion to the bore than in vertical engines. As the longer stroke gives a higher efficiency, we must increase the constant in the formula in order that the results obtained may be sufficiently accurate. Taking the constant, then, as 75 instead of 66 our formula becomes (for one cylinder)

$$BHP = \frac{75 L D^2 N}{1{,}000{,}000} \qquad (C)$$

in which the characters represent the same thing as before and as before the result must be multiplied by the number of cylinders in case there is more than one. Table IV shows the way this formula applies to engines built by different manufacturers of this type of engine.

TABLE IV.—HORSEPOWER OF HORIZONTAL GASOLINE ENGINES; SEVEN EXAMPLES COMPUTED BY FORMULA COMPARED WITH HORSEPOWER BY OTHER METHODS.

Eng.	Cyl. bore (ins.).	Stroke (ins.).	No. of cylinders.	Rated horsepower.	R. P. M. rated.	Brake H. P. claimed.	H. P. by formula, Av. stated speed	R. P. M. in public test	Brake H. P. in public test.	H. P. by formula at speed in public test.
1	8	14	1	15	250	19.5	16.75	249	19.7	16.7
2	8.75	15	1	20	240 to 290	28	22.8	254	22.0	21.85
3	8.75	15	1	20	240 to 290	28	22.8	235	24.2	20.3
4	8.75	14	2	35	320 to 325	45	50.0	292	46.0	46.7
5	10	15	1	25	240 to 290	30	29.8	253	31.6	28.5
6	9	13	2	17	260	30	41.0	...	....	.....
7	10	15	2	22	260	40	51.6	...	....	.....

Formulas A, B and C are proposed as being simple ones that may be readily applied by the average operator. It would perhaps be better to use a formula common to all types of gasoline engines in place of changing the constant, if one sufficiently simple and accurate can be found. However, it is not these particular formulas that the writer wishes to urge and they are simply suggested as something that might do. The writer does, however, wish to suggest that something be done towards the adoption of some kind of a uniform system of rating traction engines.

Lectures at the Chicago Cement Show.—Mr. Percy H. Wilson, Secretary of the Association of American Portland Cement Manufacturers, has announced an elaborate series of lectures to be given at the Chicago Cement Show, which will be held at the Coliseum, Feb. 18-26. The lectures deal with the diversified uses of concrete, and are divided into twenty-two subjects as follows: Mixing & Placing, Silos, Floors, Tanks, Stucco, Surface Finish, Sidewalks, Fire Places, Concrete Piles, Small Farm Uses, Concrete Poles, Concrete Bridges & Culverts, Jamestown Sea Wall, Concrete Steps, Determination of Voids, Selection of Aggregates, Manufacture of Cement, House Building, Odd Uses, Factories, Artistic Uses, Decoration with Colored Tile. These lectures promise to be among the most instructive of all the displays at the Coliseum, and will be interesting to every one, on account of the variety of subjects. Three lectures will be given each day, at 4:30 p. m., 8 p. m. and 9 p. m., in the west end of the balcony annex. Each lecture will be accompanied by a continuous lantern slide exhibition, which will add materially to its attractiveness.

Transvaal Gold Mine Statistics.—Consul Edwin N. Gunsaulus, of Johannesburg, furnishes the following figures showing gold-mining operations in the Transvaal: The total profits of 65 gold-mining companies in the Transvaal for the month of October were $4,665,647, of which the mines of the Witwatersrand produced $4,638,758. Working costs on the Rand were $4.09 per ton, and the rate of profit $2.68 per ton. The total gold yield of the Transvaal for the same month was 602,416 fine ounces, valued at $12,436,263. For the 10 months of the present year the Transvaal gold mines have yielded 6,077,790 fine ounces, valued at $125,469,745, an increase of $5,958,016 over the corresponding period of last year. On October 31 there were employed on the producing gold mines of the Rand 19,458 whites, 145,104 colored persons, and 3,204 Chinese. On developing mines, of which there were 44 employing labor, 2,109 whites were employed and 9,644 colored.

New Loan for Russian Public Works.—Consul John H. Grout, of Odessa, advises that the prefect of Nicolaieff, southern Russia, has favorably passed upon a new project recently voted for by the municipal council, which will involve the raising of a $4,892,500 loan for carrying out public improvements, among which are the following: An electric tramway system and the purchase of the existing line of horse cars, $1,030,000; drainage, $51,500; dredging the port of Nicolaieff, $566,500; new abattoirs, $180,250; new markets, $154,500; schools, $103,000; improving the city electric lighting plant, $103,000; for the municipal pawn shop, $103,000; construction of court buildings, $77,250. In accordance with the law, the matter has now been referred to the authorities at St. Petersburg for approval, which, it is expected, will be gained.

Plans were approved on Jan. 6 by the New York State Canal Board for four additional barge canal contracts, involving work that it is estimated will cost more than $3,000,000. They include contract No. 21, for excavating from Genesee River west to contract No. 6, in Monroe county, at an estimated cost of $1,475,900; contract No. 39, dredging the Oswego River between Fulton and Three River Point, at a cost of about $972,900; contract No. 73, dredging the Hudson River between Stillwater and Northumberland, at a cost of about $648,300, and contract No. 78, building a dyke in the Oswego River south of Fulton, at a cost of about $55,154.

Roads and Streets Section

Note: This section is devoted to methods and costs of road and street construction. It will cover road building in all its details, the construction of pavements, sidewalks and gutters, the testing and use of paving materials and the machinery and tools used in road building and paving.

Economics of Street Pavements.*

When a street roadway is to be paved the first question that arises and must be decided is, what kind of pavement shall be used? To correctly answer this question involves the consideration of the relative value in use of the different kinds of pavement available and their adaptability to the varying conditions to which city streets are subjected. This may be called the economics of street pavements.

The economic questions involved in street paving are, to the public mind, the more immediately important ones and more appropriate for discussion in this report. Some of them only can be considered:

If we regard a pavement merely as a business enterprise the question becomes what kind of pavement, if laid on a given street, subject to known conditions, will yield the best return upon the money invested in it? Like other industrial questions this must be considered on business principles and in the light of the facts so far as these are known. It cannot be intelligently decided offhand or by mere casual opinion.

It is hardly necessary to say that there is a wide range of opinion in the public mind as to the comparative value and economy of the several pavements, and even among municipal engineers opinion is more or less divided. It is therefore proper to say that what follows represents my own personal judgment and conclusions, but it may not be out of place to add that these conclusions are the result of special studies and observations in many American cities, extending over more than a score of years, and of a large experience in the actual construction and maintenance of pavements. It is also proper to say that the opinions herein expressed generally agree closely with those of other engineers and specialists who have made street paving a subject of careful study.

The cost of a street pavement should be treated as an investment to accomplish a certain purpose with the smallest expenditure of money. The purpose is to keep a street properly paved, and considered from the business standpoint the question may be stated thus: How may a suitable pavement be maintained upon the street at the lowest cost per square yard per year?

It is quite common to base opinions of the economy of a pavement upon its cost price and its durability. These two elements are important only as they may affect the general account. Considered independently they may not only be of little real value but may lead to erroneous conclusions. The first cost of one pavement may be double that of another, but if it gives three times as much return in service it is obviously the cheaper of the two.

Durability as applied to a pavement is only a comparative term. The relative durability of pavements has been a subject of wide discussion, often based on wrong assumptions, misinformation, or erroneous standards of comparisons. The life of a pavement is determined by two wholly different factors or by their combined effect—the natural durability of the materials of which it is constructed and the wear and tear of travel.

All pavements are subject to more or less deterioration by age and the action of the elements, even if subjected to no travel. But some are thus more affected than others. Thus a well constructed granite block pavement on a concrete foundation should last, if undisturbed, for a long period, while an untreated wood block pavement on a gravel foundation will be destroyed by natural decay in a few years. So far as destruction by natural decay is concerned, the life of a pavement is independent of the quantity of travel over it.

On the other hand, it is now well recognized that, disregarding the element of natural decay, the life of a pavement is measured by the quantity of travel to which it is subjected. In other words, if of two pavements, equal in other respects, one is subjected to double as much travel as the other its life in years will be but one-half that of the other. Consequently in pavements that are worn out before they are affected by natural decay the only true measure of their life is not the number of years they will last but the total quantity of travel they will carry before they are worn out. The statement that a certain pavement on a certain street has lasted a dozen or any number of years gives no idea of its durability unless the quantity of travel, say in tons per square yard per year, is also given. In other words, the endurance of a pavement is not measured by years but by the total service it is capable of giving.

To the neglect of this principle is largely due the very conflicting statements that are common about the relative durability of the several kinds of pavement. Until cities shall appreciate the importance of keeping a record, as by censuses of travel at regular intervals, of the quantity of travel carried by at least a few representative streets we shall have no exact knowledge of the relative durability of the several kinds of pavement, and in the meantime we must rely on such results of general observations as may be available.

The factors that must be taken into account in determining the comparative economy of the different pavements are the following:

1. The original cost of the pavement.
2. Interest on the original cost.
3. Payments to a sinking fund to redeem at some future time the debt incurred for construction.
4. Cost of maintenance, including cleaning and watering.
5. The useful life of the pavement, usually called its durability.
6. Value of the worn-out pavement for purposes of renewal.

Unfortunately the data for determining the value of some of these factors is far from complete or satisfactory. The first cost can usually be determined, and the prevailing rate of interest on money is known. For some kinds of pavements we have fairly satisfactory data as to cost of maintenance, for others we have not. The relative but not the actual durability or life of most of the pavements in common use is fairly well known to engineers, though the public generally has a wrong conception of it.

We shall be compelled therefore to make use of the best information available in the discussion that follows, and it is obvious that the conclusions arrived at may be only approximately correct, but the errors due to lack of complete data are likely to be so small and unimportant that they will hardly change the general conclusions.

Using the best information available we may compute the cost per square yard per year of keeping a street properly paved with a given kind of pavement for any period of years.

Take, for example, a first class granite block pavement on the heaviest traveled business streets of the city of Boston. The original first cost, including the necessary excavation, should be about $3.86 per square yard. If the pavement be paid for by an issue of bonds, the interest paid on the bonds is justly chargeable to the pavement. Assume that the pavement will last, with ordinary repairs, 13 years before it needs to be reconstructed. During this period the pavement will require more or less ordinary repairs, which we will not be very wrong in estimating will cost an average of 1½ cts. per square yard per year, which obviously is also a legitimate charge against it that must be taken into consideration.

The reconstruction will not cost as much as the original construction, because the excavation will have been done, and the concrete foundation should be still good and available for the reconstructed pavement. The old blocks taken up should still have a value equal to the cost of taking them up and of making such incidental repairs to the concrete as may be found necessary.

The cost of reconstruction with new blocks would be about $3 per square yard, and when completed the pavement should be practically as good as the original pavement when new.

The cost of reconstruction should be met without increasing the original debt, since it is really a part of the permanent maintenance of the pavement, and to do this we may provide a sinking fund by setting aside each year during the life of the original pavement a sum which, at the time the reconstruction must be undertaken, will amount to its estimated cost.

The operation of renewing the pavement may be repeated any number of times in this way, without increasing the debt incurred for the original construction. But this debt will remain and if the bonds were issued for a period of thirty years a sinking fund must be established to take them up when they fall due.

We have now provided for the structural expenses of the pavement, but other expenses must be incurred to care for it properly. It must be kept clean, and inasmuch as the cost of cleaning the different kinds of pavement varies, we must, if we wish to compare the cost one with another, take this expense into consideration. The same is true of watering, but if a granite pavement be kept properly cleaned watering will not be necessary and we may disregard its cost.

Considering all these items we may make up the cost of maintaining 1 sq. yd. of the pavement per year as follows:

Interest on first cost ($3.86 at 4 per cent)	$0.154
Annual payment to fund to redeem bonds in thirty years, interest 3½ per cent.	.075
Annual payment to sinking fund to provide sum necessary for reconstruction at end of thirteen years	.152
Cost of ordinary repairs during the life of the pavement per square yard per year.	.015
Cost of cleaning per square yard per year, say	.190
Total cost per square yard per year	$0.586

We thus find that the actual cost of this pavement to the city is about 59 cts. per square yard per year.

Every item here entered is a legitimate charge against the pavement, though it is not asserted that the amount charged is strictly accurate. The method followed is in principle the same as any careful business man would apply in getting at the true cost of the products of his factory. Assuming the same general conditions, we may make similar computations to determine the annual cost of other kinds of pavement.

It is only by the application of such methods that the annual cost, and therefore the comparative value, of the different kinds of pavement can be intelligently ascertained.

Applying this method to the three kinds of roadway pavement most largely in use in Boston—granite block, sheet asphalt, and macadam—we may compute the annual cost of each under average conditions. These conditions obviously vary with the character of the streets, which for our present purpose may be divided into four general classes:

A. Streets with a very large volume of travel of the heaviest character, as central business of streets.

B. Secondary business streets with travel of moderate volume and weight.

C. Main city or suburban thoroughfares having a large volume of comparatively light travel.

D. Suburban or residence streets where travel is mainly of a local character and light.

*From a report by Samuel Whinery, Consulting Engineer, New York City, to the Finance Commission of the City of Boston, Mass.

A different character of construction for the same kind of pavement is appropriate for these different classes of streets, and its first cost will therefore vary with the class. For instance, granite block pavements for Class A and Class B streets should be laid upon a concrete foundation, while for classes C and D a broken stone foundation may be sufficient, and where a concrete foundation is used its thickness may vary with the different classes of streets.

Considering first granite block pavement we may figure its annual cost per square yard for the four classes of streets as shown in Table I.

renewal represent what, in my opinion, should be the maximum costs in Boston at this time. The actual cost is and has been for many years much higher.

The assumed life of the pavements in years represents what should be their useful life. There comes a time in the life of every pavement when it will be cheaper to renew it than to continue repairing the old. Pavements are often continued in use long after it would be more economical to renew than to continue to repair them. The above computations assume that the useful life ends when they should be renewed rather than further repaired. The

TABLE I.—COST OF GRANITE BLOCK PAVEMENTS.

Specifications:	Classes of Streets. A.	B.	C.	D.
Foundation	6-in. con.	5-in. con.	6-in. [illegible]	6-in. br. st.
Depth of blocks	7-in. by 8-in.	6-in. by 7-in.	6-in. by 7-in.	6-in. by 7-in.
Joints filled with	Grout.	Grout.	Grout.	Grout.
First cost, original pavement	$3.86	$3.45	$3.30	$3.30
Cost of renewal	2.45	2.40	2.20	2.20
Estimated life in years	13	17	16	20
Annual cost of pavement per square yard:				
Interest on original cost, 4 per cent	$0.154	$0.138	$0.132	$0.132
Payment into sinking fund to redeem bonds, 30 years at 3½ per cent	.075	.067	.064	.064
Payment into sinking fund to meet cost of renewal, at 3½ per cent	.152	.106	.105	.078
Average cost of ordinary repairs	.015	.010	.005	.005
Cost of cleaning per year	.190	.118	.118	.079
Total annual cost per square yard of maintaining the pavements	$0.586	$0.439	$0.429	[illegible]

In the same manner the cost of sheet asphalt pavement per square yard per year may be computed as in Table II.

life given in the tables also assumes that the pavements are properly constructed originally and properly renewed when renewal becomes

TABLE II.—COST OF SHEET-ASPHALT PAVEMENTS.

Specifications:	Classes of Streets. A.	B.	C.	D.
Foundation	7-in. con.	6-in. con.	5-in. con.	4-in. con.
Thickness of bindness course	1½ in.	1½ in.	1 in.	1 in.
Thickness of surface course	2-in.	1½ in.	1½ in.	1½ in.
First cost of original pavement	$2.98	$2.64	$2.15	$2.15
Cost of renewal	1.55	1.45	1.35	1.35
Estimated life in years	9	12	14	16
Annual cost of pavement per square yard:				
Interest on original cost, 4 per cent	$0.119	$0.106	$0.093	$0.086
Payment into sinking fund to redeem bonds, 30 years at 3½ per cent	.058	.051	.045	.042
Payment into sinking fund to meet cost of renewal, at 3½ per cent	.149	.100	.076	.064
Average cost of ordinary repairs	.100	.040	.030	.016
Cost of cleaning	.150	.084	.084	.056
Total annual cost per square yard of maintaning the pavements	$0.576	$0.381	$0.328	[illegible]

The annual cost of macadam pavement may be arrived at as shown in Table III.

necessary and that they are kept in a good state of repair.

TABLE III.—COST OF MACADAM PAVEMENT.

Specifications:	Classes of Streets. A.	B.	C.	D.
Thickness of metal	9-in.	8-in.	7-in.	6-in.
Estimated life in years	5	6	[illegible]	10
First cost per square yard	$1.26	$1.16	$1.05	$0.94
Cost of renewal	64	60	51	51
Annual cost of pavement per square yard:				
Interest on original cost at 4 per cent	$0.050	$0.046	$0.042	[illegible]
Payment into sinking fund to meet renewal, 3½ per cent	.119	.092	.066	.043
Payment into sinking fund to redeem bonds, 30 years at 3½ per cent	.024	.022	.020	.018
Average cost of ordinary repairs	.400	.250	.150	.040
Cost of cleaning	.150	.080	.070	.030
Cost of watering	.045	.035	.030	.025
Total annual cost per square yard of maintaining the pavement	$0.788	$0.525	[illegible]	[illegible]

For a ready general comparison of results Table IV may be constructed.

Referring to Table IV it appears that for Class A streets macadam is the most expensive

TABLE IV.—COMPARISON OF COST OF VARIOUS PAVEMENTS.

	Classes of Streets. A.	B.	C.	D.
Granite block	$0.586	$0.439	$0.429	$0.358
Sheet asphalt	.576	.381	.328	.264
Macadam	.788	.525	.378	.194

These results are not presented as strictly accurate or conclusive. In the present state of our information they must be regarded as approximate only. All the conditions assumed and used may differ in any one city, and are likely to differ in different cities. Emphasis is laid upon the method of estimating the economic value of pavements rather than upon the correctness of the data here used. It may, I think, be claimed that the data and results are approximately correct for Boston and that they represent the best general information available at this time.

The figures given for first cost and cost of

pavement to use, and that there is a slight difference in favor of sheet asphalt over granite. But other considerations, the principal one being the difficulty and inconvenience of making the frequent and quite expensive repairs that would be necessary to an asphalt pavement on a crowded street, clearly indicate that the granite pavement is preferable.

For Class B streets macadam is also decidedly the most expensive, while sheet asphalt is decidedly the most economical.

On Class C streets granite is the most expensive, and there is a material difference in favor of sheet asphalt over macadam, but the relative cost of the two does not differ very widely.

For Class D streets granite is comparatively very expensive, and macadam is so decidedly the cheapest that if economy alone is considered it merits almost exclusive use.

Evaporation from Water Surfaces.

Mr. Sidney R. Lowcock in a paper read before the Association of Water Engineers, London, gives the following formula for evaporation from water surfaces,

$$E = 0.0001254\ md$$

in which

E=evaporation in inches

m=mean maximum sun temperature (Fahr.)

d=duration of sunshine in hours.

This formula may be true only for England where his experiments were made and gives results for the whole year. It gives a result rather too high for the winter months and low for the summer months. The author believes that radiant heat has a far greater effect upon evaporation than heat transmitted by contact; therefore evaporation records from tanks will apply to reservoirs.

In the borough of Blackpool, England, for the year ending March 31st, 1909, there were 17,969 tons of house and trades refuse disposed of at the corporation refuse destructor (incinerator). The net cost was 33 cts. per ton, for actual operating costs, not including interest and sinking fund repayments on capital.

The returns from sale of products were as follows:

Clinkers and screened ashes at from 12 cts. to 36 cts. per ton	$945.60
Mortar and ground oyster shells at from 96 cts. per ton	1,800.00
Scrap iron and old tins in compressed toles at $3.60 per ton	192.00
Fish manure at $23.40 per ton	1,387.20
Electric current	350.40
Sundries	28.80
Total	$4,704.00

Equal to a credit of 26 cts. per ton on the refuse burnt.

Your attention is called to the saving made by metering the system throughout. At the rate our pumpage has increased each year, we would have pumped 411 million gallons, or 101 million gallons more than durinig the year 1906, which would have necessitated an additional engine man and fireman. Although we have been but a few months 100% metered (270 meters having been set since January 1, 1907), and the minimum rates made $1.00 less than the correspondinig flat rates, we are able to give the following results:

Consumption decreased 38,897,373 gallons.

Water rents increased	$ 168.97
Coal saved	308.85
Packing saved	27.01
Oil and waste saved	48.39
Night attendance saved	1,200.00
Total saved not including additional deterioration	$1,753.22

—Extract from Superintendent's Report, Canandaigua Water Dept., Canandaigua, N. Y. Mr. G. R. Ellis, Supt.

Records for placing concrete in the Gatun Locks of the Panama Canal were broken on Dec. 10, 1909, when 1,866 cu. yds. were placed in 8 hours. The record for six days, Dec. 6 to 11 inclusive, was as follows:

Date.	Cu. yds.
Dec. 6	[illegible]
Dec. 7	1,706
Dec. 8	[illegible]
Dec. 9	[illegible]
Dec. 10	[illegible]
Dec. 11	[illegible]
Total	[illegible]

The total amount of excavation on the Panama Canal done by the French has been carefully estimated by a committee appointed by Chief Engineer Goethals. This committee reports the total excavation to have been 78,146,960 cu. yds., of which 29,908,000 cu. yds. is the amount useful in the present canal work.

Water-works and Sewer Section

Note: This section is devoted to methods and costs of constructing sewers and water-works. It will cover the construction work for all details of water supply and sewerage, including sewage purification and water filtration.

Formulas for the Capacity of Tile Drains.

At the annual meeting of the American Society of Agricultural Engineers, held at Ames, Ia., on Dec. 27-28, 1909 Professor E. A. Hamilton of the Iowa State College, Ames, Ia., read a paper in favor of the adoption of the Chezy and Kutter formulas by drainage engineers instead of the older formula of Hawksley, now used.

The Hawksley formula has persisted for many years because of its convenience. It is, however, among the long list of formulas declared to be obsolete by hydraulic engineers because of the fixed coefficient which does not take into consideration the condition of the pipe or the relation the area bears to wetted surface. This formula is as follows:

$$Q = 1.148 \sqrt{\frac{df}{l + 54d}}$$

in which

Q = cubic feet of water per second
A = area of pipe in sq. ft.
d = diameter of pipe in feet.
f = fall in feet for the distance l.

The formula was simply a modification by Hawksley for clean cast iron pipes, of the Eytelwein formula, and was the result of experiments upon certain size pipes in a smooth condition. For some years last century it was in common use and the survival of this formula in land drainage is a result of the lack of precision heretofore deemed necessary by many engineers in drainage calculations.

Professor Hamilton, using a value of 48 for the coefficient in the Hawksley formula, intended only for clean cast iron pipes, calculated the capacity of tile drains of diameters from 4 ins. to 36 ins. Assuming a 36-in. tile as capable of removing ¼ acre inch of water and using the Hawksley formula the results were as follows:

A 36-inch tile will remove 0.25 acre inch
A 24-inch tile will remove 0.23 acre inch
A 18-inch tile will remove 0.21 acre inch.
A 12-inch tile will remove 0.19 acre inch.
A 8-inch tile will remove 0.17 acre inch
A 6-inch tile will remove 0.16 acre inch.
A 4-inch tile will remove 0.14 acre inch.

The grade assumed was 0.1 per cent and on a percentage basis the pipe capacities are:

36-inch . . . . . 100 per cent
24-inch . . . . . 92 per cent
18-inch . . . . . 84 per cent
12-inch . . . . . 76 per cent
8-inch . . . . . 68 per cent
6-inch . . . . . 64 per cent
4-inch . . . . . 56 per cent

In Kutter's formula for the evaluation of the factor, C, in the Chezy formula a coefficient of roughness is assumed for the many kinds of surfaces found in pipes and for the many materials of which conduits are made. For well planed timber in perfect order and alinement the coefficient, $n = 0.009$, and for cement and terra cotta pipes with imperfect joints and in bad order (a condition closely approximating that of even the best laid tile drains), the coefficient, $n = 0.015$. Taking the above results given by the Hawksley formula and working back to obtain a value for the coefficient, n, the result was a number of coefficients, ranging from 0.015 for the 36 in. pipe, to a coefficient of 0.0095 in a 4 in. tile. The following table gives the results:

For a 4-in. tile, n = 0.0095
For a 6-in. tile, n = 0.0115
For a 8-in. tile, n = 0.0125
For a 12-in. tile, n = 0.012
For a 18-in. tile, n = 0.011
For a 24-in. tile, n = 0.0105
For a 36-in. tile, n = 0.0095

This shows conclusively that the Hawksley formula with its constant of 48 is not exact enough for use in any hydraulic calculations. Professor Hamilton has calculated values of C for a grade of 0.1 per cent which he believes engineers can use with the Chezy formula and avoid the laborious work heretofore connected with the use of the Kutter formula in evaluating C. He uses a coefficient, $n = 0.014$ but says that for tile carelessly or unevenly laid the coefficient might better be $n = 0.015$. If it is thought best to use a coefficient of 0.015 deduct 6 per cent from the values in this table. When the grade is near 0.05 per cent, deduct 1; when the grade is at or above 0.5 per cent add 1. The values in the table are true only for a grade of 0.1 per cent.

Table of values of C, in formula:

$$Q = AC\sqrt{rs}$$

in which
Q = cubic feet per second.
A = area of pipe in square feet.
r = hydraulic mean radius = 0.25 for pipes.
s = sine of slope = fall divided by length, or grade per cent divided by 100.
C = a factor in the table.

Size of tile.	Value of C.	Size of tile.	Value of C.
4 in.	54	15 in.	82
5	59	16	84
6	63	18	86
7	66	20	88
8	69	22	90
9	72	24	92
10	74	28	94
12	77	30	95
14	80	36	96

Note—To convert above discharge to acres drained by ¼ in. standard, divide by 0.105.

Refuse Disposal, and the New Refuse Incineration Plant for Milwaukee.*

In December, 1907, Mr. Rudolph Hering, consulting engineer, presented a report to the mayor and common council of the city of Milwaukee dealing with the problem of the disposal of the refuse of the city. This report presented data relative to the quantity and character of the refuse and fully discussed the various methods of refuse disposal. Based on the investigations described in the report, Mr. Hering recommended "as a first installment a plant capable of incinerating 300 tons daily, costing $200,000."

This report was accepted by the city council and Mr. Hering was engaged to prepare plans and specifications for the work. Bids were called for in accordance with these plans and specifications and on April 3, 1909, the contract for a 300-ton refuse incineration plant was awarded to the Power Specialty Company of New York. Their contract with the city includes the excavation, piling, concrete, furnaces, boilers, flues, cranes, and machinery for the plant. It does not include the chimney or the superstructure for the plant, these parts of the work having been let under separate contracts. The total amount of all the contracts foots up to slightly less than $200,000. The actual work of construction is now under way. Hering & Fuller, consulting engineers, 170 Broadway, New York city, have been engaged by the city to supervise the construction of the plant. It is expected that the plant will be in operation early in the spring of 1910.

The purpose of the plant is to burn refuse completely, without nuisance and at an average temperature of 1,500° Fahr. The design and development of such a plant fundamentally involve some knowledge of the character of the material to be burned.

According to the specifications, refuse is defined as being a mixture of garbage, ashes, rubbish, manure and small dead animals. These are the chief constituents of city refuse. The composition and character of such refuse vary from season to season and even from day to day. Nevertheless, limiting conditions may be determined which control the design. Thus in winter, when the percentage of ashes in the refuse is high, the clinker produced in burning the refuse will be the greatest, and its handling will be most difficult. In the summer, on the other hand, the clinkering will be easier work, but the maintenance of a high temperature will be difficult on account of the high proportion of wet garbage in the refuse. The rate of combustion will be low, and the capacity of the plant will be based on summer conditions. Following are the compositions of ashes, manure, garbage and rubbish as they were used in working out the plans for this work. They are briefly compared with analyses determined elsewhere.

Ashes.—Ashes are either steam ashes, such as come from large boiler plants, or are household ashes. They contain about 15 per cent of water, 10 per cent of volatile matter, 50 per cent of true ash and 25 per cent of carbon. Ashes analyzed in Pittsburg for a report by Mr. Hering contained on the average 7 per cent of water, 10 per cent of volatile matter, 58 per cent of true ash and 25 per cent of carbon. The average chemical analysis of ashes given in the "Report of Commission on Street Cleaning and Waste Disposal, the City of New York, 1907," is 27 per cent of water, 8 per cent of volatile matter, 53 per cent of true ash and 18 per cent of carbon. This ash contains a rather high percentage of water. The calorific value of ashes is about 3,700 B. t. u. per pound.

Manure.—Manure is the cleanings from stables. I know of no chemical analysis of manure. In El Paso, Tex., it has been used as a fuel under boilers. It has been assumed that it contains 40 per cent of water, 25 per cent of volatile matter, 15 per cent of true ash and 20 per cent of carbon. One of the bidders for the work here based his guarantee for temperature and evaporation on a composition of 70 per cent water, 13 per cent of volatile matter, 4 per cent of true ash and 13 per cent carbon. The calorific value of manure is therefore about 2,700 B. t. u. per pound.

Garbage.—Garbage is the waste from kitchens, restaurants, butcher shops, hotels, etc. It has been chemically analyzed in Milwaukee and in several other places. The results of the analyses in Milwaukee were 78 per cent of water, 14 per cent of ash and 8 per cent of combustible. Analyses made in New York by the Commission on Street Cleaning gave an average chemical content of 69 per cent water, 22 per cent volatile matter, 5 per cent ash and 4 per cent carbon. The tests made by Mr. J. T. Fetherstone at West New Brighton, N. Y., showed an average composition of 73 per cent water, 17 per cent volatile matter, 5 per cent ash and 5 per cent carbon. The calorific value is not far from 2,000 B. t. u. per pound.

Rubbish.—Rubbish contains papers, wood, rags, bedding, leather, glass, metals, sweepings from stores and offices, and litter of a similar nature. The composition taken for Milwaukee is 15 per cent of water, 45 per cent volatile matter, 15 per cent ash and 25 per cent carbon. One of the bidders for the work at Milwaukee assumed a composition of 8 per cent water, 38 per cent volatile matter, 14 per cent ash and 40 per cent carbon. Tests by Mr. Fetherstone at West New Brighton gave an average composition of 6 per cent water, 65 per cent volatile matter, 14 per cent ash and 15 per cent carbon. Analyses made by the Commission on Street Cleaning of New York gave 12 per cent water, 40 per cent volatile matter, 8 per cent ash and 40 per cent carbon. The calorific value of rubbish may vary from 5,000 B. t. u. to 7,500 B. t. u. per pound.

(Average coal has a calorific value of 14,000 B.t.u. per lb.—Ed.)

Refuse—The mixture of these component

*Read before the Engineers' Society of Milwaukee, May 12, 1909, by Samuel A. Greeley, Resident Engineer, and printed in the Journal of the Association of Engineering Societies for November, 1909.

parts and of small dead animals is defined as refuse. The proportions in which these components enter into the mass of refuse have been carefully measured and are given for the various seasons in the following table:

TABLE I.

	Summer, Per cent.	Winter, Per cent.	Average for year, Per cent.
Garbage	57	31	41
Ashes	30	60	41
Rubbish	5	6	5
Manure	8	3	13
	100	100	100

The proportions are all given by weight. If we combine these percentage proportions with the chemical composition of each component already given, we get the following composition of refuse for summer, winter and for the average throughout the year:

TABLE II.

	Summer, Per cent.	Winter, Per cent.	Average for year, Per cent.
Water	55	35	45
Volatile matter	13	11	11
Ash	20	35	30
Carbon	14	19	16
Total	100	100	100
B.t.u. per pound	2 850	3 350	3 120

If we reduce Table II to pounds per ton we get the following values:

garbage, can be burned, the proportion of garbage will be lowered and the calorific value of the refuse will be correspondingly increased.

Methods of Disposal.—There are several methods of refuse disposal, such as by dumping on the land or at sea, by burial in suitable soil, by feeding to swine, by reduction or by incineration.

Ashes and rubbish are very often dumped on waste land within convenient hauling distance, as is done in your own city and in Chicago. This is dangerous to health, because germs of disease from sick rooms and hospitals may be lodged in the cast-off clothing and bedding, in the rubbish, and may be spread by the wind, by flies, or otherwise. Such rubbish should be burned.

Dumping at sea or in the lake has been practiced in Milwaukee, but has never been favored as a permanent method of disposal. In New York City a portion of the garbage is dumped at sea.

Burial in the soil may satisfactorily dispose of garbage. Too often, however, the garbage is not buried, but is only spread out upon the ground surface to rot and create obnoxious odors. In York, Pa., such odors were objectionable at a distance of one mile.

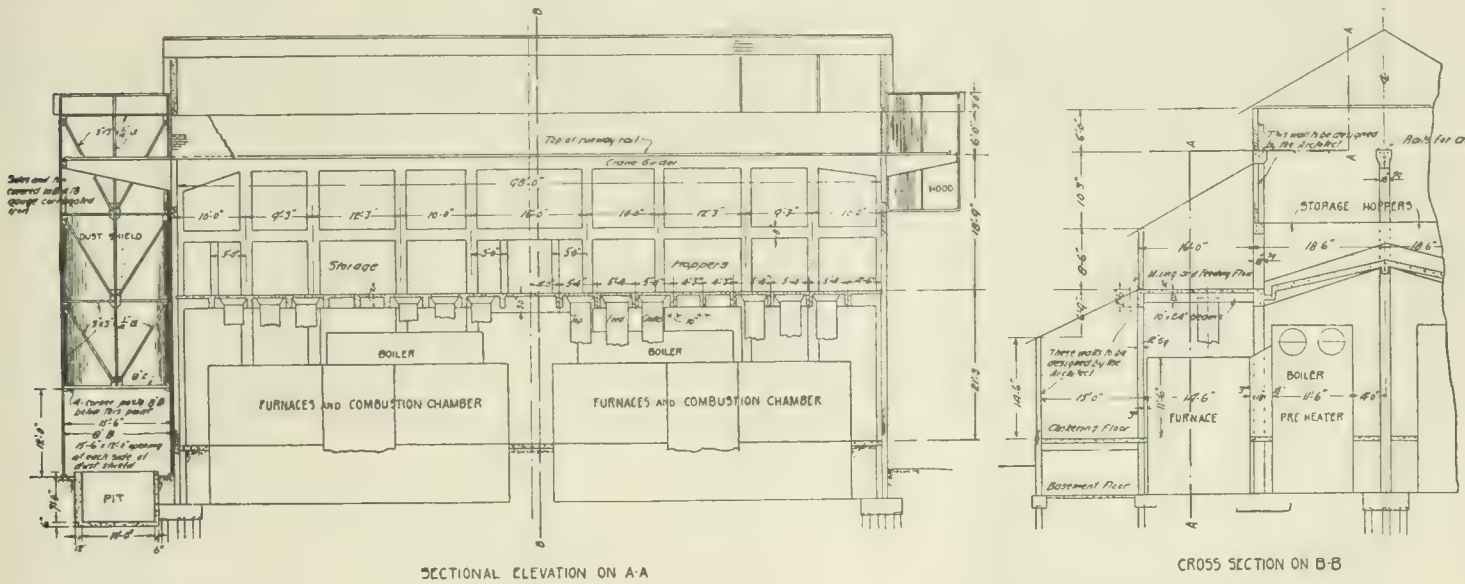
1,500 degrees Fahr. and generate useful steam.

These high temperature refuse incinerators can be classified according to the method of charging. There are the bottom charged incinerators, which are always charged by hand, and the top charged incinerators, which may be charged by hand or mechanically. The bottom charged incinerator is a front fed or a back fed incinerator, depending upon whether the refuse is shoveled in through openings in the front wall or back wall of the furnace.

The Milwaukee refuse incineration plant is a top charged plant. It is also a mechanically charged plant, because the refuse will be charged on to the grate through a mechanically operated device.

The Milwaukee Incinerator.—Figures 1, 2 and 3 show, in plan and sections, the plant designed for Milwaukee to burn the grades of refuse which have been described.

The building is about 100 ft. square and 45 ft. high to the eaves at the highest point, and the chimney is located west of the building, about 20 ft. from the wall. The plant comprises (1) the two cranes and crane runways; (2) the storage hoppers; (3) the mixing and feeding floors with the mechanically controlled tubes for charging; (4) the floor for fans and fan engines; (5) the two clinkering floors on



SECTIONAL ELEVATION ON A-A

CROSS SECTION ON B-B

Fig. 1—Sections Showing Arrangement of Refuse Incinerator Building, Milwaukee, Wis.

TABLE III.

	Summer, Pounds.	Winter, Pounds.	Average for year, Pounds.
Water	1 060	700	880
Volatile matter	260	220	220
Ash	400	700	600
Carbon	280	380	320
	2 000	2 000	2 000

The successful bidder for the Milwaukee work based his guarantee on the chemical composition given in the following table. These percentages, as elsewhere, are given by weight of the wet material as collected:

TABLE IV.

	Summer, Per cent.	Winter, Per cent.	Average for year, Per cent.
Water	45.2	25.2	35.0
Volatile matter	18.2	12.7	18.7
Ash	26.8	41.5	30.6
Carbon	9.8	20.6	15.7
Total	100.0	100.0	100.0
B.t.u. per pound	3 134	3 900	3 475

Such, then, is the character of the refuse to be burned in the new incinerator. The quantity will be 300 tons per day. This will be made up of garbage from the whole city and of the ashes and rubbish from wards 1 to 7 inclusive, together with sufficient manure to make up the total quantity. The quantity of small dead animals will not exceed one ton per day. The proportion of garbage in the refuse is, therefore, unusually high and does not represent the true average proportion for the whole city. Eventually if other incinerators are built, so that all of the ashes and rubbish of the city, as well as all of the

Feeding to swine is a method of disposal applicable to garbage only. It is used in Worcester, Mass., where about 3,000 pigs are kept to dispose of the garbage from a population of 130,000 people. The cost of disposal is about 85 cents per ton of garbage after deducting receipts from the sale of pigs.

The reduction process of disposal is also applicable to garbage only. It consists briefly in causing the garbage to be separated into three parts—water, grease and a dry material called tankage, which is useful as a base for commercial fertilizers.

Incineration or burning of the mixed refuse of the city is the method of disposal recommended by Mr. Hering, and a refuse incineration plant is now under construction. There are two classes of plants designed to burn refuse. One of these is the natural outgrowth of the early American garbage crematory, which is designed to burn garbage only, and which requires the use of coal, oil or other auxiliary fuel. A plant of this kind is now in operation on Jones Island and burns the garbage of the city. Coal is the fuel used.

The other class of incinerator is based largely on experience abroad and is designed to burn mixed refuse. As distinguished from the refuse incinerator, the garbage crematory commonly burns garbage only, requires the use of an auxiliary fuel, operates at comparatively low temperatures and is not used to generate steam. Refuse incinerators, on the other hand, burn mixed refuse, use no additional fuel, operate at temperatures averaging

which the furnaces will front and between which will be the boilers, generators, office room and lavatory; (6) the basement, in which the clinker cars will operate and which will make the settings of the furnaces and boilers accessible; (7) the main flue running east from the center line of the building; (8) the radial brick chimney; and (9) the recording and measuring instruments.

The foundations above the piles, the columns, floors, storage hoppers and crane runways will be built of reinforced concrete. The walls of the building will be of brick, and the roof of red reinforced cement tile.

The crane runways will extend out of the building over the roadways at the north and south ends of the plant. At the north end of the plant the garbage carts with their removable boxes will arrive. Bottom dumping rubbish, ash and manure wagons will deposit their contents into boxes placed in a special dumping pit at the south end of the building. The cranes, as they travel outside of the building, will be protected by galvanized iron hoods.

Three-ton, three-motor traveling cranes will be installed. They will lift the boxes from the dumping pits and will deliver their contents into the hoppers.

The storage hoppers will be built in four sections, one for each furnace, and each section will be divided into three compartments. Each section of three compartments will be about 36 ft. long over all and 17 ft. wide, with an average height of 7 ft. The floors of all

the compartments have a slope of about 1 in 4 from a ridge along the center line of the building to the feeding and mixing floors at the foot of the slopes. At the bottom of each compartment will be a gutter covered by a perforated cast iron plate and connected to the sewer. The hoppers are designed so that the ingredients of the refuse can be separately stored. In this way the free water in the garbage can drain away to the sewer.

Extending horizontally from the two hoppers, and separated by them, are the two mixing and feeding floors. The mechanically controlled charging tubes open at the level of these floors, there being six tubes for each furnace. The various ingredients of the refuse will be pulled down out of the hoppers and mixed properly on these floors, after which the mixed refuse will be pushed into the charging tubes.

The charging tubes will connect the feeding and mixing floors with the grates of the furnaces. They will enter the furnace through the top and will discharge on to a drying hearth at the back of the grate. In each tube, just above the furnace top, will be a door actuated by a wheel within the reach of the firemen on the clinkering floor. Turning this wheel lifts the door of the charging tube out of its sand sealed seat and allows the contents of the tube to fall on to the hearth below. The tubes will be made of sheet steel and will be larger at the bottom than at the top. The doors will be made of plates and angles and will move on ratchet gears with an eccentric attachment to lift the door.

There are four furnace units, each of which consists of six grates or cells, a combustion chamber, an air heater and a water tube boiler. The six cells with the ducts at the back and with the combustion chamber will occupy a space 42 ft. long by 14 ft. 6 ins. wide and will be about 2 ft. high. The six cells are divided into two groups of three cells each by the common combustion chamber at the center. Each grate will have an area of about 20 sq. ft. At the back of each grate will be a drying hearth of brick. Back of this are two ducts—the hot gas duct above and the hot air duct below.

The hot air duct will convey air, heated to a temperature of 300 degrees Fahr., and under a pressure of about 4 ins. of water, to the ash pits below the grates. This will be the air which supplies the oxygen for combustion. Fans driven by steam engines will drive this air through an air heater placed in the second pass of each boiler below the tubes, and then through the hot air duct and ash pit to the fuel on the grate.

The hot gas duct will be directly over the hot air duct and will convey gases from the combustion chamber along the duct and through holes in the division wall between the duct and the drying hearth of each grate. These gases will be at a temperature of over 1,000 degrees Fahr. and will be driven by steam jets placed near the combustion chamber. These gases will absorb moisture from the fresh refuse standing on the drying hearth before it is raked on to the grates.

The furnaces will be built of brick masonry walls 18 ins. to 24 ins. thick, 9 ins. of which will be fire brick. Special blocks will be used for the arches over the grates. The combustion chamber will extend down to the basement floor, 8 ft. below the ash pit.

The boilers will be of the horizontal water tube type, set high, with a tubular air heater set below the tubes in the second pass of each boiler. Each of the four boilers will have a rated capacity of 200 boiler h.p. The gases of combustion will pass from each group of three cells to the central combustion chamber, thence into the boilers and air heaters and finally through the flue into the chimney.

The fans and fan engines will stand on a floor raised about 5 ft. above the clinkering floor and located at the center of the building. There will be a fan and fan engine for each unit. Forty-eight inch Sirocco fans direct connected to 5-in. A B C vertical engines will be installed.

Clinkering will be done by firemen on the clinkering floor. As they draw the clinker from the grate it will fall through a trap door directly in front of each grate and into a clinker car standing on rails below in the basement. This quickly removes the dust and heat of the clinker from the firing room. Laborers in the basement will remove the clinker cars when necessary.

The basement extends under the whole building. All the boiler settings, the combustion chambers and the flue rest on foundations at the basement level and are provided with clean-out doors. In this way dust and soot can be readily removed.

The machinery is located at the level of the clinkering floor, between the furnaces and at the south end of the building. In the machinery room will be two 50 kw., 220-volt, direct-current generating sets, two boiler feed pumps and a feed water heater. At the north end of the building will be the office room and a locker room for the workmen.

Instruments for measuring the temperatures and for analyzing the waste gases will be provided.

This design provides several special features to which I wish to call your attention as follows:

(1) The garbage, being stored by itself away from the ashes and rubbish, can be drained of its free water. According to analyses made by Prof. R. E. W. Sommer with Milwaukee garbage, this free water, which will drain away under pressure of the garbage itself, amounts to as much as 7 per cent to 9 per cent of the weight of the wet garbage. Draining this water away to the sewer reduces the amount of heat used unproductively to evaporate the moisture in the refuse, and the rate of evaporation in the boilers will be correspondingly increased.

(2) The drying hearth at the back of each grate, where the refuse is partially dried before it is raked on to the fire, increases the rate of combustion. The effectiveness of this drying hearth is increased by the hot gas duct extending along the back of the hearth, which conducts the highly heated gases to the freshly charged refuse and reduces the percentage of moisture in the refuse before it is stoked on to the grate.

The drying hearth is also a valuable factor in increasing the life of the fire grate because it receives the impact of the refuse as it falls from the charging tube. Being of substantial brick construction, it is especially designed for this work.

(3) Storing the ingredients of the refuse separately in the different compartments of the hopper and providing a mixing floor as described will insure a uniformity in the grade of refuse fed to the fires. Where steam is generated, as in this plant, the value of this feature is evident. Furthermore the grade of refuse can be somewhat adapted to the station load.

(4) The mechanical charging devices will make it unnecessary to do any hand firing

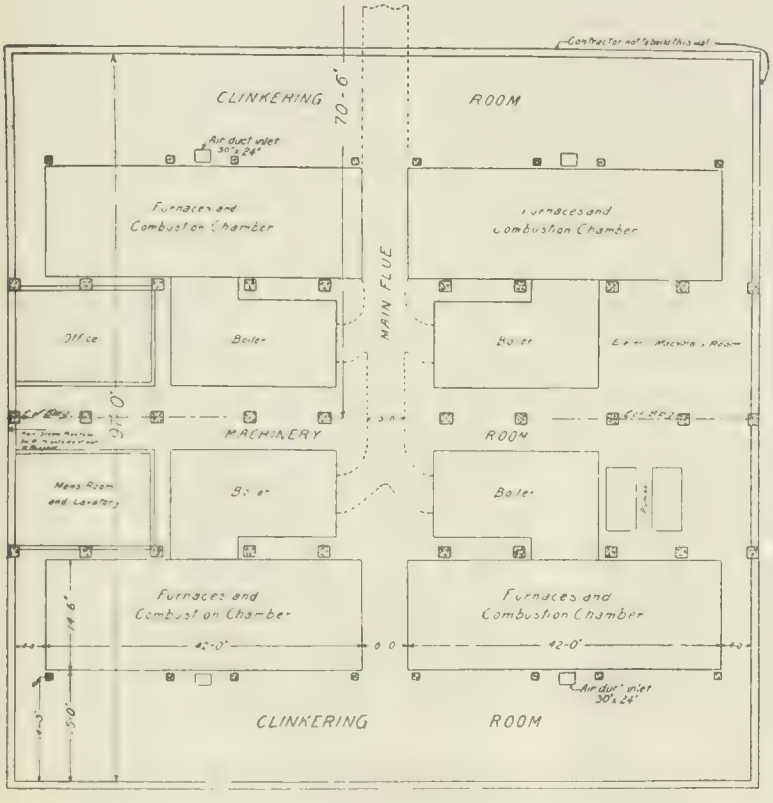


Fig. 2—Plan at Elevation of Clinkering Room, Milwaukee Refuse Incinerator.

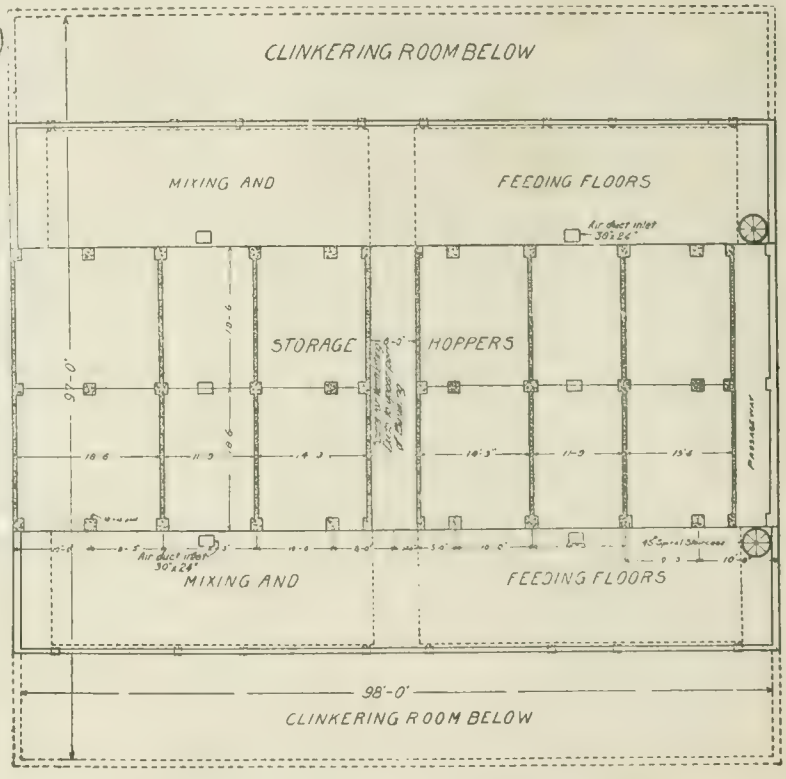


Fig. 3—Plan at Elevation of Mixing and Feeding Floors, Milwaukee Refuse Incinerator.

with wet, dirty refuse. This will reduce the manual handling of the refuse to as low a point as is possible without reducing the steaming results by removing all possibility of grading the refuse.

(5) Each operation in the conduct of the plant will be performed separately from every other. The cranesmen will work at top speed without interference from the men on the feeding and mixing floor. The men on the feeding and mixing floor will not be hindered by the men stoking the furnaces. Their whole work will be to keep the charging tubes full of refuse. Similarly the firemen will work by themselves in a room which is free from objectionable refuse and hot clinker. Their whole work will be to keep the fires as hot as possible and to thoroughly burn all the refuse. Finally the clinkermen in the basement will run the clinker cars out without interfering with the stoking above. These features should decrease the cost of operation.

(6) In burning refuse, a large amount of dust and soot is produced. If this dust settles on the boiler tubes it reduces the rate of evaporation and, if it goes up the chimney, it creates a nuisance. It is essential, therefore, to remove it. The arrangement of the grates on each side of a common combustion chamber causes the dust laden gases to enter the combustion chamber from opposite directions. This will momentarily retard the velocity of the gases and cause the dust to settle out. The combustion chamber extends 8 ft. below the ash pit and forms a pocket for the detention of this dust. It is of large cross sectional area, so that the velocity of the gases is somewhat reduced in this way. The boilers also are placed high, with their settings extending to the basement, and these settings, as well as the main flue, are all easily accessible for the removal of dust and soot and for repairs.

(7) Other features of special interest are the preheated air blast and the multicellular arrangement of the furnace grates. The air will be preheated to 300 degrees Fahr. and will increase the temperature of combustion. The multicellular arrangement of the grates will keep the temperature uniform, with no decided low points in the temperature curve during clinkering.

Results.—The contractors for the Milwaukee work have guaranteed, under bond, to maintain an average temperature in the combustion chamber of 1,500 degrees Fahr. and to evaporate 1.1 lbs. of water from and at 212 degrees Fahr. per pound of average annual refuse burned.

(Coal, depending upon boiler, will evaporate from 8 to 13 lbs. of water per lb.—Ed.)

According to the analyses and calorific values of the refuse already given, these results should be obtained. That similar results have been obtained elsewhere in practice is well known, I will briefly mention one or two such instances.

In Seattle, Wash., there is a 67-ton bottom charged refuse incinerator which has been in operation since January, 1908. Complete records of the operation of this plant have been kept and show satisfactory results. The temperature in the combustion chamber is almost always higher than 1,250 degrees Fahr., and the evaporation by actual measurement averages slightly more than 1 lb. of water per pound of refuse burned. The steam is used for the following purposes: (1) The operation of a 250 h.p. generator in parallel with the city lighting system; (2) the operation of a steam laundry; (3) the operation of a dry kiln in a kindling factory; and (4) the operation of a rock crusher with elevator and screens, which is used for the purpose of crushing and screening the clinker developed at the plant.

At Greenock, Scotland, there is a mechanically charged refuse incinerator which for the twelve months ending January 31, 1909, developed an average of 67.2 kw.-hr. per ton of refuse burned. At this plant a temperature of from 1,300 degrees to 2,160 degrees Fahr. is given as typical of a day's run. The electrical power generated netted about $8,000 for the year, and the clinker brought about $300.

Bridges, Buildings and Foundations

Note: This section is devoted to methods and costs of constructing steel and masonry bridges and buildings and of foundation work of all kinds. It will give special attention to erection plant and tools, falseworks and centers and cost data of all kinds.

A New Method of Sinking Cylinder Foundations in Underpinning the Cambridge Building, New York City.*

In July, 1907, the writer was retained by Henry G. Opdycke to report on the undermining of the Cambridge Building, on the southwest corner of Thirty-third St. and Fifth Ave., New York City, by the Pennsylvania R. R. tunnel, then under construction. Figure 1 shows the approximate cross section of the tunnel excavation at a point opposite this building, as taken by Mr. Opdycke and the writer. The space marked "To be backfilled" represents the approximate deviation from the theoretical tunnel lines, and shows that at one point an apparently misdirected blast caused a cavity extending some 3 ft. south of the building line of the Cambridge Building, or 9 ft. farther south than intended.

It also indicates roughly where Thirty-third St. caved in, on December 14, 1906, in front of the Waldorf. The cave-in had been backfilled, but the curb, the street, and the Cambridge Building had continued to settle. The tendency of the whole building was to bulge toward the north, as well as to settle vertically.

The fact that an old stream ran under the site of the Cambridge Building and the Waldorf-Astoria also aggravated matters, especialy as the break in the tunnel was at or near this old stream. The foundations of the Waldorf-Astoria had been carried down to the rock, but the east end of the Cambridge Building was founded on a spread footing of concrete and the west end on piles.

When the Cambridge Building was remodeled, in 1906, to convert it from a hotel into an office building, these piles, which were about 30 ft. long and when driven had been cut off below the water line, were found to be slightly above the water line, the latter having been lowered enough to expose their tops to the atmosphere, allowing them to rot. Therefore at that time the piles were cut off below the new water line, capped with concrete, and five heavy 20-in. I beams, about 40 ft. long, were placed on the concrete and buried in it, making a very substantial foundation for the west end of the building.

In 1907, when Mr. Opdycke and the writer examined the tunnel, they noticed that several rather large streams of water—evidently from the old stream shown on the maps—were pouring into it at this point. The examination showed that the building had settled considerably and was still settling, and the writer was requested to design a system of underpinning carried to rock. This he refused to do at that time, for fear of opening up a direct connection between the cylinders and the tunnel, thus endangering the entire building; but he recommended tying back the front wall with rods, to prevent it from falling away from the remainder of the building.

This was immediately done, as shown by Fig. 2. Two 12-in. beams, about 41 ft. long, were placed vertically just east of the main entrance on Thirty-third St., which was the point of greatest disturbance. These beams extended from the areaway floor up to and slightly above the third floor. The tops of the beams were anchored back by a 1½-in. rod, about 102 ft. long, made up of stock lengths of about 16 ft. and connected with turnbuckles.

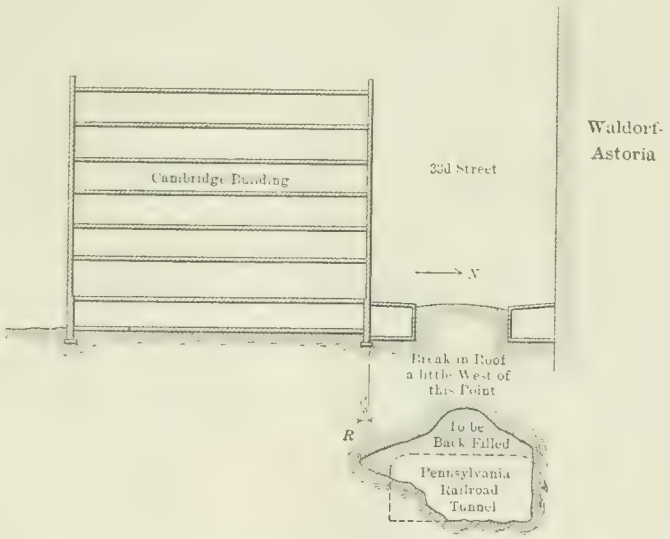


Fig. 1—Approximate Cross-Section Showing Relative Location of Pennsylvania R. R. Tunnel and the Cambridge Building.

The rear or south end of the rods ran through an open court, but close to the wall. On each side of the court 12-in. I beams, about 6 ft. long, were set vertically, and formed seats for the two 12-in. beams (18 ft. long) to which the rod was anchored. The north end of the rod was placed just under the floor in a private office and through the main hall.

The bottom ends of these long beams were anchored with two 1½-in. rods, just above the cellar floor. These rods were about 100 ft. long, and were made up of short sections, the rear or south ends being anchored to 5x9-ft. blocks of concrete, about 6 ft. deep, placed just under an old north and south partition wall, and in a position slightly inclined from the vertical. Two horizontal beams were also placed in the concrete, as shown. Near the west end of the building, another 1½-in. rod was placed, just above the cellar floor, the north end being locked over the top of the five 20-in. I beams and the south end being anchored to a similar block of concrete. Half way between this westerly rod and the first pair, a similar rod was placed and anchored in the same manner as the westerly rod. The

*Abstract of a paper by T. Kennard Thomson, Proceedings, American Society of Civil Engineers, Vol. XXXV, p. 1300.

41-ft. beams in front were then encased in sheet metal on account of their unsightly appearance.

The writer's examination was completed about July 23. A contract was at once made with Mr. Alexander Brown, Jr., to tie back the building, and the work was completed in about a week.

The rods were left in place until the permanent underpinning had been completed (during the following year), and effectually prevented the north wall from pulling away, although the entire building had apparently moved north in the interval. The anchorages in the cellar, although made very heavy, showed signs of the great strain by the cracks which opened up in the concrete floor behind them.

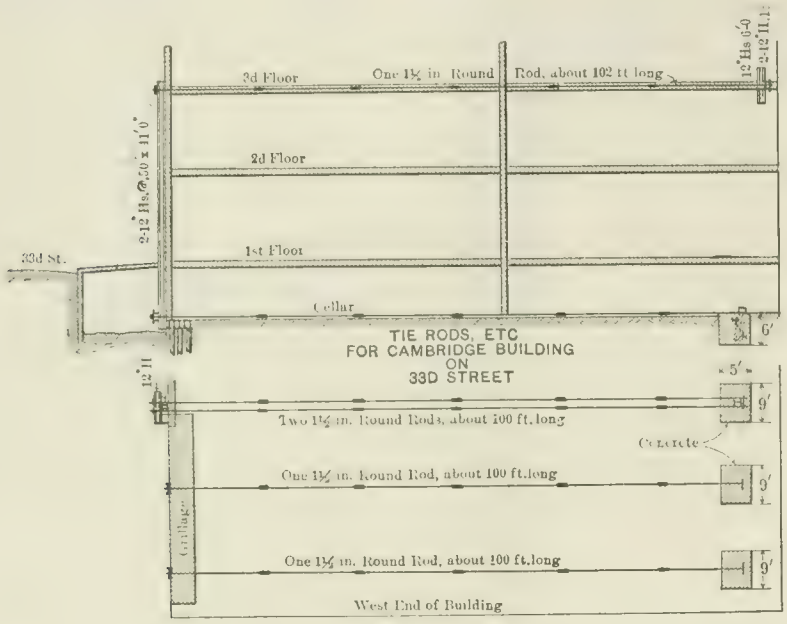


Fig. 2—Sketch Showing Method of Anchoring Cambridge Building Wall Against Bulging Outward.

When the rods were first put in, in the autumn of 1907, the writer tested them to see that they were under sufficient initial strain, and when he was called in to make another report and examination, in the following spring, a similar test indicated that they were under a considerably greater strain, showing the tendency of the building to move north. In the fall of 1908, when these rods were to be removed, the men commenced to saw through the second rod from the west on the cellar floor, quite near the end attached to the 20-in. I beams, without first slacking up the turnbuckles. When they had sawn three-quarters through the rod, it broke with a snap, and the long end sprang back about 2 ft. The men followed their instructions with the remainder of the rods, and slackened off the turnbuckles first.

The examination of the building in March, 1908, indicated that there had been considerable vertical movement or settlement since the previous fall. Borings then taken showed that the rock was about 20 ft. below the curb at the east end of the building and about 44 ft. at the west end. The substrata were found to be partly of made ground, and below that there was sand, gravel, clay, and silt or muck, such as is found in the beds of all old New York streams—a very treacherous material to have under a building.

The borings also indicated that the old stream had been entirely diverted by the tunnel, leaving the piles dry, and making their ultimate destruction by rot certain.

In the meantime the tunnel excavation had been completed, and the permanent masonry lining built in place, and it was thought that the stream which had been flowing into the tunnel the year before would back up, when it could not get into the tunnel, and again submerge the piles. The borings, however, indicated that this was not so, but that the tunnel had in some manner effectually and permanently diverted the old stream, thus lowering the ground-water level 30 ft. or more.

Reports had been obtained from H. G. Opdycke, Assoc. M. Am. Soc. C. E.; Rudolph P. Miller, M. Am. Soc. C. E.; Daniel E. Moran, M. Am. Soc. C. E., and Mr. Joseph Caccavajo, and, as these were similar in nature to that made by the writer, the Gorham Company (the lessee) decided to underpin the building to rock, and a contract for doing so was made with Mr. Alexander Brown, Jr., who retained the writer as consulting engineer to devise a plan and carry it out.

The east end of the north wall of the Cambridge Building was occupied by the show windows of the Kirkpatrick jewelry store, on the Fifth Ave. and Thirty-third St. sides of which store the old brick wall in the first story had been removed and a number of 8-in. cast-iron columns had been inserted to carry the upper brick wall and floors.

This is a kind of construction very frequently resorted to in converting old buildings into stores, etc., and answers the purpose as long as the foundations are not disturbed or the walls jacked against, as there is no transverse bracing between the columns; therefore it was decided not to use the old system, which involved jacking against the building to force cylinders or walls into the ground.

Under this end of the wall, from the curb to the cellar, there was a wall of brick and rubble masonry with some ashlar facing, which had been built, as was customary at the time and for that class of work, without any engineering supervision or advice; in other words, it was of the usual poor construction.

This foundation wall rested on a concrete footing, and on top of the wall were set the 4-in. beams, which for the length of the wall formed a base for the 8-in. cast-iron columns.

As it was not advisable to do much cutting in this wall in the condition it was then in, it was decided to reinforce it by placing a 5-ft. plate girder on each side about 1 ft. below the 4-in. beams, to bolt these two girders together with 1¼-in. bolts, and to grout the spaces between the girders and the wall. These spaces were usually 1 in. or more in width, as no attempt was made to dress down the surface of the masonry. As these girders in place were to be about 67 ft. long, they were each shipped in two sections in order that they might be put in position readily.

The west end, shown by Fig. 3, rested on the end of the old 20-in. steel beams, and the south end on a timber blocking under the sidewalk of Fifth Ave.

These girders had ½-in. web plates and one 6x6x¾ in. angle in each flange.

After the underpinning was completed, the 10 ft. under Fifth Ave. was sawn off, and a space of about 4 ft. was cut out for a door just west of the splice, the splice having been placed at that point on account of the door.

The girders were placed a little more than 2 ft. 2 ins. apart, back to back, and with the exception of the south end and the space cut out for the door were eventually bricked up on both sides, making a solid wall on top of the cylinders. As soon as the cylinders were in place and grouted, three 9-in. beams were placed under the 4-in. beams and under each column. The ends of these 9-in. beams were wedged up on top of the 5-ft. girders, thus transferring the load from the columns directly to these girders. The holes around these short beams were then filled with concrete and brickwork. There were six 8-in. cast-iron columns resting on this pair of girders, and it was now considered safe to undermine two columns at a time in order to make room for the underpinning cylinders, one of which was put directly under each of the five most easterly columns.

As the sixth column and the remainder of the wall, or the portion from the east side of the entrance to the west end of the building, was being carried on the five 20-in. grillage beams, resting on the concrete-capped piles, it was thought that it would be too expensive and dangerous to try to put the cylinders directly under the columns, especially as it would have been necessary to cut out the old piles all the way down. Therefore it was decided to sink four pairs of cylinders as close to the grillage beams as possible, and then remove enough concrete to place 20-in. I beams under the old grillage beams, the ends of these short beams to rest on the pair of cylinders, and wedges to be driven between the short beams and old long grillage beams. Three of these short beams were inserted over each pair of cylinders. At the extreme end an additional cylinder was sunk on the

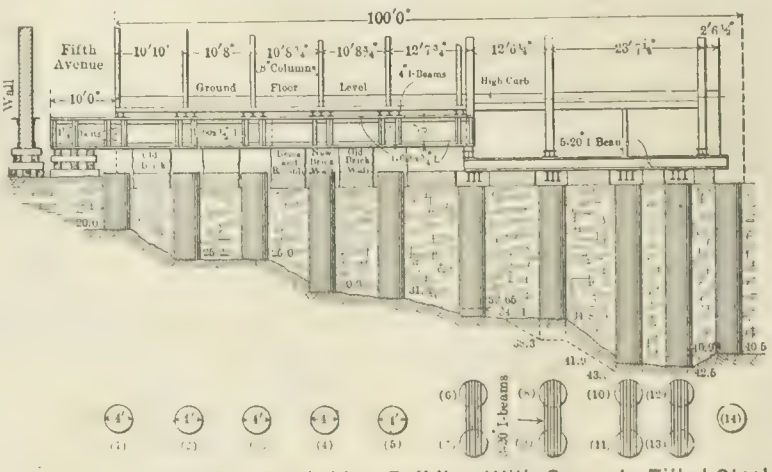


Fig. 3—Method of Underpinning Cambridge Building With Concrete Filled Steel Cylinders.

center line of the wall, making in all fourteen cylinders for the support of the building.

Two additional cylinders were sunk in the areaway, to support the north end of the boilers and the area wall.

Mr. Brown called for bids on this plan and awarded the contract to Thomas B. Bryson, as his bid was less than half as great as the other bids, and it was concluded that he could do a good job and make a fair profit, both of which he did. He also gave a bond to the owners for twice the amount of his contract. His total contract, including the extra work, was about $13,000, which included supplying and sinking the 16 cylinders, filling them with concrete, supplying and placing the girders and beams, doing the necessary wedging, etc., and back-filling with concrete where necessary.

The cylinders (Fig. 4) were 4 ft. in diameter, and had very thin shells. The method of placing them constitutes a new system of underpinning, for instead of placing the bottom section first and jacking it into the ground, and then placing another section on top and repeating the operation, a space was excavated for the top section, which was made 4 ft. deep, and the space outside of this top section

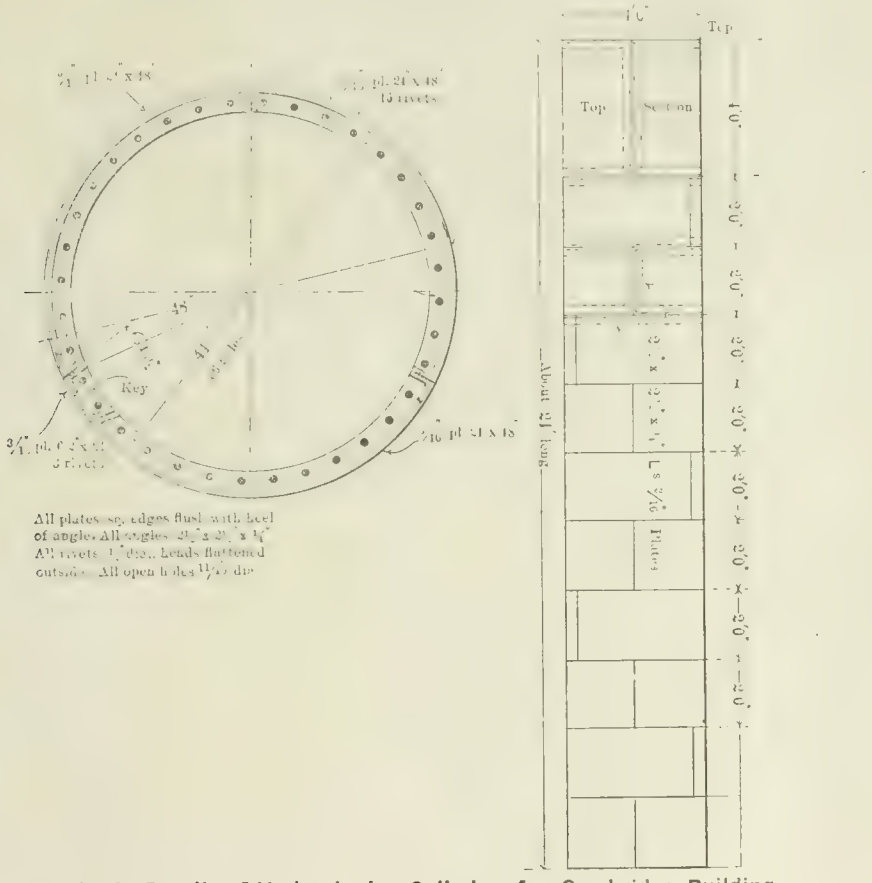


Fig. 4—Details of Underpinning Cylinders for Cambridge Building.

was back-filled, generally with concrete, and remained permanently in that position.

A laborer then entered the top section and with a short-handled shovel excavated the material under the "cutting edge" sufficiently to insert one segment of the next ring. All the rings below the top section were 2 ft. deep and in four segments, one of which was small, to act as a key, as in tunnel lining. In this key segment the connection angles were bent 13½° from the radial, to permit putting the key in place. The joints of the other segments, of course, were on the radial lines. All the plates were 3/16 in. thick and all the angles (horizontal and vertical) were 2½x2½x¼ in. When the first segment under the top section had been bolted in place, the excavation was made for the second segment, then the third, and then the fourth or key. Where the ground was good, the excavation was made for all four segments at once.

Although the borings showed that all the water had been drained off, it was considered desirable to provide in the contract for doing the work under compressed air if water should be encountered, and the first cylinder to be sunk had gaskets in the joints, but as it was found that the borings had been correct in showing the absence of water, no effort was made to obtain water-tight joints in the other 15 cylinders.

In sinking one of the cylinders the rock gave evidence of having been blasted, as it undoubtedly had been, as this cylinder was directly over the tunnel. The flushing of the street near the Waldorf allowed considerable water to percolate and get into the uncaulked joints of the cylinder, sometimes in quite a stream, but it was noted with surprise that this water disappeared as soon as it reached the bottom of the cylinder, passing into the drains or crevices alongside of the completed tunnel, although these drains were supposed to have been blocked off or choked up.

This proved the existence of the second danger feared for the Cambridge Building, resulting from the construction of the tunnel. The first was the rotting of the piles due to the removal of the ground water, and the second the removal of the subsoil, especially where it was muck or silt, as in this case, by the continual draining of the water from the streets, old streams, etc., into or alongside of the tunnels, for it is known, of course, that such continual drainage must carry a large amount of soil or muck with it, causing a gradually enlarged cavity which, sooner or later, would be filled from above, perhaps suddenly, and with disastrous results.

This action is occurring in so many places in New York City that some day we may expect to see a whole building suddenly collapse, like some of the villages in mining districts.

These plans were drawn up in July, 1908; Mr. Bryson was awarded the contract early in August, and by August 21 he had the first cylinder on rock, having spent 4 or 5 days on it, as his men were new to the work, and extra precautions were taken against water, etc. The other cylinders were put down at the rate of about 2 days each for a depth of about 30 ft. below the curb, the 16th or last cylinder being completed exactly 30 days after the first was landed. Generally an attempt was made to work on two cylinders at a time, but in such cramped spaces it was difficult and subject to delays. Mr. Bryson sublet the placing of the four 33½-ft. girders to Mr. Frank M. Tench, who handled the ticklish problem without disturbing the sidewalk in front of the jewelry store. As the cellar under this store was a salesroom for valuable goods, such as statues, paintings, etc., it was necessary to build a tight wooden partition, about 5 ft. south of the wall, which was reinforced by the girders, before work was started, and, after the girders had been bricked in, furred and plastered, the rich red burlap was replaced before the temporary partition was removed.

A Suggested Form of Building Contract Designed to Secure Justice and Equity to Both Owner and Contractor.

This paper has been limited to agreements for the construction of buildings, and no attempt has been made to cover the subject of agreements in general, because the writer has given this type special study and also feels that the principles underlying such agreements are readily adaptable to those for other construction, and that, within the limits of this paper, many of the vital questions at issue can be brought out more effectively by taking a concrete case rather than by dealing in generalities.

From the practical standpoint of the building agreement, it matters little whether the person who planned the building and will have charge of it until completion is called an Engineer or an Architect. The only practical difference would be that the word "Engineer" would be used in one case and the word "Architect" in the other, to represent such a person. Therefore, it should be understood that wherever the word "Engineer" is used throughout this paper it is intended to designate a person properly equipped by education, experience, training, or temperament, to lay out, supervise, and direct, in an executive capacity, all work, at any stage, in the erection of a building, from the time it is mentally conceived until it is finished and ready for use.

The purpose of this paper is not a defense of the Contractor, as against the Engineer or Architect, but is simply one advocating justice and equity to all parties to a contract. Destructive criticism is easy, but constructive criticism is of a different mold, and should always be welcomed among broad-minded men. In suggesting a new form of Agreement and Schedule of Conditions of Contract, it is hoped that something definite may be accomplished in righting the wrongs that most Engineers will readily admit exist, and nearly everyone has tried by different means to correct. The writer does not imagine that he has discovered some new and patentable truth, but hopes that his studies may have brought into concrete shape some practical suggestions for correcting well-recognized faults. After Engineers and Architects have set about putting their own houses in order, as typified by contract requirements, they can then more fearlessly demand that Contractors right the wrongs for which they alone are to blame.

DIVISIONS OF CONTRACTS.

Building contracts may be said to be divisable into four parts or divisions.

(1.)—*Matters Preliminary to Contracts*—Being the terms under which a contract is awarded, and giving the general information necessary before the execution of the agreement. It would include the "Form of Agreement" and "Schedule of Conditions of Contract" as given hereafter.

(2.)—*Agreement (or so-called Contract)*—Being the instrument executed between the Owner and Contractor, legally and formally binding them to fulfill their obligations. It should properly include the "Schedule of Conditions of Contract."

(3.)—*Specifications.*—Being the detailed written description of the method of construc-

*Abstract of a paper by Wm. B. Bamford Proceedings, American Society of Civil Engineers, Vol. XXXV, p. 1312.

tion and of the quality and kind of materials to be furnished.

(4.)—*Drawings.*—Being the detailed, graphic design of the work to be done, with the quantity and sizes of materials.

This paper treats only of the Agreement (or so-called Contract).

The Agreement, preferably, should not contain any matters concerning the details of construction, these belonging properly to the specifications. There are, however, a number of legal requirements which could be included in the Agreement or in the Specification. Legally, they would be just as binding in one as in the other. These matters will be mentioned under the heading "General Conditions."

REASONS FOR CONTRACTS.

A building contract is entered into by the owner in order to obtain the services of a contractor who is skilled in that particular kind of work, and by the contractor because he expects to make a certain profit in remuneration for his services and knowledge. Assured of his profit, it is immaterial to the contractor what kind of work the owner or Engineer may desire to have done, but if the contractor's profit is not assured, he becomes vitally interested in anything that may tend to affect his prospective profit. With the contractor, the work is purely a business proposition; he expects to make a certain profit for doing a particular amount of work. He must make a legitimate profit; his business life depends on it; and the more he feels this slipping away from him the more diligently will he find ways and means to reimburse himself. Even the best of contractors will try hard to obtain this profit in one way or another, else they must ultimately be forced from business and leave the field to those who are probably less competent contractors but shrewder business men.

A contract is intended to insure that an owner will obtain a definite piece of work for a stated sum and within a given time, and to insure that, for doing this, a contractor will be paid stated sums of money at definite times. The contract, therefore, should be drawn so that the owner can demand and obtain his work and the contractor his payments with the least delay and difficulty.

It is thought that the provisions of the Agreement and Schedule of Conditions of Contract given hereafter will protect more equitably the interests of all parties, and permit the engineer to enforce more certainly the proper fulfillment of the contract obligations than has been possible under the majority of such documents which have come to the writer's notice.

SYSTEMS OF CONTRACTING.

At present the systems of contracting used in building work may be divided into two general classes, the lump-sum system and the various percentage systems. They are often designated by the manner in which the work is to be paid for, as:

(1.)—Lump sum;

(2.)—Cost, plus a percentage;

(3.)—Cost, plus a percentage—where the general contractor takes estimates for subbranches of work, and makes lump-sum contracts, with the engineer's approval;

(4.)—Cost, plus a percentage, with guaranteed limit;

(5.)—Cost, plus a fixed sum;

(6.)—Cost, plus a fixed sum, with a bonus if cost is less than a fixed sum, and a penalty if it exceeds such sum.

Of these, the lump-sum system is the most usual, and is theoretically the best. Such a system pre-supposes that the contract defines the work to be performed, and that a contractor, therefore, can determine accurately what the execution of such work will cost. If, however, the contract requirements are indefinite, the contractor is never certain, no matter how conscientious he may be, that he may not be required, under broad or ambiguous clauses of the contract, to furnish more than he honestly understood would be required from his reading of the contract when estimating. Thus he may be forced to do work at a net loss instead of a profit. Under the various percentage systems, on the contrary, the contractor is assured of his profit, no matter how much work he may be required to do.

The lump-sum contract is superior to the percentage type because it more truly fosters fair and open competition, and is more economical, as has been demonstrated amply by many men of ripe experience. This presumes that the drawings and specifications describe completely and accurately everything that the contractor must do or furnish, especially where an expense is involved. If this is not done, the contractor's prices become mere gambles on probabilities, and not accurate estimates of actual costs plus a legitimate profit. In such a case is it to be wondered at that a contractor will fight at every legitimate opening in order to protect his final profit? He is not always able legally to demand additional compensation for the work which has actually cost him more than the estimated amount, therefore his only opportunity to make up his losses and come out with a fair total profit is by obtaining good prices for additional work, or, if it does not appear that there will be any such worth while, the contractor must find flaws in the contract and endeavor to get all the extra money he can, through technicalities or otherwise.

With the irresponsible or dishonest contractor there need be no sympathy, but by far the greater number of contractors only desire their legitimate profit, and the prospect of making a fair profit by hard, honest work is none too bright at the present time, under the usual lump-sum contract.

Contractors have found that the easiest and most practical way to overcome the disadvantages of the lump-sum estimates is by the various percentage systems. The contractor is thus assured of his profits, and the owner and engineer can change or increase the work to their hearts' content, as all additional expense involved is borne by the owner.

Assuming that the contractor is honest, and that the bills and statements he presents for payment are correct, and have all discounts, except a cash discount deducted, the cost of percentage work is apt to exceed the cost of work done under a lump-sum contract. The reasons for most of this increase are not hard to find. The contractor, not being responsible for the cost, and having his profits assured, readily makes any changes and does work as directed, no matter how expensive or uneconomical such work may be, and the owner does not realize how expensive his fads or fancies will be until the work is completed. Then again, if the percentage is based on the total cost, there is not the incentive for the contractor to become as zealous in obtaining the closest prices for materials as he would under a lump-sum contract.

Another most serious objection to percentage work is due to the fact that mechanics are inclined to loaf, even under the most careful supervision, and it is hard to get as much work out of them as under the lump-sum system. They seem to feel that as their employer, the contractor, will not suffer any loss, there will be no harm done, or they will not be in danger of losing their positions.

Many of the most serious objections to the percentage system have been overcome in varying degrees under systems 3, 4, 5, and 6. These systems have much to commend them, and, with all their faults, they will eventually supersede the lump-sum system, unless more care is taken to make contracts complete and accurate.

The English method of "Quantity Surveying" is another excellent attempt to overcome the worst objections to the lump-sum system of estimating, but, as at present in use, it would be too cumbersome for American practice. There the owner or engineer has the work to be done itemized in detail, and on this itemized statement, submitted to all contractors, they fill in their prices. These lists go into matters in minute detail, and, as all contractors estimate on the same list, the advantage is obvious. The Royal Institute of British Architects had approved forms, which are only slight modifications of the one for lump-sum contracting, in which the principal change is in making the "Quantities" a part of the contract. Under such a contract, the contractor would be able to obtain compensation for all items not mentioned specifically in the "Schedule of Quantities."

PRACTICAL AND EQUITABLE CONTRACTS.

Many contracts appear to be drawn by the engineer solely on the assumption that the owner's interests must be most carefully guarded against failure by the contractor to fulfill his agreements properly. In the past, when profits were sufficiently liberal, contractors could afford to take chances that "club-clauses" would not be strictly enforced, and profits lost by unfair clauses could be made up on "extras." Today, however, competition is sharper, and profits are too often figured on too slender a margin to permit a contractor to "take care" of losses caused by unfair clauses. No wonder, then, that the contractor becomes more and more technical and troublesome over small omissions or errors, whereas, before, he could charge these minor matters to profit and loss, or good-will. The chances which a contractor takes that an owner will not be fair-minded should not be overlooked. An owner may become very exacting, and may insist on "strict and literal" compliance with the letter of the specifications and contract, and may place an engineer in a very embarrassing position by referring to and insisting on the literal fulfillment of certain ambiguous conditions or the "taking of every pound of flesh," against the engineer's better judgment.

The value of a just contract to the owner and the engineer is as great as its value to the contractor. A just contract, provided it is accurate and free from ambiguity, cheapens the cost of work by eliminating the necessity for sums to cover possible contingencies; it broadens real competition, and encourages lower estimates; it ensures more rapid erection, and also acts as a powerful regulator of the mutual understanding and confidence in the fairness of all parties. Fairness, like oil for machinery, is necessary to prevent friction.

The agreement is only one of the divisions of a contract. It is the specifications and drawings, together, which must give the contractor a clear and complete knowledge of the work he must perform and the materials he must furnish, and should contain all the information necessary to permit him to make an accurate estimate and to carry out the work properly. The specification requirements should define clearly the result, the accomplishment of which is the object of the contract. It is a general statement of the work to be performed, a description of the materials, the quality required, and the workmanship to be performed, with definite limits as to what tests must be made in order to determine compliance with the requirements of the contract, or what defects would be sufficient cause for rejection.

Specification writing cannot be acquired successfully without practice and without broad knowledge, practical experience, and a careful study of the various materials and methods of construction and their relative costs. As ideas and methods change and improve, as a result of experience, so specifications should be changed to keep abreast of the times. An inexperienced writer is very apt to be uneven in his descriptions, writing at unnecessary length upon matters with which he is familiar, and covering his ignorance of equally important matters by the brief and ambiguous direction that "the work shall be done to the entire satisfaction of the engineer," "whose decision is to be final and binding on all parties." These statements are too often an admission that the engineer did not know what he desired, or that the owner had failed to express a preference and, therefore, had been left with unlimited future choice.

As previously stated, the ultimate object of a contract is to insure to the owner that he will obtain a definite finished product, of a

certain kind, for a particular cost, and in a given time; and to insure to the contractor that he will obtain certain sums of money at definite times for doing a definite amount of work; and the engineer is looked upon as the arbitrator or judge, to see that both parties receive their full justice under the contract. Contracts, therefore, should be drawn so that the owner can demand and obtain his work and the contractor his payments with the least delay and difficulty.

Engineers have always claimed to be arbitrators between owner and contractor, and not the representative solely of one party. This position is a proper one, but today it is more of a myth than a fact. The anomalous position is brought about, not because engineers are desirous of being unfair, but because of the agreements (or contracts) generally used, which make it extremely hard, if not almost impossible, for engineers to be fair if they try to conform to the agreement provisions.

It might be claimed that one of the most practical benefits to engineers and architects, in the more general use of an agreement similar to the one herein suggested, might be that it would not so insidiously "lead us into temptation" but would "deliver us" from many of the pitfalls lurking unsuspectingly around many present contracts.

While there is abundant room and great need for material improvement in specifications, it must be recognized that, with the limitations to the best of human endeavors, it will be extremely difficult, even for the most conscientious and painstaking, to prepare specifications for large work which may not contain some unfair requirements, when viewed from the contractor's standpoint. We can come near to the goal, certainly much nearer than is at present the practice, but possibly our slight oversight may mean a contractor's heavy loss.

The writer, therefore, strongly feels that one of the most practical steps toward the realization of contracts which will be fair and just to all parties will be made by the more general acceptance of the principles contained in the following forms of Agreement and Schedule of Conditions of Contract, and the adoption of similar provisions in contracts.

It is suggested that the following Agreement and Schedule of Conditions of Contract, be read through first as a whole, in order to obtain a general knowledge of their scope, omitting the reading of the notes following. They should then be read, article by article, with the comments after each.

AGREEMENT.

(For Lump-Sum Contracts.)

This Agreement, made the .... day of ....., in the year One Thousand and Nine Hundred and ...., by and between ....., of ....., hereinafter called the Contractor, and ..... of ....., hereinafter called the Owner.

Witnesseth, that the Contractor and Owner, for the considerations hereinafter named, agree as follows:

Article I. The Contractor agrees to provide all materials and perform all works for the (here briefly describe works) of a (here briefly describe type of building) at (here briefly describe location), shown on drawings numbered ..... and as described in the Specifications marked ....., prepared by ....., hereinafter called the Engineer; and to do all things required of him by the Drawings and Specifications and subject to the Conditions set forth in the Schedule hereto annexed (hereinafter referred to as "the said Conditions").

Article II.—The Contractor agrees to complete the works by and at the time or times hereinafter stated, to wit: .....

Liquidated damages should be a matter for special consideration in each separate contract. Many engineers and owners seem to desire them, possibly for the moral effect on contractors. The history of the legality of such provisions should cause them to be used with caution.

In many cases the following clause might be as far as it would be advisable to go toward obtaining just and reasonable damages for delay in completion:

The Contractor agrees that the time for completion of the works shall be considered as of the essence of the contract, and he agrees that for liquidated damages he will pay the Owner for the cost of all extra inspection, and for all amounts paid for rents, or for more protracted services on the part of the Engineer, or Clerk of the Works, or both, and other expenses entailed by the Owner by delay in completing the contract, and the Owner shall be entitled to retain from the amount otherwise to become due to Contractor an amount sufficient to reimburse properly the Owner for such expenses. Provided, however, that the sum collected as aforesaid for liquidated damages shall not exceed the sum of $.... for each and every day's delay not caused by the Owner, or otherwise as provided in the said Conditions, Section XXIV (subject to Arbitration).

Article III.—The Owner agrees to pay the Contractor for the execution of the contract ..... dollars ($.....) in current funds subject to additions and deductions as provided in the said Conditions, and upon the presentation of the certificates of the Engineer, as follows:

Before the ..... day of each month, the Contractor may submit to the Engineer a written statement showing (a) the value of the work and materials actually wrought into the building to the first of the month, (b) the value of materials delivered at the building but not incorporated into the work, and shall deduct the aggregate of previous payments. On or before the ..... day of the same month, the Engineer shall issue a certificate for .....% of the value of work as executed in the building, until the balance retained by the Owner amounts to the sum of $....., after which time the payments shall be for the full value of the work subsequently executed. The Contractor shall be entitled, under the certificate to be issued by the Engineer, to receive payment of ....., being a part of the said sum retained in hand when the works are practically completed, and in like manner to payment of the balance within a further period of ..... months, or as soon after the expiration of such period of ..... months as the work shall have been finally completed, and all defects made good according to the true intent and meaning hereof, whichever shall last happen. The Engineer, however, shall have authority to retain out of any monies actually due the Contractor only such sums as are provided by the said Conditions, Section XXX.

The manner of payment could be varied in many ways, as the conditions of the particular case made it necessary. The principle underlying the form suggested above, however, is important. As before stated, it is as essential that the contractor shall be able to demand and obtain his payments as that the owner shall be able to obtain the work for which he pays. In Article III the contractor's right to definite payments is expressed clearly. The engineer must issue a certificate for money due, and the owner must pay the amount due. It should be noted that the engineer is allowed ample discretionary power to withhold any money not justly due, as provided by Section XXX of the conditions. Thus the obligations become fairly clean cut. If the contractor's work is not done properly, there is ample power to withhold money to cover definite defects. On the other hand, if the engineer or owner withhold any payments without just cause, the contractor has recourse to arbitration, under Section XXXIV of the conditions, or to terminate the contract, under certain contingencies, as provided in Section XXXIII.

The idea of retaining percentages until the completion of the work is intended to insure its proper completion. The usual American practice of retaining an unchanging percentage from start to finish is unnecessarily extravagant, and in contracts involving large amounts is more harmful than beneficial. After the work has been approximately half completed, the remainder should be paid for in full without retaining a percentage. Of course, additional sums can be retained to cover known defects. The sum retained when the work is half completed is usually sufficiently liberal to cover possible contingencies, and is just as effectual as to continue to increase it until completion.

Article IV.—It is mutually agreed that the term "the Engineer" in the said Conditions shall mean the said ..... or in the event of his death or ceasing to be the Engineer, for the purpose of the contract, such other person as shall be nominated for that purpose by the Owner, not being a person to whom the Contractor shall object for reasons considered to be sufficient by the Arbitrators or Arbitrator mentioned in the said Conditions. Provided, always, that no person subsequently appointed to be Engineer under this contract shall be entitled to disregard or overrule any decision, or approval, or direction, given or expressed by the Engineer for the time being.

The purpose of Article IV is to cover cases which may be unusual but are generally very troublesome when they occur. It would prevent a subsequent engineer from altering at will matters of personal opinion or choice of his predecessor. No two minds are exactly alike, and few engineers or architects have exactly similar tastes. Should an engineer desire to change work which may be purely matters of opinion or judgment of both himself and his predecessor, such changes should not be paid for by the contractor, but by the owner, if he decides to follow the suggestions of his adviser. Of course defective work should be condemned at any time, when discovered Should an engineer desire to change some orders of his predecessor, and take the ground that certain work should be done as a part of the contract, he should not have arbitrary power to enforce his will, but could order the work done as provided by Section XVII of the Conditions, leaving to the Contractor the right of appeal to arbitration, under Section XXXIV., if he desires.

Article V.—It is mutually agreed that the said Conditions shall be read and construed as forming a part of this Agreement, and the parties hereto will respectively abide by and submit themselves to the conditions and stipulations, and perform the agreements on their parts, respectively, in such Conditions contained.

Article VI.—The Contractor and Owner, for themselves, their successors, executors, administrators, and assigns, hereby agree to the full performance of the covenants and agreements herein contained.

In Witness Whereof, the Contractor and Owner have hereunto set their hands and seals, the day and year first above written.

In presence of

.... [Seal]

.... [Seal]

SCHEDULE OF CONDITIONS OF CONTRACT.

1.—Drawings and Specifications.—The works shall be erected in accordance with the directions and to the reasonable satisfaction of the Engineer, in accordance with the Contract Drawings and Specifications, and in accordance with such further drawings, details, instructions, directions, and explanations as may from time to time be given by the Engineer. If the work shown on any such further drawings or details, or explanations be, in the opinion of the Contractor, extra to that comprised in the Contract, he shall, before proceeding with such work, give notice in writing to this effect to the Engineer. In the event of the Engineer and Contractor failing to agree as to whether or not there is any extra, and of the Engineer deciding that the Contractor is to carry out the said work, the Contractor shall accordingly do so, and the question whether or not there is any extra, and if so the amount thereof, shall, failing agreement, be settled by Arbitration, as provided in Section XXXIV, and the Contractor will be paid accordingly.

This section covers the troublesome question of work shown by details, etc., being in excess of the contract requirements. It might be reasonable to assume that the engineer would know better than anyone else whether his details require extra work, and the contractor should be permitted at any time to recover the value of such work upon proving that it was extra to the contract. There are many sound objections to such a course, and the more satisfactory of the two evils would seem to be to require the contractor to notify the engineer of any extra work, before proceeding with it, as a precedent to obtaining extra compensation.

II.—Contractor to Provide Everything Necessary.—The Contractor shall provide everything necessary for the proper execution of the works, within the limits established by the Drawings and Specifications, according to the true intent and meaning of the Drawings and Specifications taken together, whether the same may or may not be particularly shown on the Drawings or described in the Specifications, provided that the same is reasonably to be inferred therefrom; and if the Contractor finds any discrepancy in the Drawings, or between the Drawings and Specifications, he shall immediately refer the same to the Engineer, who shall decide which shall be followed. Figured dimensions shall be followed in preference to the scale, and figures on large-scale drawings shall take precedence over those at smaller scale.

III.—Copies of Drawings and Specifications.—The Contract Drawings and Specifications shall remain in the custody of the Engineer, and shall be produced by him at his office as and when required by the Contractor or the Owner. Three complete copies of all Drawings and of the Specifications shall be furnished by the Engineer, free of cost, to the Contractor, for his own use. The Engineer shall furnish to the Contractor within ..... days after the receipt by him of a request for the same, any details which, in the opinion of the Engineer, are necessary for the execution of any part of the work, such request to be made only within a reasonable time before it is necessary to execute such work in order to fulfill the contract. A complete set of such copies and details shall be kept on the works until the completion thereof, and the Engineer or his representative shall at all reasonable

times have access to the same, and, as instruments of service, all drawings are the property of the Engineer and shall be returned to the Engineer by the Contractor at the time of making the final payment under the contract.

IV.—Conform to Laws, Regulations, Etc.—The Contractor shall conform to the provisions of all the State building and sanitary laws, and with all municipal or local ordinances, rules, and regulations relating to building and to the preservation of the public health and safety, also with all regulations of the Board of Fire Underwriters and Fire Insurance Authorities having jurisdiction, and of any Water and Lighting Companies with whose systems the structure is proposed to be connected, and, before making any variations from the Drawings and Specifications that may be necessary by so conforming, shall give to the Engineer written notice, specifying the variation proposed to be made, and the reason for making it, and apply for instructions thereon. In case the Contractor shall not in due course receive such instructions, he shall proceed with the work, conforming to the provisions, ordinances, rules, and regulations in question, and the variation thus necessitated shall be dealt with under Section XXXIV. All contract requirements over, above, and beyond the said provisions, ordinances, rules, and regulations, shall be fully complied with. The Contractor, at his own expense, unless the law specifically requires the Owner to do so, shall obtain all necessary permits and licenses, give all necessary notices, and pay all legal fees.

The laws, ordinances, etc., of states and municipalities are often very divergent in their requirements, and in places positively contradictory. The meaning of many of their requirements, together with a great many of those of various fire insurance authorities, is not easy to determine by the most careful reading. Then again, the local authorities may have discretionary powers, and their "personal preferences" may be difficult to obtain, even by local men. Thus it would appear that, if an engineer cannot interpret correctly the local requirements in his drawings and specifications, it is unfair to place the responsibility, by a blanket clause, on the contractor. If, therefore, the authorities require work to be done in a different manner than that called for by the contract documents, and such work involves additional expense, the owner, and not the contractor, should pay for the same.

V.—Setting Out Work.—The Contractor shall set out the work in accordance with the Owner's survey and the Engineer's drawings, and, during the progress of the building, shall correct at his own expense any errors arising from inaccurate setting out, unless the Engineer shall decide to the contrary.

It is advisable that the owner have a survey made, and guaranteed, if desired, by some recognized title guaranty company. With this survey and the drawings, the contractor should be held to lay out the work correctly; but to renounce all responsibility for the survey or drawings and endeavor to place the responsibility for all conditions, both known and unknown, on a contractor, is not good business policy, nor keen professional foresight, though there may be specific cases apparently to justify such a course.

VI.—Foreman.—The Contractor shall keep constantly on the works a competent general foreman, and any directions or explanations given by the Engineer to such foreman shall be held to have been given to the Contractor.

VII.—Assignment of Contract.—The Contractor shall not, without the written consent of the Engineer, assign this agreement, and, before subletting any portion of the works, shall notify the Engineer of such fact, in writing. No sub-contractors, to whom the Engineer has made written objections, shall be employed, and the Contractor shall assume full responsibility for all his sub-contractors.

Sub-contractors are not legally recognized as parties to a contract, but, in many cases the power is assumed of dictating to a contractor what persons he must employ as sub-contractors. Such a course is not only unfair, but might cause legal difficulties later should the contractor take the ground that he is not responsible for the acts of a sub-contractor not of his own selection, but who was forced upon him by the engineer or owner. In the foregoing section the engineer may disapprove of sub-contractors who are not satisfactory, but he is not permitted to dictate who must be employed as sub-contractors. Where the engineer approves a sub-contractor, it can be implied that he considers that the person whom he may approve will be satisfactory, while, by confining himself to the disapproval of unsatisfactory sub-contractors, no such satisfaction can be implied, as the persons finally employed may be entirely unknown to the engineer.

VIII.—Work by Other Contractors.—The Contractor shall permit the execution of work by any other mechanics or trades employed by the Owner, and shall afford them every reasonable facility for the proper erection of their work. The Owner agrees not to employ any other mechanics or trades on the work against whom the Contractor shall make what the Engineer considers a reasonable objection, or who will not enter into a contract with the Contractor guaranteeing the due performance of his work and indemnifying the Contractor against valid claims which may arise during the performance of the work.

The object of this section is simply to minimize the chances for disagreement between independent contractors and their making claims to the owner for damages done to them by other contractors. By this section, if a general contractor is responsible for the completion of certain work, he is permitted to make reasonable objection to other independent contractors before they are employed, and to exact a warranty for valid claims arising out of the work. If they agree to indemnify each other, the owner has then fulfilled his obligations; then any disagreements must be settled between the individual contractors, and the owner can demand with a clear conscience that they shall perform their contract obligations, and settle their own differences.

IX.—Materials, Etc., to Conform to Specifications.—All materials and workmanship shall be of the respective kinds described in the Specifications, and the Contractor, upon the request of the Engineer, shall furnish him with vouchers to prove that the materials are such as are specified. The Contractor shall also furnish duplicate labeled samples of materials and workmanship, for the Engineer's approval, and the materials and workmanship furnished shall be equal to the approved samples.

X.—Dismissal of Workmen.—The Contractor, on the written request of the Engineer, shall immediately dismiss from the works any person employed thereon by him, who, in the opinion of the Engineer, may be incompetent, or who misconducts himself, and such person shall not be again employed on the works without the permission of the Engineer.

XI.—Access to Work.—The Engineer and any person authorized by him shall at all reasonable times have access to the works, and the Engineer and his representatives shall at like times have access to the workshops of the Contractor or other places where work is being prepared for the building.

XII.—Clerk of Works.—The Clerk of the Works or other representative shall be considered to act solely as inspector, and under the Engineer, and the Contractor shall afford him every facility for examining the works and materials. The Clerk of the Works or other representative shall have no power to revoke, alter, enlarge, or relax any requirements of the contract, except in so far as such authority may be specifically conferred by a written order of the Engineer.

XIII.—Work to Be Opened Up.—The Contractor, at the request of the Engineer, and within such times as the Engineer shall name, shall open for inspection any work covered up; and should the Contractor refuse or neglect to comply with such request, the Engineer may employ other workmen to open up the same. If the said work has been covered up in contravention of the Engineer's instructions, or if, on being opened up, it is found to be not in accordance with the Drawings and Specifications or the instructions of the Engineer, the expense of opening and covering it up again, whether done by the Contractor or such other workmen, shall be borne by, and shall be recoverable from, the Contractor, or may be deducted, as hereafter provided. If the work has not been covered up in contravention of such instructions, and be found in accordance with the said Drawings and Specifications or instructions, then the expense aforesaid shall be borne by the Owner and be added to the contract sum; provided always that in the case of foundations, or other urgent work thus opened up and requiring immediate attention; the Engineer, within a reasonable time after the receipt of notice from the Contractor that the work has been so opened, shall make or cause the inspection thereof to be made, and at the expiration of such time, if such inspection shall not have been made, the Contractor may cover up the same, and shall not be required to open it up again for inspection except at the expense of the Owner.

This section seems to indicate the fairest practical way of solving a perplexing problem.

XIV.—Removal of Work.—During the progress of the works, the Engineer shall have power to order in writing from time to time the removal from the works, within such reasonable time or times as may be specified in the order, of any materials which in the opinion of the Engineer are not in accordance with the Specifications or the instructions of the Engineer, the substitution of proper materials, and the removal and proper re-execution of any work executed with materials or workmanship not in accordance with the Drawings and Specifications or instructions; and the Contractor shall forthwith carry out such order at his own cost. In case of default of the Contractor to carry out such order, the Owner shall have power to employ and pay other persons to carry out the same; and all expenses consequent thereon or incidental thereto shall be borne by the Contractor, and shall be recoverable from him by the Owner, or may be deducted by the Owner from any monies due or that may become due to the Contractor. If, in the opinion of the Engineer, it is not expedient to remove materials delivered or alter work done which is not in accordance with the contract, the Owner may deduct the difference in value of the materials as delivered and the work as done and that required by the Drawings and Specifications, together with a fair amount for damages, which sum shall be determined by the Engineer (sub-

XV.—Defective Work.—Any defects, shrinkage, or other faults which may appear within ..... months from the completion of the works, and, in the opinion of the Engineer, arising from materials or workmanship not in accordance with the Drawings and Specifications or the instructions of the Engineer, or any damage to pointing by frost appearing within the like period, shall, upon the direction in writing of the Engineer, and within such reasonable time as shall be specified therein, be amended and made good by the Contractor at his own expense, unless the Engineer shall decide that he ought to be paid for the same; and, in case of default, the Owner may employ and pay other persons to amend and make good such defects, shrinkage, or other faults or damage, and all expenses consequent thereon or incidental thereto shall be borne by the Contractor and shall be recoverable from him by the Owner from any monies due or that may become due to the Contractor. Should any defective work have been done or should any defective materials be supplied by any sub-contractor employed on the work who has been nominated or approved by the Engineer, as provided in Sections VII and XXIX, the Contractor shall be liable to make good in the same manner as if such work or materials had been done or supplied by the Contractor and had been subject to the provisions of this and the preceding Section.

XVI.—Copy of Quantities, Etc.—The Contractor, if required before executing this agreement or before making application for any payment, shall furnish to the Engineer, upon a blank form prepared by him, a correct, verified, itemized statement, showing the quantities of labor and materials that will be required to perform the principal items of the contract, together with their prices; and the amount included in his estimate for each general item of work to be furnished complete and in position, including in each item its due proportion of expense and profit, the sum of the different items equaling the total amount of the proposal. The above schedule shall be for the use of the Engineer, at his discretion, only in preparing estimates for payments on account to the Contractor.

If this section is read in connection with Sections XVII and XVIII, it will be seen that possibly many apparently desirable modifications are covered by the provisions of these two sections.

XVII.—Variation and Extras.—The Contractor, when authorized by the Engineer, or as provided by Section IV, shall vary by altering, adding to, or deducting from the contract requirements; such authorization is to be sufficiently proven by any writing or drawing signed by the Engineer, or by any subsequent written approval by him, but the Contractor shall make no variation without such authorization. No claim for extra compensation will be allowed unless it shall have been executed under the provision of Section IV, or by the authority of the Engineer, as herein mentioned. Such an extra is hereinafter referred to as an authorized extra.

Variations in the contract (or extras) is one of the most troublesome phases of lump sum contract work. By the provisions of this section and Section XVIII, with the final redress to arbitration under Section XXXIV, it is hoped, that the greater part of such controversies can be adjusted satisfactorily.

XVIII.—Price for Extras.—No variation shall vitiate the contract; but all alterations, additions to, or deductions from the contract requirements, which may have been made with the authority of the Engineer, or without his authority, provided he gives subsequently a written sanction to such omission, shall be valued in one of the four following ways, as may be selected by the Owner:

A.—By Estimate and Acceptance of a Lump Sum. The Contractor shall submit an estimate for making the variation contemplated, and in case an agreement as to price cannot be reached, the Engineer may order the work to proceed and the Contractor shall forthwith proceed with such variation and leave the price to be settled by Arbitration. A tentative amount, however, will be allowed by the Owner, equal to the proportion of the amount of the estimate conceded by both the Owner and Contractor, and payments will be made on the basis of such amount "without prejudice" until the correct amount shall be determined by Arbitration.

B.—By Unit Prices. Where the Contractor shall have given, in his estimate for the contract, or in subsequent accepted estimates, unit prices for specified parts of the work, the Engi-

neer may make an award of a sum based on these unit prices, subject to Arbitration.

C.—By Net Cost. In this case the Contractor will be paid the actual net amount paid by him for materials; after all trade discounts, except a bona fide cash discount, have been deducted, plus the cost of labor or material required to erect and finish the work properly; plus ....% for profit, general office superintendence, and other general office expenses not peculiar to this contract; plus ....% per month on the actual cost for reproducing the plant as used for such extra work, for plant rental. The total net cost shall not exceed the usual reasonable cost for similar work, unless the Contractor can prove conclusively that the excess was due to exceptional and unavoidable difficulties or conditions At required intervals, of not less than seven days, the Contractor shall render detailed statements and vouchers, and the Engineer will award an amount as the net cost, subject to Arbitration. In variations involving the omission of work, the amount to be deducted for such omission shall be based on the net cost as given above, plus ....% for prospective profit.

D.—By Cost Plus a Lump Sum. In such cases the Contractor shall submit an estimate which he agrees the variation shall not exceed, plus a sum for profit. The Contractor, at required intervals, of not less than seven days, shall render detailed statements and vouchers of the net cost, on the same basis as given under "C" above, except that no profit shall be included. If the actual cost is less than that given in his estimate, the Contractor shall receive, in addition to the lump sum profit, ...% of the difference between the actual cost and the amount of his estimate. If the actual cost is greater than that given in his estimate, the Contractor shall receive, in addition to the amount of his estimate, only ....% of the difference between the actual cost and the amount of his estimate.

The foregoing methods of determining the price to be paid for variations to the contract (or extras) with the redress to Arbitration (Section XXXIV), is in principle the most equitable method that has come to the writer's notice, for solving one of the most vital parts of a contract—the proper compensation for legitimate extra work. This section, in detail, is entirely different from anything which the writer has seen in use, and he suggests for it special consideration. In principle, it is similar to the requirements of the Royal Institute of British Architects.

XIX.—Damage to Persons and Property.—The Contractor shall indemnify and save harmless the Owner from any and all claims and demands which may be made by reason of (1) any injury or damage suffered or sustained by any person or corporation, caused by, or alleged to have been caused by, any act or omission of the Contractor or his agents, servants, workmen, employes, or sub-contractors, in the course of the performance of the work; and (2) any injury or damage suffered or sustained by any such agents, servants, workmen, employes, or sub-contractors, however caused, in or about said building; and the Contractor, at his own cost, expense, and risk, shall defend any and all actions, suits, or other legal proceeding that may be brought or instituted against the Owner on any such claim or demand, and pay and satisfy any judgment that may be rendered against the Owner in any such action, suit, or other legal proceeding, or result thereof; provided, however, that this section shall not be construed as an assumption by the Contractor of any liability to the Owner for any injury or damage caused by an employe of the Owner who is not a Contractor or sub-contractor, or an agent, servant, workman, or employe of a Contractor or sub-contractor engaged in the performance of work in or about said building.

XX.—Damage to Work.—The Contractor shall assume the responsibility for, and repair at his own expense, all damage to his work, or the work of other Contractors, or to the building and contents, caused by the installation of work or by th carelessness or negligence of himself, his sub-contractors, or employes. He shall also be responsible for, and make good, any damage to adjoining property, caused by any movement or settlement, or by material or implements falling upon the same during construction, or for any other cause for which the Owner may be held liable, and shall thoroughly complete the whole of the works.

XXI.—Patent Infringement, Etc.—The Contractor shall indemnify and save harmless the Owner from any and all claims and demands which may be made by reason of any infringement, or alleged infringement, of any patent, patent rights, or claim, caused, or alleged to have been caused, by the use of any apparatus or appliances, or portions thereof, furnished or installed by the Contractor; and the Contractor, at his own cost, expense, and risk, shall defend any and all actions, suits, or other legal proceedings that may be brought or instituted against the owner on any such claim or demand, and pay and satisfy any judgment or decree that may be rendered or adjudged against the Owner in any action, suit, or other legal proceeding or result thereof.

XXII.—Insurance.—During the progress of the works, the Owner will maintain insurance on said works, in his own name and in the name of the Contractor, against loss or damage by fire or lightning, and the policies will cover all work incorporated in the building, except that of excavation and foundations below the level of the ground, and all materials for same in or about the premises, and be made payable to the Owner, for adjustment between the parties hereto, as their interests may appear. At the end of each month the Contractor shall deliver to the Owner a statement showing the total value of work done and materials delivered, as herein described, to that date, and the owner will maintain said insurance in accordance with the latest statement thus delivered.

The objection to most insurance clauses is the difficulty of adjusting properly the interests as they may appear. Fire insurance companies usually hold such payments until both parties sign an agreement stating the proportionate amounts each party is to receive. This adjusting, in case of a disagreement, may consume considerable time and delay the continuance of the work. Under Section XXII. the amount of the insurance is payable directly to the owner, and as he receives monthly a statement from the contractor and insures the contractor in accordance with such statement, it is fairly simple to estimate the contractor's loss at any time. If the owner neglects to insure himself properly, he then has no one but himself to blame.

XXIII.—Damages for Delay.—Should the Owner claim damages for delay in the completion of the works, the Engineer, if, in his opinion, any damages be payable, will make an award on the basis stated in the Agreement, and will write the amount across the face of the final certificate as "the amount to be deducted from the face hereof for delay in completion of the work" (subject to Arbitration). Thereupon the Engineer's services in this matter shall terminate, except as provided under Section XXXIV.

Should the Contractor, by his own fault or negligence, unnecessarily delay the completion of the work, thereby necessitating unusual or more protracted services on the part of the Engineer or the Clerk of the Works, or both, the Owner shall be entitled to retain from the amount otherwise to become due the Contractor an amount sufficient to reimburse properly either the Engieer or the Clerk of the Works, or both, for such protracted or unusual services (subject to Arbitration).

This section should be read in connection with any damages to be allowed under Article II. of the Argeement. It should be distinctly stated in the Agreement whether or not the specified sum for damages includes the protracted service of the engineer, etc., herein mentioned. In many cases compensation for such protracted service might be all the damage that should justly be demanded.

XXIV.—Extension of Time.—If, in the opinion of the Engineer, the work be delayed by force majeure or by reason of any exceptionally inclement weather, or by reason of, instructions from the Engineer in consequence of proceedings taken or threatened by, or disputes with, adjoining or neighboring owners, or by the work or delay of other Contractors or mechanics engaged or nominated by the Owner or the Engineer, and not referred to in the Specifications, or by reason of authorized extras or additions, or in consequence of any notice reasonably given by the Contractor in pursuance of Section IV, or by the combined action of workmen, in no wise caused by or resulting from default or collusion on the part of the Contractor, or in consequence of the Contractor not having received in due time necessary instructions from the Engineer for which he shall have specifically applied in writing, the Engineer will make a fair and reasonable extension of time for completion in respect thereof. In case of such combined action of workmen, the Contractor shall, as soon as may be, give to the Engineer written notice thereof; but the Contractor shall, nevertheless, use his best endeavors to prevent delay, and shall do all that may reasonably be required, to the satisfaction of the Engineer, to proceed with the works.

The usual practice is to grant an extension of time to a contractor equal to the time which he may be delayed, provided he gives notice of such delay within 48 hours. The reasons for which extensions may be granted are usually very few, and not always of the most importance. The section suggested above will probably be objected to as not definitely specifying the length of the extension of time that may be allowed. The engineer is empowered to make a fair and reasonable extension of time for completion, and he can thus take into account matters which it would be hard to cover by an arbitrary clause. Should either party feel aggrieved by the length of time of the extension, it has the right of appeal to arbitration (Section XXXIV).

XXV.—Suspension of Work by Contractor.—If the Contractor, except on account of any legal restraint upon the Owner preventing the continuance of the works, or on account of any of the causes mentioned in Section XXIV, or in case of any certificate being withheld or not paid when due, shall suspend the works, or, in the opinion of the Engineer, shall neglect or fail to proceed with due diligence in the performance of his part of the contract, or if he shall more than once make default in the respects mentioned in Section XIV, the Owner, by the Engineer, shall have power to give notice in writing to the Contractor requiring that the works be proceeded with in a reasonable manner and with reasonable dispatch. Such notice shall not be unreasonably or vexatiously given, and must signify that it purports to be a notice under the provisions of this section, and must specify the act or default on the part of the Contractor upon which it is based. After such notice shall have been given, the Contractor shall not be at liberty to remove from the site or works, or from any ground contiguous thereto, any plant or materials belonging to him which shall have been placed thereon for the purpose of the works; and the Owner shall have a lien upon all such plant and materials, to subsist from the date of such notice being given until the notice shall have been complied with. Provided always that such lien shall not, under any circumstances, subsist after the expiration of thirty-one days from the date of such notice being given, unless the Owner shall have entered upon and taken possession of the works and site, as hereinafter provided. If the Contractor shall fail for .... days after the time given in such notice to proceed with the works as therein prescribed, the Owner shall be at liberty to provide any such labor or materials, and to deduct the cost thereof from any money then due or thereafter to become due to the Contractor under the contract.

The general purport of this section is similar to the majority of similar American clauses. Its wording, however, is freer from uncertainties and deserves careful attention.

XXVI.—Termination of Contract by Owner.—If the Contractor shall fail for .... days after such notice has been given as provided in Section XXV, to proceed with the work as therein prescribed, and if the Engineer shall then certify that such refusal, neglect, or failure is sufficient ground for such action, the Owner may enter upon and take possession of the works and site, and of all plant and materials thereon (or on any ground contiguous thereto), intended to be used for the works, and all such materials as above mentioned shall thereupon become the property of the Owner absolutely, and the Owner shall retain and hold a lien upon all such plant until the works shall have been completed under the powers hereinafter conferred on him. If the Owner shall exercise the above power he may engage any other person to complete the works, and exclude the Contractor, his agents, and servants, from entry upon or access to the same, except that the Contractor or any one person nominated by him may have access at all reasonable times to inspect, survey, and measure the works. And the Owner shall take such steps as, in the opinion of the Engineer, may be reasonably necessary for completing the works without undue delay or expense, using for that purpose the plant and materials above mentioned, in so far as they are suitable and adapted to such use. Upon the completion of the works, the Engineer shall certify the amount of the expense properly incurred consequent on and incidental to the default of the Contractor as aforesaid, and in completing the works by other persons. Should the amount thus certified as the expenses properly incurred be less than the amount which would have been due to the Contractor upon the completion of the work by him, the difference will be paid to the Contractor by the Owner; should the amount of the former exceed the latter, the difference shall be paid by the Contractor to the Owner. The Owner will not be liable to make any further payment or compensation to the Contractor for or on account of the proper use of the plant for the completion of the works under the provisions hereinbefore contained other than such payments as are included in the contract price. After the works shall have been thus completed by persons other than the Contractor, under the provisions hereinbefore contained, the Owner shall give notice to the Contractor of such completion, and may require him from time to time, before and after completion, to remove his plant and all such materials as aforesaid as may not have been used in the completion of the works, from the site. If such plant and materials are not removed within a reasonable time after notice shall have been given, the Owner may remove and sell the same, holding the proceeds, less the cost of their removal and sale, to the credit of the Contractor. Any notice to be given to the Contractor under this clause shall be given by leaving the same at the place of business of the Contractor, or by a registered letter sent to him at that address.

This section conforms in substance to the generally accepted American practice, but its wording is more definite, and it leaves fewer loop holes for argument or controversy:

XXVII.—Net Cost.—The words, "Net Cost," or the initials, "N. C.," used in the Specifications, for materials to be obtained and installed by the Contractor, shall mean, unless otherwise stated in the Specifications, the sum paid to merchants, after deducting all trade discounts, for such materials, in the ordinary course of delivery, but not deducting discount for cash, and such sum shall be exclusive of special cartage, the cost of installation, and Contractor's profit.

XXVIII.—Provisional Sums.—The provisional sums mentioned in the Specifications for materials to be supplied or for work to be performed by special contractors or mechanics, or for other works or fittings to the building, shall be paid and expended at such times, and in such amounts, and to and in favor of such persons, as the Engineer shall direct, and sums thus expended shall be payable by the Contractor without deduction or discount, or (without prejudice to any rights of the Contractor existing under the contract referred to in Section XXIX) by the Owner to the said Contractors or mechanics. The value of works which are executed by the Contractor in respect of provisional sums, or in additional works, shall be ascertained as provided by Section XVIII. At the settlement of accounts the amount paid by the Contractor to the said contractors and mechanics, and the said value of such works executed by the Contractor, shall be set against all provisional sums or any sum provided for additional works, and the balance, after allowing pro rata for the Contractor's profits at the rate of ....%, unless different rates are contained in the Contractor's original estimate, shall be added to or deducted from the contract sum, provided that in estimating the amounts paid as last herein provided no deductions shall be made by or on behalf of the Owner in respect of any damages paid by the sub-contractor to the Contractor, the intention being that the Contractor and not the Owner shall have the benefit of any such damages.

There are many cases where important matters may not be definitely determined before the execution of a contract. The practice in many cases is to insert a blanket clause giving almost unlimited selection to either owner or engineer. In such case a contractor must make a shrewd guess at the amount to include in his estimate, or something as nearly as possible to what may be required may be specified and afterward the problem is to reconcile the cost of the work as specified with the work as required. The idea of having provisional sums inserted in a contract to cover matters not distinctly determined is not new but the above section may suggest a wording which will overcome many of the previous objections to such provisional sum clauses.

XXIX.—Sub-Contractors. — All contractors, merchants, mechanics, or others executing any work, or supplying any materials for which net cost prices or provisional sums are included in the Specifications, who may at any time be nominated, selected, or approved by the Engineer are hereby declared to be sub-contractors employed by the Contractor; but no sub-contractor shall be employed upon the works against whom the Contractor shall make what the Engineer considers reasonable objections, or who shall not enter into a contract with the Contractor upon terms and conditions consistent with those in this Contract, and securing the due performance and maintenance of the works supplied or executed by such sub-contractors, and indemnifying the Contractor against any claims arising out of the misuse by the sub-contractor or his workmen of any scaffold erected or plant used by the Contractor, or that may be made against the Contractor in consequence of any act, omission, or default of the sub-contractor, his servants or agents, and against any liability, as given under Sections XIX, XXI, or XXII.

This section is intended to cover cases where it becomes desirable to have special contractors execute work covered by provisional sums. In many cases particular types or makes of articles cannot be obtained excepting from special parties. To require a contractor to employ such parties and not be relieved from responsibility for their actions is a difficult problem. This section will prevent a contractor who may be under heavy penalty to complete his work from being compelled to employ a particular contractor for a sub-branch who may absolutely refuse to indemnify the contractor if he fails to complete his work on contract time or to give a warrant for the faithful performance of the work.

XXX. Payment and Certificate. The Engineer shall issue his certificates for payments due the Contractor in accordance with the terms of the Agreement, provided, however, that the Engineer may withhold only such proportion of any sum due as in his judgment will cover the expense of the liens as given under Section XXXI, or of correcting such violation as given in Section XIV, and such payments shall not become due until violations are properly corrected (subject to Arbitration) or the liens are removed as hereinafter provided. No certificate given or payment made under the contract, nor partial or entire occupancy of the building by the Owner, shall be construed as an acceptance of defective work, or of improper materials, or as condoning any omission, provided, however, that in the case of a partial or entire occupancy of the building by the Owner, the Contractor shall have been given notice of all defects or omissions reasonably noticeable before such occupation. No certificate, final or otherwise, shall be construed as relieving the Contractor from his obligations to make good any defects discovered in his work after the completion and acceptance of the same, nor as a waiver of any specific obligation the Contractor may have assumed as to the durability of his works. The acceptance by the Contractor of the payment of the final certificate shall constitute a waiver of all claims against the Owner under or arising out of the contract. The Contractor, before each payment falls due, shall submit to the Engineer a requisition therefor and shall, if required, submit therewith an itemized statement of the quantities and value of works in general items performed to date, and such statements shall be made in form provided or approved by the Engineer.

The provisions of this section are of great importance in any contract. Its importance is in its wording and not because it contains any new principle.

XXXI.—Lines.—If at any time there shall be evidence of any lien or claim, for which, if established, the Owner or the premises might be made liable, and which would be chargeable to the Contractor, the Owner shall have the right to retain out of any payment then due, or thereafter to become due, an amount sufficient to indemnify himself against such lien or claim until the same shall be effectually discharged, or bonded; and should there prove to be any such claim after all payments are made, the Contractor shall refund to the Owner all moneys that the latter may be compelled to pay in discharging any lien upon said premises made obligatory in consequence of the Contractor's default. Before the final payment shall become due, the Contractor shall deliver to the Owner a satisfactory release of all liens against the premises on the part of all persons who have delivered materials for use in, or performed work on, said premises, including a release from the Contractor himself.

XXXII.—Unfixed Materials.—When the Contractor shall have received payment of any certificate in which the Engineer shall have stated that he has taken into account the value of any unfixed materials intended for the works, and placed by the Contractor thereon, or upon ground adjacent thereto, all such materials shall become the property of the Owner, and shall not be taken away, except for the purpose of being used on the building, without the written authority of the Engineer; and the Contractor shall be liable for any loss of or damage to such materials.

XXXIII.—Termination of Contract by Contractor.—Should the Owner not pay the Contractor any sum certified by the Engineer within the times respectively named in the Agreement, the Contractor shall give to the Owner written notice of the non-payment, and should the Owner not pay any such sum within the period of .... days from the date of delivery of such notice at the Owner's address, or sent to him there in the ordinary course of mail by registered letter, or if the Owner shall become bankrupt or file any petition for liquidation of his affairs, and if his Receiver in Bankruptcy shall repudiate this contract, or if the Receiver shall be unable to show, within .... days, to the reasonable satisfaction of the Contractor, his ability to carry out the contract, and to make all payments due or to become due thereunder, or if the works be stopped for .... months, under an order of the Engineer or any Court of Law, the Contractor shall be at liberty to terminate the contract by notice in writing to the Engineer, and to recover from the Owner payment for all work executed and for any loss he may sustain upon any plant or material supplied or purchased for the purpose of the contract. In ascertaining the amount of such payment, the rates contained in the Contractor's original estimate shall be followed, or, where the same may not apply, rates proportionate to the prices therein contained, as far as the same are applicable.

Few American contracts contain any provision permitting a contractor to terminate a contract on any condition whatsoever. In fact most contracts are filled with clauses designed to bind a contractor hand and foot so that no matter what may happen he is certain to remain a party to the contract. The absolute unfairness of many such requirements is hard to account for except that they have been inherited from times when work and conditions were totally different from those existing today. The fairness of engineers including within contracts a section similar to the above should be apparent from a careful reading of the section.

XXXIV. Arbitration. Provided always that in case any dispute or difference shall arise between the Owner, or the Engineer on his behalf, and the Contractor, either during the progress of the works or after the termination, abandonment, or breach of the contract, as to the construction of the contract or as to any matter or thing arising thereunder (except as to matters left to the sole discretion of the Engineer under Sections II, VII, X, XIV, and the exercise by him, under Section XIII, of the right to have any work opened up), or as to the withholding by the Engineer of any certificate to which the Contractor may claim to be entitled, then either party shall forthwith give to the other notice of such dispute or difference, and such dispute or difference shall be and is hereby referred to the arbitration and final decision of three disinterested arbitrators, one chosen by the Owner, one by the Contractor, and the third chosen by these two arbitrators. The decision of any two of these arbitrators shall be final and binding on both parties hereto. If the parties hereto mutually agree, one arbitrator may be appointed in place of the three named as above, and his decision shall be final and binding on both parties.

When the time for submitting matters to arbitration, as herein provided, has arrived, either the owner or the Contractor may appoint an arbitrator and demand the appointment of an arbitrator by the other party. Should the party filing notice of appeal to arbitration as herein provided fail to choose an arbitrator or to agree on a single arbitrator within seven days after receiving a written request from the other party, his right to arbitration in such matters shall lapse; should the other party fail to choose an arbitrator or to agree on a single arbitrator within seven days after receiving a written request so to do, then such dispute or difference shall be and is hereby referrd to the arbitration and final decision of ....., or in the event of his death, or unwillingness or inability to act, of ....., or in the event of his death, or unwillingness or inability to act, of a person to be appointed on the request of either party after giving notice to the other party, by the President for the time being of the American Institute of Architects or of the American Society of Civil Engineers, and the award of such arbitrator shall be final and binding on both parties.

Such reference, except on the question of certificate, shall not be opened up until after the completion or alleged completion of the works, unless with the written consent of the Owner or Engineer and the Contractor. The arbitrator, or arbitrators, shall have power to open up, review, and revise any certificate, opinion, decision, requisition, or notice, save in regard to the said matters expressly excepted above, and to determine all matters in dispute which shall be submitted to him or them, and of which notice shall have been given as aforesaid, in the same manner as if no such certificate, opinion, decision, requisition, or notice had been given. Should either party refuse, or neglect, to supply the arbitrator or arbitrators with any papers or information considered necessary by him or them to arrive at a decision in the matters referred to him or them, which papers or information have been specifically demanded in writing, he or they are hereby authorized and empowered by both parties to the contract to proceed in ex parte proceedings, and such proceedings shall be final and binding.

Upon every or any such reference, the costs of and incidental to the reference and award, respectively, shall be in the discretion of the arbitrator or arbitrators, who may determine the amount thereof, or direct the same to be taxed as between attorney and client, or as between party and party, and shall direct by whom and to whom and in what manner the same shall be borne and paid.

This section caused more debate among the members of the Royal Institute of British Architects and more differences of opinion between the British architects and builders than all the other sections combined. The discussion on this subject in the Journal of the Royal Institute of British Architects is especially worthy of study.

The importance of this section justifies the most careful study which can be given to it. Around it would center the much discussed authority of the engineer or architect to settle all matters of every kind and description. Every one who has exercised such powers must realize that while they are theoretically desirable, their proper curtailment would unravel a very difficult situation, and would permit questions being considered in a more equitable light for all parties.

The usual American arbitration clause is a delusion and a snare to all parties. Many have felt that it was a guaranty of redress for possible wrongs, only to be awakened when its provisions were called into action.

It should be noted, of course, that the English "arbitration act, 1889," is a very practical document, and probably gives more legal security to the enforcement of arbitration clauses than would be possible under the laws of most of the states. Arbitration clauses are used in many contracts, and they should be made as practical and workable as possible, then if it is found that even under the most practical of clauses the state laws need strengthening to make the term "arbitration" a reality and not a myth, there would be a good foundation on which to advocate an arbitration act similar to the English statute.

The above section leaves the engineer as the deciding party between both owner and contractor, but should either party formally dissent from his decision, a notice can be given of an appeal to arbitration. Such appeals, however, will not be actually submitted to the arbitrators until the substantial completion of

the work. This seemed to be the point of greatest disagreement between the British architects and builders. The former indorsed the above procedure, while the builders desired the matters to be submitted to arbitrators at any time. The objection to permitting submissions at any time is that, under the broad powers which it is desirable to grant to arbitrators, it would cause confusion during construction, and make it possible to confuse hopelessly the power of the engineer and the arbitrator. After the substantial completion of the work such conflict cannot well arise. The engineer being supreme during construction and after completion, the arbitrator has power to review only certain of the engineer's decisions to which written exception has been taken, as herein provided. Of course, in the matters which are referred to arbitration, the decision of such arbitration is final. Such a policy, by its very broadness, would tend to make owners, engineers, and contractors more willing to listen and consider the grievances, real or imaginary, of the other parties.

Section XXXV is intended to dissuade both parties from taking unnecessary or trivial appeals from an engineer's decision.

While the foundation of the arbitration section is laid on the lines of that of the Royal Institute of British Architects, it differs in many details.

XXXV.—Damages for Submission to Arbitration.—In submitting to arbitration questions in dispute, or differences involving a variation in the amount of the contract, both the Owner and the Contractor shall have the option of submitting their appeals in separate items or groups of items. In which case the arbitrators or arbitrator, in awarding a judgment on each item or group of items, are authorized and directed by both parties to the contract, to award to the party whose contention is sustained, in addition to the sum actually determined as correct, an amount equal to ....% of such amount. Such additional sum shall be added to or deducted from the amounts in question as the case may require. Should a claim be set aside in whole, or should the nature of the case otherwise require it, the amount of such additional award shall be added to or deducted from the amount due the Contractor on the contract. These additional sums shall be considered as damages for the time and trouble incident to such appeal.

The object of this section is to act as a check to prevent appeals to arbitration becoming the fashion rather than the exception. While the principle of this section is considered good, the ability to enforce it is not settled in the writer's mind.

GENERAL CONDITIONS.

The endeavor has been to make the agreement and schedule of conditions of contract as broad and general as is consistent with good practice. There are additional conditions which may be desirable or essential for particular buildings, but as these conditions are special and of only limited, if not personal, application, it is unwise to attempt to write such in a general set of conditions of contract.

Legally such conditions would be just as binding upon a contractor whether they were given as a part of the agreement or were placed in the specifications. The writer, therefore, advocates placing in the fore part of a specification a chapter headed "General Conditions," under which would be placed special requirements of a more or less legal and general nature, which, for the purpose of the particular building, might have been made a part of the schedule of conditions of contract.

The following are given as samples of clauses which might be found under a heading "General Conditions." It must be distinctly understood that these clauses are given only as samples, without comment. The writer does not indorse them for general use and except in isolated cases he considers that many of the provisions might be more harmful than beneficial.

Checking Documents.—The Contractor shall carefully study and compare all drawings, specifications, and other information given to him by the Engineer, both as to figures, materials, and methods of construction, and shall report in writing to the Engineer for rectification any error, inconsistency, or omission therein, which he shall discover, or any modification he considers necessary or desirable for the stability or economical construction of the building.

Doing Work in Freezing Weather.—Work shall not be done when the temperature where work is being done is below 28 degres Fahr., or if exposed to rains, except by special permission of the Engineer. Frozen materials shall not be built upon.

Engineer's Approval.—All materials or work specified to be of an "approved" type, construction, or finish, shall be submitted to and approved by the Engineer before being used or executed. Where materials, quality, or finish are not distinctly specified, samples shall be submitted to and approved by the Engineer before using same. An approval by the Engineer shall be understood to mean that it is conditional upon the work being in conformity with the contract requirements. No approval of deviation from contract requirements shall be implied, but shall be specifically mentioned in the Engineer's written approval. (See Section IV, Schedule of Conditions of Contract.)

Materials and Workmanship.—All materials shall be new, and all materials and workmanship shall be the best of the respective kinds contemplated by the contract, unless otherwise specified.

Contemplated Work.—The work to be executed under the contract consists in general of a ....., constructed and completely finished in every particular ready for furnishing, within the limits shown on the Drawings and described in the Specifications, except (a) elevators, (b) lighting fixtures, (c) electrical, (d) heating work, (e) or work specifically excepted or made subject for separate bids.

Contract Documents.—(See Agreement, Article I.)

Definitions.—The following definitions of works, terms, etc., shall be understood to govern their use throughout the Contract:

Approved.—The word "approved," as applied to any material, manner or mode of construction, shall be construed as though followed by the words "by the Engineer."

Best.—The term "best," or "best quality," shall be taken to mean that there is no better quality or finish of material of the grade specified or reasonably implied, obtainable on the market supplying the vicinity, or that there is no better class of work mentioned, reasonably obtainable.

Net Cost.—(See Conditions of Contract, Section XXVII.)

Provide, Etc.—For the sake of brevity, and to avoid needless repetition, the imperative mood has been largely used throughout the specification. Wherever it is used it shall be understood to mean, "The Contractor shall furnish all material and perform all labor necessary to ....." and these words shall be read into the sentence.

Provisional Amount.—(See Conditions of Contract, Section XXVIII.)

Drawings.—The Contractor shall furnish to the Engineer at proper times all shop and setting drawings or diagrams which the Engineer shall deem necessary to carry out the work. Each drawing or diagram shall give all the information required by the nature of work which it is intended to govern. These drawings or diagrams shall conform strictly to the Engineer's drawings and specifications, and where possible upon measurements taken from existing work. No deviation from the Engineer's drawings and specifications shall be made unless by special written order. The Engineer will inspect such drawings, but his purpose being to aid the Contractor and expedite the work, he shall not be held responsible for the Contractor's errors, the result of which, should they occur, must be made good at the Contractor's expense. The Contractor shall make required changes in such drawings or diagrams and supply the Engineer with one correct copy. Any methods or templates submitted shall be changed as reasonably required until satisfactory.

Fires, Smoking, Etc.—The Contractor shall not permit open fires to be lighted at any time in or dangerously near the building, and, after the roof is on, shall prohibit smoking within the building.

Imperfect Construction.—The Contractor shall notify the Engineer in writing if at any time he finds that any work or material that has or is being furnished by another Contractor in connection with his work is imperfect; and in case of his failure to give such notice, the Contractor shall be held to have accepted such work or materials, and all other existing conditions, and shall be responsible for any defects in his own work consequent thereon, or any change to his work made necessary by the future correcting of such defective work by other Contractors, and shall not be relieved of the obligation of any warranty because of any such condition or imperfection.

Imperfect Design.—The Contractor shall notify the Engineer in writing if he thinks any part of the work as designed or constructed is unsafe or likely to become so, or unsuited to produce the intended results, and shall thereafter proceed with such work only on the order from the Engineer.

Lines and Levels.—The Contractor shall establish all lines and levels necessary to the proper locating, laying out, and erecting of the work, in accordance with the Owner's survey and Engineer's drawings, and shall be responsible for their accuracy and maintenance. (See Schedule of Conditions of Contract, Section V.)

After the foundations have been completed and before the first tier of beams is set, the Contractor shall file with the Engineer a certificate from an approved surveyor showing that the building is located correctly according to the Owner's survey, and that the foundations, column bases, etc., are correct according to the drawings.

Measuring Work in Place.—The Contractor shall measure work already in place to insure the proper execution of subsequent work, or to assist the Engineer in making his drawings, and should any discrepancy between the executed work and the drawings be discovered, he shall report at once such discrepancy to the Engineer.

Notifying Engineer.—The Contractor shall bring to the attention of the Engineer any conditions pertaining to the site, the soil, the various portions of the work, whether executed by himself or by other Contractors, or to proposed work, or to laws and ordinances governing the work that should be known by the Engineer.

Overloading Structure.—The Contractor shall not permit any part of the structure to be loaded during construction with a weight greater than it is calculated to bear.

Reports to Engineer.—The Contractor shall furnish reports to the Engineer showing the status of the work at the building and in the shops, whenever so required, and in the manner directed.

Signs.—The Contractor shall not permit signs upon the building or premises, other than that of the General Contractor, except by the written permission of the Engineer.

Storage Limits.—The Contractor shall confine the storage of materials and the operations of his workmen to the reasonable limits indicated by the Owner or Engineer, and shall not necessarily encumber the premises with his materials.

A Suggestive Letter to Municipal Officials.

A complaint made generally by contractors for many years, has been that city officials begin work so late on the necessary formalities of a legal nature in connection with public improvements that construction work is commenced too late in the year. This frequently throws the completion into the fall when uncertain weather and scracity of labor increases costs.

It is believed that costs can be reduced and better work done if the legal proceedings are commenced early in the fall or winter. In the hope of bettering conditions the Illinois Association of Municipal Contractors has sent a letter to the Boards of Local Improvements throughout Illinois.

Owing to the many advantages to be derived from an early award of contracts for municipal improvements and in view of the time necessary to follow the legally prescribed course of proceedings and secure confirmation of the same, we suggest an early start on proceedings for all contemplated improvements for the year 1910.

Reports from many sections of the State indicate that the coming season will be a very busy one and we are prepared for a vigorous campaign—to improve the Quality, Quantity and Efficiency of Public Improvements.

We realize that in order to accomplish this, it will be necessary to secure a high degree of accuracy in the legally prescribed procedure and proceedings, to eliminate from specifications conditions which are onerous to the contractor and wasteful to the public, to have estimates made sufficient to enable the contractor to employ the materials and construct the work, as prescribed by your plans and specifications, at a fair profit, thus stimulating the market and demand for your bonds and protecting the contractor against unwarranted extractions and unreasonable discounts.

We are ready and willing to aid you in accomplishing the above, also to secure the faithful execution of contracts in substantial compliance with the plans and specifications thereof.

If at any time you are in doubt as to whether the contractor is executing the work properly, write this Association and we will investigate immediately.

Let is be understood that this Association bears all expenses incident to such investigation, such as attorney's fee, inspectors salaries, etc., and in no case will your officials or property owners be solicited for money to pay the expense.

Yours very truly,

Illinois Association of Municipal Contractors,

WILLIAM HOWE, Exec. Sec'ty.

Railway Section

Note: This section is devoted to methods and costs of constructing railways. It will cover road-bed and track construction, contractor's plant and organization, surveying methods and permanent way structures.

Original Cost and Cost of Reproduction of the Northern Pacific Railway (1,645 Miles) in the State of Washington.

In ENGINEERING-CONTRACTING, Dec. 8, 1909, was given the cost of the Great Northern railway (768 miles) in the state of Washington, as determined by Mr. Halbert P. Gillette for the Railroad Commission of that state. This issue contains similar data relating to the Northern Pacific railway, data that were submitted as exhibits by Mr. Gillette in his testimony at the hearings before the Railroad Commission, but not printed in the "findings," which contain only the conclusions as to costs reached by the commission after hearing all the evidence.

Work was begun on the Northern Pacific in Washington in 1879, and the major part of the construction of the main line was done in the early 80's. The task of ascertaining the original cost of the Northern Pacific was complicated not only by the age of the records but by the purchase of a number of important branch lines. The purchase prices were available, but it was exceedingly desirable to arrive at the actual cost to the builders of those branches. This was determined with considerable accuracy by securing construction quantities from old engineering records and applying prices current at the time of construction. The total original cost of main line and branches in Washington was found to be about $64,000,000, including improvements and betterments. Of this total, 80 per cent was ascertained with great accuracy from the accounting records. Of the remaining 20 per cent fully half was determined with almost as great accuracy from old engineering records, leaving only about 10 per cent to be estimated by field inspection. It has been repeatedly stated that the original cost plus improvements can be ascertained for very few railways in America.

Doubtless this assertion has deterred other railway commissions from even attempting to secure the original cost. The facts are, however, that of the entire railway values in Washington, not much more than 5 per cent were such that the original cost plus improvements could not be found. Mere age of construction has less to do with the difficulty of arriving at original costs than is commonly supposed. The greatest difficulty exists where purchases of lines have been made without transfer of the construction ledgers from the original owners to the purchasers. In many instances such transfers of ledgers are made, and in nearly all cases transfers of cross section books and other engineering records are made. The importance of securing the original itemized costs plus itemized costs of improvements can not be overestimated. The conflicting testimony of experts in court is the bane of a judge's life, but with actual original costs as a basis there is not great difficulty in determining costs of reproduction, for wages and prices are a matter of record and the increase or decrease in the value of any item of railroad construction is readily ascertained.

The following is a summary of the mileage of the Northern Pacific railway in Washington up to June 30, 1906:

	Miles.
Main line	658.73
Branch lines (Incl. Wash. & Col. River)	986.53
Total lines	1,645.26
Second track, main line	41.65
Spurs	117.59
Yard tracks and sidings	400.75
Total track	2,205.25

In the findings of the Railroad Commission the following mileage was assigned to the Northern Pacific:

	Miles.
Main line	687.68
Branches and spurs	941.74
Total lines	1,629.42

However, we shall use the mileage determined by Mr. Gillette—namely: 1,645 miles of line—since the following costs are based upon that mileage.

The original cost of the Northern Pacific in Washington plus improvements and betterments up to June 30, 1906, as determined by Mr. Gillette, was as given in Table I. In using the last column of this table it should be remembered that there were 1.34 miles of all tracks to each "mile of line"; hence to arrive at the cost per mile of track, divide the items in the last column by 1.34.

TABLE I.—ORIGINAL COST OF THE NORTHERN PACIFIC RAILWAY IN WASHINGTON, PLUS IMPROVEMENTS.
(1,645 miles of line.)

	Total.	Per mile of line.
1. Engineering	$ 2,907,344.26	$1,768
2. Right of way	1,796,272.60	1,092
3. Real estate	1,360,895.38	827
4. Clearing and grubbing	1,213,770.19	738
5. Grading	15,589,712.88	9,479
6. Tunnels	974,519.99	590
7. Bridges, trestles and culverts	7,879,328.94	4,790
8. Masonry	156,823.46	95
9. Ties	2,278,007.25	1,385
10. Rails	8,520,625.03	5,182
11. Track fastenings	1,063,620.96	647
12. Frogs and switches	255,243.07	155
13. Track laying and surfacing	1,669,691.18	1,015
14. Ballast	1,524,759.29	929
15. Station buildings and fixtures	1,477,207.49	897
16. Engine houses and turntables	246,663.97	150
17. Engine and car shops	849,340.77	516
18. Shop machinery and tools	294,507.95	179
19. Water stations	325,042.66	198
20. Fuel stations	79,544.48	47
21. Fencing right of way	273,067.50	166
22. Snow fences, etc	130,494.72	79
23. Stock yards	31,064.11	19
24. Crossings, cattle guards and signs	101,860.54	62
25. Interlocking and signal apparatus	44,706.61	27
26. Docks, wharves and coal bunkers	1,015,566.29	617
27. Transfer boats and barges	31,662.70	19
28. Section and tool houses	122,352.50	74
29. Miscellaneous structures	1,179,108.09	717
30. Telegraph lines	207,361.48	126
31. Transportation charges and rent of equipment	1,756,796.39	1,068
32. Operating expenses	261,910.26	159
33. Construction equipment	63,743.75	39
34. General expense	640,744.02	390
35. Interest and discount	7,173,190.53	4,360
36. Legal expense	3,009.24	2
37. Undistributed expense	480,212.62	292
Total	$63,979,772.61	$38,895
38. Equipment (rolling stock)	11,478,121.38	6,978
Grand total	$75,457,893.99	$45,873

Of this $63,979,772 cost of construction, $5,896,735 was spent for "improvements and betterments" between the years 1896 and 1906. The corresponding improvement expenditures prior to that time (charged to "Construction B") were $2,951,972, making a total of $8,848,707 spent for improvements.

It will be noted that Item 1, Engineering, amounts to nearly 5 per cent of the total cost exclusive of equipment. This very high percentage was due to several factors. The explorations for a pass through the Cascade Mountains were made at an early date when little was definitely known about their topography and that exploration alone cost $300,000. The engineering on the early branch lines cost 6 per cent of the $11,400,000 spent in building them, due in part to slow progress of work in those early days. A very considerable part of the early Northern Pacific work was done by company labor, which added not only to the expenditures for engineering and supervision, but also made the entire cost of the work greater than it would have been had it been done by contract.

Items 2 and 3 are small, because nearly all the right of way was given by the government. But as a matter of fact it should be a trifle higher than given in Table I, to provide for the unascertainable original cost of right of way of about 350 miles of branch lines.

Item 31, Transportation Charges and Rent of Equipment, relates to the book charges for hauling construction materials over the N. P. lines. Under a proper system of accounting this item would have been distributed to the materials themselves.

Item 32, Operating Expense, relates to the cost of operating freight and passenger trains over the lines before they were formally transferred to the operating department.

Item 34, General Expense, was practically 1 per cent of the total construction cost.

On the early construction work, involving some $30,000,000, this item of general expense was nearly 1¾ per cent.

Item 35, Interest and Discount, is inordinately high. It consists mostly of discount on the bonds. In fact the first $22,400,000 expended, more than $5,900,000 was charged to interest and discount, or nearly 27 per cent of the total. Hence no general conclusions can be drawn from this item.

Item 36, Legal Expense, does not appear in any of the accounts except for a small branch line, where it amounted to nearly 1 per cent of the cost of that branch.

Item 37, Undistributed Expense, relates to certain items which were so entered that they could not be prorated to Washington under any definite item, and were consequently grouped here.

The cost of reproducing (new) the Northern Pacific railway in Washington, as estimated by Mr. Gillette, is given in Table II, the values of right of way and land being those finally determined by the Railroad Commission.

TABLE II.—COST OF REPRODUCING THE NORTHERN PACIFIC RAILWAY IN WASHINGTON, AS ESTIMATED BY H. P. GILLETTE.
(1,645 miles of line.)

1. Engineering, 5% of Items 3 to 37	$ 2,510,580.23
2. Right of Way, etc.:	
Terminal land, Seattle	13,038,176.50
Terminal land, Tacoma	7,638,006.00
Terminal land, Spokane	5,306,465.00
Terminal land, Everett	366,530.00
Terminal land, Bellingham	215,330.00
Right of way and other station grounds	6,298,364.50
Total Right of Way, etc.	$32,862,872.00
3. Clearing and Grubbing:	
Clearing, 9,445 acres at $100.00	$ 944,500.00
Grubbing, 16,542 stations at $22.00	330,840.00
Extra trees cut, 4,942 at $2.00	9,964.00
Six branch lines (from acctg. records)	117,811.04
Improvements (from acctg. records)	24,069.48
Total Clearing and Grubbing	$ 1,427,184.52
4. Grading:	
Earth excavation, 18,566,958 cu. yds. at $0.22	$ 4,084,730.76
Earth embank. (barrow), 3,265,120 cu. yds. at $0.22	718,326.20
Unclassified, 318,512 cu. yds. at $0.50	159,256.00
Cement gravel, 3,483,838 cu. yds. at $0.40	1,393,535.20
Loose rock, 1,321,720 cu. yds. at $0.50	660,860.00
Solid rock, 1,735,503 cu. yds. at $1.10	1,909,053.30
Overhaul, 13,767,359 cu. yds. 100 ft. at $0.01	137,673.59
Rip-rap, 186,064 cu. yds. at $1.10	204,670.40
Slope wall, 3,350 cu. yds. at $2.50	8,375.00
Log cribs, 882,632 lin. ft. logs at $0.16	141,221.12
Timber cribs, 127,774 ft. B. M. at $26.00	3,322.12
Six branch lines (cost from acctg. records)	1,113,697.75
S. L. S. & E. (estimated from field inspection)	88,000.00
Improvements and betterments (from acctg. records)	1,988,673.81
Total Grading	$12,543,395.25
5. Tunnels:	
Stampede, 9,844 lin. ft. (masonry lined), at $180.00	$ 1,771,920.00
Seattle, one-half interest, 5,141 (dbl. track in earth), at ½ of $360.00	925,380.00
Other tunnels lined with concrete, 2,570 ft. at $110.00	282,700.00
Other tunnels lined with timber, 2,329 ft. at $70.00	163,030.00
Total Tunnels	$ 3,143,030.00

6. Bridges, Trestles and Culverts: Howe Trusses and Combination.	
30-ft. spans, 1 at $1,200.00	$ 1,200 00
50-ft. spans, 4 at $1,600.00	6,400.00
60-ft. spans, 8 at $1,800.00	14,400.00
70-ft. spans, 1 at $2,000.00	2,000.00
80-ft. spans, 3 at $2,300.00	6,900.00
90-ft. spans, 1 at $3,000.00	3,000.00
100-ft. spans, 15 at $4,000.00	60,000.00
110-ft. spans, 1 at $4,500.00	4,500.00
120-ft. spans, 3 at $5,500.00	16,500.00
130-ft. spans, 1 at $6,200.00	6,200.00
140-ft. spans, 5 at $7,000.00	35,000.00
150-ft. spans, 19 at $7,500.00	142,500.00
13 miscel. spans (2,390 lin. ft. at $60.00)	143,400.00
8 draw spans, 1,625 lin. ft. at $60.00	97,500.00
Total Howe Trusses and Comb. Spans	$ 539,500.00
Pile and frame trestles (44,130 M at $30,000, and 1,304,533 lin. ft. piles at 0.25; av. height trestle 19 ft.), 168,978 lin. ft. at $10.50	1,774,269.00
Trestles filled with earth (139,862 lin. ft.), 5,988,784 cu. yds. at $0.20	1,197,756.80
Steel Bridges:	
Spokane River at Trent	$ 40,000.00
Snake River, Ainsworth	1,100,000.00
Columbia River, Kennewick	500,000.00
Tacoma Channel	105,000.00
Chehalis River	100,000.00
Walla Walla River, W. & C. R.	43,190.00
Three plate girders (260 ft.) and concrete ret. wall (350 ft.), N. & C. R.	30,200.00
Steel in other bridges, 19,516,343 lbs. at 0.0175	327,026.44
Masonry abutments and piers for 215 spans	537,500.00
Total Steel Bridges	$ 3,382,916.44
Culverts:	
Log culverts, 264,943 lin. ft. logs at $0.16	$ 42,390.88
Timber culverts, 5,015,024 ft. B. M. at $26.00	130,390.62
Box drains, 336,720 ft. B. M. at $26.00	8,754.72
Total log and timber culverts	$ 181,536.25
Concrete arch, 11,510 cu. yds. at $9.00	103,590.00
Stone drains, 6,731 cu. yds. at $8.00	53,848.00
Total masonry culverts	$ 157,438.00
Vitrified Pipe:	
4-in., 62 lin. ft. at $0.25	$ 15.50
10-in., 50 lin. ft. at 0.45	22.50
12-in., 1,229 lin. ft. at 0.50	614.50
15-in., 226 lin. ft. at 0.75	169.50
16-in., 137 lin. ft. at 0.80	109.60
18-in., 3,929 lin. ft. at 1.30	5,107.70
20-in., 168 lin. ft. at 1.70	285.60
22-in., 109 lin. ft. at 2.00	218.00
24-in., 24,895 lin. ft. at 2.60	664,727.00
30-in., 2,845 lin. ft. at 3.50	9,957.50
36-in., 276 lin. ft. at 4.50	1,242.00
Total Vitrified Pipe Culverts	$ 682,469.40
Cast Iron Pipe:	
6-in., 300 lin. ft. at $1.00	$ 300.00
8-in., 24 lin. ft. at 1.50	36.00
12-in., 892 lin. ft. at 3.00	2,676.00
14-in., 27 lin. ft. at 3.50	94.50
16-in., 732 lin. ft. at 3.75	2,745.00
18-in., 5,095 lin. ft. at 4.00	20,380.00
20-in., 889 lin. ft. at 4.75	4,222.75
24-in., 28,411 lin. ft. at 6.00	170,466.00
30-in., 2,432 lin. ft. at 7.00	17,024.00
36-in., 4,453 lin. ft. at 9.00	40,122.00
42-in., 663 lin. ft. at 13.00	8,619.00
48-in., 1,026 lin. ft. at 18.00	18,468.00
54-in., 516 lin. ft. at 21.00	10,836.00
60-in., 198 lin. ft. at 25.00	.....
36-in. corrugated iron, 900 ft. at $3.00	4,950.00
Total Iron Pipe Culverts	2,700.00
Masonry walls, etc	303,639.25
Total Bridges, Trestles and Culverts	$ 7,776,348.11
7. Ties.	
(2,205.24 miles at $3,000), 6,615,750 at $0.50	$ 3,307,875.00
8. Rails:	
221,367 tons at $40.00	$ 8,854,680.00
9. Track Fastenings:	
Spikes (6,500 lbs. per. mi.), 14,334,125 lbs. at $0.028	$ 401,355.50
Angle Bars (17,600 lbs. per mi.), 38,812,400 lbs. at $0.025	970,310.00
Bolts (1,800 lbs. per mi.), 3,969,450 lbs. at $0.032	127,022.00
Rail braces, 838,950 at $0.10	83,895.00
Tie plates, 1,525,000 at $0.08	122,000.00
Total track fastenings	$ 1,704,582.90
10. Frogs and Switches:	
Switches, 2,850 at $80.00	$ 228,000.00
11. Ballast.	
1,645 miles at $1,000.00	$ 1,645,000.00
560 miles at $600.00	336,000.00
Total ballast	$ 1,981,000.00
12. Track Laying and Surfacing:	
2,205.25 miles at $700.00	$ 1,543,675.00
13. Fencing Right of Way:	
From acctg. records plus 20%	$ 227,682.00
14. Snow Fences and Sheds:	
From acctg. records plus 20%	$ 156,595.00
15. Crossings, Cattle Guards and Signs:	
From acctg. records plus 20%	$ 122,232.00
16. Telegraph Lines:	
From acctg. records plus 20%	$ 248,835.00
17. Station Buildings and Fixtures:	
Seattle terminal station (½ interest)	$ 280,000.00
110 combination depots (frame), 167,062 sq. ft. at $1.50	250,593.00
100 passenger depots (frame), 121,684 sq. ft. at $1.25	$ 152,105.00
Spokane passenger depot (brick), 8,050 sq ft. at $4.00	32,200.00
31 freight depots (frame), 591,050 sq. ft. at $1.00	591,050.00
3 freight depots (brick), 81,320 sq. ft. at $1.50	121,980.00
Warehouses (frame), 376,741 sq. ft. at $1.40	527,437.40
720 wood platforms, 1,006,790 sq. ft. at $0.10	100,679.00
15 cinder platforms, 26,492 sq. ft. at $0.06	1,589.52
2 cement platforms, 34,631 sq. ft. at $0.15	5,194.65
198 water closets, 10,666 sq. ft. at $1.00	10,666.00
Track scales, 28 at $1,300.00	36,400.00
Total station buildings	$ 2,109,894.57
18. Engines Houses and Turntables:	
8 engine houses (frame), 27,686 sq. ft. at $0.75	$ 20,764.50
Engine houses (frame), 20 stalls $900.00	18,000.00
Engine houses (brick), 71 stalls at $1,500.00	106,500.00
Turntables, 28 at $2,800.00	78,400.00
6 ash pits, 277 lin. ft. at $15.00	4,155.00
Total engine houses and turntables	$ 227,819.50
19. Engine and Car Shops:	
43 machine shops and car houses (frame), 114,523 sq. ft. at $0.50	$ 57,261.50
39 machine shops and car houses (brick), 299,685 sq. ft. at $2.90	869,086.50
Transfer tables, 2 at $1,500.00	3,000.00
83 sand, coal, wood, oil and store houses, 20,245 sq. ft. at $0.50	10,122.50
3 bins, 2,053 sq. ft. at $0.25	513.25
Total engine and car shops	$ 939,983.75
20. Shop Machinery:	
From acctg. records plus 20%	$ 353,408.00
21. Water Stations:	
91 tanks, 41 pump houses, etc. (from acctg. records plus 20%)	$ 390,050.00
22. Fuel Stations:	
From acctg. records plus 20%	$ 95,453.00
23. Stock Yards:	
63 yards, 603,397 sq. ft. at $0.05	$ 30,169.85
24. Interlocking and Signal Apparatus:	
From acctg. records plus 20%	$ 53,648.00
25. Docks, Wharves and Coal Bunkers:	
From acctg. records plus 20%	$ 1,216,680.00
26. Section and Tool Houses:	
124 section houses, 89,866 sq. ft. at $1.25	$ 112,332.50
86 bunk houses, 29,430 sq. ft. at $0.70	20,601.00
147 tool houses, 27,839 sq. ft. at $0.50	13,919.50
Total section and tool houses	$ 146,853.00
27. Miscellaneous Structures:	
From acctg. records plus 20%	$ 1,382,530.00
28. Legal and General Expense:	
1% of items 3 to 27 inclusive	$ 502,116.04
29. Interest During Construction:	
5% of items 1 to 28 (except item 2)	$ 2,661,215.04
30. Stores on Hand	530,677.00
Total of items 1 to 30 inclusive	$89,279,064.76
31. Equipment:	
Locomotives	$ 4,242,950.51
Passenger	1,447,593.23
Freight	8,040,254.92
Work and miscellaneous	603,578.55
Total equipment	$14,334,377.21
Grand total of items 1 to 31 incl.	$103,613,441.97

It will be noted that Item 1, Engineering, was estimated at 5 per cent, instead of the 3½ per cent which was used for the Great Northern. Since engineering had actually cost the Northern Pacific 5 per cent, Mr. Gillette considered it fair to allow that amount, particularly in view of the fact that there was a large mileage of cheap branch lines where the item of engineering would form a larger percentage than on main line construction. The Railroad Commission, however, adopted a uniform 3½ per cent for all the railways in the state as a fair allowance for engineering.

Item 2, Land, does not include any land not actually used or needed for railway purposes in the immediate future. The Northern Pacific railway has a right of way 400 ft. wide on much of its line, given to it by the government. The Railroad Commission allowed a 100 ft. strip as being all that is actually needed for railway purposes, except in towns and cities. In addition to the lands owned and used for terminals, there was land of the following value, which was included in Item 2 because it is not needed for railway purposes at present.

Spokane	$ 1,194,156
Tacoma	4,980,417
Seattle	9,250,000
Total	$15,424,573

The value of the right of way land not needed for railway purposes was determined to be $913,184, and is not included in Item 2. Item 4, Grading, is equivalent to the following yardage per mile of line:

	Cu. Yds. Per Mile.
Earth excavation	11,325
Earth embank. (borrow)	1,990
Unclassified	195
Cement gravel	2,125
Loose rock	805
Solid rock	1,055
Total	17,495
6 branch lines (unclassified)	1,700
S. L. S. & E. (unclassified)	130
Improvements (unclassified)	4,545
Trestles filled (item 6)	3,650
Grand total	26,520

The items of yardage in the "6 branch lines" and of yardage in "improvements" are estimated by assuming that the unclassified yardage on these branch lines cost 40 cts. per cu. yd. and that the yardage in improvements cost 30 cts. per cu. yd. Since most of the improvement yardage was bank widening, the lower unit price for this unclassified work is justified. By referring to our issue of Dec. 8 it will be seen that the yardage per mile on the Great Northern was 28,570 cu. yds. per mile. (An error will be found in our issue of Dec. 8; the yardage of filling trestles should be 2,700 instead of 270 per mile.)

Table III gives a summary of Mr. Gillette's estimate of the cost of reproduction (new) and the present value (second hand) of the Northern Pacific in Washington. The annual rates of depreciation of the different classes of structures and of equipment were the same as those used in calculating the present value of the Great Northern, for which see ENGINEERING-CONTRACTING, Dec. 8.

TABLE III.—COST OF REPRODUCTION AND PRESENT VALUE OF THE NORTHERN PACIFIC RY. IN WASHINGTON (1.645 MILES).

	Cost of Reproduction New.	Condition Per Cent.	Present Value.
1. Engineering	$ 2,510,580	100.0	$ 2,510,580
2. Right of way, etc.	32,862,872	100.0	32,862,872
3. Clearing and grubbing	1,427,185	100.0	1,427,185
4. Grading	12,543,395	110.0	13,797,735
5. Tunnels	3,143,030	100.0	3,143,030
6. Bridges, trestles and culverts	7,776,348	84.7	6,586,567
7. Ties	3,307,875	50.0	1,653,938
8. Rails	8,854,680	80.0	7,083,744
9. Track fastenings	1,704,583	80.0	1,363,666
10. Frogs and switches	228,000	80.0	182,400
11. Ballast	1,981,000	100.0	1,981,000
12. Track laying and surfacing	1,543,675	100.0	1,543,675
13. Fencing right of way	227,682	55.0	125,225
14. Snow fences and sheds	156,595	72.0	112,748
15. Crossings, cattle guards and signs	122,232	55.0	67,228
16. Telegraph lines	248,835	75.0	186,626
17. Station buildings and fixtures	2,109,895	81.5	1,727,769
18. Engine houses and turnt'bles	227,819	68.2	155,373
19. Engine and car shops	939,984	66.4	624,169
20. Shop machinery	353,408	65.0	299,715
21. Water stations.	390,050	65.5	255,483
22. Fuel stations.	95,453	77.5	73,976
23. Stock yards	30,170	45.5	13,727
24. Interlocking and signal apparatus	53,648	85.0	45,601
25. Docks, wharves and coal bunkers	1,216,680	75.0	912,510
26. Section and tool houses	146,853	61.0	89,580
27. Miscellaneous structures	1,382,530	61.0	843,343
28. Legal and general expense	502,116	100.0	502,116
29. Interest during construction	2,661,215	100	2,661,215
30. Stores on hand	530,677	100.0	530,677
Total of items 1 to 30	$ 89,279,065	.....	$83,363,454
31. Equipment	14,334,377	67.5†	9,677,947
Grand total	$103,613,442	.....	$93,041,401

TABLE IV.—COST OF REPRODUCTION OF THE NORTHERN PACIFIC IN WASHINGTON.

	Per mile of line.*
1. Engineering	$ 1,526
2. Right of way, etc.	19,980

*There are 1.34 miles of track per mile of line.

3. Clearing and grubbing	867
4. Grading	7,626
5. Tunnels	1,911
6. Bridges, trestles and culverts	4,728
7. Ties	2,011
8. Rails	5,384
9. Track fastenings	1,036
10. Frogs and switches	139
11. Ballast	1,206
12. Track laying and surfacing	938
13. Fencing right of way	138
14. Snow fences and sheds	95
15. Crossings, cattle guards and signs	74
16. Telegraph lines	151
17. Station buildings and fixtures	1,283
18. Engine houses and turntables	138
19. Engine and car shops	571
20. Shop machinery	215
21. Water stations	237
22. Fuel stations	58
23. Stock yards	18
24. Interlocking and signal apparatus	33
25. Docks, wharves and coal bunkers	740
26. Section and tool houses	89
27. Miscellaneous structures	840
28. Legal and general expense	305
29. Interest during construction	1,618
30. Stores on hand	322
Total of Items 1 to 30	$54,277
31. Equipment	8,715
Grand total	$62,992

The actual cost of the equipment on the entire Northern Pacific system, up to June 30, 1906, was as follows:

Locomotives	$12,977,823.23
Passenger	5,074,739.99
Freight	21,436,740.43
Work and miscel	1,904,185.11
Trust equipment	3,032,526.48
Discount and commission	939,858.42
Total equipment	$45,365,882.66

The mileage of the Northern Pacific system and its chief engineer's estimate of cost of reproduction of the equipment, as well as of other items, was published in ENGINEERING-CONTRACTING, April 15, 1908.

The above does not include the equipment of the Washington and Columbia River railway, which was estimated by Mr. Gillette to have cost as follows:

Locomotives	$ 60,000
Passenger	24,000
Freight	62,000
Work	1,200
Total	$147,200

The cost of the locomotives in Washington was based upon the cost of those actually used in that state. The cost of passenger and freight cars was apportioned to Washington according to car mileage. The cost of work equipment was apportioned according to mileage of railway line operated. On this basis the following costs were arrived at for the state of Washington:

	Original cost.	Cost reprod.	Present value.
Locomotives	$ 3,689,522	$ 4,242,950	$2,715,488
Passenger	1,598,184	1,447,593	868,556
Freight	5,665,564	8,040,255	5,668,380
Work and miscellaneous	524,851	603,579	425,523
Total	$11,478,121	$14,334,377	$9,677,947

The "cost of reproduction" was determined by adding 15 per cent to the original cost to provide for increased prices. The "present value" was determined by deducting from the "cost of reproduction" a depreciation of 3.6 per cent per annum.

In this connection it is interesting to note that the report of the Northern Pacific railway to the Interstate Commerce Commission for the fiscal year ending June 30, 1906, gave the value of the equipment at $32,044,260, or about 70 per cent of its original cost. Mr. Gillette's estimate of the "present" value was 67.5 per cent of the original cost, which shows that the Northern Pacific railway had charged off for depreciation only slightly less than Mr. Gillette has estimated.

It is also worthy of comment that many railway engineers have erred in their estimates of the cost of equipping railways, largely because they have taken the total cost of equipment given in the Interstate Commerce Reports and have divided it by the total mileage of railway lines. It has not been generally known that the costs given in the Interstate Commerce Commission reports are depreciated, or second hand, values. Some years ago Mr. John F. Wallace (see Gillette's "Handbook of Cost Data," p. 548) estimated that the average mile of "trunk line" would cost $40,000, of which $4,000 was for equipment. It will be noted that the equipment of the Northern Pacific in Washington averages $8,715 per mile of both trunk (or main) line and branches.

In roughly estimating the probable cost of equipment of a steam railway line the proper method is obviously to base the estimate upon the ton-miles (or car-miles) of freight per year per mile of line. In ENGINEERING-CONTRACTING, June 19, 1907, the freight carried per mile of railway in America was shown to have been 830,000 ton-miles in 1904. Since the Northern Pacific carried 845,000 ton-miles in 1906 per mile of line in Washington, it may be regarded as nearly typical of the average American road, so far as freight is concerned. On the other hand, its passenger traffic is considerably less dense than that of the average American road. It is safe to say, therefore, that the cost of the equipment of the Northern Pacific is fairly typical of the average railway in America. Roughly speaking, then, the cost of equipment of an American railway is $10 per 1,000 ton-miles carried per annum per mile of line.

For a discussion of the life of the Northern Pacific equipment and cost of repairs, see ENGINEERING-CONTRACTING, Sept. 2, 1908.

During the fiscal year ending June 30, 1906, there were 1,390,064,467 ton-miles of freight carried over the Northern Pacific within the state of Washington, or 845,000 ton-miles per mile of line. This was almost 50 per cent more per mile of line than was carried by the Great Northern, which accounts for the higher cost of the Northern Pacific equipment per mile of line.

In drawing conclusions relative to the probable average cost of railway lines throughout the country, serious errors have been made by considering only the costs in one or two states. It will be noted that the cost of terminal lands in Washington is enormous when charged entirely to the road mileage within that state. In the findings of the Washington Railroad Commission it was determined that 56.8 per cent of the entire value of lands used by the whole Northern Pacific railway system exists in the state of Washington. (See ENGINEERING-CONTRACTING, April 15, 1908, for an itemized estimate of the cost of the entire Northern Pacific railway system.)

The Railroad Commission also determined that 62.3 per cent of the entire cost of tunnels and 31.6 per cent of the entire cost of bridges on the N. P. system is found in Washington.

These figures show clearly the rugged character of much of the country traversed by the N. P. in Washington. Unquestionably the cost of its lines in that state far exceeds the cost in any other state through which it passes. The same also is true of the Great Northern.

In a subsequent issue we shall give similar data relative to the cost of the 500 miles in Washington owned by the Oregon Railroad & Navigation Co., the cost of which is very much less per mile than the G. N. or N. P.

The Study of Engineering-Contracting in Engineering Colleges.*

BY W. R. HARRIS

Instruction in engineering-contracting is a very important matter in this age of keen and strenuous competition. Engineering has been defined by a prominent member of the profession as "The science of designing structures so as to resist the force to which they are subjected while performing their functions," and as "The art of so designing these structures that the interest upon their first cost plus annual depreciation plus annual operating expenses shall be the least sum possible of attainment."

Engineering-contracting may be defined as the art of constructing structures at a cost closely approximating the original estimates for same. In short, an engineer-contractor should know what one dollar, either in energy or materials, will accomplish.

The time is passing when one can wait to obtain knowledge of engineering-contracting solely by personal experience. We must study the experience and results of others and those who reap the benefit of the experience of others are indeed fortunate. The present method of obtaining an education in engineering-contracting is by actual work in field and office and by reading and studying books and papers dealing with methods and costs on engineering work as well as of designing.

The newly fledged graduate engineer is of small use to the contractor, for although he may be qualified to design structures, he is not always able to compute the quantities of labor and materials required in the proposed structure. He can very seldom suggest practical methods of operations, costs, etc., and hence, before he can attain to the position where he will be of much value to the contractor, he must pass through the school of experience.

It is possible to so arrange studies in engineering colleges that the graduate engineer will have some knowledge of engineering contracting such as to render his services of greater value to his employer.

The student in engineering-contracting can be instructed in methods and costs of construction. Such a course of instruction would make better engineers for they would then have made their start in the art of engineering as defined above.

An engineer or contractor is always judged by his experience, and if the student in college can gain some of this knowledge by instruction instead of experience he is saved just so many years of hard work.

A great many structures have incorporated in their design non-essential details which increase the cost of the structures beyond economic limits. This is caused by ignorance of construction methods and not by the desire to unnecessarily increase costs, hence a course in engineering-contracting will be of great assistance to an engineer as he would be able to omit non-essential details and to design his structure so that the minimum of energy would be expended in its construction. By non-essential details I do not mean the addition of lines that would beautify a structure where beauty is desirable.

An engineer instructed in simply the science of engineering, and one that the contractor usually refers to as a "theoretical engineer," would design a structure to resist certain forces and would probably not consider, due to lack of knowledge on the subject, that the contractor, to secure certain lines called for by the design, would expend more work than would be necessary by the modification of the design, which modification would not affect the ultimate strength. For example, I know of several instances in concrete design and construction work where by a slight modification in the angles and lines a better, cheaper, and more beautiful structure was obtained.

An engineer who is familiar with everything that enters into the design and construction of the proposed structure, whether it be a sewer, a building, a bridge, a piece of machinery, or what not, can produce better results than one who is simply trained in the pure theory of the science.

The question will naturally arise as to how such instruction can be imparted to the student, and I will attempt to suggest some ideas which I hope will be productive of discussion and bring out other, and better, ideas on the subject. I believe that any department of engineering, whether civil, mining, hydraulic, mechanical, electrical, etc., can be so handled as to provide instruction in engineering-contracting as applied to any particular branch of engineering.

When the student arrives at that part of the course of study embracing designing, he should be required to make up a schedule of quantities showing a bill of materials with market prices on same, and also to include in his schedule the estimate of labor required to construct, manufacture, or erect each item or group of items. He could give a statement of what, in his opinion, would be the proper crew and proper tools required in the construction of the work. He could also suggest a plan of operation for the construction crew.

Again, at the proper period of the course

*A paper read before the American Society Engineering Contractors, Jan. 12, 1910.

of instruction, plans and specifications of actual proposed work, preferably in the immediate vicinity of the college, could be secured and each student in engineering-contracting be required to make up a detailed estimate on the proposed work and to submit a bid on same. With his detailed estimate and his bid, he could present a detailed plan of operation, including the list of outfit, crew required, etc. He could also estimate the time required to complete the work or certain portions of it. Copies of the bona fide bids on which the contracts were awarded could then be secured and compared with the students' bids. Where the work was in the immediate neighborhood, students could be detailed to observe the operations, methods of working, obtain costs, etc., and report all of this back to the class.

Each student could spend a day or several days' time on this work, and another student take it up where the preceding student left off. The result of each day's operations could be reported the succeeding day in open class in a very few minutes. Such a course of procedure would not only develop the student's power of observation but would also place him in a position where he would be in actual touch with construction work.

All colleges have more or less construction work which they in most cases let by contract. Every student in the branch of engineering involved in each contract could make up a detailed estimate, bid, etc., as outlined above, and the same method of procedure adopted as to inspection, reports and discussion.

I do not believe that this is practised in many colleges, at least I have never seen such a method of procedure adopted on any work on which I have bid. I know from my own experience that the study of any piece of work is of value to any engineer or contractor.

The most important part of such a course of study would be the open discussion in class of each day's work, methods, etc., as through discussion new ideas will be brought forth.

In other learned professions such as medicine and law, practising lawyers, surgeons and physicians of repute are secured to lecture to students, which lectures are from a practical standpoint and are based on results achieved in actual practise. Certain processes, methods, etc., evolved by actual work are brought up and described. There are more books on law and medicine than have ever been written on engineering or contracting and, therefore, the classes in engineering-contracting are more in need of lectures.

I believe it would be easy to secure the services of practising engineers and contractors to lecture to classes in engineering colleges, and a few lectures from such men, engaged in actual work can be of inestimable value to every student in the class. Such lectures and discussions as would be produced by the system as outlined above would cause every student to consider plans and specifications from the view point of the constructor as well as from the view point of the designer.

The result of this could not help but eliminate unjust clauses in specifications, such clauses as would tend to increase costs without an adequate and necessary return in strength, beauty and utility.

The ethics of engineering-contracting should be taught and discussed, as well as the ethics of engineering. Engineering students should be taught that contractors are "worthy of their hire," and that the contractor is entitled to a fair profit on honest work. He should be taught that it is fair to ask only for what is possible and to pay a price that is based upon actual cost plus a fair profit. He should be taught to specify good work and to require good work.

He should so draw plans and specifications that intelligent contractors could arrive at a clear idea of what is required as well as to conditions governing costs. He should be taught to conceal nothing regarding conditions that would affect the cost.

He should be taught to make specifications as brief and plain as is consistent with a clear explanation of what is required.

The student would learn to draw specifications that would be better than many now drawn, for by studying the specifications of public works, he would himself, when called upon to prepare detailed estimate of cost and bid on these specifications, realize the unfair features that many times enter into contracts, and having impressed upon his mind the effect on the cost by these unfair features his tendency would be to eliminate these features after entering into the business field.

I have recently had the pleasure of meeting an engineer whom every contractor termed a "crank." Every contractor, however, stated that he was absolutely honorable and absolutely just, although in many things not practical. I was told that the specifications would have to be fulfilled to the letter. This engineer, I do not believe, ever did any construction work himself, and hence there were certain impractical features in some of his work that increased the cost of his structures unnecessarily. In fact, I understand that he had spent many thousands of dollars, due to impractical ideas, but he always got what was specified and his work, though costly, was always good from an engineering standpoint.

This instance simply emphasizes the necessity of the engineer having a broad acquaintance with construction methods and costs, for I do not believe that engineer mentioned above had any idea that he was impractical in the slightest. I believe that he erred on the right side because every contractor who knew him figured absolutely on the specifications and took nothing for granted except what was specified. Therefore, every contractor figured on the same basis.

I also understand that the inspection on work under this engineer's charge is very rigid, but that the contractor is never called upon to do anything not specified in his contract.

It would be very much better if all engineers would consider a structure from both the standpoint of the constructor and the engineer, and then see that the specifications are obeyed strictly.

The engineering-contracting student should familiarize himself with tools and appliances used in work coming within his branch of engineering, and to this end every college should have a catalogue library, properly indexed. Each student should study the advertising columns in technical papers and should request such catalogues as interest him and place same in the catalogue library of the college, for many times new methods are suggested by new appliances.

The student should be taught to think of actual work, first, as so much human energy expended in periods of man-hours, whether this energy is utilized by men with the pick, shovel, or other hand tool, or by means of the steam shovel, crane, or other piece of machinery.

After the student learns that a gang of a certain number of men will accomplish with a certain tool so many units of work by the expenditure of so many units of energy, he will be able to approximate closely similar work in any part of the country no matter what the cost of labor, tools, and materials may be, provided he is acquainted with the local cost of same.

All the theory of design ever taught will not help the student to arrive at the man-hours required to excavate earth, rock, etc., nor will it show him the difference in man-hours required per unit of sand, clay, loam, gravel, loose rock, solid rock, in open cut, nor the difference in energy expended per unit in tunnel or in shaft.

This can only be guessed at by the ordinary engineering student, but it can be more nearly approximated by the same student after he has studied work near him and after he has, by actual observation, obtained some data along these lines. Such observation and study of the work near him will enable him to study with intelligence cost data compiled by engineers and contractors on work that may be done at a distance remote from the college.

I know that many contractors have been disappointed in the work rendered by graduates of engineering colleges, and I believe that graduates who have taken a course in engineering-contracting will be more gladly received by the constructors as well as by the engineering fraternity.

The above statement may be somewhat crude in its presentation, but this is such a broad subject that it cannot be properly handled by one man in one article, and I trust that what I have said above will be productive of discussion among our members and that it will bring forth ideas that will assist in staring the establishment of a course in engineering-contracting in some of our engineering colleges.

LETTERS TO THE EDITOR.

Using the Bag of Cement as a Unit of Measure.

Sirs: I note in a recent issue that you suggest that specifications for concrete work should call for a certain number of barrels or of sacks of cement to the yard instead of the more common practice of specifying the proportions, and I wish to advise that the same has been my practice for several years now.

In the annual city specifications for the city of Memphis, drawn by me for 1908 for concrete work in the city, I specified three classes of concrete, using, 1st, 1½ bbls. of Portland cement, ½ cu. yd. sand and 1 cu. yd. of crushed stone; 2d, using 1¼ bbls. of cement, ½ cu. yd. sand, and 1 cu. yd. of stone; and, 3d, using 1 bbl. cement, ½ cu. yd. of sand and 1 cu. yd. of stone. These classes are designated by me as first class, second class and third class concrete, the third class being that specified for foundation work and the first class that specified for curb and gutter.

These classes have been adhered to in all city work under my supervision since I have been in office. I certainly am glad to see you advocating the practice, and I trust you will further push your recommendations in the matter and endeavor to get the custom thoroughly rooted. I see no reason for the use of the more cumbersome method, except that it has been established by custom for a number of years, and the engineers seem to follow it as do sheep their leaders.

Yours very truly,
J. H. WEATHERFORD,
City Engineer.

Memphis, Tenn.
Jan. 7, 1910.

(Our correspondent seems to have missed our point. The barrel has disappeared practically as a unit and the bag has taken its place. We advocated the disuse of all specifications involving the barrel and the yard. Engineers specify mixtures by proportions of cement, sand and coarse aggregates and contractors mix batches as a rule with small quantities of the materials. Our suggestion was that after specifying the proportions the engineer should fix quantities by establishing a unit. This unit can very properly be the present commercial size bag accepted as being equivalent to one cubic foot. The contractor can then make his measuring boxes and his batches of any convenient size. With the barrel and yard as units a certain amount of calculating must always be done involving fractions.—EDITORS.)

Directions for Coloring Concrete.

Sirs:—I want to get some information on the subject of making concrete white or any other color for ornamental work.—Adam W. Griffith.

Tornado, W. Va.

(A number of cement manufacturers now make white Portland cement and by writing to cement manufacturers advertising in ENGINEERING-CONTRACTING you can no doubt secure some. The color of concrete is largely determined by the aggregates for the cement is only from 10 to 12 per cent of the mass. By using broken marble in place of ordinary

stone and marble screenings in place of sand an almost white concrete may be obtained. The mixing water should be filtered and free from iron. For green use 5 lbs. of ultramarine and for blue use 6 to 7 lbs. of ultramarine per bag of cement. One authority says 2 lbs. of Excelsior Carbon Black per bag of cement will make a good black. Some men use 10 to 11 lbs. of manganese dioxide per bag of cement for black. For brown use 6 lbs. of Roasted Iron Dioxide per bag of cement. For yellow use 6 lbs. of yellow ochre and for buff use double this amount per bag of cement. An ordinary red can be made with from 6 to 10 lbs. per bag of red iron oxide and a bright red with 6 lbs. per bag of Pompeiian red.—Editors.)

Technical Society Meetings.

The list following names those technical societies in which engineers and contractors are most interested, whose meetings are to be held within three months of the date of this issue. There are given for each society listed the date and place of meeting and the name and address of the secretary, to whom all communications and inquiries should be addressed.

American Society of Civil Engineers.
Jan. 19-20, 1910. Annual meeting at New York City. Secy., Chas. Warren Hunt, 220 W. 57th St., New York, N. Y.

Canadian Society of Civil Engineers.
Jan. 25-27, 1910. Annual meeting at Ottawa, Ont. Secy., C. H. McLeod, 413 Dorchester St., West, Montreal, Que.

American Society of Engineering Contractors.
Feb. 24-26, 1910. Annual convention at Chicago, Ill. Secy., Daniel J. Hauer, Park Row Building, New York, N. Y.

American Society of Heating and Ventilating Engineers.
Jan. 18-20, 1910. Annual meeting at New York City. Secy., W. M. Mackay, P. O. Box 1818, New York, N. Y.

American Society of Inspectors of Plumbing and Sanitary Engineers.
Jan. 20-22, 1910. Annual convention at Trenton, N. J. Secy., C. S. McCosker, Mobile, Ala.

Connecticut Society of Civil Engineers.
Feb. 8, 1910. Annual meeting at New Haven, Conn. Secy., J. Frederick Jackson, Box 1304, New Haven, Conn.

Illinois Association of Municipal Contractors.
Feb. 24-26. Annual meeting at Chicago, Ill. Secy., Orie T. Dunlap, Edwardsville, Ill.

Illinois Lumber Dealers' Association.
Feb. 16-18. Annual meeting at Chicago, Ill. Secy., Geo. K. Hotchkiss, 315 Dearborn St., Chicago.

Illinois Masons' Supply Association.
Feb. 16-18. Annual meeting at Chicago, Ill. Secy., Geo. K. Hotchkiss, 315 Dearborn St., Chicago.

Illinois Society of Engineers and Surveyors.
Jan. 26-28, 1910. Annual meeting at Cairo, Ill. Secy., E. E. R. Tratman, 1656 Monadnock Block, Chicago, Ill.

Indiana Engineering Society.
Jan. 14-16, 1910. Annual convention at Indianapolis, Ind. Secy., Chas. Brossman, Union Trust Bldg., Indianapolis, Ind.

Interstate Mantle and Tile Dealers' Association.
Feb. 15-16. Annual meeting at Chicago, Ill. Pres., Joseph W. Lantry, Wm. H. Jackson Co., Union Square, New York City.

Iowa Association of Cement Users.
March 9-11, 1910. Annual meeting in Cedar Rapids, Ia. Secy., Ira A. Williams, Iowa State College, Ames, Iowa.

Iowa Engineering Society.
Feb. 16-17, 1910. Annual convention at Cedar Rapids, Ia. Secy., A. H. Ford, Iowa City, Ia.

Michigan Engineering Society.
Jan. 12-14, 1910. Annual meeting at Lansing, Mich. Secy., Miss L. Holmes, 574 Wealthy Ave., Grand Rapids, Mich.

National Association of Cement Users.
Feb. 21-25, 1910. Annual meeting at Chicago, Ill. Secy., Geo. C. Wright. Address all communications to Edw. E. Krause, Asst. to the President, Harrison Bldg., Philadelphia, Pa.

National Brick Manufacturers' Association.
Feb. 7-12, 1910. Annual convention at Pittsburg, Pa. Secy., T. A. Randall, Indianapolis, Ind.

Ohio Engineering Society.
Feb. 8-10. Annual meeting at Columbus, Ohio. Secy., C. J. Knisley, New Philadelphia, O.

Northwestern Cement Products Association.
Feb. 18-21, 1910. Annual meeting at Chicago, Ill. Chairman of Executive Committee, O. U. Miracle, Minneapolis, Minn.

Personals.

Mr. J. H. Weatherford has been re-elected City Engineer of Memphis, Tenn., under the new commission form of government, for a term of two years.

John H. Lidgerwood, Vice-President and Treasurer of the Lidgerwood Mfg. Co., of New York City, died Jan. 1 at his home in Morristown, N. J., aged 80 years.

Camille S. D'Invellieres, Engineer of Construction for the Pennsylvania R. R. in Pennsylvania, died Jan. 2 at his home in Cresson, Pa., from pneumonia. He was 58 years old.

Mr. F. J. Fleichbauer, Consulting Engineer, has become associated with the Wm. Graver Tank Works, and will be located at the Chicago offices of the company at 413 The Rookery, Chicago, Ill.

Mr. George W. Hackett, Deputy City Engineer of Utica, N. Y., has opened an office in the Clarendon Bldg. in that city, where he will engage in a general engineering and construction business.

Mr. Ernest J. Lederle, Consulting Sanitary Engineer for the New York State Water Supply Board and the New York City Water Supply Board, has been appointed Health Commissioner of New York City to succeed Dr. Thomas A. Darlington.

Mr. John T. Featherston, of New York City, who passed at the head of the list at the recent civil service examination in Chicago for the position of Street Superintendent, has declined to take the position. Mr. John B. Hittell, who was second on the list, will probably be appointed to the position.

Mr. W. H. Zimmerman, formerly Manager for the Michigan Power Co. in Lansing, Mich., has been retained by the Michigan State Railway Commission as Consulting Engineer under the law giving the commission certain supervisory powers over water power and electric power companies, and providing for such an appointment.

Mr. Theodore McKibben, Assistant Engineer at Minden, Mo., has been appointed Chief Clerk in the office of Mr. J. M. Meade, Engineer of the eastern lines of the Santa Fe, at Topeka. Mr. James Dansey, formerly Chief Clerk in that office, has gone to Winslow, Ariz., where he will have charge of a part of the double tracking work which the Santa Fe is beginning in that state.

Mr. Alexander B. Shepherd, who has been Superintendent of the Bureau of Water Supply and Distribution of Pittsburg, Pa., for 14 years, and who served as Acting Director of the Department of Public Works during two years of the administration of Mayor George W. Guthrie, will retire from the city service at the end of this month. Mr. Shepherd leaves the city's employ to become General Manager of the transportation interests of the Jones & Laughlin Steel Co., and it is understood that he is to be elected a vice-president of the company. He will have charge of the Monongahela Connecting R. R., which, according to recent announcement, is to be extended to the great lakes, and will have charge of all other transportation business of the company. It is understood that his salary will be $10,000 a year. His salary from the city is $4,000 a year.

Mr. James V. Costigan has associated with himself Mr. E. H. Cahoon and Mr. C. F. Beck, under the corporate name of The Portage Engineering Co., with offices in the Doyle Block, Akron, O. The new firm will carry on a general engineering business, comprising civil, mining, municipal and hydraulic engineering and land surveying, including the designs, plans and specifications, inspection and superintendence of any work prosecuted under the foregoing heads. Mr. Cahoon was formerly Assistant Engineer of Construction of the W. & L. E. R. R. Co., and for the past three years has held the position of City Engineer of St. Clairsville, O. Mr. Beck, after completing a course in Civil Engineering in Case School, accepted a position with the Land Department of the Northern Pacific R. R. Co. and later became Chief Draughtsman and Bridge Designer of the Akron, Canton & Youngstown Ry.

The Civil Service Commission of Chicago, Ill., will hold an original entrance examination on Feb. 2d for Chief Engineer of the Board of Education. The occupant of this position is over all the school engineers as well as the general office force of the engineering department. The position is one requiring a man of executive ability as well as highly technical qualifications. The salary paid for the late occupant of this position was $6,000 a year, and it is understood that this amount would be increased if a man of the highest ability is secured. Local residence is waived in this examination and the subjects and weights are as follows: Experience, tending to qualify, 4; technical knowledge required for the position to be filled, 3; special subject, 2; mathematics, 1. Under special subject it is possible that the commission may hold an oral test covering matters of administration. This examination will cover three days' time and applicants will have to come to Chicago to take it. Application blanks may be had upon application to the Civil Service Commission, Chicago, Ill., and must be filed not later than 5 p. m., Feb. 1st.

The U. S. Civil Service Commission, Washington, D. C., will hold an examination on Feb. 16-17, 1910, at various cities throughout the country to secure eligibles from which to make certification to fill vacancies as they may occur in the position of hydraulic engineer in the Water Resources Branch of the Geological Survey. The salaries range from $1,200 or less to $2,400 per annum and will be determined chiefly by the character of the training and experience of the eligibles. The U. S. Civil Service Commission will also hold an examination on Feb. 16, 1910, to secur eligibles for temporary employment as topographic aid under the Geological Survey during the field season. The entrance salary ranges from $40 to $75 a month. Appointment to permanent positions will be made only of persons who qualify in and are certified from the junior topographer examination. An examination for junior topographer will be held on Feb. 2-3, 1910. An applicant who desires to be examined for both positions must file a separate application for each position.

Catalogs Worth Having.

Engineers and contractors should have on file the latest catalogs of machines, tools and supplies that they use. In sending for catalogs reviewed or advertised in this paper, you will confer a favor on us if you will write directly to the advertisers and state that you saw the catalog mentioned in ENGINEERING-CONTRACTING. If you are in the market for tools, machinery or supplies, tell us and we will notify promptly the leading manufacturers.

Graphite as a Lubricant.—Paper, 6x9 ins., 60 pp. Joseph Dixon Crucible Co., Jersey City, N. J.

This is the eleventh edition of a work on lubrication, of considerable value to men who use machinery and should be of especial use to contractors who have frequently to use partly worn machinery. By adding graphite to the oil the effect on the running of gears is remarkable in its improvement.

Rock Drills.—Wood Drill Works, Patterson, N. J.

This circular gives a description of the test applied to Wood rock drills, and the opinions of Prof. A. C. Dart of the University of Wyoming, and J. M. Carson, Jr., of the West Point Military Academy as to work accomplished with the Wood rock drill.

The Grimm Wood Worker. Paper, 4½x7 ins., 24 pp. Littlefield & Clark, 39 Erie St., Buffalo, N. Y.

The Grimm Wood Worker is a portable circular saw outfit for contractors' use, with gasoline engine attached. It has attachments so it can be used to rip or crosscut boards, mould and shape, groove and cut tenons, joint and edge, bore, sand or be used for jig sawing.

Jeffrey Screens.—Paper, 6x9 ins., 22 pp. The Jeffrey Mfg. Co., Columbus, Ohio.

Revolving and shaking screens in great variety are here illustrated and described.

Linolite Illuminating System.—Paper, 6x9 ins., 8 pp. Electrical Dept. of the H. W. Johns-Manville Co., 100 William St., New York.

The novel feature in the linolite system of illumination is the tubular lamp with reflector.

Deane Steam Pumps.—Paper, 5¼x8 ins., 54 pp. The Deane Steam Pump Co., Holyoke, Mass.

This booklet contains a list of places where Deane pumping engines have been furnished for use on water works service, the year when they were erected, size and daily capacity in U. S. gallons.

Expansion Bolts.—Paper, 6x9 ins. Steward & Romaine Mfg. Co., 124 N. Sixth St., Philadelphia, Pa.

This is a very complete catalog of expansion bolts and fittings of great use to contractors.

Concrete Telegraph and Trolley Poles.—A. C. Chenowith, 16 Court St., Brooklyn, N. Y.

This circular describes the Chenowith concrete pole with a hollow tapered center.

Industrial Photography.—Paper, 6x9 ins., 8 pp. Williams, Browne & Earle, 918 Chestnut St., Philadelphia, Pa.

This circular explains the value of photography for industrial purpose and gives descriptions and prices of outfits.

The Parmley System of Reinforced Concrete.—Paper, 6x9 ins., 24 pp. Walter C. Parmley, Everett Bldg., New York, N. Y.

Mr. Parmley, while an Assistant Engineer in Cleveland, Ohio, patented a system of reinforcement for sewers, manholes, conduits and tunnels. This catalog describes and illustrates his system, which he contracts for and allows to be used on royalty terms.

Good Roofs.—Paper, 6x9 ins., 32 pp. Stowell Manufacturing Co., Jersey City, N. J.

This catalog describes 10 different "ready roofing" materials made by this company and paints, asphalts, etc., for roofing purposes.

Engineering-Contracting Monthly Review Index of Civil Engineering Literature.

A classified index and review of the civil engineering papers, articles, reports, pamphlets and books published during the month just passed is given in the succeeding pages. The literature indexed and reviewed—with the exception of books—relates solely to civil engineering. In the section devoted to Book Reviews all books in all branches of engineering are listed as received and such of them as seem worthy are reviewed as fully as due regard for conciseness will permit. In choosing books for review rigid selection is exercised. Next to careful choice of books for review timeliness of review is sought. All books are reviewed within a month of their receipt. The same statement is true of the articles and papers that are indexed. Also, as in choosing books for review, the choice of articles and papers for indexing is based on merit. Numerical strength in "titles indexed" is not sought; excellence of selection is sought.

The purposes of the Monthly Review Index are: First, to inform civil engineers and contractors of the articles and papers of merit that are published each month, in such a way as will give a clear idea of their character and scope; second, to supply the user with the date and place of publication, the length of each article and the cost at which it can be secured. The name, adopted abbreviations, place of publication and price per number of each periodical examined for civil engineering articles are given in the list immediately following. The other information is given in the index proper for each article separately.

Books reviewed will be sent post paid on receipt of price by the Book Department of ENGINEERING CONTRACTING; periodicals, etc., containing articles indexed should be ordered direct from the publishers.

LIST OF PERIODICALS INDEXED.

American Architect (Am. Arch.), New York, N. Y.; w; 7x10 in.; 15 cts.
American Builders' Review (Am. Bldrs. Rev.), San Francisco, Cal.; m; 7x10 in.; 50 cts.
American Carpenter and Builder (Am. Car. & Bldr.), Chicago, Ill.; New York, N. Y.; m; 7x10 in., 20 cts.
American Engineer and R. R. Journal (Am. Engr. & R. R. Jl.), York, N. Y.; m; 7x10 in.; 20 cts.
American Gas Light Journal (Am. G. L. Jl.), New York; N. Y.; w; 10x13 in.; 10 cts.
American Institute of Electrical Engineers Proceedings (Am. I. of E. E. Proc.), New York, N. Y.; m; 4x7 in.; 50 cts.
American Machinist (Am. Mchst.), New York; w; 7x10 in.; 15 cts.
American Society of Civil Engineers Proceedings (Am. Soc. C. E. Proc.), New York, N. Y.; m; 4x7 in.; 75 cts.
American Society of Mechanical Engineers Journal (Am. Soc. M. E. Jl.), New York, N. Y.; m; 4x7 in.; $1.
Annales des Ponts et Chaussees (An. P. & C.), Paris, France; m.
Applied Science, Toronto, Ont.; m; 6x9 in.; 20 cts.
Architects and Builders Journal (Arch. & Bldrs. Jl.), Baltimore, Md.; m; 9x12 in.; 20 cts.
Architects and Builders Magazine (Arch. & Bldrs. Mag.), New York, N. Y.; m; 5x8 in.; 20 cts.
Architect and Engineer of California (Arch. & Engr.), San Francisco, Cal.; m; 5x7 in.; 15 cts.
International Railway Congress Bulletin (Int. Ry. Cong. Bul.), Brussels; m; 50 cts.
California Journal of Technology (Cal. Jl. of Tech.), Berkeley, Cal.; m; 4x7 in.; 25 cts.
Canadian Architect (Can. Arch.), Toronto, Ont.; m; 7x19 in.; 20 cts.
Canadian Cement and Concrete Review (Can. Cem. & Conc. Rev.), Toronto, Ont.
Canadian Engineer (Can. Engr.), Toronto, Ont.; w; 7x11 in.; 20 cts.
Canadian Machinery and Manufacturing News (Can. Mach. & Mfg. News), Toronto, Ont.; m; 7x10 in.; 15 cts.
Canadian Mining Journal (Can. Min. Jl.), Toronto, Ont.; bi-w; 7x10 in., 20 cts.
Canadian Municipal Journal (Can. Mun. Jl.), Montreal, Que.; m; 6¾x10 in.; 10 cts.
Canadian Society of Civil Engineers Proceedings (Can. Soc. C. E. Proc.), Montreal; m; 4x7 in.; 50 cts.
Carpentry and Building (Carp. & Bldg.), New York, N. Y.; m; 11x8 in.; 10 cts.
Cassier's Magazine (Cas. Mag.), New York; m; 5x8 in.; 25 cts.
Cement, New York, N. Y.; bi-m; 5x8 in.; 25 cts.
Cement Age (Cem. Age), New York, N. Y.; m; 4¾x8 in.; 15 cts.
Cement and Engineering News (Cem. & Eng. News), Chicago, Ill.; 7x10 in ; 25 cts.
Cement Era (Cem. Era), Chicago, Ill.; m; 7x10 in.; 10 cts.
Cement-Record (Cem. Rec.), m; 4¾x8 ins.; 15 cts.
Cement World (Cem. Wld.), Chicago, Ill.; m; 9x11 in.; 10 cts.
Chemical Engineer (Chem. Engr.), Chicago, Ill.; m; 4x7 in.; 15 cts.
Clay Worker (Cl. Wkr.), Indianapolis, Ind.; m; 7x10 in.; 20 cts.
Compressed Air (Comp. Air), New York, N. Y., m; 5x7 in.; 10 cts
Concrete, Detroit, Mich.; m; 6x9 in.; 15 cts.
Concrete Age (Conc. Age), Atlanta, Ga.; m; 9x11 in.; 10 cts.
Concrete and Constructional Engineering (Conc. & Cons. Eng.), London, England; m; 5x7 in.; 25 cts.
Concrete Engineering (Conc. Eng.), Cleveland, O.; m; 7x10 in.; 10 cts.
Contract News, Chicago, Ill.; bi-w; 7x10 in.; 10 cts.
Contractor (Contr.), Chicago, Ill.; bi-w; 7x10 in.; 20 cts.
Cornell Civil Engineer (Cor. Civ. Engr.), Ithaca, N. Y.; m; 4x7 in.; 25 cts.
Domestic Engineering (Dom. Engr.), Chicago, Ill.; w; 6x9 in.; 10 cts.
Electrical Age (Elec. Age), New York, N. Y.; m; 7x10 in.; 10 cts.
Electrical Review (Elec. Rev.), New York, N. Y.; 8x10 in.; 10 cts.
Electric Railway Journal (Elec. Ry. Jl.), New York, N. Y.; w; 7x10 in.; 10 cts.
Electrical World (Elec. Wld.), New York, N. Y.; w; 7x10 in.; 10 cts.
Electric Traction Weekly (Elec. Trac. Wkly.), Chicago, Ill.; w; 7x10 in.; 10 cts.
Engineer (Engr. Lon.), London, England; w; 4x11 in.
Engineer (Engr.), Chicago, Ill.; bi-w; 7x10 in.; 20 cts.
Engineering (Eng.), London, England; w; 8x11 in.
Engineering-Contracting (Eng.-Contg.), Chicago, w; 7x10 in.; 10 cts.
Engineering Digest (Eng. Dig.), New York; m; 5x8 in.; 20 cts.
Engineering and Mining Journal (Eng. & Min. Jl.), New York; w; 7x10 in.; 15 cts
Engineering Magazine (Eng. Mag.), New York; m; 5x7 in.; 25 cts.
Engineering News (Eng. News), New York; w; 8x11 in.; 15 cts.
Engineering Record (Eng. Rec.), New York; w; 8x11 in.; 10 cts.
Engineers' Club of Philadelphia Proceedings (Engr.'s Club, Phila. Proc.), Philadelphia; qr; 4x7 in.; 25 cts.
Fire and Water Engineering (F. & W. Eng.), New York, N. Y.; 8x11 in.; 10 cts.
Le Genie Civil Paris, France; w.
Good Roads Magazine (Gd. Rds. Mag.), New York, N. Y.; m; 7x10 in.; 10 cts.
Industrial Magazine (Ind. Mag.), Cleveland, O.; m; 4x7 in.; 10 cts.
Industrial World (Ind. Wld.), Pittsburg, Pa.; w; 7x10 in.; 10 cts.
Insurance Engineering (Ins. Eng.), New York; m; 4x6 in.; 25 cts.
Iron Age, New York, N. Y.; w; 7x11 in.; 15 cts.
Iron Trade Review (Iron T. Rev.), Cleveland, O.; w; 7x10 in.; 15 cts.
Irrigation Age (Irr. Age), Chicago, Ill.; m; 7x9 in.; 10 cts.
Journal Association of Engineering Societies (Jl. Assoc. Engr. Soc.), Boston, Mass.; m; 4x7 in.; 30 cts.
Journal Franklin Institute (Jl. Frank. Inst.), Philadelphia, Pa.; m; 4x7 in.; 50 cts.
Journal New England Waterworks Association (Jl. N. E. W. W. Assoc.), Boston, Mass.; q; 4x7 in.
Journal Western Society of Engineers (Jl. W. Soc. Engrs.), Chicago, Ill.; bi-m; 4x7 in.; 50 cts.
Journal of Electricity, Power and Gas (Jl. Elec., P. & G.), San Francisco, Cal.; w; 7x10 in.; 10 cts.
Journal of Worcester Polytechnic Institute (Jl. W. P. I.), m; 4x7 in.; 20 cts.
Machinery, New York, N. Y.; m; 7x11 in.; 20 cts.
Marine Review (Marine Rev.), Cleveland, O.; w; 7x10 in.; 15 cts.
Mines and Minerals (Mi. & Mls.), Scranton, Pa.; w; 7x9 in.; 20 cts.
Mining and Scientific Press (Min. & Sci. P.), San Francisco, Cal.; w; 7x11 in.; 15 cts.
Mining Reporter (Min. Rep.), Denver, Colo.; w; 7x10 in.; 15 cts.
Mining World (Min. Wld.), Chicago, Ill.; w; 7x10 in.; 10 cts.
Modern Machinery (Mod. Mchy.), Chicago, Ill.; m; 7x10 in.; 10 cts.
Municipal Journal and Engineer (Mun. Jl. & Eng.), New York, N. Y.; w; 7x10 in.; 10 cts.
Municipal Engineering Magazine (Mun. Eng. Mag.), Indianapolis, Ind.; m; 4x7 in.; 25 cts.
Ores and Metals (O. & M.), Denver, Colo.; bi-w; 6x10 in.; 10 cts.
Pacific Building Engineer (Pac. Bldg. Engr.), Seattle, Wash.; w; 9x11 in.; 15 cts.
Popular Mechanics (Pop. Mech.), Chicago, Ill.; m; 5x7 in.; 10 cts.
The Polytechnic (Poly.), Troy, N. Y.; m; 5x8 in.; 15 cts.
Power and Engineer (Pwr. & Engr.), New York; m; 7x10 in.; 20 cts.
Railway Age Gazette (R. R. Age Gaz.), New York; w; 8x11 in.; 15 cts.
Railway Master Mechanic (Ry. M. M.), Chicago; m; 7x10 in.; 10 cts.
Railway and Engineering Review (Ry. & Eng. Rev.), Chicago, Ill.; w; 9x11 in.; 10 cts.
Railway and Locomotive Engineering (Ry. & Loco. Eng.), New York, N. Y.; m; 7x10 in.; 20 cts.
Railway and Marine World (Ry. & M. Wld.), Toronto, Ont.; m; 7x10 in.; 15 cts.
Railway Engineering and Maintenance of Way (Ry. Eng. & M. W.), Chicago, Ill.; m; 7x10 in.; 10 cts.
Roadmaster and Foreman (Rd. & For.), Chicago; 7x10 in.; 10 cts.
Rock Products (Rk. Prod.), Chicago, Ill.; bi-w; 9x11 in.; 10 cts.
Rose Technic, Terre Haute, Ind.; m; 4x7 in.; 15 cts.
School of Mines Quarterly (Sch. Min. Quart.), New York, N. Y.; qr; 4x7 in.; 50 cts.
Schweizerische Bauzeitung, Zurich; w.
Scientific American (Sci. Am.), New York; w; 9x14 in.; 10 cts.
Scientfic American Supplement (Sci. Am. Sup.), New York, N. Y.; w; 9x14 in.; 10 cts.
Sibley Journal of Engineering (Sib. Jl. Eng.), Ithaca, N. Y.; m; 4x7 in.; 20 cts.
Stevens Institute Indicator (Stev. Inst. Ind.), Hoboken, N. J.; m; 4x7 in.; 20 cts.
Street Railway Bulletin (St. Ry. Bul.), Boston; m; 6x10 in.; 10 cts.
Surveyor (Surveyor), London, England; w; 6x11 in.; 10 cts.
Technology Quarterly (Tech Qr.), Boston; qr; 4x6 in.; 35 cts.
U. S. Department of Agriculture Bulletin (Dept. Agr. Bul.), Washington, D. C.; 4x7 in.
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Waterproofing and Fireproofing (W. P. & F. P.), Detroit, Mich.; m; 7x10 in.; 10 cts.
Zeitschrift d. Oest, Ing. u. Arch. Ver. Vienna; w.
Zeitschrift d. Ver Deutscher Ing.; Berlin; w.

ROADS AND STREETS.

Possibilities of Portland Cement as a Road Material.—By Logan Waller Page. Eng. Rec., Dec. 25, 1909. 1 p.

A paper read by the Chief of the U. S. Bureau of Road Inquiry before the Association of American Portland Cement Manufacturers. He describes experiments the government is making in mixing asphalt and Portland cement in order to get the best results from both materials in road building.

Extracts from Papers Before the British Road Conference of 1909.—Eng. News., Dec. 16, 1909. 5 pp.

Nine papers on road construction, maintenance and dust prevention are here abstracted. It is good reading.

The Construction and Preservation of Macadam and Bituminous-Macadam Roads.—By Logan Waller Page. Eng. News., Dec. 9, 1909. 1½ pp.

This is an abstract of a paper read before the Western Society of Engineers, Nov. 3, 1909, and will be printed in full in the Journal of the Western Society. It is a discussion on the present day problems of macadam road construction by the Director of the Bureau of Road Inquiry of the U. S. Government.

Street Flushing in New York.—Mun. Jl. & Eng., Dec. 29, 1909. 2 pp.

Gives results of tests made on washing paved streets as compared with sweeping for the purpose of cleaning them. A table is presented showing the number of square yards cleaned per day by different makes of machines and gals. of water used per 1,000 sq. yds. cleaned.

Draining Street Intersections.—By S. D. Newton. Mun. Jl. & Eng., Dec. 29, 1909. 2 pp.

The author is engineer of Knoxville, Tenn., and this article is a reprint of a paper read at the 1909 convention of the American Society of Municipal Improvements. A paper of considerable value to engineers in towns where storm sewers are not provided.

Rubbish and Snow Removal.—Mun. Jour. & Eng., Dec. 22, 1909. 5 pp.

A description of the work done in New York city in cleaning and sprinkling streets.

Road Tarring.—Mun. Jour. & Eng., Dec. 8, 1909. 1½ pp.

Abstract of a paper by W. H. Fulweiler in Journal of The Franklin Institute Sept., 1909, describing all the leading methods for improving macadam roads with tar.

Dangers of Street Dust.—Mun. Jour. & Eng., Dec. 8, 1909. 1 p.

Gives data from New York city reports and medical sources to show that street sweepers between the ages of 25 and 45 years are peculiarly liable to consumption.

Pavements and Grade Limitations.—By S. C. Thompson. Mun. Jour. & Eng., Dec. 8, 1909. 1½ pp.

Abstract of paper read at 1909 convention of the American Society of Municipal Improvements, on kinds and costs of pavements in New York city on specified grades.

Drainage at Street Intersections.—By J. H. Weatherford. Mun. Jour. & Eng., Dec. 15, 1909. 4½ pp.

This is a paper read before the 1909 convention of the American Society of Municipal Improvements. Discusses surface drainage of streets in cities without storm sewers. The illustrations show methods used in Memphis, Tenn. Gives costs.

Concrete Blocked Pavement.—Mun. Jour. & Eng., Dec. 1, 1909. 4½ pp.

Describes the reconstruction work of the Knoxville (Tenn.) Railway & Light Co. A cross section of the roadbed is shown with details of the blocked pavement. Base is 5¼ ins. thick of 1:2½—5 concrete. Top surface is 1¾ ins. thick of 1:1½ cement and crushed granite. Surface is given rough finish and blocked with grooving tools. Expansion joints ¾-in. wide, filled with asphalt filler are placed 100 ft. apart after setting of finished pavement is completed.

Paving Practice with Respect to Crowns of Roadway Pavements and Concrete Pavements.—By George C. Warren. Eng. News., Dec. 2, 1909. 1½ pp.

Mr. Warren out of his experience as a paving contractor gives rules in his opinion best for computing crowning for roadways; also gives practical hints on construction of concrete foundations.

The Lesson Taught by the Extravagantly High Cost of Pavement Repairs Done by Day Labor in Brooklyn, N. Y.—Eng.-Contg., Dec. 1, 1909. 1¼ pp.

Gives statistics showing high cost of pavement repairs and discusses them in the light of the day labor policy of doing municipal construction work.

Cost of Patching Asphalt Pavement Using a Small Repair Plant.—Eng.-Contg., Dec. 15, 1909. ¾ p.

Describes plant and methods used in repairing some 6.64 miles of asphalt streets by city labor, with cost of plant, materials, labor and itemized unit costs of repairs.

Standard Details of the New York State Highway Department for State and County Roads.—Eng.-Contg., Dec. 15, 1909. 2¼ pp.

Illustrates and describes standard plans for road sections, concrete culverts, concrete ditch covers, dry inlets, cast iron culverts, concrete retaining walls, concrete catch basins, mile posts and guide boards, and guard rails.

Macadam Road Construction in Ohio.—Eng.-Contg., Dec. 8, 1909. ⅓ p.

Describes general practice in constructing macadam roads employed by the Ohio State Highway Department, as given by State Highway Commissioner J. C. Wonders.

Specifications of the New York State Highway Department for Bituminous Macadam and Characteristics Required of Bituminous Materials.—Eng.-Contg., Dec. 8, 1909. 1¾ pp.

This is a reprint of the standard specifications issued by the New York State Highway Department.

Hints in Oiling Macadam.—Eng.-Contg., Dec. 1, 1909. ¼ p.

Gives directions for oiling macadam roads by V. M. Frodden, Superintendent of Streets, Alameda, Cal.

Standard Specifications of the New York State Highway Commission for Brick Pavement.—Eng.-Contg., Dec. 15, 1909. 1½ pp.

Reprint of revised specifications issued by the Bureau of Plans and Surveys of the New York State Highway Commission.

Methods and Cost of Sprinkling Road Surfaces With Oil.—By W. A. Gillette. Eng.-Contg. Dec. 8, 1909. 1½ pp.

Describes methods to be followed in preparing the roadbeds and in applying and working the oil; describes special oil distributor and oil pumping plant for filling oil wagons from tank cars, and gives itemized unit costs of oil treatment. An unusually practical article on road oiling.

Method and Cost of Oiling Park Roads at Kansas City, Mo.—Eng.-Contg., Dec. 1, 1909. 1 p.

Describes the kinds of oil used and the methods of application and gives costs of oiling 672,188 sq. yds, in 1908. Plans are given of a plant for unloading tank cars of road oil.

Cost of Road Treatment With Oil and Dust Preventives at Washington, D. C.—Eng.-Contg., Dec. 29, 1909. ½ p.

Describes briefly 12 jobs of road treatment and gives itemized cost of each.

System for Recording and Accounting for Supplies and Labor in the Paving Division of a City Street Department.—Eng.-Contg., Dec. 29, 1909. 2¾ pp.

Illustrates and describes purpose of and manner of using forms for requisition of supplies, delivery tickets, receiver's daily report, inspector's daily report, custodian's final report, record of time and work of teams, etc.

Study of Street Cleaning Conditions in Boston with Data on the Cost of Snow Removal, Push Cart Patent System, Machine Sweeping and Maintenance of Horses.—Eng.-Contg., Dec. 22, 1909. 3¾ pp.

Describes methods employed and gives costs for Boston, Mass., of snow removal, push cart patent system of cleaning and machine sweeping. Very full data are given on costs of keeping department horses. A notably interesting article.

Regrading the Streets of Seattle.—Gd. Rds. Mag., December, 1909. 4 pp.

General article describing the regrading of the streets of Seattle, Wash., by the hydraulic sluicing method.

Road Materials and Some Simple Rlues for Testing Them.—By Austin B. Fletcher. Gd. Rds. Mag., December, 1909. 3 pp.

A paper read at the First American Congress of Road Builders, at Seattle, Wash. In it the author gives simple tests for the following materials entering into the construction of roads: Sand and clay, gravel, rock suitable for macadam purposes, and bituminous materials. For the last material he gives the Massachusetts Highway Commission's specifications for refined tar, asphaltic oil and oil asphalt.

Crowns of Roadway Pavements.—By George C. Warren. Gd. Rds. Mag., December, 1909. 1½ pp.

Abstract of a paper read before the last convention of the American Society of Municipal Improvements. The paper treats of various formulas and rules for determining the crown of roadway.

Bituminous Road Materials.—By Prevost Hubbard. Gd. Rds. Mag., December, 1909. 3 pp.

A paper discussing the general principles for the use of bituminous road materials. The paper was read at the second annual Good Roads Convention of the American Automobile Association at Cleveland.

SEWERS.

Asphalt Joints for Sewer Pipe.—By Carl Hennecking. Eng. Rec., Dec. 25, 1909. 1 p.

Describes the joints used in German sewers, made of asphalt to secure watertightness. This asphalt is a special compound which does not soften under about 131° F.

Utilizing a Creek Valley Bed for a City Sewer.—By Harlow Gale. Eng. Rec., Dec. 25, 1909. ⅔ p.

This describes a piece of work in Minneapolis, Minn., in which a sewer was laid in a creek bed underneath the bottom of the creek, which bottom was afterwards restored to its former natural condition so that the creek now runs over the sewer.

Sewage Disposal at Country Houses.—Eng. Rec., Dec. 18, 1909. 2 pp.

An abstract of a paper read by Mr. John D. Watson, Chief Engineer of the Birmingham, Thames and Rea District sewage disposal works in England. This paper on the disposal of sewage at country houses is well worth study.

Experiments on the Passage of Bacteria Through Soil.—Eng. Rec., Dec. 4, 1909. 1 p.

Describes some interesting experiments made in Berlin on the passage of bacteria through sandy soil, to determine the liability of endangering a water supply from wells. It was found that the strongest bacteria travelled the 69 ft. through the soil in such small numbers that it was found only 1 in 40,000 placed in the hole ever reached the well. It was concluded therefore that pathogenic bacteria, being weaker than the innocent ones chosen, would stand a very small chance of polluting the wells.

The Construction of the Bronx Storm Relief Sewer.—Eng. Rec., Dec. 4, 1909. 3 pp.

A purely descriptive article with illustrations of the construction of a sewer 6,900 ft. long with a cross sectional area of approximately 200 sq. ft.

Material for Sewer Inverts.—Eng. Rec., Dec. 4, 1909. ⅔ p.

Abstract of a paper read at the 1909 annual meeting of the American of Municipal Improvements, describing experiments made by Mr. Edward S. Rankin, of Newark, N. J., on materials used for sewer inverts. The conclusion reached is that good concrete is better than tile and there is no necessity for lining concrete sewers with tile.

A Siphon Tunnel Under the River Dee.—Eng. Rec., Dec. 4, 1909. 2 pp.

Aberdeen, Scotland, has found it necessary lately to conduct its sewage through a long pipe to an outfall in the sea. This involved going under the River Dee with an inverted siphon, having an internal diameter of 8 ft. 4 ins., a length of 344 ft. and put at a depth so the top of the tunnel lining is 41 ft. below the surface of the river. This article describes the siphon with illustrations. The tunnel is divided really into two siphons.

Some Notes on the Separation of Solids from Sewage and Waste Liquors.—By James P. Norrington. Eng. News., Dec. 30, 1909. 1¼ pp.

Describes a German and an English sedimen-

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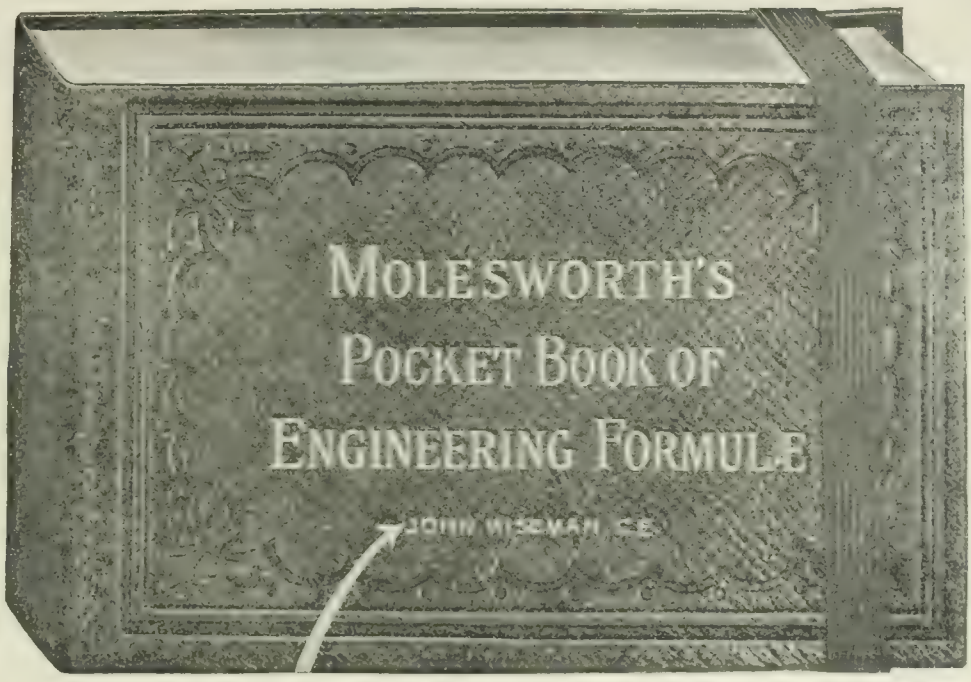

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tation tank and compares their comparative worth. These two types remove such a large per cent of solids (75% to 96%) that in some cases of weak sewage further treatment by filters is deemed unnecessary. Abstract of a paper read before the Incorporated Association of Municipal and County Engineers, England. Oct., 1909.

Disinfection of Sewage.—By Earle B. Phelps. Mun. Jour. & Eng., Dec. 22, 1909. 2½ pp.

A paper read before the American Society of Municipal Improvements. Gives a general resume of sewage purification and tells when and why sterilization is proper. Costs are given ranging from 52 cts. per million gallons containing 1 part chlorine per million to $5.05 per million gallons containing 15 parts chlorine per million.

Standards for Sewage Effluents.—By Dr. John Thresh. Surveyor, Dec. 17, 1909. 3 pp.

A paper read before the 1909 annual convention of Sewage Works Managers in London, England, Dec. 9, 1909, describing simple tests devised by Prof. Phelps of the Massachusetts Institute of Technology, Boston, Mass., and published by him in a bulletin entitled "Putrescibility and Stability of Sewage Effluents."

Sewage Clarification Tanks.—Mun. Jour. & Eng., Dec. 8, 1909. 2 pp.

Describes the Kessel tank operating by a siphon action and also a concrete separator tank of high efficiency in use in England.

Explosions of Sewer Gas in New York City.—By A. A. Breneman. Eng. News, Dec. 2, 1909. 1⅓ pp.

Describes investigations made into causes of explosions in sewers, seemingly on the increase. The cause is ascribed to gasoline from automobile garages and recommendations are made for traps to minimize the danger.

Specifications for Concrete Sewers at Richmond, Ind.—Eng.-Contg., Dec. 29, 1909. ½ p.

Reprint of specifications employed by city of Richmond, Ind., for both monolithic concrete and concrete pipe sewers.

Construction of the Baltimore Sewage Disposal Works.—Eng. Rec., Nov. 13, 1909, 2½ pp.; Nov. 20, 1909, 3 pp.

These articles describe the construction of one of the largest sewerage purification plants in the world, showing plan of work and layout of contractor's plant with descriptions of methods adopted during construction.

WATERWORKS AND HYDRAULICS

Some Phases of Hydroelectric Enterprises.—Eng. Rec., Dec. 18, 1909. 2 pp.

Abstract of a paper by Mr. Henry L. Doherty before the American Institute of Electrical Engineers. Of considerable value to men who may some time try to market a water power for the generation of electric energy.

Design and Operation of a Mechanical Filter Plant.—Eng. Rec., Dec. 19, 1909. 3 pp.

This is a very good article for men who are looking up the subject of mechanical filtration (or as it is generally termed, rapid sand filtration). Describes a plant having a 2,000,000-gallon daily capacity.

Cost of Laying Water Mains at Cheyenne, Wyo.—By H. G. Porak. Eng. Rec., Dec. 4, 1909. ½ p.

This article gives the costs of excavating and backfilling trenches 5 ft. deep and laying in them pipes ranging in diameter from 4 ins. to 20 ins. The 10-in. pipe was laid in a trench

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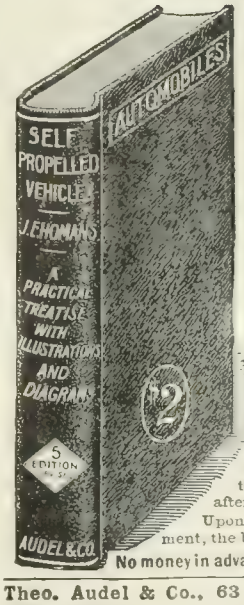

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where a 6-in. was already laid and replaced the smaller pipe.

The Pipe Line of the Canon City Water Supply System.—Eng. Rec., Dec. 4, 1909. 3⅜ pp.

Water will be delivered under a head of 210 ft. in Canon City by the new system. The pipe line consists of 1,500 ft. of 36-in. steel and approximately 35,000 ft. of 30-in. wood stave pipe. This article describes the work of putting in this pipe line with some remarks on the head works. Illustrated by half-tone views and a few details.

Data Relating to Awards for Water and Water-Power Diversion.—Eng. News, Dec. 16, 1909. 3 pp.

This article is condensed from report of committee of New England Water Works Association, Dec. 8, 1909. The paper contains considerable data on water sheds of New England and information on the value of water power.

Effect of Roughness of Bed on Depth of Water and Distribution of Velocity.—By E. C. Murphy. Eng. News, Dec. 30, 1909. 1⅓ pp.

A paper describing experiments made by the U. S. Geological Survey of flow of water. Considerable data is given in tables and diagrams. The results are given in an exponential formula for mean velocity in a channel. The experiments were made to determine (1) the relative effect of roughness of bed on the distribution of velocity in vertical planes, and (2) the relative effect of roughness of bed on mean and bottom velocity for various slopes.

Cleaning Water Filters.—By S. Bent Russell. Eng. News, Dec. 23, 1909. 2 pp.

This is an abstract of a paper entitled "Notes on Certain Points in the Design of Large Filtration Plants," read before the St. Louis Engineers' Club. Very little literature on mechanical filters has appeared that is of service to designers and this paper is timely and valuable.

The Multiple Arch Dam.—By C. E. Grunsky. Jour. El. P. & Gas, Dec. 25, 1909. 2 pp.

This is a short discussion on points of design of a new form of concrete dam of light arched section without reinforcement. The inventor, John S. Eastwood, described in the Oct. 30 issue of the same paper a dam near Hume, Cal., built on the multiple arch system.

San Francisco's Water System.—By Herman Schussler. Jl. El. P. & Gas, Dec. 11, 1909. 19 pp.

One of the best descriptions of the growth of a water works system for a large city that has been printed. The author has been chief engineer of the Spring Valley Water Works for over forty-five years.

The Partial Failure Through Undermining of the Zuni Dam, New Mexico.—Eng. News, Dec. 2, 1909. 4 pp.

The Zuni dam is 70 ft. high with a crest length of 720 ft. The lower side is a rock fill structure containing 40,160 cu. yds. and the reservoir side is a hydraulic fill dam containing 60,120 cu. yds. of earth with rip rap slope. This type of dam was selected because of its flexibility as the geological formation was not deemed proper for a masonry dam. A portion of the dam settled owing to undermining by underflow, and the selection of this type of dam was thus justified. The article is of value to hydraulic engineers and contains the findings of the consulting engineers as to cost and methods of repair work.

Some Data on Water-Works Maintenance and Operation Gleaned from a Public Service Report.—Eng.-Contg., Dec. 8, 1909. 1⅓ pp.

Extracts from the report for 1908 of the Water Commission of Boston.

The Kensico Reservoir, Catskill Water Supply.—Eng. Rec., Dec. 25, 1909. 1⅔ pp. 1½ pp., ill.

Describes a masonry dam 170 feet high above the bed of the reservoir.

The Water Supply of Springfield, Ohio.—By Paul Hansen. Eng. Rec., Dec. 11, 1909. 3 pp., ill.

The supply is mainly from gravel deposits and this article is one of a sanitary nature showing that only in certain cases can any city be certain to receive a supply of water from gravel beds that is not in danger of contamination. Such methods of filtration are not under as good control as artificially made filtration beds.

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tribution Systems.—Eng.-Contg., Dec. 1, 1909. 1¼ pp.

Discusses conditions calling for pressure control and describes and illustrates an automatic controlling altitude valve.

Methods and Costs of Laying About 1¼ Miles of 20-in. Cast Iron Water Pipe in Cuba.—Eng.-Contg., Dec. 8, 1909. ⅝ p.

Describes methods of work for trenching, pipelaying and backfilling and also method of testing and gives itemized unit costs of each portion of the work.

New Water Filtration Plant at Toledo, Ohio, With Data on Contract Methods and Costs.—By B. M. Baker. Eng.-Contg., Dec. 1, 1909. 4½ pp.

General description of the structural features of and the construction methods employed in building the new $900,000 water filtration plant at Toledo, O. Itemized contract costs of the plant are given.

Some Reservoir and Filtration Costs and Methods.—Eng.-Contg., Dec. 22, 1909. ⅔ p.

Gives miscellaneous costs for Washington, D. C., on dredging, slope paving, filtration, etc.

Suggestions on the Use of Iron and Lime Process of Water Purification. — By C. Arthur Browne. Eng. News, Nov. 18, 1909. 3 pp.

This is a paper read before the Central States Water Works Association, Sept., 1909. Mr. Brown is the chemist for the American Steel & Wire Company and really developed the method whereby iron sulphate is replacing alumina as a coagulent in water filters. The paper is a text for men operating water purification plants and brings the process down to date.

Public Service.—By John Don, Assoc. M. Inst. M. E. F. & W. Eng., Nov. 3, 1909. 2⅔ pp.

This is merely an abstract of a paper describing every filtering system known. The original paper received first award at the "Water Arbitration Prize," 1908, of the Institution of Mechanical Engineers of Great Britain.

Experiments With Double Pitot Tubes.—Eng. Rec., Nov. 27, 1909. 1 p.

Abstract of paper by Mr. K. Ellon, published in the "Zeitscrift" of the Society of German Engineers describing experiments made by himself and Prof. E. Reichel at the Berlin Technical High School. (A German high school ranks with an engineering school of standing in the United States.) A double pitot tube is simply two tubes side by side with their legs extending in opposite directions. Experiments show a tube reads correctly only when the water stream lines are parallel and the leg of the tube is exactly in line with them and against direction of flow. The pitot tube is not recommended for flow-in pipes because of the lack of definite knowledge of water stream lines, and in small pipes the tube itself obstructs flow and increases velocity. The chief claims for use in open water courses are simple construction, permanency of calibration and direct and instantaneous reacting.

The Bernhart Sand Filters, Reading, Pa.—Eng. Rec., Nov. 13, 1909. 2⅔ pp.

An article of value to water works engineers, being a complete description, with many details, of the construction of filters to purify water from Bernhart Creek, Reading, Pa. Capacity, 3,750,000 gallons daily.

DRAINAGE AND IRRIGATION.

The Reclamation Project of the Idaho Irrigation Company.—Eng. Rec., Dec. 25, 1909. 4½ pp.

Describes a project for irrigating 150,000 acres of land in southern Idaho. Gives methods for constructing an earthen dam, principally by hydraulicking.

The Shoshone Dam, U. S. Reclamation Service, Near Cody, Wyo.—By H. N. Savage, M. Am. Soc. C. E. Eng. News, Dec. 9, 1909. 3 pp., ill.

A description, with 9 illustrations, of a curved masonry dam having a height of about 250 ft. above the foundation and costing $515,730. One of the illustrations is a plan of the contractors' layout. Purely a descriptive article.

Proposed Plan for the St. Francis Valley Drainage, a Statement of Methods of Construction and Some Estimates of Cost.—Eng.-Contg., Dec. 22, 1909. 4½ pp.

Describes the plans proposed for this large drainage project, including methods of construction planned and estimates of cost.

RIVERS, HARBORS AND CANALS.

Pier 3 of the Boston Terminal of the Boston and Albany R. R.—Eng. Rec., Dec. 25, 1909. 3 pp.

This pier is 240x781 ft. in extreme dimensions with a number of slips on each side. It is of pile construction and the sheds are fireproofed. General details given and a full description.

Protecting Levee Slopes with Concrete.—Eng. Rec., Dec. 4, 1909. 1 p.

A roadway in Cincinnati constructed on a fill was undermined every time the river rose and this article describes the method adopted for protecting the embankment next the river with a 5-in. blanket of reinforced concrete for a length of 4,800 ft., the reinforcement consisting of ¼-in. round rods placed 36 ins. apart on the slope and half as far apart near the edges.

Design for Concrete Dry-Dock at Pearl Harbor, Hawaii, for the United States Navy.—By R. E. Bakenhus. Eng. News, Dec. 9, 1909. 3½ pp.

A very good description of a dry dock of modern construction. The more important details are illustrated. The present length is 589 ft., but provisions are made so it may be lengthened to 1,200 ft. when necessary. The present length will enable the largest battleship in the world to be docked here when the dock is completed.

Progress of Construction on the Panama Canal During the Year Ending June 30, 1909; Compiled from the Report of the Isthmian Canal Commission.—Eng.-Contg., Dec. 1, 1909, 3⅔ pp.

Gives the latest official estimated itemized cost of the Panama Canal and reviews in a general manner the amount and character of the work done during the year named.

Records and Costs of Excavation on the Main Channel and Lock Work of the Panama Canal for the Year Ending June 30, 1909, with Some Summaries of Excavation Costs.—Eng.-Contg., Dec. 8, 1909, 2½ pp.

Gives outputs and costs of various classes of excavation on each of the three construction divisions of the Panama Canal, and also permits nine tables of itemized unit costs of excavation covering generally a period of two years' work. A valuable analysis of cost data.

RAILWAYS.

Subaqueous Section of the Detroit River Tunnel. Eng. Rec., Dec. 18 and 25, 1909, 5½ pp.

These sections of the Detroit River Tunnel were made of steel, floated to position and sunk. This article describes the methods followed and gives half-tone illustrations.

Railway Terminals and Their Relation to City Planning.—By Frederic A. Delano. Eng. Rec., Dec. 18, 1909, 2½ pp.

This paper was read at the 1909 Convention of the American Institute of Architects. The author is President of the Wabash Railroad Co. It is an interesting addition to the present growing literature on town planning and takes up a phase hitherto glossed over by the majority of earlier writers, most of whom have looked upon town planning from the artistic standpoint

The Bergen Hill Four Track Tunnels, Erie Railroad.—Eng. Rec., Dec. 18, 1909, 2⅓ pp.

This is an illustrated article containing details of arch centering and traveler. The work is in solid rock.

Reconstruction of the Washington Street Tunnel, Chicago.—Eng. Rec., Dec. 11, 1909, 1 p.

The old street car tunnel under the Chicago River was within 10 ft. of the surface of the water and the War Department compelled the city to lower the roof. This was done by putting in steel girders and reinforced concrete slab in the tunnel near the bottom, thus putting it out of commission. Now it is proposed opening a new tunnel under this roof and lowering the sides. This article describes the method proposed by the contractors, with illustrations.

Tunnel Failures and Repairs on the Eastern Railway of France.—Eng. News, Dec. 23, 1909, 3⅓ pp.

This is a very good article for maintenance of way engineers who have in charge old tunnels. It is condensed from an article in the Revue Generale des Chemins de Fer, by M. Siegler, Chief Engineer of Maintenance of Way. The editors of the paper have appended to this

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article notes on tunnel repair work with reference to articles previously appearing in Engineering News on this subject.

The Cost of Overhead-Trolley Systems.—By A. D. Williams, Jr. Eng. News, Dec. 23, 1909, ½ p.

A short interurban line was constructed in northwestern Ohio, running along country highways. This article gives the detailed costs of the work per mile. Summarizing the costs were as follows: Bracket arm system, $3,551.31; cross span, 30 and 37 ft. poles, $3,836.25; cross span, 30 and 30 ft. poles, $3,680.25.

Comparison of Gasoline Car, Single-Phase Electric and Steam Locomotive Costs. By W. E. Harrington, B. S. El. Ry. Jour., Dec. 25, 1909, 1 p.

An article making a study of the most desirable form of power car for lightly patronized interurban roads. Costs are shown to be per car mile as follows: Direct current, $0.1717; alternating current, $0.2023; gasoline motor car, $0.142, and steam locomotive with one car, $0.1543.

Life and Maintenance Cost of British Railway Track.—By R. Price Williams. Ry. & Eng. Rev., Dec. 25, 1909, 2 pp.

Abstract of paper read Sept., 1909, before the Iron and Steel Institute. The author discusses increased maintenance costs with a view to forecasting probable future increases. In England he says the mileage in 47 years has a little more than doubled, and the number of cars has only increased three-fold. The tonnage carried has increased nearly five-fold, the number of passengers nearly seven-fold and the working expenses nearly six-fold. He attributes increased maintenance costs to high speeds and increased weights of equipment.

Recent Extensions of the Boston Elevated System.—El. Ry. Jour., Dec. 18, 1909, 8½ pp.

This article contains a map and 5 line drawings showing layouts of some stations, together with several half-tones. The text is of a general descriptive character.

Rail Grooves and Track Gage for Curved Tracks.—Ry. & Eng. Rev., Dec. 11, 1909, 2½ pp.

Extracts from a paper by C. W. L. Fillkins before the American Street & Interurban Railway Association giving the problems met with and presenting simple formulas for computing width of groove for flanges in common use. Gives tabulated flange path data.

Comparison of Operation of the New York and Paris Subway Systems.—By Robert H. Whitten. El. Ry. Jour., Dec. 11, 1909, 7 pp.

This article gives a sketch map of each system to a scale of ½-in. to the mile and plans of cars used on each system. Gives diagrams and tables comparing train headway; yearly ticket sales; traffic density; revenue from transportation; gross revenue from operation and its apportionment, and cost of each system. An analysis accompanies these data.

Cost of Constructing the Miraflores Tunnel on the Panama R. R. Eng.-Contg., Dec. 15, 1909, 1 p.

Describes construction of 736 ft. of tunnel through earth and rock and lined with concrete. General itemized costs of the work are given.

Original Cost and Cost of Reproduction of the Great Northern Railway (768 miles) in the State of Washington.—Eng.-Contg., Dec. 8, 1909, 3¾ pp.

Gives itemized cost of 768 miles of main line and branch line railway owned by the Great Northern Railway in the State of Washington. Costs are compiled from original data collected by the engineers of the Washington State Railroad Commission. The most complete article of [illegible] know.

Methods of Constructing the East River Tunnels of the Pennsylvania R. R. Entrance to New York City, with Some Data on Costs.—Eng.-Contg., Dec. 1, 1909, 4⅔ pp.

Construction of a series of articles describing construction of land and river tunnels across Manhattan Island and under the East River to a point inland on Long Island. This particular article describes methods of lining and summarizes the costs given in the series of articles.

Electric System of the Great Northern Railway at Cascade Tunnel.—By Cary T. Hutchinson. Ry. & Eng. Rev., Nov. 13, 1909. 3 pp., ill. Nov. 20, 1909, 4 pp.

This article is a digest of a paper read before

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Art. 1. Composition of Non-Concurrent Forces.
Art. 2. Resolution of Non-Concurrent Forces.
Art. 3. Equilibrium of Non-Concurrent Forces.
Art. 4. Special Constructions for Funicular Polygons.
CHAPTER IV.—MOMENTS.
Art. 1. Moments of Forces and Couples.
Art. 2. Graphic Moments.
CHAPTER V.—CENTER OF GRAVITY OF AREAS.
CHAPTER VI.—MOMENT OF INERTIA.
Art. 1. Moment of Inertia of Parallel Forces.
Art. 2. Moment of Inertia of Areas.

PART II.

FRAMED STRUCTURES—ROOF TRUSSES.

CHAPTER VII.—DEFINITIONS.
CHAPTER VIII.—LOADS.
Art. 1. Dead Load.
Art. 2. Snow Load.
Art. 3. Wind Load.
CHAPTER IX.—REACTIONS.
Art. 1. Reactions for Dead and Snow Loads.
Art. 2. Reactions for Wind Loads.
CHAPTER X.—STRESSES IN ROOF TRUSSES.
Art. 1. Definitions and General Methods for Determining Stresses.
Art. 2. Stresses by Algebraic Moments.
Art. 3. Stresses by Graphic Moments.
Art. 4. Stresses by Algebraic Resolution.
Art. 5. Stresses by Graphic Resolution.
CHAPTER XI.—WIND LOAD STRESSES.
Art. 1. Both Ends Fixed—Reactions Parallel.
Art. 2. Both Ends Fixed—Horizontal Components of Reactions Equal.
Art. 3. Leaward End of Truss on Rollers.
Art. 4. Windward End of Truss on Rollers.
CHAPTER XII.—STRESSES IN CANTILEVER AND UNSYMMETRICAL TRUSSES—MAXIMUM STRESSES.
Art. 1. Stresses in Cantilever and Unsymmetrical Trusses
Art. 2. —Maximum Stresses.
CHAPTER XIII.—COUNTERBRACING.
Art. 1. Definitions and Notation.
Art. 2. Stresses in Trusses with Counterbracing—Separate Stress Diagrams.
Art. 3. Stresses in Trusses with Counterbracing—Combined Stress Diagram
CHAPTER XIV.—THREE-HINGED ARCH.
CHAPTER XV.—STRESSES IN A TRANSVERSE BENT OF A BUILDING.
CHAPTER XVI.—MISCELLANEOUS PROBLEMS.

PART III.

BEAMS.

CHAPTER XVII.—BENDING MOMENTS, SHEARS, AND DEFLECTIONS IN BEAMS FOR FIXED LOADS.
Art. 1. Bending Moments and Shears in Cantilever, Simple, and Overhanging Beams.
Art. 2. Graphic Method for Determining Deflections in Beams.
Art. 3. Bending Moments, Shears, and Deflections in Restrained Beams.
CHAPTER XVIII.—MAXIMUM BENDING MOMENTS AND SHEARS IN BEAMS FOR MOVING LOADS.

PART IV.

BRIDGES.

CHAPTER XIX.—TYPES OF BRIDGE TRUSSES.
CHAPTER XX.—LOADS.
Art. 1. Dead Load.
Art. 2. Live Load.
Art. 3. Wind Load.
CHAPTER XXI.—STRESSES IN TRUSSES DUE TO UNIFORM LOADS.
Art. 1. Stresses in Warren Truss by Graphic Resolution.
Art. 2. Stresses in a Pratt Truss by Graphic Resolution.
Art. 3. Stresses by Graphic Moments and Shears.
Art. 4. Stresses in a Bowstring Truss—Triangular Web Bracing.
Art. 5. Stresses in a Parabolic Bowstring Truss.
Art. 6. Wind Load Stresses in Lateral Systems.
Art. 7. Stresses in Trusses with Parallel Chords by the Method of Coefficients.
CHAPTER XXII.—INFLUENCE DIAGRAMS AND POSITIONS OF ENGINE AND TRAIN LOADS FOR MAXIMUM MOMENTS, SHEARS, AND STRESSES.
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the Am. Inst. Elec. Engineers on Nov. 12, 1909, and describes in detail the work done in the electrification of a tunnel 13,873 ft. long in which gases from locomotives have made travel difficult and at times dangerous. Plans of yards are given with details of overhead construction and calculations given showing cost of operation. An 8-pp. illustrated abstract of the same paper was given in the Electrical Railway Journal, Nov. 20, 1909.

BRIDGES, BUILDINGS AND FOUNDATIONS.

The Fabrication of Heavy Curved Drawbridge Girders.—Eng. Rec., Dec. 18, 1909, 2 pp.

Describes the construction of curved girders for a bascule bridge in Chicago. The shop problems involved are quite different from those in plain steel work.

Bridge Inspection Disclosures. Eng. Re Dec. 11, 1909, 2 pp.

Describes methods adopted by Mr. Herbert C. Keith of New York in examining bridges and similar structures. Gives also results of his observations in the inspection of over 2,000 bridges and viaducts, with suggestions as to details.

Steel Erection Work.—Eng. Rec., Dec. 4, 1909, 1⅓ pp.

Two articles, one describing some rapid erection work in connection with placing plate girder spans for a viaduct in Jersey City. Each girder weighed nearly 30 tons and they varied in length from 60 to 73 ft. It took 48 hours to erect eight spans. The other article describes the putting in place of 12 large steel gates in the new dam of the Southern Wisconsin Power Co. Each gate is 8 ft. high, 25 ft. 10 ins. long and weighs approximately 7 tons. Contractor's methods in both cases are described and half-tone illustrations are given.

Suspension Bridge of 600 ft. Span Across the Culebra Cut of the Panama Canal.—By A. S. Zinn. Eng. News, Dec. 16, 1909, 3 pp.

On account of track shifting and other construction operations it was found necessary to frequently cut and change the compressed air and water pipe lines at the Culebra cut. It was estimated that in the next five years the cost of this cutting and changing would be about $60,000. A suspension bridge 600 ft. long to carry the pipes for the rest of the time the work will be going on was constructed at a cost of $22,000 and is wide enough to be used for highway purposes also. The drawings of the bridge and details and the description given of the work will be of assistance to men confronted with a similar problem.

The Construction of a Four-Track Truss Bridge with Solid Floor; Chicago and Oak Park Elevated Ry.—Eng. News, Dec. 9, 1909, 3½ pp.

This is a description of interest to structural engineers of a four track solid-floor truss bridge built to carry the Chicago & Oak Park Elevated Ry., over the ten track bridge carrying the Chicago & Northwestern Ry. Terminal approach across Lake St. The details are very fully illustrated and drawings of the falsework are shown.

The Construction and Equipment of a Modern Boiler-Making Plant.—By E. R. Fish. Eng. News, Dec. 16, 1909, 3 pp.

Abstract of a paper read before a joint meeting of the American Society of Mechanical Engineers and the St. Louis Engineers' Club. A general plan is shown, together with a general view of the plant after completion. A suggestive paper for mill building engineers.

Construction of the Lethbridge Viaduct, Crows Nest Branch, Canadian Pacific Railway Company.—Eng.-Contg., Dec. 29, 1909, 6½ pp.

Describes location and purpose of viaduct, its main structural features, and, in particular, the methods and machines employed in the erection. A special steel traveler was used which is fully described and illustrated.

A Comparison of Reports on Tests on the Same Cement by Various Laboratories.—By Alexis Saurbrey. Eng. News, Dec. 9, 1909, 1½ pp.

Mr. Richard K. Meade a few months ago suggested that cement be purchased on the result of tests. That is a cement that showed better results than another should be worth the best price. This article describes the result of a series of experiments made to determine the value of check tests. The results are given in detail and serve to show that the personal equation is such an important item that independent testers often vary widely in testing the same samples. The author calls it "annoying."

CONCRETE AND REINFORCED CONCRETE

The Reinforced Concrete Municipal Pier, Santa Monica, Cal.—By Edwin Hall Warner, M. Am. Soc. C. E. Eng. News, Dec. 9, 1909, 1½ pp.

This pier is 1600 ft. long, 36 ft. wide and cost $100,000. It was built to carry an outfall sewer pipe to deep water and is utilized for revenue producing as a municipal income producer. The piles are of reinforced concrete as well as the rest of the wharf and full details are given.

Austrian Tests of Cement Mortar in Sea Water and Salts.—Eng. News, Dec. 9, 1909, 1 p.

A progress report to the Society of Austrian Engineers and Architects on tests commenced in 1907 is here abstracted. This article is merely of interest to those who are studying the matter, as a guide to possible sources of information.

A Comparison of the Cost of Two Methods of Concrete Construction; Separately Molded Members vs. Monolithic Structure.—By Mason D. Pratt. Eng. News, Dec. 9, 1909, 2 pp.

Cost of Two Methods of Concrete Construction.—By Mason D. Pratt. Eng. Rec., Dec. 11, 1909, 2 pp. ill.

A very interesting description of the erection of two car barns each 75 ft. wide and 360 ft. long. One was cast and the other made of shop fabricated members. This shop fabricated barn was built at a cost of about 15 per cent less than the monolithic building. The costs are itemized and the most important details illustrated.

The Delaware River Concrete Bridge, Slateford-Hopatcong Cut-Off; Delaware, Lackawanna & Western R. R.—Eng. News, Dec. 30, 1909, 4 pp.

This bridge is a multiple arch concrete bridge 1,452 ft. long with a width between parapets of 28 ft. carrying a double track standard gage railway. It contains 51,500 cu. yds. of concrete. A feature of the construction work is the steel centering used, which is fully described. The article is illustrated with a number of details and half-tones.

Reinforced Concrete Siphon in Spain.—By B. A. Etcheverry. Calif. Journ. Tech., December, 1909, 4 pp.

Describes a siphon recently completed in Spain. The diameter is 1312 ft. and the maximum head of water is 97 ft. It is 2363 ft. long and has no expansion joints. The seepage is 1/24 the estimated amount.

Cement and Sand for Concrete.—Jour. Assoc. Eng. Soc., November, 1909, 28 pp.

An informal discussion at a meeting of the Boston Society of Civil Engineers in which proper qualities of cement and sand were discussed by prominent engineers.

The Use of Cold Twisted Steel Bars.—By Jesse J. Shurman. Conc. Eng., December, 1909, 2 pp.

The author is inspecting engineer for Jones & Laughlin Steel Co. Having no particular interest in any form of steel reinforcement, he discusses from the standpoint of a steel maker

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A Method of Constructing Reinforced Concrete Cylindrical Storage Bins.—Eng. News, Dec. 2, 1909. ⅔ p.

In this device steel rods are placed vertically about 8 ft. apart in the concrete and jacking levers with friction collars attached to them. By means of these levers the forms are lifted as fast as the concrete sets sufficiently, thus making the concreting a practically continuous process.

Design and Construction of Forms for Concrete Work.—Eng.-Contg., Dec. 1, 1909. 1¼ pp.

Conclusion of a series of articles on practical form construction, giving tables and formulas for computation, rules, examples and illustrations showing practice.

Details of Concrete Encasement for Elevated Railway Structure and of Special Forms Employed in its Construction.—Eng.-Contg., Dec. 15, 1909. 1¾ pp.

Describes construction of concrete encasement for 372 ft. of double track elevated railway and gives details of form construction and of methods of handling forms.

A Comparison of Timber and Concrete Piling on the Basis of Cost.—Eng.-Contg., Dec. 5, 1909. ¾ p.

Discusses comparative costs of wood and concrete piles on the basis of bearing power, permanency and time of construction.

Some Notes on Concrete Materials and Proportions.—Eng.-Contg., Dec. 15, 1909. 1½ pp.

A review of the various methods prepared for determining amounts of materials and of water required for concrete, giving rules and formulas and examples of their use.

Plain Account of the Characteristics Required of Cement, Sand and Stone for Concrete.—Eng.-Contg., Dec. 1, 1909. 2 pp.

A clear and simple statement of the characteristics which cement, sand and stone should possess for making concrete. An excellent article for the small concrete worker, the contractors' foreman and others not possessed of the more special technical knowledge of concrete materials, etc.

Building Concrete Piles With Enlarged Bases for Postoffice Building Foundations at Paris, Ill.—Eng.-Contg., Dec. 29, 1909. ⅔ p.

Describes a new method of molding concrete piles in place with enlarged basis and gives some records of work on a 211-pile foundation.

Design for a Concrete and Pile Quay Wall With Reinforced Concrete Sheet Pile Facing.—Eng.-Contg., Dec. 22, 1909. 7 pp.

Gives section of quay wall and details of sheet piling with specifications for molding and sinking sheet piles.

Methods and Cost of Constructing Concrete Sewers at Richmond, Ind. By Fred R. Charles. Eng.-Contg., Dec. 29, 1909. 2 pp.

Covers experience with half-a-dozen different forms of concrete sewer construction, giving methods, results and costs. A very valuable article for city engineers.

Some Retaining Wall Construction in Connection With the Chicago & Northwestern Ry. Track Elevation Work in Chicago.—Eng.-Contg., Dec. 29, 1909. 1¼ pp.

Describes retaining wall structure and illustrates forms, describes methods of work with a special concrete mixer elevating concrete directly into forms.

Methods Employed in Constructing a Reinforced Concrete Building for the Carter's Ink Company.—Eng.-Contg., Dec. 22, 1909. 1 p.

Describes a special excavator consisting of a dipper mounted on a pile driver frame and also method of handling concrete, with general details of construction methods.

New Design for Reinforced Concrete Slab Floors Which Can be Mathematically Analyzed.—Eng.-Contg., Dec. 22, 1909. 2 pp.

Describes a floor construction of reinforced concrete in which very flat wide beams or slabs take the place of the ordinary deeper and narrower beams, thus giving a flat ceiling and saving in height of stories, and also giving a construction which can be analyzed by ordinary methods.

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EARTH AND ROCK EXCAVATION.

A Large Blast at Morena Dam, California.—By M. M. O'Shaughnessy. Eng. News, Dec. 30, 1909. 1 p.

Describes a blast made in California that used 19,475 tons of powder, cost $9,093.95 and displaced 180,000 tons of granite. Describes method of doing the work.

A Drilling Auger for Prospecting for Coal Above Water Level.—By Baird Halberstadt. Eng. News, Dec. 16, 1909. 1 p.

Describes an auger for prospecting purposes that should be of service to contractors generally. The author prospected 75,000 acres of coal lands with such an outfit and claims it to be better than prospecting by trenching and shafting.

Some Methods and Costs of Work in Constructing the Gatum Dam for the Panama Canal.—Eng.-Contg., Dec. 15, 1909. 1 p.

Shows cross-section of dam, describes methods of construction and gives costs based on official figures of dry filling and wet filling.

A Novel Locomotive Drill and a Remarkable Drilling Record.—By Frank Richards. Eng. News, Dec. 2, 1909. 1 p., ill.

This drill has a vertical guide permitting a travel of 10 ft. instead of 2 ft. to 2½ ft. as in the drill mounted on tripod. Holes can be drilled without changing steel so considerable time is saved in changing drilling holes. Being mounted on wheels, time is saved in changing from hole to hole. Operated by two men, it does as much work as four tripod drills with eight men.

The Cost of Producing Crushed Stone in Boston, Mass., by City Operated Crushing Plants.—Eng.-Contg., Dec. 29, 1909. 3⅓ pp.

Describes equipment and conditions of work at eight city crushing plants and gives itemized unit costs of crushed stone at each plant for three years, 1905-6-7. The records are discussed and criticized and comparisons made with market prices of crushed stone.

Some Methods and Costs of Removing Stumps in Clearing Land.—Eng.-Contg., Dec. 22, 1909. ¾ p.

Describes methods of stump removal by burning, blasting, pulling, etc., and gives some general costs.

SURVEYING AND DRAFTING.

A Convenient Rack for Holding Drawings.—By John H. Gregory. Eng. Rec., Dec. 25, 1909. 1½ pp.

The method described for keeping drawings is to place them in wooden strips like loose leaf binders with the ends projecting and a rack is made on which these ends rest so the drawings hang vertically at all times. Mounted on castors so it can be wheeled around the office.

Requirements of Engineering Files and Indexes.—By Herman K. Higgins. Eng. News, Dec. 30, 1909. 2 pp.

This is a very good article giving many useful facts about the filing and indexing of printed matter, maps, field notes, etc., in engineering office. Condensed from a paper read before the Boston Society of Civil Engineers.

Filing and Indexing System of the Board of Water Supply of New York City.—By Alfred D. Flinn. Jour. Assoc. Eng. Soc., October, 1909. 33 pp.

This article is extremely detailed and prepared with care. A number of offices are maintained on the various works and a chart of the system of accountability is given. The author of the paper is the Headquarters Department Engineer.

Separate Leaf System for Recording Survey Notes.—By Lee Fraser. Eng. & Min. Jl., Dec. 25, 1909. 2 pp., ill.

Describes method used by a mining company and gives blank forms used. Cards 5x8 ins. ruled for transit, level and topography respectively are taken on the job in loose leaf binders and each day's cards are turned into the office where specially ruled loose leaves are used to transfer notes to.

Cost of Subdividing a Forty-Acre Tract Into Building Lots With a Transitman and Two Assistants.—Eng.-Contg., Dec. 15, 1909. ¼ p.

Describes conditions and methods of making survey and gives time costs of the work.

MISCELLANEOUS.

Cost of Power for Various Industries.—Eng. Rec., Dec. 25, 1909. 1 p.

Abstract of paper read by Mr. Charles T. Main before the Boston Society of Civil Engineers, giving cost of power for manufacturing plants using steam, electricity and water power.

Regulation of Compressed Air Work in France.—Eng. Rec., Dec. 4, 1909. ⅔ p.

This article gives the code of rules under which all work must be done in France where air pressure is used, to obviate the danger of bends, or other mishaps resulting from working under air pressure.

Cooling Towers for Steam and Gas Power Plants.—By J. R. Bibbins. Eng. News, Dec. 16. 1909. 5¾ pp.

This is an abstract of a paper read before a meeting of the American Society of Mechanical Engineers. The cooling tower is no longer regarded as a makeshift but is becoming an integral part of all power plants. The literature is very small and this paper goes so fully into the matter as to be very helpful in studying such power plant auxiliaries.

Refuse Disposal and the New Refuse Incineration Plant for Milwaukee.—By Samuel A. Greeley. Jour. Assn. Eng. Soc., November, 1909. 14 pp.

Gives general data on analysis of waste, rubbish and garbage in cities and follows with a description of the new plant at Milwaukee, having a daily capacity of 300 tons and costing $200,000.

A Municipal Purchasing Department.—Mun. Jour. & Eng., Dec. 22, 1909. 2½ pp.

A comprehensive description of the purchasing organization in the city of Cleveland, O.

Going Value as an Element in the Appraisal of Public Utility Properties.—By Wm. H. Bryan. Jour. Assoc. Eng. Soc., October, 1909. 13 pp.

A discussion of a paper by John W. Alvord before the 1909 Convention of the Am. W. W. Assoc. and presenting ideas on the subject held by the Wisconsin Public Utilities Commission.

What Does Your Power Cost You?—Can. Mfr., Dec. 10, 1909. 4 pp.

An article giving cost of horsepower by steam, gas, oil and gasoline engines and electricity. Tables and diagrams are given, compiled and prepared by the Ontario Hydro-Electric Power Commission.

The Design of Smelter Flues.—By F. A. Lee, M. E., Min. Sci., Dec. 16, 1909. 3 pp.

Flues are used to conduct gases from furnaces to stack and also to catch dust and facilitate condensation of fumes. Temperature variations are so great that the proper design is a nice little problem. This article describes principles of design used on a system in use in Colorado for two years past with satisfaction.

Center Walks Supplemented by Back Alleys in Place of Roadways and Sidewalks in Venice, Calif.—By H. M. Meinell. Eng. News, Dec. 2, 1909. ⅔ p.

Describes an effective method of improvement in a small seaside town. Wagons are restricted to streets parallel with the shore and to the alleys crossing them. The cross streets are improved by placing a concrete walk down the center, extending the yard walks to this walk and sodding the rest of the street, thus creating a beautiful park effect.

Costs of Various Kinds of Municipal and Sanitary Work at Panama.—Eng.-Contg., Dec. 15, 1909. 1½ pp.

Gives costs taken from the report of the Isthmian Canal Commission of constructing pipe sewers, water mains, reinforced concrete reservoir, pumping and filtering water, crushed stone and street extension.

Science of Management Engineering.—By Hulbert P. Gillette. Eng.-Contg., Dec. 15, 1909. 1⅔ pp.

An argument to show that management engineering is susceptible of reduction to scietific laws, and thus warrants being called a science. Certain of these laws are stated and demonstrated.

Oil and Gasoline Engines for Contractors' Use.—Eng.-Contg., Dec. 8, 15, 22 and 29, 1909. 3⅓ pp.

A series of articles describing the operation and care of gasoline engines and some of the uses to which they are put by contractors. The

The Journal OF Western Society OF Engineers

is a high grade bi-monthly illustrated magazine of about one hundred pages in each number, and contains the original papers of engineering interest that have been presented to the society, with the discussion of the same. These papers treat of subjects in all lines of engineering, are well illustrated and should be of value to engineers, chemists, scientific and business men everywhere.

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The October Number Contains

"Clay Products"

By A. V. BLEININGER,
Ceramic Chemist with the Clay Products Section of the U. S. Geological Survey.

An extensive paper on the work of the Section, giving results of tests on clay products used in construction work.

"Contracts for Structural Steel Work"

An extensive discussion by Attorneys, Architects, Engineers and Contract Managers, covering "Liabilities;" "Penalties," "Damages," "Arbitration," "Relations of Parties in a Contract," and "Payments." Forms of Contracts of unusual merit are given.

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Mechanical Engineer.

An illustrated paper with discussion covering commercial problems of transportation with data on costs per ton-mile, mechanical considerations, etc.

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data given regarding gas engine troubles and remedies are particularly useful.

Cost of Hauling With Traction Engines and Dump Wagons as Compared With Hauling With Horses.—Eng.-Contg., Dec. 8, 1909. 4⅓ pp.

Gives a general discussion of general conditions, field conditions, items of contractor's cost, general description of work observed and full methods and cost analysis of several pieces of work, followed by general formulas and diagrams.

First Cost and Cost of Shop Repairs of Steam Shovels, Cars and Locomotives on the Panama Canal.—Eng.-Contg., Dec. 22, 1909. 2⅔ p.

Gives detailed costs compiled from data contained in the report of the Isthmian Canal Commission.

BOOK REVIEWS.

Inspector's Handbook of Reinforced Concrete.—By Walter F. Ballinger and Emile G. Perrot. New York. Engineering News Publishing Co. Cloth 4½x7 ins. 66 pp.; 6 folding plates; $1.

This book is divided into three chapters, dealing respectively with Forms or Falsework; Reinforcement; Concrete. An appendix contains a few data on design with formulas, followed by some plates for obtaining data on strength of beams and slabs graphically. The only thing about the book to entitle it to be designated as an inspector's hand book is the title. The matter in the book is very general and such as may be found in practically every issue of periodicals devoted to concrete in a popular way. An inspector is a man placed on a piece of work to see that the specifications are complied with. A hand book for such a man must be more than a general talk on the subject and must be something less than a book on design. It should be a book dealing with the many points over which a discussion may arise and illustrating good and poor practice when such illustrations will help. It should be confined strictly to the one subject of construction. Questions of design are supposed to have been attended to before the contract is signed, therefore in such a book no formulas or designing diagrams are required.

On the subject of inspection this book is so lamentably deficient that it cannot be recommended to those who are looking for an inspector's hand book. It is hard to place it except to say that it adds a certain number of pages to an already crowded bibliography on reinforced concrete. As a book the matter is out of place but it might not be out of place in the pages of a techno-popular magazine.

Concrete Bridges and Culverts for both Railroads and Highways.—By H. Grattan Tyrrell, C. E. Chicago and New York. The Myron C. Clark Publishing Co. London, E. & F. N. Spon, Ltd. Leather 4½x7 ins. 251 pp. 66 illustrations and 10 tables in the text. $3.

The first part of this work is a complete treatise on plain concrete arches, giving examples in design and construction and methods of cost estimating. Many illustrations are given to make the text plain. A 4-page table gives a list of 56 plain concrete bridges constructed in many countries, the spans varying from 20 ft. to 365 ft. The costs are given for 18 and the designers names for 31, of these bridges. The data cover number of spans, span length, rise, width, total length, total height and form of curve. For some reason the [illegible] is not given in any case but this deficiency is of course taken care of in the preceding pages on design.

Part II, Reinforced Concrete Arch Bridges has a 6-page table similarly describing 122 bridges of this type in which no necessary item is lacking, there being in addition columns giving amount of reinforcement in the arch, the spans varying from 33 to 197 ft. On the subject of design this section is not so satisfying as the section on plain arches, and the designer needs some such work as Reuterdahl to supplement the information given by Mr. Tyrrell. Several pages devoted to estimating costs are exceedingly good. On page 158 is a table of highway arches for clear spans varying from 20 ft. to 150 ft., having a roadway 16 ft. wide. The table gives the crown thickness, rise, area of reinforcement, cu. yds. concrete in arches and approximate amount of concrete in the abutments.

Part III discusses Highway Beam Bridges of Reinforced Concrete and two tables are given containing dimensions of such bridges up to spans of 40 ft., with estimates of cost.

Part IV treats of Reinforced Concrete Culverts and Trestles with estimates of cost and rules for estimating. An 8-page table gives complete data for railroad box culverts to go through embankments from 10 ft. to 50 ft. high, having openings from 2 ft. to 20 ft. wide; with estimates of cost.

Trestles with spans from 14 ft. to 24 ft. are detailed with piers from 6 ft. to 24 ft. in height for single track railways, thus making the work of the designer very light. Cost estimates are also given.

The book shows evidence of a great deal of work on the part of the author and will be of service to a large class of men that likes to possess standard plans for structures. That it was written by a designer is shown in the calm assumption by the author that his readers do not require much, if any, instruction in reinforced concrete design. It is also shown by the ignoring of all construction problems and difficulties; and absence of information on the vital subject of forms and centering. In its present shape there are many men to whom it will be useful, especially because of the tables and estimating data. City engineers, county surveyors and road commissioners will appreciate it.

Modern Lettering: Artistic and Practical.—By William Heyny. New York. William T. Comstock. Cloth 7x10 ins. 156 pp. 35 plates. $2.00.

The author says that this book gives a course for artists, architects, sign writers and decorators; also the construction of pen and ink designs for commercial uses, advertisements, letter heads, business cards, memorials, resolutions, etc.

The eye is so often offended by examples of bad taste shown in lettering, as well as by poor execution of the work that a book like this should be of considerable value to the men whom the authors had in mind. Twenty years ago it could have been recommended to engineers. Today, however, engineers have a distinctive "commercial" system of lettering and this book can be of little interest to them.

While there is nothing in the book to commend it to engineers, every architect should have a copy. The author is entitled to praise for his careful and good work in the preparation of such a good text book.

Domestic Sanitary Engineering and Plumbing.—Dealing with Domestic Water Supplies, Pump and Hydraulic Ram Work, Hydraulics, Sanitary Work, Heating by Low Pressure, Hot Water, and External Plumbing Work. By F. W. Raynes, R. P. New York and London. Longmans, Green & Co. Cloth. 6x9 ins. 474 pp. 277 illustrations and 29 tables in the text. $3.

As a text book on the subjects mentioned in the title page this book is very good. In the sections dealing with hydraulic calculations a number of examples are worked out in detail. There is a good chapter on the disposal and treatment of sewage from country houses and one on water supply. Pressure tank systems of water supply, now used generally in the United States are not mentioned. The tone of the book is intensely practical. The fact that it deals entirely with English methods will limit the sale in this country although it can be read and studied with profit by plumbers, architects and engineers in charge of sanitary work in small and medium size cities. It is an especially good book for architects.

Stresses in Masonry.—By Herbert Chatley, Professor of Civil Engineering, Tong Shaw Engineering College, North China. Philadelphia, J. B. Lippincott Co. Cloth. 5x7½ ins. 146 pp. Illustrated. $1.25.

This is a good little book. The author in the beginning states that he does not know of a brief, yet comprehensive, treatise on the stresses in masonry, although elementary treatises on steel work are numerous.

There are ten chapters as follows: Strength of Stone Walls; Columns and Piers; Brackets and Cantilevers; Simple Arches; Vaults and Skew Arches; Domes; Retaining Walls and Dams; Artificial Stone and Concrete; Reinforced Concrete. There is a very good index.

The mathematical treatment is simple, no equations higher than quadratics being used. The author begins by showing how large a part shear plays in masonry failures and tells how to design safely when plain masonry is used in structures. Tensional stresses are considered and means shown for avoiding them. This naturally leads to reinforced concrete, of which a brief treatment is given. Methods for finding the pressure line in plain arches are given. In the chapter on reinforced concrete there is the following about the arch:

> In the case of arches and dams we proceed, as in masonry, to find the position of the resultant through the mass and compute the bending moment about the center of the section by multiplying the normal component of that resultant into the distance between it and the center of the section. There is no longer any need to restrain this resultant to the middle third, although, of course, the moment will increase rapidly as the resultant becomes more remote. It is usual to reinforce the wall or arch with rods on both sides to take the bending.

Then the usual formula for resisting moment in a reinforced concrete beam is given; a simple method of disposing of the problem and hardly as full as is necessary.

The reinforced concrete section cannot be commended, as the treatment and formulas lack the simplicity of present American methods and the ratio of deformation is taken as equal to 10 instead of 15, which is now generally used. This chapter might well have been omitted but its shortcomings do not detract from the value of the earlier chapters on plain masonry.

Squares and Logarithms.—By G. D. Inskip. Chicago and New York. The Myron C. Clark Publishing Company. Leather. 5x7½ ins. 546 pp. $3.

This is a new, revised and enlarged edition of a well known book. It contains squares and logarithms for lengths from 1 ft. to 100 ft., advancing by 32nds of an inch; Logs. of numbers from 0 to 10,000; Logarithmic Trigonometrical Functions for every minute of the quadrant and auxiliary functions for the calculation of the logarithms of trigonometrical functions from 0 to 3,600 seconds, etc.; Natural functions; Decimals of a foot; Decimals of an inch; Weights and areas of round rods and square bars of steel. Directions for use of tables are given, making this a serviceable and well-nigh indispensable book for structural detailers.

The Elements of Machine Design.—Part I, General Principles: Strength of Materials, Rivets, Bolts, and Other Fastenings; Journals and Shafting; Couplings; Pedestals; Transmission of Power by Gearing, Belting, Ropes and Chains. New edition, Revised and Enlarged. By W. Cawthorne Unwin, LL. D., F. R. S., M. Inst. C. E., etc. New York and London, Longmans Green & Co. Cloth. 6x9 ins. 531 pp. 387 illustrations and many tables in the text. $2.50.

In 1877 Prof. Unwin issued the first edition of this work and the reviewer (eight or nine years later) had it as a text book. In 1890 a new, larger edition appeared and it was again increased in size in 1901. In the second and third editions Steam Engine Design was placed in a separate volume and the work has been one of the standards of good practice to date. The volume under review (1909 edition) has been entirely rewritten and is substantially a new book thoroughly up to date on the subjects mentioned in the comprehensive sub-titles. It is a book for the drafting room and the practical designer as well as for the class room. It occupies a distinct field between works on applied mechanics and empirical books of rules and collections of examples of machine details. Part II will deal with engines.

Science of Organization and Business Development.—A Treatise on the Law and Science of the Promotion, Organization, Reorganization and Management of Business Corporations; with Special Reference to Approved Plans and Procedure for the Financing of Modern Business Enterprises. By Robert J. Frank, LL. B., of the Chicago Bar. Revised Edition, 1909. Chicago. The Chicago Commercial Publishing Co. Leather. 5½x8 ins. 278 pp. $2.75.

In a book such as this many questions, often considered elementary, are discussed. This is unavoidable from the nature of things for the book is sure to fall into the hands of those who need such information.

After a careful reading the reviewer feels that this is a book of considerable value to men interested in the matters mentioned in the lengthy title. There is a section on the Promotion of Enterprises that should interest engineers who often see opportunities to exploit enterprises without enough knowledge of business methods to save themselves. An Appendix of 74 pages gives legal forms to use in transacting corporate business.

The book is not of the "Every Man His Own Lawyer" class, but is a treatise on business organization and development for business men.

Contract News Section

of

ENGINEERING-CONTRACTING

A Consolidation of ENGINEERING-CONTRACTING—CONTRACT NEWS—ENGINEERING WORLD—THE DIRT MOVER.

Containing Items of Interest to Railroad, Public Works and Other Contractors.

The Doings of the Week. The Board of Water Supply of New York city has just awarded one of the largest single contracts yet let in connection with the new Catskill water supply system for the city. This contract was for the construction of the Kenisco Dam and appurtenant works, and was let to Rodgers & Hagerty, New York city, at $7,953,050. The work includes over 1,330,000 cu. yds. of excavation, 37,500 cu. yds. mass concrete, and 900,000 cu. yds. of cyclopean masonry.——Contracts for four large state ditches have just been let by the State Drainage Board of Minnesota, John Kohler, Frazee, Minn., secured two of the ditches totaling 1,277,721 cu. yds. of floating dredge work; Forrestal & Feveu, St. Paul, Minn., secured 687,938 cu. yds. dredge work, and the Standard Drainage Co., Windom, Minn., secured 301,217 cu. yds. of floating dredge work.——Among the large railroad contracts let the past week are the following: Smith & Campion, Mahanoy City, Pa., for constructing a third track on the Lebanon Valley Branch on the P. & R. Ry. between Prescott and Myerstown, Pa.; D. Fitzgerald, Pendleton, Ore., for constructing the 52 mile traction line of the Washington Oregon Traction Co., in Oregon; Eyre-Shoemaker, Inc., Philadelphia, Pa., for double tracking the New York, Philadelphia & Norfolk R. R. for a distance of 50 miles; The Grigsby Construction Co., Houston, Tex., for extending the Southwestern Ry. from Scotland, Tex., a distance of ten miles; J. H. McFarlin & Co., Jacksonville, Ill., for constructing the Springfield-Jacksonville interurban line between the two cities named, the contract including 400,000 cu. yds. earth excavation and 40,000 cu. yds. concrete masonry; C. C. Tate, Bogalusa, La., for laying 12 miles of track and constructing 1,000 lin. ft. pile trestle for the extension of the Lakeview Traction Co. of Memphis, Tenn.; The Northwestern Construction Co., Milwaukee, Wis., for building a 62 mile interurban line from Sterling to Rock Island, Ill., the contract amounting to $1,240,000.——The Alberta & Great Waterways Ry., of Edmonton, Alberta, has let contracts for ties, bridge timbers, and culvert timbers for the first 150 miles of its line, and it is believed that grading contracts for this first section have been or are just about to be let. ——A proposition to issue $175,000,000 of refunding bonds will be voted on Jan. 18 by the stockholders of the Missouri Pacific. Of this amount it is proposed to set aside the sum of $52,866,000 for betterments, additions and equipment.——The receiver for the Ocean Shore Ry. is seeking to issue $3,500,000 of receiver's certificates for completing the line between San Francisco and Santa Cruz.——An $18,000,000 company has been organized in Michigan to take over a number of power and gas plants in the state. The company will be known as the Commonwealth Power, Railway & Light Co., and is planning large hydroelectric developments on the AuSable River in Michigan.—A New York syndicate is negotiating for the control of a large number of electric plants and railway systems in Central Pennsylvania, and proposes to operate them as one system, the power to be obtained from a plant being erected near Hazelton and from dams at Muncy, Pa.—The New York State Canal Board has approved plans for four additional barge canal contracts which will cost about $3,000,000.—Two large irrigation projects have been financed by Denver capitalists. One of these is a project for reclaiming 60,000 acres near Hayden, at a cost of $500,000. The Bear River Irrigation & Construction Co. is back of this project. The other project has been promoted by Lafayette Hughes, of Denver, and proposes the construction of systems to cost about $4,000,000.

Standard Gage and Other Gages. For many years the standard gage of American railroads has been 4 ft. 8½ ins. In the early days of railroad building in this country, however, there were about as many different gages as there were railroads. The first railroads built in England were made the same width as the tram roads, on which ran ordinary wagons. This width happened to be 4 ft. 8½ in., and the railroads adopted this width for the convenience of using upon them the same cars. The American railroads, using at first English engines, were necessarily built with the 4 ft. 8½ in. gage. This gage was generally adopted in the New England states and in New York, but in the other states there was much confusion of gages. In New Jersey and Ohio the gage was 4 ft. 10 ins. In Virginia, East Tennessee and north of Georgia the gage was 5 ft. In Maine the Atlantic & St. Lawrence R. R. had a gage of 5½ ft., and this gage was also in use in Canada by general law. Missouri also adopted this gage by a law enacted in 1835. The gage of the Erie R. R. and connecting roads was 6 ft. In Pennsylvania alone there were at least seven different widths of tracks. The Chicago & Northwestern Ry. (then the Galena & Chicago Union) started out with a 6 ft. gage, but after 40 miles of track had been constructed, changed its name, and had the track relaid in standard width. Some of the leading railroads which were constructed originally with other than the standard gage were the Missouri Pacific with a 5½ ft. gage; the Chesapeake & Ohio, 5 ft.; the Pennsylvania, 4 ft. 9 ins.; the Lake Shore & Michigan Southern, 4t ft. 9½ ins. The promoter of the first railroad to the Pacific proposed to construct a road with a gage of 6 ft., and a competitor not to be overdone offered to build a track with a gage of 8 or even 10 ft. upon which he should run cars 200 ft. in length. In England Brunel introduced a gage of 7 ft. on the Great Western Ry., but the majority of the English roads were standard gage. In 1846 there were 1,901 miles of 4 ft. 8½ in. track and 274 miles of other gages. Naturally when these railroads met at junctions it was necessary for the passengers, baggage and freight to be changed from one set of cars to another. To do away with these inconveniences, a number of remedies were put in use. One of these was to have the axles of the cars so arranged that one portion telescopes into the other, so that the distance between the wheels could be adjusted to any gage. To lessen the gage, a catch was loosened and the car pushed along a pair of rails, the space between which gradually narrowed from 7 ft. to 4 ft. 8½ ins., and thus the wheels were forced closer together. Some roads had their cars built so that the car bodies could be swung by powerful cranes from one set of trucks to another. Other railroads had movable boxes for merchandise made of such a size that one could be carried on a standard gage track and two on a broader gage track. Other railroads laid an extra rail so that the same road could be used for both classes of cars; in some cases a pair of 4 ft. 8½ in. rails being laid within the broad gage rails, in other cases only a single rail being laid, so as to be 4 ft. 8½ ins. for one of the broad gage rails.

Pay of City Engineers in Kansas. The members of the city council of Topeka, Kan., have been having something of a squabble amongst themselves regarding the selection of a city engineer. Some of the members of the council favored the appointment of an engineer at a salary of $3,000 per year to serve until the commission form of city government went effect on April 1. The mayor approved this plan and we quote from a Topeka paper some of the reasons for his opposition: "In the first place the councilmen who have expressed themselves in favor of paying a city engineer $3,000 a year have evidently not read the state law in regard to the salaries of city engineers. The State Legislature fixes the salary of the city engineer, and the highest salary we are allowed to pay is $2,000 a year. The salary of the assistant engineer is fixed by ordinance and is $1,200 a year. . . . I am not opposed to paying $2,500 a year for a city engineer, but before we can do so we must have the consent of the Legislature."

Confirmed Reports by Engineers and Contractors

RAILROADS, POWER DEVELOPMENTS, LEVEES, DRAINAGE AND IRRIGATION WORKS.

Railroads—Steam and Electric.

ARKANSAS.

We are advised that the proposed extensions of the Fort Smith & Western R. R. southwest from El Reno and northeast from Fort Smith have not yet reached a point where any definite information can be given out, and it will likely be some time before such information is available.

ILLINOIS.

J. H. McFarlin & Co., Jacksonville, Ill., has been awarded the contract for the grading, bridge work and tracklaying for the construction of the Jacksonville-Springfield Interurban line from Springfield to Jacksonville, Ill. The contract includes about 400,000 cu. yds. of earth excavation, eight bridges, and between 40,000 and 50,000 cu. yds. of concrete. Mr. McFarlin will sublet the grading, concrete work and tracklaying and will be ready to sub the work at once.

MEXICO.

The Cia. Minera "San Juan" y Anexas, S. A., of Mapimi, Durango, Mexico, is to let contracts at the end of March or the beginning of April for the construction of 15 miles of railway between Mapimi and Bermejillo. The work will include 100,000 cu. yds. of light scraper and shovel work, 1,000 cu. yds. of rock excavation and 700 cu. yds. of masonry. L. dela Garza, Mapimi, is superintendent.

MISSOURI.

Mulvill Bros. & Shea., Alton, Ill., and Pat Shea, Medora, Kan., have the contract for filling the base of four trestles on the Rock Island R. R., at Villaridge and La Bodie, Mo., and have sublet part of the work to T. L. Smith, Williamsfield, Ill. Mr. Smith intends letting 30,000 to 40,000 yds. of this work to team outfits. Mulvill Bros. also have 30,000 yds. of good machine team work in sandy loam, on which they wish to get a good team outfit when weather permits. The material is suitable for spring work, as it is the very best sandy loam, very desirable to handle in wet months.

NEVADA.

Regarding the report that the Oregon Short Line R. R. was planning to shortly commence construction on a line between Caldwell, Idaho, and Winnemucca, Nev., we are advised that the Oregon Short Line R. R. Co. some months ago purchased a road known as the San Francisco, Idaho & Montana Ry., which road made surveys from Caldwell, Idaho, to Winnemucca, Nev. The physical property as purchased consisted of some 15 or 20 miles of right of way and grade. The Oregon Short Line R. R. Co. has at this time no intention of constructing this line, or any other line, between Caldwell and Winnemucca. Newspaper articles regarding surveys evidently refer to surveys made several years ago by the old San Francisco, Idaho & Montana Ry.

NORTH CAROLINA

The North Carolina Traction Co. of Danbury, N. C., has completed its organization and has electel the following officers: President, E. Hillman of Aberdeen, N. C.; Secretary, J. W. Krafft of Indianapolis, Ind.; General Superintendent, E. L. Krafft, Indianapolis, Ind.; Director General, Dr. H. P. Mac Knight, Southern Pines, N. C. W. L. Law, president of the W. L. Engineering Co. of Rock Hill, S. C., was selected as chief engineer for construction purposes. The company will construct over 80 miles of new, up-to-date interurban line, motor car system, that will run from Winston-Salem directly north to Stuart, Va.

NORTH DAKOTA.

E. A. Wickham, 19 Scott St., Council Bluffs, Ia., have fresno, wheeler and grader work to let on the following lines in North Dakota: 66 miles on the Chicago, Milwaukee & St. Paul R., and 40 miles on the Northern Pacific Ry. Free transportation can be obtained for outfits, teams and men over the above lines.

OREGON.

The contract for constructing the projected 52 mile line of the Washington-Oregon Traction Co., has been let to D. Fitzgerald, Pendleton, Ore. The road is to extend from Pendleton, Ore., north to Athens and south to Hermiston. Surveys have been made, the capital for construction secured. Samuel Drumheller, Walla Walla, Wash., is president of the traction company.

PENNSYLVANIA.

Smith & Campion, Mahanoy City, Pa., have been awarded the contract for constructing a third track on the Lebanon Valley Branch of the Philadelphia & Reading Ry., between Prescott and Myerstown.

The Titusville Central R. R. Co. is having surveys made for its projected 22 mile gasoline motor car line from Titusville to Corry, via Spartansburg. The capital for construction has been received and contracts will possibly be let in the spring. Jno. J. Carter, Titusville, Pa., is President, R. I. McClellan, Titusville, Pa., is Chief Engineer and Harry Gerson, Titusville, is Secretary.

SOUTH DAKOTA.

E. A. Wickham & Co., 19 Scott St., Council Bluffs, Ia., and Roberts Bros. & Wickham, 123 LaSalle St., Chicago, Ill., have 150 miles of fine grader, fresno and wheeler work to let on the Chicago & Northwestern Ry. in South Dakota. This is fine work in a good country. Both small and large outfits can be used on the work and free transportation for teams, outfits and men can be obtained over the Chicago & Northwestern Ry.

TENNESSEE.

C. C. Tate, Bogalusa, La., has been awarded the contract for 12 miles of tracklaying from Memphis to Lakeview, Miss., for the Lake View Traction Co., of which W. W. Hayden, Memphis, Tenn., is chief engineer.

Mr. Tate was also awarded the contract for constructing 1,025 lin. ft. of pile trestle for the extension.

TEXAS.

The San Antonio Traction Co., San Antonio, is building a 3-mile extension of its Lakeview car line by day labor.

VIRGINIA.

The Mill Mountain Incline Ry., Inc., of Roanoke, Va., has completed surveys and has secured the capital for the construction of its ¾-mile incline up the mountains at Roanoke. Contracts will be let as soon as all the estimates are in. A. B. Hammond is President, and Wingate & McGhee, Roanoke, are the Engineers.

WASHINGTON.

The Big Bend Transit Co. is projecting a 65 mile line from Spokane west, following generally along the Spokane River to its mouth. No decision has been reached as to the time for awarding contracts for constructing the line. L. F. McCoy is Chief Engineer, and William A. Nichols, 105 Howard St., Spokane, Wash., is President.

The Grays Harbor Interurban R. R. Co., is projecting the construction of a 150 mile line from Olympia, Wash., to Hoquiam, Wash. Surveys for the line have not been made as yet, nor has the capital been secured for its construction. A. L. Paine, Hoquiam, Wash., is president and J. M. Clapp, Aberdeen, Wash., is chief engineer.

WEST VIRGINIA.

The City & Elm Grove R. R. Co., of Wheeling, W. Va., has completed surveys for 1½ miles of new track through Park View and Wheeling Park. The construction work will be done by the company. J. W. Smith, Wheeling, W. Va., is General Manager.

WISCONSIN.

John Marsch, Railroad Contractor, Borland Bldg., Chicago, Ill., has been awarded about 56 miles of double track work from the Chicago & Northwestern Ry. Co., between Milwaukee and Clyman, Wis. The work amounts to about 4,000,000 cu. yds. Mr. Marsch has already sublet considerable of the work, but still has some attractive team and shovel work to sublet. He is in a position to show this work to sub-contractors at any time. A. T. Sabin is engineer for Mr. Marsch. This contract was mentioned in our Dec. 29 issue.

CANADA.

The Temiskaming & Northern Ontario Ry. has had a location survey made for an extension of the Charlton Branch from Charlton, Ont., to Gowganda, a distance of approximately 48 miles. No steps have been taken towards calling for bids for the work.

The City of Regina, Sask., invites negotiations with capitalists and others, for the purpose of obtaining proposals for a special franchise for street car services and gas works, for the city, subject to the right of the city to take over the undertaking at the expiry of a definite term of years, at a price to be fixed by arbitration, or in such other manner as may be agreed on. Angus Smith is City Engineer.

Power Developments, Levees, Drainage and Irrigation Works.

ARKANSAS.

The Indiana Rice Co., incorporated under the laws of Indiana, with a capital stock of $200,000, for the purpose of developing the land and raising rice at DeWitt, Ark., proposes to build a canal 7 miles long and to use centrifugal pumps to pump water from the Lagrue River. Geo. C. Doolittle, DeWitt, Ark., is superintendent.

IDAHO.

A plant is being put in at Post Falls, Idaho, to irrigate 3,500 acres near that place. The water is to be taken from Hayden Lake and pumped through a 42-in. wood stave pipe for a distance of five miles. It is expected to have the water upon this land by June, 1910, at which time the land will all be platted and placed upon the market for sale in five and ten-acre tracts. The contract has already been let for the ditch work and pipe laid complete in the ditch. Boyd Hamilton, Coeur d'Alene, Idaho, is interested.

INDIANA.

The Great Lakes Dredge & Dock Co., Chamber of Commerce Bldg., Chicago, Ill., has been awarded the contract for dredging the harbor at Michigan City, Ind., for the U. S. Government. The contract price is 10.9 cts. per cu. yd. and the work includes dredging in the harbor to widen the entrance and the removal of any wreckage that may be encountered. Bids for the work were opened Jan. 4 at the U. S. engineer's office in Chicago.

IOWA.

All bids received Jan. 6, by L. J. Nelson, County Auditor, Forest City, Ia., for ditch work, were rejected and new bids are being asked until Jan. 21. The work includes 176,000 cu. yds. open ditch work and 240 rods 12-in. tile drains in District No. 1, 32,400 cu. yds. open ditch in District No. 8 and 685 rods, 6-in., 8-in., 10-in., and 12-in. tile drains in District No. 3. Work is also noted under Bids Asked.

MINNESOTA.

Contracts for state ditches, bids for which were received Jan. 6 by the State Auditor at St. Paul, have been let as follows: Ditch No. 69 687,938 cu. yds. dredge work, Forrestal & Feyen, St. Paul, Minn., $68,645; Ditch No. 72, 677,755 cu. yds. dredge work, John Kohler, Frazee, Minn., $68,240; Ditch No. 84. 301,217 cu. yds. floating dredge work, Standard Drainage Co., Windom, Minn., $22,301; Ditch No. 88, 599,966 cu. yds. floating dredge work, John Kohler, Frazee, Minn., $48,589.

NEW YORK.

The Board of Water Supply of New York city has awarded the contract for constructing the Kensico dam and appurtenant works for the Catskill aqueduct system to Rodgers & Hagerty. Bids for this work were opened Dec. 21 and the bid of the successful contractors was $7,953,050. The firm of Rodgers & Hagerty is composed of John C. Rodgers, 10 St. Nicholas pl., New York city; James M. Rodgers, 303 W. 89th st., New York city, and John J. Hagerty, Flatbush, N. Y. The itemized bids for this work will be found on page 40 of this issue.

As stated in our last issue the Board of Water Supply of New York city has awarded the contract for constructing the Grassy Sprain cut and cover and other work under contract 53 to the Elmore & Hamilton Constructing Co., Albany, N. Y. Bids for the work were opened Dec. 16, the contract price being $1,485,150. The itemized bids for the work will be given in our next issue.

As stated in our last issue Scott Bros., Baldwinville, N. Y., has been awarded contract No. 44 for constructing a little over 7 miles of the New York State Barge Canal just west of Rome. The contract amounts to $1,750,000 and includes 3,250,000 cu. yds. of excavation, over 90,000 cu. yds. of concrete and a quantity of steel work.

TEXAS.

Williams & Dees, Fort Stockton, Tex., have been awarded the contract for the construction of a 7-mile ditch for the Fort Stockton Irrigated Lands Co., the work including 30,000 cu. yds. of excavation.

The Louisville & Nashville R. R. has acquired land in the vicinity of Boyles, five miles north of Birmingham, Ala., on which to erect large shops and car works.

The Roanoke Electric Light & Power Co. of Roanoke, Va., recently incorporated with capital stock of $1,000,000, has plans underway for a hydro-electric plant on the Roanoke River. M. Coffman, Woodstock, Va., is president and I. T. Stoneburger, Edinburg, Va., is secretary.

The Huasteca Petroleum Co., Dr. G. E. Paddleford, superintendent, Casiano, Vera Cruz, Mexico, is now having the ties cut for its projected narrow gage railroad in the state of Vera Cruz. The railroad will extend 150 miles from the navigable waters of Laguna Tamiahua to Casiano in the heart of the oil field. It will be a narrow gage road and the total cost will be fully $3,000,000. It will open up the entire oil holdings of the company.

According to a statement made recently by C. Hildreth, Franklin, Neb., arrangements have been made to secure capital for the construction of the Dakota, Kansas & Gulf Ry., and preliminary surveys are now under way between Kearney, Neb., and Beloit, Kan., where a connection will be made with the Union Pacific, and ultimately on to Newton, Kan. The length of the entire route is 115 miles.

The Chicago, Milwaukee & St. Paul Ry., will, it is said, take up the matter of building its line north from Harlem, N. D., in the spring. Grading from Harlem to Elliot was completed some years ago, but the project was then abandoned.

The Electric Traction Co., of Richmond, Ky., has plans under way for the construction of an electric railway system in that section of the country. The work contemplated also includes the construction of a 175-ft. dam across Dix's River near Kennedy's Mill and the installation of a 30,000 h. p. plant.

The city of Bedford City, Va., has voted an issue of $100,000 of bonds to establish a hydro-electric plant.

The Georgia Central Ry. is planning a number of improvements for this year and will expend $1,600,000 in the construction of new buildings and yards.

The Capitol Traction Co. of Washington, D. C., is stated to have set aside $1,500,000 for improvements this year.

A company has been formed and is stated to have received the necessary capital for the construction of an electric railway from Lake Andes, S. Dak., to Huron, S. Dak. The proposed route of the railroad is north from Lake Andes, through Douglas County to Stickney, thence to Plankinton, where the road will cross the Milwaukee; then directly north to Wessington Springs, and northeast to Huron. The company plans to build short feeders to the main line and operate both freight and passenger cars. The line is to be completed first to Stickney. William Pease and John Absher, Armour, S. Dak., are interested.

Practically $200,000 has been expended in securing right of way for the Wataugo R. R., and it is stated that active construction work will be started in May. The road is to extend from North Wilkesboro, N. C., to Butler, Tenn., a distance of 90 miles. Frank A. Linney, Ed Coffey and other men of means in Western North Carolina are behind the project. The road will pass through Lenoir and will connect the Southern railway with the coal fields of Tennessee and Virginia by the most direct route.

The Yuqui River extension of the Southern Pacific has been completed to Tonichi, Mexico.

Options have been secured on practically all of the right of way needed for the interurban electric road from Omaha to Fremont, Neb.

Capitalists of Sioux Falls, S. Dak., are projecting another railroad running from Denver to Sioux Falls connecting Charles Mix county and some of the fine agricultural areas. It is stated that the promotion of the proposed road will be started during the coming spring. The road as planned will go to Marion Junction, through Hutchinson and Charles Mix county, and thence west to Denver.

The Virginia & Truckee R. R., W. H. Kirk, chief engineer, Carson City, Nev., has been rushing surveys for an extension of the line from Meriden, Nev., the present terminus, to Wellington, Nev.

A company has been incorporated by Mexican capitalists with a view of extending the track of the Interoceanic system between Teziutlan, in the state of Puebla, and Nautla, in the state of Veracruz. The stock of the company, which is capitalized at 5,000,000 pesos, has all been subscribed in Mexico City, and the preliminary work on the first division from Teziutlan to Jalacingo, La Garita and Huaitomalco will begin early this year. Engineer Leopoldo Villarreol, City of Mexico, is one of the directors.

Grant Brothers Construction Co., Los Angeles, Cal. has begun work in Tepic Territory, Mexico, on its contract for constructing the new Harriman line in Mexico, which will extend from Guaymas to Guadalajara, making connection with the Sonora line of the Southern Pacific, which runs south from Nogales. About 4,000 men are being employed on the general railroad construction work now in progress in Mexico. These are directed by three superintendents who preside over as many departments. The headquarters are located at Mazatlan, Cumuripa and Nacozari.

The Kentucky Highlands R. R. Co. has filed amended articles of incorporation, changing the headquarters for doing business from Frankfort to Louisville. The Highlands has been purchased by the Louisville & Nashville and will be operated by that road, in conjunction with the old Lexington & Ashland, from Versailles into the mountains, as soon as junction of the two lines is completed at Versailles. P. F. Manning, Frankfort, Ky., is General Manager Kentucky Highlands R. R.

The mining syndicate interested in the Corona Copper Co., now operating in Arizona, near Wenden on the A. & C. Ry., has completed the purchase of S. E. Fuller's one-third interest in the water storage project on the east fork of Bill Williams River in Mohave County, the Corona people becoming two-thirds owners of the proposition. A site has been selected for the storage reservoir and about $500,000 will be expended in the work.

Work is reported to have been started on the Lumberton & Elizabethtown Ry., which projects a 25 mile line from Lumberton, N. C., to Elizabethtown passing through large pine forests. The company was chartered late in December and has a capital stock of $250,000. The offices of the company are in Lumberton, N. C., and the incorporators are George B. McLeod, A. H. McLeod, F. A. Bond, J. A. McDougald, and W. P. McAllister.

The city council of Ely, Nev., has refused to grant a franchise to the proposed Ely-Goldfield Ry.

Clell D. Campbell, Lincoln, Neb., has been awarded the contract for constructing a concrete conduit over Antelope Creek, for the Sanitary District of that city, the contract price being $39,900.

Surveys for a prospective electric line between Skohegan, Me., and Athens, Me., have been completed by John Jones, C. E., Lewiston, Me. C. R. Oliver Athens Me. is one of the promoters.

The Hawkinsville & Western R. R. Co. has applied for a charter to build a railroad from Hawkinsville Ga. to either Perry or Fort Valley in Houston County. The company proposes to use an old road bed for about 15 miles of the line. Howard E. Coates Hawkinsville, Ga., is interested.

Surveys have been completed for the projected canal in Florida to the Ocklockonee River. The canal is proposed to extend from Jacksonville, Fla., to Carrabelle. The plan is to cut the canal 12 feet deep and 100 yards wide, and there are places that the sides will require concrete to make it hold. The portion of Ocklockonee River that is used will require practically no work, and the straightening of Crooked River will require as large an expenditure as the dredging of the channel, as a large portion is very deep and over 100 yards wide. The distance from Jacksonville to Carrabelle via the canal will be approximately 127 miles. Capt. W. L. Seeley is in charge of the surveys.

Items Concerning Contractors and Their Work

RAILROADS, POWER DEVELOPMENTS, LEVEES, DRAINAGE AND IRRIGATION WORKS.

Arkansas Notes.

FROM CORRESPONDENTS AND OTHER SOURCES.

The Kansas City Southern Ry. has work under way on constructing its division point at De Queen, Ark. About six buildings, two 550,000 gallon water reservoirs, and a large oil tank are to be erected by the Arnold Construction Co. of Chicago for the Kansas City Southern. L. D. Chase is superintendent in charge for the Arnold Co.

Construction work is stated to have been started three miles east of Van Buren on the Fort Smith & Van Buren Interurban Ry., of Van Buren, the organization of which was mentioned in our last issue. W. F. Keller is president.

Chicago capitalists are backing a proposition to construct an interurban road from Oklahoma City to Shawnee and on east to Fort Smith, Ark. According to reports the road is to go east on Fourth St., at Oklahoma City, south to the Silverwood addition, thence east on Reno Ave. to Shawnee and then on to Fort Smith, Ark. The road is to cross the Frisco tracks in the vicinity of the Silverwood addition south of the state fair grounds and go east, probably to Harrah and Choctaw City.

James Trainor has begun work on his contract to build revetments along the bank of the Arkansas River at the state convict farm at Cummins. He will have a force of 60 men at work for about three months. The improvements will cost $22,000. He is to weave a mattress 100 ft. wide and 2,000 ft. long, which will be placed along the bank of the river at that point.

California Notes.

FROM CORRESPONDENTS AND OTHER SOURCES.

The Arrowhead Reservoir & Power Co., Victor Smith, general manager, San Bernardino, has purchased the Los Flores ranch on the Mojave River. The ranch comprises about 5,000 acres, with valuable water rights.

The John Hannifin Contracting Co., Los Angeles, has moved its outfit to Ehrenburg, where it has secured a contract to do a considerable amount of work for the Blythe estate, consisting of grading and leveling land, building about eight miles of canals and diking along the Colorado River.

F. S. Stratton, receiver of the Ocean Shore Ry., has called upon bond holders and creditors to assist him in completing the road through the issuance of receiver's certificates, for which the approval of United States Circuit Judge Morrow must be obtained. This work, he estimates, will cost on a liberal estimate $3,500,000, which will be sufficient to complete the track laying on the unbuilt section between San Francisco and Santa Cruz and provide the necessary equipment and adequate terminals. Of the above sum $1,000,000 will be needed to lay the track and cut the tunnel on the unbuilt section, and up to date equipment will take $500,000 more. Then $700,000 is required for building terminals. J. B. Rogers, San Francisco, is chief engineer.

The Adams Wharf Co., of Oakland, is to spend a considerable amount of money in repairs and enlarging wharves. The work is to be started immediately.

The dredger San Francisco owned by the California Reclamation Co. on Dec. 27, while being towed down the Sacramento River to throw up a levee on the Sacramento & Southern Ry., struck a snag near Freeport and sank in 25 ft. of water. Work was at once started on raising and repairing the dredge.

The Southern Pacific Ry. has plans underway to enlarge its yards at Sacramento. Much land now lying idle back of the Southern Pacific shops will be filled in by dredgers from the American and Sacramento rivers until the marsh is raised to the same level as the surrounding property. Work was suddenly stopped by the dredgers more than a year ago, after many acres had been partly filled. The reclamation work will again be taken up and rushed at once, according to the announcement, until the ground is in proper shape for many miles of new trackage.

Grading for the California Midland R. R. has been completed between Marysville and Hammonton, and it is expected to have the road in operation between these two cities by March 1. It is expected that the road will be extended to Grass Valley and Nevada City during the summer and fall.

The Oakland Traction Co. of Oakland is to extend the Leise Ave. car line from Penniman St., the present terminus, in a northeasterly direction, to within one block of the new Laurel school, a distance of one mile.

Surveys have been completed between Redwood City and La Honda for the projected electric railroad promoted by A. H. Lohman. It is estimated that road would cost $1,000,000. If built it would bring the rich timber and farming lands of the section into direct communication with deep water and the Southern Pacific at Redwood City.

The Southern Pacific Co. has commenced work on Ellsworth St., in Berkeley, on a branch line into the heart of the city. The new line will leave the main tracks at Woolsey and Adeline Sts., and run to the Allston way entrance to the university campus. The engineers have finished setting the grade stakes for the full distance.

Colorado Notes.

FROM CORRESPONDENTS AND OTHER SOURCES.

Citizens of Durango have pledged $100,000 to secure the entrance of the Arizona & Colorado R. R. into that city. The railroad is said to have agreed to have its trains running into the city within 15 months from the date of signing the agreement with the city. J. W. Reagan, Tucson, Ariz., is assistant chief engineer.

I. N. Pepper and a company of Montrose men have purchased the Frees mine near Montrose and will spend $100,000 in equipping the mine and in building a railroad from the mine to Montrose.

The construction of two large reservoirs west of Fort Morgan is proposed and Halstead L. Ritter, Denver, has filed maps and descriptions of them with the county clerk at Fort Morgan. The two reservoirs are to be built two miles west of Fort Morgan in the Platte River. No. 1 will have a capacity of 252,500,000 cu. ft., with a dam 20 ft. high and 1,450 ft. long. No. 2 is to have a capacity of 797,081,800 cu. ft. and a dam 25 ft. high and 1,700 ft. long. When completed, they will cover five sections. Under the present specifications it will cost $859,560 for the construction of the two dams alone. Land which will be submerged will cost about $100 an acre. It is said the project will be completed within two years.

Hancock & McMahon, sub contractors on the Milton reservoir of the Standley Lake system have opened offices at La Salle, Colo., to facilitate the handling of materials to be used in the construction of the reservoir. Large quantities of materials are already on hand. The reservoir will cost about $400,000.

Harry E. Knowlton of Denver and Horace Haskins of Platteville are planning a $10,000 reservoir for the semi-arid tract northeast of the latter place.

The Denver & Rio Grande Ry. is said to be planning installing additional yard and trackage facilities at Colorado Springs, as well as the erection of a 10 or 12 stall round house.

The reclamation of a large tract of land near Breed, about six miles south of Colorado Springs is proposed, and it is understood that a large reservoir is to be constructed at some point along Cottonwood Creek for this purpose. About 30,000 acres of land will be put under irrigation. H. B. Neff, 209 East Fountain St., Colorado Springs, is reported to be interested.

Several Colorado men, among whom are N. B. Hames, Colorado City, and T. J. Skaggs of Colorado Springs, have formed a company for developing a large tract of land in San Juan County, N. Mex. Several reservoirs will be constructed and the land opened up for irrigation. About $100,000 will be expended.

The construction of a standard gage steam railroad into the Black Hawk and Central mining districts of Gilpen county is proposed. Advices from Central City state that the Hall Construction Co., which has started the building of the road from Pactolus, on the Moffat road, to Black Hawk, held a meeting of its directors Jan. 10 to vote on increasing the capital stock of the company from $80,000 to $500,000 for the purpose of raising funds to build the proposed spur. The Pactolus spur was graded for five miles towards Black Hawk during the past summer, the Hall Construction Co. doing the work. It will be 15 miles long and will be the first broad gage line into the Black Hawk district.

The Grand Junction Interurban Company has purchased terminal sites at Grand Junction and announcement has been made that work on constructing the line to Fruita would be commenced as soon as the weather would permit, and that the line would be in operation by June 1. All necessary material for the work is now on hand. The Southern Colorado Power Co. has authorized a $5,000,000 bond issue and will increase the capacity of its Trinidad steam power plant.

Advices from Denver state that the directors of the Henrylyn ditch and reservoir project have awarded the contract for the work to the Camfield Construction Co., which is composed of the principal stockholders of the irrigation project. The work covered by the contract will bring under water about 120,000 acres of land in the vicinity of Denver. The consolidated Henrylyn project includes the original Henrylyn irrigation district, the Hudson Reservoir company, the Schaffer Land and Live Stock company, the Intermountain Water company, and the Golden-Littleton irrigation district. A bond issue is to cover the cost of consolidation and construction work. The work will cost about $4,421,500.

Georgia Notes.

FROM CORRESPONDENTS AND OTHER SOURCES.

The Georgia Power Co., which controls a water power on the Tallulah River, in Habersham County, Georgia, has been granted permission by the Georgia State Railroad Commission to issue $4,450,000 first mortgage gold bonds, $3,000,000 of preferred stock and an additional $1,450,000 of common stock. The money realized from the sale of these securities will be put into the development of the property.

J. A. J. Henderson, Ocilla, Ga., President of the Ocilla Southern Ry., has purchased the turpentine and saw mill timber belonging to the late D. L. C. Harper, of Berrien County, and intends extending his railroad, which now runs from Ocilla to Alapache and on to Adel, so that it will pass directly through this belt of timber.

The Mutual Light & Water Co. and the City & Suburban Railway Co., of Brunswick, controlling the light, water power and transportation franchises in that city, have passed into the control of a new $10,000,000 stock company, the Brunswick Terminal & Railway Securities Co., which succeeds the $5,000,000 Brunswick Dock & City Improvement Co., which for years has owned nearly 2,000 lots

in this city in addition to considerable acreage in the suburbs. One result of the merger will be that the proposed extension of the Georgia Coast & Piedmont from Darien to Brunswick will be put through as soon as McIntosh and Glynn counties provide for the bridges across the Altamaha River.

The Southern Ry. is planning to start work shortly on the construction of a transfer station and shed with additional tracks at the Inman yards at Atlanta. The cost of the work will be about $100,000.

At a recent conference of officials of the Southern Ry. estimates were considered for the work to be done immediately, which totalled up practically $5,000,000. The Southern is doing much double-tracking on the main line between Atlanta and Washington, and will take up this end of the line later. The year 1910 promises to be a year of construction for this road. W. H. Wells, Washington, D. C., is engineer of construction.

Idaho Notes.

FROM CORRESPONDENTS AND OTHER SOURCES.

At the end of December about two-thirds of the grade had been completed for the new branch track that the O. S. L. R. R. is building between Rupert and Bliss and the line will be completed early next spring. Work upon the grade will be resumed immediately the frost is out of the ground. Track laying will go on simultaneously. The railroad company will lay down five miles of sidetrack at Bliss, which will not only be the junction with the main line but the end of a division as well.

The Utah Construction Co., Ogden, Utah, has begun grading work for the new branch line of the Oregon Short Line between Burley and Oakley, in Cassia county. The distance between the two towns is about 25 miles, and the laying of rails will proceed just as soon as the grade is in readiness.

Engineers of the Minidoka & Southwestern Ry. are making surveys for the extension of its line from Salmon Falls Dam to the new town of Jarbidge, a distance of 50 miles, making the total length of the road from Twin Falls, Ida., to Jarbidge, 85 miles.

Citizens of Wallace, Idaho and Cour d' Alenes are taking steps toward securing the construction of an extension of the Spokane & Inland Empire Electric Ry. System from Coeur d' Alene City to Wallace. R. A. Wilson, Wallace, Idaho, is interested.

Work is being rushed on the Gilmore & Pittsburg R. R., and it is believed that the road will be completed to Salmon City by February. The cold weather conditions of the past few weeks have delayed the grading work somewhat, but the tracklaying has been continued.

Efforts are now being made to have the Minidoka & Southwestern R. R. extend its line from the Salmon River dam into the new gold country, a distance of about 90 miles. The Hollister branch of the Minidoka & Southwestern is already completed to the Salmon River dam, 50 miles from Jarbridge, and one of the advantages of building to the new camp from this point would be that of grade, it being almost a level route for the remainder of the way. Acording to a statement of Alex. McPherson, Twin Falls, engineers are to be put in the field as soon as the weather permits to survey a line from the Salmon River dam to the new town of Jarbridge.

Illinois Notes.

FROM CORRESPONDENTS AND OTHER SOURCES.

The dam in the race surrounding the wheel pit of the Keystone plant of the International Harvester Co. at Sterling was washed out by high water and ice on Jan. 2. The loss is estimated at $50,000.

The Illinois Central, Nickel Plate, Lake Shore and Fort Wayne railroads have been making progress with their Grand Crossing track elevation work at Chicago.

Efforts are being made by residents of Oreana, Argenta and Cisco and the farmers of those communities to interest William B. McKinley, president of the Illinois Traction Co., in the construction of an interurban line from Decatur to Monticello, paralleling the line of the Illinois Central and passing through those three villages. The line will be about 25 miles long. Among those interested are Charles A. Denison and John Armstrong of Argenta, Mel Boyer of Oreana and Jesse Young of Cisco.

The Illinois Tunnel Co., of Chicago, which has a franchise for a telephone system in Chicago, is stated to have decided to go ahead and install a system. Negotiations are said to be already under way for the necessary equipment for 20,000 'phones for Chicago.

Right of way is being secured for the proposed railroad from Spring Valley to Peoria, via Lacon. Fred Collins, Lacon, is interested.

The maintenance of way department of the Illinois Traction System is now engaged in the construction of belt lines at the following cities: Decatur, 5 miles; Springfield, 6 miles; Edwardsville, 1.6 miles; Granite City, 1½ miles. L. M. Martin, Decatur, Ill., is the engineer in charge.

The St. Louis, Springfield & Peoria R. R. Co. was chartered at Springfield on Jan. 7. The principal office is to be at Champaign, and the capital stock will be $5,000,000. The company proposes to construct a line from a point in or near Madison, Ill., thence northeast through the counties of Madison, Macoupin and Sangamon, to Springfield; also a branch line from Staunton, in Macoupin county, to Litchfield, Montgomery county; thence in an easterly direction to a point in or near the city of Hillsboro, Montgomery county. The company is incorporated to take over all the McKinley lines between East St. Louis and Springfield, and Staunton and Litchfield, and Litchfield and Hillsboro, under one company. The incorporators and directors are: George M. Mattis, W. H. Carnahan, Charles Zilly, B. F. Bramble and Charles E. Cox, all of Champaign.

The Northwestern Construction Co. of Milwaukee, Wis., has been awarded the contract for building an interurban electric line from Sterling to Rock Island, Ill., a distance of 62 miles. The estimated cost of the line is $1,240,000. Work will start early in the spring.

The Peoria Terminal Ry. Co. of Peoria is reported to be planning to have work started soon on the construction of its new line, depots and terminal facilities at Peoria. The company is said to have already placed contracts for several hundred thousand dollars' worth of equipment, engines, cars, rail, ties, etc. The work will be done under the direction of General Manager Burrill.

The Des Plaines Valley Ry. Co., the belt line of the Chicago & Northwestern to connect, at Elmhurst and Glencoe, the north and west lines of the Northwestern, has acquired its right of way between these north and south suburbs of Chicago, and has made record of all the purchases. The line is to run through the townships of Proviso, Leyden, Maine and Northfield. About $500,000 has been spent by the company in acquiring the right of way lands and other ground space for storage yard purposes.

The Baltimore & Ohio R. R. has purchased the Chicago Terminal Transfer R. R. Co., having purchased the property at a foreclosure sale for $16,000,000.

Indiana Notes.

FROM CORRESPONDENTS AND OTHER SOURCES.

The Pennsylvania lines west of Pittsburg have closed the deal for the use of the Fort Wayne division for a tract of 3½ acres of land at New Brighton. The acreage is needed by the railroad company for changing the track and connecting up the line to the track changes recently made at Beaver and other points.

The Baltimore & Ohio R. R. is said to be planning to have work started this spring on its new round house and machine shops at Garrett, where the western division shops of the road are located.

F. Y. Keator and J. S. Hopkins, representatives of the Gary-Hobart-Valpariso Traction Co., which projects a line connecting those cities, have succeeded in securing an extension of the franchise, identical with the previous one except that the company has the choice of two routes through Hobart, either Center or Main St. Construction work will be started early this year.

A number of improvements are planned for this year by the Baltimore & Ohio Southwestern Ry., on its line between North Vernon and Milan. The curves and grades east of North Vernon will be eliminated and the line will be double-tracked to Oakdale, a distance of four miles. A concrete arch will take the place of the iron bridge over the Muscatatuck River.

The Bluffton, Geneva & Celina Traction Co. of Bluffton, has increased its capital stock from $30,000 to $675,000. Wm. A. Kunkie is president.

Robert Skinner Moore, who has been with the Henry Taylor Lumber Co. of Lafayette for some time, has resigned and will engage in contracting.

Iowa Notes.

FROM CORRESPONDENTS AND OTHER SOURCES.

A company is being formed at Waterloo to carry out the proposition advanced by the Chamber of Commerce of that city for the construction of a line of railroads south from Waterloo. Surveyors are to be sent out at once, it is said, over the proposed routes to make estimates of the cost of construction.

Although nothing positive can be learned it is believed here in Muscatine that the Muscatine North & South Ry. will have work started in the spring on an extension to Burlington. All the surveys have been made for the work and it is understood that the contract for the work has already been given to an eastern firm of contractors. It is also believed that in the spring of 1911 the road will be extended to Davenport by the way of Sweetland Center and Blue Grass. Charles Howard, Muscatine, Ia., is General Manager.

The Chicago & Northwestern Ry., is reported to have secured an entrance to Davenport over the right of way on the Iowa & Illinois interurban railway. Articles of incorporation have been filed at Clinton for a subsidiary Iowa & Illinois Ry. Co., and it is believed that this company is to be a terminal association to control the terminals at Clinton and Davenport. Application is to be made to the city council of Davenport for a franchise for a track and for land for terminal purposes. Henry Thuenen, Jr., Davenport, Ia., is Vice President Iowa & Illinois Ry.

Business men of Iowa City have raised a guaranty of $100,000 to insure the building of an interurban to Davenport.

It is probable that the interurban line will this year be extended from Centerville to Numa, Cincinnati and Exline in Appanoose county at a cost of $250,000.

The Waterloo, Cedar Falls & Northern R. R., T. E. Rust, Chief Engineer, Waterloo, is reported to be planning to expend $500,000 this year for improvements to include an extension of the interurban line from Denver Junction to Waverly, addition to power plant, double tracking and residence extensions, new equipment, etc.

The county commissioners at Newton have had surveys started for the Skunk River ditch, from Colfax to the southeast corner of the county. The length of the proposed ditch will probably be about 20 miles. The length of the river between those two points is approximately 60 miles. This is the largest undertaking of its kind in the state.

The sum of $100,000 has been raised in Iowa City for the proposed Davenport-Iowa City interurban and work was started Jan. 3 to raise $300,000 in Davenport and $100,000 along the right of way. The promoters of the road have a contract with an eastern trust company to bond the road to the extent of $1,500,000, upon the sale of $500,000 in preferred stock and the securing of the right of way. Most of the right of way has been secured, and it is thought there will be no trouble about what is left.

An injunction has been secured in the Supreme court of Iowa by the Illinois Central

R. R. against the Fort Dodge, Des Moines & Southern Interurban Co., preventing it crossing the Illinois Central tracks south of Fort Dodge. This will probably prevent the interurban from making its proposed extension until after the case is heard at the May term of the Supreme court.

The Lytle Co., of Sioux City, Ia., has been incorporated with a capitalization of $100,000 and will do a general business in architecture, engineering and construction. C. F. Lytle is president, Leonard Lytle is vice president and L. W. Lytle is secretary and treasurer. The new company will work in conjunction with the Lytle Construction Co., and has been incorporated to cover a field of operations that the older company is limited in by its articles of incorporation.

Business men of Marengo, are taking steps toward securing the construction of an interurban electric line between Cedar Rapids, Ia., and that place.

An application has been made to the city council of Sioux City, for a franchise for an interurban line projected from Parkston, S. Dak. Surveys for the line have been made and two-thirds of the right of way has been secured. The road will be known as the Yankton, Norfolk & Southern Ry., and it will extend from Parkston through Sioux Falls, Freeman, Yankton, Centerville, Elk Point and thence to Sioux City. C. A. Magee, Pittsburg, Pa., is president.

Kansas Notes.

FROM CORRESPONDENTS AND OTHER SOURCES.

The Garden City, Gulf & Northern R. R. has completed its first 40 miles of track between Scott City and Garden City. As soon as spring opens it is said that the construction work will be continued from Garden City south with the Gulf as the final destination. The Kansas Construction Co., B. M. McCue, Garden City, Kan., had the contract for the first 40 mile section.

The Cherryvale, Oklahoma & Southwestern Ry. Co., has been financed in France and it is said that construction work on it will be started shortly. The first section to be built will extend from Caney, Kan., south 100 miles through the oil and coal district of Oklahoma to the white oak lands of this state, where it is proposed to obtain timber for ties for the remainder of the road. The survey for lines from Cherryvale, Kan., through Pawhuska and Guthrie to Geary, Ok., and from Caney, Kan., to the Grand River, has been made. The first is 235 miles long and the second 78. Bonuses for this road have been raised in some of the Northern Oklahoma towns. State Senator S. M. Porter, Caney, Kan. is the principal promoter of this road.

A bill has been introduced in congress to authorize the Atchison, Topeka & Santa Fe R. R. to extend its tracks over the Fort Leavenworth military reservation to connect with the government's terminal. The work is to be done by the railroad company without expense to the government.

Michigan Notes.

FROM CORRESPONDENTS AND OTHER SOURCES.

Advices from Gladwin state that W. C. Cornwell has made tentative plans for a dam across the North Branch in Arthur township.

The Baraga common council has granted a lease to the firm of Charles Hebard & Son, Inc., of Pequaming, and one to the D. S. S. & A. R. R. company for the foot of Ontonagon St. for the purpose of building a dock, also laying a spur track on the dock. Work on the construction of the dock will commence as soon as the ice and the weather will permit.

The Commonwealth Power Railway & Light Co. of Michigan has been organized with a proposed capital of $18,000,000 divided into $6,000,000 preferred and $12,000,000 common stock. The following companies are to be included in the merger: Commonwealth

The Detroit Terminal R. R., of Detroit, owned by the Michigan Central, Lake Shore and Grand Trunk Rys. and usually known as the outer belt line, has succeeded in securing right of way west from Woodward Ave., to the Michigan Central tracks at Plymouth Road.

The Michigan United R. R. Co. is reported to be negotiating for the purchase of the Owosso & Corunna electric line.

Power Co. of Grand Rapids; Muskegon Power Co.; Saginaw-Bay City Railway & Light Co.; Grand Rapids Railway Co.; Michigan Light Co.; Flint Electric Co.; Flint Gas Co.; Cadillac Water & Light Co.; Charlotte Electric Co.; Pontiac Gas Co.; Shiawassee Light & Power Co., and Au Sable River property and rights. The new concern is being formed by a syndicate of New York, Philadelphia and Michigan bankers, including Hodenpyl, Walbridge & Co. of New York, F. W. Clark & Co. of Philadelphia, and W. A. Foote of Jackson, Mich. The plans of the project call for the development of the Au Sable River by 13 or 14 dams, covering the river for a distance of 90 miles from its mouth. The engineers estimate that 66,000 H. P. can be secured. The dams on which work has already started call for the development of 10,000 H. P., with which the work will be started. The total cost of the dams will be some $7,000,000 or upwards.

Minnesota Notes.

FROM CORRESPONDENTS AND OTHER SOURCES.

Negotiations are underway with the power company at Little Falls to furnish the necessary power for a proposed electric railway from Little Falls, to Alexandria by way of Long Prairie. The proposed line will run from Douglas county to Long Prairie, the county seat of Todd county, thence to this city, the seat of Morrison county. A number of Long Prairie business men are interested. Henry Diebel, Long Prairie, is one of the promoters.

The Consumers Power Co., of Stillwater, will expend about $20,000 in March in laying about 13 miles of gas mains. The pipe has already been ordered.

The Great Northern Ry. Co., has purchased an additional 150 ft. of right of way from Red lands to Lengby, Minn., and it is supposed that the company is contemplating double tracking its line between those two points.

The plant of the Faribault Gas & Electric Co. of Faribault has been sold to H. M. Byllesby & Co. of Chicago. They have also purchased the 20,000 H. P. water falls at Cannon Falls and will transmit power to Faribault.

The Soo is reported to have men in the field looking for a route for a possible extension of a branch northeastward from Thief River Falls to a junction with the Canadian Pacific.

Duluth and the Ranges.

BY PETER E. MEAGHER.

C. G. Borchert, representing the Arthur Koppel Co., was a caller this week.

Peter Nelson, the railroad contractor who is working at present on the Soo Line, came in and made us a visit a few days ago. He is working one steam shovel at present and intends to continue running the same all winter.

John Runquist, the contractor, was awarded a new job for the Duluth, Missabe Northern Ry. There are about 150,000 cu. yds. in this work. This is a steam shovel job, and Mr. Runquist has already commenced working on the same.

W. F. King of W. F. King & Co., contractors, was a visitor recently. They are engaged on three or four concrete jobs for the Duluth, Missabe Northern Ry. Co.

H. C. Stansill, representing the Kilbourne & Jacobs Co., was a caller here last week and left for a trip to the Range country.

J. B. Mischler, railroad contractor, was a caller recently. He is figuring on some new work, but is not doing anything at the present time.

P. K. Anderson, boarding car contractor on the Duluth & Iron Range and Duluth, Missabe Northern railways, was a caller at this office. He is boarding quite a few men at the present time.

Arthur Mitchell, who is in charge of some new construction work in Canada, dropped in to see us last week. He is here on a vacation visiting with his family.

J. P. Joel, traveling representative for the Vulcan Iron Works Co., Wilkes-Barre, Pa., dropped in to see us on his way in from the Coast Country. He reported business very good.

F. J. Anderson, superintendent for Foley, Welch & Stewart, contractors, who are doing all the construction work for the Minneapolis, St. Paul & Sault Ste. Marie Ry. Co., spent a day with us recently. They had just let 24 miles of work, part of it steam shovel work, and the balance team work, to be started immediately.

J. E. Erickson of Murphy Brothers & Erickson, railroad contractors on the Soo Line, was a caller this week and said they were rushing their work as fast as possible and would continue to do so all winter.

F. C. Peabody, superintendent for Dale & Bumgardner, who have three steam shovels working on the Soo Line, was a caller and said they have closed down two of their shovels, and are moving them farther up the line and expect to start in working again very soon.

Richard Evans, steam shovel contractor on the Soo Line, has shut down one of his shovels on account of frost. He does not expect to start the same until later on in the season.

Greer Thompson, general superintendent for Drake & Stratton Co., steam shovel contractors on the Mesaba Range, was a visitor here this week. They are working quite a few men, and will continue to do so all winter.

The Duluth, Winnipeg & Pacific Ry. Co., with headquarters in Duluth, who are going to let a contract for 87 miles of work, have not done so as yet. I understand that they are ready, but are having some trouble over their right-of-way getting into Duluth. The same has not been settled at this writing.

H. J. Cooper, contractor from the Range, visited us this week. He is not doing anything at the present time.

The labor market at Duluth at present is in a very good condition. There is quite a demand for men, and about men enough to fill all the positions offered. The wages are the same as they were thirty days ago, and there will undoubtedly be no change for about 60 days.

Missouri Notes.

FROM CORRESPONDENTS AND OTHER SOURCES.

The Mississippi Valley Transportation Co., W. K. Kavanaugh, President, is having steel barges built and expects to start its first boat out of St. Louis for New Orleans on March 1. In connection with transportation project the company is reported to be planning to spend nearly $1,000,000 in the near future in terminal facilities in the cities and towns along the river between St. Louis and New Orleans, including both points. It is estimated that the terminals in St. Louis, which will be modern in every way including loading and unloading by the electric derrick system, will cost at least $225,000. Cairo, $50,000; Cape Girardeau, $10,000; Hickman, $10,000; Memphis, $100,000; Helena, $50,000; Greenville, $25,000; Vicksburg and Delta, $100,000; Natchez, $25,000; Baton Rouge, $50,000, and New Orleans, $200,000.

An appropriation of about $2,000,000 is stated to have been made by the Atchison, Topeka & Santa Fe Ry. for continuing double tracking its Missouri Division.

The Kansas City Junction Ry. Co., of Kansas City, Mo., is reported to have abandoned its old right way, and will have surveys made for a new right of way for its proposed Missouri River front terminal system. The old route paralleled the tracks of the Edgewater Connecting Railway Co. in Kansas City, Kan., and in the Missouri River bottom north of the city. The terminal system was to be used in connection with a new bridge across

the Missouri River north of Kansas City, Kan., and a new double track road to St. Joseph, Mo.

H. V. Johnson and H. E. Insley of Kansas City, Mo., promoters of the Kansas City & St. Louis Electric Ry., are reported to have stated that right of way has been secured through Boone County and that construction work will commence as soon as the right of way through Saline can be obtained. As proposed the line will be double tracked, and will be equipped with all modern devices.

A proposition is to be submitted to the stockholders of the Missouri Pacific R. R., at a special meeting to be held Jan. 18, at St. Louis, providing for the authorization of $175,000,000 of 5 per cent 50-year first and refunding mortgage bonds, convertible into the company's stock at par from Sept. 1, 1912, to Sept. 1, 1932. These bonds will be redeemable at 110 and interest Sept. 1, 1917, or on any subsequent interest day. Of the total issue of $175,000,000 of Missouri Pacific bonds, $90,633,000 will be reserved for refunding prior lien bonds and $6,500,000 to refund equipment obligations; the sum of $52,866,500 is to be used for betterments, additions and equipment, and $25,000,000 will be used for mortgage bonds of the St. Louis, Iron Mountain & Southern railway, to be issued for betterments and additions. The $29,806,000 of bonds which will be issued at 95 will enable the Missouri Pacific to pay off its floating debt and leave a balance to be used for betterments, improvements, and additions, for which a comprehensive plan has been prepared.

The Springfield Gas & Electric Co. of Springfield is to erect a larger and more modern gas plant at the corner of Main St. and Phelps Ave. The property has been acquired from the Frisco in exchange for the gas company's property at Main and Mills Sts. The Frisco is to use the land for enlarging its track and depot facilities.

Preliminary work has progressed very favorably for the construction of the proposed interurban line from Springfield to Carthage, and it is believed that the work will be undertaken this year. W. A. Bixby, Springfield, is interested.

St. Louis Items.

BY A. B. KOENIG.

W. L. Mosby, Deeson, Miss., has 40,000 yards of levee enlargement work in Lake County, Tenn., six miles north of Tiptonville, to sublet at good prices.

The Board of Public Improvements at St. Louis will open bids on Feb. 11th for a new 5 to 11 ft. sewer in the New North Harlem Creek Joint Sewer District, the sewer to be 2¼ miles in length. The total cost is estimated to be $246,120. Nearly a mile of it is to be 10 ft. 10 ins. in diameter; more than a half a mile is 9 ft.; both sections to be of concrete, and three sections nearly three-quarters of a mile are to be of brick ranging from 4 ft. 7 ins. up to 7 ft. 6 ins. in diameter. Following is the proposed location, size and length of the six sections: From Bircher St. and Newstead Ave. to King's Highway, 4,792.71 ft., the sewer is to be 10 ft. 9⅝ ins.; from King's Highway to 530 ft. west of Union in Bircher, 3,557.20 ft., it is to be a 9 ft. sewer; from 530 west of Union to Emerson, 475 ft., it is to be a 7½ ft. sewer; from Emerson to Thrush, still in Bircher, 1,737.16 ft., it is to be 7 ft.; from Thrush to Wren, 717.84 ft., it is to be 5½ ft., and from Wren to Partridge, 808 ft., it is to be a 4 ft. 7 in. sewer. It is to drain a large territory in the northwestern part of the city and is to be paid from jointly by the city and the property owners.

The Board of Public Improvements at St. Louis have asked for bids to be opened Jan. 21st, for the improvement of the following streets, aggregating seven miles and estimated to cost $400,000:

Henry Schweiter returned here for the holidays minus his right eye, which he lost through a premature explosion of some dynamite caps that his foreman was using in blowing frost at Danville, Ill. One of the caps got too near a fire and started off the whole box of them. One of them hitting Schweitzer in the eye and two in the cheek. We are very glad to announce that Schweitzer is up and around again and as alive as ever, while his foreman is still in the hospital at Danville, Ill. From the latest accounts he is doing nicely and will recover.

Asphalt—Rowan, between Ridge and Easton; Arkansas, between Winnebago and Miami; New Ashland, between Labadie and Ashland; Shamut, between Wells and Easton; Theodosia, between Academy and Union; Theodosia, between Union and Arlington.

Brick—Pennsylvania, between Osage and Chippewa; Alfred, between Scanlan and Arsenal; Fassen, between Broadway and Virginia; Louisiana, between Cherokee and Gravois; Canaan, between Broadway and Newby; Henrietta, between Compton and Louisiana; Twenty-first, between Palm and Branch; Potomac, between Wisconsin and Jefferson; Natural Bridge road, between Fair and Taylor; Dakota, between Nebraska and Minnesota; Michigan, between North Dakota and Osceola; Grace, between Fairview and McDonald; Twenty-first, between Penrose and Ferry; Spring, between St. Louis and Natural Bridge road; Twenty-second, from Cass to Herbert; Pestalozzi, from Thirteenth to Jefferson.

Bitulithic—Connecticut, between Russell and Morgan Ford road; Scanlan, between Morgan Ford road and Alfred; Twenty-second, from Washington to Cass.

Granite—Manchester, between Barron and Sublette; Manchester, between Tamm and Prather.

The board has prepared ordinances for opening the following streets and alleys:

Shenandoah, now known as Tower Grove Place, private from Alfred Ave. to King's Highway.

Tennessee and Alaska, from Iron to Fillmore.

Maffitt, from King's Highway to Union.

Alley between Florissant, Harney, Bernays and proposed Union.

Alley between Thekla, Lillian, Bernays and proposed Union.

Alley between Lillian, Bircher, Bernays and proposed Union.

Alley between Warne, Sarah, Garfield and North Market.

Alley between Edwards, Macklind, Wilson and Daggett.

Alley between Kossuth, Lee Clay and Fair.

Alley between Belt, proposed Clara, Waterman and King's Highway.

Alley between Walsh, Delor, Vermont, Virginia and Alabama.

Alley between Itaska, Neosho, Louisiana and Tennessee.

Alley between Goodfellow, Hamilton, Theodosia and Cote Brilliante.

Alleys between Itaska, Neosho, Tennessee and Grand.

Alleys between Arsenal, Crittenden, Ohio and Iowa.

Alleys between Daggett, Shaw, Cooper and Edwards.

Alley between Edwards, Macklin, Daggett and Shaw.

Alleys between Shaw, Pattison, Cooper and Edwards.

Alley between Edwards, Macklin, Shaw and Pattison.

Alley between Edwards, Macklin, Shaw and Pattison.

Alley between Maffitt, St. Louis, Cora and Marcus.

Alley 1,118 feet west of Union, proposed Clara, Kingsbury and Washington.

Chas. L. Gladheart has taken a piece of Big Four work from Henry Schweitzer in Illinois.

R. E. Oliver and Mr. Callaway of Oliver Bros. & Callaway, spent a few minutes with us the other day. Nothing new.

President Reber of the Board of Public Improvements called the new sprinkling contractors before him last Wednesday and impressed upon them that all the contracts and specifications must be carried out to the letter. He told them that the specifications meant just what they contained, and any violation would result in the annulment of the contracts. In the past it has been shown that contracts have been let to one contractor and sublet to another, with the result that the first contractor made a handsome profit. President Reber told them that this would not be permitted and any attempt at such procedure would result in the annulment of the contracts.

McCann Bros., Murphysboro, Ill., have a piece of work to let suitable for about 15-team outfit.

Suits recently filed in the Clayton Circuit Court by Robt. L. Shackelford, prosecuting attorney of St. Louis County, against the St. Louis, Montesano & Southern Railway Company, asking that their two bonds, amounting to $10,000, be forfeited, will be dismissed this week, according to Shackelford. The County Court met last Wednesday as a committee with representatives of the railway company and reached an agreement. The suits were filed following failure of the company to comply with the conditions of its franchise. The company after tearing up Lemay Ferry road in Carondelet Township for about 8,000 ft., stopped work. According to the agrement which was reached last Wednesay the company will immediately put the road in the condition it was before work was started, the reconstruction of the road to be superintended by a man named by the County Court. The representatives of the road who met the members of the County Court last Wednesday are: Former Judge August Kassebaum, Chas. W. Gutke, Wm. Ruprecht and Wm. Heil.

J. H. McFarlin, Jacksonville, Ill., was awarded the contract for grading, track laying and concrete work on the new Springfield and Jacksonville Electric Ry.

New York Notes.

FROM CORRESPONDENTS AND OTHER SOURCES.

The Wall Kill Transit Co., which has lines in Middletown and to Goshen, eight miles away, is planning to build a new line to Montgomery from Goshen, a distance of ten miles. At the same time it is understood that the Orange County Traction Co., with lines in the city of Newburgh and to Walden, twelve miles away, will build a new line from Walden to Montgomery, connecting with the Wall Kill Transit Co. The Orange County Traction Co. is controlled by former Governor Odell and it is believed that the connecting of the two big lines means a consolidation under Mr. Odell's control.

The New York State Public Service Commision has granted the application of the New York Central & Hudson River R. R. Co. for an extension of 18 months for the completion of the work in depressing the tracks and building a new terminal at the Grand Central station in New York city.

McCracken, Hauer & Terry of New York city are working a 70-ton Bucyrus shovel on their sub-contract from the Jacobs Construction Co. of Pittsburg, Pa., for construction work on the Delaware & Eastern R. R. from Grand Gorge to Blenam, and expect to put in two mine shovels shortly. This is all heavy work and covers about 20 miles of line for the Delaware & Eastern. The Jacobs Construction Co. has two shovels working and Fisher Curzzo also has a Marion 20 on the job.

The Manhattan Bridge Three-Cent Line was incorporated with a capital stock of $50,000 and proposes the construction and operation of a double track street surface railroad from Flatbush and Fourth Aves., Brooklyn, N. Y., to and across West St., at Desbrosses St., in Manhattan, N. Y., a distance of 5 miles. The directors of the company are: Andrew D. Baird, Walter Hammitt, Edward T. Horwill, Charles J. Edwards, Simon J. Harding, John H. Mowen, William F. Neu, Charles E. Parkins, Thomas P. Peters, M. D. Smith, F. W. Rowe, F. H. Tyler, F. W. Wurster, J. C. Brackenridge and Almet R. Latson.

Ohio Notes.

FROM CORRESPONDENTS AND OTHER SOURCES.

The city council of Toledo will shortly pass the final legislation for the separation of grades where Hawley St. is being opened

across Swan creek. The cost will approximate $93,000 and will be divided between the Lake Shore Ry. and the city. The $40,000 necessary to separate the grade of Post St. and the Michigan Central and the Lake Shore roads will be equally shared by the city and the railroads.

The Baltimore & Ohio R. R. is stated to be planning to expend $4,000,000 this year on the Chicago Division. One of the principal pieces of work will be at Defiance. The Defiance improvements consist of the elevation of the tracks through the city, the elimination of seven grade crossings and the construction of viaducts in their place, the extension of the Defiance yards and the building of a new freight depot and passenger station.

Work is to be started shortly, it is said, to complete the line of the Lake Erie, Alliance & Wheeling R. R. (New York Central lines) from Dillonvale to Wheeling, W. Va., a distance of 17 miles. F. W. Watkins, Alliance, O., is superintendent.

The Fremont Power & Light Co. of Fremont, has proceedings underway to condemn three acres of land in Ballville for use as a site for its new power house.

The River and Harbor Committee of the Chamber of Commerce of Cleveland has asked the city council of that city to appropriate $100,000 for the dredging and making navigable of the Cuyahoga River.

The Chespeake & Ohio R. R. is reported to have negotiations under way for the purchase of the Eastern Kentucky Ry., a short line operating 36 miles of road in Kentucky. The Eastern Kentucky Ry. has had an extension in view for sometime and it is believed that if the deal goes through the extension will be built by the C. & O.

Oklahoma Notes.

FROM CORRESPONDENTS AND OTHER SOURCES.

The city commissioners of Ardmore have awarded the contract for raising the dam at the city lake to the Healey Construction Co., Shawnee, Okla. The dam will be raised sufficiently to double the capacity of the lake which is the source of the city's water supply. The contract price is $7,300.

Reports here at Oklahoma City indicate that a deal may be under way for the sale of the Altus, Roswell & El Paso Ry., now under construction by Edward Kennedy, to the Missouri, Kansas & Texas. There is also said to be a probability that the Missouri, Kansas & Texas may also purchase the Fort Smith & Western and the St. Louis, El Reno & Western railways and build an extension of these lines from Oklahoma City along the proposed route of the Altus, Roswell & El Paso. There is also a strong probability that the route of the new road may be altered to enter Oklahoma City and become an extension of the Missouri, Kansas & Texas from there.

The Denver & Gulf R. R. chartered in Oklahoma several years ago is stated to have purchased the steel and ties for building its line out of Texhoma in two directions. A northwest line will run through Texas and Cimarron counties and through Colorado to Lamar, where a connection will be made with the Santa Fe for Denver. This line will be built on one of the old Denver and Gulf surveys through Western Oklahoma. F. A. Upstead of Minneapolis, Minn., an old-time railroad builder is the president. The other line from Texas is to be built southeast across the Texas Panhandle.

Charles E. Hagerty, county surveyor, Muskogee, has started preliminary surveys for the projected railroad from Warner to Webbers Falls.

A company has been formed by Oklahoma City business men for the purpose of constructing a railroad for Northwestern Oklahoma. Surveys for the line are said to have been completed and the necessary funds for its construction are reported to be assured. As proposed, the line will extend from Oklahoma City to Trinidad, Colo.

The Commercial Club of Ardmore has taken up the proposition of securing a bonus for a line of road from Ardmore to Lawton. It is believed the Rock Island can be induced to enter this field. The cities of Lawton and Duncan and all towns intermediate will be asked to get busy on the best proposition they can make to secure the line, and when the reports are compiled they will be forwarded to the general offices of the Rock Island with the hope that the company will take the matter in hand.

Announcements have been made by various railroad officials that 2,500 miles of new railroad, already surveyed, will be built in Oklahoma in the event of the adoption of the constitutional amendment recently initiated, which removes the restrictions against the sale of domestic lines of foreign corporations, and allows the foreign roads to exercise the right of eminent domain.

Major E. C. Gordon, promoter of a railroad to run north from Chickasha, near the Red River, to Liberal, Kan., has raised over $30,000 on 90 miles of the proposed line south of the Canadian River, including bonuses from Weatherford, Anadarko and Chickasha. Other towns in Oklahoma that are raising bonuses for this line are Mutual, Shattuck, Persimmon, Lenora and Woodward.

The St. Louis & San Francisco R. R. is to at once erect a large roundhouse in West Tulsa for the accommodation of the Enid branch of the road. A large yard will be installed in West Tulsa and the downtown yards in Tulsa will be partially abandoned.

Oregon Notes.

FROM CORRESPONDENTS AND OTHER SOURCES.

The construction of an electric railway from Canby to Molalla is proposed and it is said that 20 miles of the line will be in operation by July 1. Later the line will be extended to Portland, crossing the river at Canby, and going by way of the west side. Already an option has been placed on the steel to cover 16 miles, engine and 60 cars, formerly used on a logging railroad. This line, in no way, will interfere with the proposed Swift Railroad, as it will pass through a different section of the county, and through some of the finest timber land. The electricity for the proposed railroad will be supplied by the Canby Canal Co.

The Pacific Railway & Navigation Co. has placed 38 miles of its new line in operation. This is considerably more than one-third of the mileage of the road, which is to be 90 miles long. Seventeen miles will be operated at the Tillamook end from Hillsboro to a station, not yet named, just beyond Buxton, the other 11 miles being at the Tillamook end of the road. Thirty-three miles of the road are completed, and 100 men are working on 27 miles. This construction is about 40 per cent completed.

Work on the first 25 miles of the Klamath-Natron cut-off is being pushed with vigor, several hundred men being now employed by the contractors, Erickson & Peterson. This division will extend from Klamath Falls to Williamson River on the Klamath reservation, and it is expected to be completed by August, 1910. Although the country is comparatively level from Klamath Falls to Williamson River, there are several miles of marsh lands along the eastern margin of Upper Klamath Lake through which a grade will be thrown up by dredging, and one large dredge weighing 210 tons, is already on the work. Another one now under construction at Oakland, Cal., said to be of twice the size and capacity of the present one, will soon be placed on the work.

The Northern Pacific Ry. is stated to have secured options on 14 blocks in the northwestern part of the city of Portland as a site for terminal yards, for which $1,962,000 will be paid. It is said that the Northern Pacific is preparing to invest at least $2,000,000 additional in property for terminal and trackage facilities in that section of Portland, with a further expenditure of as much more contemplated for improvements.

Surveys for the proposed Coos Bay, Boise & Idaho R. R. have been completed into Roseburg. Four lines were run down the eastern slope of the Coast Range and an excellent grade is stated to have been secured. The crew working toward Marshfield are also stated to have completed their work to that city.

Robert Wakefield, Portland, Ore., has been awarded the contract for constructing a 4,000 ft. jetty on the south side of Siuslaw bar for the Port of Siuslaw. The contract price is $117,000.

The Pacific City Canal Co. has been incorporated with a capital stock of $1,000,000 for the purpose of connecting Pacific City on Flores Lake in Curry county, with the Pacific Ocean by means of a deep water lock canal. The building of the new canal is estimated to cost $800,000 and the plans of the company comprehended its immediate completion, as well as the building of a 50-mile railroad, which will give the new district connection with the interior of the state. The project has been examined by engineers and pronounced feasible. The canal will have sufficient depth to admit the largest vessels in the coast trade. The incorporators are George H. Stevenson, a Portland business man; W. W. Purdy, a civil engineer formerly connected with the Great Northern Railroad, and W. H. Lang, a real estate man of Portland.

The Warren Construction Co. is building two miles of street railway at Salem, for the Portland, Eugene & Eastern Ry.

Councilman Belding of the South Portland District of Portland, has been requested to have city engineer prepare estimates on the cost of a fill at Marquam Gulch, on Second St. from Sheridan St. to Arthur St., and a fill on Corbett and Seymore Sts.

Engineers of the Oregon Railroad & Navigation Co., G. W. Boschke, Chief Engineer, Portland, Ore., have completed plans for additional sidetracks at Lagrange. The revised yard will include 11 sidetracks the full length of the yards, and 6,000 ft. of "storage" tracks. The plans also include new repair shops in the northwestern part of the yards, and the old bunkers will be replaced by coal chutes.

Construction work is stated to have been started on the Astoria, Seaside & Tillamook Ry. Co.'s proposed electric line from Astoria to Seaside. The first section of the road to be built will be from Astoria around Smith's Point to a connection with the county drawbridge across Young's Bay. F. L. Evans, Astoria, is president.

Work on the extension of the Pacific & Eastern Ry. to a point in eastern Oregon, where it will connect with the Oregon trunk line now being built through the Deschutes canyon, will be resumed shortly. The Pacific & Eastern was until last spring but a 6-mile line, from Medford to Eagle Point, but during the summer it has been extended from Eagle Point to Butte Falls, a distance of 12 miles, the fall rains stopping construction work.

Pennsylvania Notes.

FROM CORRESPONDENTS AND OTHER SOURCES.

The Coal and Iron Co., of Shamokin, has decided to build a concrete reservoir at Bear Valley, to supply the various operations of the coal company in Shamokin, which include Bear Valley, Burnside, Sterling and Henry Clay workings. Work will be started on the reservoir in the spring.

The Philadelphia & Reading Ry. has secured land at Harrisburg far a large freight depot and distributing yard.

A New York syndicate is reported to have secured an option on the Shamokin Light & Power Co., the figure being $620,000, and are said to be trying to get an option on the plant of the Edison Illuminating Co. at Mt. Carmel. It is said that the syndicate has already secured options on the several electric railway lines that center at Sunbury, and that they are now negotiating for the Bloomsburg, Milton and Danville lines, and that they will make a bid to take over the lines of the Shamokin and Mt. Carmel Traction Co., and also those controlled by the Schuylkill Railway Co. It is said to be the purpose of the syndicate to get control of all the electric plants and railway systems in

central Pennsylvania and operate them under one system, the power to be generated at the great plant being erected at Harwood, near Hazelton and at the big dams at Muncy.

Eyre-Shoemaker, Inc., contractors, Arcade Bldg., Philadelphia, Pa., are reported to have been awarded a contract by the New York, Philadelphia & Norfolk R. R. for double tracking about 50 miles of line, the contract including widening the roadbed and bridges.

Texas Notes.

FROM CORRESPONDENTS AND OTHER SOURCES.

The railroad committee of Pecos is stated to have obtained the necessary subscriptions to secure the railroad from Pecos south.

The Kansas City Southern Ry. in connection with Adolphus Busch and other capitalists are said to be planning to construct a line from Shreveport, La., to Jefferson, Tex., which will be used in bringing iron ore from the Jefferson iron fields to Shreveport. It is understood that furnaces will be established. It is also understood that the road between Shreveport and Beaumont will be ballasted, heavier steel laid and the track greatly improved in a general way. A. F. Rust, Kansas City, Mo., is resident engineer.

Announcement has been made that the St. Louis & San Francisco R. R., is planning the expenditure this year of $15,000,000 for improvements and extensions. The Fort Worth & Rio Grande Ry., which is a part of the Frisco, will branch in two directions from Brady, one line entering Menardville, the other entering Comfort, meeting the S. A. P. road and giving direct connections into San Antonio and Mexico. Surveyors are already working on the Menardville line but the Comfort branch is an entirely new proposition. The St. Louis, Brownsville & Mexico road will be extended from Brownsville across the Rio Grande to Tampico, Mexico. After these improvements are completed the Marshall & East Texas road will be extended north to Paris and south to Newton, forming the final link in the Frisco's short line between St. Louis and the gulf. M. C. Byers, St. Louis, Mo., is chief engineer, St. Louis & San Francisco R. R.

The San Diego, El Paso & St. Louis R. R. has completed surveys and estimates for its line as originally projected from El Paso, Tex., to Artesia, N. Mex., a distance of 197 miles. The company is now planning to extend the line through the entire state of Texas, where it will connect with the Frisco route either at Quanah in Hardeman county or at Vernon in Wilbarger county, and as contemplated, the line will be 500 miles to Quanah or 520 miles to Vernon. The proposed route from Artesia, N. Mex., is via Knowles, N. Mex., Gaines and Yoakum counties; Brownfield, Terry county; Lynn county; Sude, Lubbock county; Emma, Crosby county; Afton, Dickens county; Motley county, Paducah, Cottle county, and thence either to Quanah in Hardeman county or to Vernon in Wilbarger county. At either of these places it will connect with the Frisco for the north or east. P. A. McCarthy, Houston, Tex., is chief engineer.

The Beaumont Traction Co. of Beaumont is stated to be planning to expend $75,000 for improvements to its present system if a satisfactory franchise can be obtained from the city.

Mayor Joseph F. Nichols of Greenville, has succeeded in interesting several parties in that city and at Wolfe City in the organization of a local corporation to build an interurban railway. The first line to be considered will be one from Greenville to Wolfe City. The proposed line will be extended from Wolfe City, possibly in the direction of Clarksville. It is also proposed to extend the line in a southwesternly direction from Greenville, possibly to Plano.

It is expected that by June the Gulf, Colorado & Santa Fe Ry. will have a 90-lb. rail on all the main line from Purcell to Galveston. This work comes under the 1909 fiscal year appropriation and much of it has already been done. The total cost will be about $700,000. The 1910 budget of the Gulf, Colorado & Santa Fe Ry. is said to contemplate expenditures of about $6,000,000—embracing various improvements to existing property and the construction of new. The erection of some 20 new depots is considered.

The Estacado & Gulf R. R. is stated to have been financed and it is said that work will begin at once to complete the road from McCauley to Roby. The road is now within four miles of Roby and material has been secured to complete this stretch of road. It is said to be the intention of W. A. Butts, Stamford, president of the road, to build at least 100 miles of road during 1910 and his plan is to build east and west. The east line to come to Stamford and the west to go to Colorado City and on toward Rosewell, N. M. Mr. Butts has asked Stamford for a proposition and the matter is now under consideration. It is known that Mr. Butts is also figuring on building his road into Abilene.

The recent visit to San Antonio of several officials of the Southern Pacific has given rise to the report in that city that the S. P. was planning to take over the Artesian Belt Ry. and build it to a point near Brownsville on the Rio Grande, and the Uvalde & Crystal City and extend that road to connect with the Laredo & Minera, at Minera.

A company is being organized by Greenville and Wolfe City capitalists for the purpose of building an interurban line between the two cities. It is hoped to have active work started this spring. Mayor Frank Nichols of Greenville is organizing the company.

The Santa Fe is said to be contemplating the expenditure of $250,000 in the building of a new round house, machine shops and turntable at Galveston.

Work has been resumed on the new rice irrigation canal being constructed on the W. C. Woods farm on Cow bayou, near Orange, which will be cultivated during the coming season. The canal has been completed for half a mile and the work will be rushed through to an early completion. L. F. Daniel, C. E., Beaumont, has charge of the engineering work on the canal. Mr. Daniel has also made surveys for an extension of the rice irrigation canal of Dr. E. W. Brown, east of Orange.

Work under the present appropriation on the U. S. Government jetties at Aransas Pass will be completed July 10, 1910. If another appropriation is made as a bill pending before congress asks, the work will be continued. Under the present appropriation 2,500 carloads of rock have been dumped into the salt water. These rocks make up the north and south jetties on which work is still in progress. These jetties extend out two miles. The present appropriation is $990,000. One hundred men are at work on the jetties. Present plans are to use the outer harbor where the water is shallower, for the smaller boats and reserve the entire inner harbor for larges vessels. The government work is exclusive of the work being carried on by the Aransas Pass Channel and Dock Co. This organization, under a state charter, is cutting a channel through Harbor Island.

The Chamber of Commerce of Wichita Falls and the citizens of Byers, have offered a bonus of $150,000 for extending a railroad from Byers to Waunika, Okla.

The Houston Lighting & Power Co., of Houston, Tex., has filed an amendment to its articles of incorporation, increasing its capital stock from $1,000,000 to $1,500,000.

The Grigsby Construction Co., Houston, Tex., is reported to have been awarded the contract for extending the Southwestern Ry. from Scotland to Archer City, a distance of ten miles.

Washington Notes.

FROM CORRESPONDENTS AND OTHER SOURCES.

The city council of Aberdeen will call for bids shortly for filling in the tide lands west of Broadway and east of Division St. The work will involve the expenditure of many thousands of dollars.

The Chicago, Milwaukee & Puget Sound R. R. is stated to have secured right of way through Coeur d 'Alene, for its projected line to Spokane. Engineers are stated to be still in the field making estimates and securing data for the construction of the line into Spokane. The final route for the new line has not, however, been definitely decided on.

A settlement has been made outside of court whereby the Northern Pacific has secured the property of the Seattle Sand & Gravel Co., for which it has started condemnation proceedings. The property was part of the right of way for the new water grade line out of Tacoma via Point Defiance and the Narrows. A portion of the tract includes an excellent gravel pit, which is located half a mile north of Chambers creek. The consideration is said to be $165,000.

The Well's Construction Co. is making good progress with the work of straightening the Puyallup River near Puyallup, by means of cuts made through the Boatman, Lacey and Stewart properties and will probably complete the work by the end of January.

The Northern Pacific Ry. has preliminary surveys well along for shortening its main line from Spokane to Tacoma and Seattle by about 100 miles. The new line will be a continuation of the branch which is now being built from Ritzville in Adams County, to a point directly west of there on the Connell-Adrian branch. The latter joins the old Washington Central, now a branch of the Northern Pacific, at Adrian. The line from Ritzville to the intersection with the Connell-Adrian branch is 45 miles long and the present survey has been extended to the Columbia River, approximately doubling the length of the line and leaving it within 20 miles of Ellensburg where the additional survey will probably bring it in connection with the main line again.

The city council of Olympia has renewed the franchise of the Eastside Ry. Co., which operates a spur from the Northern Pacific line on Jefferson St. to the water front at Olympia. Fred Schomber is secretary.

The construction of a ship canal connecting the Chehalis River at Elma with Puget Sound in the neighborhood of Olympia is proposed. The canal as proposed will be 16 miles long and would afford a safe passageway to all deep-water vessels in the Sound region. Representatives of the Andrews Engineering Co., 120 Liberty St., New York, are stated to have been over the ground.

The Puget Sound Bridge & Dredging Co., Seattle, Wash., has been awarded the contract by the city council of Olympia for making the fill at Water St. The contract price is $83,665.

The Northern Pacific Ry. has several crews of surveyors working out of Ellensburg on the Lind cut-off. This cut-off if built will parallel the line of the Chicago, Milwaukee & Puget Sound, and will save Northern Pacific trains the present detour south to Pasco and thence north through the tortuous Yakima canyon. The new line would save about two hours in the running time between Ellensburg and Spokane, and will cut about 100 miles from the present route. The new cut-off will also make possible the double tracking of the Northern Pacific from Stampede tunnel to Spokane, a proposition already determined upon, and will make Ellensburg the principal shipping point of the fruit and grain region now tapped at North Yakima. A. C. Stoner, Ellensburg, is in charge of the surveys.

Advices from Milltown, state that farmers and business men in the lower Skagit River Valley have raised over $50,000 toward constructing a dike to be about 15 miles long and to cost $100,000. The largest and most difficult work in the whole project will be the construction of a large dam across the head of the new channel which was formed during the recent high freshet. This work alone will cost about $60,000, but, as it is expected that the federal government will take hold of this work, the local farmers are bending every effort towards the main dike.

Right of way agents for the North Coast Ry. are working west of North Yakima securing the balance of right of way, which indicates that the work on the extension to Tacoma is to be pushed as soon as the road is

built into Tacoma this winter. The located line runs up the Rattlesnake River to the Cowlitz pass, thence by two routes, one down the Cowlitz River, the other up the Cowlitz to Bear prairie and down by way of Longmire Springs. The survey runs north to Tacoma and south to Portland, the Portland line following the Cowlitz down to Olequa. Surveys have also been made running down the east side of the Cascades and thence to Portland. Engineers for the last three months have been working on another survey running up the Natchez River and through the Snoqualmie pass, following down the middle fork of the Snoqualmie to Seattle. This is said to make a better route than the Milwaukee, which takes the North fork. The fact that right of ways is being secured by way of the Cowlitz pass is taken to indicate that construction work is to be along the original survey, rather than by the newly surveyed line by way of Snoqualmie.

The Inland Empire Electric Ry. has surveys underway for an extension from Colfax. Two routes are under consideration—one up Spring flat, thence crossing Union flat to Dusty and on to Hooper; the other is the old right of way purchase to Penawawa, crossing Snake River and going up Deadman Creek into the country back of Asotin. It is also possible that extension may go to Walla Walla. A. M. Lupfer has been in Colfax directing the surveys.

Right of way for the Ritzville branch of the Cornell Northern R. R. has been secured to a junction 38 miles north of Ritzville.

Advices from Husum state that the engineers surveying the big Klickitat Canal, which is to irrigate 600,000 acres throughout the Horse Heaven country, have reached a point near Bluelight in the eastern part of the county. The surveyors have been locating a large reservoir site in Spring Canyon, two miles south of Bluelight.

Right of way is being secured in Everett for the Everett branch of the Chicago, Milwaukee & Puget Sound Ry., and it is believed that active construction work will be started in that city by March 1. Construction work elsewhere on the line has been started, and the first construction camp has been established at Moncton, a short distance from the Snoqualmie Pass. E. J. Pearson, Seattle, Wash., is chief engineer.

The Aberdeen Construction Co., of Aberdeen, has begun work on its contract for preparing the ground for the station at Aberdeen for the Grays Harbor & Puget Sound Ry., a Union Pacific line. The contract provides for the removal of the sawdust and other refuse which now fills the tract along its entire length from the Western Cooperage plant to the Anderson & Middleton mill, the building of a bulkhead and the filling of the street with solid earth.

The city council of Chehalis has granted the Twin City Light & Traction Co., a six months' extension on its electric railway franchise in that city. The Centralia Council has also granted an extension. The company is pushing work at Centralia, the contractors grading National St., the heaviest work on the route. The council ordinance provides that the line must be completed and cars running by next July.

According to reports from Nine Mile, Wash., the Big Bend Transit Co., which has been granted the right of way at the junction of the Columbia and Spokane Rivers, is contemplating the purchasing of the Spokane & British Columbia right of way and constructing a line through Nine Mile, during the following summer.

Wisconsin Notes.

FROM CORRESPONDENTS AND OTHER SOURCES.

The Minneapolis, St. Paul & Sault Ste Marie Ry. is reported to have purchased the Bayfield & Western, a short line on the south shore of Lake Superior, running from the city of Washburn to a point near Cornucopia in Bayfield County. The line in question is used chiefly for logging purposes although the roadbed is sufficient for use for other purposes. It is said that this is the first step in the constructing of a road from Ashland to Superior. The line built is about 25 miles long and runs to within a short distance of Cornucopia. From the latter place to Superior is about 5 miles. The proposed Soo line from Ashland to Superior would extend from Cornucopia to Port Wing and Orienta and from there on into Superior, following closely the south shore of the lake.

Canadian Notes.

FROM CORRESPONDENTS AND OTHER SOURCES.

The Lachme, Jacques Cartier & Maesonneuve Ry., a subsidiary line of the Grand Trunk Ry., has applied to the city council of Montreal for permission to extend its line through the north and east end of the city in order to provide increased terminal facilities for the Grand Trunk.

The Alberta & Great Waterways Ry. Co., W. R. Clark, president, Kansas City, Mo., has awarded the contract for ties, bridge and culvert timber for its first 100 miles of line to the McInnis Lumber Co., Edmonton, Alberta. Contracts for ties, etc., for 50 miles of the line were let to James Walker, Fort Saskatchewan.

T. E. Kaiser, W. F. Cowan, R. McLaughlin, Oshawa, Ont., and R. R. Mowbray, Kinsale, Ont., have applied to the Dominion Parliament for a charter for the Toronto Eastern Ry., which proposes to construct an electric railway from Port Hope, Ont., to Toronto.

The Pine Pass Ry. Co., with offices at Edmonton, Albert, has applied to the Dominion Parliament for articles of incorporation. The company proposes to construct a railway from Edmonton, Alta., northwesterly to the confluence of the MacLeod with the Athabasca River, thence continuing northwesterly to Pouce Coupe Prairie, and thence southwesterly to Fort George on the Fraser River, B. C. The provisional directors include A. R. Chisholm, T. W. Lines and B. J. Saunders, all of Edmonton.

Advices from Spearfish, S. Dak., state that local contractors have submitted figures on grading to the Burlington and Northwestern railroads for two proposed extensions. The Burlington extension is to the coalfield northwest of Spearfish. The Northwestern estimates are said to be on grading for an extension from Whitewood to Sundance, Wyo.

A company of local capitalists at Aberdeen, S. Dak., are to build a street railway line there as soon as spring opens. The franchise calls for the construction of six miles of railway by Dec. 31, 1910.

The construction of a railroad from Chattanooga, Tenn., to Henderson, Ky., with a possible extension to Evansville, Ind., is reported to be under consideration. George Hickson, general traffic manager of the Chattanooga Packet Co. of Chattanooga, Tenn., is said to have been investigating the probable amount of traffic for such a road.

Advices from De Funiak Springs, Fla., state that contractors have been in that city figuring on the construction of the new De Funiak Springs R. R.

The Central Construction Co. of Memphis, Tenn., has been chartered with a capital stock of $25,000, the incorporators being C. E. Terrell, H. P. Woods, C. B. Rutledge, T. A. Evans and G. T. Fitzhugh.

Announcement has been made that the Union Pacific will build a roundhouse and shops at Evanston in the spring. The main line is also to be double-tracked east and west of Evanston.

The Chesapeake & Ohio Ry. has taken over all property of the Coal River Ry. and has agreed to expend $750,000 in improvements and extensions. The Coal River Ry. has 175 miles of road. H. Pierce, Richmond, Va., engineer of construction on the Chesapeake & Ohio.

BIDS ASKED.

Bridges.

Bids are asked on following work, the notes being arranged alphabetically by states:

Washington, D. C.—Until 2 p. m., Jan. 25, by Department of Interior, Office of Indian Affairs, Washington, D. C., for the construction of a bridge at the Uintah and Ouray Agency, Utah.

Jacksonville, Fla.—Until 9:30 a. m., Jan. 21, by Board of County Commissioners, for furnishing all material and labor for the construction of three steel and concrete bridges. Gail L. Barnard is County Engineer.

Buckley, Ill.—Until 10 a. m., Jan. 12, by W. Strouse, Town Clerk, for the construction of the Kauffman bridge to be built on the line between Loda and Artesia townships.

Philadelphia, Pa.—Until Jan. 18, by George R. Stearns, Director, Department of Public Works, for the construction of a bridge over the Richmond Branch of the Philadelphia & Reading Ry. in line of Wissahickon Ave. The structure will be of steel beam and plate girder encased in concrete type consisting of one 60 ft. span. The roadway between curbs will be 36 ft. wide and paved with asphalt with a 12-ft. granolithic sidewalk on each side. The work will require no substructure. Plans for the bridge, which is estimated to cost $18,000 are on file at the City Hall, Room 412. All bids must be for the work complete.

Toronto, Ont., Can.—Until noon, Jan. 18, by Board of Control, Joseph Oliver, Chairman, for supplying timber piles and driving same for the bridge on the extension of Wilton Ave. over the River Don.

Buildings.

Bids are asked on following work, the notes being arranged alphabetically by states:

Hot Springs, Ark.—Until 12:30 p. m., Feb. 7, by Maj. G. D. Deshon, Constructing Quartermaster, for the construction, heating, plumbing, wiring and electric fixtures of two double sets officers' quarters at the Army and Navy General Hospital.

Storrs (P. O. Eagleville), Conn.—Until 10 a. m., Jan. 15, by Thomas D. Bradstreet, State Comptroller, Hartford, Conn., for the construction of four cottages and one dining hall at the Connecticut Agricultural College, Storrs, Conn.

Pensacola, Fla.—Until 8 a. m., Feb. 9, by Board of County Commissioners for the erection of a building to be used for court house, office building and jail. James MacGibbon is Clerk of the Board of County Commissioners.

Bloomington, Ill.—Until 5 p. m., Jan. 25, by city, for the remodeling of its water works plant, including the reconstruction and remodeling of its buildings. Official advertisement will be found elsewhere in this issue.

Emporia, Kan.—Until 3 p. m., Feb. 15 (extension of date from Jan. 14), by James Knox Taylor, Supervising Architect, Treasury Department, Washington, D. C., for remodeling, etc., the U. S. Post Office at Emporia, Kan.

Kings Park, N. Y.—Until 3 p. m., Jan. 26, by State Commission in Lunacy, Capitol, Albany, N. Y., T. E. McGarr, Secretary, for the construction of four cottages for chronic patients, including heating, plumbing and electric work at Kings Park Hospital, Kings Park, N. Y.

Pittsburg, Pa.—Until noon, Jan. 12, by R. J. Cunningham, County Controller, for the installation and completion of the electric lighting fixtures for the Allegheny County Soldiers' Memorial.

Houston, Tex.—Until noon, Feb. 7, by Dan. C. Smith, Jr., City Controller, City Hall, for furnishing all necessary labor and material for the erection and completion of the new city auditorium. F. L. Dormant is Consulting Engineer.

Jacksonville, Tex.—Until 10 a. m., Jan. 24, by J. E. McFarland, Secretary School Board, Jacksonville, Tex., for the construction of a school building at this city.

Roads and Streets.

Bids are asked on following work, the notes being arranged alphabetically by states:

Birmingham, Ala.—Until 11 a. m., Jan. 19, by Maury Nicholson, City Engineer, for certain vitrified brick, asphalt, bitulithic and granitoid paving.

Dothan, Ala.—Until March 15, by W. J. Parish, County Commissioner, Gordon, Ala., for the construction of 51 miles of graded roads in Houston County.

St. Louis, Mo.—Until Jan. 21, by Board of Pubilc Improvements, for the improvement of 7 miles of streets with asphalt, brick, bitulithic and granite. The work is estimated to cost $400,000. Further information regarding the work will be found under St. Louis Items of Interest to Contractors.

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CONTENTS.

EDITORIAL:

Commission Government in Cities 49
Selection and Proportion of Aggregates for Portland Cement Concrete 50
John W. Alvord, President of Western Society of Engineers 51

CONCRETE SECTION:

Economical Selection and Proportion of Aggregates for Portland Cement Concrete .. 52
Comparative Cost of Constructing Two Identical Reinforced Concrete Buildings, One of Separately Molded Members and One of Members Molded in Place 55

EARTH AND ROCK SECTION:

Earth and Rock Filled Dam with Concrete Core Wall, Patillas Irrigation Project, Porto Rico 57
Cost of Stripping a Gravel Pit 58
A Special Hand Auger for Test Boring and Method of Using It in Prospecting for Coal 58
Method of Making a Blast Displacing 180,000 Tons of Rock, with Some Costs 59

ROADS AND STREETS SECTION:

Data on Street Work at New Bedford, Mass. 61
Concrete Pavement Construction at Boise, Idaho 61

RAILWAY SECTION:

Reports on Interurban Lines by Engineers and Promoters 62
Appraised Value of the Steam Railways of Wisconsin 62
Methods of Determining Relative Economy 63

GENERAL SECTION:

Methods of Filing Books, Pamphlets, Trade Catalogs and Periodicals for Small Private Libraries or Information Departments 65
Annual Meeting of the Illinois Society of Engineers and Surveyors 66
Processes for the Preservative Treatment of Timber and Approximate Costs of Treatment 66
The Fortieth Annual Meeting and Dinner of the Western Society of Engineers 67
The Reinforced Concrete Girder Bridge at Florence, Arizona 68

LETTERS TO THE EDITOR 69
COMING TECHNICAL MEETINGS 70
PERSONALS 70
CATALOGS WORTH HAVING 70

The Commission Form of City Government Is Certain to Come. How Will It Affect Engineers and Contractors?

"There is no denying the fact that the government of cities is the one conspicuous failure of the United States."—The American Commonwealth, by James Bryce.

This was the verdict of the great Englishman who is credited with having written the fairest and most searching treatise on American government. Mr. Bryce reached this conclusion years in advance of the full realization of its truth by Americans themselves. Suddenly, however, the country seems to have decided that the limit of municipal misrule has been reached in nearly all the larger cities and in most of the smaller ones. As illustrating the extent of this awakening we note the fact that on January 11th every city in Illinois excepting Chicago sent a special representative to the State legislature asking for legal authority to adopt the commission form of government.

Galveston, Texas, adopted this form of government ten years ago, following the "flood" that almost destroyed the city. We quote from the Philadelphia Press:

"Galveston was destroyed in September 1900, and the people, realizing that they needed the most efficient form of government obtainable to rebuild and rehabilitate that city, created a commission government. They placed the municipal government in the hands of five men. Councils were abolished and the whole duty of legislation, levying taxes, making appropriations and administering the affairs of the city devolved on those five men and the subordinates appointed by and responsible to them. The form of government proved so satisfactory and efficient that it has been retained and has been adopted by nearly a score of other cities and towns and grows in favor as far and as wide as the people have been made familiar with it."

Des Moines, Ia., a city of 62,000 by the last census, adopted this plan a few years later in a somewhat modified form. The government of that city is placed in the hands of a mayor and four councilmen, elected by the people. The functions of those five men are analogous to the board of directors of a private corporation. The business of the city is divided into five departments, viz., Public Affairs, Accounts and Finances, Streets and Public Improvements and Public Safety, Parks and Public Property. To each department is assigned that member of the governing board best qualified by experience and ability to act as superintendent of that particular work.

Haverhill, Mass., adopted the commission form of government about a year ago. It is a city which had a population of 37,000 at the last census, and was growing rapidly. It probably has over 45,000 now, but it was troubled under its old form of government by a deficit in its revenue at the end of each year. The commission government has changed this. At the end of the first year of commission rule the treasury showed an unexpected and unappropriated balance of $40,000, which favorable showing is naturally put to the credit of the new form of government. The justice of this is challenged, however, on the ground that the efficiency of the commission government is not due to the fact that a commission governs instead of Mayor and councils, but because the commission is composed of extra good men who if placed in power would have given good government under any form of government.

The city of Haverhill could get five good men to run its government when it could not have gotten fifty such men in its service. These five men needed the power of a commission in order to make it worth their while to give their time, energy and ability to the task of managing the city government. In a legislative body they would have had to meet and overcome the inertia, indolence and ignorance of associates less capable than they. In executive authority they would have been hampered by councils and perhaps thwarted by political bosses not holding any public office. They were good men, given power and responsibility, and good results followed.

This is the experience of commission government for cities wherever it has been tried in this country. Even if it failed to come up to expectation it could not possibly be so persistent and lamentable a failure as the average city government by mayor and councils. The commission form of government is being adopted with joy in many States. The demand for it is as wide as the continent and shows no sign of abating.

We have commented editorially upon the recent adoption of a commission form of government by Boston, the first large eastern city to make any change from the time-honored "representative system." With such examples before the country it is not risking too much to predict an entire revolution in American city governments within the next five to ten years. How will this affect civil engineers and contractors?

Considering first the effect upon engineers, it is plain to be seen that many engineers will become members of the commissions that govern the cities provided they exert themselves in the slightest degree personally, and particularly if they act in bodies to secure recognition. We have repeatedly urged the importance of appointing engineers as the executive heads of the majority of city departments, for the major part of a city's work is of a civil engineering nature. The streets, the sewers, and the waterworks certainly present nothing but civil engineering problems for an executive to consider; and it is idle to talk of having engineers to act under an executive who himself is incapable of judging their ability.

The very fact that engineers are not politicians will be itself a powerful appeal for their selection as commissioners. But it devolves upon engineers to present this appeal to the public, acting as a body, just as organizations of doctors have secured the appointment of physicians on boards of health, just as organizations of teachers have, in a measure, obtained recognition on boards of education. As soon as any city adopts the commission form of government, the engineers of that city, acting as an organized body, should use every means to promote the selection of engineers as members of the commission. If they do no more than conduct a publicity campaign, they are likely to secure the selection of at least one or two engineers, and that will be a leaven at least which will work for the good of economic administra-

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tion of those departments that are civil engineering in their nature.

We have spoken of economic city administration, and to some contractors this may savor of niggardly appropriations for city work. But a little thought will prove that the reverse will be true. Tax payers do not object to the spending of money wisely and honestly. In fact they have been so long used to unwise and often dishonest expenditure of public funds that a change to the commission form of government is bound to result in greater liberality in expenditures for pavements, sanitation and water supply—*for economic expenditures always pay as an investment.* Lives saved by sanitation, such as filtering water, represent a monetary gain to the community. Sickness saved from absence of microbe laden dust is likewise an economic gain. While larger loads hauled over good pavements is self-evidently a profitable result of street improvement, particularly where it is secured by means of a durable pavement.

"In twenty-five years," says a recent editorial of the Leavenworth Times, "under the old political council system, Leavenworth paved only fourteen and one-half miles of streets. This year five and one-half miles of streets are being paved. Under the old political government the city paved a little more than one-half a mile a year, although a reserve of $10,000 a month was pouring in from the saloons. Under the commission government we are paving more than five miles this year. At this rate we will pave 130 miles of street in twenty-five years, while the old political government paved fourteen and one-half miles in twenty-five years.

"Under the old system of government property owners objected to paving the streets, paving costing too much. The present system of government cannot pave the streets fast enough to please the people, for they know now they get value for their money."

It is one of the fundamental principles of political economy that if you cheapen the unit cost of production you increase the number of units consumed. So, too, money that has been wasted or stolen would have been used for actual betterments—pavements, sewers, etc.

Clearly the only contractors who can see anything but more business for themselves by the change to commission government are political-contractors. They are too few to be worthy of consideration, even if they had a worthy cause. Moreover, those very men—if they have real business ability, as many of them have—will ultimately be the gainers by this house-cleaning.

One more quotation with reference to Houston, Texas, will serve to indicate the effect of honest and economic city administration under the commission form of government:

"In the first eighteen months the commission brought the city to a cash basis, paid off a floating debt of $375,000, spent over $150,000 for new school buildings, paved with vitrified brick three important streets, Main, Milan and Liberty; paid all officers and employes in cash and paid all interest on bonds and reorganized the police and fire departments so that all departments of the city are now working harmoniously. What surprised the interested inquirer is that after the large expenditure made by the commission, they were able to reduce the tax levy for this year by ten cents on the one hundred dollar valuation."

Finally, the commission form of government will surely lead to the doing away with the day labor system, and the substitution of the more economic contract system of doing public work. Even classes of work like street cleaning and repairing, where inspection and measurement of contract work is not always easy, are pretty sure to be handled under some form of contract rather than by day labor. For, with an administration largely free from politics, it will be possible to enforce cleaning and repair contracts as well as to secure open competition in the bidding. As it now stands, many an honest contractor is often deterred from bidding on municipal work for fear he will "get the harpoon thrown into him" if he is awarded the contract.

We trust and believe that a lasting and profound reform in American city government is at hand.

The Selection and Proportion of Aggregates for Portland Cement Concrete.

The literature of concrete is very full on the important subject of proportioning the aggregates, yet we feel no apology necessary for printing in this issue an article on the subject by Mr. Albert Moyer. The idea is not at all new that maximum density means maximum strength. Many years ago concrete workers noticed that an excess of mortar was weakening and that an excess of mortar was only present in concrete made with aggregates containing a large per cent of voids. It is a condition similar to that in masonry walls with wide mortar joints.

Acting upon this discovery some of the older, shrewder men began to make void determinations and graded the aggregates. It was believed and was commonly mentioned in the older text books that broken stone fairly regular in size occupied double the space of solid stone, hence the voids were 50 per cent and this amount of sand was provided, the cement in turn being one-half the bulk of the sand. Thus came the 1:2:4 mix and in all concrete specifications the stone had to be very regular in size and the sand coarse. Concrete made 50 years ago under such specifications cannot be as dense as similarly proportioned concrete of today.

Some man found that fine gravel equal in amount to the sand would not increase the bulk of the stone, but did make a dense concrete, so we find men advocating mixtures of 1 sand, 1 fine gravel and 2 of broken stone. Believing that this was still a 1:2:4 mixture, as it actually was, the cement was still in bulk equal to half the sand. We can readily believe that in the course of time the significance of the large quantity of stone disappeared and men used a 1:3:6 proportion. Just how much cement was used no one knows. As late as 20 years ago specifications for concrete used bushels, loose, heaped and struck as well as loose barrels and packed barrels for measuring the cement. Superintendents in charge of work generally left the concrete work to the wise old foremen who had experience. Many engineers at that time discharged men who mixed "mushy" concrete, much to the astonishment of old fellows who knew by experience just how much water to use, and "sensed" density and thus proportioned the cement.

When it was realized that a little cement went a long way there was a period, from which we are now beginning to emerge, in which fancy ran riot in concrete proportioning. In a 1:2:4 mix the cement is 1-9th and in a 1:3:6 mix it is 1-10th the mass and the 4¾ per cent costs money. Lean mixtures and fat mixtures meant the percentages of cement shown on paper, whereas the voids, about which no one cared, made a tremendous difference, unknown however. When men read papers and told about mixtures of 1 to 12 and 1 to 16 they did not in all cases tell about the care exercised in filling the voids. That was a trade secret and a man who obtained a very strong concrete with an extraordinary lean mix was preferred to the man who could not do so well.

The study of scientific grading is a development of very recent years. The most ignorant concrete workers now know that it is proper to mix fine and coarse material and that good concrete is dense concrete. Much that has been written has come from laboratories and is on the face difficult to follow in reading and considered, as much of it is, almost impossible to apply on actual work. Whether all that Mr. Moyer recommends can be applied on all construction work, or even a small part of it, is of no moment. He has given in a plain understanding way a conception of concrete manufacture that will have a good effect on this industry.

The idea of a fixed arbitrary proportion will obtain for a long time. From the nature of things it must unless we add enormously to the inspection cost of work. That the fixed arbitrary proportion will give way in time to a scientific grading of materials, and quality of concrete can be assured within very small limits and that ultimately a proper method for writing specifications will come into common use to insure this desirable result no one now doubts. The importance of the subject being understood; methods to secure good results being now available in proper form to be serviceable to even the contractor on the hurried construction, a specification is needed. An opportunity is offered for some engineer to clothe the idea in proper words so that the fixed arbitrary proportion will disappear and the concrete of maximum density be required hereafter on all work. Some men are now doing it on their own work in a more or less crude way, but the practical worker for whom specifications are written positively requires specifications as a part of his instruction in his business.

The Library of Congress at Washington, D. C., is now probably the third largest collection of books in the world, passed only by the British Museum in London and the Bibliotheque Nationale at Paris. During the fiscal year ending July 1, 1909, 167,677 volumes were added, making the total number in the library 1,702,685. The collection of maps and charts now numbers 111,343, the music collection comprises 501,293 volumes and pieces, and the statistics of the prints division show 303,036 pieces.

John W. Alvord, President Western Society of Engineers.

John Watson Alvord, hydraulic and sanitary engineer of Chicago, recently elected president Western Society of Engineers, was born Jan. 25, 1861, at Newton Center (Boston) Mass. He was the son of the Rev. John Watson Alvord and Myrtilla (Peck) Alvord. The Alvord family came originally from Somersetshire, England, ancestors arriving in this country in 1630-35, settling at Windsor, Conn., and later at Northampton, Mass., where several generations lived. Branches of the family removed to Easthampton, Conn., where Mr. Alvord's father was born.

The family removed to Washington, D. C., at the close of the war in 1866. The subject of this sketch was educated in private schools and prepared for Sheffield scientific school at Yale in 1877, but was prevented from entering by poor health. A year as a law student in New York city, followed by two years of practical railroad work in Colorado, preceded his commencement of engineering work in Chicago, January, 1880, in the office of John A. Cole, C. E.

The first work of importance upon which Mr. Alvord was engaged (as assistant engineer) was the extension of the sewer system of the Hyde Park district of Chicago and the new water-works built there in 1882-3. This work involved the construction of an inlet tunnel under Lake Michigan a mile in length. Later work included the laying out and improving of such suburbs as Edgewater and Buena Park and general surveying. In 1883 he had charge of the large trunk sewers in the Hyde Park and Lake View districts of Chicago.

In 1884 Mr. Alvord was appointed city engineer of Lake View (now Chicago) and held that office for four years, during which time he remodeled and extended the Lake View water-works to about fourfold its original capacity. He also had charge of many miles of street paving, lake shore protection and sewer work, and organized the methods and records of an office that cared for a total expenditure of about $2,500,000 during the four years he held office.

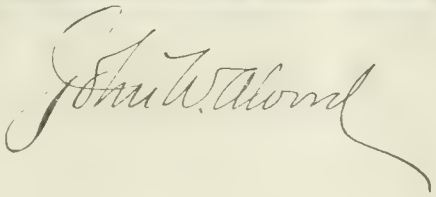
After the annexation of Lake View to Chicago in 1888, Mr. Alvord spent nearly a year in Europe examining public works and collecting data on water supply, sewerage and sewage and water purification. In 1889 he was appointed town engineer of Cicero, west and adjacent to Chicago, where he designed a system of main drainage comprising about 380 miles of sewers, much of which has since been built. He also superintended some 40 miles of street improvement and was consulted at this time on water-works matters by Duluth, Minn., Muskegon, Mich., Hurley, Wis., and Ironwood, Mich.

In 1890 Mr. Alvord was appointed chief of an engineering department of the world's Columbian exposition at Chicago, having for three years charge of the dredging, grading and filling of the grounds and the construction of roads, surveys and grades. At the dedication ceremonies he was presented with one of the seventy medals received by the designers of the fair.

During 1892-3 he was chief engineer of a water supply conduit 92 miles long from Waukesha to the world's fair grounds for supplying refrigerated drinking water. At the close of the fair he assisted in compiling the report of the director of works.

In 1894 Mr. Alvord again visited England and the continent and broadened further his information on foreign engineering works. Returning home he opened an office in 1895 for the general practice of his profession in the especial lines in which he has been actively engaged ever since.

From 1897 to 1901 he was consulting engineer to the commissioners of the Illinois and Michigan Canal, conducting important litigation and advising on the construction of large hydraulic works at Joliet and reporting on



various hydraulic powers belonging to the state of Illinois.

In 1899 he was retained by the city of Columbus, Ohio, as consulting engineer on sewer problems, designing a system of 75 miles of sanitary sewers for that city since constructed; also reporting on the sewage purification problem.

In 1905 he was entrusted by the United States Steel Corporation with the design and construction of the sewerage and water supply of its new steel city at Gary, Ind. This work occupied three years, cost about $1,500,000, and involved a 3-mile inlet tunnel under Lake Michigan, a pumping station of 20,000,000 gals. daily capacity, 25 miles of water distribution system and over 25 miles of trunk and local sewers with ultimate designs for sewage purification works.

In 1907 he was engaged by the city of Evansville, Ind., to advise and superintend the erection of a mechanical filtration plant of 12,000,000 gals. daily capacity on quite difficult foundations; also a low lift pumping plant and interesting foundation problems for the repair of the original pumping station.

Of late years Mr. Alvord has acted as consulting engineer on water-works problems for the cities of Grand Rapids, Mich.; Rock Island, Ill.; Cedar Rapids, Ia.; Terre Haute, Ind.; Council Bluffs, Ia.; St. Louis, Mo.; the city of Chicago, the Union Stock Yards of Chicago, Evansville, Ind.; Des Moines, Ia.; Gary, Ind.; Racine and Kenosha, Wis.; Davenport, Ia.; water works, Norway, Mich.; Bloomington, Ind.; Manistee, Mich.; Winona, Minn., and many other smaller cities.

Mr. Alvord has made many valuations of water works properties as member of boards of appraisers or by testifying as expert in court. Among the cities and water companies he has served in this manner are: Omaha, Neb.; Mobile, Ala.; Sheboygan, Wis.; Flint, Mich.; Knoxville, Tenn.; Dubuque, Ia.; Fergus Falls, Minn.; Fort Smith, Ark.; Valparaiso, Ind.; Des Moines, Ia.; Waterville, Me.; Quincy and Peoria, Ill., and other places.

Mr. Alvord has made a special study of sewerage work and has designed sewer systems for upwards of 75 municipalities. In many cities he has, in addition, constructed sewage disposal plants which have successfully purified the wastes of these communities. Some 20 cities have adopted this system under his advice.

Mr. Alvord has also been often called upon to report on water power projects both from the economic and engineering standpoint. He reconstructed the dam and water power at Des Moines, Ia., and has investigated river flow and water power at numerous places, and has been retained as expert in many cases of flood litigation.

Mr. Alvord is a member of the American Society of Civil Engineers, past first vice-president of the Western Society of Engineers, first vice-president (1909) of the American Water Works Association, member of the New England Water Works Association, the Central States Water Works Association, the Illinois Water Supply Association, the American Society of Municipal Improvements, past president (two terms) of the Illinois Society of Engineers, member of the American Public Health Association, the American Association for Advancement of Science and the American Academy of Political and Social Science.

Mr. Alvord is the author of a number of professional papers contributed from time to time to the societies of which he is a member. The more important of these deal with the subject of sewage purification and the economics of valuation. In 1902 he received the Chanute medal of the Western Society of Engineers for his paper on "Sewage Purification Plans."

Mr. Alvord resides at 5203 Hibbard avenue, Hyde Park, Chicago, and has his office in the Hartford building, corner Madison and Dearborn streets. He is locally a member of the Chicago Engineers' Club, the City Club, the Chicago Y. M. C. A. and the Hyde Park Presbyterian church. He married September 4, 1889, Helen C. Cornell of Chicago.

Concrete and Reinforced Concrete Section

Note: This section is devoted to methods and cost of constructing concrete and reinforced concrete structures. It will cover the selection, testing and proportioning of concrete materials; laboratory tests of concrete; concrete mixing, transportation and placing; fabrication and placing of reinforcement, and form construction and erection. It will also contain articles on new and interesting developments in the design of reinforced concrete.

Economical Selection and Proportion of Aggregates for Portland Cement Concrete.

BY ALBERT MOYER.

The object of this article is to give a practical method which will enable any concrete constructor to make economical use of the best aggregates, so proportioning them as to give the maximum strength and density with a minimum amount of cement. Concrete under discussion is plain and not reinforced, for reinforced concrete, an over-cemented mixture, is sometimes necessary, particularly in column construction.

There is a theory that the strength of concrete depends entirely on the adhesion of the cement to the sand and stone. The writer cannot see any tangible reason for this theory as applied to compression strength, for which concrete is designed. Eliminating tensile strength from the mind, it would be possible to make a concrete with a hardening noncementing material, which could be poured in between the particles of sand and stone so as to fill the voids. While this material would not adhere to the sand or stone, it binds around each particle and thus not only furnishes an arch action, but by its own strength keeps the mass from spreading. Portland cement not only binds around, but also adheres to each particle of the aggregate. Therefore maximum density is maximum strength in a well balanced concrete of the best materials.

The ideal or theoretically perfect concrete is that in which the best aggregates are scientifically proportioned and graded in size so as to reduce the percentage of voids to the minimum giving the greatest density. It is theoretically possible to so grade the aggregates in regular progression from 2 to 3 in. stone down to distinct pieces the size of dust, so that the voids of each progressive volume are filled with the largest size particles that will fit them. Thus a minimum of cement will give a stronger concrete in compression than could be obtained with a larger percentage of cement, using same quality of sand and stone, but not properly graded in size.

The ideal and practical, however, are entirely different matters. What the practical user of cement needs is practical information and not a mass of theories which obscure the vision and make it difficult for the "man in the field" to see the few simple laws and underlying principles which, if kept constantly in view, will lead to the best results.

Concrete should be considered as a whole, a definite material designed to meet the requirements of the particular work it has to perform; however, in order to intelligently consider concrete as a whole, we must analyze the function of each of the aggregates.

SELECTION OF THE LARGER AGGREGATES.

In discussing the selection of aggregates, I will first deal with the larger size, for the reason that in proportioning the ingredients it is first necessary to measure the voids existing in any given quantity of the largest particles, so as to determine the quantity of mortar necessary to fill these voids. After selecting the best stone or gravel economically obtained in the particular locality in which the work is to be done, the next thought is the grading of this material so as to obtain maximum density, thus reducing the voids and consequently the amount of mortar required to furnish the bond.

As the value of broken stone depends on several conditions, the following classification, read in the order in which they are stated, must be taken merely as a guide: Trap, quartz gravel, limestone (hard), granite, marble, limestone (soft), slag, sandstone, slate, shale and cinders. (N. B.—Poor grades of schist and all micaceous stone should not be used.) Among the conditions which must be taken into consideration are toughness and hardness as being better than stone which may be of a higher classification, but which is more easily fractured. The importance of toughness and hardness as related to strength, increases with the age of the concrete.

The purpose for which the concrete is intended must always influence the selection. For a very strong concrete, a hard stone without any surface scale is necessary; a richer mortar will not entirely counterbalance a deficiency in the strength of the stone. For a medium strong concrete the hardest stone need not be insisted upon, but rather one to which the mortar will best adhere, such as some of the limestones. For fireproof construction some of the limestones and rocks containing feldspar should be avoided; good boiler furnace cinders have proved best for fire-resisting concrete.

For all classes of concrete, stone breaking in cubical form is far better than one breaking in flat layers such as shale or slate, it being almost impossible to ram or tamp such stone into as dense and compact a mass as that breaking in cubical fracture.

The size of the stone aggregates depends on the purpose for which the concrete is to be used. For large masses of concrete, 2½-in. stone is usually considered the maximum size, but for 12-in. walls and the usual class of concrete construction, ¾-in. will be found sufficiently large. In considering the selection of broken stone, it must be borne in mind that screenings, quarry tailings, etc., in crushed stone, are not a detriment, as is commonly supposed, but in fact a decided advantage, for the reason that the voids are thus reduced, giving greater density and consequently greater strength; each particle is proportionately as strong as the largest piece of stone from which it came, unless stunned in crushing, as might occur in granite and sandstones. When screenings are used as a portion of the larger aggregates in concrete, the (1-100 or less) dust should not be in excess of 10 per cent of the volume of screenings, which will pass a ¼-in. mesh, as the dust is apt to coat the stone so that the mortar does not come as readily in direct contact with the larger pieces of stone. If the mortar does happen to reach every portion of the surface of the larger aggregates, it is from necessity made less rich by the dust; therefore, dust and other particles which will pass through a ¼ or ⅛-in. mesh should be screened out and used as part of the mortar. This, however, is largely a matter of very careful and thorough mixing. If mixed thoroughly the stone dust becomes incorporated in the mortar. Therefore, the mortar will adhere as readily to the stone as if the dust were not present. However, the mortar is weakened, and for this reason in making test as to the quantity of stone to be used, the dust should be screened out and figured as part of the mortar, which question will be treated later.

Material which is foreign to the stone, such as vegetable mold, scale, or loam, which cling to the surface, will reduce the strength of the concrete. This again is largely a question of careful and thorough mixing. Numerous tests conducted during the last several years by competent engineers have shown that clay in small proportions not over 15 per cent, when well mixed in the mortar, does not reduce the strength of the concrete; in fact, tests have shown that the strength has been increased. This applies particularly to the leaner mixtures. If carefully mixed, therefore, the clay will not cling to the stone, but will become part of the mortar, and in testing for proportions of stone, sand and cement, the amount of clay present should be figured as part of the mortar and not as part of the stone.

Gravel is often superior to broken stone, being usually found graded from coarse to fine; the roundness of the pebbles lends aid to compactness. It is not likely to bridge and leave holes in the concrete. The percentage of voids is usually less than in broken stone; the quartz pebbles are harder, stronger and less liable to fracture. In this discussion quartz pebbles or other very hard pebbles are referred to; sand stone pebbles are not considered as good as the better grades of crushed stone. The usual argument against gravel is that the mortar is not supposed to adhere as well to the surface as to that of freshly broken stone. This is one of the theories which is practically due to the appearance of the surface to the eye or touch; the adhesion of mortar to limestone of a smooth surface may be far greater than to sandstone or rougher materials. If roughness were the only requirement for adhesion it would seem impossible to cement together two pieces of glass.

From the standpoint of durability, gravel must be superior to stone for the reason that, by the laws of the survival of fittest and by process of elimination, nature has supplied us with the most durable. Short time tests for compression strength usually show broken stone concrete to be superior, but long time tests of from six months to a year show gravel concrete on an average to be equal if not stronger. In construction work where tensile or other stresses are to be cared for, as may occur in reinforced concrete, crushed gravel should be used. The cement will adhere more readily to crushed than to the rounded, polished surface of the gravel.

There is much more to be said on the subject of the selection of the larger aggregates, but the writer believes that the ground has been covered sufficiently for practical purposes.

MORTAR FOR CONCRETE.

Mortar for concrete is composed of Portland cement and sand (preferably coarse, but graded in size), or other fine materials, such as crushed stone, all of which will pass a ¼-in. sieve. Considering the mortar, we have to keep in view the purpose to which the concrete, as a whole, is to be put, so as to judge the necessary strength of the mortar.

It is possible to determine the voids in the larger aggregates, but in the matter of sand for mortar, such a method is practically useless, owing to the variable conditions surrounding the use of sand. However, the writer will endeavor later on in this article to describe a means whereby the quantity of cement required for mortar can be determined.

In the selection of screenings of quarry tailings, these materials should be from hard, tough stone and free from mica, loam, peaty matter, decayed particles and scale. If used as the entire aggregate for mortar without addition of any sand, 33 per cent of dust has given good results, as is demonstrated in the manufacture of architectural cement stone, which is now being made in considerable quantities by the use of sand moulds. Lime stone screenings graded in size from ¼-in. to fine dust have in numerous instances given greater strength than has mortar made of the same quantity of the best sand. It will also be found that the resulting mortar is denser than a sand mortar, and thus better for waterproofing purposes.

The character of the particles, whether they be flat, cubical or round in the matter of quarry tailings, has little to do with the dense mortar which is obtained by their use. That the mortar is dense is a practical fact, and

1123 Broadway Building, New York City.

as this paper is not a theoretical treatise, I do not feel called upon to go deeply into the theory which will explain these results, excepting briefly to outline that the density depends on the proper graduation in size of the particles and the percentage of very fine particles and dust present.

In the densest sand mortar obtainable, the crystallization of the cement which binds together these grains still leaves minute spaces between the crystals, no matter what percentage of cement was used. It is altogether probable that in the case of quarry tailings these minute spaces are filled with particles of dust. There can be no reasonable doubt that with the best material the densest concrete will be the strongest under compression. This idea can be readily grasped if you will eliminate tensile strength from your mind, as concrete is designed almost entirely for compression.

It so happens, however, that quarry tailings or screenings from the best crushed stone when made into briquettes for tensile strength tests will show far greater tensile strength in long periods than will the best quality of sand mixed in the same proportions. The writer has in his possession a broken briquette made of one part Portland cement, 2½ parts quarry tailings which contained 33 per cent of fine dust, which briquette in two years' time broke at 1,000 lbs. per sq. in.

We now come to the selection of sand. The value of sand for concrete mortar depends largely on its coarseness, graduation in size of the grains and cleanliness. Fine sand contains more voids, more surfaces to coat, and requires more cement and water than coarse sand.

The sharpness of the grains of sand has little to do with its value. It has commonly been supposed that sand should be sharp. This, however, is one of the theories which has been exploded. The writer has never seen any tangible reason for such theory. In fact, there are many arguments in favor of coarse, round grain sand. Compactness is what is desired, giving density to the mortar; round grains compact more readily than sharp grains, and the cement will cling to the surface of round grains as well as sharp grains, the character of the surface being identical. Sharp sand is only of value as indicating a silicious sand.

Good sand cannot be easily defined, or an inflexible specification written, as sands of various properties may make equally good concrete. All things being equal, a coarse sand containing a large percentage of coarse particles is far superior to a fine sand in which few coarse particles are present. Sand test for coarseness should be as rigidly enforced as the cement test. The full strength of any cement cannot be developed with a sand, all the particles of which are fine, or so fine as to all pass through a 16 or 20 mesh sieve.

The best sand is that which, when mixed with cement and water in the required proportions by weight, produces the least volume of mortar. Economy can be practiced in the matter of the selection of sand. It will nearly always pay the concrete constructor to haul sand even from a considerable distance, paying a higher price, provided he cannot get a sand in the immediate locality of the work, which sand is so graduated in size of grains as to give the greatest density.

As a means of determining the best sand for use in any given mortar, it will be well to experiment as to a mixture of two or more sands which will give the desired results. Cement should be mixed with the sand so as to provide conditions similar to actual work, for the reason that cement acts as a lubricant, allowing greater compactness than could be obtained with sand alone. The following method will be found far more accurate than that of void determination, and is practical, as it more nearly approximates the conditions surrounding the use of such sand in actual work.

Provide two or more glass graduates, each containing from 200 to 250 c. c., the glass graduates to be about 1½ to 2 ins. in diameter. Select several samples of sand, one a coarse sand, another a medium sand and another a fine sand. Wet each of the samples of sand so that the consistency when squeezed in the hand will cause the sand to hold its form without there being any appreciable excess of water, so that each sample of sand, while containing necessarily various percentages of water, will be about the same consistency. Take 70 c. c. of the coarse and mix 30 c. c. of the fine sand. Weigh 1.609 ozs., or 1 oz. 266.8 grs. of cement. This will give you approximately a mixture of 1 part cement to 3 parts sand. Mix the cement with the sand, add sufficient water to bring the sample to the consistency as is usually used by brick or stone masons, and note carefully if the mortar works smooth and is reasonably free from air bubbles. Place this in the graduated glass, little by little, tamp slightly, a little at a time. After your entire sample has been placed in the glass, note the volume as is read on the scale.

Mix the second sample, using 50 c. c. of the coarse sand, 30 c. c. of the medium sand and 20 c. c. of the fine sand, add same quantity of cement as before, mix with water as before, place in graduated glass and note the volume. Make several samples, using different proportions of the different size grains of sands, always using the same total quantity of sand (100 c. c.) and cement (1.609 oz.) in the mixed mortar; the sand which produces the least volume of mortar will be the best to use. The proportion of cement to be added to this selected sand to give the best results required by the character of work to be done will be described later.

To determine cleanliness, take a sample of sand, pour some clean water into a glass, pour a little sand in at the time. If the water become muddy, the sand may contain loam, peaty matter and decayed particles. It is also well to ascertain whether the murky condition of the water is caused by the presence of clay. If so, the sand should not be rejected, provided the clay is not in excess of 15 per cent of the volume of the sand, it having been shown by numerous tests that clay is not a detriment when in small proportions. Ground, well burned terra cotta or brick, all of which will pass a ¼-in. mesh sieve, may be used with sand or screenings without appreciably reducing the strength of the mortar.

SELECTION OF PORTLAND CEMENT.

Now comes the most important ingredient in concrete, Portland cement, as it is this material which forms the bond. The other aggregates being usually stronger, upon the uniform strength of the cement depends the strength of the concrete. The selection of stone, screenings, slag, cinders, sand or other ingredients can be determined often by sight or touch, or at least by simple tests. They are well known and have definite requirements; not so with Portland cement. Tests require experts of some years' experience; the results of known laboratory tests are merely a guide from which deductions may be made only by the best scientific understanding available. Owing to the variable conditions surrounding such tests, the results cannot be absolute. Specifications as to numerous tests to which the cement shall be submitted before passing inspection furnish a check or guide as to the quality, but there is as yet no specification which has come under the writer's observation which could not be complied with by shrewd manufacturers substituting an adulterated product.

Each manufacturer exploits his particular brand as the best cement, some claiming extraordinary fine grinding the criterion, others larger bulk per barrel, others low lime content, others coarse grinding (such as a prominent German brand), others high lime content and hard burned clinkers, etc., etc., and all of them claim the strongest by test, which claims they support by various published test sheets.

In order to select the best grade of cement for very important work, the engineer or constructor should specify the requirements of the standard specifications as adopted by American Society for Testing Materials. He should then select for purchase the brand that is produced by manufacturers of experience and reputation, as ascertained from engineers, not one but a number, their experience extending over at least five years with several of the well known brands. Having selected one or more brands of the best reputation, he can hold as check against errors or mistakes in manufacture the test described by the specifications above referred to. The brand purchased will necessarily not be the cheapest, but results will undoubtedly prove such brands to be more economical, as less cement may with safety be used, that of the universally best reputation is more liable to be uniform and would not require the same factor of safety. The strength of a concrete beam is limited by the strength of its weakest part. Two bags of inferior cement may jeopardize an entire floor. This method of selecting Portland cement always gives the user the best material obtainable at the fairest price, making it to the advantage of the manufacturers to produce for the engineer's interest, also offering an incentive to the manufacturer to produce the best product at all times, making improvement as science advances.

CORRECT PROPORTION OF AGGREGATES.

I have now described as briefly as possible the requirements of the ingredients entering into good concrete. The proper proportion of these ingredients, or aggregates, will now be considered. First in order are the larger aggregates. Having selected the available stone or gravel best adapted for the character of construction desired, it is necessary to determine the voids or spaces between the stones, in order to ascertain the quantity of mortar required to bond together the stone or gravel, at the same time furnishing a maximum density with a mininmum amount of mortar. Table I, if followed accurately, will be a simple method of furnishing this information:

TABLE I.—PERCENTAGE OF VOIDS.

Make a box of such dimensions as will contain 3 cu. ft. (1x1½x2 ft.). Dry the stone or gravel, heated over 212° F. Throw stone in box loose, small quantity at a time; level off top with straight edge. Having first weighed the box, weigh the box when filled, deduct the weight of the empty box from the gross weight and divide the net weight (which is the weight of the contents) by 3, which will give the actual weight of one cubic foot. Apply following table:

Weight per cu. ft.-lbs	Gravel.	Sandstone.	Limestone, medium soft.	Limestone, medium hard; Sandstone hard.	Granite, Blue stone, Limestone hard.	Granite hard, Trap medium.	Trap hard.
70	57	53	55	57	59	60	61
75	54	50	52	54	55	57	59
80	51	47	49	51	52	54	56
85	48	43	45	48	50	51	53
90	45	40	42	45	47	48	50
95	42	37	39	41	44	46	47
100	39	33	36	38	41	43	45
105	36	30	33	35	38	40	42
110	33	26	29	32	35	37	39
115	30	23	26	29	32	34	36
120	27	20	23	26	29	31	34
125	24	16	20	23	26	28	31
130	20	13	17	20	23	26	28
135	17	10	13	17	20	23	25
140	14	6	10	14	17	20	23

Before ascertaining voids in stones containing screenings and in gravel containing sand, dry by heating, screen out all the particles which will pass through a ¼-in. mesh sieve. Such particles should be figured as a portion of the mortar, which will be treated later. Having obtained the percentage of voids in the larger aggregates, the proportion of mortar necessary to fill these voids is thus known. The stone having been measured loose, you are figuring on a slight percentage of voids more than would be actual in tamped concrete, due to lubrication of the stone by the mortar and by compaction in tamping. You will thus have a little more mortar than is required to fill the actual voids. This, however, is necessary to offset any unevenness in mixing.

The quantity of mortar having been deter-

mined, the most difficult problem of all now confronts us, that of obtaining the proper proportion of cement to sand or other finer particles which will give the maximum density and strength, with the minimum amount of cement, so proportioned as to give the volume of mortar required. Many have supposed that by ascertaining the voids in the sand the quantity of cement is thus definitely stated. This is not so; in fact, an attempt to apply the voids in sand to the quantity of cement required will prove misleading. There are a number of conditions surrounding and affecting sand which will make the available voids in the same sand vary to such an extent as to make such a method useless. When moisture is added to sand and the sand mixed, it swells in volume. Thus we have more voids in a cubic foot of damp sand than we have in a cubic foot of dry sand. At the same time, the available voids in the damp sand are different from the available voids in the dry sand. Fine sand takes up more water than coarse, and swells in volume considerably more. Again, water added to cement so as to form a thick paste reduces the volume. A cubic foot of packed cement will not always make a cubic foot of paste.

The formation of mortar by mixing sand or other finer aggregates with cement will now be described. This is best done by test, not as to voids, but as to the density and plasticity of the mortar produced by certain proportions of cement to sand.

The writer's object is to make practical and easy tests of the material at hand. Tests to be made in such manner as to approximate as nearly as possible the conditions which will exist in actual work. Having studied over various methods of obtaining these desired results, I have found that most of the methods are not practical to the average concrete constructor or the "man in the field," to whom this information is of the most value.

Provide two or more graduated glasses 1½ ins. in diameter containing 100 c. c. or over, and scales which will weigh 8 ozs. to 1-64 ozs. (or ounces or grains) (or ounces and tenths). In proportioning mortar for actual work, it is convenient to assume 95 lbs. (one bag) of Portland cement as representing 1 cu. ft. in volume when packed. Therefore, in making test samples to determine the percentage of cement to a given quality of sand which will give the required density or strength of mortar, the Table II is provided, which gives the same relation of weight of cement to 1 c. c. in volume packed, as 95 lbs. is to 1 cu. ft. of cement packed. It will therefore make no difference whether 95 lbs. is actually 1 cu. ft. or not. More accurate results can be obtained by weighing the cement than by measuring. At times you would shake the cement in the graduated glass to a greater density, or tamp it to a greater compactness than you might at others.

On the assumption that: One cubic foot of Portland cement packed weighs 95 lbs., then any number of cubic centimeters will weigh the amounts given in Table II.

TABLE II.

1.....		23.5 grs.	= 3-64 approx.	=0.047
[illegible]		[illegible]	[illegible]	[illegible]
15.....		352. grs.	=52-64 approx.	=0.813
20.....	1 oz.	32. grs.	1= 5-64 approx.	=1.078
25.....	1 oz.	149.5 grs.	1=22-64 approx.	=1.344
30.....	1 oz.	266.8 grs.	1=39-64 approx.	=1.609
40.....	2 oz.	64.1 grs.	2=10-64 approx.	=2.156
50.....	2 oz.	298.9 grs.	2=44-64 approx.	=2.688

Measure out 50 c. c. of the sand you intend using, the sand to be moist so that when squeezed in the hand it will hold its form without pressing out any excess water. The sand in this condition to be then placed a little at the time in a 1½-in. graduated tube, divided off into cubic centimeters. Tamp each lot as it is placed in the tube with a stick having a flat end about 1 in. in diameter. Having thus measured 50 c. c., empty the sand out on a piece of paper or a small cardboard box or other convenient receptacle. Make several such samples, five should be sufficient. Be careful to get all the sand out of the glass tube. Estimate from the character of the sand as to about the quantity of cement which would be required to make a mortar of the desired plasticity, density or strength.

We will suppose your estimate is 1 part cement, 2 parts sand; you must then add to the first sample 25 c. c. of cement by weight (see Table II). To the second sample, 1 part cement, 2½ parts sand, and so on. After each sample has been measured out and the cement mixed with the sand thoroughly, add sufficient water to make a mortar of about the consistency in which it will be used in concrete. Now experiment with each sample, thus mixed separately, by placing a little at a time in the graduated glass; tamp with a flat end stick as before. Note the space occupied by each sample. If the total quantity of any one sample proves to be more than the volume of the sand alone, that is, 50 c. c., it is probable that you have added too much cement. If the next sample containing less cement does not increase the total volume of mortar, you will then know that the first sample did contain too much cement; therefore, for a dense mortar use the sample containing the most cement, which appears to be just short of causing an increase in the volume of the mortar. If the concrete does not require a very dense or strong mortar, you can use the proportions as determined in one of the samples containing the least cement, but which shows sufficient plasticity of mortar to give a good bond in the concrete.

The cement having been measured in each instance and the quantity noted for each sample, you are thus in possession of the proportions required for a mortar which will be used in actual work (the unit for measurement of cement being 95 lbs. one bag). For instance, if the work requires a very dense concrete, almost impervious to water, and you find that the sample to which was added 1 part cement to 2½ parts sand is that which is just short of increasing the volume of mortar in your graduated tube, your proportions for the actual work are 95 lbs., or 1 bag of cement, to 2½ cu. ft. of sand measured in the condition as it came from the bank. The sand should be measured so as to approximate the condition in which it will be found when in place in concrete; that is, as to compactness and the moisture which it would naturally absorb. It therefore will be found best to measure sand in the conditions found in the bank, and shake it down while measuring, as when placed in concrete it will be tamped, and in very wet concrete it will settle as tightly as if tamped. If this is impracticable owing to the sand having dried out, you might make a test in a length of sewer pipe. Proceed by wetting the sand to about the same consistency as was used in the sample; then measure in the pipe and compare it with the same quantity when measured fairly dry. If the bulk has been increased by the addition of moisture, then you can use less of the fairly dry by not quite filling your measuring box. When reasonable doubt exists, make sure that your proportions of mortar will not be increased by the addition of water and cement to the sand by carrying these experiments along a little further, actually mixing up a small batch of mortar in the determined proportions, use same quantity of sand as previously measured in the sewer pipe; tamp same in the pipe and note whether the volume is greater than the volume of sand used, for it may be that while the addition of moisture will show an increased volume in the sand, this may not take place when the cement is mixed with the sand, owing to the cement acting as a lubricant and causing the mortar to compact under tamping to a greater extent than would the sand alone.

In the matter of screenings or quarry tailings for mortar, all of which will pass through a ¼-in. sieve, you may obtain an approximately fair proportion of cement to quarry tailings by applying the same methods as described above, with the exception that a larger diameter glass graduate must be used, and it will not be necessary to moisten or wet the screenings. When measuring the screenings alone in the graduated glass, measure dry, add cement to each sample, then mix with sufficient water to make a plastic mass, and proceed the same as in determining the proportions to be applied to the sand.

The architect, engineer or concrete constructor is now in possession of the proportions of cement to sand or screenings for the mortar required by the character of work to be done, also the volume of mortar required to fill the voids in the stone or larger aggregate. By the method pursued the relation of weight to volume of cement is constant; the figures given are based on 95 lbs. of cement being equivalent to 1 cu. ft.; therefore, it makes no difference whether this be actual or not, for the reason that in determining the proportion of cement to sand the weights given in Table II are based on 95 lbs. being equivalent to 1 cu. ft. Thus the variations in different brands of cement are automatically cared for, provided the same brand is used to determine proportions in mortar as will be used in actual work. With these volumes definitely known, the correct relative proportion of cement, sand and stone may be figured, but as a convenience the writer has compiled Table III.

TABLE III.—SHOWING PROPORTION OF AGGREGATES WHICH WILL GIVE MAXIMUM DENSITY WITH A MINIMUM OF CEMENT. PROPORTION OF CEMENT TO SAND HAVING BEEN DETERMINED BY TEST AS DESCRIBED PREVIOUSLY; VOIDS IN STONE HAVING BEEN ASCERTAINED BY METHOD EXPLAINED BEFORE.

(The unit for measurement being 95 lbs. (1 bag) of Portland cement as being equivalent to 1 cubic foot. Proportions of mortar expressed 1 part cement: parts sand (1:3), etc.)

Voids in stone	Proportions of Stone expressed in cubic feet. Proportions of Mortar.									
%	1:1	1:2	1:2½	1:3	1:3½	1:4	1:4½	1:5	1:5½	1:6
20	5	10	12½	15	17½	20	22½	25	27½	30
21	4⅘	9½	12	14¼	16⅔	19	21½	23¾	26¼	28½
22	4½	9	11⅓	13⅔	16	18¼	20½	22¾	25	27¼
23	4⅓	8⅔	10¾	13	15¼	17⅓	19½	21¾	24	26
24	4	8½	10½	12½	14⅔	16⅔	18¾	20¾	23	25
25	4	8	10	12	14	16	18	20	22	24
26	3¾	7⅔	9⅔	11½	13½	15½	17½	19¼	21¼	23
27	3½	7⅓	9¼	11	13	14¾	16⅔	18½	20⅓	22¼
28	3½	7¼	9	10⅔	12½	14¼	16	17¾	19⅔	21½
29	3½	7	8⅔	10½	12	13¾	15½	17¼	19	20⅔
30	3⅓	6⅔	8⅓	10	11⅔	13⅓	15	16⅔	18⅓	20
31	3¼	6½	8	9⅔	11⅓	13	14½	16	17⅔	19⅓
32	3	6¼	7¾	9½	11	12½	14	15½	17¼	18¾
33	3	6	7½	9	10⅔	12	13⅔	15¼	16⅔	18¼
34	3	6	7⅓	8¾	10¼	11⅔	13¼	14¾	16¼	17⅔
35	2¾	5¾	7¼	8½	10	11½	12¾	14¼	15¾	17¼
36	2¾	5½	7	8⅓	9¾	11	12½	14	15¼	16⅔
37	2⅔	5⅓	6¾	8	9½	10¾	12¼	13½	14¾	16¼
38	2⅔	5¼	6½	8	9¼	10½	11¾	13¼	14½	15¾
39	2½	5	6⅓	7⅔	9	10¼	11½	12¾	14	15½
40	2½	5	6¼	7½	8¾	10	11¼	12½	13¾	15
41	2½	4¾	6	7¼	8½	9¾	11	12¼	13½	14⅔
42	2½	4¾	6	7¼	8⅓	9½	10¾	12	13	14¼
43	2½	4⅔	5¾	7	8¼	9⅓	10½	11⅔	12¾	14
44	2¼	4½	5⅔	6¾	8	9	10¼	11⅓	12½	13⅔
45	2¼	4½	5½	6⅔	7¾	8¾	10	11	12¼	13⅓
46	2¼	4⅓	5½	6½	7⅔	8⅔	9¾	10¾	12	13
47	2¼	4⅓	5⅓	6⅓	7½	8½	9½	10⅔	11¾	12¾
48	2	4	5¼	6¼	7⅓	8⅓	9⅓	10½	11½	12½
49	2	4	5	6¼	7¼	8¼	9¼	10¼	11¼	12¼
50	2	4	5	6	7	8	9	10	11	12
51	2	3¾	5	6	6¾	7¾	8¾	9¾	10¾	11¾
52	2	3¾	4¾	5¾	6¾	7⅔	8⅔	9⅔	10½	11½
53	2	3½	4⅔	5⅔	6⅔	7½	8½	9½	10½	11½
54	1¾	3½	4⅔	5½	6½	7⅓	8⅓	9¼	10¼	11
55	1¾	3½	4½	5½	6⅓	7¼	8¼	9	10	11
56	1¾	3½	4½	5½	6¼	7¼	8	9	9¾	10¾
57	1¾	3½	4⅓	5¼	6¼	7	8	8¾	9⅔	10½
58	1¾	3½	4⅓	5¼	6	7	7¾	8⅔	9½	10⅓
59	1¾	3½	4¼	5	6	6⅔	7¾	8½	9⅓	10¼
60	1¾	3½	4	5	5¾	6⅔	7½	8⅓	9¼	10

Illustration.—The best stone obtainable being a hard lime stone, which has been selected crushed in sizes of, say, 1 in., ¾ in., ½ in. and ¼ in. These sizes mixed together are found to weigh 120 lbs. per cu. ft. (see Table I), voids are therefore 29 per cent. The available sand in locality requires (by test) 1 part cement, 2½ parts sand to meet the requirements of the character of work to be done, but by purchasing a sufficient quantity of coarse sand at a point distant to mix with the local sand, a far greater density results; which mixture allows a proportion of 1 part cement to 4 parts sand; therefore, the relative proportion giving maximum density as per above table will be 1 part (95 lbs.) cement, 4 cu. ft. of sand, 13¾ cu. ft. of stone. As there may be conditions due to character or size of particles of stone and sand which affect the volume, hence density of the whole, it might be well when a reasonable doubt exists to apply same method to the stone with

sand and cement added in the determined proportion as was applied in determining a mixture of two or more sands and the proportion of cement to sand. To test the total mixture of all the ingredients use a piece of 8 or 12-in. sewer pipe, mix wet and tamp, making several test samples. Note proportion of stone used in each sample, use that containing the largest amount of stone which is just short of increasing the volume of concrete. The proportion of cement to sand remains the same, the proportion having been accurately determined by test in the glass tube.

It is altogether a reasonable proposition to state that these proportions made of selected ingredients above described produce a concrete which is actually stronger and more dense than if the concrete had been made of unselected local aggregates. And also allows an immense saving in cement.

The method above described of proportioning the aggregates as opposed to the usual practice of specifying arbitrary proportions regardless of the character of the available ingredients or of the work to be done, has the advantage of offering an incentive to good workmanship. While the aggregates may in some instances prove more expensive, the resulting concrete actually costs less per yard. With expensive aggregates the contractor and foreman will take less chances of waste, and therefore exert more care in mixing and in placing. Arbitrary specifications written by the architect or engineer, which simply state good sand and stone shall be used together with Portland cement, meeting certain tests, mixed in proportions of 1:2:4 or 1:3:6, as the case may be, may mean a very rich concrete, or again may result in a very lean mixture. Supposing the only available aggregates which can be used in the locality in which the work is to be done proves to be a stone breaking in flat layers which does not compact so as to give less than 52 per cent in voids, a 1:2:4 mixture would not give the maximum density; it would be too lean. Then again the aggregates may prove to be a very good grade of stone, which are crushed ¾-in. sizes, well graded down to particles which are just short of passing a ¼-in. mesh, and the voids are found to be 30 per cent, your mixture is then entirely too rich. These two propositions are sufficient to illustrate the fallacy of arbitrary proportions.

Specifications should read—best aggregates must be used, graded in size and so proportioned as to give maximum density. Samples of the aggregates to be used must be submitted to the engineer or architect before bids will be accepted. Contractor must also state the proportions he intends using. The engineer or architect reserving the right to correct these proportions, the contractor being allowed the privilege of revising bid in accordance with the corrected proportions.

One of the reasons why no definite formula has yet been developed, from which can be figured the ultimate strength of concrete within a reasonable margin, is that there has been no well defined and definite method adopted for scientifically proportioning the aggregates so as to give maximum density, which is equivalent to maximum strength. If all concrete construction was figured on basis of maximum density, variations in strength of such construction would not be as great.

It is a reasonable proposition and one within reach, that the ultimate strength for concrete can be figured within a small margin, provided the character of aggregates are known and the proportion of such aggregates definitely stated, which will give maximum density. This is particularly within easy reach in and around New York city, where an excellent grade of trap rock and good coarse sand is readily obtained.

If the specifications require maximum density, it will be found by practical test, if the best cement is used, the resulting concrete will be of about the same strength, even though the proportions of concrete may be 1 part cement, 3½ parts sand and 10 parts stone, and the other concrete 1 part cement, 3 parts sand and 6 parts stone, provided the aggregates have been so graded in size so that each of the above proportions will give maximum density with minimum quantity of cement. In other words, in the first instance, the sand required the proportion of 1:3½ to give maximum density of mortar, and the stone contained 35 per cent of voids. In the other instance, the sand required 1:3 parts to give maximum density of mortar, the stone contained 50 per cent of voids.

The thought of maximum density should be kept constantly in mind and the idea of a fixed arbitrary proportion eliminated, for the character of the available aggregates will entirely govern the proportions which will give the strongest concrete. With these thoughts firmly in mind, we are certainly approaching a basis for a definite formula by which engineers can figure the ultimate strength of concrete. Thus concrete becomes more economical and its safety better assured.

The next important subject is the mixing of these aggregates. Good mixing is absolutely essential. This is a subject, however, which cannot be conveniently covered in a paper of this sort, as the location of the work, and the character of the construction, will govern entirely the method of mixing. This subject, furthermore, is one which is very generally understood and requires very little more said.

Comparative Cost of Constructing Two Identical Reinforced Concrete Buildings—One of Separately Molded Members and One of Members Molded in Place.

BY MASON D. PRATT.*

In 1904 the Central Pennsylvania Traction Co. of Harrisubrg, Pa., built a car barn and a repair shop of reinforced concrete, probably the first buildings in this country built entirely of this material for this purpose. The buildings are one story in height and were constructed in the usual manner by erecting wooden forms and casting all concrete work in place. The same company has just completed a second barn adjacent to the one above described of the same dimensions as the first barn—viz.: 75 ft. wide by 360 ft. long. The last barn is also of reinforced concrete, but owing to conditions which seemed favorable for the purpose, an entirely different mode of construction was followed. All of the members for that portion of the building above the foundation and floors, including columns, beams, wall and roof slabs, were separately molded on the ground and afterwards erected by means of a traveling stiff-leg derrick. This method of construction proved economical and owing to the close similarity of the two buildings in size and general design it is possible to make an accurate comparison of the costs. In describing the two buildings, Barn *A* refers to the original building and Barn *B* the last one erected.

Barn *A* was built on ground which was from 2 to 10 ft. below the floor level. The column footings were placed on solid ground 6 to 12 ins. below the sod and carried up within 1 ft. of floor level, the ground being filled in after the building was under roof. In general plan the building had three rows of non-reinforced hexagonal columns spaced 15 ft. centers longitudinally and 37 ft. centers transversely. The roof consisted of transverse beams, resting on the columns, longitudinal purlins and a 3-in. slab cast in place, the columns being connected longitudinally with beams 6 ins. thick and 2 ft. deep. After the forms were removed from this skeleton the three longitudinal walls were filled in place. Provision was made for future extension laterally by casting brackets in the columns to support roof girders for an adjacent bay. The barn also had a wing 16 ft. wide and 90 ft. long, containing barn foreman's office, lockers and lavatory for the use of motormen, conductors and barn men.

Concrete for this building was mixed in a rotary batch mixer, into which the aggregate was dumped directly from wheelbarrows, and the concrete distributed from the mixer to the job in wheelbarrows by means of runs and an elevator operated by a power hoist.

Barn *B* was built entirely independent from Barn *A*, the first wall being placed 37 ft. beyond the wall of Barn *A*, thus permitting the increase of the plant by one additional bay in the future by simply adding a roof between the two buildings. Column spacing was made the same as Barn *A*, but the columns were square. In order to get roof slabs of a size which could be conveniently handled, the roof beams were spaced 10 ft. centers and alternated in the two bays. Thus on the outer walls a roof beam came at every other column, while on the center wall each column carried a beam and a longitudinal beam between columns supported the ends of two roof beams. The roof proper consisted of slabs, 3½ ins. thick, 10 ft. long and 6 ft. and 7 ft. wide, which were laid directly on the roof beams. Two slabs at the center of every alternate 10 ft. bay were omitted to allow placing skylights. The walls were 6 ins. thick, as in the case of Barn *A*, but were made up of slabs of various sizes. These slabs were all tongued and grooved, as were also the columns. Three-eighths of an inch was allowed for all joints, the horizontal joints being mortared as the work was laid up and the vertical joints filled and pointed after everything was in place. A small percentage of reinforcement was placed in all slabs as an insurance against breakage in handling.

The concrete for this building was mixed in the same mixer used on Barn *A*, located at a central point, the materials being moved in wheelbarrows as before.

Barn *A* had about 290 ft. of open pits under each track, 60 ft. of the front end of each bay being paved with granolithic floor and used as space for washing cars. Barn *B* had the same arrangement in one bay, the other bay, which was intended for storage purposes only, had granolithic floor from end to end. The ground on which Barn *B* was built had been filled in with various materials, mostly cinder from a nearby steel plant, and excavations had to be made for all foundations. In the figures given below, all labor for excavation in both buildings is omitted. In Barn *B* each column had a separate footing as in Barn *A*, which, however, was carried to a point 15 ins. above floor level, and provided with a pocket to receive the column. A layer of sand was put in each pocket to give the column good bearing and to adjust height. A beam 12 ins. wide and 2 ft. deep connected these footings, being cast at the same time with the footings.

The tracks were laid in the storage bay and the granolithic floor cast in place at the time of starting excavations for the foundations, and as soon as the floor was in place the casting of beams, columns and slabs began. The beams and columns were nested by casting the alternate pieces a suitable distance apart, and after removing the forms these became the forms for the intermediate pieces. The slabs were cast in piles, the ends being offset to enable rapid handling. The pieces were separated by means of 40-lb. waxed manila paper. No difficulty whatever was experienced during the erection in separating. In some instances soap was used, but the results were not as satisfactory and the cost was higher than with the paper. The surface of the pieces formed by paper separation showed a close, smooth, dull surface, except for the wrinkles formed by the paper, which was not heavy enough to prevent wrinkling. The paper was also responsible for other defects in the surface finish, owing to the mortar running in between joints where the paper overlapped and forming thin slivers. The paper was easily removed with water from a 1-in. hose, with nozzle ¼ in. The top surfaces of all pieces, of course, were troweled. This gave a rather variegated wall surface to the structure, but a coat of cement wash using a thin mixture of about equal parts of cement and limestone dust applied with whitewash brushes produced a fairly uniform appearance. This method of construction involved the use of slightly more reinforcing steel and a larger yardage of concrete, but the saving in forms, lumber and carpenter work was more than

*16 South Market Square, Harrisburg, Pa.

sufficient to pay for this difference and the additional cost of derrick and erection labor.

The number of loose pieces required was 1,400. These were completely erected in 33 working days, with a loss of only three slabs from breakage.

The derrick used was a standard stiff-leg with 60-ft. boom and 38-ft. mast, mounted on a truck so that it could be moved around the work. Power was furnished by a regular street railway motor through a gear bolted to the flywheel on the driving shaft of a two-drum hoist, the motor being equipped with standard street railway controller and suitable resistance coils. A traction company motorman operated the hoist and a rigger crew placed the material. The heaviest pieces handled were the roof beams, which weighed 7½ to 8 tons. A number of special devices were used to handle the various pieces. For the heavy beams a loop was formed at the quarter points by bending a reinforcing rod, bringing it flush with the top of the beam and scooping out a portion of the concrete while green, and a special hook used to engage this loop. These hooks entered the slotted ends of a steel spreader. The rig was thus adjustable for variable spacing of the loops and for balancing. The slabs were handled by means of slings, holes being formed in the slabs with a short section of ¾-in. gas pipe for receiving bolts. In setting up the side walls, these holes were used to fasten 3x4-in. sticks on each side of the three wall slabs of each bay, thus keeping them in line, and by means of props, in a vertical position until erection had proceeded far enough to remove them. Fig. 3 shows these sticks in position.

TABLE I.—SHOWING COST OF CONCRETE IN SEPARATELY MOLDED CONCRETE CAR BARN.

Barn B.

	Total.	Per cu. yd.
Foundations and Floors, 710 cu. yds.:		
Materials:		
Stone at $1.25 cu. yd.	$ 856.00	$1.20
Sand at $1.30 cu. yd.	132.00	.61
Cement at $1.15 bbl.	1,082.50	1.53
Steel	120.00	.17
Lumber	633.00	.89
Tools	100.00	.14
	$3,223.50	$4.54
Labor:		
Placing reinforcement	$ 19.00	$0.03
Forms	771.00	1.09
Concreting	1,015.00	1.43
	$1,805.00	$2.55
Total materials and labor	$5,028.50	$7.09
Building above Foundations, 948 cu. yds.:		
Material:		
Stone at $1.28 cu. yd.	$1,085.60	$1.16
Sand at $1.30 cu. yd.	546.00	.58
Cement at $1.15 bbl.	1,735.00	1.86
Steel	1,755.00	1.87
Tools	140.00	.24
Lumber	220.00	.15
	$5,481.00	$5.86
Labor:		
Forms	$ 818.00	$0.87
Bending and placing reinforcement	360.00	.39
Concreting	1,152.00	1.23
Erection	1,776.00	1.89
Pointing and cement wash	617.00	.66
	$4,723.00	$5.04
Total labor and materials	$10,204.00	$10.90
Totals, 1,648 cu. yds.	$15,232.50	$9.245
Area covered by building, 360 × 75 ft. = 27,000 sq. ft.		
Cost of foundations and floors	18.5 cts. per sq. ft.	
Cost of building	38.0 cts. per sq. ft.	
Total	56.5 cts. per sq. ft.	

TABLE II.—COMPARISON OF COST BETWEEN CAR BARNS, SEPARATELY MOLDED AND CAST IN PLACE.

(Average including Foundations and Superstructure.)

	Barn A. (Cast in place.)	Barn B. (Separately molded pieces.)
	Per cu. yd.	
Materials:		
Stone, sand and cement	$3.480	$3.480
Steel reinforcement	.915	1.140
Lumber	1.335	.480
Paper		.040
Tools, wheelbarrows, etc.	.145	.145
	$5.875	$5.285
Labor:		
Carpenters	$3.240	$0.965
Bending and placing steel	.095	.230
Concreting	2.210	1.685
Erection		1.080
	$5.555	$3.960
Total cost per cu. yd.	$11.430	$9.245
	9.245	
Dif. in favor Barn B.	$2.185	

Table I gives complete detailed cost of all the concrete work in Barn *B*.

Table II is a comparison of the average costs of all the concrete work on Barns *A* and *B*, the figures covering all charges except general supervision. The concrete aggregate is put at same figure in each to eliminate any difference in unit cost of these materials. The mix was practically the same in each, the largest percentage being 1:2:4. Unit costs for labor were the same in both cases—viz.: ordinary labor, $1.25 per day, and carpenters, $2.50 per day.

It will be noted more steel was required in *B*, but very much less form material and labor. The roof of Barn *B* required more concrete, as all beams and slabs had to be treated as simple members, whereas in Barn *A* full advantage was taken of the T sections. Making full allowance for these differences the actual cost of the concrete structure of Barn *A* over Barn *B* was 15 per cent. Both buildings were constructed by day labor from plans made by the writer and under his direct supervision.

The Sixth Annual Convention of the National Association of Cement Users.

The National Association of Cement Users organized in the winter of 1904-5 has become one of the most important special associations in the United States. The annual reports are valuable contributions to the literature of the cement industry and the committee reports, prepared as they are by authorities, form the basis of many building ordinances and specifications.

The sixth annual convention will be held in Chicago at the time of the Cement Show. Invitations have been extended to foreign concrete associations and delegates will be sent, thus giving the convention international significance. It is believed this will be the largest gathering in the world in the history of the cement industry. The Auditorium Hotel will be headquarters where the officers may be found and meetings will be held.

The following program (subject to minor changes) has been announced.

MONDAY, FEBRUARY 21, 1910.

10 o'clock a. m.:

1. Meeting of the Executive Board at the Auditorium Hotel.

2 o'clock p. m.:

2. Meeting of Sectional Committee on
a. Art and Architecture.
b. Building Laws and Insurance.
c. Concrete and Reinforced Concrete.
d. Exterior Treatment of Concrete Surfaces.
e. Machinery and Appliances.
f. Roadways, Sidewalks and Floors.
g. Specifications for Cement Products.
h. Specifications for Fireproofing.

3 o'clock p. m.:

3. Meeting of the Section on Roadways, Sidewalks and Floors. General discussion covering the preparation of materials, laying, finishing and costs.

8 o'clock p. m.:

4. Formal opening of the convention, Auditorium Hotel.
5. Address of Welcome by the Honorable Fred A. Busse, Mayor of Chicago.
6. Response by the President, Mr. Richard L. Humphrey.
7. Address by Christian C. Kohlsaat, President Lewis Institute, Chicago.
8. Address, John M. Ewen, Consulting Engineer, Chicago, Ill.
9. Business session.
10. Report of the committee on Roadways, Sidewalks and Floors. Mr. C. W. Boynton, chairman.
a. Proposed Standard Specifications for Concrete Street Pavements.
b. Proposed Standard Specifications for Portland Cement Curb and Gutter.
c. Proposed Revision of the Standard Specifications for Portland Cement Sidewalks.

TUESDAY, FEBRUARY 22, 1910.

9 o'clock a. m.:

11. Meeting of the Section on Specifications for Cement Products. Discussion on the Manufacture, Curing, Cost, etc., of Cement Hollowing Building Blocks, Architectural concrete Blocks, Drain Tile and Pipe.

10:30 o'clock a. m.:

12. Report of Committee on Specifications for Cement Products, Mr. W. P. Anderson, chairman.
a. Proposed Standard Specifications for Architectural Concrete Blocks.
b. Proposed Standard Specifications for Plain Concrete Drain Tile.
13. Report of Committe on Machinery and Appliances. Mr. L. V. Thayer, chairman.
14. Business Session.
a. Report of the Executive Board.
b. Report of the Committee on Contributing Members.
c. Place of next Convention.
d. Election of Officers.

8 o'clock p. m.:

15. Annual address by the President, Mr. Richard L. Humphrey, Consulting Engineer, Philadelphia, Pa.
16. Report of the Committee on Art and Architecture, Mr. F. A. Norris, chairman.
17. Report of the Committee on the Exterior Treatment of Concrete Surfaces, Mr. L. C. Wason, chairman.
18. The Use of Concrete for Farm Buildings from the Sanitary Standpoint, S. Cunningham, Jr., New York, N. Y.

WEDNESDAY, FEBRUARY 23, 1910.

9 o'clock a. m.:

19. Meeting of Section on Concrete and Reinforced Concrete, Mr. A. B. Lindau, chairman. General discussion on methods, selection of materials, costs, etc.
20. Laying Concrete under Water—Detroit River Tunnel. Olaf Hoff, Consulting Engineer, New York, N. Y.
21. Comparative Value and Cost of the Groined Arch in large Reservoirs. T. H. Wiggin, Senior Designing Engineer, Board of Water Supply, New York, N. Y.
22. Report of Committee on Concrete and Reinforced Concrete, Mr. A. B. Lindau, chairman.

8 o'clock p. m.:

23. Concrete for Maritime Structures. Chandler Davis, Department of Docks and Ferries, New York, N. Y.
24. Application of Concrete in Barge Canal Work. R. S. Greenman, Resident Engineer, office of State Engineer and Surveyor, Albany, N. Y.
25. Comparative Cost and Efficiency of the Pneumatic Reinforced Concrete Dam.
26. Additional Notes on Use and Cost of Concrete for Small Houses. R. C. Knapp, Philadelphia, Pa.

THURSDAY, FEBRUARY 24, 1910.

9 o'clock a. m.:

27. Meeting of the Section on Building Laws and Insurance.
28. Meeting of Section on Specifications for Fireproofing. Topical discussion on fire-resistive construction of buildings, building regulations and their effect on insurance rates.

10:30 o'clock a. m.:

29. Report of the Committee on Building Laws and Insurance, Mr. W. H. Ham, chairman.
a. Proposed Standard Building Regulations for the Use of Reinforced Concrete.
b. Report on Insurance.
30. Report of the Committee on Specifications for Fireproofing, Mr. R. P. Miller, chairman.
31. Advantages and Costs of Reinforced Concrete Construction. J. P. H. Perry, Contracting Engineer, Turner Construction Company, New York, N. Y.

8 o'clock p. m.:

32. Reserved for Social Entertainment, etc. This evening is reserved for a reception by the officers and members of the association.

(Continued on page 70.)

Earth and Rock Section

Note: This section is devoted to methods and costs of excavating earth and rock and building embankments. It will cover the grading of roads and railroads, diking and canal work, dredging, building reservoirs and earth dams, sewer and water pipe trenching, quarrying, etc.

Earth and Rock Fill Dam with Concrete Core Wall, Patillas Irrigation Project, Porto Rico.

An earth and rock fill dam with concrete core wall, which with its appurtenant structures will cost about $500,000, is a part of the Patillas irrigation project now under way in Porto Rico. The main structural features of this dam are shown by the accompanying drawings and further explained in the text which follows.

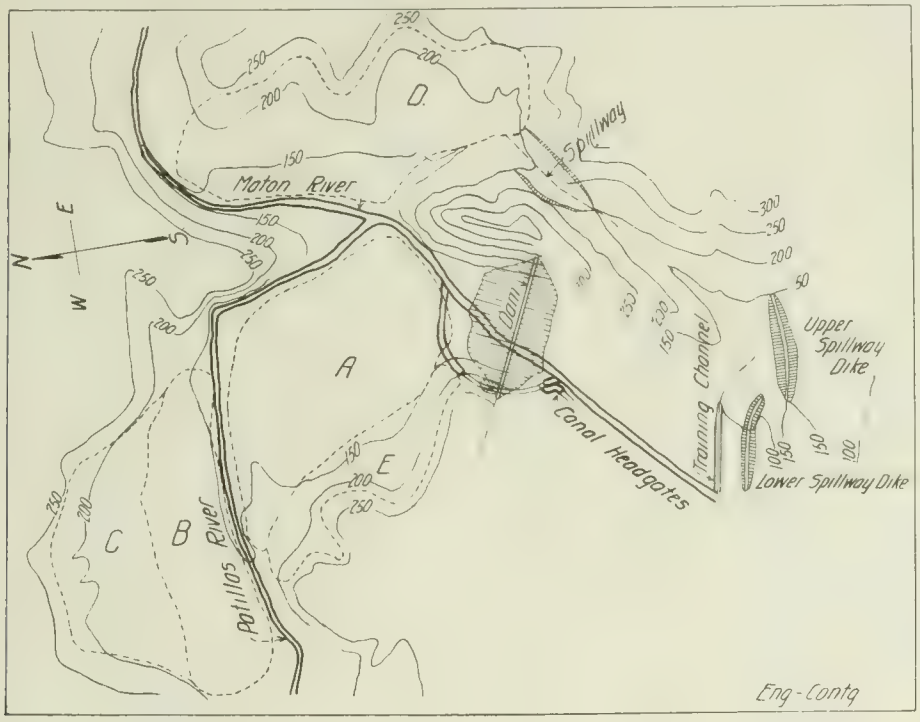


Fig. 1—Plan of Earth and Rock Filled Dam, Patillas Irrigation Project, Porto Rico.

The plan of the dam work is shown by Fig. 1. The embankment crosses the gorge of the Patillas River in approximately an east and west direction. Circling around the west flank of the embankment is the outlet canal, which is partly open channel and partly tunnel through the rock side of the gorge. Flanking the east end of the embankment is the spillway channel, through which the flood water passes by the dam to well below the toe, where it is diverted by dikes and a training channel into the below dam channel of the original stream. The work comprises some 950,000 cu. yds. of excavation and fill in spillway, tunnel and dam and some 3,800 cu. yds. of concrete in core wall, tunnel lining, etc. The dam structure proper chiefly merits description.

As shown by the sections, Figs. 2 and 3, and by the profile, Fig. 4, the dam construction consists of a cut-off trench in which is a concrete core wall, and of an embankment embracing the core wall and composed of a center trapezoid of fine, impervious soil flanked on both stopes with trapezoids of coarser material and finally faced on both stopes with trapezoids of rock fill. The depth of fill is a maximum of 122 ft. and the bottom of the cutoff trench goes down some 20 to 25 ft. further, as shown by the profile, Fig. 4. The length of the dam along the crest is slightly over 1,000 ft. The work comprises, then, two divisions, first the construction of the cutoff trench and core wall, and, second, the embankment fill proper.

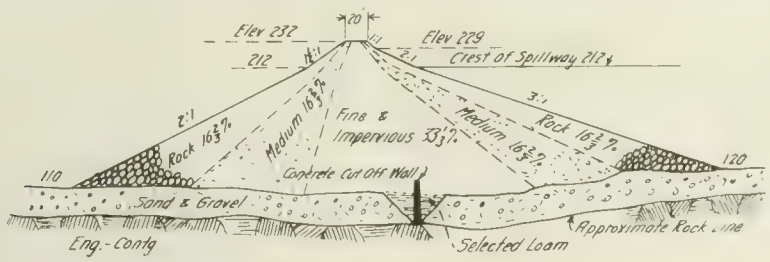


Fig. 2—Section of Patillas Dam Near Center.

The cut off trench is carried down to rock and into the rock deep enough to give the wall a good anchor, as shown by Fig. 5. The core wall, also shown by Fig. 5, is 12 ins. thick at the top, with both sides battered outward at the rate of ½ in. per 1 ft. depth. It extends the full length of the dam across the base and up the stopes to the crest, as indicated by Fig. 4. Its top varies in elevation, but at all points it extends 4 ft. into the dam embankment. Particular attention is given to

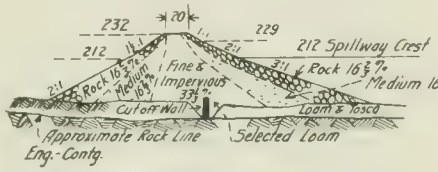


Fig. 3—Section of Patillas Dam Near End.

the anchorage of the core wall into the foundation rock and to the close bond of the concrete and the rock at the base. The exact proportions of the concrete in the core wall are to be determined by test as the work proceeds—the basis of selection of proportions being concrete of maximum density—but the proportions are to be at least 1 part of cement to 2½ parts of sand and 4½ parts of graded stone or gravel, ranging from ¼ in. to 2½ ins. in size. As stated above, density or imperviousness is to be the criterion of satisfactoriness of the core wall. It is therefore to be given rigid inspection and test. The inspection is to be particularly for porosity. The test will be to flood the wall on each side flush to its top with water; the side of the wall opposite that flooded is not to show any definite leakage at the end of 12 hrs. After the test the upstream face of the wall is to be given by plastering a ¼-in. coat of 1:1 mortar.

The backfilling of the cut-off trench on each side of the core wall and to flush with the ground surface is to be done with equal care to secure imperviousness. A natural material, which is found in the excavation areas marked *C*, *D* and *E*, Fig. 1, is to be used; the material selected is to consist of a mixture of clay, sand and gravel or small rock particles, of which the clay content is not less than 45 per cent. The specifications for placing and compacting this material are as follows:

The material shall be deposited as nearly as practicable in horizontal layers which will not exceed 6 inches in thickness after being compacted with rollers, and all stones larger than 4 ins. in diameter shall be removed. Each layer shall be thoroughly and uniformly wetted by sprinkling carts or hose and nozzle, the amount of water used being just sufficient to secure the greatest practicable compacting from the rolling. The rollers shall weigh not less than 1 ton per lin. ft. of tread, and shall be made of alternate large and small discs, whose difference in diameter shall be 2 ins. and whose thickness shall be not more than 12 ins. No brush, roots, or other perishable material shall enter the back-fill. The material shall be brought up uniformly on both sides of cut-off wall so as to avoid excess pressure against either side. Great care shall be exercised in rolling near the cut-off wall and immediately adjacent to the wall the compacting shall be done by hand tamping, the tamping tool weighing not less than 20 lbs. on a face of 12 sq. ins.

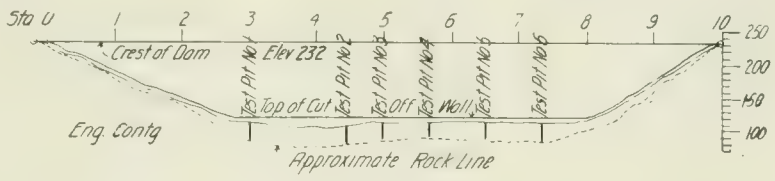


Fig. 4—Profile of Patillas Dam.

Turning now to the dam embankment proper, it will be noted from the sections, Figs. 2 and 3, that it will consist of two grades of earth fill and of loose rock fill. All these

materials will be obtained from barrow pits in several fields within the reservoir and adjacent to the dam, or possibly in part from the spillway excavation. On Fig. 1 the various areas available for the selection of filling material are marked *A, B, C, D* and *E*. The location, area, approximate volume and character as to clay and sand content of these fields are as follows:

Field.	Area in acres.	Depth of good mat.	Av. haul, feet.	Approx. cu. yds.	P. c. by wt. of clay and silt.	P. c. by wt. of sand and gravel.
A.....	44.2	11.2	1,500	800,000	16	84
B.....	26.6	6.0	3,000	260,000	35	65
C.....	24.5	6.0	3,500	235,000	50	50
D.....	45.6	5.0	2,200	370,000	53	47
E.....	15.5	6.6	1,600	165,000	47	53

While it is realized that the exact percentages of the different grades of materials indicated in Figs. 2 and 3 cannot be exactly obtained, it is believed that by careful proportioning they can be closely approximated. The bulk of the material for the dam will come from Field *A*, which contains a large percentage of boulders, which when separated from the finer material are to form the outer rock portions of the dam. By a proper proportioning of Field *A* material, after all stones more than 4 ins. in diameter have been separated from it, with material from one of the other fields, the material from the impervious portion of the dam is secured. This impervious material is to contain not less than 25 per cent and not over 35 per cent of clay, the remainder being sand and gravel. For the portion of the dam marked "medium," material from Field *A*, after all stones over 4 ins. in diameter are removed, is to be used.

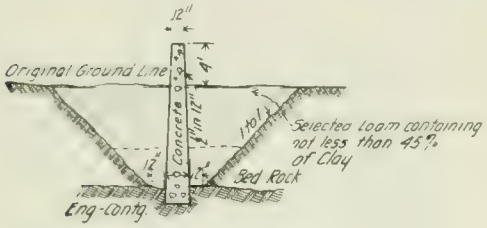


Fig. 5—Section of Core Wall for Patillas Dam.

To prepare for the fill, the area covered by the dam will be plowed to a depth of 12 ins. The method of forming the embankment is specified as follows:

> The dam shall conform to the slopes and dimensions shown on the drawings and if not constructed by the hydraulic method, it shall be built up in successive layers of 6 ins. thickness, thoroughly rolled and compacted as provided for backfill of cut-off trench, excepting the rock portions of dam, which, however, shall be carried up simultaneously with and maintained slightly above the central portion of dam. All rock larger than 4 ins. in diameter shall be removed from the central portions into the rock portion of dam. To effect the proper mixture of materials for the central third of dam the loads from different fields shall be deposited in such sequence and at such places as the engineer may direct and the method of spreading will be subject to the approval of the engineer. In so far as it may be practically effected in the regular handling of the material, small and large rock will be mixed, to the end that large cavities may be avoided in the rock masses on either slope, but a sufficient quantity of finer material must be incorporated with the boulders in the up-stream slope to practically fill the voids.
>
> The contractor may, at his option, build the embankment by the hydraulic process, either by delivering the material dry to the dam, depositing same in successive narrow dikes on either slope and effecting the final segregation of the materials in these dikes by sluicing with water, or he may adopt some system of pumping the material to place. Whatever the process adopted, however, it will be subject to the approval of the engineer, the proportioning of materials hereinbefore provided shall practically be maintained and it will be further subject to the following requirements: Until cut-off wall has been topped, material shall be delivered simultaneously to both sides to avoid unbalanced pressure against the wall; longitudinally the dam shall be built up as uniformly as possible; the waste water from settling pond shall be promptly and safely discharged by means of flumes carried through breaches in rim of down stream embankment or by any other means that may be necessary to facilitate settlement of the sluiced material; the size and depth of settling pond, the slopes leading toward center of dam and the points at which the sluiced material is first delivered shall be so regulated as to secure disposition of the finer materials near the center of dam and produce the desired gradation of materials from the centre outward, but a pure silt or clay, even at centre of dam, is neither desired nor will it be permitted; any tendency toward stratification shall be continuously and effectively prevented by poling or other approved means; the manner of disposing the materials will at all times be subject to the approval and regulation of the engineer.

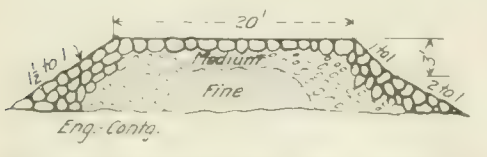


Fig. 6—Section Showing Top Paving of Patillas Dam.

Figure 6 shows the manner of finishing the crest of the dam. The dry rock paving is to be done with stones having a top face of at least 1 sq. ft. and a depth of 1 ft. These stones are to be laid close and are to be wedged and tightened by driving spalls into the interstices.

The Patillas dam as described is to be constructed under the direction of the Porto Rico Irrigation Service, Mr. B. M. Hill, chief engineer.

Cost of Stripping a Gravel Pit.

BY GEORGE RATHJENS.*

During the month of September, 1909, the following record was made in stripping a gravel pit in the Dakotas. The pit in question was evidently of glacial origin and was covered with a sandy loam, there being a number of pockets of varying depths, the maximum about 10 ins. The length on the railroad right of way was 3,000 ft., the width 50 ft. and the length at the back 2,000 ft., one end being square with the railroad. The contract called for stripping a width of 250 ft., the material being carried from the track towards the back of the pit and deposited in winrows with a base of 45 ft. A part of the material was used for grading the straight storage tracks paralleling the main line, the pit being on a curve.

The outfit consisted of 1 Austin grader, 6 1¼ cu. yd. dump wagons, 4 No. 2 wheelers and 2 plows. Two more wagons could have been used to advantage, as the grader sometimes had to wait for wagons.

The Austin grader usually worked a strip or line about 350 ft. long by 35 ft. wide, with an average haul of about 150 ft., the longest haul being 220 ft. Wheelers were used where pockets were found. The contractor owned his teams, but teams with drivers were worth $5 per day when hired. Hay and other feed was purchased from nearby farmers. During the month mentioned the contractor stripped 19,970 cu. yds. at the costs here given:

Austin Grader:	
[illegible] teams on push*, 21 days at $5.....	$ 300
[illegible] teams on machine, 21 days at $5.....	960
[illegible] Wagons:	
[illegible] teams, 24 days at $5.....	660
Wheelers:	
3 teams on wheelers, 11 days at $5.....	165
1 team on plow, 11 days at $5.....	55
1 team on scraper, 11 days at $5.....	55
Labor:	
1 foreman, straight time.....	85
1 mucker, 24 days at $2.....	48
1 corral man, 28 days at $2.....	56
2 Austin grader drivers, 24 days at $2.25.	108
Total	$2,492

*Teams on push operated the elevator, team power being the only power used.

The cost is almost 12½ cts. per cubic yard.

The total time was 28 days, as shown by corral man's pay, but 2 working days were lost on account of rain and 2 on account of dust. The writer does not know what other expenses the contractor had nor the cost of feeding teams nor cost of repairs, etc.

*Box 55, Urbana, Ill.

A Special Hand Auger for Test Boring and Method of Using it in Prospecting for Coal.

The hand auger shown by the accompanying illustrations was developed by Mr. Baird Halberstadt, engineer and geologist, Pottsville, Pa., in the course of his work in prospecting some new coal fields in West Virginia. The conditions under which the device was worked out and the methods of using it are described farther on. From this description it will be seen that the auger is apparently well suited for use by engineers and contractors for making test borings of any kind. The following description is condensed from a paper by Mr. Halberstadt before the Appalachian Engineering Association:

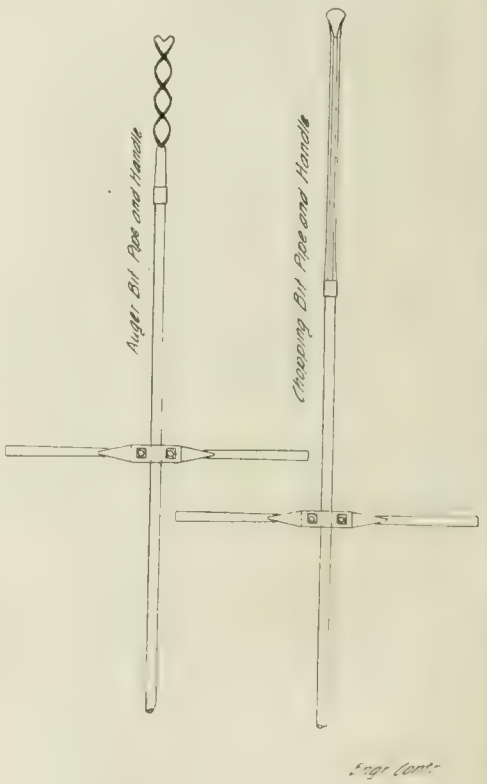


Fig. 1.—Auger for Making Test Borings.

Some few years ago the writer was engaged to examine and report on a tract of land comprising some 75,000 acres in West Virginia. The primary object of the examination was to determine whether this tract in whole or in part was underlaid by a coal bed or beds of workable size and of commercial value, and later, if the prospects were found to be of a promising nature, to have the property carefully and thoroughly developed.

The total area developed exceeded 50 square miles and the area underlaid by this bed approximates 10,000 acres. As the work was not pursued continuously, the exact time required to perform it can not at this time be accurately given. Work was suspended at different times, while at others the drill crews were transferred to distant parts of the tract

for special work. Suffice it to say, with these exceptions, through summer's heat and winter's cold, the work was pushed on almost uninterruptedly.

The work was at times carried on when a zero temperature was registered. A small fire was kindled and if snow lay on the ground it was melted in a bucket to supply not only water but hot water, which enabled us to drill through frozen ground without difficulty and at the same time the necessity of making long trips down to the streams was done away with. Neither drilling nor drift driving were interfered with by even excessively cold weather. Sleet and rain did, however, interfere and at such times the men were set to driving drifts. I generally had a few trial drifts driven in a few feet under cover, so that when surface work was not possible the men could be employed in them instead of losing time in the camps because of rain and sleet. These facts are given to show that a thorough test was made of the drilling auger and accessories which are about to be described:

For a number of years prior to the beginning of the work referred to, the usual methods of prospecting by trenching and drilling with a hand churn drill, were by no means satisfactory to the writer. To all the large drill manufacturers letters were written asking for information regarding a tool which would meet the requirements. These fully explained what was desired. To each letter an answer was received stating that no such tool was made, neither had they ever heard of one. In metal prospecting in the far west a drill auger resembling the one to be described had been sometimes used. Of this I obtained a description and, after modifying and improving upon both the form of auger and handle, drawings were sent to several shops and from them the tools were made. As the work progressed, such changes were made as were found to be improvements upon the originals. In its present form it has given the greatest satisfaction and no trouble from breakage or in fact of any kind has been experienced.

The tool, Fig. 1, consists essentially of four parts—a heavy auger, a handle, a cutting bit and a number of sections of 1 in. gas pipe (one 8 ft., the others 3 ft. in length), threaded at both ends and fitted with ferrules. The auger made of ¼-in. steel, 4 turns in 13 ins., rounded and threaded to fit the ferrule, and to this are screwed the sections of pipe as the depth of the hole increases. It has been found well to have the first section made longer than the others, as the handle can be passed up and down as required without entirely uncoupling it, as becomes necessary when passing over a ferrule. The handle is made in two sections as shown in the drawing, the joining ends are held firmly by two bolts and a circular hole drilled of a diameter slightly less than that of the pipe. With the bolts tightened up fully, the pipe will twist before the handle will slip around the pipe.

For holes exceeding 10 ft., when loose rock is encountered, a cutting bit replaces the auger until the obstruction is passed through. It has been found that greater speed can be made by using for holes wherein obstructions are met at a depth of less than 10 and more than 4 ft., ordinary jumpers are made of 1⅛-in. octagon steel of good quality. The bits are of the round rather than triangular shape. Two of these are usually carried with the party, one 6 ft. and the other 10 ft. long. The accompanying detail working drawing, Fig. 2, fully explains the forms of each of the parts and, the dimensions being given, from them the whole outfit can be made should any desire to have one. Any good colliery blacksmith should be able to make one at a cost not to exceed $15.

The outfit consists of 2 auger bits (one for any emergency, although but two or three were broken in drilling the 65 miles outcrop), a cutting bit, 2 jumpers 6 and 10 ft., one-half dozen 18-in. bastard files for sharpening the blades of the auger, an 8-lb. striking hammer, an 18-in. Stilson pipe wrench, a monkey wrench for loosening the bolts in handle, a galvanized iron bucket and tin cup, a mattock and short handle shovel, an oil cadger filled with lubricating oil for use on ferrules and pipes, and a short handle cutting axe.

The entire outfit can be carried readily by a party of three men almost anywhere, in fact where the holes are not far apart two men by making an extra trip can transport them. It has been found advantageous to use three rather than two men to a crew, as three can work to far better advantage, and the difference in cost is more than made up by the increased amount of work accomplished.

If the hole be on the slope of a hill, a space of say 2½ to 3 ft. square should be leveled off with a mattock and spade. This gives the men firm foothold. The auger attached to an 8-ft. section of pipe to which the handle is securely attached is put down and the handle turned until the auger has cut through 7 or 8 ins. of "wash"; it is then removed and a cup or two of water is poured into the hole and drilling is resumed. The purpose of the water, if the ground be very dry, is to dampen the soil, but do not make it too wet. The material cut through will then cling to the auger, filling the grooves, and the whole can be quickly removed when the auger is withdrawn. On each drawing up of the auger a small quantity of water is introduced.

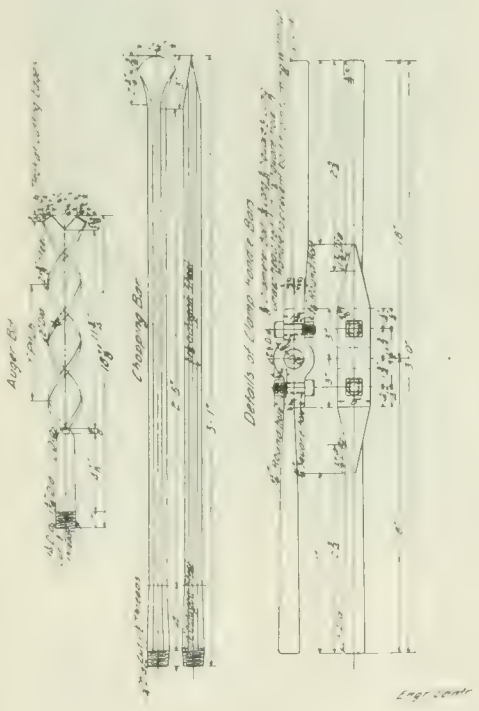


Fig. 2—Details of Bits for Test Boring Auger.

The advantage of the auger over the churn drill is here exhibited, for with the former neither a scraper, swab stick or sand pump is required, while with the latter the whole mass must be made pasty, so that it can be drawn up with swab stick or in a sand pump. Another advantage the auger has is that the sides of the hole become packed hard and no difficulty is experienced from caving in. The holes drilled with it, if covered, remain open for many months. The sand pump was used only in extremely wet holes and generally it was only necessary to use it when holes were drilled near water level. Throughout this entire work the sand pump was resorted to in but a few instances.

Now suppose a boulder or rock was encountered when a depth of 4 or 5 ft. had been reached, the auger was removed and the 6-ft. jumper was put in and a hole driven through the rock with the aid of the striking hammer. How was it possible to know that it was only a boulder and not a solid ledge of rock that had been struck? The sense of touch determines this, for if a boulder there is seemingly a giving away feeling which is not experienced when a solid ledge is struck. Rocks 18 ins. thick or more have been cut through and after some little experience the men can quickly decide whether the rock encountered is a floater or a solid ledge. The rock being cut through, the auger is again put into service and the drilling continues.

As the blades of the auger may become dull after 20 to 30 ft. of soil have been cut through, these are filled up and made sharp again without removing the auger from the pipe. Should the drill become fast in the hole, a few reversed turns will most likely free it and it can be drawn up with but little effort. If difficulty be encountered, the 10-ft. jumper can be used as a bar, placing it beneath the handle and with one end on a stone a short distance up the hill. In all this work an auger was not lost. A Stilson or other pipe wrench can be used to advantage in uncoupling the sections of pipe, and the method used was to place the drill on the ground with handle held down by one man, while the other uncoupled the sections with the pipe wrench. If oil be used on the threads, but little difficulty will be experienced in detaching the sections.

The best record made in this concrete like "wash," including the drilling through a boulder, was 10 ft. in 70 mins. In ordinary "wash" of course greater progress could be made.

In further comment on this auger Mr. Halberstadt writes us as follows: "The whole thing is so simple in construction and moderate in price that it is surprising to me that no one had heretofore used such a tool in surface prospecting. I used it very successfully in drilling over a distance of 60 miles along the outcrop of a coal bed and it never failed me. It is very far superior to the old churn drill, since by using a small quantity of water the earthy matter becomes pulpy and when the auger is withdrawn it brings with it in the grooves the material cut, thus doing away with swabbing and sand pumping. I have estimated that with the use of this tool we saved at least $10,000 to $15,000 in the development of a mining property in West Virginia."

Method of Making a Blast Displacing 180,000 Tons of Rock with Some Costs.

A blast in which about 19½ tons of powder were exploded, displacing some 180,000 tons of rock, was fired on Aug. 30, 1909, at the Morena Dam of the Southern California Mountain Water Co. The purpose of this blast was to supply rock for the rock fill forming the dam named and the method of making the blast and the costs given are presented from information furnished us by Mr. M. M. O'Shaughnessy, San Diego, Cal., chief engineer of the water company.

The plan and profile Fig. 1 show the ledge or quarry blasted. The rock is solid granite. The general plan of operations was as follows: An open cut 12 ft. wide and 100 ft. long was excavated along the toe of the old quarry wall. About 100 ft. back of this cut and parallel to it a 4x5 ft. tunnel 115 ft. long was carried into the hill. This tunnel was charged with "Champion" powder and dynamite and the blast was fired. The sketches Fig. 1 show the lines broken to, which were considerably wider than was expected.

The level of the floor of the open cut was —10 and the level of the floor of the tunnel was 0, or 10 ft. higher; the two levels conformed, therefore, to the natural dip of the formation, which is about 10°. The idea of the layout was that the blast would raise and shatter the mass between cut and tunnel and throw it toward the cut. At this point it may be noted that Mr. O'Shaughnessy writes that the "blast lifted the whole mass up gently to an elevation of 20 or 30 ft., and threw it to the left as intended." The tunnel drift was run level into the hill, but about 70 ft. back from the portal there was excavated a powder chamber and at the extreme end of the drift a second and larger chamber. As will be seen, both powder chambers were depressed

below the grade of the tunnel and were also set off-line.

The charges employed were as follows: In the main powder chamber 8x8x14 ft there were 571 50-lb. boxes of 7 and 9 per cent "Champion" powder, 38 boxes of No. 2, 40 per cent dynamite and 40 boxes of No. 1, 60

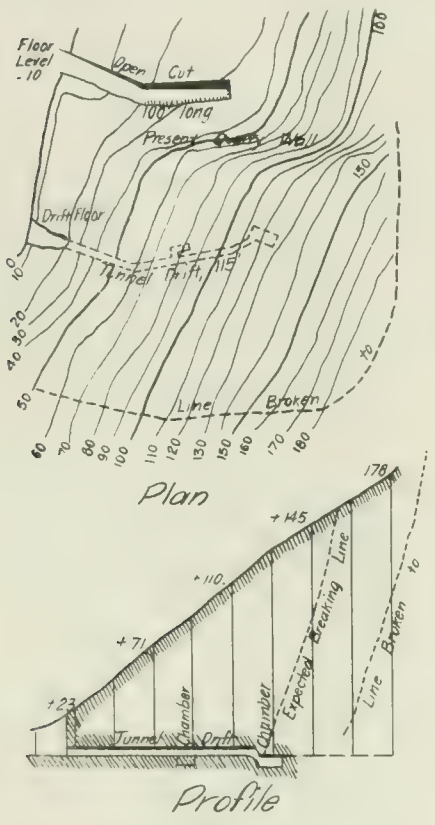


Fig. 1—Plan and Profile of Large Blast.

per cent dynamite. The weight of the explosive was thus:

	Lbs.
571 boxes powder at 50 lbs.	28,550
38 boxes 60% dynamite	2,000
40 boxes 60% dynamite	1,600
Total (16.5 tons)	32,150

In the smaller chamber there were 100 boxes of 7 per cent powder, weighing 5,000 lbs., and 30 boxes of 40 per cent dynamite, weighing 1,500 lbs., or a total of 6,500 lbs., or 3¼ tons.

Commenting on these charges Mr. O'Shaughnessy writes: "In large blasts where powder forms the bulk of the charge it is preferable to sink pits below the floor level of the tunnels. The first reason for this is that loose powder is loaded into pits with greater facility and greater compactness of the charge is obtained by the men in the pit constantly treading the powder while placing it. The second reason is that the sides of the pit offer greater resistance than it is possible to obtain where the powder is loaded directly into the end of the tunnel or drift. The greater resistance offered by the pit is of the utmost importance, as the resistance offered determines the quantity as well as the quality of explosive necessary to obtain results and maximum results will be obtained only where the powder has been confined until the maximum pressure has been attained. The seemingly large pressure of dynamite used in this blast, namely 2,000 lbs. of 60 per cent and 1,900 lbs. of 40 per cent in the end pit and 1,500 lbs. of 40 per cent in the intermediate pit, were used first to obtain instantaneous maximum pressure, this being dependent on the rate of speed of detonation of the dynamite, and second for their percussive action."

The manner of loading the chambers was as follows: In the end chamber about 10,000 lbs. of powder was first placed over the bottom. On this powder was stacked two boxes high the 2,000 lbs. of 40 per cent dynamite, the boxes being arranged in a semi-circle touching the west wall of the chamber. In a similar manner the 1,900 lbs. of 60 per cent dynamite was arranged in contact with the east wall of the chamber. The remaining powder was then placed around and over the dynamite. The purpose of this arrangement of the charge was to have the percussive action of the dynamite open a horizontal break about 2 ft. below the tunnel floor into which the more slowly expanding powder gases would spread, thus obtaining a greater lifting purchase and reducing the chances of a blowout. In the intermediate pit much the same arrangement of explosives was adopted. First 2,500 lbs. of powder were placed over the bottom; on top of this was piled two boxes high against the north pit wall the 1,500 lbs. of 60 per cent dynamite; the remaining powder was piled over and around the dynamite. In this case the dynamite was arranged to open a

Fig. 2—View of Face of Quarry After Blast.

horizontal break in the direction of the end pit or chamber.

The wiring of the charges was arranged as follows: From the battery a No. 16 gage insulated wire run to the 60 per cent dynamite in the end pit and thence to the 40 per cent dynamite in the same pit; the circuit was then continued with a No. 24 gage wire to the dynamite in the intermediate pit and thence by a No. 16 gage wire back to the battery. All wires were covered with dirt to prevent damage and were frequently tested during loading. The resistance of the circuit at the portal was 8 ohms.

The tamping of the charges was as follows: Beginning at the end pit, fine dirt was well tamped into the powder and to fill the tunnel to a distance 10 ft. back from the pit. Then rock bulkheads were built across the tunnel at intervals of 10 ft. and filled between with dirt, the bulkheads permitting the way to be tamped solid. At the entrance to the short drift into the intermediate powder chamber a green oak timber bulkhead was built, after tamping the chamber, and was braced against the facing wall of the tunnel proper. The tunnel tamping was then continued to within 20 ft. of the portal, using the rock bulkheads filled between as before described.

In loading, the men were required to remove all matches and smoking material and to remove their shoes and work with feet wrapped in sacking. The loading was superintended by Mr. J. S. Molony, resident engineer, and by Messrs. A. H. Crane and H. F. Smith, agents, Du Pont Powder Co.

The blast as before stated broke up some 180,000 tons of rock. The view Fig. 2 shows the face of the quarry after blasting. Figure 3 shows the Lidgerwood cableway bucket handling small stone into the dam; large stones were chained.

The cost of this blast as given by Mr. O'Shaughnessy was as follows:

Tunnel and loading	$2,478.15
Open cut	3,499.80
Explosives	3,116.00
Total	$9,093.95
Salvage, 1,400 cu. yds. rock from open cut at $1	$1,400.00
Corrected total	$7,693.95

This gives a cost per ton of rock blasted at 4.274 cts.

Civil Service Examinations.—The United States Civil Service Commission announces an examination on Feb. 16-17, 1910, to secure eligibles from which to make certification to fill a vacancy in the position of computer, $1,600 per annum, in the Coast and Geodetic Survey, for duty at Manila, Philippine Islands, and vacancies requiring similar qualifications as they may occur in the Coast and Geodetic Survey. The Commission also announces an examination on Feb. 16-17, 1910, to secure eligibles from which to make certification to fill vacancies as they may occur in the positions of assistant geologist and junior geologist in the Geological Survey, at salaries ranging from $1,000 to $1,600 per annum. The salaries paid will depend upon the experience and qualifications of the eligibles secured. In certain cases where only a portion of the time of the appointee can be given to the work of the Department, the compensation will be per diem basis for the service

Fig. 3—View Showing Cableway Depositing Broken Rock in Dam.

rendered. Employment in the position of temporary field assistant will also be made from the resulting eligible list as far as possible. The compensation of such positions ranges from $60 to $100 a month, and the length of employment from three to seven months.

The new double-track steel bridge across the Susquehanna River at Havre de Grace, Md., built for the Baltimore & Ohio R. R. Co., was opened for traffic January 6. The new bridge was constructed at a cost of more than $2,000,000, and is more than a mile in length.

Roads and Streets Section

Note: This section is devoted to methods and costs of road and street construction. It will cover road building in all its details, the construction of pavements, sidewalks and gutters, the testing and use of paving materials and the machinery and tools used in road building and paving.

Data on Street Work at New Bedford, Mass.

The greater part of the street improvement work of the city of New Bedford, Mass., is done by city forces under the direction of the superintendent of streets, from whose report the following data have been abstracted. During 1908 a total of 25,925 sq. yds. of new macadam pavement was constructed at a cost of 54 cts. per square yard, the average amount of crushed stone used being .383 ton per square yard. This stone was obtained from the city crushers and cost 98½ cts. per ton. The stone cost an average of 66 cts. per ton delivered at the crusher and the average cost of crushing was 32½ cts. per ton. As an average of .383 ton of stone was used per square yard of macadam, the cost of the stone was 37.72 cts. per square yard, leaving 16.28 cts. for the labor cost of spreading, rolling, etc. A total of 82,332 sq. yds. of macadam was rebuilt in 1908 at a total cost of $34,007, or 44.9 cts. per square yard, an average of .315 ton of stone being used per square yard. The cost of the stone at the crusher was 31 cts., making the labor cost of rebuilding the macadam 13.9 cts. per square yard. In previous years the cost of contracting new macadam and rebuilding old macadam has been as follows:

New Macadam:	1903.	1904.	1906.	1907.
Area, sq. yds.	38,572	41,600	20,527	35,478
Stone used, tons.	13,945	14,697	6,289	.....
Tot'l cost per sq. yd.	$0.463	$0.470	$0.475	$0.530
Average amount of stone used per sq. yd., tons.	.497	.352	.357	.323
Macadam Rebuilt:				
Area, sq. yds.	37,403	30,727	28,004	10,229
Stone used, tons.	11,584	8,296	8,288	.....
Tot'l cost per sq. yd	$0.422	$0.383	$0.418	$0.503
Average amount of stone used per sq. yd., tons	.309	.270	.298	.305

During 1908 a total area of 3,934 sq. yds. was paved with bitulithic at a total cost of $2.264 per square yard. In previous years the cost of this kind of pavement had been as follows: 1903, 10,791 sq. yds. laid, at $2.26 per square yard; 1904, 13,338 sq. yds., at $2.22 per square yard; 1907, 12,802 sq. yds., at $2.40. In 1907, 9,851 sq. yds. of bitulithic were given a top coat at a cost of about 10 cts. per square yard.

A total of 8,367 sq. yds. of granite block pavement on concrete foundation was laid in 1908 at an average cost of $3,713 per square yard. The average cost of this type of pavement in previous years, some being laid in 1905 and 1907, was as follows: 1903, 2,823 sq. yds., at $3.11 per square yard; 1904, 3,209 sq. yds., at $3.12 per square yard; 1906, 1,769 sq. yds., at $2.23 per square yard. In 1903 251.78 sq. yds. of granite block pavement on gravel was laid at a cost of $2.50 per square yard. Only 840 sq. yds. of cobble pavement was laid in 1908, the average cost being 51 cts. per square yard. In 1904 810 sq. yds. of this type of pavement was laid at a cost of 40 cts. per square yard. Approximately 22,405 lin. ft. of gutters were constructed in 1908, the total area of the gutters at a cost of 40 cts. per square yard. Approximately 22,405 lin. ft. of gutters were constructed in 1908, the total area of the gutters being 8,531.8 sq. yds. The average cost per square yard was 66 cts. and the average cost per lineal foot of average width was 26.6 cts. A total of 4,020 lin. ft. of gutters, having a total area of 1,527 sq. yds., was repaired, the average cost per square yard being 33.6 cts. and the average cost per lineal foot 12.7 cts.

The costs for gutter work in previous years, none being done in 1905, were as follows:

New Gutters.	1903.	1904.	1906.	1907.
Length in feet.	33,745	38,288	21,921	26,024
Average width, ft.	3.3	3.3	3.5	
Area, sq. yds.	12,372	14,244	8,551	10,879
Cost per sq. yd.	$0.741	$0.661	$0.764	$0.752
Cost per lin. ft.	$0.269	$0.246	$0.298	$0.291
Gutters Repaired:				
Length in feet.	1,894	435	540	162
Area, sq. yds.	814	145	206	54
Cost per sq. yd.	$0.115	$0.27	$0.350	.....
Cost per lin. ft.	$0.187	$0.09	$0.13	.....

The stone curbing laid in 1908 amounted to 14,605 lin. ft., the cost per lineal foot being 83.3 cts. Of this amount 55 cts. was for the stone and 22.7 cts. for the labor. The cost of stone curbing in previous years, none being laid in 1905, was as follows:

	1903.	1904.	1906.	1907.
Length, ft.	18,094	13,714	2,466	11,371
Cost of stone, per ft.	$0.52	$0.52	$0.52	$0.550
Cost of labor, per ft.	$0.18	$0.28	$0.27	$0.321
Total cost per foot.	$0.70	$0.80	$0.79	$0.871

During 1909 the city used 12 cars of dustoline on its macadamized streets. The first car was applied June 6, and the last car Aug. 14. On those streets on which two applications were made, an interval of 67 days elapsed between the first and second applications. Data on the use of the dustoline follow:

Amount used	100,501 gallons
Cost of material	$7,504.70
Cost of distribution	$467.96
Total cost	$7,972.66
Length of roadway treated once	27,207 miles
Length of roadway treated twice	8.939 miles
Length of roadway treated as of one application	45.085 miles
Number of gallons to mile of road, one application	2,229.000
Cost per mile of road, one application	$176.84
Number of square yards, as of one application	597,223.00
Cost per square yard, one application	.0133 or 1⅓c
Cost of application per mile of road for one month (estimated)	$70.00

Concrete Pavement Construction at Boise, Idaho.

The city of Boise, Idaho, is now having constructed a considerable amount of concrete pavement. The city had had some previous experience with this type of pavement, as two years before the street commissioner had built a number of concrete sidewalks, and a year ago an alley had also been paved with concrete. The sidewalks had plain surfaces without marks or creases. The crossings were 6 ins. to 8 ins. thick, 5 ft. wide, of a 1—8 river run mixture, and the top was smoothed off with a shovel. These crossings were built exceptionally high and as a consequence they receive the thumping of everything that crosses them. These crossings show no mark nor sign of wear at the present time. The alley was paved in a manner similar to the crossings, except that the concrete was placed in two layers, the bottom layer being a 1—10 mixture and the top a 1—7 mixture. This pavement also has shown no signs of wear. This year it was decided to lay 8½ blocks of concrete pavement on Front St., and in a paper read at the last annual meeting of the American Society of Municipal Improvements the city engineer, Mr. J. B. Marcellus, describes the work now being done. The street now being paved is parallel to the railway freight yards, where warehouses and the freight depot face the street, as also does the hay market and electric interurban freight depot. As a result the traffic is slow, but heavy.

The width of pavement is 69½ ft., the reason for this being that on the south side no sidewalk or curb is required because teams drive directly up to the warehouses, and, the street car tracks being laid in the center, the north sidewalk and curb are narrowed to 10½ feet.

The work is being done by contract and the usual bond for performance and quality of work was entered into, but no guarantee or maintenance agreement was required. The bidder, however, is to protect the city against any claims for infringement of any patented article, invention, arrangement or appurtenance that may be used in connection with this work. The work at the present time is about half completed. The sub-grade so far has been good. All of it is being rolled thoroughly with a 16-ton roller. The specifications require all spongy places to be refilled with gravel.

The cement used on the work is made at Devil's Side, Utah, and is known as "Red Devil." All tests of the cement are made by the standard method of the American Society for Testing Materials. A good quality of river sand is being used, very clean, although a little fine, and having 30 per cent of voids as determined by a number of tests. The gravel is excellent. It consists of crushed granite boulders up to 6 ins. in diameter, porphyry, rhyolite and various other forms of river wash in a mountainous country. These are screened through a 2½-in. mesh screen and grade up well in size. The gravel is obtained from the bed of the Boise River, and is all passed through a jaw crusher to crush the oversize, but, as in all jaw crushers, "flats" or "pumpkin seeds" over 2½ ins. in longest diameter will come through. These are easily broken with a 7-lb. hammer, and one man, working only a part of the time, keeps most of the pumpkin seeds broken. A number of tests shows the gravel to contain about 40 per cent of voids.

These materials are mixed in the proportion of 1—3—7 and give a concrete that fills well and which, after thorough tamping, can be smoothed off with a wooden float. No topping or special mixture is required for the top, the specifications requiring only a uniform surface with no stones larger than ½ in. in diameter to show. Sometimes a mixture of sand and cement is used to level up with if the concrete does not tamp down level, or an unusual number of large stones appear on the surface. The final thickness of the pavement is 8 ins. Two mixers are being used, one run by a gasoline engine and the other by a motor, at a cost of $22 per month, including moving of connections. Both mixers are small size, but turn out from 30 to 40 cu. yds. per day.

Expansion joints of ½ in. are provided at the curbing and at every 25 ft. at right angles to center line of street. These joints are to be filled with paving pitch. At present they are filled with ½-in. dressed boards. After the concrete is set sufficiently it is covered with 2 ins. of dirt and kept wet for seven days.

The bid accepted by the Board of Public Works was as follows:

	Per cu. yd.
Concrete	$5.29
Excavation	.48
Excavation below subgrade	.55
Refill below subgrade	.85

The gravel and sand cost 80 cts. per cubic yard delivered. The cement costs about $2.75 per barrel f. o. b. Boise. Labor is $2.50 for eight hours, and teams $5, although the contractor has sublet the hauling of the gravel and sand at 60 cts. per cubic yard. At the contract prices the cost of the pavement will be about $1.51 per square yard. The other pavements in Boise have cost $2.50 per square yard and upward, so with this difference in price the city can afford to do considerable maintenance.

Mr. H. M. Wheeler, chief engineer of the Chicago Railways Company, in an article in the Electric Railway Journal gives the following formula for headway on merged car lines:

$$\text{Resulting headway} = \frac{Hh}{H+h}$$

in which

H=headway on one car line.

h=headway on another car line.

Railway Section

Note: This section is devoted to methods and costs of constructing railways. It will cover road-bed and track construction, contractor's plant and organization, surveying methods and permanent way structures.

Reports on Interurban Railway Lines by Engineers and Promoters.

Mr. J. W. Billingsley* lately read a paper before the Louisiana Engineering Society on "Interurban Railway Development in the South," in which some good hints were given for the benefit of engineers who may some time endeavor to promote such enterprises.

Engineers, the author said, often make the mistake of giving undue importance to the item of cost of construction and to the physical features of the line. The object of the preliminary report is to satisfy the promoters and other parties interested that the line will be a paying proposition. Only those matters should be considered that will affect to a considerable degree the question of net earnings. The question of whether a survey will be necessary is one to be settled as a result of this report, the only object of the survey being to more accurately determine the cost.

A survey will enable the amount of earthwork to be determined closely. In many sections this item amounts to only from 8 to 12 per cent of the total cost of construction and a discrepancy of even 25 to 30 per cent will affect the total cost of construction only 3 or 4 per cent. There may be considerable bridge construction, but this item can be estimated within close limits by going over the country. The country in the mind of the writer is the low lying, comparatively flat country of the south and southwest.

In the preliminary report special attention should be given to the gathering of reliable traffic data between the termini. It is interesting to note that a difference in estimates of cost of construction of $100,000 would make a difference in the net earnings of approximately, say $5,000, whereas a difference of only about $8,000 in estimate of gross earnings would change the net earnings by nearly the same amount; hence it is evident the preliminary report should deal more with estimates of revenue than with estimates of cost of construction.

A certain value attaches to the ability to compare the proposed line with others operating under as nearly similar conditions as possible. The check, however, to be of value should be on lines located in the same section of the country and serving similar traffic conditions. It is said that in a rapidly growing, somewhat undeveloped country like the states of Texas and Oklahoma the passenger travel is from 40 to 50 per cent greater per capita than in old and more closely settled communities. Interested parties may often be led to erroneous conclusions by estimating earnings on a basis of so much tributary population per mile of track. Examinations by the author of ten interurban lines at random in the middle west showed the per capita earnings to range from $2.30 to $11, so the danger in using this method alone in estimating gross receipts is evident. The most difficult and important part of a preliminary report is the estimating of gross receipts. Consequently local conditions must be very carefully studied as regards the habits of the people, their principal occupations, and all local characteristics and phenomena. It has been found advisable to have statisticians spend weeks in counting passengers handled by parallel steam lines, wagon and pedestrian traffic, and estimating express business. Local conditions vary so greatly that only a study of the territory will indicate the best methods to adopt in ascertaining existing travel and traffic and estimating how much of this would be handled by the proposed line and how much the building of this line would increase traffic.

The investor wants the information mentioned. There is no question that an interurban line will assist in the development and building up of a territory, but it should be a paying proposition to the investor. Promoters must present the matter to possible investors in an attractive and sane manner. Bond houses are cautious about investing in interurban railway propositions. An examination of statistics about street and interurban properties in the state of Ohio shows that of a total of 89 only 58 show net earnings. Of these, 18 show a deficit for the last 2 years, 6 a deficit for 1 year and a slight earning for the other year, and 8 show a very slight earning, making a total of 32 which are a poor investment to the bond holder. This is particularly so, inasmuch as very few of these poor properties are probably properly maintaining the physical condition of their property. Thus in the state of Ohio 55 per cent of the companies showing operating statements offer a questionable security to the bond holder. This is 36 per cent of the total number in the state. Going back of cold statistical reports it may be found that a number are short lines built to develop real estate and therefore have been extremely profitable in that way.

From the bond holder's point of view, and it is the bond holder for whom all reports are made, a railroad is a losing investment if there is not sufficient traffic between termini. Inefficient management is a passing phase of operation. Poor judgment in location can be corrected before construction. Poor judgment in construction is kin to bad management. The bond holder wants to know that traffic expectations will be realized and net earnings (gross less operating expenses and fixed charges) assured. It is therefore necessary that the proposition be handled in a most thorough and business like manner and facts presented to show it to be a safe investment.

A logical method of procedure in building an interurban railway is for the local people who are interested in its construction to form an association to look into the matter thoroughly. The members of this association will pay for the preliminary report, to ascertain the important fact of probable, not possible, net earnings. This report being satisfactory, the next step is to have surveys made and prepare careful financial and engineering reports in sufficient detail to enable the outside investor to form a correct mental image of the proposition. As a rule the association should provide sufficient money for securing rights of way and to defray the general expenses attendant on underwriting the bonds. Bond underwriters usually require that from 20 to 25 per cent of the money for construction be obtained locally. It is further required that part or all of this money be actually expended upon construction work before applying to the underwriters. After the bond underwriters have been called for about 20 per cent of their underwriting, it is generally possible to secure a loan on the bond underwriting to carry the work to completion. The financing is of course simplified when private interests build the road without stock subscriptions or underwriting, but the probable net earnings can never be forgotten, as they furnish the whole incentive to build such roads.

The outside investor must be assured of a safe return on his investment within a period of at least one year after commencement of operation. If the preliminary report is favorable, surveys should be made to show right of way and obtain detail estimates of showing cost of construction and cost of operation. In addition there should be a statistical report showing in detail business conditions in the tributary territory, all data and information being supplemented by photographs. This statistical report is really an enlargement of or addenda to the preliminary report. It adds information obtained from the result of the surveys and rights of way canvass and data collected in a leisurely manner as compared with the preliminary report.

The interurban railway should be built as much as possible on private right of way and should seek to obtain as short entrance as possible into the termini of the line. It is desirable, especially if there be competing steam lines, to reach the center of a terminal city, but it is essential that the entrance be as short as possible. One line 65 miles long consumes 15 per cent of the schedule time in getting out of the larger city. In small intermediate towns it is not so essential that the center be reached. It is desirable to run on private right of way as much as possible, so if it is necessary to pass along the built up main street to reach the center of the town, it is in many cases best to pass through the edge of the town instead. To follow highways means slower running time and increase in number of accidents.

When paralleling steam lines the interurban must be built for high speed service. This means heavy rails, probably catenary trolley construction, in some cases block signal system, reserve equipment in power plant, and large cars. Without competition high speed is a smaller factor and the line to build is that one which will best meet traffic conditions and soonest insure net earnings.

Mr. Billingsley recommends for southern conditions three systems of motive power, viz.:

600 volt D. C. system.
1,200 volt D. C. system.
Single phase A. C. system.

The 600 volt D. C. system operates at a trolley voltage of 600 and most of the installations built use this system. Often the interurban railway is of such length as to require substations and in such case A. C. power is transmitted to these substations and transformed by means of rotary converters or motor generator sets.

The 1,200 volt D. C. system operates at a trolley voltage of 1,200 volts and has been made possible by the development of the commutating pole motor. Within the past three years several roads have been built using this system, conspicuous among which is the Indianapolis-Louisville line, which operates a 41 mile section without the use of substations.

The single phase A. C. system uses single phase A. C. motors operating with a high trolley voltage stepped down through transformers on car to a suitable voltage for the motors. In general there are no reasons why the trolley should not carry a potential of 11,000 volts, under which conditions a very heavy service (as in the case of heavy freight traffic) can be handled without an excessive amount of copper in the transmission conductors. There have been many single phase systems built within the past few years.

*Manager, The Fred A. Jones Co., Engineers, New Orleans, La.

Appraised Value of the Steam Railways of Wisconsin.

In our issue of June 26, 1907, was published the appraised value of the railways of Wisconsin, as of June 30, 1903. The following is a brief summary of the last valuation, as of June 30, 1907, which was completed in December, 1908, under the direction of Prof. W. D. Pence, Engineer of the Wisconsin Tax Commission and of the Railroad Commission. Table I is a summary of the first and the last valuations.

TABLE I. COMPARISON BETWEEN FIRST AND FIFTH WISCONSIN STEAM ROAD VALUATIONS.

	Valuation as of date. June 30, 1903.	June 30, 1907.
Number of railroad properties included ..	47	52
Total length, road mileage	6,656.88	7,090.39
Cost of reproduction—		
Property, new, total....	$205,760,519	$244,128,868

Cost of reproduction—		
Existing condition, total	169,758,518	196,239,314
Reproduction cost per mile of line—		
Property, new	30,900	34,400
Present value per mile of line	25,500	27,700
Per cent condition	82.5	80.3

The mileage on June 30, 1907, was as follows:

Main line	6,549.69
Main line, joint, ½ interest	9.80
Branch line	551.83
Branch line, joint, ½ interest	9.07
Total main and branch line	7,090.39
Second track	431.57
Third track	40.62
Fourth track	35.54
Total "trackway"	7,598.12
Spurs and sidings	2,523.33
Spurs and sidings joint, ½ interest	52.83
Spurs and sidings joint, ⅓ interest	4.32
Spurs and sidings joint, ⅔ interest	0.29
Crossovers	0.04
Grand total track	10,178.93

The total appraised values, new and in present (depreciated) condition, as of June 30, 1907, are as in Table II.

TABLE II.—VALUATION NEW AND AND IN DEPRECIATED CONDITION OF WISCONSIN RAILWAYS.

	Cost of reproduction. New.	Present condition.
1. Right of way and station grounds	$ 26,339,419	$ 26,339,419
2. Real estate	.....	.....
3. Grading	39,391,307	39,391,307
4. Tunnels	797,412	776,972
5. Bridges, trestles and culverts	18,616,486	14,688,887
6. Cross ties and switch ties	11,181,399	5,826,021
7. Rails	30,111,358	24,605,740
8. Track fastenings	5,254,013	3,367,649
9. Frogs, switches and crossings	1,179,056	743,079
10. Ballast	5,768,084	3,969,476
11. Track laying and surfacing	3,345,555	2,770,572
12. Fencing	1,611,775	826,512
13. Crossings, cattle guards and signs	440,896	269,880
14. Interlocking and signal apparatus	613,354	538,801
15. Telegraph lines	167,840	99,587
16. Telephone lines and distribution system	89,639	81,439
17. Station buildings and fixtures	3,918,995	2,902,418
18. Shops and round houses: powerhouses and car barns	3,892,882	3,048,497
19. Tools	144,419	86,384
20. Water stations	1,345,218	986,357
21. Fuel stations	466,745	351,432
22. Grain elevators	826,706	612,171
23. Warehouses	262,539	200,278
24. Docks and wharves	3,645,907	2,956,821
25. Miscellaneous structures	2,106,101	1,409,949
26. Sub-stations	45,130	44,119
Totals of all the above items	$161,562,235	$136,893,767
27. Engineering, superintendence, and legal expenses 4.5% of all the above items.	$ 7,270,300	$ 6,160,220
28. Locomotives	11,531,174	7,331,573
29. Passenger equipment	5,317,465	3,193,301
30. Freight equipment	30,944,348	20,479,648
31. Miscellaneous equipment	901,935	588,260
32. Ferries and steamships	.....	.....
33. Electric plants	161,476	146,114
34. Shop machinery and tools	1,573,000	1,186,369
Totals of all the above items	$219,261,933	$175,979,252
35. Freight on construction material, 0.7% of items 1-34	1,523,656	1,209,539
36. Interest during construction, 3%: Organization,[1] contingencies, 5.5%; in all,[2] of items 1-34	20,738,225	16,463,297
37. Stores and supplies on hand for use in Wisconsin	2,605,054	2,587,226
Totals	$244,128,868	$196,239,314

[1]1% and 1.5%.
[2]9.5% and 10%.
Includes dock property and all lines under construction.

Dividing each of the items in the first column of Table II by 7,090, we have the following cost per mile of roadbed:

	Per mile of roadbed
1. Right of way, etc.	$ 3,714
2. Real estate	.....
3. Grading	5,554
4. Tunnels	112
5. Bridges, etc.	2,625
6. Ties	1,577
7. Rails	4,246
8. Track fastenings	741
9. Frogs, etc.	166
10. Ballast	813
11. Track laying and surfacing	472
12. Fencing	227
13. Crossings, etc.	62
14. Interlocking and signal	86
15. Telegraph	24
16. Telephone	13
17. Station buildings	553
18. Shops and roundhouses	548
19. Tools	20
20. Water stations	189
21. Fuel stations	66
22. Grain elevators	121
23. Warehouses	37
24. Docks and wharves	514
25. Miscellaneous structures	297
26. Substations	6
Total of above	$22,783
27. Engineering	$ 1,025
28. Locomotives	1,625
29. Passenger equipment	750
30. Freight equipment	4,363
31. Miscellaneous equipment	127
32. Ferries, etc.	...
33. Electric plants	23
34. Shop machinery and tools	222
Total of above	$30,918
35. Freight on constr. mtls.	215
36. Interest during construction, contingencies, etc.	2,924
37. Stores on hand	367
Grand total	$34,424

Since there are 1.435 miles of track per mile of roadbed, each of the above items should be divided by 1.435 (or multiplied by 0.7) to obtain the cost per mile of track. For example, item 11, "Track laying and surfacing," is $472 per mile of roadbed, which is equivalent to $0.7 \times \$472 = \$331$ per mile of track, which, by the way, is an exceedingly low estimate of cost.

A Method of Determining Relative Economy with Rules and Tables for Practical Computation.

BY S. S. ROBERTS.*

Possibly the question most frequently occupying the thoughts of the present day railroad man and engineer is: Which is the most economical? The answer is dependent upon many factors, of which time is probably the most uncertain, and good judgment is by no means the least important. Since the future cannot be foretold with certainty and since judgment may err, an absolutely correct answer may not always be obtained. It is not the purpose of this article, therefore, to attempt to lay down infallible rules, but to outline rules which are in use and to present convenient tables based on them which, coupled with common sense, reduce the probability of mistake in the final decision.

So much has already been written by others on the subject of relative merit or relative economy, that to outline again those things that enter into its consideration may seem plagiarism. The writer wishes at once to purge himself of such a charge by claiming no special originality for anything following and to lay claim to the reader's consideration only through the accompanying tables which he believes convenient, simple and time-saving, and to contain some parts differently presented than any others the writer has seen.

To the average young engineer the request to compare two or more articles on a basis of "Capitalization"; "Annual Cost"; "The Present Value of the Ultimate Amount" for a fixed term of years; or on the basis of "Equivalent Cost" is distressing; and from the character of requests frequently made by the older engineers of their subordinates, it would seem that even some of them are not entirely familiar with the relationship between the different methods named, and are skeptical of the fact that the order of merit will be the same no matter which one of these processes is employed.

There are four elements always considered in determining relative economy or merit.

(1) First Cost: Which should include the cost of raw material, cost of fabricating, cost of transportation and handling, and cost of placing or erecting.

(2) Life: That is the time elapsing between the date of installation and the date when it becomes necessary to renew or replace.

(3) Cost of replacing or renewing.

(4) The cost of money or rate of interest.

To these may be added:

(5) Maintenance: Which is the cost of repairs or depreciation, and

(6) Salvage: The scrap value of the article at the close of its period of usefulness.

In the formulas, developed later, the first five elements only shall be considered.

On the basis of "Capitalization" that article is considered the cheapest which, present conditions prevailing, will require the least amount to install it and to be set aside now at compound interest to reproduce it for ever.

The capitalization is made up of

(a) First cost $= C$.

(b) The amount at simple interest necessary to produce annually the cost of maintenance $= M' = \frac{M}{R}$.

(c) The amount at compound interest necessary to produce in interest during the life of the article the first cost of it $= C' = \frac{C}{(1+R)^N - 1}$

Total capitalization equals

$$(C + M' + C') = \frac{C(1+R)^N}{(1+R)^N - 1} + \frac{M}{R} \quad \ldots\ldots (1)$$

in which N = the years of life of the article, $R = \frac{\text{rate of int.}}{100}$, and M the cost per year to maintain.

As frequently occurs, the cost of maintenance is the same for the articles considered, and may be neglected, then

$$\text{Total capitalization} = \frac{C(1+R)^N}{(1+R)^N - 1} \quad \ldots\ldots (2)$$

On the basis of "Annual Cost," that article is the cheapest which shows the least annual cost. The annual cost being made up of

(a) Interest on first cost $= I = CR$.

(b) The amount that must be spent annually for maintenance $= M$.

(c) The amount that must be set aside annually at compound interest to provide for renewal at expiration of the life of the article, equal to $F = \frac{CR}{(1+R)^N - 1}$

Total annual cost =

$$(I + M + F) = \frac{CR(1+R)^N}{(1+R)^N - 1} + M \quad \ldots\ldots (3)$$

$$\text{Neglecting maintenance} = \frac{CR(1+R)^N}{(1+R)^N - 1} \quad \ldots\ldots (4)$$

On the basis of "The Present Value of the Ultimate Amount" where each article is considered in use for the same period of time and where the period of time considered is a common multiple of the lives of the articles considered.

The Ultimate Amount (UA) at compound interest of the first cost (C) occurring now and recurring every N years for T times or periods of N years each is

$$U.A. = \frac{C(1+R)^N}{(1+R)^N - 1} \times [(1+R)^{NT} - 1] \quad \ldots\ldots (5)$$

The amount set aside now (Present Value) which at compound interest will equal the accumulation (UA), in NT years is

$$P.V. = \frac{U.A.}{(1+R)^{NT}} = \frac{C(1+R)^N}{(1+R)^N - 1} \times \frac{(1+R)^{NT} - 1}{(1+R)^{NT}} \quad \ldots\ldots (6)$$

The difference in the present value of two articles as obtained from equation (6) plus or minus the difference in cost of maintenance gives the present advantage of one over the other.

On the basis of "Equivalent Cost." One article is considered to cost the same as another when the capitalization or annual cost of one

*Professor of Railroad Engineering, University of Illinois, Champaign, Ill.

TABLE I.—EQUIVALENT COST AT 4 PER CENT INTEREST.

Life. N.	Amt.	Interest.	Capitalization.	Annual cost.	Equivalent Cost. 5.	6.	7.	8.	9.	10.	11.	12.	13.	14.	15.	16.	17.	18.	19.	20.	21.	22.	23.	24.	25.	N.
5	1.217	0.217	5.616	0.225	**1.000**	0.849	0.742	0.661	0.599	0.549	0.508	0.474	0.446	0.421	0.400	0.382	0.366	0.352	0.339	0.328	0.317	0.308	0.300	0.292	0.285	5
6	1.265	0.265	4.769	0.191	1.178	**1.000**	0.873	0.779	0.705	0.646	0.598	0.559	0.525	0.496	0.471	0.450	0.431	0.414	0.399	0.386	0.374	0.363	0.353	0.344	0.336	6
7	1.316	0.316	4.165	0.167	1.348	1.145	**1.000**	0.891	0.807	0.740	0.685	0.640	0.601	0.568	0.540	0.515	0.493	0.474	0.457	0.442	0.428	0.415	0.404	0.394	0.384	7
8	1.369	0.369	3.713	0.149	1.512	1.284	1.122	**1.000**	0.906	0.830	0.769	0.717	0.674	0.637	0.606	0.578	0.553	0.532	0.513	0.495	0.480	0.466	0.453	0.442	0.431	8
9	1.423	0.423	3.362	0.134	1.670	1.418	1.239	1.104	**1.000**	0.917	0.849	0.792	0.745	0.704	0.669	0.638	0.611	0.587	0.566	0.547	0.530	0.515	0.500	0.488	0.476	9
10	1.480	0.480	3.082	0.123	1.822	1.547	1.351	1.205	1.091	**1.000**	0.926	0.864	0.812	0.768	0.730	0.696	0.667	0.641	0.617	0.597	0.578	0.561	0.546	0.532	0.519	10
11	1.539	0.539	2.854	0.114	1.968	1.671	1.460	1.301	1.178	1.080	**1.000**	0.933	0.877	0.829	0.788	0.752	0.720	0.692	0.667	0.645	0.624	0.606	0.590	0.575	0.561	11
12	1.601	0.601	2.664	0.107	2.108	1.790	1.564	1.394	1.262	1.157	1.071	**1.000**	0.940	0.888	0.844	0.805	0.771	0.741	0.715	0.691	0.669	0.649	0.632	0.616	0.601	12
13	1.665	0.665	2.504	0.100	2.243	1.905	1.664	1.483	1.343	1.231	1.140	1.064	**1.000**	0.945	0.898	0.857	0.821	0.789	0.760	0.735	0.712	0.691	0.672	0.655	0.639	13
14	1.732	0.732	2.367	0.095	2.373	2.015	1.760	1.569	1.421	1.302	1.206	1.126	1.058	**1.000**	0.950	0.907	0.868	0.834	0.804	0.777	0.753	0.731	0.711	0.693	0.676	14
15	1.801	0.801	2.249	0.090	2.498	2.121	1.852	1.651	1.495	1.371	1.269	1.185	1.113	1.053	**1.000**	0.954	0.914	0.878	0.847	0.818	0.793	0.769	0.748	0.729	0.712	15
16	1.873	0.873	2.146	0.086	2.617	2.223	1.941	1.731	1.567	1.437	1.330	1.242	1.167	1.103	1.048	**1.000**	0.958	0.920	0.887	0.857	0.831	0.806	0.784	0.764	0.746	16
17	1.948	0.948	2.055	0.082	2.733	2.321	2.027	1.807	1.636	1.500	1.389	1.296	1.218	1.152	1.094	1.044	**1.000**	0.961	0.926	0.895	0.867	0.842	0.819	0.798	0.779	17
18	2.026	1.026	1.975	0.079	2.844	2.415	2.109	1.880	1.703	1.561	1.445	1.349	1.268	1.198	1.139	1.086	1.041	**1.000**	0.964	0.931	0.902	0.876	0.852	0.830	0.810	18
19	2.107	1.107	1.903	0.076	2.950	2.505	2.188	1.951	1.766	1.619	1.499	1.399	1.315	1.243	1.181	1.127	1.080	1.038	**1.000**	0.966	0.936	0.909	0.884	0.861	0.841	19
20	2.191	1.191	1.840	0.074	3.053	2.593	2.264	2.019	1.828	1.676	1.551	1.448	1.361	1.287	1.222	1.166	1.117	1.074	1.035	**1.000**	0.969	0.940	0.915	0.891	0.870	20
21	2.279	1.279	1.782	0.071	3.151	2.676	2.337	2.084	1.887	1.730	1.601	1.495	1.405	1.328	1.262	1.204	1.153	1.108	1.068	1.032	**1.000**	0.971	0.944	0.922	0.898	21
22	2.370	1.370	1.730	0.069	3.246	2.757	2.408	2.146	1.944	1.782	1.650	1.540	1.447	1.368	1.300	1.240	1.188	1.142	1.100	1.063	1.030	**1.000**	0.973	0.948	0.925	22
23	2.465	1.465	1.683	0.067	3.337	2.834	2.475	2.207	1.998	1.832	1.696	1.583	1.488	1.406	1.336	1.275	1.221	1.174	1.131	1.093	1.059	1.028	**1.000**	0.974	0.951	23
24	2.563	1.562	1.640	0.066	3.425	2.909	2.540	2.265	2.051	1.880	1.740	1.625	1.527	1.443	1.371	1.309	1.253	1.204	1.161	1.122	1.084	1.055	1.026	**1.000**	0.976	24
25	2.666	1.666	1.600	0.064	3.509	2.980	2.603	2.320	2.101	1.926	1.783	1.665	1.564	1.479	1.405	1.341	1.284	1.234	1.189	1.150	1.114	1.081	1.051	1.025	**1.000**	25

is equal to the capitalization or annual cost respectively of the other, or

$$C' = \left[\frac{C(1+R)^N}{(1+R)^N - 1} \quad \frac{(1+R)^{N'} - 1}{(1+R)^{N'}}\right] + \left[\frac{M \quad M'}{R} \cdot \frac{(1+R)^{N'} - 1}{(1+R)^{N'}}\right] \quad . \quad (7)$$

neglecting the cost of maintenance

$$C' \quad \frac{C(1+R)^N}{(1+R)^N - 1} \quad \frac{(1+R)^{N'} - 1}{(1+R)^{N'}} \quad \cdots\cdots (8)$$

where C' is the cost of one article of life of N' years and where C is the cost of the other article with life of N years.

From inspection of equations (1) and (3) or (2) and (4) it is at once seen that the "Annual Cost" is simply the product of R times the "Total Capitalization," that is, it is the capitalization placed at simple interest.

From inspection of equations (2) and (5) it will be seen that the "Ultimate Amount" is simply the interest at compound interest of the "Total Capitalization" for the period of time concerned.

From inspection of equation (6) the "Present Value of the Ultimate Amount" is simply the capital sum which placed at compound interest now together with the interest, will at the close of the period of time considered be equal to the interest on the "Total Capitalization" for the same period.

Further, from equation (8), if N' is a multiple of N and equal to NT, the "Equivalent Cost" for the article lasting N' years is found to be equal to the "Present Value of the Ultimate Amount" of the article lasting N years considered in use for N' years.

From these comparisons it will be seen that the same order of merit will be obtained no matter on what basis the comparison is made.

If the cost of renewal of the articles should be the same as the present first cost, or if the future cost could actually be determined and considered, and if the estimated life could be actually realized, then the mathematical comparisons given would be exact. If an article now of lesser first cost and life were known to be unattainable or attainable at prohibitive cost at the end of its life, but which now showed a saving over a second article, and if the increase in cost of the second article were known and shown to be less than the accumulation of the saving placed at compound interest for the life of the first, the rules would again be certain guides.

The ideal conditions outlined above do not prevail in practice. The time element, life, is always uncertain. Not only because it is impossible to say exactly how long an article will last but also because of the possible and probable inability to enjoy the use of an article to the full extent of its actual life. This may be illustrated by practice in renewing cross ties. If treated ties are used, many railroads are not in a position to say positively that the character and efficiency of treatment is as estimated. Granted that it is. The ability in service to get the entire life out of the tie is doubtful. The most universal practice in maintenance is very probably a rotative method of overhauling. That is, every one and a half or two miles of track will have to be "put up," generally overhauled and repaired, about every third or fourth year, and an effort is made to distribute the old and new cross ties so that one tie out of every three or every four ties will have to be renewed every third or fourth year. Now, if in the judgment of the foreman overhauling such a section of track, a tie will not last until the time of the next general overhauling, but will last for say two years, he will leave it in track. If on the other hand, the foreman thinks the tie has remaining only about a year of life, he will take it out. Very good policy, because it is possibly more economical to remove the tie at the loss of a year of its usefulness than to disturb the bed of the track so frequently. But, as to whether a tie will last one year or two years longer is a matter of very doubtful judgment, with the tendency of the track men to be on the safe side, and it is believed that it is more difficult to judge correctly the treated ties, and that more mistakes are made against the ties of long life and very gradual deterioration than in the case of ties of short life and rapid deterioration.

Again of the conditions of practice may be cited a road struggling for existence and desiring to purchase ties. A tie of long life and great first cost may, from every theoretical point of view, be shown to be economical. Yet the large expenditure necessary to purchase it would bankrupt the road.

So that in the end common sense or good judgment and a knowledge of all local and physical conditions play an important part in consideration of relative economy. Good judgment alone without the backing of mathematical assistance is no more or less than a guess. Reliance on the mathematical equations alone is of less value. However, by a combination of the two, the best results attainable should be had. An opinion based on good judgment substantiated by mathematical demonstration should certainly be worthy of consideration, and the better the judgment displayed in placing a proper valuation upon the elements of the mathematical equations, the more surely are the chances of error in the result decreased.

The accompanying tables I and II are intended to offer a convenient means for the combination of one's judgment and the mathematical equations given above. They are based on equations (2), (4) and (8) where the cost of maintenance is neglected.

There are two tables computed on a basis of money at 4 per cent and 5 per cent respectively and covering periods of from 5 to 25 years inclusive. Examples: With interest rate for the money at 5 per cent.

(1) To find the amount, principal plus interest, at compound interest of $1,000 for 14 years. From column "Amount," line 14: Amount = $1,000 × 1.980 = $1,980.

(2) To find the interest on $1,000 at compound interest for 14 years. From column "Interest," line 14: Interest = $1,000 × 0.98 = $980.

(3) Given an accumulation of $1,980 at compound interest at the end of 14 years. To find the principal or present value. Column "Amount," line 14: Present value = $1,980 ÷ 1.980 = $1,000.

(4) To find the capital sum that at compound interest for 14 years will produce interest amounting to $980. Column "Interest," line 14: Capital sum = $980 ÷ 0.980 = $1,000.

(5) To find the total "Capitalization" of a cross tie that costs 55 cts. in the track and will last 7 years. From column "Capitalization," line 7: $0.55 × 3.456 = $1.901.

(6) To find how long a cross tie should last that costs 55 cts. and has a capitalization of $1.901. (1.901 ÷ 0.55) = 3.456. Under column "Capitalization" on line 7 is the corresponding "Capitalization"; therefore the tie should last 7 years.

(7) To find the "Annual Cost" of the tie given in example (5). From column "Annual Cost," line 7, $0.55 × 0.173 = $0.095.

(8) To find how long a tie should last that costs 55 cts. and has an "Annual Cost" of $0.095. (0.095 ÷ 0.35) = 0.173, and under column "Annual Cost" on line 7 is the cor-

TABLE II EQUIVALENT COST AT 5 PER CENT INTEREST.

Life N	Amt	Interest.	Capitalization.	Annual cost.	Equivalent Cost. 5.	6.	7.	8.	9.	10.	11.	12	13.	14.	15.	16.	17.	18.	19	20.	21.	22.	23.	24.	25.	N.
5	1.276	0.276	4.620	0.231	**1.000**	0.855	0.748	0.670	0.609	0.561	0.521	0.488	0.461	0.437	0.417	0.399	0.384	0.370	0.358	0.347	0.338	0.329	0.321	0.314	0.307	5
6	1.340	0.340	3.940	0.197	1.172	**1.000**	0.877	0.785	0.714	0.657	0.611	0.573	0.540	0.513	0.489	0.468	0.450	0.434	0.420	0.407	0.396	0.386	0.376	0.368	0.360	6
7	1.407	0.407	3.456	0.173	1.357	1.140	**1.000**	0.895	0.814	0.749	0.697	0.653	0.616	0.585	0.557	0.534	0.513	0.495	0.479	0.464	0.451	0.440	0.429	0.419	0.411	7
8	1.477	0.477	3.094	0.155	1.493	1.273	1.117	**1.000**	0.908	0.837	0.778	0.729	0.688	0.653	0.623	0.596	0.573	0.553	0.535	0.519	0.504	0.491	0.479	0.468	0.459	8
9	1.551	0.551	2.814	0.141	1.642	1.400	1.228	1.100	**1.000**	0.920	0.858	0.802	0.757	0.718	0.685	0.656	0.630	0.608	0.588	0.570	0.554	0.540	0.527	0.515	0.504	9
10	1.629	0.629	2.590	0.130	1.784	1.521	1.334	1.195	1.086	**1.000**	0.932	0.871	0.822	0.780	0.744	0.712	0.685	0.661	0.639	0.620	0.602	0.587	0.572	0.560	0.548	10
11	1.710	0.710	2.408	0.120	1.919	1.637	1.436	1.285	1.169	1.076	**1.000**	0.937	0.884	0.839	0.800	0.766	0.737	0.711	0.687	0.667	0.648	0.631	0.616	0.602	0.589	11
12	1.796	0.796	2.257	0.113	2.047	1.746	1.532	1.371	1.247	1.148	1.067	**1.000**	0.944	0.895	0.854	0.818	0.786	0.758	0.733	0.711	0.691	0.673	0.657	0.642	0.629	12
13	1.886	0.886	2.129	0.106	2.170	1.851	1.624	1.453	1.322	1.216	1.131	1.060	**1.000**	0.949	0.905	0.867	0.833	0.804	0.777	0.754	0.733	0.714	0.696	0.681	0.666	13
14	1.980	0.980	2.020	0.101	2.286	1.950	1.711	1.532	1.393	1.282	1.192	1.117	1.054	**1.000**	0.954	0.913	0.878	0.847	0.819	0.794	0.772	0.752	0.734	0.717	0.702	14
15	2.079	1.079	1.927	0.096	2.397	2.045	1.794	1.606	1.460	1.344	1.250	1.171	1.105	1.049	**1.000**	0.958	0.921	0.888	0.859	0.833	0.810	0.789	0.770	0.752	0.736	15
16	2.183	1.183	1.845	0.092	2.503	2.135	1.873	1.677	1.525	1.404	1.305	1.223	1.154	1.095	1.044	**1.000**	0.961	0.927	0.897	0.870	0.845	0.823	0.803	0.785	0.769	16
17	2.292	1.292	1.774	0.089	2.604	2.221	1.948	1.744	1.586	1.460	1.357	1.272	1.200	1.139	1.086	1.040	**1.000**	0.964	0.933	0.905	0.879	0.856	0.836	0.817	0.800	17
18	2.407	1.407	1.711	0.086	2.700	2.303	2.020	1.809	1.645	1.514	1.407	1.319	1.244	1.181	1.126	1.079	1.037	**1.000**	0.967	0.938	0.912	0.888	0.867	0.847	0.829	18
19	2.527	1.527	1.655	0.083	2.791	2.381	2.089	1.870	1.700	1.565	1.455	1.364	1.287	1.221	1.164	1.115	1.072	1.034	**1.000**	0.970	0.943	0.918	0.896	0.876	0.857	19
20	2.653	1.653	1.605	0.080	2.878	2.455	2.154	1.928	1.753	1.614	1.500	1.406	1.327	1.259	1.201	1.150	1.105	1.066	1.031	**1.000**	0.972	0.947	0.924	0.903	0.884	20
21	2.786	1.786	1.560	0.078	2.961	2.526	2.216	1.984	1.804	1.660	1.544	1.447	1.365	1.295	1.235	1.183	1.137	1.097	1.061	1.029	**1.000**	0.974	0.951	0.929	0.910	21
22	2.925	1.925	1.519	0.076	3.040	2.593	2.275	2.037	1.852	1.705	1.585	1.485	1.401	1.330	1.268	1.215	1.168	1.126	1.089	1.056	1.027	**1.000**	0.976	0.954	0.934	22
23	3.072	2.072	1.483	0.074	3.116	2.658	2.331	2.087	1.898	1.747	1.624	1.522	1.436	1.363	1.300	1.245	1.196	1.154	1.116	1.082	1.052	1.025	**1.000**	0.978	0.957	23
24	3.225	2.225	1.449	0.072	3.187	2.719	2.385	2.135	1.941	1.787	1.661	1.557	1.469	1.394	1.329	1.273	1.224	1.180	1.142	1.107	1.076	1.048	1.023	**1.000**	0.979	24
25	3.386	2.386	1.419	0.071	3.255	2.777	2.436	2.181	1.983	1.825	1.697	1.590	1.500	1.424	1.358	1.300	1.253	1.206	1.166	1.131	1.099	1.071	1.045	1.021	**1.000**	25

responding value, therefore the tie should last 7 years.

(9) To find how much may be paid for a tie lasting 16 years to show the same merit as a tie lasting 7 years and costing 55 cts. From column 7 and line 16: $0.55 \times 1.873 = \$1.03$.

(10) To find how much may be paid for a tie lasting 7 years to show the same merit as a tie lasting 16 years and costing $1.03. From column 16 and line 7: $\$1.03 \times 0.534 = \$0.55$.

(11) To find how long a cross tie should last that costs $1.03 in order to be as economical as a tie that costs 55 cts. and lasts 7 years. $(1.03 \div 0.55) = 1.873$. Under column 7 the corresponding value is found on line 16; therefore the tie costing $1.03 should last 16 years.

(12) To find how long a tie that costs 55 cts. should last in order to be as economical as a tie that costs $1.03 and lasts 16 years. $(0.55 \div 1.03) = 0.534$. Under column 16 the corresponding value is found on line 7; therefore the tie costing 55 cts. should last 7 years. When the life (N') of one article is a multiple of the life (N) of another and both are considered in use for the same period of time; equal to the life (N') of the more lasting of the two.

(13) A tie costs 42 cts. in the track and lasts 5 years. A second tie costs 67 cts. in the track and lasts 10 years, and both are considered for a period of 10 years on a basis of the "Present Value of the Ultimate Amount." From the tables, column "5," line 10, the amount that may be given for a tie that will last 10 years to be as economical as the 5-year tie is, $\$0.42 \times 1.783 = \$0.75$. The present advantage of the tie lasting 10 years over that lasting 5 years is, $\$0.75 - \$0.67 = \$0.08$.

(14) To compare the merit of a tie costing 90 cts. in the track and lasting 5 years with a steel tie costing $2.44 in the track and lasting 25 years. When the steel tie weighs originally 180 lbs. and has remaining 40 per cent of its original weight when it is renewed. The scrap value of the steel being $11 per ton. Interest rate for money 4 per cent. From the 4 per cent table, column "5," line 25. There may be given for a tie lasting 25 years, $(0.90 \times 3.509 = \$3.158$ to be of equivalent value to the tie lasting 5 years and costing 90 cts.

There is salvage on the steel tie amounting to $\frac{180}{2240} \times 0.40 \times \$11 = \$0.347$ at the end of 25 years. The present value of this salvage is from column "Amount," line 25: $(0.347 \div 2.666) = \$0.130$. So that the present cost of the steel tie may be considered $2.44 — $0.13 = $2.31.

The advantage of the steel tie is therefore $3.158 — $2.31 = $0.848, where tie for tie is used.

(14a) In cases where opinion prevails that it is necessary to use 20 steel ties to a 33-ft. rail where 18 wooden ties answer the same purpose, then the advantage of the steel tie is

$$\frac{(\$3.158 \times 18) - (\$2.31 \times 20)}{20} = \$0.531 \text{ per tie.}$$

Or, a steel tie lasting 25 years, having the salvage given above, would have to cost more than $2.84 before it becomes less economical than the wooden tie lasting 5 years and costing 90 cts.

Or, from the table, column 25, line 5: If the steel tie costs $2.31, then with equal economy, tie for tie, there may be given for the 5-year wooden tie, $(\$2.31 \times 0.285) = \$0.658$.

Or, where 20 steel ties are used to 18 wooden ties, $(\$2.31 \times 0.285) \times \frac{20}{18} = \$0.731$

That is to say, the wooden tie lasting 5 years would have to cost less than 73 cts. to be more economical than the steel tie lasting 25 years and costing $2.44 with the salvage assumed above.

The examples given above have been taken at random without having in mind any specific case in actual practice, and are intended to serve only for the purpose of illustrating the working of the tables.

Unclassified and General Articles

Note: This section is devoted to methods and cost articles on construction work not properly coming under any of the preceding classifications.

Methods of Filing Books, Pamphlets, Trade Catalogs and Periodicals for Small Private Libraries or Information Departments.

The development of the special library, or information department, in engineering, contracting and industrial fields has marked, and has in part caused, a considerable increase in business efficiency. In any modern office or concern dealing with technical problems, the bulk and variety of the data that need to be preserved speedily get beyond the capacity of the filing cabinet. Something more efficient is needed that can hold a great variety of material clearly classified and instantly available, and this demand for the something more efficient is being filled to an increasing degree by the information department or "special library" organized with reference to the particular needs of the organization it serves. The multiplication of these special libraries, it may be noted, has led to the forming of an association of special libraries, numbering over a hundred members, which impressively denotes the growing importance of this new tool.

A very suggestive example of the special library for a particular field is that given in a recent paper before the convention of the American Chemical Society. Therein Mr. Guy E. Marion of the Arthur D. Little, Inc., laboratory of engineering chemistry, describes the "Information Department" under his charge, which is attached to the Little laboratory. As an explanation of methods which have proved of high practical efficiency in handling a great mass of material bearing on a wide range of engineering-chemical matters, Mr. Marion's paper is full of suggestions that will prove helpful and stimulating to engineers who have not yet realized the value and the feasibility of some such system for preserving data of various sorts. Describing the organizing and handling of the material, Mr. Marion says:

Sources of Material.—Material is obtained chiefly through five channels: (1) The purchase of special books or pamphlets to meet definite requests; (2) through the mailing lists of outside concerns that send their advertising literature from time to time; (3) through the kindness of individual acquaintances at various points who desire to exchange results; (4) from chance notices appearing in the technical periodicals, which prompt us to initiate ourselves the getting of the information in question; and (5) from the calls of clients and salesmen who may leave with us at their visits information of one kind or another. These are outside sources. The material produced within cur own business of course comes to the library through the regular office routine.

Classification.—All of this material then on its receipt falls into one of the following six groups: (1) Books, (2) pamphlets, (3) trade catalogues, (4) special data, (5) periodicals and (6) the museum collection.

Books.—The books are classified by the Dewey decimal system, which long ago proved its claims in the public libraries. It serves our purposes very well indeed, and maintains uniformity with the best prevailing library practice in the majority of public libraries. By its use, like books stand together on the shelves and those related stand closely by. It permits of perfect intercalation of new material upon the shelves in proper order. Supplementing the Dewey subject number, each book has its Cutter's author number. The Kate E. Sanborn arrangement of C. A. Cutter's alphabetic order table is used for assigning these numbers. All books are entered in an accession book on their reception, thus keeping accurate data on each volume.

Pamphlets.—Pamphlets receive treatment similar to that of the books as far as their numbering goes, but in order to keep this material in a distinct class by itself, the small letter p is used before the classification number. The pamphlets are then placed in regular pamphlet boxes on the shelves.

Trade Catalogs.—Trade catalogs receive a somewhat different treatment. This is the most objectionable class of material entering the library, owing to its entire lack of uniformity. The best practical treatment has been found to be a shelf arrangement, in which all the small material is inclosed in envelopes (9⅝x11¾ ins., without flap, opening on the long side) and standing in one alphabet from a to z. To each company's catalogue is assigned a Cutter number; thus the catalogue of the Sturtevant Mill Co. is S 936, which places it at one and the same time in a strictly alphabetical and numerical decimal order. This arrangement has the additional advantage of allowing those coming to the library seeking a particular concern's catalogue to go directly to the shelves without consulting an index.

Special Data.—Special data make up a somewhat miscellaneous class of material composed of an accumulation of newspaper clippings, reviews of articles, results of personal interviews, special investigations, data culled from correspondence, and many other sources. The greater part of it is copied on correspondence size sheets and placed in a vertical file. A small letter s preceding the number keeps this material distinctly in one class. The arrangement here is also by subject with the use of the decimal system.

Periodicals.—The class of periodicals is made up of a selected list of about 50 scientific and technical publications, both foreign and domestic. Many of these are purchased directly, while others are received with memberships in the different learned societies. For convenient reference all the periodicals are given symbols such as E R J for "Electric Railway Journal" and P T J, "Paper Trade Journal." Thus with the date of issue known, a certain reference can be easily and briefly made to any article. When the periodicals are later bound, as many of the better ones are, they of course leave this class and become books. As for the others, after clipping, they are thrown away.

Muscum.—The museum collection is made up of a large assortment of samples obtained from various sources, clients, etc.; for example, fibrous materials, mineral matter, special papers, artificial silks, standardized steels and irons, paper making chemicals, electric railway materials, etc., etc. To each individual sample is given a consecutive number, preceded by a small letter m, which serves to keep this material in one group by itself. The material is filed in glass cabinets, where it is on constant exhibition, and proves, at least to visitors, a source of lively interest.

Color Scheme.—In the actual handling of this material a color scheme is used. White tags are placed on the books, salmon on the pamphlets, blue on the catalogues, yellow on the special data, green on the periodicals and cherry on the museum material. This is found to be helpful in the work, always aiding the eye in the rapid classification of material, and preventing often the return of material to the wrong place.

Accessioning.—Now as to the processes through which this bulk of material passes. Everything entering for permanent file is first accessioned, then catalogued and filed. The accessioning of the books has already been

described; the other classes are accessioned on sheets kept for one week only, from which the information is later transferred to the weekly bulletin which will be described below. This does not apply to the periodicals which are checked upon a special card system as they are received, nor to the museum articles, which are not accessioned.

Cataloging.—The classifying takes place next, which is followed as soon as finished by the indexing. Author, title and subject cards are made out in nearly every case and often several subject cards. The cards completed, the materials go to their respective files, and the cards to the library index.

Card Catalog.—This index is one large dictionary catalog from a to z, and now numbers between 30,000 and 40,000 cards. These are all standard 3x5-in. library cards, and the entire index is liberally supplied with guides for the searcher. After locating the proper material wanted in the index, the nature of the call number on the card will always indicate the group in which the material itself will be found. This has already been explained in earlier paragraphs upon the different groups of material, by the use of the small letters, s, p, m, etc., as symbols in the call numbers. A distinctive feature of filing cards is the placing of them first in their proper places, without the removal of the rods from the drawers. A second party then goes through the cabinet, verifying them and dropping them into their permanent arrangement.

Charging.—The charging system carries out the color scheme. We have a small tray with the necessary compartments, in which narrow slips are used for keeping records of the material out of its regular place. White slips receive the book charges, salmon the pamphlet, blue the catalogue, and so on. On each slip is written the call number of the material, the initials of the borrower, and the date on which the loan is made. All material which is returned during the day is kept together in one place and is returned to the files the first thing the following morning, the charge slips being removed at the same time from the charging tray.

Correspondence.—For indexing purposes all of the correspondence of the various departments of our laboratory goes to the library before being filed. This is the regular channel through which all mail must go, and nothing is filed until noted by the library with its library stamp. This enables the library to pick out and index such useful bits of information as would otherwise be lost sight of.

We have a form called "inquiry blanks," printed on paper of a distinctive color. A pad of these blanks lies on nearly every desk in the various departments about the laboratory. When a need for information arises in any department, one of these forms is filled out and sent to the library, whence it becomes our duty to provide an answer at the earleist possible moment. These slips are numbered consecutively as received, and after going to the accounting department for the distribution of their time charges, are returned to the library and kept in consecutive order. They serve thereafter as memoranda from which the answers can be readily found in case the inquiries are duplicated later from other sources, for each slip is filled out with the sources from which any information has come.

Annual Meeting of the Illinois Society of Engineers and Surveyors.

The annual meeting of this society will be held in Cairo, Ill., Jan. 26 to 28. The Halliday Hotel will be headquarters and all the meetings will be held in Armory Hall.

A feature of the meeting will be the topical discussions, a profitable one at past meetings and of great interest to the members. For the present meeting 20 topics have been suggested, all being of vital interest to civil engineers and surveyors, especially those practicing in the smaller communities. Discussions on these topics are not limited to members and a printed list will be sent to all inquirers, written discussions being invited. The secretary, Mr. E. E. R. Trotman, 1636 Monadnock Block, Chicago, will present written discussions sent in by those unable to attend.

Reports will be made by the committees on sewers, roads and pavements, drainage, records of bridges on public highways, surveying, government control of land surveys, railways, metric system, measures of length, and legislation.

The following papers have been announced: The Relation of the Typhoid Fever Death Rate to the Water Supplies of Illinois, E. Bartow; Municipal Engineering Work at Cairo, W. B. Thistlewood; Chicago's Sidewalk Problem, N. E. Murray; Materials and Workmanship in Street Paving, W. W. Marr; Instruction in Hydraulics and Water Supply Engineering at the University of Illinois, Geo. C. Habermeyer; Sewage Disposal Plants for Small Institutions, Geo. C. Habermeyer; Recent Practice in Sewage Purification, W. S. Shields; Reinforced Concrete Construction, A. J. Widmer; Reinforced Concrete Aqueducts, H. E. Reeves; Instruction in Road and Pavement Construction at the University of Illinois, R. B. Slippy; Tests of Road Materials, R. B. Slippy; Roads in Central Illinois, J. O'Brien; The Drainage and Protection of Lands Subject to Overflow, C. W. Brown; The Legal Liabilities of Levee and Drainage Districts, J. V. Waddell; The Tallahatchie Drainage District, A. L. Dabney; Water Supply and Drainage Investigations in Illinois, R. I. Randolph; The Maintenance of Open Ditches, E. H. Cowan; The Highway Work of the U. S. Government, by a U. S. road engineer; Observations on Engineering in Europe (illustrated), F. O. Dufour; Developments in Road Construction, A. N. Johnson; The County Surveyor, P. T. Hicks; The Cairo and Thebes Railway, G. F. Dewey; The Cairo Electric Railways; Steel and Concrete Bridge Work on the Illinois Central Railway, R. E. Gant; Monazite and Its Uses, S. K. Atkinson; Railway Engineering at the University of Illinois, S. S. Roberts; Mining Engineering at the University of Illinois, H. H. Stoek; The St. Louis and Cairo Deep Waterway, J. W. Woerman. Following Mr. Woerman's paper there will be discussions on river traffic.

Processes for the Preservative Treatment of Timber and Approximate Costs of Treatment.

BY G. B. SHIPLEY.*

The evolution of timber preserving processes in this country within the last ten years has developed many new methods of treating ties, piling, timber, poles, cross arms, mine timbers, etc., and a great many antiseptics or compounds are being proposed, but the subject is of such vital importance that the leading organizations are backward about experimenting. Consequently the processes actually employed may be subdivided into only two methods and these are the full cell and partial cell treatments. The full cell treatment consists of impregnating the wood fibres and filling the cells with the antiseptic, whereas the partial cell treatment consists of impregnating the wood fibres only. These two methods are sometimes confused with processes or the matter in which the treatment is performed.

The treatment of wood depends upon where the wood will be used, the climatic conditions, the permissable cost of treatment and the wood structure. If first class wood is to be used for such work as docks around salt water, telegraph poles, building foundations or for railroad ties, where there is no mechanical wear, the full cell method is best, but if the wood is soft and not protected from mechanical wear, then the partial cell method will be satisfactory for the reason that with the latter method the chemical life will be equivalent to the mechanical life.

The important processes that are in use in this country and which may be classed under the full cell method are the burnettizing, wellhouse, full cell creosote and card processes and those which may be classed under the partial cell method are the Reuping, Lowry and absorption processes. These processes, with the exception of the absorption process, are manipulated by mechanical contrivances, such as pressure pumps, vacuum pumps and air compressors and can be controlled to suit the wood structure, while with the absorption process the treatment is governed by temperature and atmospheric pressure, therefore is limited to certain woods.

Burnettizing Process.—This is often referred to as the zinc chloride process and consists of impregnating the wood fibres with a solution containing ½ lb. of dry zinc per cubic food of wood and is operated as follows: The wood is first air seasoned in the open, or steamed in retorts to expel the moisture, then a vacuum is produced and maintained until the solution is introduced and the wood is completely submerged, the pressure is then increased to about 100 lbs. or 125 lbs. per sq. in., by pumping in additional solution until the required penetration and impregnation is obtained, when the solution is drained from the retort. The approximate time required for the process is:

	Hrs.	Mins.
Steaming to 20 lbs. pressure	0	30
Steaming, 20 lbs. to 35 lbs. pressure	3	30
Blowing off steam	0	15
Vacuum	0	45
Solution to about 100 lbs. pressure	0	15
Solution maintained to 100 lbs. pressure	1	15
Forcing back solution	0	15
Total cycle	7	15

If the steaming time is reduced 2 hrs., then the total cycle is 5 hrs. 15 mins.

Wellhouse Process.—This is often referred to as the zinc tannin process. It consists of impregnating the wood fibres with a hot solution containing about ½ lb. of dry zinc chloride plus ½ per cent of glue or gelatine per cubic foot of wood, then following by injecting a second solution containing ½ per cent of tannic acid. The purpose of the tannin is to solidify the first injection to prevent leaching.

The wood is first air seasoned in the open or steamed in retorts to expel the moisture, then a vacuum is produced and maintained until the solution is introduced and the wood is completely submerged, the pressure is then increased to about 100 to 125 lbs. per sq. in. by pumping in additional solution until the required penetration and impregnation are obtained, when the solution is drained from the retort and the second movement takes place by filling the retort with a solution containing tannic acid and increasing the pressure by pumping in additional solution at about 100 or 125 lbs. per sq. in. until the required penetration is obtained, when the solution is drained from the retort. The approximate time required is:

	Maximum Time. Hrs.	Mins.
Steaming to 20 lbs. pressure	0	30
Steaming, 20 to 35 lbs. pressure	3	30
Blowing off steam	0	15
Vacuum	0	45
Solution and glue to 100 lbs. pressure	0	45
Solution and glue maintained at 100 lbs. pressure	1	15
Forcing back solution and glue	0	15
Tannin introduced to 100 lbs. pressure	0	20
Tannin maintained at 100 lbs. pressure	0	50
Forcing back tannin	0	15
Total cycle	8	40

If steaming time is reduced 2 hrs., then the total cycle equals 6 hrs. 40 mins.

Absorption Process.—This is often referred to as the non-pressure process and consists of submerging the wood in a boiling preservative at a temperature of from 180° to 230° F., then following with a cold preservative as follows: The wood is first air seasoned in the open to reduce the moisture, then placed in either an open or closed receptacle where it is submerged in a hot preservative which expels the air and additional moisture; the receptacle is then drained and the wood submerged in a cold preservative. The first movement opens the pores or cells of the wood forming a vacuum within, while the second movement causes absorption due to the difference in temperature and atmospheric pressure. This process can be used in either open tanks or closed retorts. For treating the butts of poles, fence posts, piling and small quantities of ties the open tank is satisfactory, but for treating large quantities of material the closed retort is rec-

*477 Marshall St., Milwaukee, Wis.

ommended where thorough impregnation is desired. The time of treatment is as follows:

Green Timber:
Boiling in hot preservative from 8 to 10 hrs.
Bath in cold preservative from 8 to 16 hrs.
Total time of treatment, 16 to 26 hrs.

Seasoned Timber:
Boiling in hot preservative from 3 to 6 hrs.
Bath of cold preservative from 4 to 8 hrs.
Total time of treatment, 7 to 14 hrs.

With this process it is possible to impregnate a limited class of woods with about 6 to 12 lbs. of concrete oil per cubic foot.

Full Cell Creosote Process.—This consists of impregnating the wood fibres and cells of ties with 6 to 12 lbs. of creosote oil per cubic foot and timber and piling with 10 lbs. to 20 lbs. of creosote oil per cubic foot, as follows: The wood is first seasoned in the open or steamed in the retorts (generally both) to reduce the moisture and expel the sap; then a vacuum is produced and maintained until the creosote oil is introduced and wood is completely submerged. The pressure is then increased to about 100 to 125 lbs. per sq. in. and maintained until the desired penetration and impregnation is secured, when the creosote oil is drained from the tanks. In some cases a vacuum is produced and maintained at the finish to drain the surplus oil from the exterior of wood to prevent loss by drippage after the wood has been removed from retorts. The approximate time required is:

10-lb. Treatment.

	Hrs.	Mins.
Steaming to 20 lbs. pressure	0	30
Steaming, 20 to 35 lbs. pressure	3	30
Blowing off steam	0	15
Vacuum	0	45
Creosote to 100 lbs. pressure	1	30
Forcing back solution	0	15
Vacuum		30
Total cycle	7	15

If the steaming time is reduced 2 hrs., then the total cycle equals 5 hrs. 15 mins.

Rueping Process.—This is often referred to as a partial cell treatment and it is used principally in connection with creosote oil. It consists of forcing compressed air into the pores or cells of the wood and at a higher pressure creosote oil without relieving the air pressure and upon relieving the combined pressure the air expands and forces out the surplus oil, leaving wood fibres impregnated. The wood is first air seasoned in the open or steamed in the retorts (sometimes both) to reduce the moisture; then a vacuum is produced and next the air is compressed to from 80 to 100 lbs. per sq. in., thus filling all the wood cells with compressed air and by air equalizing reservoirs or pumps the retorts are filled with oil without releasing the air pressure. The oil pressure is thus started at from 80 to 100 lbs. per sq. in. and gradually increased to about 100 to 150 lbs. per sq. in., having the effect of compressing the air in the cells to a smaller volume and permitting about 10 to 12 lbs. of creosote per cubic foot to enter. The pressure is then released and the oil drained from the retorts; then a vacuum is produced, which causes the air within the cells to expand and forces the surplus oil out of the wood, leaving the wood fibres impregnated with from 4 to 6 lbs. of creosote per cubic foot. This process is best adapted for treatment of ties. The approximate time required using equalizing cylinders is:

	Hrs.	Mins.
Air to 80 lbs. pressure	0	30
Transferring oil	0	20
Creosote to 150 lbs. pressure	1	30
Maintaining 150 lbs. pressure	0	15
Forcing back oil	0	20
Vacuum	1	0
Maintaining vacuum	0	15
Draining	0	10
Total cycle	4	20

This time is based on thoroughly air seasoned ties.

Lowry Process.—This is often referred to as a partial cell treatment and it is used in connection with creosote oil. It consists of forcing creosote oil into the wood cells and then drawing out by vacuum the surplus oil, leaving only the wood fibres impregnated. The wood is first air seasoned in the open, then placed in retorts and submerged in creosote. The pressure is then applied by forcing in additional creosote of 10 to 12 lbs. per cu. ft. at about 180 lbs. pressure so as to saturate the pores and cells, after which the retort is drained and a quick vacuum is produced and maintained from 1½ to 2 hrs., leaving the wood fibres impregnated with from 4 to 6 lbs. of creosote per cubic foot. This process is used principally in the treatment of ties. The approximate time required is:

Ties thoroughly seasoned:

	Hrs.	Mins.
Creosote to 180 lbs. pressure	2	00
Draining oil from retort	0	10
Vacuum	2	00
Draining	0	10
Total cycles about	4	20

Card Process.—This process consists of impregnating the wood cells with an emulsion consisting of zinc chloride and creosote oil, as follows: The wood is first air seasoned in the open or steamed in the retorts (generally both) to reduce the moisture and expel the sap. Then a vacuum is produced and maintained for 1 hr., when the retort is filled with the hot emulsion consisting of ½ lb. of dry zinc and from 1½ to 4 lbs. of creosote per cubic foot. The pressure is then applied by forcing in additional emulsion at about 100 to 150 lbs. pressure per square inch, after which the retort is drained and a vacuum produced and maintained for about 30 min. to draw the surplus emulsion from the exterior of the wood to prevent loss by drippage when wood is removed from retort.

It is necessary to keep the emulsion constantly agitated to prevent a separation of the zinc and creosote and to accomplish this a centrifugal pump draws the emulsion from top of retorts and discharges into the bottom of the perforated pipe.

This process is used principally in the treatment of ties. The approximate time required is:

	Hrs.	Mins.
Steaming to 20 lbs. pressure	0	30
Steaming, 20 to 35 lbs. pressure	3	30
Blowing off steam	0	10
Vacuum	1	00
Emulsion to 120 lbs. pressure	1	00
Maintaining 120 lbs. pressure	1	30
Forcing back oil	0	15
Vacuum	0	20
Draining	0	10
Total cycle about	8	25

If the steaming time is reduced 2 hrs., then the cycle equals 6 hrs. 25 mins. If ties are thoroughly seasoned this time can be reduced to 4 hrs. 25 mins.

Cost of Treatment.—The prevailing rates for treating material with these processes depend upon locality, structure of wood, condition of wood; that is, whether it has been air seasoned or requires steaming, residual impregnation and quality to be treated; however it is safe to assume that the following is an average rate when taking creosote at $0.07 per gal. and zinc chloride at $0.04 per lb.

Process.	Per 7x9-in.x8-ft. tie.	Per 1,000 ft. B. M.
Burnettizing ½ lb. zinc chloride per cu. ft.	$0.17	$4.10
Wellhouse, etc.	0.23	5.50
Card	0.26	6.10
Rueping	0.32	7.60
Lowry	0.32	7.60
Absorption	0.33	7.80
Full cell	0.47	11.15

The Fortieth Annual Meeting and Dinner of the Western Society of Engineers.

On the evening of January 12 the fortieth annual meeting and dinner of the Western Society of Engineers was held in the University Club building in Chicago. There were present 168 members and guests.

Mr. Andrews Allen in his retiring address reviewed briefly the growth of the organization, which now has nearly 1,200 members and is rapidly approaching the importance and standing of a national society. He dwelt upon the protection of the standing of full members and the need of an intermediate grade, matters now under consideration by the officers of the society. Steps are now being taken looking to the affiliation of local societies in other states or at least some arrangement whereby local sections may be organized among members not residents of Chicago. In the state of Illinois the law licensing architects bears very hard on structural engineers, who must either obtain the signature of a licensed architect on plans they draw for mill buildings or factories or must work on salary for licensed architects. The present condition is distasteful and the officers of the Western Society are now considering ways by which the present injustice can be removed, preferably by legislation similar to that now protecting architects. The dominant note in Mr. Allen's address after disposing of matters of detail was that of service. The duty of the unit to the whole and the sinking of self in the advancement of common interests was a text about which was woven a thoughtful and altruistic talk designed to stimulate the members to greater activity in their life work and, as an incident, the upbuilding of the Western Society of Engineers. Mr. Allen then introduced Mr. John W. Alvord, the president-elect for 1910.

Mr. Alvord thanked the members for permitting his name, the only monument it so far had being a tablet on a septic tank in an Illinois city, to be engraved on the rolls of the society as president in company with distinguished engineers who had other claims to fame as builders of bridges, railways and waterways. The municipal engineer was a man whose works were not in the eyes of observers and growing cities outgrew his works so it finally happened he was forgot. Mr. Alvord paid a tribute to the municipal engineer, who was among the most solitary of the profession. His compensation is seldom adequate, his tenure of office short and uncertain, his dealings being principally with men not of his own profession. He wished a way could be found to interest municipal engineers generally in the Western Society so they would come in. Less than one-fourth of the engineers in the employ of the city of Chicago are members of the Western Society of Engineers, although the society offers them pleasant, commodious quarters, a good reference library and opportunity to mingle with engineers representing many branches. Mr. Alvord was happy in his remarks and it is evident the new president will take rank with Mr. Allen, whose manner of conducting his office called forth much favorable comment during the year just completed.

Mr. Bernard E. Sunny, president of the Chicago Telephone Co., was the speaker of the evening and his address on "The Engineering of Chicago" was well received. This address will be printed in the Proceedings, and as it deals with Chicago conditions entirely is omitted here. Mr. Sunny criticised the municipality for working without an engineering plan. He instanced private corporations with their plans prepared by competent engineers looking to a definite development many years in the future, and contrasted it with the city working from day to day through departments not coordinated and having to do over again many kinds of work. A recommendation was made for a commission of engineers to prepare plans for all work with an insight into the future.

Councilman B. W. Snow, chairman of the council finance committee, seemed to resent the point of view of the engineers present, who glorified their profession, and showed how men who engineered a city budget through an insurgent city council might really be as smart as the engineers whom he was addressing. He recognized the fact that there are "engineers and engineers," likewise all politicians were not alike, and he calls himself a politician. Mr. Snow discussed the growth of Chicago from the standpoint of the man charged with the apportionment of inadequate taxes.

Mr. L. C. Fritch, chief engineer of the Chicago Great Western Ry., spoke of railway terminal facilities in great cities and especially in Chicago. He believed that with proper cooperation among the roads a good system of terminal yards could be arranged and then the electrical operation of railroads within the city limits would follow.

Colonel Milton J. Foreman, chairman of the transportation committee of the Chicago city

council, spoke vigorously on the necessity for consolidating the various taxing bodies in Chicago. The sanitary district, parks and boulevards received almost 75 per cent of the taxes raised, while the strictly municipal needs, such as the departments of streets, sewers, water works and health department, had to worry along with the rest. If he had his choice he preferred clean garbage cans to parks and preferred paved alleys to boulevards. As for engineering plans he thought them not always good because no one could tell what would happen in a certain district. Dissatisfaction with the plans and work of men gone before was evidence of growth. The only perfectly ordered, quiet, peaceful place he knew was a cemetery and it was the last place he cared to enter. He believed in competent men handling things, but not being bound by inflexible plans. He would rather see good men with plenty of money to meet conditions as they arose, something not now possible in Chicago.

Mr. Bion J. Arnold received an invitation to another banquet the same night, to speed Mr. Calhoun on his voyage to China. He chose to come to the Western Society, where, being among friends, the loss of his trunk on a trip ended that day cut no figure. Mr. Arnold discussed points brought out by other speakers on the local transportation question, deploring the lack of cooperation between the street car companies and giving reasons why consolidation into one large company would be good.

Mr. L. P. Morehouse, secretary of the Western Society of Engineers from June, 1869, to January, 1888, then addressed the gathering, to show, as he said, that the society had a past, and he was present at the fortieth banquet to prove there had been a first.. He paid a tribute to the late Mr. E. S. Chesbrough, former president of the society and for many years city engineer of Chicago, who had designed and built the present sewer system over 40 years ago.

Prize Designs for Concrete Houses.—A competition for designs for a concrete house and garage has been inaugurated by the Pittsburg Architectural Club through the liberality of the Universal Portland Cement Co., of Pittsburg, Pa. There will be six prizes of the following amounts: First prize, $250; second prize, $100; third prize, $50; fourth prize, $50; fifth prize, $25, and sixth prize, $25. The competition is open to every one. Full conditions of the competition can be secured by writing the Pittsburg Architecural Club, Pittsburg, Pa.

The Reinforced Concrete Girder Bridge at Florence, Arizona.

The bridge to be erected over the Gila River near the town of Florence, Pinal County, Arizona, is of the girder type with piers and abutments supported on concrete piles. The total length, c. to c. of end piles, is 700 ft., there being 14 spans each 50 ft. long. The plans provide for the use of 60 piles 18 ins. in diameter driven to the surface of a cemented gravel formation believed to be about 25 ft. below the bed of the river. Under each pier the piles are spaced 5 ft. 6 ins. c. to c. and capped with a concrete block 41 ins. wide by 38 ins. deep. The piles are reinforced with

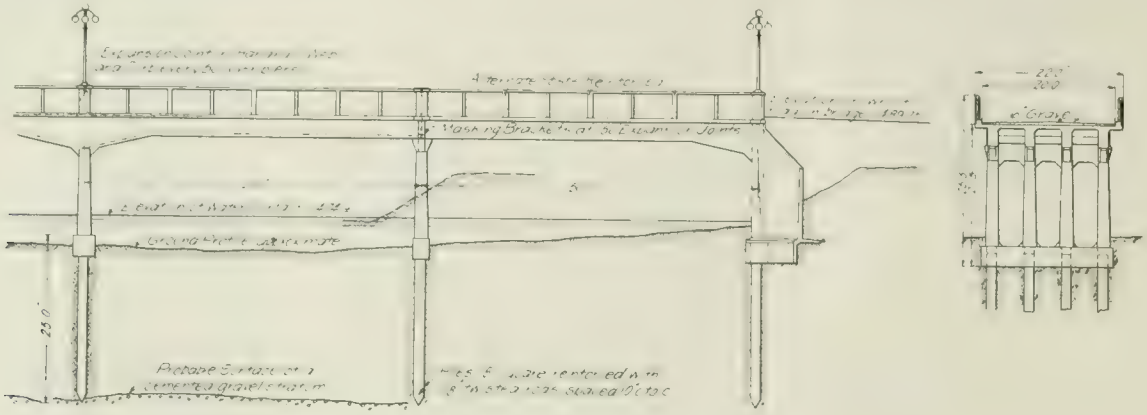


Fig. 1—General Elevation and Section of Concrete Girder Bridge.

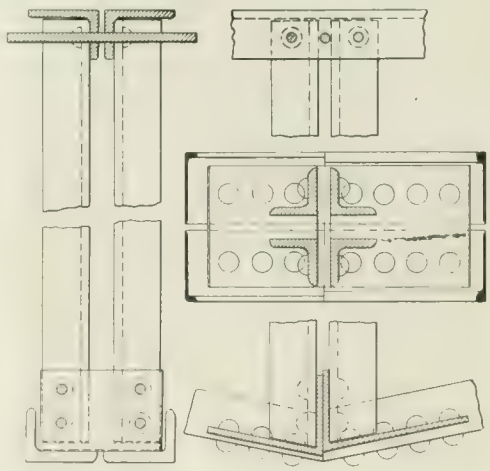


Fig. 2—Connection of Reinforcement Over Piers.

⅞ in. sq. bars in each corner with horizontal frames of ¼ in. square twisted bars 18 ins. apart around them. The concrete block on top serving as a sill for the pier posts, has a ⅞ ins. square bar near each corner with a frame of the same size bars around them set 14 ins. each way from the center line of the piles, there being 8 of these frames. The pier posts are 24 ins. square at the bottom and 18 ins. square at the top with same reinforcement as the piles, the length being about 14 ft. Figure 1. The over all width is 22 ft., the width between curbs being 20 ft., the curbs having a projection of 4 ins., thus giving a clear width of 20 ft. 8 ins. between hand rails. All concrete is 1:2:4.

Expansion joints are provided in handrail, web and curb every 50 ft., over piers, and in girders and slabs only at piers 1, 4, 7, 10 and 13, or 150 ft. apart, masking brackets being used at these points. Fig. 2 is a detail of the connection of girders over fixed piers. In Fig. 1 only two end spans are shown with location of expansion joint over pier.

The three next spans are connected, the end ones being supported cantilever girders, the middle one being fixed and with flat arch outline. The main girder is reinforced over the fixed piers with two 5x3½x⅝ in. angles in each girder. The bottom reinforcement in each main girder in fixed spans consists of two 5x3x⅜ in. angles and in each supported girder of two 5x3½x¾ in. angles. The reinforcement in each girder being of the unit type and independent, is connected over the fixed piers by rivetting as shown (Fig. 2), a method that will facilitate erection and simplify form work.

In Fig. 3 the main details are shown. On the right is shown the expansion joint. On top of each post is placed a bearing plate 1 in. thick, 16 ins. wide and 36 ins. long rivetted to two 5x3½x¾ in. angles 36 ins. long having four 14x¾ in. studs. On the bottom of each girder is a bent plate 1 in. thick and 16 ins. wide bolted to each bottom girder angle, as shown. To maintain a small bearing surface a 1 in. rod 16 ins. long is placed between the bottom angle and this plate. Only the alternate posts in the hand rail are reinforced, the reinforcement consisting of four ⅜ in. round rods spaced 6 ins. c. to c. The hand rail has at the top four ⅜ in. round rods spaced 2x6 in. c. to c. horizontally and 22 ins. below one horizontal square twisted ¼ in. bar. The vertical reinforcement for the panels consists of ¼ in. sq. twisted bars 9 ins. c. to c.

In the main girders the angles are kept in place in a very ingenious manner by separators consisting of ¾ in. round rods bent around them, with the ends turned in over the tops of the legs, the angles having their feet turned in. Wherever a rod or bar ends it is turned with a hook over the nearest intersecting bar or angle. The only rivetting is in the expansion joints and in the connections over fixed piers. The floor slab is 7 ins. thick, framed with beams 8x12 ins., 12 ft. 6 ins. c. to c. across the bridge carried by the four main girders. The slab reinforcement consists of ⅝ in. round rods spaced 7¾ ins. c. to c. across the bridge and ⅜ in. sq. twisted bars spaced 22 ins. c. to c. longitudinally with the bridge. The main girders are 16½ ins. wide by 32 ins. deep below the slab in the middle of each span. There are 30 drains of 3 in. diam. galvanized pipe in the floor slab with screens, the

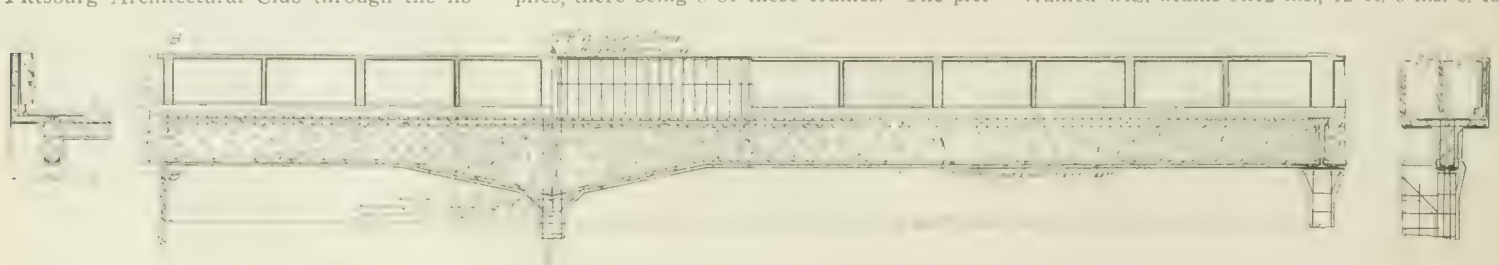


Fig. 3—Longitudinal Section of Concrete Girder Showing Reinforcement.

lower end being 1 in. below the bottom of the slab.

Particular interest attaches to the abutment and wing walls, the sections being very thin. The section on the right in Fig. 4 is on the center line of the bridge. The short section on the left is that through the wing wall and the high section is that through the junction of the abutment and wing wall.

The material in the river bottom to hard pan is sand and silt with considerable gravel and some stones up to one man size. The footings of reinforced concrete piles capped with a concrete block seems to be an efficient and economical foundation. The structure, from a study of the complete detail drawings, is an example of good design. Medium steel is specified throughout. The plans were prepared in the office of Mr. J. B. Girand, C. E. Territorial Engineer, Mr. R. R. Ryan, C. E., Designing Engineer, Tucson, Arizona.

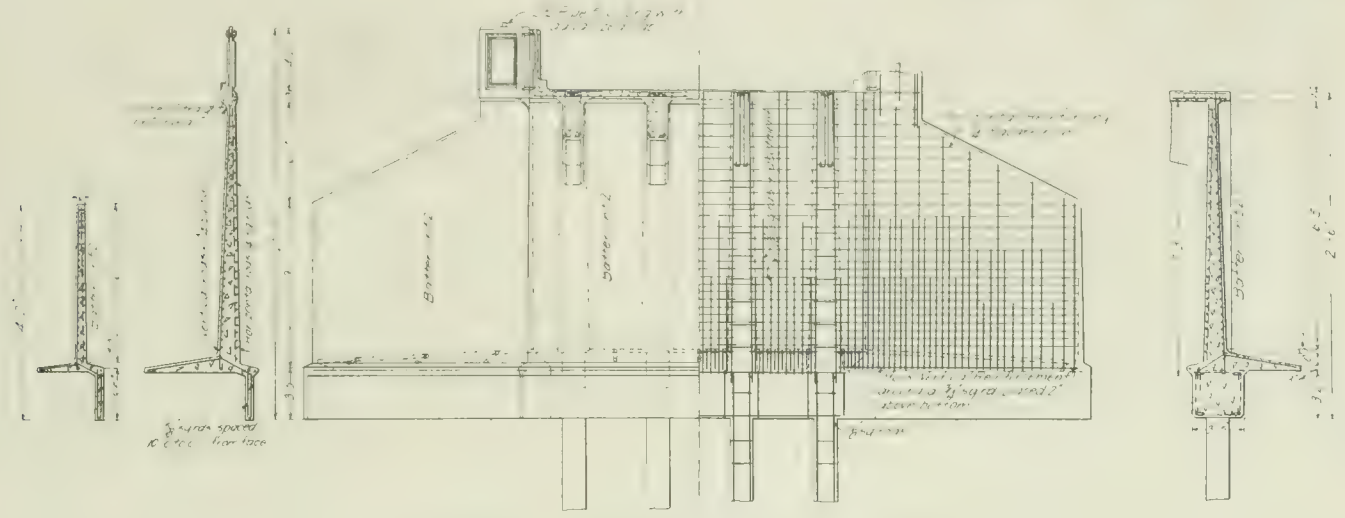


Fig.4—Details of Reinforced Concrete Abutment.

According to information sent out by the Pennsylvania Co., 673 grade crossings have been removed on the lines of this company east of Pittsburg and Erie. This includes only work completed up to Sept. 1, 1909, and does not include the ten crossings to be eliminated by the projected change of the line through Bristol, Pa., on the New York division. On the lines between New York and Washington, Philadelphia and Pittsburg, 256 public grade crossings and 129 private crossings at grade have been removed in the past ten years, leaving only 774 public crossings scattered over 574 miles of road. On the division between Philadelphia and Washington alone, 106 grade crossings have been eliminated; between Jersey City and Philadelphia, 78 crossings have been removed; and, on the Pittsburg division, 46 crossings have been taken out.

In 1906 we were unable to supply our customers with water pumping from two wells almost incessantly. In January, 1907, we installed a meter system. We are now pumping from one well only and using from this well shorter hours than when we ran both wells. It is obvious from this that our expense of pumpage is greatly reduced, thus making a big saving upon fuel, labor, machinery and the superintendent's time. Our customers have a better service and are better pleased, although in a number of cases the water tax has increased. The water plant is now on a paying basis. The fire protection is better, having more water and a greater pressure at all times.—Report of Andalusia Light & Water Co., J. H. Morgan, Mgr.

The new main line railroad track built in the United States in 1909 amounted to 3,748 miles, according to the "Railroad Age Gazette." In 1908, 3,214 miles were laid. These figures do not include additional tracks on the same road bed or sidings.

LETTERS TO THE EDITOR.

Articles on Concrete Lined Shafts.

Sirs:—I want to get some information on concrete lined shafts. H. J. S.

Chicago, January 8, 1910.

(Articles on the construction of concrete lined shafts and the lining of shafts with concrete have appeared in the *Contractor*, Sept. 18, 1908; *Engineering News*, Sept. 24, 1908, April 8, 1909; ENGINEERING-CONTRACTING, Nov. 11, 1908; *Engineering and Mining Journal*, Aug. 21, 1909. These references are taken from the "Monthly Review Index" published each month by ENGINEERING-CONTRACTING as a part of its regular issue for the second week of the month, and they show one of the valuable uses of the "Index" to engineers. By keeping a file of the indexes, or, better, by cutting out the items and pasting them on library index cards, the owner can in a comparatively short time find reference to articles on almost any subject relating to civil engineering work. The items as printed in the index are backed with advertising matter, so that they may be cut out and pasted without destroying any other items.—Editors.)

A Design for a Stadia Rod.

Sirs: I send a design for a stadia rod which I think is an improvement on the one shown in your issue of Jan. 5, 1910. The tenths of feet

Design for a Stadia Rod.

are not numbered, but twenty-five, fifty, and seventy-five hundredths of each foot are readily found as is shown by the design. This eliminates all error and confusion due to two sizes of figures. This rod can be seen as far as the large figures can be distinguished and is not very likely to be read while in an inverted position.

Yours truly,
JOSEPH M. PERKINS.

204 Lincoln Avenue, Valparaiso, Ind., Jan. 11, 1910.

Cost of Hand-Sweeping of Streets.

Sirs: I notice in the last issue of Engineering-Contracting a request for information as to the cost of hand-sweeping. We do considerable hand-sweeping in this city and find that the price varies from $1.40 to $1.70 per 1,000 sq. yds.

Respectfully,
JAS. C. TRAVILLA,
Street Commissioner.

St. Louis, Mo., Jan. 8, 1910.

A Bag of Cement Is One Cubic Foot of Cement.

Sirs:—I note in your issue of Dec. 22, 1909, an article on the subject of "A Bag of Cement is One Cubic Foot of Cement," with the idea of using this as a unit for measuring. I think you will find this whole subject covered very thoroughly in an article I wrote a year or two ago on the subject of "Selection and Proportion of Aggregates." This is a subject which should be given wide publicity as the barrel unit measurement is entirely obsolete and the measurement of barrels vary considerably. This whole subject has previously been approached from an entirely wrong standpoint. It is the amount of wet paste which will entirely coat each grain of sand and fill the voids between each grain of sand that should be specified and then the resulting mortar should a little more than fill in the crushed stone or gravel. If this point of view is taken it can be readily seen that arbitrary specifications of 1 : 2 : 4; 1 : 2½ : 5 and 1 : 2 : 6 are meaningless, maximum density being the object to be accomplished.

Very truly yours,
ALBERT MOYER.

New York, N. Y., Dec. 28, 1909.

(The paper referred to by our correspondent is reprinted in another column and we have also discussed it editorially.—Editors.)

On January 5, after a long debate, the Mann bill providing for a change in the government of the Panama Canal Zone, was passed by the House of Representatives. The vote was 119 to 102. The bill provides for the abolition of the Isthmian Canal Commission and the appointment of a director-general of the Canal Zone, who shall have entire supervision. This was favored in order that the authority might be centralized. The bill also makes provision for a Supreme Court in the zone, and gives the right of appeal to the Supreme Court of the United States.

The Board of Water Supply of New York City has awarded the contract for constructing the Kensico Dam and appurtenant works, in connection with the New Catskill water supply, to Rodgers & Hagerty, New York City. The contract price was $7,953,050, and the work includes 900,000 cu. yds. Cyclopean masonry, 37,500 cu. yds. mass concrete, and 1,330,000 cu. yds. of excavation.

(Continued from page 56.)

FRIDAY, FEBRUARY 25, 1910.

9 o'clock a. m.:

33. Meeting of Section on Art and Architecture.

34. Meeting of Section on Exterior Treatment of Concrete Surfaces. Topical discussion on the artistic treatment of concrete surfaces of various kinds.

35. Meeting of the Section on Machinery and Appliances.

10:30 o'clock a. m.:

36. Cost and Advantages of Concrete Drain Tile. J. H. Libberton, Assistant Inspecting Engineer, Universal Portland Cement Company, Chicago, Ill.

37. Installation and Operation of a Steam Curing Plant. F. S. Phipps, Manager, Central Stone Company, St. Joseph, Mo.

38. The Preparation of Concrete—From Selection of Materials to Final Deposition. Harry F. Porter, Consulting Engineer, Bridgeport, Conn.

8 o'clock p. m.:

39. Reinforced Concrete Columns. Robert A. Cummings, Pittsburg, Pa.

40. Reinforced Concrete Columns. Peter Gillespie, Lecturer, University of Toronto.

41. Use of Concrete in Protecting Wooden Pile against Teredo. Ralph Barker, Assistant State Engineer, San Francisco, Cal.

The requirements for membership in the association are simple; every concrete worker and civil engineer being eligible, provided 2 members of the association recommend the applicant. The annual dues are five dollars and each member receives free a copy of the transactions, containing all papers in full together with the discussions. The proceedings of the Fifth Annual Convention made a volume of over 600 pages, 6 by 9 ins. with many illustrations. All communications should be addressed to National Association of Cement Users, Harrison Building, Philadelphia, Pa.

Technical Society Meetings.

The list following names those technical societies in which engineers and contractors are most interested, whose meetings are to be held within three months of the date of this issue. There are given for each society listed the date and place of meeting and the name and address of the secretary, to whom all communications and inquiries should be addressed.

American Society of Civil Engineers.
Jan. 19-20, 1910. Annual meeting at New York City. Secy., Chas. Warren Hunt, 220 W. 57th St., New York, N. Y.

Canadian Society of Civil Engineers.
Jan. 25-27, 1910. Annual meeting at Ottawa, Ont. Secy., C. H. McLeod, 413 Dorchester St., West, Montreal, Que.

American Society of Engineering Contractors.
Feb. 24-26, 1910. Annual convention at Chicago, Ill. Secy., Daniel J. Hauer, Park Row Building, New York, N. Y.

American Society of Heating and Ventilating Engineers.
Jan. 18-20, 1910. Annual meeting at New York City. Secy., W. M. Mackay, P. O. Box 1818, New York, N. Y.

American Society of Inspectors of Plumbing and Sanitary Engineers.
Jan. 20-22, 1910. Annual convention at Trenton, N. J. Secy., C. S. McCosker, Mobile, Ala.

Connecticut Society of Civil Engineers.
Feb. 8, 1910. Annual meeting at New Haven, Conn. Secy., J. Frederick Jackson, Box 1304, New Haven, Conn.

Illinois Association of Municipal Contractors.
Feb. 24-26. Annual meeting at Chicago, Ill. Secy., Orie T. Dunlap, Edwardsville, Ill.

Illinois Lumber Dealers' Association.
Feb. 16-18. Annual meeting at Chicago, Ill. Secy., Geo. K. Hotchkiss, 315 Dearborn St., Chicago.

Illinois Masons' Supply Association.
Feb. 16-18. Annual meeting at Chicago, Ill. Secy., Geo. K. Hotchkiss, 315 Dearborn St., Chicago.

Illinois Society of Engineers and Surveyors.
Jan. 26-28, 1910. Annual meeting at Cairo, Ill. Secy., E. E. R. Tratman, 1636 Monadnock Block, Chicago, Ill.

Indiana Engineering Society.
Jan. 14-16, 1910. Annual convention at Indianapolis, Ind. Secy., Chas. Brossman, Union Trust Bldg., Indianapolis, Ind.

Interstate Mantle and Tile Dealers' Association.
Feb. 15-19. Annual meeting at Chicago, Ill. Pres., Joseph W. Lantry, Wm. H. Jackson Co., Union Square, New York City.

Iowa Association of Cement Users.
March 9-11, 1910. Annual meeting in Cedar Rapids, Ia. Secy., Ira A. Williams, Iowa State College, Ames, Iowa.

Iowa Engineering Society.
Feb. 16-17, 1910. Annual convention at Cedar Rapids, Ia. Secy., A. H. Ford, Iowa City, Ia.

Michigan Engineering Society.
Jan. 12-14, 1910. Annual meeting at Lansing, Mich. Secy., Alba L. Holmes, 574 Wealthy Ave., Grand Rapids, Mich.

National Association of Cement Users.
Feb. 21-25, 1910. Annual meeting at Chicago, Ill. Secy., Geo. C. Wright. Address all communications to Edw. E. Krause, Asst. to the President, Harrison Bldg., Philadelphia, Pa.

National Brick Manufacturers' Association.
Feb. 7-12, 1910. Annual convention at Pittsburg, Pa. Secy., T. A. Randall, Indianapolis, Ind.

Ohio Engineering Society.
Feb. 8-10. Annual meeting at Columbus, Ohio. Secy., C. J. Knisley, New Philadelphia, O.

Northwestern Cement Products Association.
Feb. 18-21, 1910. Annual meeting at Chicago, Ill. Chairman of Executive Committee, O. U. Miracle, Minneapolis, Minn.

Western Drainage Contractors' Association.
Feb. 17, 1910. Fort, Dodge, Ia. Secy., S. F. Moeller, Knierim, Ia.

Notes from Technical Societies.

The Ohio Engineering Society announces that the date of the annual meeting has been changed from Feby. 15-16-17 to Feb. 8-9-10, at Columbus, Ohio.

A new society, The Western Drainage Contractors' Association, has been organized. The first regular meeting will be held in Fort Dodge, Iowa, on Feby. 17.

The Northwestern Cement Products Association will hold the sixth annual convention in Chicago, Feby., 18-19-20-21 at the time of the Cement Show. This change from the plan to hold the convention in St. Paul was caused by the serious illness of President Martin T. Roche and the resignation of Secretary Pfiffner whose employers transferred him to far western territory. President Roche is improving rapidly and intends taking a long rest from business.

Personals.

Mr. John M. Hackett has been elected City Engineer of Dunkirk, N. Y., to succeed Mr. J. P. Morrissey.

Dr. E. J. Laclede of the firm of Laclede & Provost, Sanitary and Hydraulic Engineers, has been appointed Commissioner of Health of New York city.

Mr. A. J. Hammond has resigned his position of City Engineer of South Bend, Ind., to go into private practice as a Civil and Hydraulic Engineer with offices in the same city.

Mr. C. J. Jeppeson has opened an office as Consulting Engineer at 118 East 28th St., New York city. Mr. Jeppeson has been for a number of years Chief Engineer of J. B. & J. M. Cornell, Structural Steel Contractors, New York city.

Mr. Ralf R. Newman has been appointed Engineer and Manager of the Concrete Bureau, Boston, Mass. Mr. Newman is a graduate of the Massachusetts Institute of Technology and has had experience in concrete work with French & Hubbard, Boston, Mass., Mr. E. L. Ransome, New York, the Kern River Co. and the San Joaquin Light & Power Co.

Mr. T. J. Wyche has been appointed Chief Engineer of the Western Pacific R. R. to succeed Mr. Virgil A. Bogue, who has resigned the position to resume private practice with offices in New York city. Mr. Wyche is regarded as one of the best Railroad Engineers of the west, and he has had a wide experience in railroad construction in the intermountain country. As Construction Engineer for the Union Pacific Mr. Wyche practically rebuilt the road between Laramie and Ogden and several million dollars were expended by the Harriman lines under his direction. Mr. Wyche's work on the Western Pacific has been of unusual quality and he has been regarded as the logical successor to Mr. Bogue since his announcement that he would return to New York when the Western Pacific was turned over to the operating department.

Catalogs Worth Having.

Engineers and contractors should have on file the latest catalogs of machines, tools and supplies that they use. In sending for catalogs reviewed or advertised in this paper, you will confer a favor on us if you will write directly to the advertisers and state that you saw the catalog mentioned in ENGINEERING-CONTRACTING. If you are in the market for tools, machinery or supplies, tell us and we will notify promptly the leading manufacturers.

The Insulation of Pipes and Boilers.—Paper, 3½x6 ins., 24 pp. H. W. Johns-Manville Co., 100 William St., New York, N. Y.

This is a booklet describing pipe coverings, with recommendations for particular uses of the several sorts mentioned.

Steam Road Rollers.—Paper, 8x10½ ins., 38 pp. The Kelly-Springfield Road Roller Co., Springfield, Ohio.

This is a complete catalog of the well known Kelly-Springfield Road Roller. With it is sent a smaller booklet entitled "The Why of the Kelly-Springfield Road Roller."

Hydraulic Stone Machinery.—Paper, 9x12 ins., 44 pp. Fisher Hydraulic Stone and Machinery Co., Baltimore, Md.

Describes machinery for making concrete building blocks by the "wet process," using hydraulic pressure instead of hand tamping to compact the mass in the molds.

Mine Locomotives.—Paper, 8x10 ins., 68 pp. The Jeffrey Manufacturing Co., Columbus, Ohio.

This is Bulletin No. 17, and while mainly descriptive of electric locomotives used in mines, also illustrates electric industrial locomotives used in lumber yards around industrial plants and for contractors' use.

Contractors' Portable Saw Rigs.—C. H. & E. Manufacturing Co., Inc., Milwaukee, Wis.

This circular illustrates a portable circular saw outfit for contractors, equipped with gasoline engine.

Road Making Machinery.—Paper, 3½x6 ins., 24 pp. The Good Roads Machinery Co., Kennett Square, Pa.

This pamphlet illustrates all the machines used by road builders from plows to rollers and crushing plants.

Progress on New York State Barge Canal.—State Engineer F. M. Williams reports that there have been excavated on the new and enlarged Erie canal more than 25,000,000 cubic yards of material, and over 2,500,000 cubic yards of embankment have been built. There have been laid more than 500,000 yards of concrete. The total value of the work completed since the beginning is $15,800,000, and it is estimated that during the year 1910 work will be completed amounting to $16,000,000. The building of this canal has called into use every type of machinery employed in works of construction, and it is estimated that there is at present invested in operating plant about $7,600,000. By April 1 next it is expected that the work for the entire length of the canal will be under contract, and it is not unreasonable to expect that at the present rate of progress the entire canal will be completed by the end of 1914. The work is being carried on within the original estimates, and present calculations give assurances that all the construction contemplated by the law of 1903 will be completed within the original appropriation of $101,000,000. The act provides for the construction of a canal having a minimum bottom width of 75 ft. and a minimum depth of 12 ft. in land line. The locks are designed for boats of 2,000 tons capacity; there will be 53, ranging in lift from 10 ft. to 40½ ft., this latter lift occurring at Little Falls. Fifteen of the large locks are now completed, with the exception of gates and operating machinery, and three of these locks will be used as a part of the state canal system on the opening of navigation next spring. When completed, the barge canal locks, with their immediate approach walls will have cost approximately $16,000,000. There will be 22 fixed dams and 14 movable dams. Of the latter seven are now under construction, two of them nearly completed. By one year from next spring the eight movable dams in the Mohawk river will be in operation and will be used to aid in the dredging of the channel, by retaining water for the floating of the dredging machinery.

Contract News Section

of

ENGINEERING-CONTRACTING

A Consolidation of Engineering-Contracting—Contract News—Engineering World—The Dirt Mover.

Containing Items of Interest to Railroad, Public Works and Other Contractors.

The Doings of the Week.

James McGraw & Co., Philadelphia, Pa., has been awarded the contract for the changing the present4-track through Bristol, Pa. The work which will eliminate 10 grade crossings and an undesirable curve, includes the construction of 10 bridges and the construction of a 4-track line one and one-half miles long.—W. P. Tierney & Co., Nelson, B. C., has been awarded the contract for the construction of the Canadian Pacific 15-mile spur from Hartford Junction, B. C., to the Wellington Camp.—C. F. King & Co., Land Title Bldg., Philadelphia, Pa., has been awarded the contract for grading and masonry work on the Philadelphia & Reading Ry., between Perkiomen Junction and Phoenixville, Pa., a distance of 1½ miles.—The Galveston-Houston Electric Ry. Co., Houston, Tex., has mortgaged its holdings in Texas to the City Trust Co., Boston, Mass., for $5,000,000, and proposes the immediate construction of its proposed line between Galveston, Tex., and Houston.—The Union Pacific Ry. Co., A. L. Mohler, Omaha, Neb., vice president and general manager, has filed survey plats at Cheyenne, Wyo., for the construction of a cutoff from the Northport, Neb., branch to a junction with the main line at Medicine Bow, Wyo., shortening the line from Medicine Bow, Wyo., to Chappell, Neb., 40 miles and reducing the grade. The work includes some heavy tunnelling.—The Denver & Rio Grande R. R. has decided to broad gage its Third Division from Gunnison, Colo., to Crested Butte and ultimately to Montrose.—Ninty miles of track on the San Pedro, Los Angeles & Salt Lake R. R. have been washed out, causing a loss of approximately $14,000,000. Steps are being taken toward the immediate reconstruction of the line.—Plans and specifications have been prepared by the engineers of the Escondido Electric Railway Co., for the construction of the proposed line, which includes a 2,600 ft. tunnel through Scripps' Summitt, and bids for the work are to be asked at once.—Plans and specifications have been prepared by the Municipal Board of Commissioner, of Dallas, Tex., for the construction of the proposed dam at the White Rock Reservoir site. The proposed dam will be 2,100 ft. long, 211 ft. wide at the base, 16 ft. wide at the top and 42 ft. high The work is estimated to cost $750,000. Bids for the work are to be asked at once.

A Mine of Dredge Buckets.

Our friends in the dredging line can be got at times to relate queer experiences of unexpected materials encountered in their delvings into the bottoms of harbors and things, but the report coming from Panama of one dredge man having located a mine of dredge buckets is in a class by itself. As the story is told this dredge man had been ordered to take up a new position in the Rio Grand near Corozal, and had obeyed orders with no more comment than moving a dredge in a hot climate naturally engenders. "She" had hardly begun to bite well, however, when with a snort and a wrench a fairly well preserved dredge bucket was lifted and dropped with a splash into the hoppers. This was followed by a second and a third and others in rapid succession until just when the operator had decided to throw up his job and get a contract to mine dredge buckets for the Canal Commission the pay streak petered out. A count of the day's work showed 55 buckets mined in 8 hours. No more buckets were discovered and the dredge man has given up the idea of developing a mine, but he still claims the greatest output per day of dredge buckets in a regular run of any man in the business and defies anyone, gringo or white man, to show that he is wrong.

The Respect Due to Contractors.

A number of contractors' organizations have come into existence within the past two years, chief among them being of course the American Society of Engineering Contractors.

Just what is an engineering contractor? In the minds of some men a comparison is made with the old style gentleman farmer who knew how to farm by the book; the engineering contractor being thought of as a contracting engineer too high toned to be called a contractor. A man who knows by the book and who prefers fine clothes to overalls. The definition of an engineering contractor is really so simple as to be absurd when one has listened awhile to the conversation of some men who do not like the name.

An engineering-contractor is a contractor able to handle engineering contracts in a satisfactory manner. The house builder whose largest job is an ordinary three or four story building is a building contractor. When he counts the four story brick as beneath his notice, except as one of a large group, and takes contracts for large steel frame or reinforced concrete structures he becomes an engineering contractor. The man who puts in small culverts may be a mason contractor or a tile layer, but let him start out to erect good size country and other bridges and he is an engineering contractor. The concrete sidewalk builder is not an engineering contractor until he makes a specialty of contracts involving engineering problems and drops his sidewalk work except as a side issue.

The engineering contractor, it is easy to see, is not necessarily trained as an engineer in a technical school, so is not a "high brow" masquerading as a contractor. He may never have seen the inside of an algebra and is vastly more interested in the X on a greenback than in an equation. The equation of payments, taught in a common school arithmetic, is about the only thing in the shape of, or bearing the name of, an equation that many engineering contractors understood in mathematics. The fact is that present day contractors are handling propositions involving important problems capable of solution only by methods patterned upon the methods of engineers. That a large number of the most successful contractors have been educated as engineers, shows the training of the engineer is in many ways a desirable one for men engaged in the calling of the contractor.

Some day schools will establish courses prepared for men who intend taking up construction work as contractors or contractor's superintendents. They will not be engineering courses nor tacked on to engineering courses, although attempts will be first made along those lines, but will be courses of study prepared expressly for the purpose of shortening the term of pupilage on work all contractors now serve.

It will be some time yet before the school-trained contractor becomes a fact. In the meantime an engineering training may be useful but it is not essential, for the engineering contractor is not always a contracting engineer but is merely a contractor confining his operations to large jobs where system and scientific methods must be employed. He is on a plane with other business men handling large interests and is treated with more respect than contractors have heretofore been accustomed to.

In Illinois the Association of Municipal Contractors had the courage to send a letter to the Boards of Local Improvements throughout the state giving advice on certain business matters. This communication was treated with consideration nearly everywhere it went. Imagine the reception such a letter would have received a few years ago before contracting was regarded as a real business. In New York the General Contractors' Association drew up a list of objections to clauses in contracts and specifications and the powers that be sent a request to the Association to present a brief in order that proceedings may be simplified. This marks only a beginning and shows that from the moment the engineering contractor drew away from the crowd and assumed an identity, he was accorded the respect that every legitimate business man deserves.

Confirmed Reports by Engineers and Contractors

RAILROADS, POWER DEVELOPMENTS, LEVEES, DRAINAGE AND IRRIGATION WORKS.

Railroads—Steam and Electric.

ILLINOIS.

The Northwestern Engineering & Construction Co., Majestic Bldg., Milwaukee, Wis., have been awarded the contract for the construction of an electric railroad from Sterling to Rock Island, Ill. Preliminary surveys have already been made for the line which will be 62 miles in length. The company expects to be in the market for tools, equipment, supplies, etc., and also may consider subletting some of the work. Nothing definite has yet been decided. J. J. Dunket is Secretary of the company.

The East St. Louis, Columbia & Waterloo Ry. Co. has surveys completed for the construction of the proposed line from East St. Louis, Ill., to Waterloo, Ia., a distance of 23 miles. The route as projected will pass through Dupo, Bixby, Columbia, Ill. Contracts for the work are to be let in the spring of 1910. Baxter Brown, 610 Laclede Bldg., St. Louis, Mo., is Chief Engineer of the company and H. Reichenbach, Columbia, Ill., is Secretary.

INDIANA

The Beench Grove Traction Co., recently incorporated in Indiana for the purpose of building an electric line from Indianapolis to Beach Grove and to build and operate power plants, has completed surveys and secured capital for the construction of 4 miles of line. No contracts are to be let for the work. C. N. Cottingham, Indianapolis, Ind., is Chief Engineer of the company. W. H. Ogan is one of the Directors of the company.

IOWA.

The Waterloo, Cedar Falls & Northern Ry. Co., has completed surveys for the construction of the projected 6 mile line from Denver, Ia., to Waverly in Bremer County, Ia. Capital for the work has been secured and contracts will be let about March 1, for the construction, which will be mostly steam shovel work. L. S. Cass, Waterloo, Ia., is President, and T. E. Rust, Waterloo, Ia., is Chief Engineer of the company.

Current reports stating that the Waterloo, Cedar Falls & Northern Ry. Co., of Waterloo, Ia., was planning to build an electric railway to connect Mason City, Waterloo and Fort Dodge, Ia., are unfounded. L. S. Cass is President of the company.

KANSAS.

Surveys are under way for the proposed lines of the Kansas Union Traction Co., by Archer, Rollins & Co., Kansas City, Mo. As projected one line will be from Parson to Coffeyville, Kan., and the other from Cherryvale to Columbus, Kan., a total distance of 90 miles. William J. Jones, Altamont, Kan., is the President of the company and Barney McDaniel is Secretary.

The Kansas Northwestern R. R. Co., which projects a 300-mile line from the northern border of the state to Wichita, Kan., is desirous of figuring with some strong contracting firm able to place a part of the company's securities. O. W. Dawson, Great Bend, Kan., is Secretary of the company.

KENTUCKY.

O. G. Peterson, President, Associated Engineering Co., Lincoln Bank Bldg., Louisville, Ky., would like to get in touch with a contractor with about 20 teams to do the hauling of the material for concrete work. The work includes the hauling of 15,000 yds. of stone, sand and cement from one to three miles and is located at Crofton, Ky. The job would be finished by April, leaving the contractor free to enter other work.

LOUISIANA.

Reports to the effect that the Lake Charles Railway & Water Works Co., Lake Charles, La., is planning the construction of an electric railway from Edna to Kinder, La., a distance of 6½ miles, are incorrect, as no such work is under consideration. P. O. Moss, Lake Charles, La., is Secretary.

MICHIGAN.

Preliminary surveys have been completed and right of way secured for the proposed extension of the Kewanee Central Ry., from Mandan, Mich., to Fish Cove Bay. Capital for the work has not yet been obtained but it is expected that all preliminaries will be arranged and contract let in the spring. F. E. Simar, Hancock, Mich., is chief engineer.

MISSISSIPPI.

The Mississippi River Western Construction Co. denies the report that the contract was awarded them for the construction of a 193 miles of line for the Mississippi River Western R. R. This work was recently mentioned in ENGINEERING-CONTRACTING. A. H. Longino, Jackson, Miss., is president of the Construction Company.

MISSOURI.

The St. Louis, Bartlesville & Pacific Ry. has completed surveys and partly secured right of way for the proposed line from Joplin, Mo., to Carmen, Okla., a distance of about 220 miles. D. H. Rhoades, West Fourth St., Joplin, Mo., is chief engineer.

NEW YORK.

MacCracken-Hauer-Terry Co., has about 25 miles of very heavy earth and rock work on the Delaware & Eastern R. R., in New York state. The work is being sublet from the offices of the company at Gilboa, N. Y. Daniel J. Hauer is one of the company.

The Elizabethtown Terminal R. R. Co., Elizabethtown, N. Y., through Vincent R. Coon, its general contractor and manager, will receive bids at once for the construction of a steam railroad from Westport to Elizabethtown, Essex County, N. Y., a distance of eight miles. The work will be mostly scraper and shovel work.

OKLAHOMA.

The Beaver Valley & Northwestern Ry. Co. has completed surveys for the construction of the projected line from Gage, Okla., to Hooker, Okla. Capital for the construction work has been partly secured, but no definite date has as yet been decided for letting the contracts. J. W. Webb, Beaver City, Okla., is President of the company and C. H. Holmes, Gage, Okla., is Secretary.

The Clinton & Oklahoma Western Ry. Co. has completed surveys for the entire system, including 568 miles projected from Lehigh, Okla., via Clinton, Okla., to Trinidad, Colo. Frank L. Adams & Co., Contractors, Oklahoma City, Okla., who have the contract for the construction of 75 miles of line, has 25 miles of the work completed. Guy V. McClure, Oklahoma City, Okla., is Chief Engineer of the company, and T. J. Nance, Clinton, Okla., is President of the company.

OREGON.

D. Fitzgerald, Pentleton, Ore., has the general contract for the construction of a 52-mile interurban railway from Athena to Hermiston, with general offices and shops at Pendleton, Ore., and also for the development of a 6,000 h.p. water power on the Walla Walla River for electrical purposes. The work includes 26,000 cu. yds. of earth excavation, 7,000 cu. yds. of rock excavation, 9,000 cu. yds. of embankment, 3 bridges 230 ft. long, one steel and two wooden with concrete piers, 600 ft. of pile trestling 22 ft. high, 1,200 cu. yds. of masonry, 200 cu. yds. of stone masonry. All of the work is to be sublet. The contractor is in the market for ties, poles, piling, bridge timbers, trailing cars, hydraulic machinery, 12 miles of galvanized iron or steel or 48-in. wood pipe and 30 miles of transmission equipment.

TEXAS.

S. M. Bush, Railroad and Levee Contractor of Memphis, Tenn., has work under way on his contract on the Santa Fe cut-off from Coleman to Texico, Tex., and expects to finish all the heavy work by April 1. The work includes 16 miles of the proposed line and 1,200,000 cu. yds. of material, a good part of which is rock work. Bush has an office at Roscoe, Tex.

The Gulf, Colorado & Santa Fe R. R. has completed surveys for the construction of the projected 60-mile line from Lometa to Brady, Tex. Capital for the construction has also been secured and contract will be let for the work January 31, 1910. E. P. Ripley, Chicago, Ill., is President of the company and F. Merritt, Galveston, Tex., is Chief Engineer.

The Grigsby Construction Co., Dallas, Tex., has been awarded the contract for the construction of the proposed 30 mile line of the Southwestern Ry. Co. southwest of Henrietta, Tex., through Archer City. Surveys for the work have all been completed. M. B. Mobberly, Henrietta, Tex., is Chief Engineer of the company, Henry J. Scott, Toronto, Ont., is President and A. C. Parks, Henrietta, Tex., is General Superintendent.

The Glen Rose & Walnut Springs Ry. Co. of Glen Rose, Tex., which has under construction a 14 mile line has completed 7 miles of the work. J. H. Farr is vice president and general manager; Thomas M. Simpson, Glen Rose, Tex., is engineer of the company.

The Beaumont Traction Co., Beaumont, Tex., has under contemplation considerable improvement to its property and is taking the matter up with the city. C. H. Kretz is general manager of the company.

The San Diego, El Paso & St. Louis Ry. has completed surveys for 200 miles of the proposed 500-mile line from El Paso, via Hope and Artesia, N. Mex., through the Pan Handle of Texas to the Red River. Negotiations are under way for securing capital for the construction of the line. A. Courchesne, El Paso, Tex., is president of the railroad and P. A. McCarthy & Sons, Houston, Tex., are the engineers. It is expected to let contracts for the construction work in the spring.

UTAH

The franchise granting the Salt Lake & Los Angeles Ry. Co. to double track and electrify its line to Saltair is before the city council of Salt Lake City, Utah. Nothing will be done toward the work until the franchise is granted. J. E. Langford, Jr., is Secretary of the company.

CANADA.

The Great Northern R. R. Co. has let contract for grading the line between Princeton and Tulameen, B. C., on the Vancouver, Victoria & Eastern and also between Abbotsford and Chillewack, B. C., a total distance of 37 miles to J. W. Stewart. A. H. Hogeland, St. Paul, Minn., is Chief Engineer of the company.

The Hamilton, Waterloo & Guelph Ry. Co. has had surveys made for the construction of three lines radiating from Hamilton, Ont., as follows: Hamilton to Waterloo; Hamilton to Guelph; Hamilton to Toronto, Ont., the latter being double tracked. The line comprises 140 miles. Capital for the construction of the above system has been party secured and it is expected to let contracts for the work

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MORRISON TENT & AWNING CO., 115-117 OLIVE STREET ST. LOUIS, MO.

in the spring. Thomas E. Hillman is Chief Engineer of the company, Paul J. Myler, Hamilton, Ont., is President of the company and J. Patterson, Hamilton, Ont., is Secretary and General Manager.

The Southwestern Traction Co., London, Ont., which is considering the construction of an extension of its line from London to Ingersoll and from St. Thomas to Aylmer, Ont., has as yet decided nothing definite regarding the project. W. T. Coy.

Power Developments, Levees, Drainage and Irrigation Works.

COLORADO.

Reynolds & Covey, McPheel Bldg., Denver, Colo., have an irrigation district comprising 20,040 acres of land located in Arapahoe and Elbert counties, Colorado, within 25 or 35 miles from Denver. Bonds have all been voted and estimates are being made to submit to responsible contractors. The work will include the construction of three large reservoirs and 40 miles of ditch work. Lee A. Reynolds is a member of the company.

KANSAS.

Capt. William D. Davis, Constructing Quartermaster, Fort Leavenworth, Kan., has received bids for 84,000 cu. yds. of earth work. Joyce Bros. & Bogwell and M. A. Wogan, both of Kansas City, Mo., were the lowest bidders.

NEW YORK.

The Hodenpyle, Walbridge Co., 7 Wall St., New York, N. Y., have under development at the present time one dam on the Au Sable River, known as the Cooke Development, being about 14 miles from the mouth of the river. The work is being done with the company's own forces, no contracts being let for the construction. Bids for the major portion of the apparatus are in preparation. William Eaton.

WASHINGTON.

Residents of the Yakima, Wash., Valley have formed the Valley of the Yakima High Line Association which will secure competent engineers to make a preliminary survey for the extension of the Kittitas Canal, a distance of 200 miles, to bring water from the lakes in the Cascades to North Yakima, Wash., at an altitude of 2,000 ft., making it possible to reclaim all the bare ridges surrounding the city long considered worthless. The survey will be submitted to the Reclamation Service, and should the project prove feasible, the association is in hopes of inducing the government to take up the matter and continue with a permanent survey. Lee A. Johnson, Sunnyside, Wash., is President of the Association.

E. E. Ball, Winslow, Ariz., Division Engineer of the Atchison, Topeka & Santa Fe Ry. Coast Lines, is quoted as stating that contracts will be let at once for the construction of the double track from Flagstaff, to Ash Fork, Ariz. It is thought that the company considers the double tracking of the whole line to Los Angeles, Cal.

The Sanford & Everglades R. R. Co., operating 7 miles of line between Sanford, Fla., and Cameron, projects the construction of a 200 mile line south to Miami, a point on the Atlantic Coast. The route proposed by the company will be 20 miles inland from the Florida Coast line and will tap the richest virgin pine section in Florida. The syndicate controlling the railroad has also purchased 102 acres of land in Sanford, Fla., for the construction of terminals, including storage tracks, shops, passenger station, freight and ware houses and general offices.

The Seaboard Air Line Ry. Co. was authorized by the State Railroad Commission of Georgia, to issue $1,380,000 of equipment trust notes, in addition to the $7,000,000 already issued. The work will be used for the equipment and extension of the facilities of the road. L. R. Watt, Norfolk, Va., represented the company.

According to reports from Glascow, Ky., John F. Mallette, Philadelphia, Pa., is interested in the construction of the proposed Louisville, Lincoln Farm and Mammoth Cave Traction line, for which, Charles Vandenburgh, Glascow, Ky., was granted a franchise last fall.

Citizens of Ellsworth, Me., are taking steps to have the Maine Central R. R. construct a branch line from Ellsworth up the Union River valley touching the cities of Mariaville, Amherst, Aurora and Great Pond, thence across the country touching Alligator and Nicatous Lakes to Grand Lake and to connect with the St. Croix branch at Princeton. Morris McDonald, Portland, Me., Vice President and General Manager of the Maine Central, is reported to be considering the proposition.

Plans for the extension of the Boston, Mass., Elevated Ry. Co. to Malden, a suburb of the city, have been completed and are awaiting the approval of the commissioners.

Engineers of the New York, New Haven & Hartford R. R. are working on plans for the construction of a tunnel beneath Boston, Mass., to connect the two terminals stations. Plans are also under consideration, it is said, for the electrification of the suburban system. H. L. Ripley, New Haven, Conn., is Construction Engineer.

The Roswell, Northern & Gulf R. R. Co. has been incorporated with a capital stock of $150,000 and proposes the construction of a railroad from Roswell, N. H., 100 miles north to Tucumcari, N. M., where it will make connections with the Rock Island and El Paso & Southwestern Rys. The incorporators of the company are C. C. Tannelhill, Alvin R. Morrison, Philadelphia, Pa.; A. Pruit, James F. Hinkle, J. Phelps White, Clifton Chisholm, J. Smith Lea, Edgar L. Bedell and John W. Rhea. The company has other steps under contemplation.

The Illinois Central R. R. Co. is reported to be considering the construction of an extension of the Trail Lake branch to Belzon, Miss., thence on to Tchula. L. C. Fritch, Chicago, Ill., is Consulting Engineer.

A movement is under way toward extending the levee from Vicksburg, Miss., to Brunswick. The construction of this levee would make 100,000 acres of waste land in Washington County cultivatable. W. Thomas Rose, Vicksburg, Miss., is President of the Brunswick-Vicksburg Levee Board.

According to a statement reported to have been made by E. F. Frendenthal, Pioche, Nev., the Pioche & Calienthe R. R. Co. is planning the construction of a 7 mile extension around Pioche Mountain. Construction work will be started on the new line as soon as winter breaks up. The following important mining properties are located on the proposed extension: Prince, Golden Prince and Pioche King.

According to announcement made by C. B. Anderson, General Manager of the Gallatin Interurban Ry. Co., Bozeman, Mont., the company is considering the construction of an extension to its line in the direction of Three Forks.

Location surveys have been started for the construction of the double tracks on the Oregon Short line between Farmington and Ogden, Utah. Preliminary surveys for this work were completed some time ago. Actual construction work will not be started before August. William Ashton, Salt Lake City, Utah, is Chief Engineer of the railroad company.

Surveys are under way for the construction of the proposed Mono Lake & Tonopah R. R. The line will leave the Tonopah & Goldfield R. R. in the neighborhood of Coaldale, Nev., and tap the rich lumber section in Inyo County, Nev. F. T. Armistead, Tonopah, Nev., is Engineer M. W., of the Tonopah & Goldfield R. R.

Plans are being made for the construction of the proposed Hazen Center, New Salem Electric Line which projects the construction of a line from Hazen to New Salem, paralleling the north branch of the Northern Pacific Ry. The company is contemplating the installation of a large power house at Center, N. Dak., which will be the division point.

The Great Northern Ry. Co. has decided to construct the proposed cutoff in North Dakota. Ayr, Cass County, N. D., will be the eastern terminal and Surrey, Ward County, is the Western Terminal. J. C. Patterson, St. Paul, Minn., is Assistant Chief Engineer of the Great Northern Ry.

The Chicago, Milwaukee & St. Paul R. R. is reported to be taking steps toward the construction of the proposed line from Fargo, N. Dak., to Winnipeg, Manitoba. Active work will be started in the spring, it is expected. A. J. Earling, Chicago, Ill., is President of the C. M. & S. P. Ry.

According to reports from the vicinity of Charlotte, N. C., work is to be started in May on the construction of the proposed railroad from North Wilkesboro, N. C., to Butler, Tenn., a distance of 90 miles. The company which is known as the Watauga Railroad Co., has already spent $200,000 for rights-of-way. Frank A. Linney and Ed. Coffey of Western North Carolina are interested.

J. A. Mills, Raleigh, N. C., President and General Manager of the Raleigh & Southport Ry. Co., is quoted as stating that contracts have been let for the construction of an extension to its line to Elizabethtown, Bladen and beyond. The line is to be standard gage and is to be laid with 56-lb. rails.

The Jefferson Construction Co. of Shenandoah Junction, W. Va., was granted a charter at Charleston, to mine and deal in clay, iron, stone and manufacture same into useful products, operate pottery, drill for oil and gas and also to engage as general contractors and builders. The capital stock of the company is $5,000 and the incorporators are Nelson R. Roberts and James Grantham and Eugene Shugerr and Abram Kaplon, Harper's Ferry, and James H. Mason, Jr., of Charlestown.

Items Concerning Contractors and Their Work

RAILROADS, POWER DEVELOPMENTS, LEVEES, DRAINAGE AND IRRIGATION WORKS.

Arkansas Notes.

FROM CORRESPONDENTS AND OTHER SOURCES.

According to reports in circulation at Van Buren, Ark., the Fort Smith Light & Traction Co., is to take steps immediately toward extending its Electric Park Line to the Arkansas River opposite Van Buren.

Reports from Fort Smith, Ark., state that Chicago capitalists are promoting the construction of an electric interurban line from Oklahoma City, Okla., to Fort Smoth, Ark., and that surveys for the proposed lines are already under way.

The Fort Smith, Van Buren & Eastern Interurban Light & Traction Co. has been chartered to construct and operate by either steam or electricity a line from Van Bren, Ark., across Crawford County into Franklin, Johnson, Madison, Newton, Boone and Searcy counties. The company has an authorized capital of $100,000, $650 of which has been paid in. The incorporators are W. F. Keller, Sam R. Chew, W. F. Blocker, L. F. Sherwood, J. W. Keller, T. H. Kibbler, John Kibbler, J. H. Keller, L. W. Burgett, S. A. Pernot, T. A. Bayley, J. L. Rea and F. T. Woolen.

California Notes.

FROM CORRESPONDENTS AND OTHER SOURCES.

Frank K. Mott, Mayor, Oakland, Cal., has asked congress to provide funds for the proper dredging of local harbors for the accommodation of deep water shipping.

Board of Supervisors of San Francisco, Cal., have decided not to grant a franchise to the United Railroads for the construction of a cross town line. G. B. Willcut is Secretary of the railroads company.

The Arlington Land & Development Co., in which the Robert Marsh Co., and Wright & Callender Co., of Los Angeles, Cal., are interested, have purchased the El Sobrante De San Jacinto Ranch including 40,000 acres of land and will take immediate steps toward vast improvements including the construction of reservoirs, and extension of electric railways.

The Dredge Sierra, of the United States Dredging Co., has completed its work opposite Yuba City, Cal., on the Feather River Cutoff and will start work on another contract ½ mile south

W. G. Hunter, Engineer, has filed with the county commissioners at Stockton, Cal., a report on the Bellota Flood Problem. He recommends the construction of a dam 130 feet above low water and 950 feet in length across the Calaveras River about 6½ miles up the river from Jenny Lind, Cal. The Board has the report under consideration.

Articles of incorporation have been filed with the county clerk, at Redding, Cal., by the Mount Shasta Power Co., which proposes an immense power development project in Shasta County. The company has principal offices at San Francisco, Cal., and a capital stock of $1,000,000. According to the plans of the company a tunnel 7 miles in length will be constructed to divert the 200,000 inches of the Pit River and convey the whole stream through the mountains instead of around the Big Bend. By this undertaking, which it is estimated will require an expenditure of several millions of dollars, 250,000 h. p. can be developed electrically. The Board of Directors of the company are as follows: John Coffee Hays, Visalia, Cal.; William A. Cooper, San Francisco; R. E. Johnson, San Francisco; H. V. Gates, Hillsboro, Ore.; Jesse W. Lilienthal, Albert Raymond, A. J. Treat, San Francisco, Cal.

The Street Committee of the Mission Promotion Association, San Francisco, Cal., is taking steps toward having the Southern Pacific and the United Railroads to widen the Bernal Cut, in order that the right of way of the Southern Pacific Co., south of Randall or 31st St., will permit the passage of vehicles and other traffic besides the railroad cars.

Right of way for the proposed line from Fullerton, Cal., to Richfield has been secured by the Atchison, Topeka & Santa Fe Coast Line Ry. Co., and according to reports from that vicinity construction work will be started at once. H. C. Phillips, Los Angeles, Cal., is Chief Engineer.

The Los Angeles Ry. Co. has been granted a franchise to operate an electric railway on Alpine St., from the intersection of San Fernando and Alpine Sts., to Buena Vista St. and on Ann St., from the intersection of Main and Ann to San Fernando.

The United Railroads of San Francisco, Cal., have agreed to grant the request of the Mission Promotion Association of that city to extend the new Cortland Ave. line from Mission St., along Mission to Third, thence to Kearny, Broadway and East St., and the ferries. The Association has also asked the United Railroads to extend the Polk and Mission lines from Onondaga Ave., and Mission St., to the County line.

Surveyors are running lines for the construction of a railway from Arbuckle, Cal., through Colusa to Hamilton and it is believed that a connecting line will be built from the Vallejo Northern to the Northern Electric.

Engineers are viewing the route of the projected Sacramento Valley Line from Eureka, Cal., through the mountains to some point in the Sacramento Valley and are securing data of every nature to submit to those who will be asked to finance the lines.

The Oakland & Antioch Ry. Co., which has headquarters at 347 Grant Ave., San Francisco, Cal., will, it is said, start construction work soon on its proposed electric railway from Oakland to Berkeley, Walnut Creek, Concord and Bay Point, a distance of 34 miles. H. A. Mitchell is President of the company.

The Stockton Terminal & Eastern R. R. Co., of Stockton, Cal., has secured necessary right of way and has started work on the proposed 28-mile line connecting Stockton, Linden, Waterloo, Bellota and Jenny Lind, Cal. The estimated cost of the work is $400,000. The officers of the company are as follows: M. J. Gardner, president; F. J. Dietrich, vice-president; James A. Barr, secretary; J. Egbert Adams, manager; H. W. Newell, consulting engineer.

According to a statement reported to have been made by S. B. McLenegan, general manager, Central California Traction Co., 413 Webber Ave., Stockton, Cal., the company will spend about $1,000,000 on the new line under construction from Lodi to Sacramento, Cal.

Plans and specifications for the Escondido Electric Ry. Company's line and bids for the work are to be submitted to contractors shortly. The work includes the construction of a 2,600-ft. tunnel through Scripps Summit. The company has an office at San Diego, Cal.

Colorado Notes.

FROM CORRESPONDENTS AND OTHER SOURCES.

Necessary surveys and filings with the Interior Department of the United States Government have been made for permits, rights of way, etc., by the company projecting the construction of a hydro electric power plant on the Conejos River in Colorado. C. S. Barnes, Monte Vista, Colo., is Engineer of the company.

The Montrose & Paradox Valley R. R. is reported to be making good progress in financing its road in Colorado. The proposed line will extend into the Paradox Valley, where large irrigation projects are now under way. A connection is also planned with the Denver & Rio Grande R. R.

The Pueblo Interurban Traction Co., Pueblo, Colo., is reported to have begun work on an electric line extending from Canon City and Florence to Pueblo and ultimately to the Kansas border. The company contemplates the construction of about 100 miles of track during the year of 1910.

The Northwestern Terminal Co., of Denver, Colo., controlled by the Denver, Northwestern & Pacific Ry., and the Denver Tramway interests, has succeeded in securing the entire right of way for its proposed belt line around Denver. All preliminary financing has been completed and actual construction work will be started in the spring. The improvement will involve an expenditure of about $6,000,000 or $10,000,000. D. H. Moffat, Denver, Colo., is President of the Denver, Northwestern & Pacific Ry. Co., and is at the head of the terminal movement.

The Southern Pacific Ry. Co. has had surveys completed for the construction of a line from the main line in southern New Mexico to the coal fields at or near Durango, Colo. J. D. Mathews, Tucson, Ariz., is Division Engineer.

Thte Denver & Rio Grande R. R. is taking steps toward broad gaging the Marshall pass and Gunnison Division as far as Crested Butte, and ultimately to Montrose. Headquarters of the Third Division are now located at Gunnison instead of Salida, Colo. J. W. Deen is Division Engineer.

Idaho Notes.

FROM CORRESPONDENTS AND OTHER SOURCES.

At an election held by the Pacific & Northern Idaho Ry. Co., in Weiser, Ida., the following officers were elected:

President, Edgar M. Heigho, of Weiser, Idaho; vice president, F. R. Cordley of Weiser; vice president and general counsel, Samuel Morris of New York, vice J. H. Richards, resigned; treasurer, James B. Ford, of New York, vice C. W. Webb, resigned; secretary, John D. Carberry, vice C. W. Webb, resigned.

The company plans to extend its line from Council, Idaho, with the possibility that it will be met at Meadows, Idaho, by an extension of the Northern Pacific from Grangeville.

The directors of the road are Edgar H. Heigho, Weiser, Idaho, vice F. R. Cordley, resigned; Dr. J. R. Numbers, Weiser, Idaho, vice J. H. Richards, resigned; A. L. Wiley, Weiser, vice E. M. Barton, resigned; W. H. Truesdale, New York, vice C. W. Webb, resigned, and Samuel Morris, New York.

The Idaho-Inland Ry. Co. an auxiliary company of the Northwestern Lumber Co., has filed articles of incorporation and proposes the construction of a railroad from a point near Vollmer, Idaho, on the Camas Prairie Road, to the timber holdings on Craig Mountain. Survey and other data are now being prepared by engineers.

The Northern Pacific is said to be considering the abandoning of the route through Lo-Lo Pass and are having surveyors locate a route up the Little North Fork to the headwater of the stream in view of crossing the mountains by that way. The new route proposed is through the wildest part of Idaho.

Illinois Notes.

FROM CORRESPONDENTS AND OTHER SOURCES.

The Hammond, Chicago Heights & Southern Traction Co. has been incorporated with principal offices at Chicago, Ill., and a capital stock of $500,000 and proposes the construction of an electric line from some point on the Illinois State Line immediately contiguous to the corporate limits of the City of Hammond, Ind., thence in a southwesterly direction to a convenient point within the corporate limits of the city of Chicago Heights, in Cook County, thence in a southwesterly direction through the counties of Will and Kankakee to a point within the corporate limits of the City of St. Anne in Kankakee County. The incorporators and first

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THE COLUMBUS TENT & AWNING COMPANY, Columbus, Ohio

Board of Directors are William S. Reed, Andrew Ward, Joseph Orr, Edward R. Davis, all of Chicago Heights, Ill., and Alfred Van Steenberg of Lansing, Ill.

The Egyptian Traction Co. has been incorporated with principal offices at Eldorado, Ill., and a capital stock of $5,000 and proposes the construction of an electric line from Murphysboro, Ill., through the counties of Jackson, Williamson, Saline, Gallatin, and White to the Wabash River. The incorporators and the first Board of Directors of the new company are G. C. Leggett, Winchester, Ind., John W. Murphy, Eldorado, Ill., John D. Stayton, Texas City, Ill., G. E. K. Hixson, Chicago, Ill., and S. W. Latham, Eldorado, Ill.

Construction work on the A. O. Fox Electric Light Plant at Galena, Ill., is being rushed to completion and steps will soon be taken toward the construction of the proposed Dubuque-Platteville Interurban.

The Chicago, Bloomington & Peoria Ry. Co. has been incorporated with a capital stock of $25,000 and principal offices at Chicago, Ill., and proposes the construction of a line from Chicago to Bloomington and Peoria, passing through the counties of Cook, DuPage, Will, Kendall, Grundy, LaSalle, Livingston, Woodford, Tazewell, McLean and Peoria. The incorporators and first board of directors of the new company are as follows: Jerome J. Danforth, Charles S. Sollars, Avern Hyde, Frank M. Campbell, Chicago, Ill.; Virginius L. Garnett, Highland Park, Ill.

It is reported that the Chicago, Milwaukee & Gary Ry. Co. is preparing to begin active construction work on its line from Joliet to Aurora in the spring. I. W. Troxel, Rookery, Chicago, Ill., is Chief Engineer of the company.

The Desplaines Valley R. R. Co., the Chicago & Northwestern R. R. Belt line has acquired all right of way for the construction of the proposed line between Elmhurst and Glencoe, Ill., costing the company about $500,000. The route as projected will run through Proviso, Leyden, Maine and Northfield, Ill.

A bill has been introduced into the Illinois State Senate granting the Chicago Recreation Pier Exposition Co. right to build a 50-ft. pier 4,000 ft. out into the lake off 31st St., Chicago, Ill.

The Hotchkiss Contracting Co., Chicago, Ill., has been incorporated with a capital stock of $50,000 and will engage in general contracting business. The incorporators are William S. Hotchkiss, Lawrence E. Hotchkiss, J. Lawrence Merritt.

The Chicago United Railway Co., of Chicago, Ill., has been incorporated with a capital stock of $2,500, and proposes the construction and operation of railroads in Chicago and the counties of Cook, Lake, McHenry, DuPage and Will. The incorporators are Chas. G. Dawes, Emile K. Boisof, George P. Hoover and Andrew Cooke.

Smith & Brown Co., Contractors, Chicago, Ill., has been incorporated with a capital stock of $60,000. Henry D. Smith, John F. Brown and George B. Smith are the incorporators.

The Chicago & Northwestern R. R. has plans laid to enter Portland, Ia. The trains will run over the Three I. R. R. from Ladd to Granville, Ill., then a line will be constructed to Portland paralleling the Oglesby & Granville branch of the Chicago, Milwaukee & St. Paul Ry. E. C. Carter, Chicago, Ill., is Chief Engineer.

The Tri City & Northwestern Ry. is to have new surveys made for the proposed line between Rapids City and Watertown, Ill. The new line will follow the river passing through Hampton. At Rapids City it is planned to go under the Milwaukee tracks together with the public highway. Wallace Treichler, Rapids City, Ill., is Chief Engineer of the company. Options on all the right of way from Watertown to Albany, Ill., are reported to have been secured.

Indiana Notes.

FROM CORRESPONDENTS AND OTHER SOURCES.

Stockholders of the Columbus, Greensburg & Richmond Traction Co., recently held a meeting at which they took steps toward the construction of the proposed line from Columbus, Ind., to Richmond. C. F. McCallie, of Columbus, Ind., is one of the stockholders in the company.

The Bluffton, Geneva & Celina Traction Co., of Bluffton, Ind., has increased its capital stock from $30,000 to $675,000. William A. Kunkle is President of the company.

J. E. Greeley, President of the Cincinnati, Madison & Western Traction Co. is quoted as stating that construction work on the new line will begin not later than April. The route of the projected line is from Scottsburg to Madison, Ind., where it will connect with the Indianapolis and Louisville Traction Co., for Louisville and Indianapolis, Ind.

The Vincennes Traction & Light Co., of Vincennes, Ind., has decreased the capital stock of the company from $300,000 to $500. S. A. Culbertson is president of the organization.

The Wabash & North Manchester Interurban Co., of Wabash, Ind., plans to start work on the grade for the proposed line early in the spring.

Iowa Notes.

FROM CORRESPONDENTS AND OTHER SOURCES.

Hugh L. Cooper announced recently in Keokuk, Ia., that a syndicate of New York and Boston capitalists will finance the building of the second largest dam in the world which will span the Mississippi at that point. The structure will be 5,800 ft. in length, 37 ft. height, extending 7 ft. in the solid rock bottom of the river. It will be constructed of reinforced concrete, extending straight across the river and is estimated to cost $15,000,000. The dam will create a lake extending up the river for 30 miles. It is planned to develop 200,000 h. p. at a plant on the Iowa side of the dam. The work will be done under supervision of the government.

Plans are under way for the construction of an electric interurban line from Guthrie Center, Ia., to Des Moines, by way of Dale, Redfield, Adel, Dallas Center and Grant, a distance of 55 miles. Efforts to secure right of way for the line are to be made at once. The estimated cost of the project is $27,000 a mile. A. P. Chamberlain, General Manager, Railway Promotion & Construction Co., of Des Moines, Ia., is reported to be interested in the project.

The Northwestern Construction Co. of Davenport, Ia., has been incorporated with a capital stock of $25,000. The incorporators of the company are T. J. McCarthy, H. T. McCarthy and Herman Staak.

Articles of incorporation filed in Nebraska by the Yankton, Norfolk & Southern Ry., have been revoked because the officials failed to pay occupation tax. The line was mentioned in our last issue and projected the construction of a line from Parkston, S. Dak., to Sioux City, Ia., by way of Sioux Falls, Freeman, Yankton, Centerville, Elk Point. C. A. Magee, Pittsburg, Pa., is president of the company.

The Iowa Traction Co. is planning the construction of a dam across Cedar River below Vinton, Ia. Engineers have completed surveys and proceedings for condemning the necessary land are to be effected at once.

Chicago, Milwaukee & St. Paul Ry. Co. is reported to have surveys under way for the construction of a new line east of Charles City, Ia., in order to reduce grades and eliminate curves. D. J. Whittemore, Chicago, Ill., is Chief Engineer of the railroad company.

Waterloo, Ia., has under consideration the organization of a company with a capital stock of $500,000 to build a railroad south to Tama or Belle Plaine to connect with the Chicago, Milwaukee & St. Paul and the Chicago & Northwestern R. R.

A company is being formed to construct a railroad between Waterloo, Ia., and Tama, and articles of incorporation will be filed in the near future. No name for the company has as yet been decided upon.

Kansas Notes.

FROM CORRESPONDENTS AND OTHER SOURCES.

Preliminary surveys for the proposed line of the Kearney, (Neb.) & Beloit (Kan.) Railway are reported to be rapidly nearing completion.

According to reports the Missouri Pacific Ry. is considering the construction of a line from Sterling, Kan., to Great Bend.

The Motor Grand Traction Co. has been incorporated with a capital stock of $1,000,000, $3,940 of which has already been paid up, and proposes the construction of an interurban system in Kansas. The route of the projected line will start at the north line of Republic county, pass through Belleville, Concordia, Minneapolis, Canton, Salina, Newton and on to Wichita. It will pass through the counties of Republic, Cloud, Ottawa, Saline, McPherson, Harvey and Sedgwick and will be 150 miles in length. The directors of the company are E. S. Alnutt, E. N. Van Hosen, A. L. Litel, and Roy S. Johnson of Belleville, Kan., and W. L. Hope of Fairbury, Neb.

The headquarters of the company are at Phoenix, Ariz., and the Kansas headquarters are at Belleville, Kan.

Surveys are now under way for the construction of the proposed line for the Gulf & Northwestern R. R., through Sherman, Wallace, Greeley, Hamton, Stanton and Morton Counties in Western Kansas. The Chicago, Rock Island & Pacific R. R. is reported to be behind the project.

Charter was granted a railroad company at Topeka, Kan., to construct an interurban line from Belleville to Wichita, Kan., by way of Newton, Canton, Salina, Minneapolis, and Concordia, Kan. The capital stock of the company is set at $1,000,000 and the incorporators are all of Belleville, Kans.

The Verdigris River Drainage District No. 1, F. S. Hathaway, Engineer, has appointed A. M. Ragle, G. J. Phister and S. McMurtry as appraisers in the matter of condemning the right of way across the Hoffman land, east of Coffeyville, Kan., for levee purposes.

The Kiowa, Hardtner & Pacific R. R. Co., which has completed the line from Kiowa to Hardtner, Kan., will begin work in the spring on the proposed extension of the line through Comanche, Clerk, Meade, Seward, Stevens and Morton counties to the coal fields of Brooksfield, Colo., and Des Moines, N. Mex. The line has been leased for 20 years by the Missouri Pacific Ry. and will be operated by that company.

Michigan Notes.

FROM CORRESPONDENTS AND OTHER SOURCES.

W. H. Zimmerman Co. has been incorporated with principal office at Chicago and Branch office at Lansing, Mich., and will engage in general engineering.

Plans are under way for one of the largest power developments in northeastern Michigan. The project, which involves the construction of seven dams in the Tittabawassee River, starting at Edenville, Mich., and continuing into Gladwin County, is being promoted by Frank Wexson, Midland, Mich.

According to reports from the vicinity of Farmington, Mich., contracts have been let for the construction of the projected traction line from Farmington, to Lansing, Mich. Connection is planned with the Detroit Union Ry. lines at Farmington, Mich. Eastern capitalists are reported to be backing the line, which will later be extended to Grand Rapids.

Minnesota Notes.

FROM CORRESPONDENTS AND OTHER SOURCES.

A movement is on foot to construct an electric railway line from Mankato, Minn., to Twin Cities connecting with the Dan Patch Lake line in Iowa, is reported to be pushing line at Savage and entering St. Paul and Minneapolis over the right of way. J. D. Browning, promoter of the Sioux City-Spirit this project.

Stockholders of the General Electric Co., Minneapolis, Minn., are considering authorizing an issue of bonds amounting to $1,000,000 for the purpose of improving and enlarging the company's plant.

Advices from Long Prairie, Minn., state that Henry Diebel is endeavoring to finance a company to construct an electric line from Little Falls through Long Prairie to Alexandria, Minn. The company expects to obtain power for the operation of the line from the power plant on the Mississippi River at Little Falls.

Missouri Notes.

FROM CORRESPONDENTS AND OTHER SOURCES.

Engineers have completed the survey for the projected electric interurban line between Palmyra, Mo., and Bethel. The survey passes ¼ mile south of Burksville and a 1% grade is reported from Palmyra to that point.

The Business League of Greenville, Miss., is to take up the matter with the president of the company projecting the construction of a railroad from St. Joseph, Mo., to Mobile, Ala. The line will be a trunk road, connecting the grain fields of the West with the gulf shipping, and has already been surveyed and located from St. Joseph to Fort Smith, Ark. As planned, the road will cross somewhere in the vicinity of Monticello, Ark., bearing southeast to Greenville and taking a route out of Greenville by Yazoo City, Canton and crossing the Alabama and Vicksburg railroad in the western part of Rankin county or the eastern boundaries of Scott county.

The St. Louis, Iron Mountain & Southern R. R. Co. has submitted plans to the Board of Public Improvements and City Counseler, of St. Louis, Mo., for the elevation of its tracks in order to eliminate the grade crossings at Broadway, Fourth, Sixth and Seventh Sts. James W. Way, St. Louis, Mo., is Consulting Engineer.

The Manufacturers' Ry. Co. is reported to to be planning the construction of a new line in St. Louis to supplant the present belt line around that city. G. F. Moore, South Side Bank Bldg., St. Louis, Mo., is general manager of the company.

St. Louis Items.

BY A. B. KOUNS.

W. H. Montgomery came in from Trinidad, Colo., spent a couple of days in town and left for Texas.

The collapse of the frame work of the McKinley Bridge recently, caused by the breaking of ice floes, and resulting in a delay of several months in the completion of the structure, will prevent the bridge being ready for use on April 6, the date set by ordinance, and it is likely that an extension of time will be asked of the Municipal Assembly, according to a statement made to the writer by R. D. Smith, president of the Illinois Construction Company. Under the provision of the franchise granted the McKinley System for the construction of the bridge and tracks in St. Louis and their use, April 6 was the date set. Mr. Smith, to be on the safe side, believes it best to have an extension by the city and will in a few days have introduced in the Assembly a bill granting an extension of six months.

The Iron Mountain Railroad Company last week submitted plans to Mayor Kreismann for an elevated track south of Poplar street to take the place of the track now used by that road on the surface of Poplar street from Eighth street to the river. The move by the road is the result of an investigation by the Board of Public Improvements to prepare an ordinance compelling the road to either remove its tracks or put them in a tunnel under Poplar street. It is likely that an ordinance will be introduced in the Municipal Assembly authorizing the company to erect the elevated road from Cupples block to Third street south. The plans submitted by the company, however, provide for a track 3 feet higher than the clearance under the free bridge approach at Chouteau Avenue under plans that have been prepared for that structure, and before the company is allowed to build the elevated track it likely will have to make terms to get under the bridge. The company suggested it would like to make things easy for the city in getting the bridge approach across its property at Chouteau Avenue and Third Street, provided the city would raise the bridge 3 feet, but the city's engineers say they are not worried about having to raise the bridge to get fair treatment. The company can not build an elevated track without a franchise and the Municipal Assembly can dictate the terms of that. According to the reports at the City Hall the company has had the plans up its sleeve for twenty years, prepared for a contest of its rights to use the surface of Poplar street. Several months ago the Board of Public Improvements took up the question of compelling the company to put its tracks under the ground, and the offer to elevate them on private property is said to be an effort to escape a subway. The tracks now are not much used, but their location makes them a menace to public safety in the grade crossings at Third, Fourth, Broadway, Sixth and Seventh Streets. Four car lines, the Fourth, Broadway, Cass and Seventh, cross the tracks at grade.

Wm. T. Rotery, bookkeeper for the J. F. Adelsberger Commissary and Supply Co., tried to stop a general fight that occurred in camp among the laborers at Dupo, Ill., after pay day last Tuesday with the result that he was cut in the back five times by one of the drunken laborers. Rotery was brought to East St. Louis and placed in the Henrietta hospital where his condition is said to be serious.

Grant Bros. have a grader outfit idle at Monmouth, Ill.

W. A. "Black Bill" McDonald writes us from Missoula, Mont., that he is idle there at present.

Wood blocks are becoming more popular in the city since the pavements on Washington boulevard and Westminster place have stood the test for so many years. Merchants have come to the conclusion that they are desirable for the business district and street commissioner Travilla is convinced of their durability. Since the laying of wood blocks on Olive street petitions have been filed for the same treatment for Fourth street between Washington Avenue and Chestnut Street. Another petition was filed by business men along Washington Avenue between Fourth and Twelfth streets, the center of the wholesale district. Two petitions for the same pavement have been been filed for Rauschenbach Avenue from Benton to Herbert Street and Washington boulevard from Kingshighway to Union boulevard. A public hearing has been arranged by the Board of Public Improvements for February 4 on the improvement of the following streets: San Francisco Avenue, from Fair Avenue to Newstead Avenue; Slattery Street from Montgomery Street north 225 feet; North Market Street, from Kingshighway boulevard to Union boulevard; Ohio Avenue, from Miami Street to Cherokee Street; Hereford Street, from Bishoff Avenue to Northrup Avenue; San Francisco Avenue, from Taylor Avenue to Cora Avenue, Newcomb place from Walton Avenue east 285 feet; Newcomb place, fram Marcus Avenue west 272 feet; Louisiana Avenue, from Eiler Street to Neosho Street; Elliot Avenue, from University Street to Herbert Street; Glasgow Avenue, from Dodier Street and intersection with Parnell Street and Barrett street; McLaran avenue, from Broadway to Church road; Pacific Avenue, from Chouteau Avenue to Papin Street; Margaretta avenue from Taylor avenue to Cora Avenue; Compton Avenue, from Meramec Street to Gasconade Street; Keokuk street from Missouri Avenue to Broadway; Adelaide Avenue, from Florissant Avenue to Rosalie Street; Rosalie Street, from Carter Avenue to Fair Avenue; Forest Avenue, from Manchester Avenue to Plateau Avenue; Tyrolean Avenue from Salzburger Avenue to Gravois Avenue; Habsburger Avenue, from Salzburger Avenue, from Loughborough Avenue north 618 feet; Stanley avenue, from McCausland Avenue to Blendon place, Kingshighway southwest, formerly Kansas Street, from Colorado Avenue to Grand, Kingshighway; Grand Kingshighway, formerly Grand Avenue between Kingshighway southwest formerly Kansas Street and Bates Street; Grand Avenue from Bates Street to Neosho Street; Kingshighway boulevard from Gravois Avenue to Nottingham Avenue; Kingshighway boulevard from Nottingham Avenue to Arsenal Street; Mississippi Avenue from Geyer Avenue to Lafayette Avenue; Nineteenth Street, from North Market Street to St. Louis Avenue; Palm Street, from Fourteenth Street to Twentieth Street; North Market Street from Broadway to Fifteenth Street; Fourth Street from Chestnut Street to Washington Avenue; Washington Avenue, from Fourth Street to Twelfth Street; Washington Avenue from Kingshighway boulevard to Union boulevard; Rauschenbach Avenue, from Benton Street to Hebert Street.

Another bond issue, to complete the approaches to the Municipal free bridge, construct sewers and for such other public improvements as are needed, is now being considered by the Board of Public Improvements. Mayor Kreismann and Comptroller Taussig will confer with the board during the week at which time it will be determined whether a bill for another bond issue will be sent to the Municipal Assembly. The members of the Conference Committee of the Municipal Assembly also will attend. That the board is anxious to have the free bridge accessible as early as possible is evident from the fact that all the contracts were let as rapidly as the ordinances were passed and the provisions of the charter would permit the advertisements for proposals. The sewer question has been giving the board much trouble of late. The members have been anxious to begin work on the River des Peres. Contracts have been let for the River des Peres foul-water sewer in the extreme southern section of the city, but the big sewer through Forest Park cannot be considered for the present because of the lack of funds. Plans for this have been prepared and surveys all made and the only drawback is the lack of available funds. By a bond issue the board hopes to be able to handle this, together with sewers in both North and South St. Louis. Additional funds for the completion of Kingshighway boulevard in the northern part of the city will be needed, and this will be included in the bond issue if it should be agreed to send the bill to the Municipal Assembly.

Frank B. Dietz, a prominent contractor of Edwardsville, Ill., died last Tuesday after an illness of two months. He is survived by his wife and 7 children.

"Shorty" Wells is at Nysasa, Oregon.

The board of Public Improvement last week announced a public hearing for February 4 on the improvement of thirty-six streets. In the list are Washington Avenue from Fourth Street to Twelfth and Fourth Street from

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Chestnut Street to Washington Aveniue, both to be paved with wood blocks. Four stretches of Kingshighway are included in the list. Following are the streets: San Francisco Avenue, Fair to Newstead; Slattery, 225 north from Montgomery North Market, King's Highway to Union; Ohio, Miami to Cherokee, Hereford, Bischoff to Northrup; San Francisco, Taylor to Cora, Newcomb, 285 feet east from Walton; Newcomb, 272 feet west from Marcus; Louisiana, Eiler to Neosho; Elliot, University to Hebert; Glasgow, Dodier to Parnell at Barrett; McLaren, Broadway to Church road; Pacific, Chouteau to Papin; Margaretta, Taylor to Cora, Compton to Meramec to Gasconade; Keokuk, Missouri to Broadway; Adelaide, Florissant to Rosalie; Rosalie, Carter to Fair; Forest, Manchester to Plateau; Tyrolean and Habsburger, Salzburger to Gravois, Salzburger, 618 feet north from Loughborough; Stanley, McCausland to Blendon; King's Highway, Southwest (Kansas Street) Colorado to Grand King's Highway (Grand Avenue), King's Highway Southwest to Bates; Grand, Bates to Neosho; King's Highway, Gravois to Nottingham, King's Highway, Nottingham to Arsenal; Mississippi, Geyer to Lafayette, Nineteenth, North Market to St. Louis; Palm, Fourteenth to Twentieth; North Market, Broadway to Fifteenth, Fourth, Chestnut to Washington; Washington, fourth to Twelfth; Washington, King's Highway to Union; Rauschenbach, Benton to Hebert.

Dr. J. S. Hasty, 511 S. 3rd St., Lamar, Colo., writes us that the Fort Lyon Canal Co. will have about 300,000 yards of earth to move which is mostly dredging work and he wants the addresses of persons interested in dredges who want to figure on this.

J. W. Skinner returned from his ranch in southwest Missouri. Expects to spend at least a week in town.

The Missouri, Kansas & Texas Railway Company has notified the city that it will remove its tracks on Aurora avenue from Ferry street to the river front. The tracks were laid without authority from the city, and City Attorney Tom Anderson issued a summons against them to appear in Police Court.

Work is to begin as soon as river conditions permit upon a system of dikes to protect the lowlands about Harlem in Clay County, Missouri from flood water. The North Kansas City Levee District Association authorized by law several months ago, was organized formally at a meeting held in the office of the justice of the peace in Harlem last week. Five supervisors were chosen who will direct the apportioning of expense among the property owners and the work of building the dikes. The supervisors selected are F. W. Fratt, president of the companies holding the Armour-Swift-Burlington lands; C. M. Carter, assistant treasurer of the Chicago, Burlington & Quincy Railway; I. H. Rich, manager of the Swift Packing Company here; C. M. Crouse of Harlem, and Hugh J. Curran, secretary of the Armour-Swift-Burlington Companies. Mr Fratt drew the one year term and was elected chairman and Mr. Curran the five year term and the secretaryship. Mr. Carter got the two year term and Mr. Rich the three year term. Mr. Crouse will serve four years. The dike will begin upriver, three miles above Harlem, at the Perkins farm. The west main track of the Burlington Railroad is to be raised to form a dike from this point to the north end of the Hannibal bridge. This dike is to be three feet above the highway mark of the flood of 1903. The dike will continue following the harbor line down the Missouri River to a point opposite Rock Creek. Here it will be turned inland and extended as an inland dike to the Wabash and Burlington tracks at Rock Creek. This inland dike will be extended along the bluffs so that back water cannot flow into the district. This dike will intersect the point of beginning at the Perkins farm. Thirty-five thousand feet of dike will be constructed and the estimated cost of the work is $540,000.

Montana Notes.

FROM CORRESPONDENTS AND OTHER SOURCES.

The Somer, Polson & Missoula Ry. Co., has been incorporated with a capital stock of $50,000 and proposes the construction of an electric line from Kalispell, Mont., to Polson and eventually to a connection with the Northern Pacific R. R. on the South and with Whitefish and Columbia, Mont., on the North. The incorporators of the company are as follows: J. A. Coram, F. H. Nash, T. D. Long, E. R. Gay and A. L. Jacquit, Kalispell, Mont.; James A. Talbott, Columbia Falls, Mont.

The Whitefish and Polson Electric Railway Co. has been incorporated with a capital stock of $200,000 and headquarters at Kalispell, Mont., and proposes the construction of an electric railroad from Kalispell, northward to Whitefish and southward through Somers and Polson on the West Shore of Flathead Lake. The incorporators are G. H. Adams, J. H. Stevens, Joseph Edge, D. Ledgerwood, O. P. Mosby and Peter Nilson, all of Kalispell, Mont.

Nebraska Notes.

FROM CORRESPONDENTS AND OTHER SOURCES.

The United States Government has rejected all bids for the construction of the Pathfinder dam in Wyoming and will do the construction work during the coming summer with its own forces. The dam which will store 1,000,000 acre ft. of water is to cost $1,500,000. The water will be used to irrigate 350,000 acres of land in western Nebraska and in eastern Wyoming. R. H. Davis is Superintendent of Construction.

Articles of incorporation have been filed in Pierre, S. Dak., by the Omaha Western & Lincoln Ry. Co., with a capital stock of $3,000,000 and headquarters at Highmore, S. Dak., and proposes the construction of a 200-mile line extending from Omaha, Neb., to Hastings, with a branch to Lincoln, Neb., where the business office of the company is located. The incorporators of the new company are as follows: Frank E. Schaaf, Charles Lee, Lincoln, Neb.; A. P. Tilley, Osceola, Neb.; Charles Butler, Kenesaw, Neb.; E. J. Quirk, Highmore, S. Dak.

The Union Pacific Ry. Co. has filed survey plats at Cheyenne, Wyo., confirming the long rumored plan of the company to construct a cutoff which will shorten the main line 40 miles and save 1,000 ft. in the climb to the grade crest of the Black Hills of Wyoming, and leave Cheyenne, Laramie, Sidney and other towns south of the main line. As planned the Northport, Neb., branch will be extended to a junction with the main line at Medicine Bow, Wyo., to form a new main line from Chappell, Neb., to Medicine Bow, Wyo. Among the tunnels included in the work are two, one being 15,500 ft. in length and the other 3,100 ft. A. L. Mohler, Omaha, Neb., is vice president and general manager of the company.

New Jersey Notes.

FROM CORRESPONDENTS AND OTHER SOURCES.

Officials of the Phillipsburg & Washington Trolley Co., of Phillipsburg, N. J., announced, according to reports, that the line will be extended from Port Murray, the present terminus to Hackettstown and thence to Lake Hopatcong, where it will connect with the Morris County Traction Co. Construction work will be started early in the spring.

Ordinance granting a franchise to the Stroudsburg & Delaware Water Gap St. Ry., Stroudsburg, N. J., to extend its line to the point of the Gap, making through trolley service to Philadelphia, Pa., has been vetoed by Burgess Kelly of Delaware Water Gap.

A plan is under discussion in Port Norris, N. J., for the construction of a trolley line between West Millville and the New Jersey Southern R. R., at Haleyville, N. J., to connect with Millville and Port Norris.

New York Notes.

FROM CORRESPONDENTS AND OTHER SOURCES.

The Paul J. Rainey Pier Co., New York, John L. DeSaulles, President, has signed a contract for the construction of the proposed pier, which will be constructed of steel and concrete and will extend 1,500 ft. over the Beach and Ocean. Work will commence at once.

Plans are being prepared by Henry Robert, one of the Engineers, who planned the Sea Wall at Galveston, Tex., for the construction of a concrete dam across the Susquehanna River west of the Lackawanna Railroad bridge in Oswego, N. Y. The dam, which is estimated to cost between $10,000 and $12,000, will probably be constructed during the coming summer.

A. J. Stafford, representing the Beebe Syndicate interests is securing right of way for the construction of an electric line from Sodus, N. Y., and Port Byron to Red Creek. It is believed that it is planned to construct a railway from Red Creek to Wallington, through the towns of Wolcott, North Rose, and Alton, to connect with the Rochester & Sodus Bay Ry. and the Pennsylvania R. R. The length of the proposed road is 4 miles.

Ohio Notes.

FROM CORRESPONDENTS AND OTHER SOURCES.

Nearly all right of way has been secured by the company projecting the construction of an electric interurban line from Conneaut, O., to Ashtabula. The road is financed by a number of New York capitalists. Offices of the company have been opened at Ashtabula, O.

The Baltimore & Ohio R. R. Co. is to start work in the spring on its proposed ore docks at Lorain, O. The new docks will extend 400 ft. into the lake and will be surpassed by no other harbor on the great lakes. Hoists and conveyors will be operated by electricity. A. M. Kinsman, Baltimore, Md., is Chief Engineer of the company.

The Mahoning Water Co., Mahoning, O., has purchased 25 acres of land in the Squaw Creek Valley for the construction of the proposed reservoir in that locality.

The Cleveland, Cincinnati, Chicago & St. Louis Ry. Co. is planning improvements in Carey, O., necessitating an expenditure of about $30,000. The work includes the construction of a round house, turn table and new freight tracks.

The Fostoria, Napoleon & Defiance Ry. Co. has been incorporated with a capital stock of $10,000 and proposes the construction of an electric line through Seneca, Wood, Henry, Hancock and Defiance Counties. The incorporators of the company are W. S. Reece, R. T. Betts, George Schreck, Charles A. Ater and Charles A. Bliss.

Peter McCave, Greenford, O., is reported to be interested in the proposition to construct an electric railway from Salem, O., to Youngstown by way of New Albany, Green-

ford, Calla, Canfield and Lanterman's Falls, with a branch from a point near Gettysburg south to Washingtonville, Leetonia, Franklin Square and Shelton's Grove to Lisbon, O. The construction of a belt line at Salem is also under consideration by the promoters.

E. J. Landor, contractor for constructing the government dam at Ellis Station on the Muskigum River in Ohio, has suspended work for the winter. Work will be resumed about the last of April or the first of May.

Oklahoma Notes.

FROM CORRESPONDENTS AND OTHER SOURCES.

The Beaver Valley & Northwestern Ry. Co. has established general offices at Beaver, Okla. The company was chartered about two years ago to construct a line from Wichita, Kan., across Northern Oklahoma to New Mexico.

The Wichita Falls & Northwestern R. R. Co. is planning the construction of a line from Altus, Okla., to Wellington, Tex., by way of Hollis, Duke, Gibson and Wilkes. The company is also engaged in constructing a line across western Oklahoma. R. A. Thompson, Wichita Falls, Tex., is Chief Engineer of the company.

According to an announcement reported to have been made by J. H. Crouch, attorney of the recently incorporated Webber Falls, Shawnee & Western R. R. Co., surveys have been made from Checotah to Shawnee, Okla. The company which is capitalized at $100,000 proposes the construction of 105 miles of line from Webber Falls, Okla., to Shawnee, Okla., passing through the towns of Warner, Checotah, Weleetka, Wetumpka, and Shawnee. The Board of directors are as follows: A. R. Peyinghaus, Muskogee, Okla., general manager; J. F. Sparrow and J. B. Crouch, Porum, Okla.; O. L. Hayes, Webber Falls, Okla.; Campbell Russell, Warner, Okla.

The Oklahoma City Junction R. R. of Oklahoma City, Okla., has filed an amendment to its charter increasing its capital stock from $10,000 to $1,000,000.

Oregon Notes.

FROM CORRESPONDENTS AND OTHER SOURCES.

L. B. Wickersham, Portland, Ore., General Manager of the United Railways Co., has announced that the construction of the line between Portland and Forest Grove, a distance of 28 miles, will be completed by June, 1910. The company also plans the construction of a branch line to Hillsboro from Glencoe, a point on the main line now under construction.

The right of way is said to have been acquired for the construction of the proposed St. John-Troutdale line of the Oregon Railroad & Navigation Co., and construction work will be started in the spring. The proposed line is 16 miles in length and is estimated to cost $700,000. The new line is intended to be used as a second track entrance into Portland, Ore.

The Pacific & Eastern R. R. Co., William Gerig, Medford, Ore., Vice resident and Chief Engineer has under construction a 25-mile extension from Eagle Point to Butte Falls, and is said to be planning to run the road across the Cascade Range to a connection with the Oregon Short Line R. R. The work now under way is estimated to cost $400,000. The Concord Construction Co., of Portland, Ore., has filed articles of incorporation with the Secretary of State. The company has a capital stock of $10,000 and the incorporators are D. Madonna, D. Ragnone, N. Casciato and F. A. Bisotti.

Reports from Portland, Ore., state that a company has been formed and proposes the construction of a canal from Flores Lake in Curry County to the Pacific Ocean and equip it with locks and jetties, thus making the lake a harbor for all coastwise vessels.

United States District Attorney John McCourt, on the part of the government took judgment before Federal Judge Robert S. Bean, providing that the Wilson Irrigation Co. should tear down the partly constructed dam across the Umatilla River, which is alleged will divert the waters of the stream menacing the Umatilla irrigation project of the Reclamation Service, which is planned to irrigate 20,000 acres in the Umatilla County, Ore.

Contracts are to be let at once for the straightening of the Oregon Railway & Navigation Company's line between Pendleton, Ore., and Yoakum, a distance of 15 miles. G. W. Boschke, Portland, Ore., is the Chief Engineer of the company.

According to a statement reported to have been made by J. P. O'Brien, (Portland, Ore.) Vice President and General Manager of the Oregon Railway & Navigation Co., an expenditure of $1,020,000 has been authorized for straightening the line between Yoakum and Pendleton, Ore., a distance of 12½ miles. The work includes the construction of a 1,100 ft. tunnel through solid rock in order to eliminate the horseshoe curve and also the construction of two 300 ft. steel bridges over the Umatilla River. The 75-lb rails now in use on this section will be replaced with 90-lb stock. The line will be shortened 1.7 miles and will eliminate the 11,361 degrees of curvature and 48 ft. of adverse grades. Work will be started as soon as possible.

The Mount Hood R. R. Co. is contemplating the construction of a 75-mile line to connect with the Oregon Railroad & Nevigation Co. lines. Joseph W. West, Hood River, Ore., is Chief Engineer of the company.

The Rogue River Valley Ry. Co. has issued bonds amounting to $125,000 for the construction of a 9-mile extension between Jacksonville, Ore., and Ruch. W. H. Barnum, Jacksonville, Ore., is vice president of the company.

Pennsylvania Notes.

FROM CORRESPONDENTS AND OTHER SOURCES.

The Tuscarora Railroad Co. has been chartered at Harrisburg, Pa., with a capital stock of $450,000 and proposes the construction of a 45-mile line from Blair's Mills, Huntingdon County, to a point in Fulton County, Pa., where Licking Creek crosses the line between Pennsylvania and Maryland. The incorporators of the company are as follows: George L. Catlin and L. S. Catlin, Bridgeport, Conn.; L. S. Farlee, New York, N. Y.; M. G. Addison, New York, N. Y.; D. H. Patterson, Webster's Mills, Pa.; J. M. Blair, Blairs Mills, Pa.; N. H. Suloff, Rossfarm, Pa.; N. S. Ross, York, Pa.

The Philadelphia & Reading R. R. has let a contract to C. F. King & Co., for grading and masonry work for the construction of a fourth track from Perkiomen Junction to Phoenixville, Pa., a distance of 1½ miles.

The Pennsylvania R. R. has awarded James McGraw Co., Philadelphia, Pa., the contract for changing the present four-track through Bristol, to eliminate ten grade crossings and an undesirable curve. The work involves the construction of four tracks one and one-half miles long and 10 bridges.

The Pittsburg & Great Lakes Connecting Co., with offices at the Fulton Bldg., Pittsburg, Pa., was recently chartered and engineers are now making final surveys for the construction of 42 miles of road from Ellwood City to Raymilton, Pa., forming a connecting line between several trunk lines and shortening the distance between this city and northeastern points on the New York Central Lines. The new road will require the construction of two bridges and three tunnels, the latter being 400, 1,200 and 2,200 ft. long. The company has completed plans for the construction of 12 miles line connecting the Pittsburg & Western R. R. at Ellwood City with the Western Allegheny R. R. at Portersville and extension will ultimately be built to Grove City and Raymilton, connecting with the Bessemer & Lake Erie and the Lake Shore road.

The Renova & Gleasonton St. Ry. Co. has been chartered in Pennsylvania with a capital stock of $30,000 and proposes the construction and operation of a 5-mile trolley line in Clinton County, Pa. The Board of Directors of the company are as follows: R. V. Rogers and W. B. Reilly, Renova, Pa.; J. H. Crissman, Dubois, Pa.; L. W. Gleason, Gleasonton, Pa. E. W. Hess, Clearfield, Pa., is president of the company.

Tennessee Notes.

FROM CORRESPONDENTS AND OTHER SOURCES.

The Clarksdale, Covington & Collierville Interurban Ry. Co. has submitted an ordinance to the Board of Commissioners of the city of Memphis, Tenn., asking for a charter authorizing ten new routes in that city, including a cross town and belt line.

The stockholders of the Clarksville Ry. & Light Co. met Jan. 4 and reorganized the company and elected the following officers: N. L. Carney, President; L. E. Fischer, Danville, Ill., Vice President and Treasurer; George Burton, Peoria, Ill., Secretary; A. C. Murray, Assistant Secretary and General Manager. The new company contemplates a number of improvements including the construction of an extension of its lines to Dunbar's Cave and New Providence, Tenn.

Work has been resumed on the Memphis-Chattanooga R. R., a subsidiary company of the Southern Ry. Twenty miles of the road had been graded and all right of way secured when the work ceased in 1906. The line is projected from Stevenson, Ala., to Chattanooga, Tenn. W. H. Wells, Washington, D. C., is Chief Engineer of Construction for the Southern Ry.

The Central Construction Co., of Shelby County, Tenn., has been incorporated with a capital stock of $25,000. The incorporators are C. E. Terrell, H. P. Woods, C. B. Rutledg, T. A. Evans and G. T. Fitzhugh.

Texas Notes.

FROM CORRESPONDENTS AND OTHER SOURCES.

The St. Louis, Brownsville & Mexico R. R. Co., recently acquired by the (Frisco) St. Louis & San Francisco R. R. is planning an expenditure amounting to $25,000,000 for the construction of a line into Mexico and for branch lines in Texas. C. B. Rogers, Kingsville, Tex., is General Manager of the St. Louis, Brownsville & Mexico R. R. Co.

W. H. Denison, who has the heaviest contract on the Coleman-Texico Cutoff in Texas of the Santa Fe R. R., cutting down the cap rock, expects to finish work in about six months. The contract includes 3 miles and amounts to more than $200,000.

Judge R. G. Johnson, Chairman of the Board of Commissioners of the Fort Worth Improvement District No. 1, Fort Worth, Tex., announces that owing to a lack of funds bond issuance has been delayed and actual construction work will not be started before March 1.

A movement is on foot to reconstruct a reinforced concrete dam across the Colorado River at Austin, Tex. In 1900 a dam at this site was washed away. The structure was 1,275 ft. long and 67 ft. above bed rock.

The Rio Grande Construction Co. of Brownsville, Tex., has filed an amendment to its charter increasing its capital stock from $10,000 to $50,000.

Company is being formed for the construction of an immense dry dock at Fort Arthur, Tex. No plans has as yet been considered.

Mayor of Austin, Tex., is to take up the matter with the county commissioners of having plans and specifications prepared for the construction of a dyke on the south side of the river bridge. Bide for the work will be advertised later.

Directors of the proposed Brownwood North & South R. R. of Texas, proposes the construction of its line to May, Tex., providing that town subscribes $20,000 of bonds. Charter for the company has not yet been secured.

Surveys are now under way for the construction of the proposed railroad between Waco and Georgetown, Tex., by way of Belton. Joseph Goddard, Waco, Tex., County Surveyor and Judge Felt, Belton, Tex., are interested in the new project.

Surveys for the proposed Dallas-Terrell Interurban Ry. have been completed as far as Forney, Tex.

W. C. Carmile, of Dallas, Tex., is at the head of a movement to construct a 40-mile railroad from Pecos, Tex., to San Solomon Springs via Saragosa and Balmarshea to the head of Toyah Creek. Committees are now

securing subscriptions to the bonus fund necessary for the construction of the road.

Texas Central R. R. Co. is to extend its line from DeLeon to Rising Star and Cross Plains. Surveys have been made and grading will be started the latter part of January. C. H. Sharman, Waco, Tex., is Chief Engineer of the railroad.

A plan is under way involving the construction of a railroad from Gardendale, a station on the International & Great Northern R. R. to Brundage, Tex., in Dimmit County. J. R. Brown, Carrizo Springs, Tex., is reported to be interested in the project.

S. A. Robertson, San Benito, Tex., representing a syndicate of capitalists of St. Louis, Palestine and Pine Bluff, Ark., is promoting the construction of an interurban line from San Benito, Tex., to the Rio Grande. Preliminary surveys have already been made and all financial arrangements have been perfected and construction of the line will commence as soon as the property owners along the line sign bonus contracts. It is expected that about six months time will be required for the construction of the road.

The Abiline Central R. R. has been chartered with a capital stock of $150,000 and headquarters at Abiline, Tex., and proposes the construction of a railroad from Abiline southeasterly through the counties of Taylor, Callahan, Eastland, Brown, Commanche, Mills. Hamilton, Coryell and McLennan to Waco, Tex., a distance of 150 miles. The incorporators of the company are as follows: D. T. Bomar, Fort Worth, Tex.; Morgan Jones, Abiline, Tex.; John Guitar, J. M. Radford, Henry James, H. O. Wooten, C. W. Merchant, George L. Peyton, W. G. Swenson and Ed. S. Hughes, Abiline, Tex. The company is said to be subsidiary to the Colorado & Southern Ry.

The El Paso & Fort Hancock Ry. Co., capitalized at $100,000 to construct a railroad line from El Paso to Ysleta, Tex., a distance of 10 miles has succeeded in securinng subscriptions amounting to $55,000. C. N. Bassett, El Paso, Tex., is president of the company.

The James Black Masonry & Contracting Co. has been granted a permit to operate in Texas. The company is a St. Louis, Mo., firm and has a capital stock of $5,000. The Texas office is at Austin, Tex.

According to an estimate of F. U. Taylor, University of Tex., the proposed municipal dam across the Guadalupe River below the International & Great Northern Bridge in the city of New Braunfels, Tex., will cost the city $15,000. The work will require 1,900 cu. yds. of reinforced concrete.

The Galveston-Houston Electric Ry. Co., of Houston, Tex., has issued bonds amounting to $5,000,000 and will commence construction work on the proposed line from Galveston, Tex., to Houston, Tex., in a short time. The company has mortgaged its holdings in Texas to the City Trust Co., Boston, Mass., for $5,000,000.

Plans and specifications have been prepared by the Municipal Board of Commissioners of Dallas, Tex., for the construction of the proposed dam at White Rock reservoir site, and City Secretary is to call for bids for the work at once. As planned the dam will be 2,100 ft. long, 211 ft. wide at the base and 16 ft. wide at the top, and 42 ft. high, with a 450-ft. spillway two feet below the level of the dam. The upper face of the dam is to be of concrete to a distance half way the verticle depth of the dam and half the face, extending from end to end. The entire cost of the work is estimated at $750,000. Each bid is to be accompanied by a certified check for $5,000.

Virginia Notes.

FROM CORRESPONDENTS AND OTHER SOURCES.

The Gould interests are preparing to lay plans for the construction of an electric railroad from Norfolk, Va., to Washington, D. C. Permission was received from the legislature some years ago to construct a line from Washington, D. C. to Richmond, and plans to extend the line which almost parallels the Richmond, Fredericksburg & Potomac Ry., to Norfolk, are now under way. W. G. Whitney, Chief Engineer of the Gould interests is now busy making surveys for the new work.

Work on the Richmond & Chesapeake Bay R. R. will be started some time this year it is said. Surveyors under Cecil L. Reid, Fredericksburg, Va., are now in the field making locations for the proposed lines, one from Fredericksburg to Ashland and the other from Fredericksburg to Washington.

The Western Maryland R. R. Co. is reported to have necessary funds raised for the construction of the contemplated line from Cumberland, Md., to New Haven, Va., and construction work is to be started at once. H. R. Pratt, Baltimore, Md., is Chief Engineer of the company.

Washington Notes.

FROM CORRESPONDENTS AND OTHER SOURCES.

Residents of South Bend and Raymond, Wash., are taking steps to secure an appropriation of $250,000 from Congress for the purpose of dredging a channel 18 ft. deep from Willapa Harbor Bar to Raymond, Wash. Surveys for the proposed improvement were made last summer.

The new Valley Railroad & Power Company, recently incorporated, which is contemplating the construction of an electric railroad between Kent, Wash., Orillia, O'Brien and Renton, will place its stock on the market within a few weeks. Surveyors are now going over the proposed route to locate the line of the road. As soon as the engineers make their final estimate it is planned to capitalize the company, probably at $300,000. The officers of the company and original incorporators are: H. B. Madison, of Kent, president; Robert Bridges, of O'Brien, vice president; Isaac P. Calhoun, of Kent, Wash., secretary; Thomas Chapman, of O'Brien, Wash., treasurer; Lee Chapman, of Renton, Wash., auditor. A. T. West, of Seattle, who is manager of the Independent Telephone Company of the White River valley, is to be general manager.

The Construction Department of the Northern Pacific has turned over to the Operating Department, the entire double track on the division between Vancouver and Kalama, Wash.

Anacortes, Wash., City Council has granted E. G. English a franchise to construct a railroad through this city.

The Grand Trunk Pacific Dock Co., with a capital stock of $150,000 has been organized on the west coast. The first undertakings of the new company will be to construct new docks at Seattle, Wash., Victoria and additional docks at Prince Rupert. The officers are: President, Chas. M. Hays; vice-president, Capt. J. S. Gibson, of the McCabe and Hamilton Stevedoring Company; secretary-treasurer, Henry Philips, Montreal, Can.; assistant secretary, Somers Hayes Smith. The trustees are Mr. Chas. M. Hays, E. J. Chamberlain, Capt. J. S. Gibson, Somers Hays Smith and L. V. Druce.

Work is reported to be progressing very satisfactorily on the double track of the Northern Pacific and Oregon & Washington joint line between Tenino and Kalama, Wash. Winston Bros. & McDougal are the contractors.

The Chicago, Milwaukee & Puget Sound is reported to have recently closed a contract for the construction of an extension of the Tacoma & Eastern R. R., which is controlled by the former company. The T. & E. R. R. extends south from Tacoma, Wash., 50 miles to Glenavon, with a branch to Ashford. The new work will extend from Glenavon 20 miles south and is supposed to be the first step of the Milwaukee to enter Portland. John Bagley, Tacoma, Wash., is Vice President and General Manager of the Tacoma & Eastern R. R.

The Puget Sound & Baker Ry. Co., generally known as the English-Dempsey Logging Co., is to take steps immediately toward the extension of its line from Baker City to Anacortes, a distance of 25 miles. The company now operates about 25 miles of road. The route as projected will follow that of the Rockport Branch of the Great Northern R. R. for a part of the way.

The Couteau Power Co., Okanogan, Wash., is promoting a new railway project and asks the interested municipalities of White Valley to guarantee bonds to the extent of $2,000,000, supplementing $2,000,000 of British capital already in hand for construction. The proposed line is to extend from Enderby to Penticton and Summerland, Wash.

The Toppenish, Simcoe & Western R. R. Co. has surveys under way for the construction of its line to Goldendale, Wash., and contracts for grading the first 17 miles of line have already been let. The estimated cost of the work, which will include 80 miles of track, is $2,000,000. F. A. Williams, Toppenish, Wash., is interested.

The Northern Pacific Ry. Co. is reported to be planning the construction of improvements in the vicinity of Seattle, Wash., estimated to cost the company about $5,000,000. The work includes the encircling of Lake Union with a line and changing the main line between Ballard, a substation of Seattle, and Fremont. Under the franchise granted the company by the council a short time ago the new line will begin at Shilshole Ave., and West 45th St., and run to Eighth Ave. N. W. It will be a four-track line and changes the main line to new grades made necessary by the proposed canal. A. R. Cook, Tacoma, Wash., is Engineer of the Maintenance of Way.

The North Coast is reported to have started surveys for the construction of a line in Klickitat County in the vicinity of Camas Prairie, north of Bristol, Wash.

Articles of incorporation have been filed by the Woodland Water & Power Co., of Woodland, Wash. The company is capitalized at $50,000. The incorporators are S. A. Burns, E. L. Burns and G. K. Gilluly.

Wisconsin Notes.

FROM CORRESPONDENTS AND OTHER SOURCES.

A stock company with a capital of $25,000 was recently organized at Prairie Farm, Wis., and proposes the construction of a railroad from that place to a point on the Wisconsin Central division of the Minneapolis, St. Paul & Sault Ste. Marie R. R. The line as projected will pass through Graytown and Downing terminating at Glenwood or directly through to Emerald with a terminal at that point.

The Central Construction Co., according to reports, has been dissolved and Robert Wynn will, it is said, form a new company to take up the construction of the proposed road between Waukegan and Kenosha, Wis.

Surveys are being made for the construction of a railroad line between New Richmond, Wis., and Somerset. It is generally believed in this section of the country that the Minneapolis, St. Paul and Sault Ste. Marie R. R. Co. is planning to abandon its present line over the St. Croix River west of Somerset. Thomas Green, Minneapolis, Minn., is Chief Engineer of the company.

The Chicago & Northwestern has secured all right of way for the double track from West Allis to Clyman, Wis., a distance of 55 miles and grading will be started soon. The company also has under consideration plans for the construction of a belt line around Milwaukee, Wis. W. W. Gaffin, North Fon du Lac, Wis., is Division Engineer.

Right of way for the proposed line of the Maplehurst & Black River R. R. is completed from the Ladysmith branch of the Minneapolis, St. Paul & Sault Ste. Marie R. R. to Maplehurst, Wis., and work will be discontinued until March 1. The company expects to have 15 miles of the road in operation by Jan. 1, 1911.

Canadian Notes.

FROM CORRESPONDENTS AND OTHER SOURCES.

The Alberta & Great Waterways Ry. Co., mentioned in our issue of Jan. 12, which was recently incorproated to construct a line in Alberta, from Edmonton, a city on the great transcontinental railways, Canadian Pacific, Canadian Northern and Grand Trunk, almost

due north to a point near Fort McMurray, has final surveys under way. The Canada West Construction Co., Ltd., with B. R. Clarke, brother of W. R. Clark, President of the railroad company, at its head, has been formed to construct the line which will be 350 miles in length. W. R. Clarke, President, who secured subscriptions in France and England, amounting to $14,000,000 for the project, also contemplates running a packet line on the water way system, formed by the Athabasca River, the Peace River and the Mighty McKenzie and also Lake Athabasca and Great Slave Lake, totaling a 3,500 water way available six months of each year.

The British Columbia Ry. Co., Vancouver, B. C., has plans under way for the construction of about 100 miles of interurban line radiating from Vancouver, and for taking over and electrifying the Victoria & Sidney Ry. on Vancouver Island.

The International Waterways Committee have under consideration the application of the St. Lawrence Power Co., Ltd., and the Long Sault Developing Co., to construct power works in the Long Sault Rapids of the St. Lawrence River. The work proposed by these companies include the construction of a dam across the St. Lawrence river at the Long Sault Rapids. No action has as yet been taken. The Commission have also under consideration the advisability of constructing a dam across Lake Erie from Bird Island Pier to Fort Erie to maintain the level of the Lake.

E. F. Wheaton and George W. Mathews, Cleveland, O., are promoting the construction of an electric railway system radiating from Kalispell, Mont.

Surveys have been made for the construction of the Buffalo-Clearmont Ry., connecting Clearmont, Wyoming, on the north main line of the Burlington with Buffalo, Johnson County seat, a distance of 38 miles.

The Panama Railroad Co., G. W. Goethals, Culebra, Panama, President, and the Isthmian Canal Commission is considering the proposition of constructing a 274-mile railroad from the city of Panama to David. The material, including rolling stock and plant equipment will be second hand, furnished by the Isthmian Canal Commission.

Reports from Chihuahua, Mex., state that preliminaries are being arranged for the immediate construction of a large dam and hydro-electric plant on the Conchos River.

Greenville, Spartanburg & Anderson Ry. Co., with a minimum capital of $300,000 and a maximum capital of $2,000,000 has been incorporated with principal offices at Greenville, S. C., and proposes the construction of an electric line from Anderson to Spartanburg. The incorporators of the company are as follows: J. B. Duke, Somerville, N. J.; B. N. Duke, New York City; W. S. Lee, Charlotte; Ellison A. Smyth, Lewis W. Parker, W. J. Thachston and H. J. Haynsworth, Greenville, S. C.

The Carolina Traction Co. has been chartered with a capital stock of $150,000 and proposes the construction of an electric railway from Rock Hill to Charlotte, N. C., passing through York and Chester Counties in South Carolina and Mecklenburg county in North Carolina. The charter also includes the right to operate an electric line through the streets of Rock Hill, S. C. The principal offices of the company are located at Rock Hill, and the officers of the organization are as follows: J. M. Cherry, president; W. S. Lee, vice president; James S. White, secretary; J. M. Cherry, treasurer.

The Governor of Mississippi has issued a proclamation authorizing the formation of the Clarksdale & Lakeview Co. and the Clarksdale & Webb Co. with a capital stock of $2,500,000. The purpose of the enterprise is for continuing the construction of the line of the Lakeview Traction Company from Memphis to Clarksdale, and thence to Webb, where connection would be had with the North and South line of the Southern Railroad from Webb to Belzoni, on the Yazoo River. The incorporators of the company are R. F. Tate, W. A. Percy, of Memphis, Tenn.; A. Walsh, D. D. Saunders, R. M. Norfleet, W. B. Neohut, I. A. Dolan, J. J. Myers, J. W. Cutrer, F. I. Williams, Henry J. Davis, W. A. Alcorn W. B. Campbell, Earl Brewer, J. H. Johnson, W. A. Montroy, R. S. Alexander, Frank Trimble, W. M. Ball, R. T. Lamb, P. Clark, G. M. Roach, S. A. Withers, J. F. Withers, E. J. Mullens and T. H. McKenzie.

The Savannah Hydro-Electric Co., which recently moved its headquarters from Jacksonville to Savannah, Ga., is to have charge of the construction of a hydro electric plant on the Cannochee River near Savannah, which will according to estimates cost over $500,000. The officers of the company are as follows: S. K. Platshek, president; D. G. Zeigler, vice president and general manager; G. H. Miller, secretary and treasurer. All location surveys for the plant, which includes the construction of a large dam, have been made.

According to reports Alexis Shriver, president Baltimore & Belair Electric Co., Belair, Md., is interested in plans to construct an electric railway connecting Baltimore, Belair and Havre de Grace. The project would necessitate an expenditure of about $1,500,000.

United States Engineers have resumed work on the survey for the Florida Ship Canal. The survey has practically been completed from Apalchicola to a point on the Suwannee River near Brantford, Fla. The proposed route will follow the Suwannee River for several miles bordering the county line. At Brantford the route will take a southeasterly direction.

According to reports from Salt Lake City, Utah, 90 miles of track on the San Pedro, Los Angeles & Salt Lake R. R. have been washed away, causing a practical loss of about $14,000,000. Steps toward the reconstruction of the line will be taken immediately and it is expected that work will be completed by September. R. K. Brown, Salt Lake City, Utah, is Division Engineer Maintenance of Way.

BIDS ASKED.

Bids are asked on following work, the notes being arranged alphabetically by states:

Bridges.

Jacksonville, Fla.—Until 9:30 a. m., Jan. 21, by Board of County Commissioners, for furnishing necessary material and labor for the construction complete of three steel and concrete bridges. A certified check for $300 must be filed with each bid. Gail L. Barnard, Jacksonville, Fla., is County Engineer.

Bryan, O.—Until 11 a. m., Jan. 31, by R. H. Weaver, County Auditor, for the construction of one steel bridge. The estimated cost of the structure is $1,790. A certified check for 5 per cent the estimated cost must be filed with each bid.

Cleveland, O.—Until 11 a. m., Feb. 5, by Board of County Commissioners, for the construction of two bridges, one on the Coe Ridge Road, Rocky River Township, and the other on River Road, Rockport Township. John F. Goldenbogen is Clerk.

Columbus, O.—Until noon, Jan. 28, by Board of County Commissioners, for the construction of a new floor system on the Decker Bridge over Little Walnut Creek, on the Groveport and Lithopolis Pike, about 1 mile southeast of Groveport; on the Grandview Ave. bridge, over the Scioto River, in Franklin Township.

Antlers, Okla.—Until Jan. 22, by Board of County Commissioners, for the construction of two county bridges. W. D. Parks is County Clerk and H. A. Evans is Chairman of the Board of County Commissioners.

San Antonio, Tex.—Until noon, Jan. 20, by Board of County Commissioners, for the construction of a reinforced concrete arch bridge across the Medina River at the Pleasanton Road crossing. The structure is to consist of two 110-ft. spans and two 30-ft. spans with an 18-ft. roadway. It will require 850 cu. yds. of reinforced concrete and approximately 1,600 cu. yds. of rubble concrete. Thomas E. Ramsey is County Auditor.

Winnipeg, Man.—Until Jan. 22, by Chief Engineer, Canadian Pacific, Winnipeg, Man., for the construction of substructure of bridge over the Saskatchewan River at Outlook.

Buildings.

Bids are asked on following work, the notes being arranged alphabetically by states:

Hot Springs, Ark.—Until 12:30, Feb. 7, by Maj. G. D. Deshon, Constructing Quartermaster, for the construction, heating, plumbing, wiring and electric fixtures for two double sets of officers' quarters at the Army & Navy General Hospital.

Washington, D. C.—Until 11 a. m., Feb. 19, by Bureau of Yards and Docks, Navy Department, for the construction of three officers' quarters at the Navy Yard, Puget Sound, Wash.

Fort Barrancas, Fla.—Until 11 a. m., Jan. 28, by Constructing Quartermaster, for the construction, plumbing, heating and electric lighting of one double set of non-commissioned officers' quarters and one band kitchen at Fort Barrancas, Fla.

Louisville, Ky.—Until 3 p. m., Feb. 18, by James Knox Taylor, Supervising Architect, Treasury Department, Washington, D. C., for the construction, including plumbing, gas piping, heating apparatus, electric conduits and wiring, of the laundry and attendants' quarters, U. S. Marine Hospital, Louisville, Ky.

Jefferson Barracks, Mo.—Until 11 a. m., Jan. 25, by Capt. Stanley H. Ford, Constructing Quartermaster, for furnishing and installing the heating system in new additions and improvements to band barracks, building No. 66.

Fort Slocum, N. Y.—Until 10 a. m., Jan. 25, by Capt. Peter Murray, Constructing Quartermaster, for construction, plumbing and hot water heating in alterations to third floor of the post hospital at Fort Slocum, N. Y.

Henderson, N. C.—Until 3 p. m., Feb. 18 (extension of date from Jan. 17), by James Knox Taylor, Supervising Architect, Treasury Department, Washington, D. C., for the construction, including plumbing, gas piping, heating apparatus, electric conduits and wiring at the United States Post Office, Henderson, N. C.

Kenosha, Wis.—Until 10 a. m., Feb. 15, by Russell H. Jones, County Clerk, for the labor and materials for the construction of the proposed county jail at Kenosha County. Joseph Lindl, 312 Main St., Kenosha, Wis., is Architect.

Roads and Streets.

Bids are asked on following work, the notes being arranged alphabetically by states:

Fort Dade, Egmont, Fla.—Until 10 a. m., Jan. 26, by Constructing Quartermaster, for constructing granolithic walks at the Fort.

Creston, Ia.—Until 8 p. m., Jan. 25, by City Council, for about 25,000 sq. yds. of paving and 16,000 lin. ft. of curbing. J. F. Golden is City Clerk.

Anderson, Ind.—Until Jan. 25, by Board of County Commissioners, for street improvement in Pipe Creek Township, in Elwood.

Princess Anne, Md.—Until noon, Feb. 1, by Board of County Commissioners, for improving the public highway between Pocomoke and Dividing Creek, known as the River road. The work includes the grading and macadamizing of 1.2 miles of road. L. N. Whitcraft is Roads Engineer.

Jefferson Barracks, Mo.—Until 11 a. m., Feb. 5, by Capt. Stanley H. Ford, Quartermaster, for the construction of roads, walks, etc., at Jefferson Barracks, Mo.

Lincoln, Neb.—Until 1 p. m., Jan. 29, by Roscoe C. Ozman, City Clerk, for grading, paving and curbing of the roadway in Paving Districts Nos. 53, 55, 66, 139 and 148. The work includes 13,883 of asphalt pavement, 2,482 sq. yds. of brick pavement, 4,852 cu. yds. of extra excavation, 1,153 lin. ft. of concrete curb and 8,254 lin. ft. of concrete curb and gutter.

Raleigh, N. C.—Until noon, Feb. 2, by William W. Willson, City Clerk, for approximately 25,000 sq. yds. of brick pavement to be placed on Fayetteville and other streets. A certified check for $500 must accompany each bid. R. B. Seawell is City Engineer.

Cincinnati, O.—Until noon, Jan. 28, by Board of County Commissioners, for the improvement of Bramble Ave., from Central Ave. to Plainville Pike, in Columbia Township. Fred Driehs is Clerk of the Board.

Charleston, S. C.—Until 11 a. m., Jan. 29, by Bureau of Yards and Docks, Navy Department, Washington, D. C., for road paving in the Navy Yard at Charleston, S. C. William M. Smith is Acting Chief of the Bureau.

Norfolk, Va.—Until noon, Feb. 8, by Board of Control, for regulating and repaving with some smooth material parts of Granby and Chapel Sts. W. T. Brooke is City Engineer. Official advertisement of the work will be found elsewhere in this issue.

Spokane, Wash.—Until 2 p. m., Feb. 1, by Board of Public Works, for furnishing and erecting of a municipal asphalt paving plant for the city of Spokane, Wash. George W. Armstrong is Secretary of the Board of Public Works.

Sewers.

Bids are asked on following work, the notes being arranged alphabetically by states:

Anniston, Ala.—Until 11 a. m., Jan. 26, by City Clerk, for the construction of a certain sanitary sewer in the city. The work includes 10,000 lin. ft. of 8-in. terra cotta pipe, 1,000 ft. of 10-in. terra cotta pipe, 2,500 lin. ft. of 12-in. terra cotta pipe, 3,200 ft. of 15-in. terra cotta pipe, 50 manholes, 4 flush tanks. J. L. Winkle is Mayor.

Fort Wayne, Ind.—Until 7:30 p. m., Jan. 27, by Board of Public Works, for the construction of a local sewer in several streets and alleys. H. W. Becker is Clerk of the Board.

Baltimore, Md.—Until 11 a. m., Feb. 9, by Board of Awards, Baltimore, Md., for the construction of power house, pump house and land conduits, sanitary contract No. 46; underwater discharge conduits, contract No. 47; lateral sewers in district No. 19-B, sanitary contract No. 48; lateral sewers in district No. 35, sanitary contract No. 49; storm water drains, storm water contract No. 9. George N. Numsen is President of the Board of Awards.

Watertown, N. Y.—Until 8 p. m., Jan. 21, by Board of Public Works, for the construction of an 8-in. sanitary tile sewer in Grand Ave. for a distance of about 600 ft. south of Salina St. E. W. Sayles is City Engineer.

Provo, Utah.—Until 4 p. m., Jan. 24, by City Engineer, for the construction of a 1,234-ft. 24-in. outfall sewer. The work is estimated to cost $4,296. E. A. Jacob is City Engineer.

Provo, Utah.—Until 4 p. m., Jan. 24, by E. A. Jacob, City Engineer, for building 55,083 lin. ft. of sewers in Sewer District No. 12. The work is estimated to cost $73,610.

Water Supply.

Bids are asked on following work, the notes being arranged alphabetically by states:

Washington, D. C.—Until noon, Jan. 24, by the Commissioners of District of Columbia, for installing a water supply system in the Congress Height School. Henry B. MacFarland is one of the Commissioners.

Burlington, Ia.—Until 2 p. m., Feb. 2, by Board of County Supervisors, for furnishing and erecting complete pumping station, including the buildings and machinery. Harman Engineering Co., Peoria, Ill., are the Engineers. Official advertisement found elsewhere in this issue.

Hastings, Neb.—Until Jan. 24, by City Council, for the construction of a new well at the city pumping plant.

New York, N. Y.—Until 11 a. m., Jan. 25, by Commissioner of the Board of Water Supply, New York, for Contract No. 54 of the Catskill Aqueduct, for the construction of a portion of the Yonkers siphon, a deep pressure tunnel 16 ft. 7 in. inside diameter and about 2 miles long. The work is located in the City of Yonkers about 1½ miles from Mt. Vernon Station on the Harlem division of the New York Central & Hudson River R. R.

Miscellaneous.

Bids are asked on following work, the notes being arranged alphabetically by states:

Baltimore, Md.—Athletic Field.—Until 11 a. m., Jan. 26, by Board of Park Commissioners, Baltimore, Md., for the construction of an athletic field in Carrol Park.

Materials, Machines, Supplies, Etc.

Bids are asked on following work, the notes being arranged alphabetically by states:

New London, Conn.—Cable.—Until noon, Feb. 5, by Lieut.-Col. Harry Taylor, U. S. Engineer, New London, Conn., for furnishing insulated cable.

Washington, D. C.—Dynamite, Blasting Caps, Fuses, Etc.—Until 3 p. m., Jan. 24, by Capt. F. C. Boggs, General Purchasing Officer Isthmian Canal Commission, for furnishing dynamite, blasting caps and fuses.

Washington, D. C.—Pipe Fittings.—Until Jan. 19, by Capt. F. C. Boggs, General Purchasing Officer, Isthmian Canal Commission, for furnishing 6 copper L's, 3 copper T's, 7 12-ft. lengths of 10-in. cast iron pipe, 4-12-in. two cast iron bends, nine cast iron L's, one double Y.

Washington, D. C.—Dump Cars.—Until 10:30 a. m., Jan. 25, by Capt. F. C. Boggs, General Purchasing Officer Isthmian Canal Commission, Washington, D. C., for all-metal 12-yd. dump cars.

Washington, D. C.—Wire and Cable.—Until noon, Jan. 19, by Capt. C. F. T. Chandler, Captain Signal Corps, Office Chief Signal Officer, Washington, D. C., for furnishing wire and cable.

Washington, D. C.—Wrecking Crane, Steel Castings, Etc.—Until 10:30 a. m., Jan. 28, by Capt. F. C. Boggs, General Purchasing Officer, Isthmian Canal Commission, for furnishing under Canal Circular 554, wrecking crane, steel castings, steel, iron, bronze, brass, copper, wire bolts, nuts, rivets, screws, nails, steel tubing, boiler tubes, pipe and fittings, steam separator, valves, cocks, hose clamps and couplings, steam gauges, hand suction pumps, ratchet drills, taps, bitts, chisels, chain blocks, tube expanders, bolt clippers, turnbuckles, trowels, rail tongs, saws, lawn mowers, oil filters, water coolers, coal baskets, oilstones, night latches, rules, hose, rubber valves, leather belting, sandpaper, emery cloth, sheeting, sponges, lumber, etc.

Jeffersonville, Ind.—Quartermaster's Supplies.—Until 10 a. m., Jan. 20, by Maj. J. T. Davidson, Depot Quartermaster, for furnishing miscellaneous quartermaster's supplies for replenishment of stock.

Jefferson, Ind.—Pans, Parafine, Oil, Etc.—Until Jan. 19, by Maj. J. T. Davidson, Depot Quartermaster, for furnishing under Circular 504, pans, parafine, oil, cushions, couplings, linch pins, wheels and oil.

St. Paul, Minn. — Hardware, Pipe Fittings, Batteries, Etc.—Until 10 a. m., Jan. 20, by Chief Quartermaster, Department of Dakota, St. Paul, Minn., for furnishing and delivering at the army building the following: 100 galvanized iron coal scuttles, 60 Columbia dry batteries, 2,000 carriage bolts, 36 Fuller balls for hot water, 36 for cold water, 36 elbows with unions, 24 do female, 1,400 gas hooks, 50 lbs. tinned straps.

Walter, Okla.—Pipe, Poles, Etc.—Until Jan. 24, by Board of Trustees, for furnishing 27,000 lin. ft. of sewer pipe, 37,000 ft. of cast iron pipe, 5 miles pole line equipment and arch and tungsten street lights. O'Neil Engineering Co., Dallas, Tex., are Engineers for the work.

Philadelphia, Pa.—Machinery.—Until 10 a. m., Jan. 20, by Commanding Officer, Frankford Arsenal, for furnishing two 2-in. Cleveland new model automatic turret machines, two Brown & Sharp's automatic screw machines, No. 0, and one Thwing portable promoter.

Fort Sam Houston, Tex.—Repair Supplies.—Until Jan. 20, by Capt. F. H. Gallup, Quartermaster, for furnishing repairs to shower anti-scalding valves No. 4 the following: 2 doz. bodies, 2 doz. caps, 6 doz. cocks, 24 doz. lead packing, 4 doz. lower valves, 12 doz. locknuts, 24 doz. packing washers., 4 doz. packing nuts, 24 doz. packing washers, 24 doz. set screws, 12 doz. springs, 2 doz. spindles, 2 doz. stuffing nuts for repairs to lavatories, 1 gross bolts, brass, 10 doz. street elbows, 1 gal. glycerine, 25 lbs. litharge, 10 doz. nipples, 12 doz. nipples, 50 nickel nipples, 50 pipe supporters, 6 doz. pipe hangers, 10 doz. compression stops and 5 doz. tees.

Bangkok, Siam.—Cast Iron Pipe.—At once, by the Minister of Local Government, Bangkok, Siam, for the supply of cast iron pipes and accessories for the water supply of the city of Bangkok. Official advertisement will be found elsewhere in this issue.

CONTRACTS LET.

The following contracts have been let recently:

BRIDGES.

Murfreesboro, Ark.—Bridges.—Memphis Bridge Co., at $16,000, for the construction of two steel bridges, one across the Murfreesboro river at Murfreesboro and one over the Caddo river at Glennwood, both in Pike County. Bids were opened Jan. 11.

Madera, Cal.—Bridge.—Pacific Construction Co., at $4,290, for the construction of the Berenda Slough bridge.

Merced, Cal.—Bridge.—Western Bridge & Construction Co., 5 Ochsner Bldg., Sacramento, Cal., at $14,263, for the construction of a steel bridge across the Merced River on the Stevinson Colony and Merced River Road in Road District No. 4. Bids were opened Jan. 4.

Clayton, Ill.—Bridge.—C. A. Wever & Son, at $440, for the construction of a bridge at the South Side Cemetery.

Indianapolis, Ind.—Bridge.—American Construction Co., at $4,400, for the construction of a reinforced concrete, stone-faced bridge over Pogue's Run at Commerce Ave.

Creston, Ia.—Bridge.—Standard Bridge Co., Omaha, Neb., for the construction of county bridges during 1910.

Saginaw, Mich. — Bridge. — Central States Bridge Co., Indianapolis, at $23,200, for the construction of a bridge across the Tittabawassee River on the line of State St., extended. The bridge will be a steel trussed bridge with concrete floor and will have a carrying capacity of 100 lbs. to the sq. ft. The floor will be 18 ft. wide in the clear. The contract for the fill from the end of State St., to high ground on the west side of the river was awarded to Albert Reed, Midland, at $.17¾ per cu. yd. Work estimated to cost $5,600.

Meridian, Miss.—Bridge.—B. E. Ratchiff, Lauderdale, R. F. D., Miss., at $475, for the construction of a wooden bridge across Big Reed Creek on DeKalb and Lauderdale Road near Mosby's old mill. Bids were opened Jan. 3.

Geneva, Neb.—Bridges.—Standard Bridge Co., Omaha, Neb., for furnishing all necessary labor and material for the construction of all county bridges during the ensuing year.

Nebraska City, Neb.—Bridge—H. F. Ward & Co., for the construction of all county bridges during the year 1910. Bids were opened Jan. 11.

Chillicothe, O.—Bridge.—E. G. Nave & Co., Portsmouth, O., for the construction of a steel bridge at this place for the Norfolk and Western Railroad.

Brookings, S. Dak.—Bridges.—Iowa Bridge Co. for the construction of all bridges during the year 1910. Bids were opened Jan. 5.

Wenatchee, Wash.—Bridge.—E. E. Davisson, Seattle, Wash., at $12,399, for the construction of the new bridge across the Chelan River connecting Chelan and Lakeside.

ROADS AND STREETS.

Little Rock, Ark.—Paving.—D. L. Cook, of this city, at $13,068, for paving West 8th St. improvement district with macadam with asphalt binder.

Long Beach, Cal.—Paving.—Board of Public Works has awarded the following contracts for street paving: C. W. Brashear, Hellman Bldg., Los Angeles, at $20,276, for paving Appleton St., at $13,019, Railway St. West, at $32,154, American Ave.; Fairchild-Gilmore-Wilton Co., Pacific Electric Bldg., Los Angeles, at $17,721, for paving Railway St., east; C. H. White, at $40,086, for paving Linden Ave., at $1,152, for paving Kennebec St.

Oakland, Cal.—Paving.—Ransome Crummey Co., for paving Broadway between 19th St. and Piedmont Ave. with asphalt under a private contract.

Fort Mason, P. O. San Francisco, Cal.—Road.—Following bids were opened Jan. 6 at the office of the constructing quartermaster, for the construction of a supply road at Presidio of San Francisco: Buena Vista Improvement Co., 1st National Bank Bldg., San Francisco, Cal., $2,790; D. O. Church, 109 Montgomery St., San Francisco, Cal., $1,590; C. Cochill, 1309 Octavia St., San Francisco, Cal., $2,300; Peter McHugh, 307 Humboldt Bank Bldg., San Francisco, Cal., $1,645; Healy, Tibbitts Construction Co., 268 Market St., San Francisco, Cal., $2,840; Pringle, Dunn & Co., 338 Pine St., San Francisco, Cal., $1,240; P. Montague, 49 Guerrero St., San Francisco, Cal., $1,400.

Davenport, Ia.—Paving.—McCarthy Improvement Co., for paving 25,000 yds. with brick and 10,000 yds. with asphalt in this city.

Winnetka, Ill.—Street Improvements.—James Capre & Sons, Racine, Wis., at $20,000, for street improvements in this city.

Lafayette, La.—Cement Walk.—West Construction Co., Chattanooga, Tenn., for laying cement sidewalks in the city.

New Bern, N. C.—Paving.—Bone & Page, at $1.43, for paving about 48,000 sq. yds of street with brick, cement filler; brick, sand filler; bitulithic and asphalt macadam. Bids were opened Jan. 4.

Winston, N. C.—Paving.—Atlantic Bitulithic Co., Mutual Bldg., Richmond, Va., for constructing 6,700 sq. yds. of bithulithic pavement.

Fulton, N. Y.—Paving.—J. A. Fitch, of this city, at $9,055, for paving portions of North First St.

New York, N. Y.—Filling and Grading.—Frank J. Gallagher, 90 Park Place, Brooklyn, N. Y., at $9,740, for furnishing all necessary labor and material required for filling and grading at Coney Island Hospital site on Ocean Park. Bids were opened Dec. 21.

Schenectady, N. Y.—Paving.—Union Paving Co., 525 State St., this city, at $2.20 per sq. yd., for asphalt and $2.42 for brick, for paving Altamont Ave.

Columbus, O.—Paving.—William H. Luchenburg & Co., at $32,472, for paving Wyandotte with Trimble block; Geigler & Garns, at $9,176, for paving Centner Ave.; Budd & Bortling, at $5,400, for paving Ninth St.; Harry Shaw, Outlook Bldg., at $9,896, for paving Scioto St., and at $5,870, for paving Wesley Ave.

Elk City, Okla.—Paving.—Southwestern Construction Co., Muskogee, Okla., at $82,236, for the construction of 20 blocks of vitrified brick pavement, including grading, storm sewer, curbing, guttering, etc. Bids were opened Jan. 10.

El Paso, Tex.—Paving.—Texas Bitulithic Co., Dallas, Tex., for the construction of 9,170 sq. yds. of bitulithic pavement on South Oregon St.

Wharton, Tex.—Cement Walks.—Edward Carson, of this city, at $3,400, for the construction of cement sidewalks and concrete work on street improvements.

Spokane, Wash.—Curb & Sidewalks.—Massie & McKay, at $950, for curbing and sidewalking Highland Ave.

Spokane, Wash.—Sidewalks.—Naylor & Narlin, at $15,890, for grading and constructing sidewalks on a portion of Bernard St.

SEWERS AND WATER SUPPLY

Whittier, Cal.—Septic Tank and Sewer.—M. L. Hostetter, of this city, for the construction of septic tank and four miles of outfall sewer.

Shenandoah, Ia.—Sewers.—Charles A. Hamilton, of this city, for the construction of vitrified pipe sewers in portions of Sunmit and Eighth Aves.

Holton, Kan.—Sewer System.—J. M. Keras, 636 S. Washington St., Denver, Colo., at $41,366, for the construction of a sewer system in this city. Bids were opened Jan. 12.

Louisville, Ky.—Sewerage System.—C. T. McCracken & Co., Columbus, O., at $35,000, for the construction of a sewerage system on Jane St., to be known as the Jane St. sewer.

Louisville, Ky.—Sewer.—Guild & Co., Chattanooga, Tenn., at $32,355, for the construction of the 21st St. sewer, Contract No. 58. Bids were opened Dec. 17.

Lincoln, Neb.—Reinforced Concrete Conduit.—C. D. Campbell, Lincoln, Neb., at $39,900, for the construction of a reinforced concrete conduit. The work includes 800 ft. of 10-in. by 20-in. reinforced concrete sewer. Bids were received Dec. 27.

New York, N. Y.—Aqueduct.—The following bids were received Dec. 16, by the Board of Water Supply of New York City for contract 53—construction of grassy sprain cut and cover, Platt Ave., siphon and portions of Ardsley cut and cover—Catskill aqueduct, (1) standing for the Elmore & Hamilton Contracting Co., Albany, N. Y. (awarded contract); (2) for F. V. Smith Contracting Co., 125th St. and Lexington Ave., New York City; (3) for David Peoples, Betz Bldg., Philadelphia, Pa.; (4) for James M. Rodgers, 303 West 89th St., and John J. Hagerty, 56 Lexon Road, Flatbush, New York City; (5) for the Pittsburg Contracting Co., 1942 Forbes St., Pittsburg, Pa.; (6) for Smith, Hannan, Hickey & Co., Memphis, Tenn., and St. Louis, Mo.; (7) for Foye-Root Co., 20 Broad St., New York City; (8) for Patrick McGovern, 6 Beacon St., Boston, Mass.; (9) for Pennell, O'Hearn & Co., 3 Palisade Ave., Yonkers, N. Y., and (10) for the average of the bids:

Description.	Unit.	Quantity.	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
Removal of top-soil	cu. yd.	70,000	$0.45	$0.50	$0.40	$0.40	$0.40	$0.50	$0.80	$0.55	$0.60	$0.51
Open-cut excav., Type A, Stas. 407-433, 450-457, and 515-521.	cu. yd.	97,000	.45	.55	.58	.59	1.00	.82	.70	.85	1.50	.78
Open-cut excav., Type B, Stations 433-450, 457-464, 572 + 70 to 581	cu. yd.	80,000	.60	.68	.70	.65	1.00	.82	.80	.90	1.27	.82½
Open-cut excavation, Station 464 to Station 483, Type A..	cu. yd.	34,000	.75	.90	1.35	1.21	1.00	.82	1.10	1.75	1.50	1.15¼
Open-cut excav., Type B. Stas. 483-515 and 521-559 + 15.....	cu. yd.	90,000	.45	.62	.58	.52	1.00	.82	.75	.95	.75	.71½
Open-cut excav., Type A, Stations 581-522 and 631-666 + 55	cu. yd.	100,000	.90	.95	1.35	1.33	1.00	.82	1.10	1.88	1.80	1.23½
Open-cut excavation, Station 622 to Station 631, Type A..	cu. yd.	26,000	1.00	1.12	1.39	1.63	1.00	.82	1.20	1.90	2.00	1.34
Refilling and embanking Stations 407-433, 450-457 and 515-521	cu. yd.	67,000	.25	.27	.25	.28	.25	.25	.35	.25	.25	.26¾
Refilling and embanking, Stations 433-450, 457-464 and 572 + 70-581	cu. yd.	67,000	.28	.27	.25	.28	.25	.25	.35	.25	.25	.27
Refilling and embanking Station 464 to Station 483.....	cu. yd.	27,000	.30	.27	.35	.28	.25	.25	.50	.25	.25	.30
Refilling and embanking, Stations 483-515 and 521-559 + 15	cu. yd.	87,000	.25	.27	.30	.28	.25	.25	.35	.25	.25	.27
Refilling and embanking, Stations 581-622 and 631-666 + 55	cu. yd.	114,000	.35	.27	.40	.28	.25	.25	.50	.25	.30	.31¾
Refilling and embanking, Station 622 to Station 631.....	cu. yd.	8,000	.40	.27	.40	.28	.25	.25	.50	.25	.40	.33
Surface dressing and grassing.	cu. yd.	70,000	.50	.50	.50	.50	.40	.60	.60	.50	.45	.50½
Concrete masonry for aqueduct in open cut and on embankment	cu. yd.	115,000	5.25	5.25	5.00	5.25	5.50	6.50	6.00	5.00	5.80	5.50½
Concrete masonry for culverts, retaining-walls, etc.	cu. yd.	4,000	8.00	8.00	5.60	6.00	7.00	7.00	7.00	6.00	7.00	6.84½
Reinforced concrete	cu. yd.	800	10.00	15.00	9.00	12.00	12.00	8.00	12.00	6.00	10.00	10.44½
Rubble masonry and paving in mortar	cu. yd.	100	5.00	4.00	4.50	5.00	3.00	5.00	5.00	2.00	5.00	4.28
Dry rubble masonry and paving	cu. yd.	2,000	2.75	2.50	3.00	2.50	3.00	3.50	3.00	2.00	3.00	2.08½
Sand, gravel and broken stone.	cu. yd.	2,500	1.50	2.00	2.00	2.50	3.00	2.25	2.50	2.00	2.25	2.22
Surfacing macadam roads.....	cu. yd.	3,500	3.50	3.00	4.00	3.00	3.00	3.00	4.00	2.50	3.00	3.22
Sluice-gates and gate-valves for permanent works	gate or valve	6	100.00	100.00	100.00	100.00	100.00	75.00	90.00	100.00	200.00	107.22
Gates and valves for works of sanitation	gate or valve	20	55.00	50.00	50.00	50.00	25.00	25.00	12.00	100.00	1.50	40.94½
Cast-iron pipe and special pipe castings	ton	6	90.00	100.00	100.00	100.00	100.00	100.00	100.00	75.00	100.00	96.11
Tile pipe, 6 inches or less in diameter	lin. ft.	6,000	.60	.40	.25	.50	.25	.40	.50	.20	.50	.40
Tile pipe, 8 in. to 12 in. inclusive in diameter.....	lin. ft.	1,000	.90	1.00	.75	1.00	.35	.60	.75	.40	1.00	.75
Tile pipe, larger than 12 in. and not over 18 in. in diameter	lin. ft.	300	1.20	1.50	1.50	2.00	.75	1.00	1.25	.75	1.50	1.27
Timber and lumber.....	M. ft. B. M.	310	60.00	5.00	50.00	70.00	50.00	60.00	60.00	40.00	67.00	51.33
Testing portions of aqueduct..	portion	6	750.00	900.00	700.00	500.00	250.00	500.00	600.00	800.00	500.00	611.11
Testing portions of aqueduct exceeding 200 ft. in length..	lin. ft. of exc.	1,500	2.00	1.60	2.00	2.50	5.00	3.00	3.00	3.00	1.00	2.56¾
Portland cement	barrel	160,000	1.60	1.70	1.60	1.60	1.60	1.50	1.50	2.00	2.00	1.68
Stone boundary walls.....	lin. ft.	50,000	1.00	.90	1.25	1.00	1.00	1.00	1.00	1.75	1.75	1.18
Wooden fences and guard-rails.	lin. ft.	15,000	.30	.40	.40	.40	.40	.40	.30	.25	.40	.36
Man-proof fence	lin. ft.	15,000	.40	.60	.70	1.00	.60	.75	.75	.30	.75	.65
Steel for reinforcing concrete...	pound	250,000	.04	.04	.04	.04	.03	.04	.05	.05	.06	.04¼
Cast-iron, wrought iron and steel	pound	25,000	.06	.06	.07	.06	.10	.08	.07	.05	.09	.07
Bronze	pound	2,000	.60	.60	.70	.75	1.00	.60	.60	.50	.60	.66
Galvanizing	pound	8,000	.03	.02	.06	.05	.05	.05	.05	.05	.10	.05
Poles and other supports for telephone system	mile	8	200.00	600.00	400.00	200.00	300.00	250.00	250.00	212.06	1,500.00	434.66¾
Conductors and their appurtenances for telephone system..	mile	40	30.00	75.00	100.00	150.00	100.00	100.00	100.00	225.00	300.00	131.11
Installing and maintaining tel. inst. and devices furnished by city	instrument	7	50.00	25.00	150.00	860.00	100.00	50.00	50.00	100.00	30.00	157.22
Cleaning up	lump sum		5,000.00	1,000.00	4,000.00	5,000.00	5,000.00	1,000.00	1,000.00	5,000.00	1,000.00	3,111.11
Totals			$1,485,150	$1,526,055	$1,580,880	$1,593,020	$1,643,675	$1,684,315	$1,743,355	$1,798,471	$1,996,885	

Time required: 42 months. Bond, $370,000.

Bradford, O.—Water Works Plant.—Larkin Bros., Dayton, O., at $25,000, for the construction of a water works system.

Dayton, O.—Sewer.—Backus Construction Co., 950 Reibold Bldg., Dayton, for the construction of a 36-in. reinforced concrete by-pass sewer, from the east side drain along the north side of the levee to the Longworth St. pumping station. The work includes 390 lin. ft. of 36-in. reinforced concrete sewer, 7-in. shell. Bids were opened Dec. 30.

East Liverpool, O.—Filters.—Sand & Gravel Co. of this city, at $59,963, for constructing a system of mechanical filters, reinforced concrete subsiding basin, laying cast iron water pipe and constructing filter house.

Chickasha, Okla.—Laying Water Pipe.—C. P. Hollingsworth of this city, at $8,369, for laying 60,928 lin. ft. of 6-in. and 4,610 ft. of 8-in. cast iron water pipe.

Oklahoma City, Okla.—Sewer.—T. J. Mayfield, at $16,000, for the construction of two sections of the Deep Fork Sanitary Sewer. Derr Construction Co., for the construction of the third section.

Oklahoma City, Okla.—Sewers.—City Council has awarded the following contracts for the construction of sewers: McCreedie Co., at $15,762, sewers in Jordan Place, Oak Park, etc.; J. O. Severns, at $22,000, Culbertson's East Highland District; J. O. Severns, at $4,900, Blocks 10, 11, 12, etc.; McCreedie Co., at $11,523, Blocks 2, 7, 22, 27, etc.; J. O. Severns, at $17,010, Putnam Heights and Military Park.

Dallas, Tex.—Sewers.—Dallas Home Improvement Co., at 40 cents per lin. ft. and $5.50 for specials, for the reconstruction of certain sewers in Jackson St., near Austin.

Spokane, Wash.—Sewer.—Kleffner & Quaring, at $20,950, for the construction of the First Ward trunk sewer.

Vancouver, Wash.—Sewers.—Sewers Cascades Contract Co., at $17,151, for the construction of sewers in Grant, Harney, Ingalls and Jefferson Sts.

Milwaukee, Wis.—Sewer.—G. E. Zimmerman, Milwaukee, Wis., at $14.74 per lin. ft., for the construction of a concrete relief sewer on Brown St., from 26th to 30th Sts. The work will cost about $18,793, and will be 1,275 ft. long.

Cobourg, Ont.—Drain.—Samuel Cann, at 80 cents per ft., for the installation of 2,050 ft. of 8-in. vitrified tile drain. Bids were opened Dec. 12.

EXCAVATION, MISCELLANEOUS, MATERIALS.

New London, Conn.—Rebuilding Wharf.—Schwiers & Sutton Co., 90 West St., New York, N. Y., at $2,937, were the lowest bidders for the rebuilding of the timber wharf at Fort Mansfield, R. I. The work includes the rebuilding of approximately 190 ft. of runway to wharf. Bids were opened Jan. 10.

Washington, D. C.—Wire.—Bay State Insulated Wire & Cable Co., Boston, Mass., at $33 per thousand ft. for furnishing 150,000 ft. of outside twisted pair wire for the signal corps, U. S. army. Wire must be delivered within 14 days. Bids were opened Jan. 3.

Columbus, Ga.—Sewer Pipe.—E. Philips & Son for furnishing the city with sewer pipe for the year 1910.

Nevada, Ia.—Drains.—Morse & Houghsted, Nevada, Ia., at $18,501, for furnishing all necessary labor and material for the construction of county drains in District No. 20. The work includes 7 miles of 8-in. to 20-in. tile drain. Bids were opened Jan. 14.

Gary, Ind.—Building.—American Bridge Co., Pittsburg, Pa., for the erection of steel frame buildings which will cover 100 sheet mills and 100 tin plate mills, an office structure, tinning house, open-hearth department and an extensive galvanizing department for the new sheet and tin plate plant of the American Sheet & Tin Plate Co. Construction work will begin during the early part of the spring.

Jeffersonville, Ind.—Sanitary Carts.—Geo. H. Holzbog, Jeffersonville, Ind., for furnishing the office of the depot quartermaster sanitary carts, at prices as follows: Five 4 wheel, 2 horse, for all, $1,340; 10, 2 wheel, 1 horse, for all, $2,000.

Cawker City, Kan.—Pipe Line and Pump.—T. C. Brooks Sons Co., Jackson, Mich., at $15,764, for furnishing all necessary material and labor for the installation of a pipe line and pump.

The work includes the following approximate quantities: 7,050 ft. 6-in. and 15,580 ft. of 4-in. cast iron pipe; 2,250 ft. of 2-in. galv. iron pipe; 28 hydrants, etc., one 75,000 gal. tank on 125 tower, foundation, triplex pump and powerhead, etc. Des Moines Bridge & Iron Co., at $4,350, for the construction of sewer and tank.

Detroit, Mich.—Building.—The Carey Construction Co., 209-211 Lennox Bldg., Cleveland, O., at $100,000 for the construction of the Healy bldg., Woodward Ave., Detroit. Pastle & Mahler, Architects, 1732 Marquette Bldg., Chicago, Ill.

Minneapolis, Minn.—Cast Iron Pipe.—Sheffield Cast Iron Pipe & Foundry Co., Sheffield, Ala., at $26.50 per ton, for furnishing 2,600 tons of cast iron pipe for use during 1910. Crown Iron Works, Minneapolis, Minn., at $53.50 per ton, for furnishing 100 tons special castings. Bids were opened Dec. 17.

Vicksburg, Miss.—Dry Dock.—Following bids were received Jan. 5 by Capt. Clarke S. Smith, Corps of Engineers, U. S. Army, for the construction and delivery of a steel floating dry dock: American Bridge Co., of New York, Frick Bldg., Pittsburg, Pa., at $45,000, $45,000, $43,000 and $39,000; The Springfield Boiler & Mfg. Co., Springfield, Ill., at $40,400, $42,250; The Johnson Iron Works, Ltd., 1412 Duffosort St., New Orleans, La., at $47,500, $51,950; C. Trimborn, Milwaukee Bridge Co., 1400 34th St., Milwaukee, Wis., at $42,185, $42,330; Des Moines Bridge & Iron Co., Des Moines, Ia., at $44,990.

Cottage Grove, Ore.—Lights.—Cottage Grove Lighting Co., for furnishing the city with street lights for a period of five years, at $80 per year for arcs and $28 for 32 candlepower incandescents, the minimum charge to be $2,825.

Fort Moultrie, S. C.—Concrete Cisterns.—R. E. & E. N. Beaty, 100 Broad St., Charleston, S. C., at $6,453, for the construction of 7 reinforced concrete cisterns. Bids were opened Jan. 9.

Sumter, S. C.—Building.—Bartlett Heyward Co., Baltimore, Md., at $50,000, for the construction of the plant of the Sumter Gas and Light Co.

National Soldiers Home, Va.—Remodeling Electric Plant.—Newport News Ry. & Electric Co., Hampton, Va., at $4,300, for furnishing all necessary labor and material for remodeling electric plant, poles, wires, etc., to suit new plant built on home reservation. Bids were opened Jan. 11.

Winnipeg, Man.—Water Mains.—Stanton Iron Works, Nottingham, Eng., at $39,100 f. o. b., for furnishing 1,128 tons of water mains.

PROJECTED WORK.

Bridges.

Items Arranged Alphabetically by States.

Florence, Ariz.—A site has been selected for the new territorial bridge across the Gila by territorial engineer, J. B. Girand.

Sacramento, Cal.—Board of Supervisors of Sutter county will be petitioned for a bridge to cost in the neighborhood of $120,000, to be built at the town of Meridian by the counties of Colusa and Sutter and the Northern Electric Railway Co.

Pueblo, Colo.—County Commissioners of Pueblo and El Paso counties have completed arrangements for the construction of the bridge over the Fountain river at Wigwam on the county line of El Paso and Pueblo counties.

Bridgeport, Conn.—Streets and Sidewalks Committee has filed with the city auditor an item asking for the appropriation of $16,000 for a Boston Ave. bridge, and one of $6,000 for Arctic St., bridge approaches.

Columbus, Ga.—City will hold an election Feb. 17 to vote on the issuance of $100,000 worth of bonds for the erection of a new bridge.

Jackson, Ga.—Commissioners of roads and revenues have decided to build a steel bridge at Indian Springs.

Streator, Ill.—Plans for the construction of the proposed new bridge over the Vermillion river at this city have been completed by Engineer Ralph Modjeski of Chicago.

Peoria, Ill.—Blue prints of the proposed new high steel wagon bridge have been prepared by the city engineer. The bridge will be 2,700 ft. in length, beginning at the alley on Bridge St., between Adams and Washington St., and will have an abutment, being supported on 16 steel columns.

Cedar Rapids, Ia.—Petition is being signed by property owners which will be presented to the city council asking that a bridge be erected across the river at F Ave., before the Third Ave. bridge is built.

Atchison, Kan.—Citizens will vote in the spring to decide whether a new concrete bridge is to be built at Fourth and Main Sts., at a cost of $15,000. A resolution has been passed by the city council instructing the city engineer to prepare estimates on the bridge.

Brandenburg, Ky.—Judge Miller of Hardin county has ordered the construction of a bridge over Salt river, about a mile from West Point, which will connect Jefferson county with Hardin county. The bridge proper will cost approximately $60,000 and will be under the direction of a commissioner from each of the counties, to be appointed by the Fiscal Court.

Cheboygan, Mich.—Plans are being prepared by L. O. Pettyes for the construction of a bridge across the Cheboygan river for the Cheboygan Paper Co. It is estimated the structure will cost $30,000.

Detroit, Mich.—Petition has been signed by 40 freeholders asking the township board to call a second election to vote on a proposition to issue $175,000 for the building of a municipal bridge, connecting Trenton with Grosse Ile.

Detroit, Mich.—City will soon sell bonds for the construction of the new Stewart St. bridge, which will span the Miami river.

Menominee, Mich.—City Attorneys Joseph F. Cuddy of this city and Harry R. Goldman of Marinette are preparing petitions to be introduced in congress asking for permission to construct two bridges across the Menominee river.

Minneapolis, Minn.—Resolution providing for a bridge over the Narrows at Lake Minnetonka has been introduced before the board of county commissioners by William Knight, vice chairman of the board. The bridge will cost between $25,000 and $50,000.

Miles, Mont.—City Council has decided to go ahead with the construction of a new bridge over the slough at Milwaukee park to replace the one that was washed out last spring.

Buffalo, N. Y.—The Mexican or Vera Cruz Co., has under consideration plans for building a new bridge over the Barranca de Metlac. It is proposed to erect a structure which will unite the two sides of the deep valley in a direct line. The height of the bridge will be about 400 ft.

Rochester, N. Y.—Ordinance has been introduced in the city council providing for the construction of a reinforced concrete bridge, with a uniform width of 66 ft. The improvement is estimated to cost between $150,000 and $200,000.

Dickinson, N. D.—The bridge across the Little Missouri river for the new cutoff of the Northern Pacific main line from near Oakes to Forsythe has been located at the Nitsey ranch buildings. The structure will stand 250 ft. above the river level and will be 5,000 ft. in length.

Cleveland, O.—Chamber of Industries has indorsed the proposal of Mayor Beahr to pass a $2,000,000 high level bridge bond issue. An election will be held Feb. 17.

Dayton, O.—Plans are being prepared by Engineer Cellarius for the construction of the Keowee St. bridge. The structure is to be over 200 ft. in length.

Girard, O.—Petition will soon be presented to the county commissioners asking that a bridge be constructed on Main St., from High St. to the Crandon Lane, and in addition to spanning the river to span the various railroad tracks.

Sandusky, O.—County Surveyor is preparing specifications for the construction of the Huron lift bridge. The bridge will be constructed with concrete arches, and will cost about $75,000.

Portland, Ore.—Port of Portland will hold a special meeting to consider the report of Consulting Engineer Lockwood relative to the proposed Broadway high bridge. The cost of constructing the bridge is estimated at from $1,500,000 to $2,000,000.

Cookeville, Tenn.—Putnam county court has ordered an additional bridge built acros Falling Water river, near the falls, the bridge to be built by Putnam and White counties acting in conjunction.

Decatur, Tenn.—County Commissioners are contemplating on the construction of two bridges.

Sweetwater, Tenn.—County Court of Monroe county has ordered the construction of three county bridges as follows: Over Loco, Natchy and Sinkhole creeks, to cost $4,000.

Dallas, Tex.—Fourteen competitive plans have been submitted to the Dallas County Commissioners for the viaduct which is to be erected at a cost of more than $500,000 between Dallas and the Ninth Ward, Oak Cliff. Plans have been submitted by the following: E. Lee Heidenreich, New York; Daniel B. Luten, Indianapolis; W. G. Kirkpatrick, Jackson, Miss.; H. M. Jones, Nashville, Tenn.; Bartlett & Ranney, San Antonio; W. J. Watson, Cleveland, O.; C. A. P. Turner, Minneapolis, Minn.; Brenneke & Fay, St. Louis, Mo.; James H. Fuertes, New York; Hubbell & Greene, Dallas; I. G. Hedrick, Kansas City; Waddell & Harrington, Kansas City; Concrete Steel Engineering Co., New York.

Ephrata, Wash.—County Commissioners have voted $1,000 for the construction of a bridge across Crab Creek at Warden.

North Yakima, Wash.—County Commissioners have decided to erect a 60 ft. bridge across the Toppenish Creek on the McLeod Road, about two miles from Toppenish.

Tacoma, Wash.—Plans have been received from the Northern Pacific Railway by H. J. McGregor, Commissioner of Public Works, for the steel viaduct on 21st St., from Pacific Ave. to the Union passenger station yards.

Wenatchee Wash. — County Commissioners have decided to erect a new $15,000 steel bridge across the Chelan River on Woodin Ave., at Chelan.

Prairie Du Chien, Wis.—Chicago, Milwaukee & St. Paul Railway will begin the construction of a $1,000,000 bridge over the Mississippi River at this point within a month. The bridge will be built of steel.

Milwaukee, Wis.—City Council has refused to increase from $140,000 to $150,000 the appropriation for a new bridge at Oneida St.

Mexico City, Mex.—Pan-American Railroad will soon receive permission to erect a bridge to extend from the Mexican to Guatemalan territory and across the Suchiate River, connecting Mariscal, Mexico, with Ayntla, Guatemala. The bridge will connect the Pan-American Road with the Oscos Railroad, running from Oscos to Caballo Blanco.

Roads and Streets.

Items Arranged Alphabetically by States.

Auburn, Cal.—Supervisors of Placer County have decided to put the Auburn-Newcastle County Road in first class condition. They will spend in the neighborhood of $2,800, and macadamizing it from one end to the other. Supervisors James Brennan and M. J. Predom, representing the Newcastle and Auburn Districts, will supervise the work.

Marysville, Cal.—Petition has been granted for an extension of Third St., in the town.

Placerville, Cal.—City has been asked by the county surveyors to co-operate with them in the construction of a new county road through the big cut in the Sacramento hill.

San Diego, Cal.—Work will be started early in the spring on a comprehensive system of good roads, which will cost $1,250,000. All the work will be done under the direction of Austin B. Fletcher of Boston, Mass.

Stockton, Cal.—Bids for the construction of the Mossdale Manteca, Hogan and Manteca-Ripon Roads, known as the Manteca Division, to be built from the $2,000,000 bond issue, were rejected by the board of supervisors, and the highway commission was authorized to proceed with the work.

Canon City, Colo.—Surveys have been completed for the construction of the new scenic driveway from Three Mile Springs to the top of the Royal Gorge and on to the crest of the Parkdale Hill, where it will connect with the present Salida Road.

Bridgeport, Conn.—Streets and Sidewalks Committee has filed a requisition of $156,541 with the city auditor, which includes the following. Street grading, $5,000; sidewalks, curb and gutter, grading, $3,000; new cross walks, $5,000; for permanent pavement, Elm St., Main St., Broad St., Broad St. from Elm St. to Fairfield Ave., $7,350; Congress St. from Main St. to Housatonic Ave., $2,740; block pavement, West Housatonic Ave. from Congress St. to North Washington Ave., $4,220; new macadam, $51,950.

Jackson, Ga.—City will hold an election to vote on the issuance of $15,000 worth of road improvement bonds.

Havana, Ill.—Railroad St. is to be paved from the C., P. & St. L. station as far north as Main St., then the improvement will be carried east to the corner of Main and Plum Sts. At this point a turn may be made and the pavements laid around the block bounded by Main, Plum, Market and Orange Sts.

Moline, Ill.—City Council has ordered the board of local improvements to lay 70 blocks of new cement sidewalks. Property owners may lay the walks themselves, awarding their own individual contracts.

Peoria, Ill.—Board of Local Improvements propose to pave Cutler St. with asphalt. Board will also consider two ordinances, one for the paving with brick of Bryan Ave., from Adams St. to Glendale Ave., and Eaton St., from Adams to Water. The paving of Wayne, Irving and North Washington Sts. is also under consideration.

Evansville, Ind.—Grand Ave. will be improved by the Board of Public Works before summer if possible. A petition has been received from the residents on Grand Ave. asking that it be improved.

Fairfield, Ia.—City Council, Jefferson County Supervisors and others have extensive plans for a determined campaign for better roads.

Dighton, Kan.—Lane County Industrial Club has passed a resolution and has appointed a committee to meet with the counties of Greeley, Wichita, Scott, Ness and Rush to discuss the proposed motor car road for Great Bend to the state line of Colorado; the road to pass through Dighton.

Fort Leavenworth, Kan.—Joyce Bros. & Bagwell, and W. A. Wogan, both of Kansas City, Mo., were the lowest bidders for grading approximately 84,000 cu. yds. of earth at this city.

Wichita, Kan.—The township trustees of Delano, Park, Union, Sherman and Greeley Townships will call meetings in the near future to plan a macadam or sand-clay road to extend from Wichita to Denver. As planned the road will be 24 ft. wide if it is made of sand-clay, but if of macadam it will be 14 ft. wide. The cost of the two kinds of roads is estimated at $6,000 per mile for the macadam and $1,000 per mile for the sand-clay. The road will be approximately 277 miles long, from Wichita to the Colorado-Kansas line. C. A. Messer, County Engineer of Sedgwick County, and W. B. Harris, County Engineer of Reno County, are pushing the project.

Annapolis, Md.—State Treasurer M. Vendiver will sell bonds on Feb. 1 in the sum of $1,000,000 for road improvements.

Newburyport, Mass.—City Council has adopted a resolution providing for the appointment of a committee to purchase a road roller at an expense not to exceed $2,500.

Hancock, Mich.—Street Committee has opened negotiations with the Hancock Mining Co., for the supplying of crushed rock which the city officials will use for the making of a system of paved thoroughfares for Hancock's back streets. The streets will be paved with tar macadam.

Duluth, Minn.—County Commissioners have been asked by G. G. Hartley of Duluth to build a five-mile road into Floodwood from the vicinity of Island Farm. The commissioners will probably act favorably upon the matter.

Kansas City, Mo.—Petition for the proposed road from Kansas City to Excelsior Springs is being circulated. The petition has been signed for the first nine miles, from Kansas City to Liberty. Efforts are being made to have the petition signed for the rest of the distance.

St. Joseph, Mo.—Representatives of the water company have petitioned the county court for the macadamizing of what is known as the bottoms road to the water works reservoirs, from the city limits northward a distance of one and three-quarters miles. It is estimated that the improvement will cost about $10,000.

Atlantic City, N. J.—County Board of Freeholders has rescinded the $200,000 contract entered into with Bryant Reilley of this city for the paving of the Shore Road automobile boulevard owing to the dissatisfaction shown by the bidders, who claim that specifications were changed after the letting of the contract.

Canton, O.—Stark County Commissioners state that the improvement of the west Brookfield Road from Massillon to West Brookfield will be started in the spring. The road will be paved on one side, and the other side will remain a dirt road.

Mansfield, O.—City Council has been petitioned by property owners of Sturges Ave. for the paving of that street with asphalt block.

Portland, Ore.—Portland Automobile Club, E. Henry Wemme, President, is back of the movement for the proposed auto road to connect Portland and Hood River.

Portland, Ore.—Riverside Terrace Improvement Club recently held a meeting to discuss hard surface paving and other improvements for South Portland. Interest is taken especially in that part of Portland south of Marquam's Gulch to the city limits. A plan is advocated to make Front St. into a great boulevard, extending from the down town part of Portland south to the city limits.

Philadelphia, Pa.—Ordinances are before the City Council for the paving of the following streets: Twenty-third Ward—Bermuda St., from Orthodox to Tucker St.; Worth St., from Margaret to Bridge St.; James St., from Margaret to Wakeling St.; Wakeling St., from Tacony to Jackson St.; Melrose St., from Orthodox to Duncan St. Thirty-sixth Ward—Cartway of Passyunk Ave., from Schuylkill Ave. to the Schuylkill River. To repave streets—Fifteenth Ward: Perot St., from 24th to 25th St. Twenty-second Ward—Wakefield St., from Coulter to Penn St.; Wakefield St., from Wister to Logan St.; West Hortter St., from Germantown Ave. to Emlen St.

Anaheim, Tex.—A bond election to raise funds for the purpose of paving the intersection of Center St., will be called by the trustees.

Houston, Tex.—Petition has been filed with the city secretary requesting the city to pave Dupree's Alley and Shipman, Crosby and Arthur Sts. with shell or some other material.

Lufkin, Tex.—Representative citizens are circulating a petition for the establishment of four main highways to pierce each section of the county, diverging from Lufkin and touching the border line on each side. The county commissioners will be asked to expend all the money that can be lawfully expended upon these roads.

Orange, Tex.—County Commissioner Martin Schuh has about completed arrangements for the early grading and perfecting of the Newton County Road as far as the Gum Grove School House, four miles north of Orange. This part will be finished right away, and the work prosecuted on to the county line as fast as possible.

San Antonio, Tex.—All the county roads are to be improved either by graveling or retopping.

Sherman, Tex.—A committee has been appointed to organize road improvement district No. 2, to include the City of Sherman and contiguous territory.

Salt Lake City, Utah [illegible] called by Governor Spry, will be held in this city Jan. 26, 27 and 28 for the purpose of adopting a system of road construction particularly adapted to the topographical, climatic and commercial requirements of [illegible] for the states of Idaho, Utah, Wyoming and Colorado.

Norfolk, Va.—City will hold an election for the purpose of voting on the issuance of $75,000 worth of municipal improvement bonds.

Bellingham, Wash.—County Commissioners have been petitioned to build about two miles of county road, just across the river from Maple Falls.

Bellingham, Wash. [illegible] side of the Nocksack Valley below the town of Ferndale have presented a petition to the county commissioners for the rebuilding of the river road, leading from Ferndale down the bank of the river to the Lummi reservation. William Manning is Road Supervisor of the district.

Seattle, Wash.—Petition for the paving of West 59th St., from 24th Ave. northwest to 32d Ave., northwest has been rejected.

Seattle, Wash.—The road from Kent to Orillia is to be surveyed and will probably be put through in the near future. A road also is being surveyed from Kent to Thomas, and this portion of the work will be done in connection with the Kent-Orillia section. The road will go through the western side of Kent.

Spokane, Wash.—City Council has decided to improve Water Ave. from Cedar St. to 100 ft. west of the west line of Ash St., and Cedar St. from Water Ave. to about 140 ft. south of the south line of Water Ave., by grading, curbing, parking and sidewalking.

Milwaukee, Wis.—Viaduct Committee of the county board has passed a resolution to extend the Grand Ave. road from the western end of the viaduct to the county line, making the width 150 ft. the entire distance. It is planned to have the road extended to Madison. The road will be macadamized.

Neenah, Wis.—Residents of Sherry St. have been granted a petition for the paving of that street between Church St. and the Soo line crossing with a concrete pavement.

St. Boniface, Man.—City Council has decided to confer with property owners along Dawson Road and ascertain their views relative to the paving of that road at an estimated cost of $45,000.

Sewers.

Items Arranged Alphabetically by States.

Morrilton, Ark.—Board of Commissioners of Improvement District No. 1, organized for the purpose of constructing a sewer system in this city, is arranging to float the bonds necessary to secure the funds necessary to pay for the work. The cost of the system, it is estimated will be about $21,000.

Winslow, Ariz.—City voted on Jan. 7 on the issuance of bonds for the construction of a new sewer system.

Berkeley, Cal.—City Engineer J. J. Jessup is preparing plans and specifications for improvements to the Berkeley sewer system which will cost about $500,000, and to approve which the voters will decide by a bond issue.

Fresno, Cal.—City is contemplating the construction of a large sewer under Kern St.

Newman, Cal.—Plans for the sewer system for this city have been submitted to Prof. Hyde of the University of California and if he considers the grades and general plans practicable and satisfactory, they will be accepted.

Sacramento, Cal.—City Trustees have decided to submit to the people the proposition of voting $666,000 bonds issue for the erection of a sewage filtration plant for this city.

Visalia, Cal.—City Engineer has been instructed to prepare plans and make estimate of cost of 2,800 lin. ft. of conduit to have minimum capacity of 600 cu. ft. per second to carry Mill Creek through the business portion of the city. Mowe L. Weaver is City Engineer.

Ansonia, Conn.—Plans have been prepared for the construction of sewers on the west side and for extensions on the east side. The work is estimated to cost $200,000. Contracts will be let about Mar. 15, one being for about 1,250 ft. of 45-in. brick sewer for outfall, which will extend through the railroad yards. T. B. Clarke, City Engineer, has charge of the work.

Columbus, Ga.—Alderman Seabrooke, Chairman of the Streets Committee, has urged the City Council to take steps toward the construction of a new sanitary sewerage system.

Dublin, Ga.—City has decided to extend as soon as practicable the sewer system to West Dublin.

Belle Plaine, Ia.—City will soon construct about five miles of sanitary sewers.

Coon Rapids, Ia.—Survey is being made of the town by Frank Jones for the construction of a sewerage system for this town.

Missouri Valley, Ia.—Engineers are at work collecting such information as might be necessary to plan an adequate sewerage system for this town. Experts who have made the preliminary examination have estimated the cost of construction between $17,000 and $25,000.

Oskaloosa, Ia.—City contemplates the construction of a sewage disposal plant and sewer extension at a cost of $50,000 and the extension of the storm sewer system at a cost of $10,000.

Valley Junction, Ia.—Engineering Department of this city has been instructed to make surveys for the proposed sewer, which the city intends to build along the Rock Island tracks to an outlet below the filtering galleries in the Raccoon River.

Bushnell, Ill.—City has purchased an acre of ground west of town and with an acre owned in the east part of town proposes to construct two septic tanks.

Joliet, Ill.—Santa Fe track elevation department has changed its plans relative to reconstruction of sewers under the subways at Cass and Clinton Sts.

Rockford, Ill.—Petitions are in circulation asking the board of local improvements to make a sewer improvement in the first ward. This sewer will be the largest in the city.

Rock Island, Ill.—City Engineer W. E. Treichler has announced the completion of the right of way for the west section of the proposed Seventh Ward sewer system. Preparations are being made to secure the right of way for the east division. Work will be commenced in the spring.

Gary, Ind.—John W. Alford has finished his inspection of the route of the proposed extension of the sewerage system. The new section will connect with the big sewer and extend south across the Pennsylvania Railroad to 25th Ave. and thence west to Main St. The septic tank will probably be located in the southeastern part of the city.

Shelbyville, Ind.—City is contemplating on installing a surface storm sewer to cost from $20,000 to $30,000 immediately after the installation of the sewerage system, which is under construction.

Vincennes, Ind.—City Council has passed a resolution providing for the construction of a sewer system for the city.

Atchison, Kan.—A remonstrance against the construction of a sewer in District N has been granted by the city council. It is probable that the question of a sewer for Northeast Atchison will come up at the spring election.

Lawrence, Kan.—City Council has been recommended to instruct the City Engineer to draw plans, specifications and approximate cost of the construction of a system of storm water sewers for the city.

Topeka, Kan.—City Engineer W. S. Fulton has submitted plans and specifications for sewer district Nos. 29, 30 and 32.

New Orleans, La.—As soon as the remaining $7,000,000 bonds are sold the Napoleon Ave. canal which will extend all the way to station No. 1 at Melpomene and Broad Sts., will be constructed. This drainage system when completed will relieve all that territory lying between Louisiana Ave. and Peters Ave.

Berlin, Md.—Residents of the town are making arrangements to ask the Mayor and City Council for a charter to lay sewer pipes. If this is granted a company will be formed. The refuse will be emptied into the Trap mill pond.

Baltimore, Md.—Specifications for contracts for the Sewerage Commission amounting to more than $350,000 were approved by the Board of Awards. The work covers sanitary contracts and storm water contract No. 9, covering powerhouse, pumphouse, land conduits and under-water discharge conduits at the Back River disposal works and the construction of lateral sewers in sanitary districts 19-B and 35. Chief Engineer Hendricks will soon have ready contracts for an extension of the sanitary intercepting sewer north from above Preston St., running along Jones' falls and passing under the new Union Station. This will be a large concrete sewer, one part 64 ins. and the other 56 ins. in diameter, extending to North Ave., where it branches in three directions. The disposal plant will be arranged so that the flow of the purified sewage from the plant to the river will have sufficient fall to operate turbines, which will run dynamos generating electricity, which will be used for flushing, lighting and pumping.

[illegible]ich.—City Council has declared it necessary to construct a sewer on Court St., and Crown St. from the corner of Fifth and Avon to Court, and on Court from Avon to a point midway between Avon and Thomson Sts., and the construction of a sewer on Fifth Ave., from Mason St. to Smith St.

Cameron, Mo.—City is contemplating on constructing a sewer system.

Carthage, Mo.—City Council has directed City Engineer F. B. Newton to make a survey of the proposed new sewer district to be known as Sewer District No. 9, which would be south of Macon St. and west of Lyon.

Kansas City, Mo.—City Engineer J. L. Darnell has reported to the board of public works that the plans have been completed for the building of Brush Creek sewers from 51st and Mercer Sts. to Brush Creek and Jackson Ave.

St. Joseph, Mo.—Board of Public Works has introduced in the City Council plans and estimates providing for the construction of a sewer in a portion of Sewer District No. 54.

St. Louis, Mo.—Plans have been prepared for the construction of a foul water sewer following the course of the River Des Peres from the river almost to Manchester Ave. The estimated cost is $950,000. Plans have also been completed for the construction of the Baden public sewer at a cost of $419,000, and plans contemplate the South Harlem joint sewer at $432,000 and the Glaise Creek joint district sewer at $260,000.

Springfield, Mo.—City is contemplating on constructing several large district sewers during this year.

Laurel, Mont.—Plans for the sewerage system of this city have been accepted. The plans call for the laying of several miles of sewer pipe and the erection of a sewage disposal station near the Yellowstone River east of the city.

St. Joseph, Mo.—Board of Public Works has recommended an ordinance to the city council providing for the construction of a sewer in District No. 54. A notice was prepared for a sewer in District No. 112.

Havelock, Neb.—City Council has decided to order the construction of a sewer in this city. The main will run west on Jackson St. to the section line, then north to Salt Creek to carry off the sewage for Havelock proper and to tap the Burlington sewer in the northeast part of town to accommodate Norwood Park. The system will cost approximately $25,000.

Margate City, N. J.—City Council has appointed a committee to have plans and specifications prepared for the construction of a sewer system for this city.

Carnarsie, P. O. Brooklyn, N. Y.—Board of Trade has passed a resolution relative to the disposition of sewage. The board insists on immediate and permanent relief from the outrage of emptying raw sewage along the shore of Paerdegat basin by the building of proper and adequate disposal plants, as recommend by the Sewer Department.

Binghamton, N. Y.—City Council intends to construct a storm water sewer on Main st. from Cedar St. to Clarke St.

New York, N. Y.—New sewerage plans calculated to keep New York Harbor free from pollution and to permit the Bronx Valley Sewerage Commission to complete the work now under way, are said to be under consideration by the government authorities at Washington.

Rochester, N. Y.—LeGrand Brown has completed surveys and investigations relative to the matter of sewage disposal and has made his report to the city engineer. The plans recommended is the construction of a sewer in a deep tunnel beginning at the intersection of the Front St. outlet sewer in Central Ave. and intercepting at this point the sewer in Central Ave. and the sewer in Water St., thence extending through Central Ave., under the Genesee River to the intersection of Mill St. in tunnel.

Carrington, N. D.—City is contemplating on constructing a public sewer system to cost $75,000. The sewage is to be disposed of by the septic tank method.

Mandan, N. D.—Acting City Engineer Ray Wickham has been given the contract for the preparation of plans and specifications for the new sewerage system that will be constructed in this city. The system will be along the lines of a natural drainage system, the Missouri River being the outlet.

Dayton, O.—City Council passed an ordinance providing for the issuance of $2,000 worth of bonds for the construction of a storm water sewer on Glendale Ave. and Oxford Ave.

Dayton, O.—Plans, specifications and estimates for the sanitary sewers in part of Sewer District Nos. 8 and 9.

Dayton, O.—Petition is being signed by property owners in the neighborhood of Second St., from Perry to St. Marys, which will be presented to the City Council asking for the construction of a storm water sewer.

Mansfield, O.—Petition has been signed by property owners on Hanmond Ave., asking that an 8-in. sanitary sewer be built on that thoroughfare.

Springfield, O.—City contemplates on expending $20,000 during the year toward keeping up 44 miles of streets, and is considing the purchase of a new road roller at a cost of $2,700.

Youngstown, O.—City Council has declared it necessary to construct sewers in portions of the following streets: Garlick, Buckeye, Frederick and McHenry.

Mountain View, Okla.—Engineers are drawing plans and specifications and estimate the cost of constructing a sewer system.

Klamath Falls, Ore.—City Council has adopted the plans and specifications for the sewer system for this city. The main sewer will be on Main St., and a septic tank will be installed. Bids for the work will be advertised for soon.

Portland, Ore.—Surveys have been made for a sewer on East 45th St., between Belmont and East Stark Sts.

Portland, Ore.—Stephen Slough District, which begins at Division, near East Grant St., and covers the territory not provided for by the Brooklyn sewer south, and the Sunnyside system on the north side has been formed. The cost of the system is estimated at $18,431.

Salem, Ore.—City Engineer and the Sewer Committee have outlined a plan for the construction of a sewer system in South Salem. It will probably be constructed in that portion lying west of High St., down High St. to Mission, from Mission to Bellevue, thence following South Mill Creek to the Williamette Slough and along Williamette Slough to the outlet below Ferry St.

The Dalles, Ore.—This city is contemplating a new sewer system, and the erection of a crematory or garbage disposal plant. L. T. Boyle is City Engineer.

Altoona, Pa.—City Engineer Franz Engstrom is stated to have started surveying the district from First St. over into Pleasant Valley to determine whether there is enough fall to enable the city to erect a sewage disposal plant at that place. It is planned to run a tunnel through the hill along the eastern line of the city to carry the sewage down into Pleasant Valley.

Jenkintown, Pa.—Dr. Samuel G. Dixon of the State Department of Health, has urged this city to act at once in behalf of a system of intercepting sewerage and sewage disposal.

Parsons, Pa.—City Council has passed an ordinance which authorizes an increase in the bonded indebtedness of this borough in the sum of $50,000 for the installation of a sewerage system.

Philadelphia, Pa.—Bids are before the City Council for the construction of sewers in the following streets: Rising Sun Ave. from Clarkson to Tabor St.; De Lancey St. from 59th to 60th St.; Pine St. from 58th to 59th St.; Addison St. from 57th to 58th St.; Osage Ave. from 57th to 58th St.

Williamsport, Pa.—City Solicitor Cummings has advised the expenditure of the amount called for by the ordinance authorizing the employment of Engineer Congelton to prepare the plans for the construction of a sewage disposal plant.

Florence, S. C.—City Council will soon order the issuance of bonds for the construction of a sewer in this city.

Brownsville, Tex.—City has granted a charter to the Brownsville Sewerage Co. to construct a system of sewers throughout the city and all property owners are required to make connections with it. The capital stock of the company all paid up, is $30,000.

Kennewick, Wash.—City is contemplating on installing a sewer system before next summer. The city clerk will soon engage an engineer to prepare plans and estimates.

Hoquiam, Wash.—Plans for the sewer system for this city have been completed by City Engineer Moughmar and have been submitted to City Engineer Thompson of Seattle for report. The trunk sewer will run along K St., and will cost about $200,000 to build.

Spokane, Wash.—City Council has decided to improve Water Ave. from Cedar St. to 100 ft. west of the west line of Ash St., and Cedar St. from Water Ave. to about 140 ft. south of the south line of Water Ave., by constructing a sewer.

Corliss, Wis.—Plans and specifications have been prepared by W. S. Shields Engineering Co., Chicago, Ill., for a proposed sewer system. A. G. Cady is Village Clerk.

Nanaimo, B. C.—City Council has passed a bylaw to provide $100,000 for a sewerage system.

St. Boniface, Man.—The St. Boniface Union Stock Markets Co. has asked the City Council to construct the proposed trunk sewer, which is to be built from the new stock yards to the Red River at an estimated cost of over $200,000

Kincardine, Ont.—Provincial Board of Health has approved the plans for the sewage system and disposal plant for this city.

New Liskeard, Ont.—Plans for the sewage system and disposal plant for this city have been approved by the Provincial Board of Health.

Nipegon, Ont.—Plans for the sewage system and disposal plant for this city have been approved by the Provincial Board of Health.

Oshawa, Ont.—Provincial Board of Health has approved the plans for the sewage system and disposal plant for this city.

Water Supply.

Items Arranged Alphabetically by States.

Bessemer, Ala.—Mayor I. A. Lewis has vetoed the resolution passed by the city council providing for the purchase of the water works of this city.

Pratt City, Ala.—The Birmingham Water Co. of Birmingham, Ala., is to purchase the water works system of Pratt City at a cost of $25,000. The company plans to run a big main to connect with the Ensley main at Tuxedo Park and furnish the supply direct from Birmingham, cuting the old Pratt City plant.

Texarkana, Ark.—City recently voted a bond issue of $200,000 for a municipal water works plant.

Pasadena, Cal.—An election is to be held Jan. 26 for the purpose of voting bonds amounting to $1,200,000 for the purchase of the water works system.

San Rafael, Cal.—Preliminary steps are under way by San Rafael, San Anselmo, Larkspur, Ross, Kentfield, Corte Madero, Sausalito and Mill Valley for the formation of a water district to include those towns. The scheme, which will, it is estimated, involve a bond issue of $1,550,000, will be carried out during the year of 1910.

Spring Valley, Cal.—Board of Directors of the Spring Valley Water Works has voted to offer the plant to the city for $35,000,000.

Longmont, Colo.—At a recent election it was voted to install a new adequate water system for this place.

South Canon, Colo.—City has entered into an arrangement with G. R. Gwillim of Canon City, for the construction of a system of water works. The water will be piped from three artesian wells at Chandler, seven miles south of this city. The work includes the construction of a reservoir. Thomas Pease of Colorado Springs is said to be interested. The cost of installing the system will approximate $50,000.

Clinton, Ia.—The Chicago & Northwestern Railway Co. is planning the construction of a new pumping plant between Sixth and Marquette Sts., involving the installation of an extensive filtration system. The pumping plant will take the water from the well to the company's mains.

Corydon, Ia.—An election is to be held here to vote on the issuance of $40,000 worth of water works bonds.

Waterloo, Ia.—City has voted the issuance of $525,000 worth of bonds for the purchase of the local water works. N. W. Harris & Co., Chicago, Ill., offered to take over the wafer plant at $362,000, the balance of the sum raised from the bond sale to be used in extensions.

Aurora, Ill.—An appropriation of $8,000 has been granted for the construction of an additional well at the city pumping station. Although nothing definite has yet been accomplished the matter will probably be taken up at an early meeting of the Board of Public Works. Theodore D. Stinson is Superintendent of the Water Department.

Chicago Heights, Ill.—Plans have been prepared by the Stephens Engineering Co. of Chicago for the installation of deep well pumps direct driven by motors at the water works plant. The work will require an expenditure of about $30,000.

Chicago, Ill.—The Board of Trustees of the Sanitary District are considering the installation of electrical pumps for the pumping stations instead of the steam ones now in use. The power could be supplied by the Sanitary District.

Macomb, Ill.—Committee of City Officials have inspected the water works system of Decatur, Ill., in view of installing a similar system at Macomb. About $40,000 is available for the improvement.

Newman, Ill.—Citizens are advocating the installation of a water works system at this place.

Rockdale, P. O. Joliet, Ill.—Plan is being promoted by the mayor for the installation of a water works system. Joliet capitalists are said to be interested.

Tilton, Ill.—Danville Water Co. has asked the commissioners of Catlin Township to grant them a franchise to extend its main from Tilton to the county farm.

Ashland, Kan.—Plans and specifications are being prepared for a water and light system at this place, and bids for the work will probably be called for early in February. J. S. Worley Co., 206-7 Reliance Bldg., Kansas City, Mo., are the Engineers.

Assaria, Kan.—Blue prints and estimates have been prepared for a water plant sufficient for this city and it is expected that something definite will be done by Summer.

Dodge City, Kan.—Plans and specifications are being prepared for the construction of a water works system for this city. J. S Worley Co., 206-7 Reliance Bldg., Kansas City, Mo., are the Engineers.

Osage City, Kan.—City is contemplating on the construction of a sewer system early in the spring. Secretary Crumbine of the State Board of Health recently addressed a mass meeting and urged the improvement.

Crowley, La.—Consulting Engineer Walter B. Reid of New Orleans has presented to the city council a comprehensive set of plans and specifications for a new system of water works to replace the temporary plant now in operation.

Brainerd, Minn.—City has taken over the system of the Minnesota Water Works Company, and has placed it under control of the Water and Light Board. The cost of the plant was $57,500.

Aurora, Mo.—Citizens have voted not to grant the Lawrence County Water & Light Co. another 20 year franchise and a contract for 10 years to furnish water and lights. The people are not in favor of Municipal Owneship, but are disposed to offer a franchise and contract to a new corporation at reasonable prices and terms. The opposition is lead by Mr. John A. Williams, a local engineer, who will answer inquiries from persons interested.

Kirksville, Mo.—Bonds amounting to $10,000 have been voted to improve the water works system of this place.

Beatrice, Neb.—Plans are under way for the construction of a water works system for this place and the question of voting bonds for the purpose is before the council.

Havelock, Neb.—City Council has decided to install an independent water system and pumping station. The improvement as proposed is estimated to cost about $50,000.

North Platte, Neb.—The Union Pacific are to take immediate steps toward securing a good supply of water at this place. The drilling of a 5,000 ft. artesian well, estimated to cost $15,000 or the construction of a pipe line from White House Creek is under consideration.

Peru, Neb.—At a recent election it was voted not to issue bonds for the water works system.

Fargo, N. D.—Citizens will vote on Jan. 28 on the proposition of bonding the city in the sum of $65,000 for the purpose of building a filtration plant and new water works.

Albion, N. Y.—An appropriation of $2,500 for making test borings for the proposed municipal water works system for this village is to be voted on.

Fort Erie, P. O. Buffalo, N. Y.—Village Council favors the installation of a water works system. J. J. Foster is chairman.

Newark, N. Y.—The Municipal Board proposes increasing the water supply by drilling several wells in the north end of the city.

Niles, O.—City has sold $1,500 worth of water works extension bonds. Plans are being made for further extension of water pipes on new streets.

Warren, O.—Citizens will soon vote on the issuance of $250,000 worth of bonds to build a water works system.

Ardmore, Okla.—J. W. Maxey Engineering Co. of Houston, Tex., has been employed to make estimates on a water power plant on the Washita River.

Durant, Okla.—City Clerk W. S. Shannon will sell water works bonds in the sum of $10,000 on Jan. 18.

Mountain View, Okla.—Engineers have started work of running the preliminary lines for an extension to the water works system.

Portland, Ore.—Plans are being prepared for the construction of a new water main pipe line capable of delivering into the reservoirs 45,000,000 gals. per 24 hours, in addition to that now delivered, with the intention of placing the work under construction early in 1910.

Shenandoah, Pa.—Plans and specifications for the new reservoir have been presented to the city council by Surveyor Geary. The estimated cost is from $39,000 to $41,000.

Knoxville, Tenn.—The Knoxville Water Commission has ordered the extension of six water mains, five of which are in Knoxville and the other in Park City.

Midland, Tex.—Mayor J. A. Haley will sell $50,000 worth of semi-annual water works bonds on Feb. 15, 1910.

Gunnison, Utah.—City is soon to hold an election to vote on the issuance of bonds for the installation of a water works system.

Martinsburg, W. Va.—City has issued bonds in the extent of $40,000 for the extension of the water works system.

Hollister, Wash.—The Hollister Water Works Co. has been incorporated with a capital stock of $10,000. The incorporators are, William S. Kuhn, D. C. McWatters, V. B. McCain, Harve W. Hurlebaus and Mervin J. Kirkpatrick.

Oshkosh, Wis.—Committee of 12 with himself as chairman has been appointed by Mayor Voss for the purpose of investigating the proposition of purchasing the plant and system of the Oshkosh Water Works Co., and operating it as a city plant.

Guernsey, Wyo.—T. A. Kinck, Town Clerk, will sell Jan. 22, 1910, $20,000 worth of water works bonds.

CONTENTS OF JANUARY 12, ISSUE OF ENGINEERING-CONTRACTING.

EDITORIALS:

Percentage Bidding as Viewed by the Contractor and the Engineer..... 25
Engineer Department Heads for New York City 25

CONCRETE SECTION:

Reducing Contraction and Absorption of Concrete by Mixing It with Mineral Oil.. 26
The Disposal of Sewage Sludge..... 27
Election of Officers for 1910 of the Western Society of Engineers..... 27

EARTH AND ROCK SECTION:

Suggestions on the Design and Selection of Traction Engines 28

ROADS AND STREETS SECTION:

Economics of Street Pavements..... 30

WATER-WORKS AND SEWER SECTION:

Formulas for the Capacity of Tile Drains.. 32
Refuse Disposal and the New Refuse Incineration Plant for Milwaukee..... 32

BRIDGES, BUILDINGS AND FOUNDATIONS:

A New Method of Sinking Cylinder Foundations in Underpinning the Cambridge Building, New York City..... 35
A Suggested Form of Building Contract Designed to Secure Justice and Equity to Both Owner and Contractor..... 37

RAILWAY SECTION:

Original Cost and Cost of Reproduction of the Northern Pacific Railway (1,645 Miles) in the State of Washington..... 44
The Study of Engineering Contracting in Engineering Colleges 46

LETTERS TO THE EDITOR 47
COMING TECHNICAL MEETINGS..... 48
PERSONALS 48
CATALOGS WORTH HAVING..... 48

WATER-WORKS BONDS.

Mount Pleasant, Tenn.

Bids will be received by the Mayor and Board of Aldermen of Mount Pleasant, Tenn., until 8 o'clock p. m., on Tuesday, February 1, 1910, for the purchase of $55,000 thirty-year six per cent (6%) water works improvement bonds for the construction of a gravity system of water works for the town of Mt. Pleasant. For further information address Dr. J. E. Anderson, Chmn., Mt. Pleasant, Tenn. The right is reserved to reject all bids.

W. H. LONG, Mayor.
F. M. RICKETTS, Recorder.

PUMPING STATION.

DES MOINES COUNTY DRAINAGE DISTRICT NO. 1.

Burlington, Iowa.

Sealed bids will be received by the Supervisors of Des Moines County at Burlington, Iowa, until 2 o'clock p. m., February 2d, for furnishing and erecting a complete pumping station including the buildings and machinery. A considerable portion of the building materials will have been delivered at the pumping station site.

The pumping plant will be used for drainage of agricultural lands; shall have a capacity of 525 cubic feet per second against a head of 12½ feet exclusive of friction.

The plant will consist of two or three centrifugal pumps each direct connected to a cross or tandem compound condensing Corliss or four-valve steam engine; three water tube boilers for a working pressure of 150 lbs. per square inch, equipped with superheaters for a maximum working temperature of 475°; one small vertical auxiliary boiler for working pressure of 100 lbs.; shaking grates; induced draft; duplicate feed water system; open heater; electric lighting system for the plant and a coal tramway electrically operated.

For further information, plans and specifications address the HARMAN ENGINEERING CO., 120 Fredonia Ave., Peoria, Ill.

WATER-WORKS AND SEWER

Weatherford, Okla.

The City of Weatherford, Okla., will receive sealed bids until Friday, Jan. 28, 1910, at 2 p. m., for the construction of a concrete septic tank of about 84,000 gallons capacity, two sand filter beds 60'x 100'x3'-3", 32,450' of 6", 9,400' of 8", 7,770' of 10", 4,770' of 12", 1,450' of sewers of the first quality pipe, together with manholes, lampholes and other appurtenances.

Also the construction of a water works standpipe 24' diam. by 40' high, one 18'x 72" high pressure boiler, return tubular, full flush front, an air lift pumping system for five wells, one duplex force pump of about 900,000 gallons capacity, 36,000' of different size water mains with valves, hydrants, etc., etc.

All bids must be accompanied by a certified check for approximately 5% of the bid, made payable without reserve to the City Treasurer, Weatherford, Okla. Bids must be made on blanks furnished by the city and addressed to Mayor J. J. Winne, Weatherford, Okla., and must be marked plainly with the words, "Proposal for Sewerage," or "Proposal for Extension of Water Works System," as the case may be, as the bids will be taken up and considered separately.

Plans and specifications are on file with and blanks may be obtained from W. K. Cunningham, City Clerk, Weatherford, Okla., or J. L. O'Hearn, Consulting Civil Engineer, Clinton, Okla.

The city reserves the right to reject any and all bids and to accept any bid.

W. K. CUNNINGHAM,
City Clerk, Weatherford, Okla.

CAST-IRON PIPES.

Bangkok, Siam, Jan. 6, 1910.

The Minister of Local Government, Bangkok, Siam, is prepared to receive tenders for the Supply of Cast Iron Pipes and accessories for the water supply of the City of Bangkok.

Specifications with forms of tender and contract may be obtained on application to Secretary of the Siamese Legation, Washington, D. C., on payment of $1.25.

CEMENT BRIDGES AND CULVERTS.

Montezuma, Iowa.

The Board of Supervisors of Poweshiek County, Iowa, will meet at their room in the Court House at Montezuma, Iowa, Feb. 23, 1910, to let the contract for building cement bridges and culverts in Poweshiek County for the year 1910.

The Board wishes those interested in that kind of work to meet with them on that date.

J. W. ROSE,
County Auditor.

SEWER SYSTEM.

Traer, Iowa.

Bids will be received until January 28, 1910, by T. F. Stokes, City Clerk, for constructing a sanitary sewer system, consisting of 13,294 feet of 6, 8, 10, 12, and 15-inch pipe, 27 manholes, 4 drop manholes, 4 flush tanks, 1 septic tank and bulkhead.

Proposal Advertisements Continued on Page 48.

BOOKS

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Count 6 words for address.

WANTED—POSITION as superintendent of company manufacturing cement blocks or sewer pipe. Have had experience in the manufacturing of building blocks, sewer pipe and ornamental cement work. Also experienced in sidewalk, curb and gutter, and culvert work. Address Box 235, care of Engineering-Contracting, 355 Dearborn St., Chicago, Ill. 3-1t

WANTED—POSITION with company laying underground cable conduit. Am 31 years old. Have executive and managing experience. Capable, reliable; best of references. Address Box 237, care of Engineering-Contracting, 355 Dearborn St., Chicago, Ill. 3-4t

WANTED—POSITION—Contractors' superintendent and engineer (34) with ten years' experience in building bridges, tunnels and all kinds of massive and reinforced concrete construction, location and grading for electric and steam railroads; able to organize and handle large forces. Open for immediate employment. Address Box 238, care of Engineering-Contracting, 355 Dearborn St., Chicago, Ill. 3-1t

WANTED—POSITION with contractor doing reinforced concrete or drainage work by young engineer, aged 23. Six years' general experience. Can go at once. Address E. L. B., care of Engineering-Contracting, 355 Dearborn St., Chicago, Ill. 3-3t

WANTED—POSITION—Associate A. S. M. E. desires position. Experienced in design and construction of buildings and mechanical equipment. Competent executive in field or drafting room. Address Box 239, care of Engineering-Contracting, 355 Dearborn St., Chicago, Ill. 3-1t

WANTED—POSITION with engineering or contracting company. Experienced in compressed air tunneling, miscellaneous concrete and steel erection, railroad and city surveying, land development, drafting, computing, etc. Address A. C., care of Engineering-Contracting, 13 Park Row, New York City. 3-1t

WANTED—POSITION in North or West by engineer. Seven years' experience. Five years of it on railroad work, doing location, construction and maintenance. At present engaged on levee proposition. Ready to make change any time after Feb. 1. 28 years of age. Address Box 232, care of Engineering-Contracting, 355 Dearborn St., Chicago. 2-4t

WANTED—POSITION by boom derrick man. Thoroughly familiar with this class of work. Fourteen years' experience. Best of references. Will go anywhere. Address Box 222, care of Engineering-Contracting, 355 Dearborn St., Chicago.

WANTED—POSITION as dredge engineer. Will go any place. Can give references. Address Lock Box 305, St. Cloud, Minn. 2-2t

WANTED — POSITION — By experienced timekeeper. Will go anywhere. Address H. C., care of Engineering-Contracting, 355 Dearborn St., Chicago, Ill. 2-3t

WANTED — POSITION — Civil engineering graduate now engaged in technical journalism desires similar position or one in publicity work with commercial house. Fluent writer; good technical education and experience; executive ability. Address Box 234, care of Engineering-Contracting, 355 Dearborn St., Chicago. 2-2t

WANTED—POSITION as office engineer with large engineering or contracting firm. Position to be permanent. Correspondence solicited. Address "East," care of Engineering-Contracting, 355 Dearborn St., Chicago, Ill. 2-4t

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WANTED—POSITION with electric railway construction or operating company by man 26 years of age; experienced in operating, maintenance and construction of electric street and interurban cars equipped with hand and automatic control, automatic air brakes, as motorman car inspector, assistant to master mechanic. Thoroughly reliable. Address Box 229, care of Engineering-Contracting, 355 Dearborn St., Chicago.

WANTED—POSITION as general foreman on railroad or canal construction. Experienced. Can bring good steam shovel and dinkey engineers if needed. A1 refernce if desired. Will go anywhere on large job. Address L. W., care of Engineering-Contracting, 355 Dearborn St., Chicago, Ill. 26-4t

WANTED—POSITION as superintendent or tie and timber inspector for cross tie work. Have had experience in cutting white oak, post oak, cypress and long leaf pine, for construction and repair, and the latter for export; fifteen months' experience in operating the improved cross tie machine. Desire to locate west of Mississippi River. As to character, etc., guarantee satisfaction. Address Hunter Bowen, Pinckard, Ala. 26-6t

POSITIONS VACANT

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WANTED — Two thoroughly competent building estimators in office buildings, hotels and large office building propositions generally. Men with drafting experience preferred. State experience and salary expected. Address Box 236, care of Engineering-Contracting, 355 Dearborn St., Chicago, Ill. 3-2t

WANTED—A contracting engineer to act as general manager for an incorporated company who are doing special work in municipal and industrial lines. Must be able to close contracts. Must have $10,000 to $25,000. Salary $3,000 per year. Will make a term contract with right man. Address P. O. Box 181, Houston, Texas. 3-2t

WANTED—POSITION as cook for man and wife in camp. Years of experience. White. State wages. Mrs. Sarah Babcock, Sullivan, O. 2-5t

WANTED—MANUFACTURER'S AGENT—Wide awake man now calling on manufacturing trade can secure a desirable agency for a well-established line of structural steel, building and marine paints on a liberal commission arrangement. We have some exceptionally good territory to close and will make a profitable proposition to the right man. Address Sales Manager, 406 O'Brien Bldg., Cleveland, Ohio.

WANTED—EXPERIENCED TIMEKEEPER for work in southern Illinois. Give experience and references. Carter Construction Co., Room 218, 184 La Salle St., Chicago, Ill. 2-2t

SUPERINTENDENT on big work wishes to go into the contracting business. Have had experience on railroad construction, dam construction and heavy concrete work. Can use pick, shovel and spike maul and show how to use them. Graduate civil engineer. Age 32. Have $2,500 to invest on the co-operative plan and am willing to handle gang, take charge of work, draft or make estimates. Correspondence solicited. Address Box 230, care of Engineering-Contracting, 13-21 Park Row, New York, N. Y. 1-5t

WANTED—Dinkey engineers, pumpman and shovel firemen. One year's work. D. S. Gerow, Bosworth, Mo. 26-3t

WANTED — Capable experienced superintendent for heavy concrete construction company operating on Pacific Coast. Give full information as to experience, references and salary expected. Address Box 226, care of Engineering-Contracting, 355 Dearborn St., Chicago, Ill. 26-4t

WANTED—SALES MANAGER by company manufacturing concrete mixers. Only those familiar with this line and possessing selling experience need apply. Address Box 219, care of Engineering-Contracting, 355 Dearborn St., Chicago. 24-tf

MISCELLANEOUS WANTS

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TO LET—About 30,000 yards grader and wheeler work; short hauls and nice work; seventeen cents, with one cent overhaul after five hundred feet. Ware & Spencer, Bosworth, Mo. 3 tf

WANTED—I am in the market for a good secondhand road grading outfit, including scrapers, dump wagons, slips, etc. Address H. L. Miles, Contractor, Wichita, Kan. 2-2t

WANTED—PARTNER with ten thousand cash and fifteen thousand at command to purchase half interest in an established general contracting business. Correspondence invited. Address Box 233, care of Engineering-Contracting, 355 Dearborn St., Chicago. 2-4t

We have fresno, wheeler and grader work to let on the following lines in North Dakota: 66 miles on the C., M. & St. P. Ry.; 40 miles on the N. P. Ry. Free transportation for outfits, teams and men over the above lines. Address E. A. Wickham & Co., Council Bluffs, Ia. 2-3t

We have 150 miles of fine grader, fresno and wheeler work to let on the C. & N. W. Ry. in South Dakota. This is fine work in a good country. We can use both small and large outfits. Free transportation for teams, outfits and men over the C. & N. W. Ry.
E. A. Wickham & Co., Council Bluffs, Ia.
Roberts Bros. & Wickham, 123-125 La Salle St., Chicago. 2-3t

WOULD LIKE to get the address of A. J. Vanhoy. Write J. W. Sikes, Seymour, Tex.

WANTED—An experienced railroad man to take from $5,000 to $10,000 stock in an incorporated company and act as superintendent with salary. Address P., care of Engineering-Contracting, 355 Dearborn St., Chicago. 1-4t

STONE QUARRY—Want to contract with responsible party to take out rubble and crushed stone. Quarry opened up and plant installed. Must let contract by Jan. 15, 1910. Carothers Contracting Co., Lake Altoona, R. F. D. No. 2, Altoona, Pa.

WANTED—100 additional teams about March 1st for full year's work. Double tracking on Norfolk & Western Ry. Address J. S. Slone, Kingston, Ross County, Ohio. 1-4t

WANTED—Have machine outfit of eighteen teams and desire early spring work. Address B. A. Carder, Mott, N. D.

OPPORTUNITY to buy controlling interest in drainage and construction company having several lucrative contracts and several machines at work. Good reasons for selling. Address "Contractor," care of Engineering-Contracting, 355 Dearborn St., Chicago, Ill. 26-4t

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Engineer in Charge of Philadelphia Municipal Testing Laboratories.

THIS is the first practical and exhaustive treatise on this important subject. It has already been adopted as a text book by leading technical schools.

Each chapter contains a minute description of the methods followed in the author's laboratory and many valuable suggestions as to the "how" and "why" of cement testing. The observations on the interpretation of results, one of the most difficult tasks of the novice, are especially pertinent and are expressed in a fair and conservative manner.

The book is so complete that it can be put in the hands of a young engineer with confidence that it will enable him to make reliable tests on cement. The wealth of photographs and line cuts furnish the pictorial examples of how to conduct cement tests, and the 300 pages of texts are so explicit that even the most inexperienced man can soon learn the art of cement testing. Yet the book has not a superfluous paragraph.

Cloth, 6x9 inches; 330 pages; 142 illustrations; 58 tables; $3.00 net, postpaid.

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REFUSE INCINERATOR, STEEL STACK AND SEWAGE PUMPING STATION EQUIPMENT.

El Paso, Texas, January 1, 1910.

Sealed proposals for furnishing all labor and materials for the construction and erection of a refuse incinerator, steel stack and sewage pumping station equipment, with appurtenances, in the city of El Paso, Texas, will be received by the City Clerk at his office at the City Hall, El Paso, Texas, until 12 o'clock noon, standard time, Thursday, February 3, 1910, in accordance with the plans and specifications on file at the office of the City Engineer of the city of El Paso, Texas, from whom copies may be obtained on payment of $10. Plans and specifications may also be seen at the office of Hering & Fuller, Consulting Engineers, 170 Broadway, New York, N. Y.

The equipment to be installed consists of one three grate top charged incinerator of a capacity of 48 tons of wet weather refuse per 24 hours, two horizontal 125 horse power water tube boilers, two direct connected engine driven direct current 65 K. W. generating sets, three direct connected motor driven vertical centrifugal pumping units each of a capacity of 2 million gallons per 24 hours, one one-ton three-motor electric traveling crane, one self supporting steel stack 4 feet 6 inches in internal diameter and 70 feet high above the base, a four ton platform wagon scale, a ventilating apparatus, a pre-heater for the incinerator, together with the necessary refuse boxes, flues, tools, instruments, valves, pipes, wires and other appurtenances.

Proposals shall be made on the blank forms to be obtained from the City Engineer, and shall be sealed and filed with City Clerk before the hour above stated, when they will be opened by him and publicly read in the Council Chamber in the City Hall.

All proposals will be considered informal and rejected which contain bids not asked for, or which do not contain prices in words and figures for all items given in the Form of Proposal, or which otherwise are not in conformity with this notice.

Each proposal shall contain the full name of every person, firm or corporation interested in the same and the address of the person, firm or corporation and secretary of the corporation bidding, and shall be accompanied by a certified check upon a national bank drawn to the Treasurer of the city of El Paso in the sum of Five Thousand ($5,000) Dollars.

The bidder to whom the contract may be awarded shall attend at the office of the City Clerk with the sureties offered by him (or them) within 12 days (Sundays excepted) after the date of the notification by the city of the acceptance of his or their proposal and there sign the contract in triplicate for the work. In case of the failure so to do he or they will be considered as having abandoned the same and the certified check accompanying his proposal shall be forfeited to the city.

The checks of all unsuccessful bidders will be returned upon demand and also the check of the successful bidder upon the execution of the contract and the furnishing of the required bond.

A bond in the sum of twenty-five (25) per cent of the amount of the contract with sureties satisfactory to the City Council will be required for the faithful performance of the work.

The refuse to be burned will be a mixture of vegetable and animal matter, bones, paper, rubbish, cans, bottles, ash, dust, floor sweepings, manure, dead animal and street sweepings, as these constituents are defined in Article II of the contract.

No tests have been made to ascertain the calorific value of the refuse. The bidder must make for himself such investigations as he may deem necessary and after he has made his proposal to the city of El Paso he shall not make any claims or complaints as to the character of the refuse because of any failure on his part to properly fulfill the specifications and required guarantees. It may be stated, however, that at the present time refuse is commonly burned on the dump or in piles in the back yards of the houses. On account of the dry climate, evaporation of water from the refuse is rapid.

Each bidder shall furnish all of the drawings, specifications and statements called for under this contract and they shall accompany and form a part of his proposal to the city of El Paso.

All bids will be compared on the basis of the Engineer's estimate of the work to be done as outlined in the five items given below:

Item.

I. Furnace, combustion chamber, preheater, refuse boxes, tools, flues, instruments, duplicate materials and tests. Lump sum.

II. Generators, motors, pumps, valves, piping, ventilating apparatus and tests. Lump sum.

III. Electric crane, platform scales, float gage and tests. Lump sum.

IV. Boilers, feed pumps, feed water heater and steam piping. Lump sum.

V. Self supporting steel stack and foundations. Lump sum.

The quantities in these items are not given in detail and are only to serve as the basis of a uniform comparison of bids. The City Council reserves the right to increase or decrease the amount of any class or portion of the work as may be deemed necessary and according to the specifications and contract.

The City Council reserves the right to reject any or all bids.

PERCY M'GEE,
City Clerk.

F. H. Todd,
City Engineer.

CONSTRUCTION OF REFUSE INCINERATING AND SEWAGE PUMPING STATION, FORCE-MAIN AND SEWAGE DISPOSAL WORKS.

El Paso, Tex., January 1, 1910.

Sealed proposals for furnishing all labor and materials for the construction of a refuse incinerating and sewage pumping station, force-main and sewage disposal works, with appurtenances, but not including furnaces, pumps and machinery, in the city of El Paso, Texas, will be received by City Clerk of said city at his office at the City Hall, El Paso, Texas, until 12 o'clock noon, standard time, February 3, 1910, in accordance with the plans and specifications on file at the office of the City Engineer of the city of El Paso, Texas, from whom copies may be obtained on payment of $10. Plans and specifications may also be seen at the office of Hering & Fuller, Consulting Engineers, 170 Broadway, New York, N. Y.

Proposals shall be made on the blank form to be obtained from the City Engineer, and shall be sealed and filed with the City Clerk before the hour above stated, when they will be by him opened and publicly read in the Council Chamber in said City Hall.

All proposals will be considered informal and rejected which contain bids not asked for, or which do not contain prices in words and figures for all items given in the Form for Bids, or which otherwise are not in conformity with this notice.

Each proposal shall contain the full name of every person, firm or corporation interested in the same and the address of the person, firm or corporation and secretary of the corporation bidding, and shall be accompanied by a certified check upon a national bank drawn to the Treasurer of the city of El Paso in the sum of Five Thousand ($5,000) Dollars.

The bidder to whom the contract may be awarded shall attend at the office of the City Clerk with the sureties offered by him (or them) within twelve days (Sundays excepted) after the date of the notification by the city of the acceptance of his or their proposal and there sign the contract in triplicate for the work. In case of the failure so to do he or they will be considered as having abandoned the same, and the certified check accompanying his proposal shall be forfeited to the city.

The checks of all unsuccessful bidders will be returned upon demand and also the check of the successful bidder upon the execution of the contract and the furnishing of the required bond.

A bond in the sum of twenty-five (25) per cent of the amount of the contract with sureties satisfactory to the City Council will be required for the faithful performance of the work.

All bids will be compared on the basis of the Engineer's estimate of work to be done, as follows:

Item.

1. Earth excavation at site of incinerating and pumping station.2,770 cu. yds.
2. Earth excavation for force-main and disposal works.....5,800 cu. yds.
3. Rolled embankment.....6,700 cu. yds.
4. Rock excavation.....50 cu. yds.
5. Seeding.....1 acre
6. Roadways and walkways.....
7. 24-inch force-main and main distributor exclusive of trench...2,850 lin. ft.
8. 30-inch cement pipe exclusive of trench.....120 lin. ft.
9. 24-inch cement pipe exclusive of trench.....395 lin. ft.
10. 18-inch cement pipe exclusive of trench..... 45 lin. ft.
11. 14-inch cement pipe exclusive of trench.....250 lin. ft.
12. 12-inch cement pipe exclusive of trench..... 44 lin. ft.
13. 8-inch cement pipe exclusive of trench.....640 lin. ft.
14. 4-inch cement pipe exclusive of trench..... 10 lin. ft.
15. Gate valves and shear valves..... .....lump sum.
16. Concrete—1:2½:5—in sprinkling filter (except slabs), settling basin, manholes, foundations to laboratory and other concrete of similar nature required.....1,425 cu. yds.
17. Concrete—1:2:4—in foundations, walls, columns and floors in the incinerator and pumping station building below the top of the incinerator floor..... .....625 cu. yds.
18. Concrete—1:2:4—in sedimentation tank and concrete slabs over the main and lateral collectors of filter..... .....202 cu. yds.
19. Steel reinforcement....41,450 pounds.
20. Lateral distributors.....lump sum.
21. Risers.....lump sum.
22. Nozzles.....lump sum.
23. Dosing Apparatus.....lump sum.
24. Miscellaneous wrought iron and steel work.....10,000 pounds.
25. Miscellaneous cast iron work..... .....3,000 pounds.
26. Wooden appurtenances.1.2 M. ft. B. M.
27. Laboratory.....lump sum.
28. Superstructure of incinerating and pumping station.....lump sum.

These quantities are approximate, being given only as a uniform basis for comparison of bids, and the City Council reserves the right to increase or decrease the amount of any class or portion of the work as may be deemed necessary and as specified.

The City Council reserves the right to reject any or all bids.

PERCY M'GHEE,
City Clerk.

F. H. Todd,
City Engineer.

CONSTRUCTION OF SEWAGE POWER HOUSE, CONDUITS, PUMP HOUSE, LATERAL SEWERS, ETC.

Baltimore, Md.

SEALED PROPOSALS, indorsed "Proposal for Constructing Power House, Pump House and Land Conduits, Sanitary Contract No. 46"; "Proposal for Constructing Underwater Discharge Conduits, Sanitary Contract No. 47"; "Proposal for Constructing Lateral Sewers in District No. 19B, Sanitary Contract No. 48"; "Proposal for Constructing Sanitary Sewers in Lateral District No. 35, Sanitary Contract No. 49"; "Proposal for Building Storm-Water Drains, Contract No. 9"; addressed to the Board of Awards of Baltimore city, will be received at the office of Mr. J. Sewell Thomas, City Register, City Hall, Baltimore, Md., until 11 a. m., Wednesday, February 9, 1910, for constructing power house, pump house and land conduits and underwater discharge conduits at the Back River Disposal Works, sanitary lateral sewers in Districts 19B and 35, and storm-water drains, Contract No. 9, as shown on plans on file in the office of Mr. Calvin W. Hendrick, Chief Engineer of the Sewerage Commission.

Specifications and plans can be obtained upon application at the office of the Sewerage Commission, Room 904, American Building, Baltimore, Md., on and after Monday, January 17, 1910. The following charges will be made for each specification and blue prints:

Power house, pump house and land conduits, Sanitary Contract No. 46.$5.00
Underwater discharge conduits, Sanitary Contract No. 47..... 5.00
Lateral sewers in District No. 19B, Sanitary Contract No. 48..... 5.00
Lateral sewers in District No. 35, Sanitary Contract No. 49..... 5.00
Storm-water drains, Storm-Water Contract No. 9..... 5.00

These charges will be refunded upon the return, on or before February 9, 1910, of the unused specifications and plans in good condition, or upon the return of the general specifications, if any, and plans, in case a bid is submitted.

A certified check of the bidder, for the respective amounts shown below, on a clearing house bank, made payable to the order of the Mayor and City Council of Baltimore, will be required to be deposited with each bid:

	Amount of Check.
Power house, pump house and land conduits, Sanitary Contract No. 46.....	$3,500.00
Underwater discharge conduits, Sanitary Contract No. 47.....	2,500.00
Lateral sewers in District No. 19B, Sanitary Contract No. 48.	3,000.00
Lateral sewers in District No. 35, Sanitary Contract No. 49.....	1,500.00
Storm-water drains, Storm-Water Contract No. 9.....	3,500.00

Approximate quantities:

Power House, Pump House and Land Conduits, Sanitary Contract No. 46.
4,200 cu. yds. excavation and refill for power house, etc.
1,535 lin. ft. excavation and refill for conduits.
35 M. ft., B. M., lumber in foundations.
75 M. ft., B. M., ordinary shoring, sheeting and bracing left in place.
2,000 lin. ft. underdrains, 4 to 10 inches diameter.
3,560 cu. yds. concrete masonry.
1,500 lin. ft. reinforced concrete piles.
425,000 pounds reinforcing steel.

Underwater Discharge Conduits, Sanitary Contract No. 47.
5,125 linear feet wooden piles.
100 3"x12" wooden caps.
5,030 linear feet 60" diameter wood stave pipe.
5,000 pounds 1" diam. galvanized steel conduit stirrups.
2 special discharge elbows.

Lateral Sewers in District No. 19B, Sanitary Contract No. 48.
36,000 lin. ft. vitrified pipe sewer, 8" to 20" diam.
17,500 lin. ft. 6-inch house connections.

Lateral Sewers in District No. 35, Sanitary Contract No. 49.
10,000 lin. ft. vitrified pipe sewer, 8" diam.
5,000 lin. ft. 6-inch house connections.

Storm-Water Drains, Storm-Water Contract No. 9.
1,235 lin. ft. 72-inch circular drain.
1,910 lin. ft. 69-inch circular drain.
55 lin. ft. 57-inch circular drain.
35 lin. ft. 48-inch circular drain.
40 lin. ft. 42-inch circular drain.
625 lin. ft. 33-inch circular drain.
364 lin. ft. 30-inch circular drain.
2,281 lin. ft. 24-inch circular drain.
1,670 lin. ft. 20-inch circular drain.
1,402 lin. ft. 18-inch circular drain.
1,036 lin. ft. 15-inch circular drain.
380 lin. ft. 12-inch circular drain.
62 manholes.
3 Drop-wells.
3,372 lin. ft. inlet connections, 12" to 18".
3 bellmouths.
128 inlets.
100 M. ft., B. M., sheeting.
10 M. ft., B. M., lumber in foundations.

The successful bidder on each contract will be required to give bond and comply with the city charter respecting contracts.

The Board of Awards reserves the right to reject any and all bids.

By order of the Sewerage Commission.
(Signed) PETER LEARY, JR.,
Chairman.
(Signed) Harry W. Rodgers,
Secretary.

Approved:
(Signed) GEO. N. NUMSEN,
President, pro tem., Board of Awards.

PAVING.

Norfolk, Va., Jan. 10, 1910.

Sealed proposals will be received by the Board of Control at its office in the City of Norfolk Va., until 12 o'clock noon on the 8th day of February, 1910, for regulating and repaving with some smooth material, parts of Granby and Chapel Streets in the said city.

Bids must be made for each street separately.

Specifications with all other information may be obtained on application to the City Engineer, Norfolk, Va.

Certified checks for ten per cent of the amount bid must accompany each separate proposal, under the conditions set forth in "Instructions to Bidders."

The right to reject any or all bids is reserved by the Board of Control.

THE BOARD OF CONTROL.
Norfolk, Va.

W. T. BROOKE,
City Engineer.

CITY AUDITORIUM.

Houston, Tex., Dec. 21, 1909.

Sealed proposals will be received at the office of Dan C. Smith, Jr., City Controller and Secretary, City Hall, Houston, Tex., until 12 m., Monday, February 7, 1910, for performing all labor and furnishing all material for the erection and completion of the new City Auditorium, in accordance with the plans and specifications of Mauran & Russell, Architects, Houston and St. Louis. Specifications and plans and form of proposal can be obtained in payment of ten dollars ($10.00) at the office of F. L. Dormant, Consulting Engineer, or at the office of Mauran & Russell, Chemical Bldg., St. Louis. A certified check of the bidder on any bank in Houston, Tex., payable to the order of H. B. Rice, Mayor, for $5.000.00 will be required to be deposited with the bid. The successful bidder will be required to give bond and comply with the city charter respecting contracts, and to execute the usual form of contract as prepared by the City Attorney. The right is reserved to reject any or all bids, or to accept any bid considered advantageous to the City of Houston.

H. B. RICE, Mayor.

ROAD WORK.

Gordon, Ala., Dec. 20, 1909.

Sealed bids will be received at the office of W. J. Parish, County Commissioner, Gordon, Ala., until March 15, 1910, for the construction of 51 miles of graded roads in Houston County. The plans and profiles for same are at the office of Probate Judge, Dothan, Ala., copies of which will be sent upon request. Address

W. J. PARISH,
County Commissioner, Gordon, Ala.

REMODELING WATER-WORKS PLANT.

Bloomington, Ill., January 5, 1910.

Sealed proposals will be received by the city of Bloomington, Illinois, until five o'clock p. m., January 25, 1910, for the remodeling of its water-works plant, including the reconstruction and remodeling of buildings. One 6,000,000 or two 4,000,000 gallons pumps, a battery of boilers, stack, main connections and all other work to be done and machinery and appliances to be furnished in and for the said work according to the plans and specifications therefor now on file in the office of the city clerk of the city of Bloomington.

Bidders and contractors are advised to consult the ordinance passed by the City Council of the city of Bloomington therefor at its regular meeting, held Friday, December 31, 1909.

Copies of plans and specifications may be had upon application to F. H. Lamp, superintendent of water and light, at his office at the city hall in the city of Bloomington.

All bids must be accompanied with a certified check made payable to R. Maxton, City Comptroller of the city of Bloomington, for five per cent of the amount of the bid, as an evidence of good faith, the same to be forfeited to the city of Bloomington upon a failure of the bidder to accept contract upon any bid accepted.

All bids should be addressed to R. Maxton, City Comptroller of the city of Bloomington, Illinois.

The city of Bloomington reserves the right to reject any and all bids.

H. W. ULBRICH,
E. E. JONES,
J. C. MEANS,
Water Board of the City of Bloomington.

NOW READY

Cost Keeping and Management Engineering

By HALBERT P. GILLETTE and RICHARD T. DANA

This is the first book ever published on the subject of cost keeping on contract work. Its authors are pioneers in the field, and, although they have written much that has appeared in the form of articles—particularly in the pages of *Engineering-Contracting*—this book is the first presentation on the subject in a complete and logical sequence.

In the opening chapter the authors endeavor to reduce the **management of men** to a science, by laying down **ten fundamental laws of management,** each of which is fully discussed.

The secon chdapter contains **17 fundamental rules for securing minimum cost.** These two chapters are wholly novel and of far reaching importance to all men who are, or hope to be, in charge of other men.

The authors then proceed to describe and illustrate their own systems of cost keeping, which they have developed on their own contract work and have also been installed on the work of other contractors, giving both the **punch card reports**—a form of report which they were the first to devise—and the more common blanks to be filled in with pencil.

The last chapter contains numerous systems of cost keeping developed by other engineers and contractors, and is a **veritable mine of suggestive hints** as well as of examples of excellent blanks for special purposes.

The following is the list of chapters:

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CHAPTER II—Rules for Securing Minimum Cost.
CHAPTER III—Piece Rate, Bonus and Other Systems of Payment.
CHAPTER IV—Measuring the Output of Workmen.
CHAPTER V—Cost Keeping.
CHAPTER VI—Office Appliances and Methods.
CHAPTER VII—Bookkeeping for Small Contractors.
CHAPTER VIII—Miscellaneous Cost Report Blanks and Systems of Cost Keeping.

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CONTENTS.

Page

EDITORIAL:

Incompetence and the Tribute it Levies 71

CONCRETE SECTION:

Reinforced Concrete Bridge, Bexar County, Texas 72

Reducing the Cost of Concrete Building Work One-Tenth by Raising Labor Efficiency by Rivalry 73

Notes on English Concrete Work 74

EARTH AND ROCK SECTION.

A Novel Locomotive Rock Drill and a Remarkable Drilling Record 75

Some Notes on Handling Men on Construction Work 75

Design of Combination Timber, Steel and Reinforced Concrete Caissons for the McKinley Bridge With Some Data on Methods and Rate of Sinking 77

ROADS AND STREETS SECTION:

Cost of Constructing a Macadam Pavement With Concrete Curb and Gutter, Manistee, Mich 79

Notes on Road and Street Work 80

Concrete Road Construction in Wayne County, Mich., with Some Data on Cost 81

The Maintenance of Dirt Roads 81

WATER WORKS AND SEWER SECTION:

Results Achieved in Reducing Consumption of Water in Washington, D. C. 82

Relative Cost of Municipal Work Done by Day Labor and Contract 83

GENERAL SECTION:

Methods and Cost of Constructing a Concrete Lock and Timber Crib Dam with Appurtenant Structures, Employing Day Labor Under Government Engineers 88

LETTERS to THE EDITOR 91

COMING TECHNICAL MEETINGS 94

PERSONALS 94

CATALOGS WORTH HAVING 94

Incompetence and the Tribute It Levies.

In the pages of ENGINEERING-CONTRACTING two classes of articles stand out prominently. The one deals with well conducted work and is designed to show young and comparatively inexperienced men the methods whereby men succeed. The other class deals with work that is not well conducted and the object of publication is to hold up to view examples of how not to do things. That the latter examples are generally selected from reports of work in cities is incidental. This paper holds no brief for contractors, but does believe all engineers should have business training if they are to go into business as contractors; and successful contractors are only successful because they must be business men. Of two equally competent men, that one meets with the greatest success who has the opportunity to make the greatest gain.

In "Bradstreet's" the percentages of failures for 1908 were classed as follows:

Lack of capital	31.2
Incompetence	21.6
Disaster, etc.	18.9
Fraud	11.5
Inexperience	4.0
Neglect	2.2
Unwise credits	2.0
Failures of others	1.8
Competition	1.8
Extravagance	1.0
Speculation	1.0
Total	100.0

In looking over the list the following items seem to be in the one class:

Incompetence	21.6
Inexperience	4.0
Neglect	2.2
Competition	1.8
Total	29.6

They should really all be under the one heading of incompetence and it means that of the men who fail in business nearly 3 out of 10 fail because they are unfit. Taking up the subjects in reverse order it is found that nearly 2 per cent fail because of competition. Competition is the life of life itself and is the spur that forces men on to success. When a man succumbs to competition he is unfit, for being forced out by larger concerns is a failure classified under "Lack of Capital."

A little over 2 per cent fail because of neglect of business and this is plain incompetence. It speaks well for men in general that so few fail because of inattention to business. Inexperience claims 4 per cent and this is plainly incompetence, for no one is more incompetent than an inexperienced man if he lacks the wisdom to allow himself to be guided by competent men. In the list sheer incompetence is blamed for 21.6 per cent of all failures. Suppose we go one step farther and say that, lack of capital and disasters excepted, all failures are caused by incompetence, inexperience and carelessness, the three of which can properly be classed as incompetence.

Lack of capital simply means that men undertook more than they could carry out. In many cases such a cause for failure is a compliment, in that it implies that a man may have started a business which grew so fast that he was unable to supply the demand he himself created for his goods. Such a thing has happened in the contracting business where firms have bid on a number of jobs at the same time, never thinking to secure more than one or two, and they were found to be the lowest bidders on more work than they could undertake. Such failures may have meant that the men really knew their business very well. Disasters in the above list mean acts of Providence, for which the victim was in nowise to blame and which care on his part could not avert. This then leaves to incompetence the responsibility for practically 47 per cent of the failures in business life. It is freely stated by students of the subject that out of 100 men going into business for themselves about 85 fail, which means that about 37 men out of 100 are doomed to fail because incompetent to succeed.

Assuming that 37 men out of every 100 who go into busness for themselves are incompetent we are warranted in believing that at least this proportion exists among men in public positions. Assuming that this is true and that in the course of time the proportion of incompetent business men increases in public positions one great cause for the unbusinesslike administration of American cities is discovered. An incompetent or unfit man seeks always his path along lines of least resistance. His subordinates naturally imitate him and the few good ones among them cannot overcome the inertia surrounding them. Our examples of high cost and inefficient management of work have been pretty generally selected from municipal reports because on close analysis such examples abound in these reports. Incompetence in the elected or appointed official (21.6 per cent) coupled with fraud on his part or perhaps on the part of some subordinate (11.5 per cent), inexperience all through the organization (4 per cent), neglect of many items (2.2 per cent) and extravagance (1 per cent) in every individual connected with the work results in the levy of a heavy tribute on the tax payer.

When work is let by contract the contractor who obtains it is an example of the survival of the fittest. He is competent because of experience in his work and he has learned to guard against neglect and extravagance. He watches every detail of his work and measures every day's output by the dollar standard. Descriptions of the methods of doing things used by successful contractors are of value to students, but a close study of methods of doing things by incompetent men are no less valuable, provided the fact is pressed home that one is good practice and the other is bad.

In the city of Chicago an official recently resigned who blamed certain subordinates for his being compelled to resign. He admitted that in certain matters he did not possess enough knowledge of the subject under discussion to be able to judge, so was compelled to rely on his skilled subordinates. Without at present expressing any opinion on the subject which led to his resignation we do claim that his letter trying to throw all the blame on his subordinates was a confession of incompetency. A qualified engineer should have held this position instead of a politician who confessed he knew nothing about the details of the work. The man at the top does not have to deal with the petty details personally, but should have such a knowledge of them that he can know when his subordinates are neglecting them or trying to mislead him. To lessen the amount of tribute levied by incompetence is the object of this paper and it is our reason for laying so much stress on details. A man diligent in his business stands before the mighty ones and stands not with small men.

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Concrete and Reinforced Concrete Section

Note: This section is devoted to methods and cost of constructing concrete and reinforced concrete structures. It will cover the selection, testing and proportioning of concrete materials; laboratory tests of concrete; concrete mixing, transportation and placing; fabrication and placing of reinforcement, and form construction and erection. It will also contain articles on new and interesting developments in the design of reinforced concrete.

Reinforced Concrete Arch Bridge Bexar County, Texas.

The following information regarding the reinforced concrete arch bridge on the Pleasanton road over the Medina River in Bexar County, Texas, has been given to us by the designing engineer, Mr. Terrell Bartlett, C. E., of San Antonio, Texas.

The Medina River at the proposed bridge location flows through a gorge, shown in cross section by Fig. 1. The river is subject to occasional rises and is never dry at the bridge site. Three test pits were sunk to rock foundation and they are shown underneath the piers in Fig. 1. Under the north pier site the top alluvial soil was found to be 7.5 ft. deep, underlaid with 1 ft. of light, gravelly hard pan and then 8 ft. more alluvial soil. Under this was found 3.5 ft. of loose gravel and blue clay for a depth of 16 ft. to hard shale. Under the middle pier site the alluvial soil was found to be 3 ft. deep, 8 ft. of coarse gravel, 2 ft. of soft clay, 3.5 ft. of fine, loose gravel, 11.5 ft. of blue clay to shale. On the site of the south pier the test pits showed 9 ft. of alluvial soil, 12 ft. of loose gravel, 2 ft. of red clay, 6 ins. of fine gravel, 1 ft. of blue clay and under this hard rock. The bridge site is approximately ten miles by first class macadam road from the railway yards nearest San Antonio. Stone for concrete can be obtained from ledges about 300 ft. from south end of bridge and sand from pits at a distance of 4 to 6 miles. At ordinary low water stage all three piers will be on dry land.

The bridge is of reinforced concrete of four spans. The two main arches are two ribbed and each span is 110 ft., with 20-ft. rise. The two end arches are of 20-ft. span each. The over-all length is 342 ft. The arch ribs support spandrels of open columnar construction, which in turn support a reinforced slab floor system, including railways and an 18-ft. roadway. The pavement is of gravel macadam and drainage is provided. The approaches to the bridge are made by earth fills. All parts of the structure above the springing lines of the arch rings, spandrels, floor system, railings, wing walls, and portions of abutments and piers adjacent to junction of arch ribs, as shown on drawings, are of 1:2:4 concrete. Main abutments and piers are of 1:3:6 concrete, extending 1 ft. below the tops of the wooden piles, all of which are cut off below the lowest low water height. The wooden piles are 8 ins. in diameter at the bottom, 12 ins. diameter at the top and are driven to bed rock. The approach abutments rest on concrete piles 20 ft. long, 18 ins. in diameter at the top and 8 ins. in diameter at the bottom, of 1:4:8 concrete. Rubble stones are permitted in foundations and abutments, but there must be a space of not less than 3 ins. between each stone and the stones must be kept at least 12 ins. from the faces of the structure. Adjacent to the spring lines of the arches a 1:2:4 concrete must be used. The reinforcement throughout is of cold twisted squares of medium steel. Full length bars are used when practicable, but if lapped the lap must be not less than 50 times the thickness. In special cases a less lap will be permitted if suitable clips or clamps are used.

The finish on faces of the concrete work is obtained entirely by spading, and no whitewashing or rubbing will be permitted by the engineer. In criticism of the plans and specifications this one clause can be properly objected to as tending unduly to increase the cost of a highway bridge 10 miles from a city. Even in the largest cities such a clause has been found almost impossible to carry out fully. It is not a good clause when wooden forms are used, and this specification reads:

> All concrete facing on exposed surfaces shall be finished by spading. The forms shall be so carefully placed that when removed, the concrete will present a smooth, hard surface, and will require no whitewashing or rubbing to make the surface uniform.

The specifications provide that it is necessary to construct one set of main ribs complete throughout the two spans before striking any centers, the centers after a proper interval of time to be shifted to the other side of the bridge for the second set of main ribs. Each arch rib has to be constructed in one operation, the contractor working night and day if necessary to accomplish this result. Instead of loading the crown first, as is often done, the pouring of the ribs is proceeded with simultaneously on each side from the abutments to the crown. The reinforcing bars for the cross struts are placed and built into the first set of ribs with projecting ends to be built into the second set of ribs as built, the cross struts inclosing these bars to be poured after the completion of the second set of ribs.

At the crown the bars for the floor are placed while the first set of ribs is under construction and this portion of the floor slab is

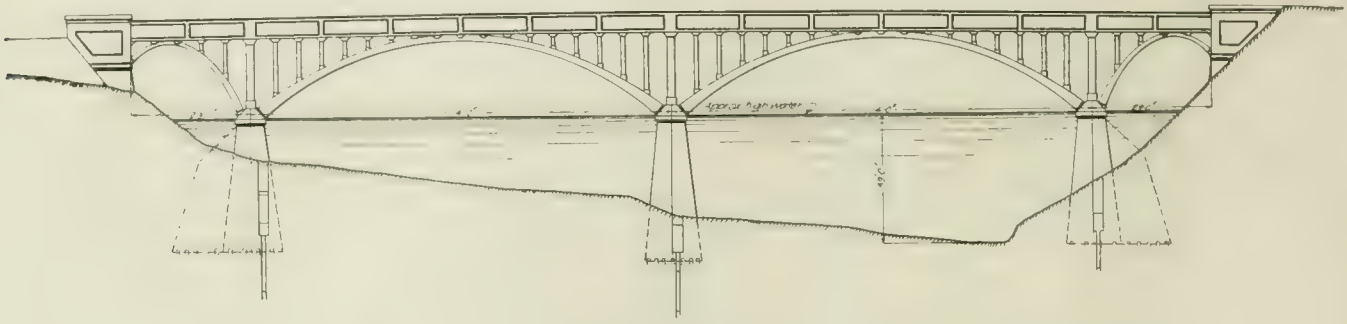


Fig. 1—General Elevation of Reinforced Concrete Arch Bridge, Bexar County, Texas.

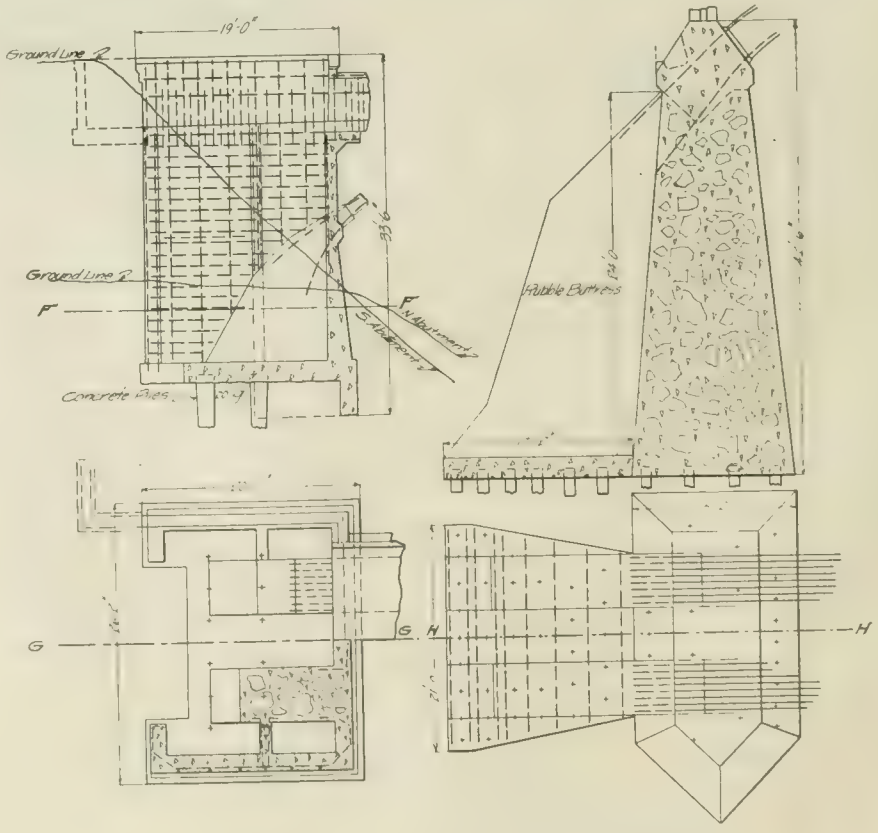


Fig. 2—Details of End Piers, Bexar County Bridge.

poured simultaneously with the second set of ribs. Spandrel columns are constructed as monoliths from the pedestals to the floor system. Expansion joints 1 in. wide and filled with pitch are placed where shown, the floor system, including floor beams, corbels, brackets and slabs, being constructed as a monolith between expansion joints. Through the floor 20 drainage holes 3 ins. in diameter are placed, these holes being formed by collapsible wood cores, pipe being prohibited. Railing and curbs are built in place after the completion of the floor, with expansion joints, as shown, filled with pitch.

Figure 1 is an elevation from the drawings of the engineer. The ribs end in buttresses back of the main abutments, Fig. 2 giving details of buttresses for the main ribs as well as for the approach span ribs. The inclosing walls for the approach abutments are also shown. The approach arches have free joints on cylindrical lead bearing plates as shown. None of the other arches are hinged. Figure 3 gives detail of expansion joint in floor and railing, a ¼-in. lead bearing plate being used and the vertical joint filled with pitch.

Figure 3 illustrates the arch ribs. The reinforcement in the main arch rib consists of eight 1⅛-in. bars continuous from end to end in each rib, the spacing being about 7½ ins. In the top and bottom of each rib are ¾-in. transverse bars 4 ft. 6 ins. long spaced 5 ft. apart. In each small arch rib are eight ¾-in. bars spaced about 7½ ins. apart with ¾-in. transverse bars 4 ft. 6 ins. long spaced 5 ft. apart. In each connecting strut for the large ribs four 1⅛-in. bars 10 ft. long are used, the same number of ¾-in. bars being used in the cross struts for the small arch ribs. In the spandrel columns the reinforcement consists of ¾-in. bars spaced 16 ins. on centers. The railing reinforcement consists of ⅝-in., ⅜-in. and ½-in. bars.

Figure 4 shows a cross section at the crown where the arch ribs form the floor also, the curb and rail being cantilevered to obtain full width. The floor slab proper begins at a point 12 ft. 6 ins. from the center of the arch and at this point is 12 ins. higher than the top surface of the rib, from this point going on a level to the ends of the bridge, carried on beams supported by spandrel columns. The floor slab is 11 ins. thick, reinforced with ½-in. bars longitudinally with the bridge and spaced 5½ ins. c. to c., the cross bearing bars, spaced 26 ins. apart, being ½ in. square and going up into the rails, acting there as reinforcement. The macadam is 8 ins. thick in the middle of the roadway and 6 ins. thick at the sides.

The engineer's estimates gave approximately 849 cu. yds. of 1:2:4 concrete, 72 cu. yds of 1:3:6 concrete of small stone and 1,603 cu. yds. of 1:3:6 rubble concrete, 99,400 lbs. of steel, 200 sq. ft. of lead, 2,300 lin. ft. of wood piling, 480 lin. ft. of concrete piling, 2,000 cu. yds. of wet excavation, 400 cu. yds. of dry excavation, 3,500 cu. yds. of embankment in the north approach and 600 cu. yds. of excavation in the south approach, and 350 cu. yds. of gravel to be loosely deposited, the county to do the rolling.

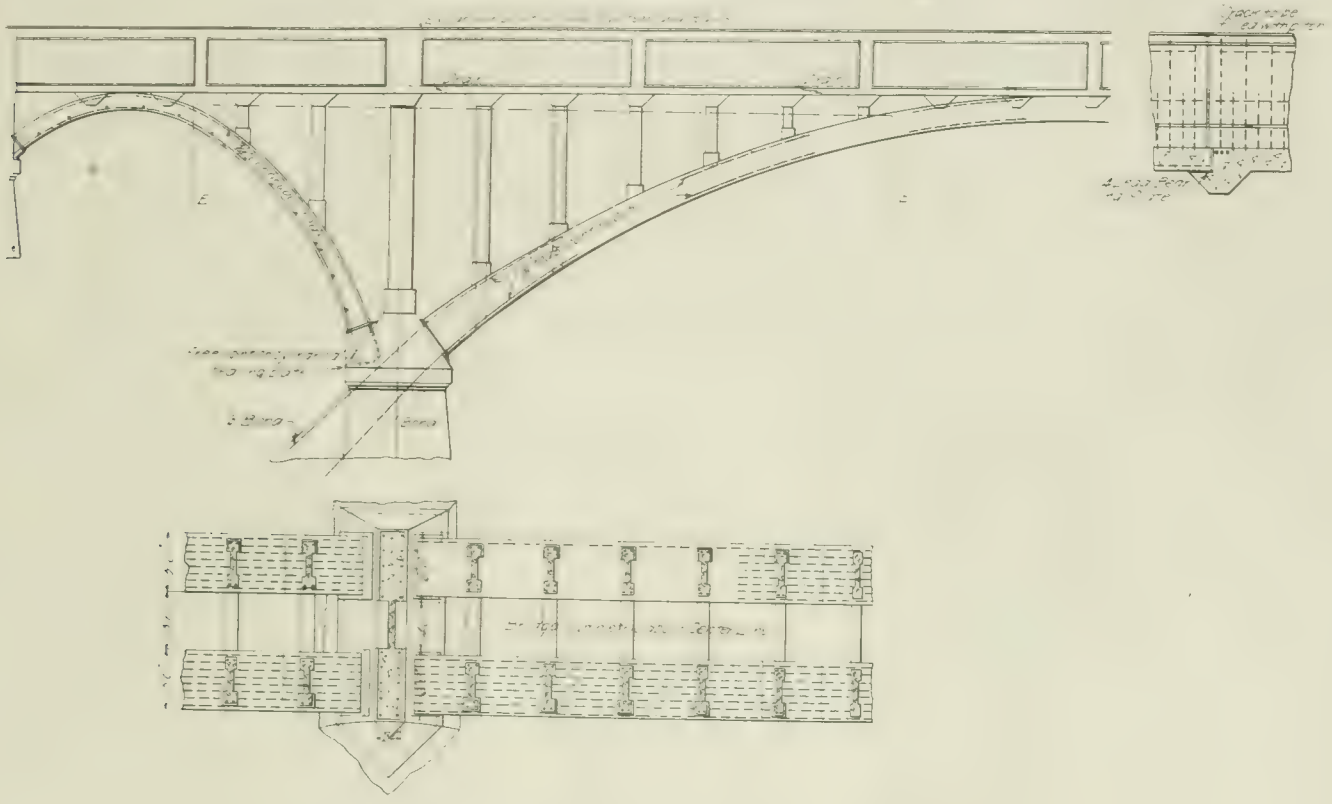


Fig. 3—Details of Arch Ribs, Bexar County Bridge.

The Grand Trunk Pacific is now operating three steamers on the Skeena river, and they are busily engaged in transporting supplies for the mining and trading of the interior country. The Skeena River is one of the principal torrential streams of British Columbia, and its fisheries are noted.

A terminal storage and transfer elevator under construction at Fort William has a total capacity of about 10,000,000 bushels. The first unit of this elevator is rapidly nearing completion, and will hold 3,800,000 bushels.

Reducing the Cost of Concrete Building Work One-Tenth by Raising Labor Efficiency by Rivalry.

BY WALTER B. SNOW.*

Every workable device for increasing the efficiency of labor is of importance to the contractor, and there is therefore considerable suggestive value in the experience of the Aberthaw Construction Co., of Boston, with the competitive working of labor gangs engaged in similar work on the same job. This company has for years past used this device for stimulating labor whenever the circumstances of a construction job made a friendly rivalry between gangs possible. The most striking results of the system, however, were obtained in the recent construction of twin buildings for the Winchester Repeating Arms Co., at New Haven, Conn.

The work consisted of two buildings lying side by side, and connected by a middle structure which provided toilet rooms, elevators, and a passage way between the two wings. With the exception of a steel frame, plaster walled storage room to go on the roof of one of them, the wings were precisely alike, each 300x60 ft., two stories high, with columns spaced 20 by 24 ft. and built heavily enough to

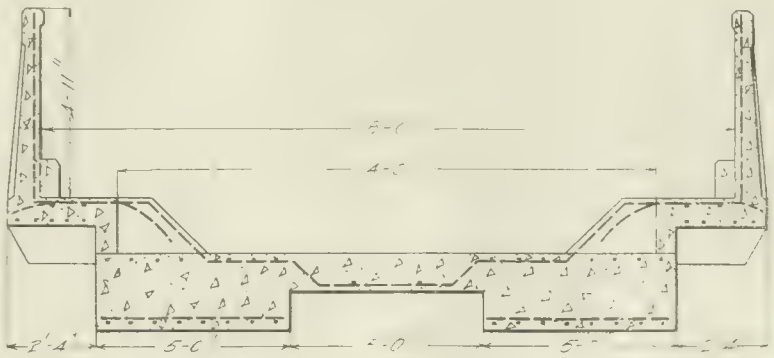


Fig. 4—Transverse Section of Bexar County Bridge.

*170 Summer St., Boston, Mass.

allow of the later addition of two more stories. The interior had flat slab concrete floors built on the Turner mushroom system supported by steel columns. There was a tunnel running under both buildings.

The amount of work involved in each building was carefully estimated and a dividing line was drawn 6 ft. 8 ins. on one side of the center of the connecting corridor so as to mark off two equal jobs; the two foremen who were to be put in charge of the two buildings agreed, after seeing the estimates, that the division was an absolutely fair one. They snapped up a cent for choice of sides. The two competing gangs were given duplicate equipment, the foremen were allowed to select their labor bosses, carpenter foremen, and to some extent were given a free hand in the number of carpenters and laborers that were to be employed on their respective buildings. A bonus was promised to these two foremen, to be divided in a given proportion according to the labor economy realized on the two buildings in executing the work.

The company organized the job on the plan followed in all its larger work. A superintendent, with such clerks as he required, was given responsible charge of the entire job and the handling of all ocal and minor business details. He reported to the president of the company, who visited the work at short intervals and put in such time as was necessary. In addition to the superintendent the company detailed from its own permanent forces a time keeper, two foremen (one for each wing of the building), one labor boss and a carpenter boss with six or eight experienced men under him for each wing. All the rest of the labor force was recruited on the ground. The company uses an accounting system which shows unit cost of each item, the progress and the cost of labor and material used. On this job the reports on each wing were kept separate. Placing the forms and handling the concrete naturally made up the chief labor cost of the work.

Rivalry between the two sides began at the start of the job and continued with increasing keenness until the end. The carpenters on the two wings were separated only by the width of the central court and were in plain view of each other. The amount of centering placed by the carpenters on one side was carefully noted by the men on the corresponding work of the other building, who made an effort to do better. The north wing started two days ahead of the south building, and the marks set up by the men on the north side drew corresponding speed from the men on the other side. The two mixers were placed side by side on the Winchester Ave. end of the buildings, so that the two concrete gangs worked from the same stock pile side by side.

A 50 per cent increase in the amount of concrete laid in a day was striking testimony to the gain in labor efficiency that resulted largely from the competition. At the outset the casting of two bays' length of floor the full width of the building was counted a good day's work. But towards the end of the job three bays were laid in 8 hours. Part of this gain was no doubt chargeable to practice, but the spirit of the game deserves most of the credit. The labor boss on the north wing had been with the company for a long time, and had handled well the labor on the 8-story Baxter Building, at Portland, Me., where the company had built at the rate of a story per week. But neither on the Portland job nor on other large work that he had handled successfully had this foreman ever put in concrete so cheaply or so great an amount per day as on the New Haven job.

In computing the saving on labor costs due to this competition of working gangs, the basis of comparison is necessarily somewhat a matter of opinion. The Aberthaw company adopted as a basis the unit labor costs per yard of concrete, per square foot of forms, and per ton of steel, in two other concrete buildings of about the same size as those at New Haven. Using this standard it appeared that the saving in labor costs on the New Haven job was 19 per cent on the concrete labor, 5 per cent on the labor on forms, and 22 per cent on the labor on steel erection. The total saving on all labor items was 10.8 per cent of the labor cost for the job as it would have been without competition, figured from the other buildings taken as standard work. In any such estimate there is of course room for differences of opinion because the labor cost in concrete buildings is so largely influenced by matters of design, and in estimating the weight to be assigned to such differences judges might not exactly agree. But with all reasonable allowances on this head it seems evident that by this competitive system the Aberthaw Company did get out of its New Haven job with an outlay for labor about 10 per cent less than that outlay would have been without the rivalry between the working gangs. There was less than $400 difference in the labor cost of the two wings.

So far as the laborers were concerned the spirit of rivalry created an atmosphere of play which pervaded everything and lasted throughout the job. The concrete laborers were largely Italians, but they, as well as the others, showed the keenest interest in the progress of the competition and went at their jobs day after day with all the zest of sport.

Carefully restrained, and not pushed to the extreme which would lead to the evident mistake of over-hasty and imperfect concrete work, competition of this sort evidently has a considerable practical value, and gets from the laborer more work and work done in a spirit of greater content and interest than is otherwise possible. The superintendent in charge needs considerable tact in dealing with the workmen, and he needs to insist very rigidly on the best quality of work; but with all these complications the competitive system is evidently within limits a practicable way of raising the efficiency of labor and thus of cutting down the total labor cost of construction.

Notes On English Concrete Work

At the Dec. 16, 1909, meeting of the Canadian Society of Civil Engineers Mr. A. D. Swan read a paper on the docks recently built in Bristol, England, on which work he was resident engineer. He stated that the stock of cement was never allowed to fall below 6,000 tons, specially designed storage sheds being erected to store it. When delivered on the works it was emptied from the bags and kept thoroughly dry and well aerated. The bins were constructed of timber in the usual manner, but the sides were pierced with holes, 1½ ins. in diameter, 20 ins. apart, in two rows near the bottom of the bin. Compressed air was supplied from a compressor to each shed by means of a pipe running the whole length of the building, with connections at intervals for rubber hose. A perforated wrought iron pipe 1 in. in diameter was inserted through each hole and one end attached by rubber hose to the air pipe, the other end being supplied with a solid point. Air was then admitted at a pressure of about 5 lbs. per square inch and kept on until it escaped at the top of the bin.

A number of 6-in. cubes of concrete were made of gravel taken from the same heap. Half the cubes were made with unwashed gravel and an equal number with gravel carefully washed. After a month the blocks were tested, and the unwashed material began to crack at an average of about 828 lbs. per square inch and crushed completely at an average of about 940 lbs. per square inch. The concrete made of washed material began to crack at an average of about 1,260 lbs. per square inch and crushed completely at an average of about 1,850 lbs. per square inch., or practically double the strength of concrete made of unwashed gravel. The water used for mixing the concrete was fresh and averaged about 21 gals. per cubic yard.

Mr. Swan expressed the opinion that sound, impervious concrete using first class cement is not affected to any extent, if at all, by sea water. In nearly all the walls large pieces of rubble stone, "plums" the English engineers call them, were embedded in the concrete, the saving being from $1 to $1.25 per cubic yard, and it was claimed that the wall was made heavier in this way. Where the concrete was deposited in heavily timbered trenches these large stone could be used to about 6 to 8 per cent only of the total bulk. In open work the author saw from 20 to 35 per cent used.

The U. S. Geological Survey has just issued Bulletin 416 entitled Recent Development of the Producer-Gas Power Plant in the United States by Robert Heywood Fernald. It is a careful study of what has been done and the author concludes that in the United States cheaper power is constantly sought. The water-power possibilities of the country are being realized and the hydro-electric power plant is a wholesome cause of competition. The supply of fuel of marketable grades is not unlimited. Prices for such fuel must of necessity increase. The cost of transporting coal from the mines is high, and the possibility of obtaining a sufficient supply of cars to handle low-grade fuels is questionable. The power demands of the country are increasing, and this power must be developed at a reasonable cost. The time is approaching when the cheapest fuel obtainable must be used to the best economic advantage in order to develop power at a unit cost consistent with commercial progress.

Consideration of the conditions indicates that in order to keep the price of power developed from fuel down to a consistent figure—

(a) Grades of fuel which warrant transportation, or which may be defined as "marketable," should be used with the greatest practicable economy.

(b) The very large percentage of coal of so-called low grade which today is left at or in the mine must be utilized.

(c) Advantage must be taken of the large deposits of lignite and peat which are found in many sections of the country.

It is undoubtedly true that in general, under conditions which do not require the use of steam for other than power purposes, the producer-gas power plant meets the requirements of (a).

At present the only method of advantageously handling the fuels mentioned in (b) and (c) is in the gas producer, and the utilization of these lower grades of fuel on an extensive scale demands concentration of the power plants within close proximity to the fuel supply.

The logical conclusion from a careful study of the producer-gas power situation is that the time is not distant when financial interests in power production will be directed toward the centralization of the producer-gas power plant at the mines and the distribution of the energy developed either by high-voltage long-distance electrical transmission or by pipe systems for conveying the gas.

While the proposition to transmit energy from coal mines in the form of electricity is not new, this is the first time we remember seeing it recommended that gas be conveyed to any distance.

Importance of Having More Than One Station for Rainfall Observations.—The importance of extending the field of observation on rainfall for run-off studies from that of single station record to a series of properly located stations covering the urban area cannot be well overestimated. The design of all drainage works being so dependent upon rainfall data, it is considered a matter of primary importance that the observations be sufficiently complete so that the study and analysis of run-off can be intelligently made, leading to less dependence upon the approximations by the empirical formulae. In the report of the Engineer Department of the District of Columbia for the last fiscal year the following abstract from the record of a 1909 storm is given to show the serious error of relying upon a single station observation:

Time (rainfall in ins.)	Station 1. Ins	Station 2. Ins	Station 3. Ins
To 8 p. m.	0.00	0.00	0.00
To 9 p. m.	.10	.14	.06
To 10 p. m.	.55	.98	.20
To 11 p. m.	1.02	1.32	1.25
To 12	1.31	2.57	1.54
To 1 a. m.	1.81	3.16	2.95
To 2 a. m.	1.91	3.16	3.42

Earth and Rock Section

Note: This section is devoted to methods and costs of excavating earth and rock and building embankments. It will cover the grading of roads and railroads, diking and canal work, dredging, building reservoirs and earth dams, sewer and water pipe trenching, quarrying, etc.

A Novel Locomotive Rock Drill and a Remarkable Drilling Record.*

Successive "new records" made in rock cutting operations are often not fairly comparable with either preceding or succeeding records elsewhere made, on account of the differences in the conditions under which they are made. Thus the rock-filling record set forth in the following may not be properly comparable with performances in other cases of rock-drill work. But it is sufficiently striking and notable in itself, and may point the way toward more efficient methods of wide applicability.

This record was made in the work of excavating the Livingstone Channel, a detail of the improvement of the Detroit river. Here was a straight channel to be cut in rock, 300 ft. wide, in the bottom of the river. The contractors for the section in question are Grant, Smith & Company & Locker; the work lies between Amherstburg, Ont., and Grosse Isle, Mich.

The area to be worked over was enclosed by cofferdams at each end, so that the operations were entirely "dry." The entire site was commanded by three Lidgerwood cable conveyors movable lengthwise of the channel as the work progressed; these conveyed all the material from the excavation and dumped it at a sufficient distance on either side. The overlying earth and loose stones were first removed by the aid of steam shovels, with which operation we at present have nothing to do, and then there remained a clear surface of rock to be excavated to a varying depth up to 12 ft. and over. The material is a soft lime rock running into dolomite and is unusually free from seams, making it a comparatively easy proposition for the rock drill.

The drilling over the entire surface was all done in a single operation to the required bottom level. In commencing the drilling what might be called a standard equipment was employed, consisting of the usual type of rock drills, air operated, mounted on tripods and requiring two men for each. These drills were moved from hole to hole, usually a distance of about 8 ft., as required. These, of course, required a change of bit for every 2 ft. of depth of hole drilled, and a successive reduction of gage for each additional steel, so that to drill to a depth of 14 ft. and a bottom diameter of 3 ins., seven steels would be required with 3¾ or 3⅞ ins. for the starter. The actual average rate of the drills on this work was about 46 ft. of hole for an eight-hour shift. Four 3¼-in. Ingersoll-Rand drills were crowded all the time to keep one cable conveyor occupied.

A locomotive rock drill has recently been devised which has revolutionized all this. It is the invention of Mr. C. H. Locker, of the firm above referred to. It comprises in fact a single rock drill with a carriage and mounting and air-power devices which enable it to keep at work, actually drilling, as constantly as possible and *minimize the delays* required for shifting from hole to hole, for changing the steels, and for raising the drill by the feed screw when either change is made. This drill has largely made its record by avoiding stops, just as the big through express trains do. It has also the additional advantage of extra weight and power, which would not be practically available in a drill entirely operated and moved about by hand.

Briefly described, there is a horizontal frame built of heavy timbers and mounted upon four wide-tread wheels, those in front being on a fixed axle while those in the rear are swiveled for steering. There is a vertical air receiver or "air dryer," as they call it, on the rear of the platform and in front of this is a two-cylinder reversible hoisting engine which supplies the power for the several operations required. An extension of the shaft carries a small sprocket-wheel which connects by a chain to a larger sprocket driving the front carrying-wheel when the machine is to be moved. In front is a vertical heavily braced gallows-frame which carries the drill. When everything is in place the preponderance of weight is upon the front wheels, which is as it should be, and when the apparatus is in exact position for starting a hole the two jackscrews seen in front are set down solid upon the rock taking most of the weight and holding everything rigidly in place. The manipulation of these jackscrews is the only hand operation involved when changes of position are made.

The drill used in this case is a 5-in. Ingersoll-Rand machine ("H2"). The first change made in it was to dispense with the usual shell or guide in which the drill cylinder travels up and down by the operation of the slow-acting feed screw. In place of the drill shell the front of this carriage provides vertical guides in which the drill cylinder fits as in its original shell, but with a travel of 10 ft. instead of 2 or 2½ ft. The drill is suspended by a wide cable of suitable size carried to the drum of the hoisting engine, one or two revolutions of which will raise the drill from the bottom to the top of the guides.

A single steel is used of sufficient length to take advantage of nearly the entire vertical travel of the drill cylinder. The feed is entirely by the suspended weight of the drill, a slow retrograde movement of the hoisting drum being accomplished by a worm gear arrangement which can be clutched in or out as required (as is also the fast speed for hoisting the drill and withdrawing the steel from the hole). Holes to a depth of 8 ft. can thus be drilled with a single steel without a stoppage, and the loss of gage in the operation is in this rock scarcely noticeable. For keeping the drill in place when starting there is a guide attached to the front of the machine and brought down quite close to the rock. This guide of course does not fit the steel, but gives it a little liberty to dodge around, while still locating the beginning of the hole with sufficient accuracy. The front half of this guide is hinged and can be swung back out of the way when changing steels.

It is not necessary to describe this apparatus any more in detail. It is evidently a crude and, in a way, merely an experimental arrangement; even the air hoisting-engine was home-made. The machine is already being replaced by a carefully designed machine constructed entirely of steel and with additional provisions for economy and facility of operation. However, such as it is it has worked steadily for two or three months or more and made astonishing records.

The following figures are given by a responsible and careful observer: On Sept. 23, 1909, drilling 3-in. holes, 29 ft. of hole was drilled in 55 min. This included moving the drill four times, the time occupied in moving being about 45 secs. each. On another day the drill was timed for one hour. Handicapping the drill in this case was dull steel and low air pressure. Yet the first hole was drilled to a depth of 7 ft. 8 ins. in 7½ mins., the next hols was 6 ft. 6 ins. in 26½ mins., and at the end of the hour, with five moves, 37 ft. 3 ins. of holes had been drilled.

The following is from another observer: In 32 mins. it put down three holes, 6 ft. 2 ins., 7 ft. 2 ins. and 7 ft. 2 ins., and was moved three times, leaving it ready for the fourth hole, all in 32 mins. In this time there was a delay of 4 mins. caused by the driller neglecting to raise his bar and getting it bent.

The 6 ft. 2 in. hole in this case from start to finish took 5¼ min. The time of moving, that is, from when one hole was finished until another was started, was exactly 2 mins.

The performance of this machine is more strikingly expressed, however, by the following statement: Operated by two men, it took the place of the four tripod drills and eight men, and easily kept well ahead of the conveyor at all times. Its work compared with the tripod drill was approximately as *five to one.* The saving of air consumed has not been investigated.

On the new machine a reheater will be installed, and also a supplementary compressor to generate high-pressure air to follow the drill into the hole and blow out the dust.

*From a paper by Frank Richards in "Compressed Air" for January, 1910.

Some Notes on Handling Men on Construction Work.

The following interesting notes of experience of well known contractors in handling men on construction work so as to obtain the greatest efficiency were brought out in a discussion at the December meeting of the American Society of Engineering Contractors of the paper on "Science of Management Engineering" by Mr. Halbert P. Gillette. This paper was reprinted in full in our issue of Dec. 15, 1909, and can be consulted by readers desirous of seeing the original statements commented on in the following discussion:

F. B. Gilbreth.—No engineering contractor can read the papers of Frederick W. Taylor, past-president of the American Society of Mechanical Engineers, without appreciating the value of the remarkable work that he did in managing men while he was chief engineer of some of the largest steel mills in the world. Wherever he has been in charge he has always accomplished the three most desirable of results, viz: (1)He has decreased costs per unit of output. (2) He has increased the wages of workmen. (3) He has never been opposed by a strike.

The basis of compensation of the workman which has been discussed at length by Mr. Taylor is one of the most important problems that confronts the engineering contractor. The most common bases of compensation are: (1) Day Work. (2) Piece rate. (3) Gift propositions. (4) Premiums. (5) Task and bonus. (6) Differential piece rate.

Each method has its advocates, although local conditions undoubtedly affect the value of the different methods. Many papers have been and could be written about the merits and laws of each of the above systems. But the purpose of all is the same, namely,—to lower production costs.

Mr. Gillette is undoubtedly right when he emphasizes the importance of discovering and applying the law which states the relation of compensation to output, "the law of reward increasing with increased performance," as he words it. But it should not be lost sight of, that there are more than a score of different factors that make for high outputs besides the desire for extra money. Such a factor is the grouping of the men.

Mr. Gillette speaks of "doing away with gang work entirely, or at least of reducing the number of men of each gang." As a typical example from our own experience which proves the wisdom of this method, we found that in loading brick on to packets in a freight car, the brick to be placed right face up and with the tops of the brick all in one direction, the laborers would load the brick for 20 cts. per 1,000, day after day, if there was but one man in each car with his output tallied separately. With two men in the same car, with their outputs tallied together, the average cost was 38 cts. per 1,000, while if 4 men were in the same car the price averaged 45 cts. per 1,000,—and so on upward. When the men were distributed again the costs were 20 cts. per 1,000 whenever their outputs were measured separately. The point to be noticed is the importance of recording the output of each man separately, as a factor in "increasing of performance."

We have found that to measure the output

of each and every man separately costs but little compared with the consequent reduction in costs, even though in some cases it is extremely difficult to do. On a brick wall, for example, it has been difficult to measure accurately the output of each bricklayer, even by marking off the work into sections, and there are many disadvantages to that. Making the bricklayers throw their empty packets into individual piles and counting the empty packets in each pile hourly, solved this problem for us. Counting the empty packets of each individual bricklayer caused them to average some days as high as 375 brick laid per hour.

It is undoubtedly true, as has been said before, in quoting Mr. Gillette's paper, that doing work with gangs of workmen should be avoided. Where gangs are used, athletic contests between gangs of men arranged according to their creeds, color, nationality, or other bonds of sympathy, will increase output. But the highest scores with gangs will never be obtained unless the individual scores of each member of each gang is also kept separately.

Mr. Gillette states that "there are many classes of work that do not admit of working men in small gangs." While this may be occasionally true, it is not true as often as is generally supposed. Sufficient determination will generally discover a way of dividing up the gang so that some unit of measurement of their output or of their efficiency can be made.

We have found that the number of piles that a pile driving gang can drive in a day can be much increased by keeping records of the number of minutes and hundredths of minutes each hour that each man delayed the entire gang by such things as "not steam enough for full speed driving" or "not spare chains enough to permit hooking on immediately within the standard time allotted for hooking on," or "waiting while pile was being measured instead of having each pile plainly marked with its length." This is, perhaps, as hard an example as any, and is a desirable illustration, because it shows that the output of a gang, difficult to separate, can be separated into the output of each man, and the output of each man can be measured by the number of minutes in each hour that he did not delay any other member or members of the gang.

The discussion possible on these factors of "increase of output," that is, grouping the men properly and recording their output separately, shows plainly the immense amount of data that must be accumulated before all the laws of management can be discovered and formulated.

The experience of the members of this society, if written down in the form of instructions to managers, would contribute greatly to the world's knowledge. It would help to solve the problems that arise between the employer and the employee. It would help all of our members and it would help us to become better managers of ourselves and of our employees, who, though they sometimes do not understand us, are after all the best friends we have.

DeWitt V. Moore.—There are classes of labor in which it is perfectly feasible to produce rivalry and competition, as was so well stated by Mr. Gilbreth. But in other classes of labor, where you use large bodies of common labor, it is almost impossible to arrange matters in this way—that is, in a gang such as Mr. Gillette proposes. Where the rate is $1.50 a day, we have some good men, and some second rate men, and some who are "indifferent."

Now, grant that under ordinary circumstances, the work is important and must be accurate, even the indifferent man is of some good; we cannot dispose of him but we must keep him to do what he can do, but his influence is bad on the rest of the organization. If we then attempt to pay him in proportion to the amount of work done—granted that we can keep a record of the individual output of the man—and we pay the better man a greater rate per hour we only have trouble. This is caused by increasing the rate to the better man. In the case of every workman, especially if he is a citizen of the United States, he believes he is the equal of any and every man; and he is not satisfied with your judgment that he is not as good as the other man. So, in work of this character, the only way is to make the better man a working straw boss over the smaller gang, and thereby increase the efficiency of the small gang under him. This is the only way I have found to increase the efficiency of the individual.

It is also difficult to determine the proportion of work accomplished, except by observation of the individual men. A man might be working in a sewer trench along with a bunch of men working in the same trench, then, unless the individual is timed, you have no way of determining how much each man performs. Therefore, it is my opinion, that the only way in which this law could be applied to the heavier and cheaper grade of labor in contract work, would be by the smaller gang unit making a straw boss out of the better man.

There is another point in reference to this subject: that is, the penalty clause. I am not prepared to come to a conclusion on the matter, but it is a subject I have been thinking about for a long time. I have not as yet solved it.

For instance, in one case, a shovel gang was excavating ballast for a railroad under a contract, whereby the pit, also the switching engines and the cars were provided. At the start of the work it was arranged that the men would be paid a minimum daily wage, and would get a bonus for loading over a certain number of cars per day. It was beautiful in theory—it was an ideal pit, dry, plenty of cars, and there was every reason for the workman to earn a bonus on that job. As the work proceeded it was found that it depended upon the co-operation of the general contractor, who was to furnish the switching locomotive and the pit and the cars, and the railroad which was to provide a certain amount of the transportation of the gravel to a point fifty miles away. The general contractor provided two locomotives, but they were in bad repair, and because of his fault in that particular, the output of the gang was decreased. But more than this was the railroad sacrificing gravel shipments for their ordinary run of business. That was a difficulty that could not be overcome in any manner in our power. The railroad gave first attention to their own business, and handled the gravel business as a third-rate business. We had to abandon the bonus system on that job.

I could mention three or four jobs where the lack of co-operation, through relying upon some other party, and where the penalty could not be enforced, defeated the bonus plan with our own men. I believe thoroughly in the bonus system on some work, but there are many difficulties in applying it.

Daniel J. Hauer.—I have been greatly interested in this subject for many years, and although I have not had much experience in paying bonuses, yet I have experimented somewhat with tasks on contract work. I am a very firm believer in the task and bonus system, yet I find it must be tried out very carefully, keeping in mind many other factors that go to make up successful work. For instance, I cannot quite agree with Mr. Gillette in several of his deductions, and some of his statements. I agree with Mr. Harms that in reducing the size of a gang of men, it must be done with consideration to other classes of work or machines that you may have. The idea of Mr. Gillette, as he sets forth, of two men loading a wagon, would be a most expensive one in practice. Team-time is worth 50 cts. an hour, and man-time is $1.50 a day or 15 cts. an hour. To detain a team worth 50 cts. an hour while two men at 30 cts. were loading it up, would be a disastrous policy in an earth-removing contract. The same way with other classes of work of that kind.

I speak of this, not to discourage anyone, or to show that the bonus system cannot be applied; but it is apt to be applied by those who have not given it thorough study, to the detriment of some other element of cost.

Another thing is to decide upon what unit to pay. In many cases you could not pay rock drillers by the foot of hole drilled. If one had a large area of the same kind of rock, where the holes were spaced at equal distances, and the same class of drilling was repeated over and over again, the rock running uniform, one might choose the lineal foot of rock drilled as the unit of payment. But in the vast majority of rock blasting, these conditions are not obtained. The judgment used in placing the holes is a far more important consideration. A man might place the holes very close together, or in soft places where they were not needed. Mr. Gillette's answer is that the foreman must look to that and see that they are not so placed; but one idea of the task and bonus system is to reduce also the cost of superintendence, as this system holds men as slaves to their work, then there must be some basis of payment, so that you do not need this extra superintendence. I find that the better basis for paying in rock drilling, is by the cubic yard of rock excavated, and not by the number of lineal feet of holes drilled.

There are a few other things in Mr. Gillette's paper to which I object, believing we can obtain many of these results by fines. For instance, Mr. Gillette speaks of the engine man who would have his roller steamed up the moment that the working day began, if he is paid a bonus. If a man working for me did not have steam on his dinky engine or roller five or ten minutes before starting time, I would have some other man on his job, and mighty soon. He would have to do that to hold the job, and not because he was paid extra. However, I am a firm believer in this method of rewarding workmen.

During the past month I reduced the cost of hauling cast iron pipe six miles by making a round trip equal to one-half a day's work and two trips one day's work. That was a task, without a bonus, and the cost of hauling case iron pipe was reduced from $3.00 a ton to a little over $1.50 a ton.

W. D. Lockwood.—I believe Mr. Gillette is moving in the right direction; that is to say, "give the men more money"; that is what it amounts to. That is the view the average man takes of it.

Mr. Hauer was speaking of the wagon loading with two men, and he thought there would be a loss through the cost of the teams standing there. Mr. Gillette did not intend to leave the teams standing there doing nothing. He intended to use three wagons, say, with two teams. I have used them in that way and found there was little advantage in so working. I found it was better to let the team take a rest on the wagon, and use a slightly larger load. If I had a space of two or three minutes I would let the men rest. One yell from the foremen, and they would make the dirt fly. They did it quicker because of that rest.

The bonus system one should use depends on the locality. If you are in the south, you want a task. You put a string of "coons" down a line, with so much to do, and the coon thinks he is his own boss; that he has a piece of work, and that it is his work, and "don't you forget it," and "don't you get on my ground." And then he works and makes his dirt fly. The Poles like that, too. But the Italians do not care for it. The Italians would rather drill along eight or nine hours a day, work all day.

Now, in loading brick or handling certain materials in certain places, I do not doubt that it can be done with profit by the bonus system. I haven't had much experience in that. But take a well-managed piece of work, and have a good foreman, and your organization is working together, and you are getting good work, and then talk about increasing the output 50 per cent and you kill your men.

I differ with Mr. Gillette on the point of separating your gangs—that is, good men in one gang and poor men in another. If you put a lot of dummies in one gang, they will all get discouraged. And if you don't let

them go, the other gang will run them off the job. I believe in having a fair distribution right straight through, and working leaders. If you can get one good leader, the men cannot get out of line on a 12-in. plank, and that fellow can keep the gang going, and providing the mixer turns out the concrete fast enough, you will get a good output.

Frank B. Gilbreth.—I think Mr. Gillette is absolutely right in his statement, judged by experience of my own during the past year, where we went into considerable detail in timing the difference between this matter of having one man at the cart, and changing the horses on the cart. You will remember that I said that too much stress cannot be laid on placing every man, so that his work shows up separately. The foreman who gets the biggest opportunity with me is the man who places the largest proportion of men so their work shows up separately.

Now this matter of changing horses on the carts: On a brick job I had about a year ago, six carts were employed with two horses on each cart. Someone suggested that the cost of carts taking bricks up on the floor was much less than to have men do it with wheelbarrows. I happened to be on the job when the controversy was on, and I said, "If you fellows will let four pairs of horses and drivers go home this noon and not come back, I will guarantee to do as much with two drivers and two teams and six carts as you can do now. We backed three carts up against a conveyor with one man in each cart. It took those men about ten minutes to put the bricks in a cart so they would not spill. It took three or four minutes for the driver to haul them to the first floor of the building. There he immediately hitched on to an empty cart and returned to the freight car. The first time we tried it, it took 1.20 minutes to change a horse from one cart to another, but at the end of one day they were trained as well as fire horses, so that the best time in which we ever did it was .35 of a minute. So you see on that scheme, Mr. Gillette was absolutely right. We did as much with two drivers, two pairs of horses and six carts as we did with six drivers, six pairs of horses and six carts, for we did not lose any time in having the horses and drivers tied up while being loaded and unloaded.

Of course the argument is that the horses need the rest. Then a good argument is to say, "Let them rest in the stable." If eight hours are too long for them to work on the job, let them work seven hours and rest the other hour in the stable. We did exactly as much work. I think Mr. Gillette is absolutely right on that point.

Dewitt V. Moore.—My experience has shown me there is a difference. Now in handling brick, tile or cement from a car to a building it is very good to use two or three wagons, according to the size of loads you are hauling, and have it so timed that the team work is almost continuous, having a proper number of men in the cars to load the wagons. In hauling dirt, I never knew it to work out. It is better to load the team quickly and let it get away. The whole proposition assumes that we are working on earth work, with a large body of men, and that the teams are loaded adjacent to this work. Therefore it is a slight interruption only to load the teams. There is a difference in the class of work to be handled as to the method you should adopt.

Daniel J. Hauer.—I want to state that I agree with Mr. Gilbreth. In other words, I did not catch the full drift of Mr. Gillette's meaning. He uses the word "wagons." I took wagons to mean a wagon with two horses in it. I took it to mean teams, as I expressed it, where I mean a horse and a mule to haul dirt, coal, steel or what not.

When I disagreed with Mr. Gillette, I considered that the horses were waiting as well as the vehicle; if that is not what Mr. Gillette meant, it shows the necessity for the warning I spoke of, that one might be readily deceived in trying out this scheme if one took that to mean as I did a team and then followed the suggestion of putting two men at work loading dirt, for I know from actual records kept he would lose money on his teams.

But if he referred to the increasing of the number of his wagons and not necessarily the number of his horses, then under certain conditions, even in dirt hauling, Mr. Gillette is right.

In the past month I was taking dirt out of a railroad cut with dog scrapers. I went there for a few minutes and I said to the man in charge, "You are losing $1.50 a day on each team you are working, and I advise you to take them out." He kept them in a day or so longer, to keep his own records, then he soon decided to take them out. As we did not have wheel scrapers, I said, "Put in slat bottom dump wagons." I went out the second day after and four such wagons were at work with eight horses. The haul was 170 or 175 ft. I said, "If you put two of those teams doing something else, you will take out as much dirt and reduce expenses $8 a day." We reduced the total cost of excavating that earth the next day very nearly 5 cts. a yard, and I noticed several times in passing the work that the men were standing idle for a few moments waiting for a wagon to come up, so I suggested that we put in three wagons for each set of horses. The next day we reduced the cost, over the four wagons, 1 ct. a yard. I have tried that on long hauls for earth and have not found it successful, but on short hauls it is saving money. I believe it is necessary to have individual records, but a man working, especially at earth work, and in the handling of concrete, will not work as rapidly by himself as with another man close by. I could go through my records and give you 25 cases of that. I do not want to be understood as saying that the individual record should not be kept. That is most important of all. But if you can work two or three men at a job, close by one another, so they get a glance at one another once in a while, you will increase their work by keeping their records just as Mr. Gilbreth did with his so called athletic contest.

Design of Combination Timber, Steel and Reinforced Concrete Caissons for the McKinley Bridge, with Some Data on Methods and Rates of Sinking.

The three main spans of the McKinley Bridge at St. Louis are carried on four masonry piers founded on pneumatic caissons. The steel spans are each 517 ft. long; the piers are of concrete faced with limestone masonry and are not unusual. The caissons on which the piers are founded are novel in having a steel cutting edge and a combination timber and reinforced concrete roof and wall construction. They were designed by the contractors, the Missouri Valley Bridge & Iron Co., Leavenworth, Kan. The following description of these caissons and of the methods employed in making them are taken from a paper by C. E. Chase in the *Cornell Civil Engineer* for January, 1910.

The design for the caisson for Pier IV shown in Fig. 1 is representative of all the other caissons. The walls of all but that for Pier III were formed of 6x12 in. timbers, laid horizontally, with butt joints in the middle and halved joints at the corners, and drift-bolted together with ⅞-in. drift bolts, spaced 5 ft. c. to c. The walls were strengthened against the hydraulic pressure to which they were subjected, by 6x8-in. cross and 10x10-in. longitudinal struts, each cross brace being provided with a ¾-in. tension rod to protect the crib against the strains due to launching or pressure of the freshly laid concrete. At intersection points of the struts and also where they met the walls, 6x6-in. posts were provided. The working chamber is 7 ft. high, with 12x12-in. timbers forming the roof. The alternate timbers extend to the side walls, where they are framed in with halved joints. The other roof timbers extend only across the roof of the chamber and meet the upper ends of the timbers forming the side walls of the working chamber. These are 6x12-in., laid at an angle of 45° and framed into the wall timbers in the toe of the cutting edge. At the intersection of the sidewalls, the inclined timbers, necessarily of varying lengths, are protected against upward displacement by 5/16-in. bent plates bolted on the outside. The toe of the cutting edge is encased in ⅜-in. plate iron, composed of a 3-ft. 9-in. and an 8-in. plate on the outside of the caisson, riveted to a 3-ft. bent plate, which extends up the inclined roof of the working chamber on the inside. To protect this iron cutting edge, which was only 1⅛ in. wide, from buckling when settling on bedrock, lugs were riveted to it inside the working chamber, under which shores could be placed when settling on bedrock. These lugs, formed of ½-in. plate and filled with concrete for strength, were spaced 2 ft. c. to c. and provided horizontal bearing areas of 36 sq. ins. each. The caissons were sheathed on the outside with 2x12-in. sheeting, placed vertically and thoroughly calked with oakum.

The reinforcement of the concrete, upon which the caisson depends for its strength, consisted of two layers of ½-in. steel rods, placed longitudinally and transversely of the crib, directly over the roof of the working chamber, and of two rows of ⅝-in. rods, one placed 2 ins. from the wall timbers and the other 2 ins. from the inclined roof timbers in the V-shaped part of the caisson. These latter were provided to take the tensile stresses induced in the concrete of the cutting edge by distortion in either direction. It was intended, after depositing as much concrete in the crib as the timber roof would support, to allow the concrete to set one week, after which the layer of concrete would act as a slab, supporting further layers of concrete. However, the rate of concreting was in general rather slow, and it was considered that the concrete had set sufficiently by the time the full strength of the timber roof had been developed to allow concreting to proceed uninterrupted.

As it was assumed that considerably greater depth of water existed at the site of Pier III, the caisson for that pier was made considerably heavier than those just described. All wall timbers, struts and cross bracing were of 12-in. by 12-in. timbers and in general all the details and splicing were made stronger.

The advantages of this design for the caisson lay in the saving in the amount of timber required, the average proportion of timber to total volume being 13 per cent as against 33 per cent for wooden caissons used on another recent bridge—the saving in time and labor in construction and in the greater ease in sinking and excavating, due to the use of the iron cutting edge. The only disadvantage of the metal cutting edge is that its bearing area is so small, that bearing blocks are required to distribute the weight uniformly and prevent buckling.

The caissons were all constructed on ways erected by the contractor in Venice, Ill. These consisted simply of several rows of 12x12-in. timbers, sloping 1.75-in. to the foot, supported on piles and running far enough into the river to prevent the caissons, when launched, from grounding. The cutting edge arrived from the shop in four sections and was riveted together by hand in the field. When assembled it rested on greased skids or "butterboards" placed on the ways and prevented from sliding by planks which ran to the upper end of the ways, where they were bolted. The caisson timbers, all of longleaf yellow pine, were framed on the spot, hoisted into place with an ordinary boom derrick, and then securely driftbolted together. As soon as the roof of the working chamber was in place the first sections of the main and material shafts, 3 ft. and 2 ft. in diameter, respectively, were hoisted into place and firmly bolted down. These sections were of ⅜-in. boiler plate and were made in three lengths, 4, 8 and 10 ft., the 10-ft. sections weighing 1,800 lbs. Cast iron diaphragms were riveted into each end of each section for bolting them together. Each section could be used as an airlock when doors were properly hung in the diaphragms and valves provided.

As soon as the horizontal wall timbers were completed several courses high, the sheathing

of 2x12-in. plank was spiked into place. The edges of these planks were beveled to facilitate the driving of the oakum, with which the walls of the caisson and roof of the working chamber were tightly caulked against leakage of water and air.

Before the caissons were launched the engineers placed benches on the inside of the crib wall, at a known elevation above the cutting edge, in each corner. These were later used in finding the elevation of the cutting edge when sinking. From the center of each side of the cutting edge a perpendicular was constructed on the outside of the caisson walls, by swinging equal arcs from the corners of the cutting edge. This, after immersion, located the position of the cutting edge regardless of the irregularities of crib construction, as it was prolonged as the caisson sank. Three clusters of piling were driven at the vertices of a triangle just above the future position of the caisson in the river and tied together by horizontal piles, lashed to them. These clusters, together with two others driven downstream, provided for the control tamping was required, the men treading out the air bubbles and voids with their boots, or occasionally using a wooden tamp.

As the caisson sank lower in the water under the weight of the concrete, which was placed at a rate of about 150 cu. yds. per day, the walls of the crib were built up in courses of 6x12-in. timbers, sheathed with vertical 2x12-in. planks and caulked for several feet above the water line. As it touched bottom, a few pounds of air pressure was put on and the "sand-hogs" entered the working chamber to clean out the debris, such as old timbers, butterboards, etc., which were caught in the working chamber in launching or lay on the river bottom.

After the debris on the river bottom had been removed, the caisson was located in the correct position by the engineers, directions for movement being given by observers stationed at opposite ends of the base line. Upon small platforms at the ends of the caisson, points, whose position in reference to the cutting edge was know, were marked. The observers on shore, using the computed angles away the material from one side of the pier, or settling on inclined shores,—but very often without success, as the piers had become very heavy on account of the masonry placed to keep them above high water. Where these methods were unsuccessful in correcting the errors in position the stone shaft was later shifted slightly on the large area of the concrete foundation block, or the batter of the sides modified.

As the caisson neared the bottom, gravel and boulders were often encountered of such size that the blow pipes could not handle them. In this case a large airlock, known as the clay-hoist, was placed in position on top of the material shaft and the material locked through it. When all the debris had been cleaned from the bedrock, using the water jet, a highly polished and hard crystalline limestone was exposed. The bedrock in the bottom of all the piers was deeply corrugated and waterworn. It was drilled several feet to ensure that it was not merely a layer or ledge overlying softer strata, and preparations were then made for sealing.

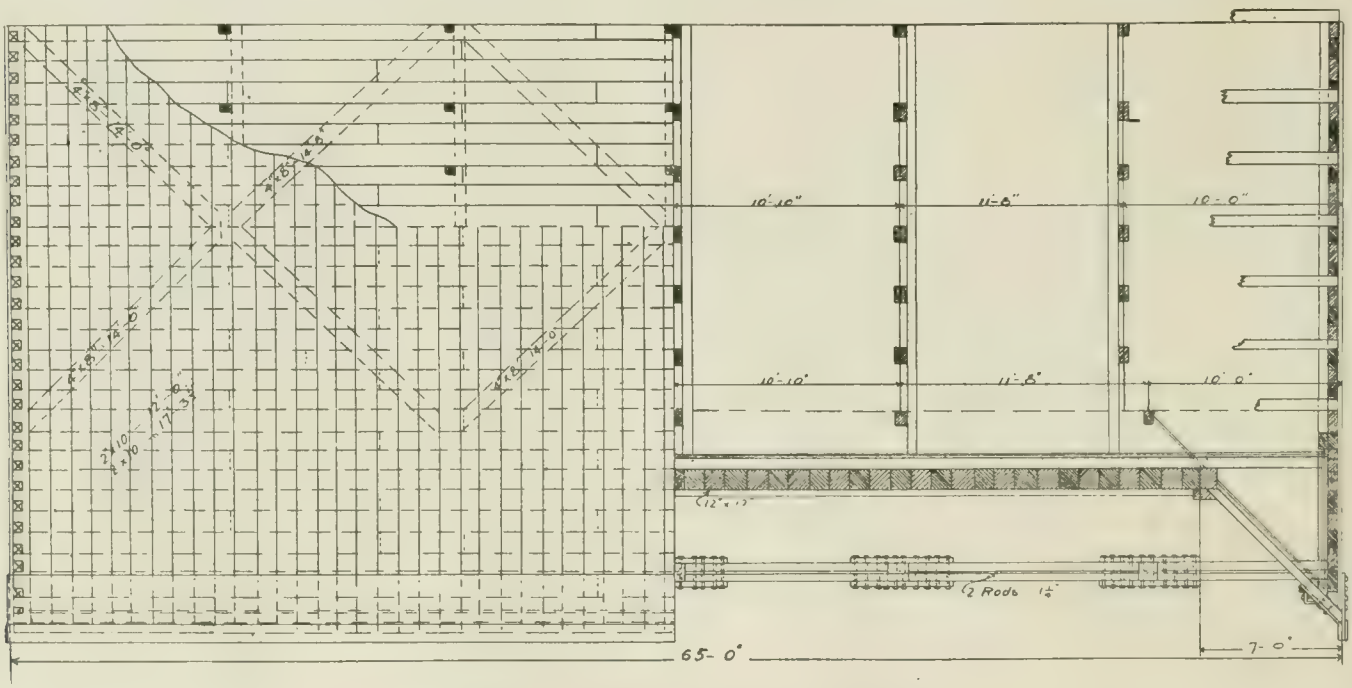


Fig. 1—Caisson for McKinley Bridge, St. Louis, Mo.

of the caisson and its adjustment into exact position, during sinking.

When all was in readiness for the launching, the timber work being only partially placed to reduce the draft required, the planks which held back the skids were sawed, eight or ten teams of sawyers working in unison, so that each skid might be released at the same instant. When but a fraction of an inch of the planks held back the caisson, jacks were tightened to increase the tension until the planks parted and the caisson traveled with rapidly increasing velocity down the ways. Lines fastened to it before launching were used to tow it to position, where each end in turn was lined into exact position by observers placed at the baseline stations on shore.

As soon as the caisson was secured in position, the contractor's fleet was moved alongside. This consisted of a derrick barge, another containing cement storehouse and mixer, and the sand and gravel barges. The greater part of the mixer barge, which was 80x26 ft., was occupied by the cement storehouse, a structure 20x42 ft., and 11 ft. high. A runway led from this to the charging platform, 4½ ft. higher. On a level with the platform was the hopper of the Smith mixer, which dumped into a bucket in a pit built into the hold of the barge, below the level of the deck. The bucket used was a very simple bottom dump affair, capacity 1¼ cu. yds., which was emptied by simply making fast the snatch line and slacking off the fall lines. The concrete used in the foundations was all 1:2½:5 proportion and was mixed so wet that very little

to the proper position of these points, located their correct position on the platform, showing the movement required to bring the caisson to place. By successively determining and correcting position, the caisson was located exactly, after which the air pressure was removed, and the cutting edge allowed to bury itself in the mud.

Sinking was then begun, to provide against movement from position by giving the cutting edge greater penetration. This was accomplished by either the dry or wet blow—the sand being forced out through pipes by the pressure of the compressed air in the chamber. In the dry blow, the sand is simply shoveled against the inlet of the pipe, which sucks it up, while in the wet blow, the end of the hose is kept submerged in a pool of water, piped down from the surface under pressure, and the sand is shoveled into the pool, or sluiced by the hose. In either case the material issues from the pipe at the top of the pier with great velocity, the stream of sand, pebbles and water shooting at times 50 ft. out over the water.

As the caissons sank, daily locations were made by the engineers, from the baseline on shore, and notice given the contractor of the amount of skew in the caisson from the true perpendicular to the bridge line and the distance north or south, or east and west that the caisson was out of its true position. The contractors then resorted to the usual methods of correcting position, such as giving the caisson and pier a lean opposite to the direction in which motion was desired, dredging

Gangs of 15 or 16 sandhogs were used, the hours of work and rates of pay for this as well as the sinking being as follows:

Depth.	Pay.	Shifts.
0- 50...	$2.50 for 8 hrs....	20 min. for lunch, time on Co.
50- 60...	2.75 for 6 hrs. .	3 hrs. on, 3 hrs. off.
60- 70...	3.00 for 4 hrs...	2 hrs. on, 1 hrs. off.
70- 80...	3.25 for 2 hrs...	1 hr. on, 1 hrs. off.
80- 90...	3.50 for 1 hr....	¾ hr. on *
90-100...	3.75 for ¾ hr...	½ hr. on *

Above prices for sinking. For concreting add 25 cts. per day to amount corresponding to depth at which rock was struck.

In the caisson the concrete was shoveled from where it dropped through the material shaft, to the ends of the working chamber, and there placed in layers or benches, built up to within 4 in. of the top of the chamber, and well tamped. The space between the concrete and the roof of the chamber was filled with mortar tightly rammed into place. As the size of the space to work in got smaller the temperature rose, probably due largely to the heat generated by the setting of the green concrete, and it was difficult to keep men in the gangs or get them to work properly. All were stripped to waist and perspiring freely, and took turns at working and refreshing themselves with ice water and the warm air, cool by comparison with the chamber atmosphere, which was pumped in. Some relief was obtained by using electric fans in the chamber and also by pumping

*Takes ¼ hour to equalize in on company time and ¼ to equalize out on own time.

the air through coils of pipe suspended in the river, before it entered the caisson.

After the space under the opening of the material shaft was filled, the concrete was locked down through the main shaft in bags and placed by the one or two men who could find room to work. The shafts were in most cases partially filled in the same way under pressure, while in one case the pressure was taken off and the concrete dumped into the shafts as rapidly as possible, to fill them before the water rose in them, which it did in a very short time, working its way through and around the concrete already placed. The pressure was always held on to allow the concrete to set for 12 hours, to avoid as much as possible any injurious effects of disturbing it after partial setting. Levels taken on top of the piers before and after the air was removed showed that no settlement occurred.

The rate of sinkage of the piers depended on the rate of the masonry construction, character of the material encountered, size of caisson, depth of water and temperature. The average rate, obtained by dividing the total sinkage by the actual number of working days was about 2.0 ft. per 24 hours, the maximum being 7.7 ft. in 24 hours in the case of Pier D. The following table gives the rates of sinkage for all the piers:

Piers	Maximum ft.	Average ft.
I	3.0	1.8
II	3.0	1.0
III	4.0	1.6
IV	4.3	2.1
C	7.3	2.5
D	7.7	4.1

After the piers had been sunk to bedrock and sealed, the remainder of the work of erecting them to their full height proceeded without incident, and without the use of any but ordinary methods and apparatus.

Before commencing work on the detail plans for the new harbor, wet dock and graving dock at Avenmouth, Bristol, England, the material was thoroughly studied upon which the massive works were to be built. Mr. A. D. Swan resident engineer for the work, in a paper read Dec. 16, 1909, before the Canadian Society of Civil Engineers, said that previous to the exact site of the works being finally settled, two cast iron trial cylinders, each 8 ft. in diameter, were sunk, one about the middle of the dock and the other at the entrance channel. By this means the nature of the various strata to be passed through before a rock foundation could be reached was made absolutely certain.

The United States Consul-General at Winnipeg, Man., says concerning the Grand Trunk Pacific, which is being built across the continent by a company under agreement with the Canadian government:

Roads and Streets Section

Note: This section is devoted to methods and costs of road and street construction. It will cover road building in all its details, the construction of pavements, sidewalks and gutters, the testing and use of paving materials and the machinery and tools used in road building and paving.

Cost of Constructing a Macadam Pavement With Concrete Curb and Gutter Manistee, Mich.*

This improvement includes one block and one intersection of street which had been originally improved by the application of 8 to 10 ins. of clay to the roadway. The land where the street is, was a swamp in former years and the subsoil immediately beneath the pavement is swamp sand. The total area between faces of curbs is 1,577.7 sq. yds. The area of concrete gutter 18 ins. wide on each side is 147.7 sq. yds., leaving 1,430 sq. yds. as the net area of macadam roadway. The length of improvement is 440.5 ft. and width between faces of curbs is 30 ft. The width between faces of return curbs at the intersection is 26 ft. The depth of compacted macadam, after rolling, is designed to be 8 ins.

The concrete curb and gutter was built by contract. The combined curb and gutter had the following dimensions. Curb, 6 ins. thick and usually 6 ins. high; gutter, 18 ins. wide and usually 5 ins. thick except at driveways where it is 6 ins. thick. The intersecting curbs are joined with circular sections of 8 ft. radius and the faces of circular curbs are protected by ¼ x 2-in. steel bands 12 ft. long, securely anchored by ¼ x 3½-in. bolts spaced 18 ins. The concrete used was a 1:2:4 screened lake gravel mixture; the finish coat, 1 in. thick, was a 1:2 gravel screenings mixture, the gravel being screened through a ¼-in. mesh. In proportioning, 1 bag of cement was assumed to be 0.9 cu. ft. The gravel cost $1.75 per cu. yd. delivered on the work. The cost of this gutter was as follows:

Item.	Total.
Setting grades (engineering)	$ 18.60
886.2 lin. ft. curb and gutter	332.32
886.2 lin. ft. sub-base 12 ins. thick	8.86
48 lin. ft. steel band	5.76
Total	$365.54

This gives a cost of 41.25 cts. per lin. ft. of curb and gutter completed. There is 0.875 cu. ft. of concrete per lineal foot, so that the cost of concrete work was $332.32 ÷ 28.8 cu. yds. = $11.54 per cu. yd. The cost of concrete curb and gutter alone was $332.32 ÷ 886.2 lin. ft. = 37.5 cts. per lin. ft.

The macadam pavement was constructed by the city by day labor. The work was done under the city surveyor as manager and the street commissioner in direct charge as superintendent. The commissioner was not on the job continually but enough every day to see that the work was properly and well done. The time of men and teams was kept by the street commissioner on blanks for the purpose. One blank was filled out daily by the commissioner (Fig. 1) and every few days the data from these blanks were transferred by clerks to similar larger blanks. The day's work was 10 hrs., for which the men were paid wages ranging from $1.50 to $2 per day, depending upon experience and ability. The city owns two teams, one driver of which receives $1.50 per day and the other, who is also caretaker at the city's barn, receives $45 per month. The labor of these teams is charged to improvements at the rate of $3.50 per day and the "Team Account" is credited with a like amount. All hired teams received $4 per day. Crushed, dolomitic lime stone was delivered on the city's dock for $1.15 per cu. yd., in cargoes of about 700 cu. yds. Each improvement using stone was charged, in addition to the actual cost of the stone, 5 cts. per cu. yd. for dockage. The stone was hauled in common wagons, with dump boards and 20-in. sideboards. The haul was exactly 1¼ miles and all of it over paved streets. The loads were hauled up an 8 per cent grade for the first 200 ft. from the dock, then over practically level streets, slightly ascending, for two blocks, then up a 5 per cent grade for one block, then a 4 per cent grade for another block, making in all a rise of 35 ft. in the first 1,900 ft. From this point to the work, 4,700 ft., the grade was all descending with a total fall of 39 ft.

The costs of the work are first itemized for each class and then the classes are summarized.

Excavation and Grading.—The excavation averaged about 10 ins. deep, or about 1 cu. yd.

*Rearranged from data furnished by Geo. B. Pike, City Surveyor, Manistee, Mich.

Herman Long ..... Labor Account for the 1 t Half, Month of August, 1909 Per Day 1 75

Date	Street Dist's 1 2 3 4 5 6 7	Ramsdell St Pav	Pine St. Hill Ac.	Gen'l St	Gen'l Sew	Arthur St. Pav	River St. Pav	Cleve. St. Pav	Labor Performed.
2		1							Grading Stone
3		1							"
4		1							"
6			½	½					Loading clay / Cleaning off city dock
6		1							Grading Stone
7		1							"
9		1							"
10		1							"
11		½		½					Cutting Weeds city hall max
12		1							Grading Stone
13		1							"
14	½ ½								Loading sand / Grading W. end St.
16					½				Cleaning Inlet
17				1					Grading
18					1				Grading

Fig. 1—Blank for Keeping Daily Records.

for each 3.5 sq. yds., making 410 cu. yds. The items of cost were as follows:

Item.	Total.	Per cu. yd.
Team 7½ dys at $3.50	$ 26.25	
Team 2 dys. at $4	8.00	
Total teams	$ 34.25	$0.083
Labor 25½ dys at $1.75	$ 44.20	
Labor 16¼ dys at $1.50	24.37	
Total labor	$ 68.57	$0.167
Grand total	$102.82	$0.250

The cost per square yard of pavement (net area) was $102.82 ÷ 1,430 sq yds. = $0.0719. The average cost of teams per day was $3.605 and the average cost of labor per day was $1.642.

Hauling and Loading Stone.—A total of 549 cu. yds. of stone were hauled. Of this amount, 528 cu. yds. were used in the macadam proper and 21 cu. yds. were used in the tarvia surfacing. Of the macadam stone, 82 per cent was 1½ to 2½-in. stone and 18 per cent was material ranging from dust to ¾-in. size. The tarvia surface stone was all of the finer material. The cost of loading and hauling this 549 cu. yds. of stone was as follows:

Item.	Total.	Per cu. yd.
Team 53¾ dys. at $3.50	$ 20.12	
Team 26¾ dys. at $4	107.00	
Total team	$127.12	$0.232
Labor 28½ dys. at $1.75	$ 49.90	
Labor 1½ dys. at $2	3.00	
Labor ¼ dy. at $1.50	0.38	
Total labor	$ 53.28	$0.097
Grand total	$180.40	$0.329

It will be seen that 549 cu. yds. of stone were loaded in 30¼ man days, or 18.15 cu. yds. per man per day. The number of loads hauled was 274 so that each load was closely 2 cu. yds. The length of haul was 1¼ miles, so that each team traveled 2½ miles per load or for 274 loads the total distance traveled was 685 miles. There were 32½ team days worked, which gives an average travel of 21.08 miles per team per day. In this work the average cost of teams per day was $3.911 and the average cost of labor was $1.761 per day.

Macadamizing.—The costs of macadam stone and of hauling, grading, rolling and sprinkling were as follows:

Item.	Total.	Per sq. yd.
Material:		
433 cu. yds. stone (1½ to 2½ ins.) at $1.20	$519.60	
95 cu. yds. stone (dust to ¾ in.) at $1.20	114.00	
Total materials	$633.60	$0.4431
Labor:		
Loading and hauling 528 cu. yds.	$173.50	$0.1213
Grading, 34¼ days at $1.75	59.95	
Grading, 3½ days at $1.50	5.25	
Total grading	$ 65.20	$0.0456
Rolling, 8¾ days steam roller at $7	$ 61.25	$0.0428
Sprinkling team 1 day at $4	$ 4.00	$0.0028
Total labor	$303.95	$0.2125
Grand total	$937.55	$0.6556

A total of 528 cu. yds. of stone were used for 1,430 sq. yds. of 8-in. pavement; 528 cu. yds. of loose stone made, therefore, 317.7 cu. yds. of stone compacted, or there were required for each 1 cu. yd. of stone compacted 1.67 cu. yds. of loose stone. The item grading in the above costs includes all labor performed in helping the teamsters unload wagons, spreading stone and screenings and finishing the surface while the roller was working. The steam roller averaged 164 sq. yds. completed per day.

Tarvia Surfacing.—In applying the tarvia, the street was thoroughly cleaned by hand, ordinary bass fiber push brooms being used for this purpose. The stone dust and screenings gathered by these brooms were swept from the center to each side and deposited upon the concrete gutter. Enough more stone, running from dust to ¾-in. size, was hauled and placed upon and along the gutter so that the total amounted to approximately 1½ cu. yds. to every 100 sq. yds. of macadam pavement. The tarvia was heated in a kettle, with fire box underneath, mounted on four wheels, which is so constructed that one or two barrels of tarvia may be placed on top of the kettle and allowed to run slowly into it, while the hot tarvia is being drawn and spread upon the street. The kettle has connection, with valve, for 1½-in. rubber steam hose about 20 ft. long. The tarvia was applied by opening the valve and allowing it to flow from the hose, when it was spread over the pavement with push brooms, using a pulling motion most generally.

The gang was composed of 6 men and 1 boy, to wit: One kettleman, whose duty it was to tend the fire, keep sufficient tarvia in the kettle and work the valve; one hoseman, who held the unconnected end of the hose close to the pavement, and gradually moved it about over the street; two men with brooms spreading the tarvia; two men with brooms cleaning pavement ahead and also spreading a light sprinkling of stone over the tarvia as soon as it was applied, and one boy leading horse that was used to pull the kettle along the street.

After the tarvia was all applied, the entire gang was used to spread screenings and the roller then finished up the work; two men remaining on the street, as long as the roller worked, in order to apply extra screenings as necessary. "Screenings" as here used means stone running from dust to ¾-in. in size.

The cost of the tarvia surfacing was by items as follows:

Tarvia and Fuel:	Total.	Per sq. yd.
New tarvia used, 680 gals. at $0.065	$ 44.21	
Old tarvia used, 35 gals. at $0.065	2.21	
Fuel used in heating tarvia	1.75	
Total	$ 48.17	$0.0337
Tarvia Labor:		
Team labor, ¼ day at $4	$ 1.00	
Hand labor, 3 days at $2	6.00	
Hand labor, 7 days at $1.75	12.25	
Hand labor, 1½ days at $1.50	2.25	
	$ 21.50	
Boy labor, 1 day at $0.50	$ 0.50	
Total	$ 22.00	$0.0154
Tarvia Stone:		
21 cu. yds. (dust to ¾-in. size) at $1.20	$ 25.20	
Labor, loading and hauling stone	6.90	
Total	$ 32.10	$0.0224
Rolling Stone:		
Steam roller, 1½ days at $7.00	$ 10.50	$0.0073
Total cost of tarvia work	$112.77	$0.0788

The amount of tarvia used per square yard of pavement was ½ gal.

Sewer Work, Catch Basin Repairs and Setting Inlets.—In connection with the pavement work proper there were the following items of miscellaneous construction:

Team labor, 1 day at $3.50	$ 3.50
Team labor, ¼ day at $4.00	1.00
	$ 4.50
Hand labor, 4½ days at $2.00	$ 9.00
Hand labor, 11¼ days at $1.75	19.68
Hand labor, ½ day at $1.50	0.75
	$29.43
Cement, brick and castings	$15.80
Grand total	$49.73

Summary.—Summarizing the above costs we have the following costs per square yard of pavement:

Item.	Per sq. yd.
Excavation and grading	$0.072
Crushed stone	0.442
Loading and hauling stone	0.121
Spreading stone	0.046
Rolling macadam	0.043
Sprinkling macadam	0.003
Tarvia surface	0.079
Total	$0.808

These costs do not include anything for use and depreciation of tools and appliances or any charges for superintendence.

Notes On Road and Street Work.

Work of the Municipal Asphalt Plant of San Francisco.—During the seven month period from March 1, 1909, to September 30, 1909, the municipal asphalt plant of San Francisco turned out 151,238 cu. ft. of asphalt binder and 159,750 cu. ft. of asphalt wearing surfaces, a total of 132,266 sq. yds. of asphalt pavement were laid during the period, the detailed cost being as follows:

	Total.	Per sq. yd. pavement.
Material for binder	$ 21,702	$0.164
Material for wearing surface	43,790	.331
Labor at plant	13,622	.103
Plant expenses	5,480	.041
Labor, teams, etc., on street	41,009	.310
Total	$125,603	$0.949

The binder material cost about 14.3 cts. per cu. ft. and the surface material about 21.1 cts. per cu. ft.

Some Costs on Testing Road Materials.—The Bureau of Research of the New York State Commission of Highways has charge of the tests of all materials submitted for use upon the roads constructed in that state. In a preliminary report to the State Legislature a brief resume of the work of the bureau is given and from this we have taken the notes that follow: During the year 330 samples of stone proposed for use on 110 separate roads aggregating approximately 600 miles were tested in the laboratory of the bureau. This material was from all parts of the state and of many different classes of stone. The cost of stone sampling was $8.55 per sample including the cost of collection of each sample. The average time necessary for making tests was five days. The bureau also sampled and tested 2,003 samples of cement representing 20,030 bbls. of cement from a total of 163 lots. The cement was used on 95 roads throughout the state. Forty-eight samples were rejected. The cost of the testing averaged 5 cts. per barrel of cement used. Of bituminous materials 2,640 samples comprising 721 lots were tested: 496 of these lots were of asphalt and road oil representing in round numbers 2,900,000 gals., while 225 lots were of rock asphalt taken from 205 carloads, approximately 8,100 tons. The cost of this sampling was at the rate of $8.05 per lot, or approximately 7¾ cts. per barrel of material represented by the test. Of this, 4 cts. was laboratory work and 3¾ cts. represented the cost of factory sampling and office expenses properly chargeable to this test.

Repairing Asphalt Pavement by the "Heater" Method.—During [illegible] of 1908 the engineer department of the District of Columbia made some tests on repairing and resurfacing asphalt pavements by the Lutz heater system. By the use of a large patented heating machine the old surface is heated through and the upper crust taken off; new asphalt material is then placed on the surface

DETAILS IN REPAIRING ASPHALT PAVEMENT BY THE LUTZ HEATER SYSTEM.

Test No.	Asphalt per load	Cart loads of asphalt	Area in sq. yds.	Total sq. yds. covered	Sq. yds. per cart load	Time of starting heater (average)	Total time of heater in use	Average time of heating 1 sq. yd. per cart load, minutes.	Max. time of heater per cart load, min.	Min. time of heater per cart load, min.	Cost per sq. yd.
[illegible]	6¾	39	1¼	1790	30½	8:40 a.m.	36	36 3/5	75	5½	$0.63
E	[illegible]	102	1⅛	3419	33½	8:28 a.m.	88	52	72	8	.61 2/5
[illegible]	10	50½	1 3/10	1463	29	8:00 a.m.	44	52	65	3½	.71
K	6½	41	1 1/10	1475½	34⅜	8:00 a.m.	28	39	..	2	.60
[illegible]	6 9/10	101	1 1/10	3610½	36	8:00 a.m.	75	44½	..	6	.57½
M	9½	42	1 1/10	1454	34½	8:15 a.m.	41	59	..	4	.59½
General averages	7 4/5	39½	1 1/10	13212	33¼	8:14 a.m.	*312	47	†75	29*	.61 9/10

*Total. †Highest.

and rolled. According to the annual report of the engineer commissioner for the last fiscal year good results from the use of this method are being obtained and it is believed that this method of resurfacing will prove more economical than the old method of removing the top surface by cutting out. Through the kindness of Captain E. M. Markham, assistant to the engineer commissioner, District of Columbia, we are enabled to give the accompanying table showing a summary of the details of the work of repairing asphalt pavements by the heater method. The work was paid for by the cubic foot of material furnished and used, measured in carts at the site of the work, the rate being 70 cts. per cu. ft. for asphalt top material and 25 cts. per cu. ft. for asphalt binder. The average thickness given in the table is the thickness before rolling. All the streets repaired were sheet asphalt, except 18th street, which was asphalt block. In the work a total of 397½ cart loads of asphalt top surface at $20.58 per load, and two cart loads of binder at $6.45 per load were used.

Concrete Road Construction in Wayne County, Michigan, with Some Data on the Cost.

Wayne County, Michigan, now has a little over 1¾ miles of concrete roadway, and it is stated to be giving such excellent satisfaction that the county commissioners propose building eight or ten additional miles during the coming summer.

The first concrete roadway of the county was constructed on the Woodward Ave. road. This road is in the suburbs of the city of Detroit and is subjected to a very heavy traffic. The roadway was laid in two courses, 24 ft. in its narrowest width, the concrete portion being 8 ft. wide and 6½ ins. deep. The first course was made of 1—2½—5 Portland cement, sand and limestone, 4 ins. deep, and the second course of a 1-2-3 mix of Portland cement, sand and crushed cobblestones, 2½ ins. deep. It was in 25-ft. sections. Several kinds of experimental joints were used in the construction of this road. Two thicknesses of 3-ply tar paper were used in some sections, a southern pine ½ in. thick was used in other sections, a composition of asphalt, still wax and pitch was tried in still other sections, and in other sections the edges were protected by an angle iron embedded in the concrete and filled in with the above composition. The section was one mile long and was constructed by contract, the contract price being $10,200.70. The total cost of the road was as follows:

Concrete, contract	$10,200.70
Open ditch, labor	153.05
Tile drain, labor	376.62
Tile drain, material	312.41
Inspection, building shoulders and all other items	2,494.81
Total cost	$13,537.59

Last year a section of concrete roadway 2,652 ft. long was constructed on the Wayne road south by day labor by the Board of County Road Commissioners. Wayne road south is one of the main highways into the village of Wayne, a place of about 2,000 population, situated about 18 miles from the city of Detroit. The subsoil on which the concrete roadway was built is a light, sandy mixture. The road was built 16 ft. over all, 10 ft. being of concrete, the shoulders abutting up to it being a combination of gravel and limestone. The accompanying cut shows a cross section of the road.

A 1—2—4 mixture was used, the concrete begin put down 10 ft. wide and 6 ins. deep. Washed pebbles over ¼ in. in size and passing through a 1½-in. mesh were used. Expansion joints ¼ in. thick of 3-ply tar paper were put in every 26 ft. The surface of the road was finished rough and gives good traction to both horses and motor vehicles.

The cost of the concrete roadway proper was $3,214.41, or $1.09 per square yard. This is at the rate of about $6,400 per mile for a 6-in. concrete roadway 10 ft. wide. The above cost does not include the costs of drainage, building the shoulders, nor grading.

The labor cost of the work was $1,327.43, or about 45 cts. per square yard. This includes the cost of a night and a day watchman for two weeks after the concreting was finished.

The cost of the concrete materials was as follows:

Washed pebbles, 658 tons at 99 cts.	$ 651.42
Sand, 375 tons at 71 cts.	270.75
Cement, 781 bbls. at 99 cts.	773.19
Total concrete materials	$1,704.33

The price for concrete materials is f. o. b. the road commission's siding. The average length of haul was ½ mile. In addition $100 was paid for the rental of a concrete mixer.

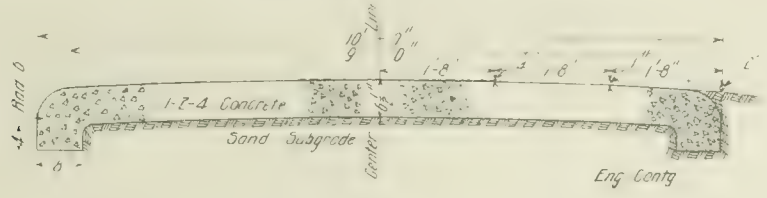
The wages paid on the work per 9-hour day were as follows:

Subforeman	$3
Watchmen	2
Laborers	2
Teams	4

The members of the Board of County Road Commissioners and the engineer superintended the work. The common labor was largely incompetent, the work being done outside of a small town, and there being no idle men available. The men were brought out from Detroit, being recruited largely from the free employment bureau in that city.

Weather conditions were very unfavorable, the road being constructed late in the fall, necessitating the use of hot water in the mixing of the concrete. Gravel and sand also had to be thawed out every morning before being available for use. Heavy and continuous rains delayed the work for several days, so that, while the road was actually built in 12 days' time, 18 days really elapsed between the time of starting and finishing, which necessitated the payment of watchmen for the extra time consumed. There was also an extra expense for covering the work with straw and manure.

We are indebted to Wm. Murdock, member of the Board of County Road Commissioners of Wayne County, for the above information.



Section of Concrete Road, Wayne County, Indiana.

The Maintenance of Dirt Roads.

Of the total mileage of roads in this country over 90 per cent are the ordinary dirt road and this type of road will for many years continue to be the practical form of construction throughout all sections of the country. In an address before the Cornell Society of Civil Engineers, Mr. Charles H. Hoyt, superintendent of road construction, U. S. office of public roads, discussed the dirt roads as follows:

A word about the long abused dirt road, and by dirt road let me explain that I mean the ordinary country roads that have been built and worked by town officials for the past centuries through any kind of material that happened to be encountered from sods, gravel, sand, boulders, clay, soil or mud.

The dirt road is a good road so long as it is dry, smooth and hard—three conditions that we do not get all at once for very long periods of time. It is beyond the province of man to say when it shall rain or when it shall not rain; therefore, to a certain degree it is not possible for us to keep an earth road dry.

It is possible for us, however, to put our earth roads in such locations and to build them of such cross-section, and to build ditches and culverts of such design as will keep the water away from the road as much as possible.

The great trouble with miles and miles of earth roads throughout this country is (I don't know just how to express it unless I say) the stupidity of their location and their care. I would like to repeat that the great trouble with miles and miles of earth roads throughout this country is the stupidity of their location and their care.

You just look at a poor stretch of earth road and you will often find that it is lower than the surrounding land on either side. That is, the road is a natural ditch, built by man, for acres and acres of surrounding land. Water that falls in the road cannot get out except by evaporation or soaking into the ground, and just as much lower as the road is than the adjoining land, it is just so much nearer the ground water line and therefore more wet. The water from the adjoining land runs or sinks into the road and stays there until it dries out.

Do you wonder that the road is muddy, spongy and soft, and that an empty wagon is about all that a team can draw over a road that is in this condition for various lengths of time throughout the year? Another condition is when the road dries hard, the ruts are deep and the road is rough. This rough condition often occurs in the fall of the year when the road freezes after a muddy spell.

Suppose these ruts had been leveled off with a split-log drag before the road baked or froze hard. Then the road would have been smooth and hard and in good condition for a time. The split-log drag is a very simple affair; costs about $2 to build, is economical to use, and every farmer or teamster living along a country road, who is interested in having the road past his place kept in good condition and is also interested to keep highway taxes down, should have a split-log drag.

Suppose that every such farmer or teamster had one of these drags and would drag the road in front of his own property after each rain or when ruts had formed. It might take him from one-half hour to an hour occasionally throughout the season. After the road has once been built in proper shape it is surprising how good the road may be kept by using split-log drags as suggested.

Now, the practical lesson of all this is—study the drainage of your road; keep the water away from it by ditches and culverts, and don't look just in the road. Study the surrounding land and turn the water away from the road before it gets into the road. Open up ditches for hundreds of feet away from the road, if necessary.

Grade your roads up higher than the adjoining ground. Keep the center of the road 6 to 8 ins. higher than the sides, and from 1 to 2 ft. higher than the side ditches, so that the water will run from the road to the side ditches and then along the road in the side ditches and not in the road. Give the dirt road a chance with intelligent care and it will surprise you.

It is an easy matter to talk about our country roads, and no one appreciates more keenly than I do, the difficulties and the responsibilities that our town highway officials have been struggling with during the past years. We must recognize conditions as they exist and meet them in a practical way, otherwise our talking will do no good. The average amount appropriated for repairing country roads in the United States is about $37 per mile. This is not enough, especially if it is worked out by day labor. There may be places where less than $37 per mile will do very well, but there are a great many places where $37 per mile is not sufficient. It is useless for us to talk about better roads unless necessary funds and skilled supervision are provided.

Water-works and Sewer Section

Note: This section is devoted to methods and costs of constructing sewers and water-works. It will cover the construction work for all details of water supply and sewerage, including sewage purification and water filtration.

Results Achieved in Reducing Consumption of Water in Washington, D. C.

In ENGINEERING-CONTRACTING for Dec. 22, 1909, some data were given on the reduction in per capita consumption of water in Washington, D. C., taken from the report on the filtration plant. The report of the superintendent of the Water Department for the year ending June 30, 1909, gives some very interesting information on the matter and shows how the savings were made.

The reduction in water supplied amounted to 13 gals per capita, the total mean daily consumption being reduced from 64,500,000 gals. to 61,200,000 gals. with a population increase of 6,000. These gratifying results are attributed to three causes: The location and stoppage of underground leaks, careful house to house inspection, and increased use of meters.

During the year underground leaks and illegitimate use of water were discovered and corrected, aggregating a flow of 9,551,000 gallons a day. On a diagram accompanying the report the population line from 1896 to date is almost straight. The per capita consumption increased very slightly from 1896 to 1900, the line representing it meeting the population line, showing the ratio increase in per capita consumption to be decreasing. The total consumption ratio increased rapidly to 1898, from which date it was parallel with the per capita consumption until 1900, after which date both lines rapidly parted from the population line, but remained parallel until 1904. In 1900 the population in round numbers was 283,000, the per capita consumption was about 172 gals. daily and the total daily supply was approximately 49,000,000 gals.

In 1904 the population was 309,000, an increase of about 9 per cent. The per capita consumption was 201 gals., which, taking the 9 per cent population increase into account, was a per capita increase of nearly 30 per cent. The total daily consumption was 63,000,000 gals., an increase of nearly 30 per cent. In 1904 the local inspection work commenced to increase in efficiency so that the per capita consumption remained practically constant, although the population continued to increase, which brought the per capita line and the population line closer together, while the total consumption line paralleled the population line. In 1906-7 a fund became available for a systematic underground survey for leaks as well as for the general installation of meters. From this point the per capita and total consumption lines drop sharply, while the population line increases at a practically constant rate. In 1908-9 the per capita consumption has dropped to 178 gals. and the total daily consumption to 61,200,000 gals.

Had the use of water continued to increase at the rate which prevailed from 1900 to 1904, the present daily average rate would be about 81,000,000 gals. instead of about 61,000,000, with a per capita of 235 instead of 178. In the absence of special preventive and corrective measures there is no reason to doubt that the rate would have so increased, especially as available water pressures throughout the district average more than 100 per cent higher than in 1896. (The foregoing statement is made by the superintendent, but he fails to state how much of the increase in pressure is due to stoppage of leaks. It has been found in all waste and leak surveys that an increase in pressure is one of the first results noticed after waste is stopped.—Eds.) A mean daily rate for the year of 81,000,000 gallons would mean a maximum daily rate during cold weather of about 125,000,000 gallons, the capacity of the present conduit being only 90,000,000 gallons.

A division of tests and experiments has been established. The work of this division was shown in the increased economic efficiency of the pumping station. The "station duty" secured averaged 95,600,000 ft. lbs. of work for each 100 lbs. of coal burned, an increase of 17.7 per cent over the duty obtained during the preceding year. This represents an annual saving of 643 gross tons of coal and there is every indication that there will be a still further improvement.

It is interesting to note that 14 per cent of the entire flow is supplied to the District of Columbia. This being the case it would appear that the per capita supply is not so great after all when comoared with other cities. The question naturally comes up as to accounting methods in American cities. Assuming that 14 per cent of a total daily supply is put to public uses and 40 per cent to leakage and preventable waste due to incompetence or inefficiency of officials in charge, or due to parsimony of the men who apportion funds so that officials in charge cannot do their work propertly, how much water is actually used per capita? In reporting per capita consumption is it figured alike in all cities as the total daily consumption divided by the population or do some officials first deduct water used for public purposes?

There were 1,555 leaks repaired, evidence of which appeared on the surface of the ground, and these were in addition to leaks found by the underground survey. Only 41 of these leaks were on trunk mains, the remainder being on service lines.

The underground survey found the most fruitful source of underground waste was in the service pipes, although the leaks on the mains represented a large percentage of the total amount, 5,214,015 gals. per day being chargeable to service pipes and 1,750,120 gals. to the mains. On the services the two principal causes of leakage were corrosion of black iron pipe, wiped joints or lead services and lead connections on iron services. Defective wiped joints were generally due to inferior workmanship and a number of cases were found in which the condition of the pipe indicated an overheating during the process of wiping. It might be generally stated that leaks on service pipes usually occur through inferior material or inferior workmanship, two things that may be guarded against by proper inspection.

Damage due to settlement was confined almost entirely to the iron pipes, lead services being rarely affected by this condition, and in the few exceptions the breaks were at the joints. The effect on the iron pipe was the fracture both laterally and longitudinally along the seam. Of the leaks on the mains more than 50 per cent of the waste was through the calked joints. This condition was due to the poor workmanship on the old mains (an insufficient quantity of lead having been used), to unequal settlement of the pipes and to the vibration of mains caused by their proximity to street car tracks. An open 3 inch sewer blow off valve was found and closed, the waste amounting to 737,000 gals. per day. As this valve was unrecorded, the waste might have continued indefinitely. A number of unrecorded mains and valves were discovered on the underground survey, so the indirect benefit was large.

The total waste found and prevented amounted to 9,560,634 gals. per day, nearly 16 per cent of the present total daily supply. This figure represents only the leaks radically cured, leaking fixtures and leaks where permanent repairs were impossible are not included. Leaks in this latter class, composed principally of defective house and yard fixtures, were referred to the water registrar's office for disposition. In this connection it is of interest to note that of 27,758 houses inspected, 4,621, or over 16 per cent, were found with defective fixtures. Special attention was given to the cutting off of abandoned water services at the tap in the main, thus eliminating a continual source of trouble from leakage due to old pipes. During the year 1,032 services of this kind were cut off. On page 354, Vol. XXXII (1909), of ENGINEERING-CONTRACTING this point was discussed in connection with the Chicago water waste survey. It was found that the custom generally was to hammer the ends of the lead service pipes instead of turning off the water at the main. In Boston also (p. 495, Vol. XXXII, ENGINEERING-CONTRACTING) these old imperfectly closed house services were found to be a great source of loss.

The value of the common house meter as a protection to the consumer is well shown in Washington. If an abnormal use of water is indicated by the meter in large houses where considerable water is used, the occupant is notified by card to that effect and the case is dropped. If the consumption is found to be excessive in medium sized houses a notice is sent to that effect. If after a reasonable time no change is observed an examination is made and if leaks are found the occupant is again notified that if this condition is allowed to continue large bills will naturally result.

A third class of houses consists of small houses which are generally occupied by irresponsible parties. In such cases where an extraordinary wastage of water is found the supply is discontinued after one notice has been served. In the first two classes of houses the owners cooperate promptly with the water department as a rule, but the principal waste is traced to the occupants of the small houses and considerable trouble is experienced. The report gives the case of one house to illustrate the efficiency of this system of supervision. The registration of the meter in a small house indicated an extraordinary consumption since last reading, and on examination of the premises a hydrant was found running nearly full head, in addition to other leaks of a minor character. Notices were served on both occupant and agent and the water promptly cut off. Had this wastage been allowed to continue to the end of the year, 5,721,970 gals. of water would have been consumed (based on the actual meter measurement) and the bill would have amounted to $228.88. In many instances several leaks were found on one service by means of the meter. In some cases as many as six repairs have been made in as many months. In no way can such conditions be controlled except by meter, without great expense; and then, too, the fact that all water that passes through the meter must be paid for is an enormous factor in bringing about speedy repairs and a reasonable use of water. In a majority of houses that pay in excess of the annual minimum rate, leaks have been found which were only remedied after a warning from the water department, and the bill for excess has been rendered. It is safe to say that all leaks in those premises hereafter will receive the prompt attention of the occupants.

The following shows the average cost of installing a meter:

Meter	$ 8.50
Material	5.00
Labor	2.44
Total	$15.94

The force engaged in installation is as follows: A man in charge, who also has charge of taking out and resetting meters for test and repairs, and repairs to service pipes; therefore only half of his time and the cost of the horse and wagon used by him is properly chargeable to installation. In addition to the man in charge the force consists of 1 plumber, 5 laborers, 1 2-horse wagon and 1 1-horse wagon.

Relative Cost of Municipal Work Done by Day Labor and Contract.*

BY HARRISON P. EDDY.†

Among the various lines of investigation carried out by the late Boston Finance Commission were several which threw considerable light upon the relative efficiency of the contract and day-labor systems and some of the causes of the inefficiency of the day-labor forces of the city of Boston. An effort was made to ascertain as nearly as possible the actual facts in all cases, and to reduce the conditions to figures, thus eliminating opinions. The results of these investigations are, therefore, interesting and important, as showing the results of conditions surrounding city departments, and not as exploiting theories of ideal conditions which are rarely found in any city. While most of the data refer to the city of Boston, it is believed that the lessons drawn from them are typical, and that similar results would be obtained from like investigations in many other cities.

Relative Prevalence of Contract and Day-Labor Systems.—In order to ascertain the general municipal practice throughout the country in building water works and sewerage systems, a postal-card inquiry was sent to all cities in Massachusetts, and to all cities in the country exceeding 30,000 in population, as shown by the Census Bureau in 1905. The results of this inquiry appear in Tables I and II. The questions were so worded as to apply only to ordinary extensions, and it is probable that in some cases work upon new systems may have been done by contract, while ordinary extensions were made by day-labor.

Postals were sent to 154 cities, and replies relating to sewerage systems were received from 73 cities, and relating to water works extensions from 58 cities.

Of the 73 cities making replies to the inquiries relating to sewerage systems 52 or 71 per cent were found to be doing this class of work wholly by contract. Of the cities located outside of New England 94 per cent were found to be doing their work by contract, while but 67 per cent of the cities in New England outside of Massachusetts were using this system, and in Massachusetts only 6 per cent. The prevalence of the day-labor system in Massachusetts is very strikingly shown by these figures, which it should be noted, are based upon replies from all of the 18 cities to which inquiries were sent. Putting it in another way, of the 18 cities in Massachusetts 1 was doing its sewer work wholly by contract, while 17 were doing similar work wholly by day labor.

Replies to the inquiries relating to water works extensions were received from 58 cities, and of this number 33 per cent were found to be doing the work wholly by contract. Outside of New England 48 per cent of the cities have adopted the contract system, while in Massachusetts of the 15 cities making reply to the inquiries all were found to be doing the work by day labor. The results of the inquiries relating to water pipe extensions are very similar to those relating to sewer construction, and both show very clearly that the day-labor system is very widely adopted in Massachusetts, and is much more prevalent in that state and in New England than throughout the remainder of the country.

Comparative Costs of Day-Labor and Contract Sewer Work in Various Cities.—A comparison was made of the cost of building sewers in cities where work was known to be done by day labor with that in other cities where similar work is done by contract. These comparisons were confined to New England cities, and very largely to cities in Massachusetts.

To make this investigation less difficult and reduce the element of uncertainty as much as possible, the inquiry was confined to small pipe sewers from 8 ins. to 12 ins. in diameter. Since most sewers of this class built in Boston have been constructed under contracts (largely "gift" or non-competitive contracts), the number available for comparison was smaller than was desired. As the difficulty in selecting work done under comparable conditions was fully realized, and as such selection could only be made by engineers familiar with local conditions, an assistant was sent from place to place to interview the local engineers, who always very kindly, and at times at considerable inconvenience to themselves, carefully considered the conditions surrounding a large number of pieces of work, and advised which should be selected for use in this comparison. The number of sewers selected in each city was small, but included all which could be classed as being built under conditions enabling fair comparison within the last few years. While it is realized that this study may be criticized as being based upon fragmentary and possibly insufficient data, it is presented as comprising the best data which could be obtained after a long and earnest effort to get at the truth. Unfortunately, in no city except Boston was this class of work found to be done both by day-labor and by contract, so that comparisons between the two methods in the same city were impossible, with the single exception noted. The results are shown by Table III.

These investigations were made in 17 cities, 13 of which do their work by day-labor (including Boston which does part of its work by day-labor and part by contract), and 5 (including Boston) which do the work by contract. The average cost of building 12-in. sewers in 12 cities was found to be $2.17 per lin. ft., while in the city of Boston similar work appeared to cost $5.20 per lin. ft. Like work done by contract was found to cost on the average $1.82 in four cities, while in Boston it cost $2.35. The average cost of labor and teaming in cities, exclusive of Boston, where the work was done by day-labor, was $1.34 per lin. ft., while in the four cities doing work by contract this cost averaged $0.75 per lin. ft., while upon that done by contract it was $3.50 per lin. ft., while upon that done by contract it was $1.05 per foot, a reduction of 70 per cent.

In Tables IV and V the cost of labor upon small sewers built by day-labor and by contract has been tabulated after being reduced to a uniform basis of wages of $0.315 per hour, the rate paid in Boston.

Reduced to this basis, it appears that the cost of sewers built by day-labor (not including Boston) averaged for labor $1.79 per lin. ft., while in the cities doing work by contract (excluding Boston) the average cost of labor was $1.17. Treating in the same manner similar work done in Boston by day-labor and by contract, it is found that the labor cost was $3.50 and $1.32 per lin. ft., respectively. It, therefore, appears that had the rate of wages been uniform in all cities the labor cost of the work done by contract would have been 35 per cent less than the labor cost of that done by day-labor, not including Boston in this comparison. Comparing the work done by both methods in the city of Boston, it appears that had the work done by day-labor been done by advertised contract the reduction in the cost of labor would have amounted to over 62 per cent.

Comparative Cost of Sewers Built by Day-Labor and by Contract in Boston.—The costs of eight pairs of sewers, so selected as to be as nearly comparable with each other as possible, have been compiled in Table VI. In each pair one sewer was built by day-labor, and one by contract. The pairs were selected by engineers employed by the city, who had direct personal knowledge of the conditions under which the work was done. After re-

TABLE I.—RELATIVE PREVALENCE OF CONTRACT AND DAY LABOR SEWER CONSTRUCTION IN AMERICAN CITIES OF POPULATIONS EXCEEDING 30,000. (Not including Boston.)

Population	Number of cities of specified size (1905 census estimate).	Number of cities enumerated.	Cities doing work wholly by contract	Cities doing work wholly by day labor.	Per cent of cities doing work by contract.
30,000- 50,000	67	31	20	11	65
50,000-100,000	47	22	15	7	68
100,000-150,000	14	8	5	3	63
150,000-200,000	6	6	6		100
Over 200,000	20	10	10		100
Totals	154	73	52	21	71
Outside of New England	126	51	48	3	94
New England, excepting Massachusetts.	10	6	4	2	67
Massachusetts	18	18	1	17	6

TABLE II.—RELATIVE PREVALENCE OF CONTRACT AND DAY LABOR WATER PIPE LAYING IN AMERICAN CITIES OF POPULATION EXCEEDING 30,000. (Not including Boston.)

Population.	Number of cities of specified size (1905).	Number of cities enumerated.	Cities doing work wholly by contr.	Cities doing work wholly by day labor.	Per cent of cities doing work by contract.
30,000- 50,000	67	26	9	17	34.6
50,000-100,000	47	15	5	10	33.3
100,000-150,000	14	6	1	5	16.7
150,000-200,000	6	2		2	....
Over 200,000	20	9	4	5	44.4
Totals	154	58	19	39	33.0
Outside of New England	126	40	19	21	48.0
New England, excepting Massachusetts..	10	3		3	....
Massachusetts	18	15		15	....

*A paper read before Section I of the American Association for the Advancement of Science, Dec. 28, 1909.

†Of the firm of Metcalf & Eddy, Boston, Mass., Consulting Engineers to the late Boston Finance Commission.

TABLE III.—AVERAGE TOTAL COST PER FOOT OF COMPARABLE 12-IN. SEWERS LAID 10 FT. DEEP IN VARIOUS CITIES.

City or Town.	Prevailing diameter of sewer (inches).	Actual total cost per foot.	Total cost of equivalent 12" sewer without allowance for difference in wages.	Subdivision of cost into: Labor and teaming only.	Materials and sundries.	Engineering.
(1)	(2)	(3)	(4)	(5)	(6)	(7)
A—Built by Day Labor.						
Brockton	12"	$1.73	$1.96	$1.20	$0.68	$0.08
Cambridge	12"	2.35	2.58	1.70	0.81	0.07
Everett	12"	2.09	2.32	1.55	0.68	0.09
Fitchburg	12"	1.80	*1.80	0.95	0.77	*0.08
Haverhill	10"	1.68	*1.80	0.90	0.82	*0.08
Lawrence	10"	2.38	*2.50	1.80	0.62	*0.08
Lowell	16"	3.36	3.42	2.35	0.98	0.09
Medford	8"	1.80	2.03	1.05	0.92	0.06
New Bedford	10"	1.88	2.00	1.30	0.67	0.03
Newton	8"	1.65	1.88	1.05	0.73	0.10
Quincy	8"	1.54	1.77	1.00	0.68	0.09
Worcester	10"	2.00	**2.00	1.20	0.70	0.10
Average	...	.....	$2.17	$1.34	$0.75	$0.08
Boston	12"	‡$5.20	$5.20	†$3.50	$1.55	$0.15
B—Built by Contract.						
Brookline	8"	$1.73	$1.95	$0.80	$0.80	*$0.25
Portland	10"	1.50	1.62	0.65	0.81	*0.16
Providence	12"	1.68	1.68	0.65	0.83	*0.20
Somerville	8"	1.75	2.05	0.90	0.91	*0.24
Average	...	.....	$1.82	$0.75	$0.86	$0.21
Boston	12"	$2.35	$2.35	†$1.05	$0.90	$0.40

*Engineering and inspection.
†Advertised contracts only.
Note—That no correction has been applied on account of difference in wages.
Note—That the day-labor cost shown in Column 4 includes labor on manholes, whereas the contract labor does not include this, but does include loss on sheeting, which substantially offsets it.

**Engineering estimated $0.08 per ft.
**Exclusive of office and shop charges as in other cities.
†Owing to the fact that this figure is based upon a comparatively small number of examples, it should be used with caution.
‡Not including proportion of undivided construction cost, which amounts to about 5% of total construction cost.

ducing the costs to equal terms as to size, depth and wages, it appears that in the case most favorable to day-labor the cost of the sewer built by direct labor was nearly double that of the one built by contract, while in the case of the pair most favorable to the contract system the one built by day-labor cost nearly four times as much as the one built by contract.

The Relative Cost of Cleaning Catch-Basins by Day-Labor and by Contract. A study was made of the cost of cleaning catch-basins by day-labor and by contract. This study included the cost of cleaning nearly 9,000 catch-basins at a total expense of over $54,000. The cost of doing this work by day-labor averaged $6.39 per catch-basin, or $2.47 per cu. yd. of refuse removed from the basins, while that done by contract cost $4.15 per basin, or $1.46 per cu. yd.

Relative Cost of Manufacturing Valves by the Boston Water Department Shops and Purchasing the same by Contract.—For many years the Boston Water Department has maintained a shop for repairs and the manufacture of a portion of the gate valves, hydrants and smaller fittings required for construction purposes. The business of the shop amounted in 1907 to $14,000. A comparison of the cost of manufacturing valves with the cost of the same if purchased by contract showed an increased cost under the day-labor system varying from 6 per cent to 60 per cent., as follows:

Valves, ins.	Per cent.
3	36
4	60
6	53½
8	47½
12	41½
16	10
18	12
20	6

Under stress of these investigations and simply by the automatic stimulus of them, the cost of labor upon these gates was reduced about 35 per cent.

Decrease in Efficiency of Labor Force in Boston Water Department.—The city engineer of Boston has for many years kept a careful record of the cost of trench work done in connection with the laying of certain classes of water pipe. The results of this tabulation are shown by Fig. 1. The upper line beginning in 1878 shows the cost per foot for labor upon trench work for pipe up to 12 ins. in diameter. In this compilation the engineers have carefully excluded all work done under unusual conditions, so that the figures are as nearly as possible comparable from year to year. The lower line indicates the same costs reduced to a uniform basis of wages and hours of labor. It will be noticed that during the first two years the cost per foot was a little over $0.20, and during 1905 it was about $0.88. The cost, after reducing to a uniform basis of 10 hours per day and a wage of $2, was of course increased during the periods when the employes were receiving $1.75 per day, and decreased during the latter years when the hours of labor and wages were less than 60 hours per week, and more than $2 per day respectively, and shows accurately the relative efficiency of the labor from year to year.

These data have been used in producing an efficiency curve, Fig. 2, by averaging the unit costs for the first 15 years during which period there was no marked tendency either up or down (1880 to 1895), and assuming that that average represents an efficiency of 100 per cent. Stating the premises in another way, the average number of feet of pipe laid for $1 during those 15 years represents an efficiency of 100 per cent. The variation from year to year is shown by the dotted line and the averaging for 15 years (100 per cent) as well as the curve showing the general tendency from 1895 to 1907 by the heavy line. Beginning in 1895, it will be noticed that the line of efficiency fell gradually until it reached 50 per cent in 1907.

From all the information available, it appears that this study of cost and efficiency is based upon very full and reliable data, and that comparison from year to year can be fairly made, although of course a better and safer result may be obtained by averaging several years, and making a comparison on that basis. In whatever manner the comparisons are made, it is apparent that the efficiency of the day-labor force has dropped about 50 per cent in the last 12 years. In other words, in 1907 the average employe did only one-half as much work in a given length of time as he did in 1895. In this connection it should be remembered that there are many causes for this decline in efficiency, some of which are entirely independent of the personal effort of the laborers, and for which they should not be held in any way responsible. It is also true that this decline is not necessarily an inherent result of the operation of the day-labor system, and that system has been in use in other cities for many years, where a decline of such proportions is not apparent.

It is also interesting to note that the cost of work (Fig. 2) was reduced by including with the work by day-labor also that done by contract during the years 1904-7.

Efficiency of Labor and Rate of Wages Paid.—An effort was made to ascertain the prevailing rate of wages paid by contractors in the vicinity of Boston for work similar

TABLE IV.—COST OF LABOR, TEAMING AND ENGINEERING UPON SMALL SEWERS BUILT BY DAY LABOR.

(Labor costs reduced to uniform basis of $0.315 per hour, as paid in Boston. Data reduced to uniform basis of 12-in. pipe laid 10 ft. deep.)

City or Town.	Cost of labor per ft., inc. teaming and engineering, but not office and shop charges.	Nominal wage per day of eight hours.	Actual hourly rate of wages per hr. for common labor.	Cost per ft. of labor inc. teaming reduced to comparable basis (rate $0.315 per hour).	Cost of teaming per foot.	Cost of engineering per foot.
(1)	(2)	(3)	(4)	(5)	(6)	(7)
Brockton	$1.20	$2.25	$0.281	$1.34	$0.03	$0.08
Cambridge	1.70	2.00	0.297	2.01	0.06	0.07
Everett	1.55	2.00	0.261	1.87	....	0.09
Fitchburg	0.95	1.75	0.220	1.36	...	....
Haverhill	0.90	2.00	0.250	1.13	...	...
Lawrence	1.80	2.00	0.250	2.27	...	...
Lowell	2.35	2.00	0.250	2.96	...	0.09
Medford	1.05	2.00	0.250	1.32	...	0.06
New Bedford	1.30	2.00	0.250	1.64	0.04	0.03
Newton	1.05	1.75	0.219	1.51	0.06	0.10
Quincy	1.00	1.75	0.219	1.44	...	0.09
Worcester	1.20	1.85	0.231	1.63	0.11	0.10
Average	....	....	$0.246	$1.79	$0.06	$0.08
Boston	$3.50**	$2.25	$0.315	$3.50**	$0.50	†$0.15

*Estimated.
†Direct teaming only. 10 per cent has one horse and wagon.
**Not including proportion of undivided construction expenses, which amount to about 5% of total construction cost. Furthermore, owing to the fact that this figure is based upon a comparatively small number of groups, it should be used with caution.

to that performed by the city water and sewer departments. Data were obtained from 35 different contractors.

The minimum rate of wages paid in this vicinity appears to be $0.15 per hour, and the city departments, and consequently they do not give continuous employment.

Inquiries were sent to sewer departments of all the cities in Massachusetts and several of the larger cities of the other New England

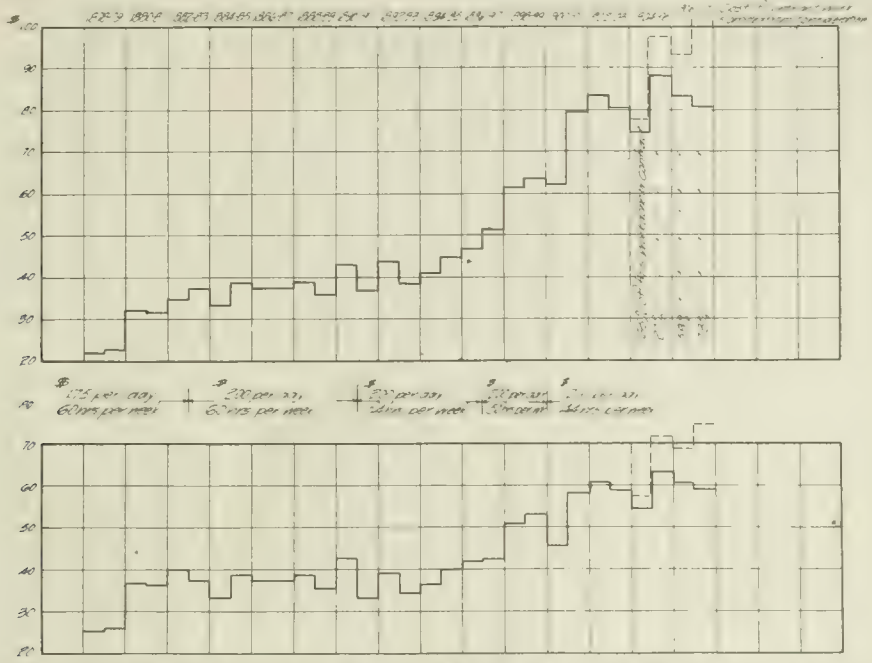


Fig. 1—Diagram Showing Cost of Trench Work in Laying Mains Up to 12 ins. Diameter.

(All work involving special difficulties omitted. Upper table shows actual cost. Lower table shows what cost would have been if a uniform wage of $2.00 and a uniform working day of 10 hours had prevailed throughout the entire period.)

the maximum did not exceed in any case $0.30 per hour. Comparatively few laborers are employed at rates of pay exceeding $0.25 per hour, while large numbers are paid as low as $0.20. In general, it may be stated that English speaking laborers are paid more than others, and further that the rate of $0.30 applies quite generally to building laborers or to laborers who possess rather more than average skill. In no case was it found that laborers were paid for legal holidays, and only in two instances were Saturday afternoons allowed. None of the contractors gave Saturday afternoons off with continued pay, and in no case were laborers paid in event of absence from work on account of injuries received.

The contractors furnishing data do not "carry" their employes through the winter unless they have work which must be done. In other words, they do not "find" work for their laborers during the winter season as do states, to ascertain the length of day and the rate of wages in force upon municipal sewer work in the city departments. The data thus collected is compiled in Table VII. Several of the cities included in this inquiry performed their construction work by contract, so that the figures given in those cases apply only to the maintenance forces. From these data it appears that the prevailing length of day is 8 hours, although in some cases a 9-hour day is required. Excluding Boston, the nominal rate of pay varies from $0.17 to $0.287 per hour, while the prevailing rate of pay may fairly be said to not exceed $0.25 per hour. In about one-third of the cities the laborers are permitted to have half holidays on Saturday, although in about one-half of these cases the half holidays are restricted to the summer months. In several of the cities where half holidays are granted th length of day is so arranged that the laborers work 48 hours during the week. In five cities granting Saturday half holidays laborers are paid in full for Saturdays during the summer months (varying from two to six months).

From a comparison of the wages paid by contractors and by municipalities, it is evident that city laborers are paid considerably more than laborers employed by contractors and that they work fewer hours per week. It is difficult to determine the relation existing between high wages and the efficiency of the employees. It is doubtless true, however, that higher wages are paid by municipalities very largely because of political influence.

In this connection it is very interesting to note the increase in wages paid for common labor in the city of Boston from 1878 to 1907. From 1878 to 1883 the wages paid were $1.75, and the length of day was 10 hours. In 1883 the rate of wages was increased to $2 per day. In 1891 the length of day was reduced to 9 hours, and in 1897 Saturday half holidays were allowed *with pay*. In 1900 the 8-hour day was granted, together with the continuance of the Saturday half holiday, and in 1907 with the same hours the rate of wages was increased to $2.25. It therefore appears that between 1878 and 1907 the rate of wages had increased from $1.75 to $2.25 per day or 28 per cent, and the hours of work had been reduced 26⅔ per cent. The result of reducing the length of day and increasing the rate of pay is made more apparent by comparing the rate of compensation per hour as in Table VIII.

From this table it appears that the hourly wage, making due allowance for the Saturday afternoons and holidays, has increased from $0.175 to $0.315, an increase of 80 per cent, in the cost to the city for the work done, assuming equal efficiency. In this connection it should be noted that while the cost of labor to the city has increased 80 per cent per hour, the increase in daily wages received by employees has amounted to but 28 per cent.

It is further important to note that while the cost per hour to the city for labor has increased 80 per cent, the efficiency of labor, as already shown, has fallen 50 per cent. In other words, a dollar's worth of time in 1878 would today cost the city $1.80, but the efficiency having dropped 50 per cent the city is obliged to pay $3.60 for the amount of work done in 1878 for $1, an increase of 360 per cent.

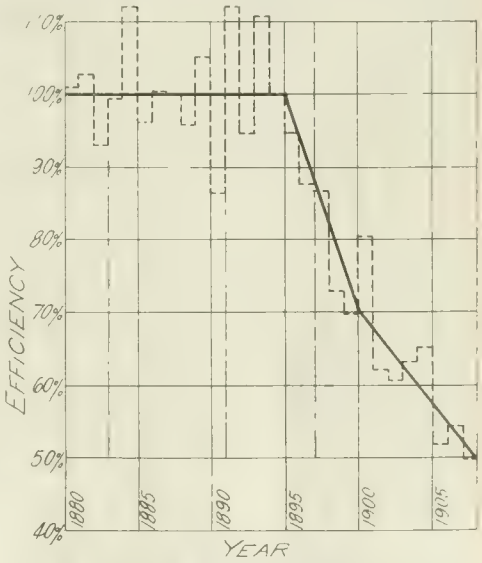


Fig. 2—Diagram Showing Efficiency of Labor in Boston Water Department.

(The average efficiency for the 15 years, 1880-1894, has been taken as 100 per cent. Data for this diagram have been reduced to a uniform basis of wages and hours for the entire period.)

It would not seem unreasonable to expect that some relation may exist between the rate of wages paid and the efficiency of labor,—

TABLE V.—COST OF LABOR, TEAMING AND ENGINEERING UPON SMALL SEWERS BUILT BY CONTRACT.

(Labor costs reduced to uniform basis of $0.315 per hour as paid in Boston. Data reduced to a uniform basis of 12-in. pipe laid 10 ft. deep.)

City or Town.	Cost per foot for labor and teaming.*	Corresponding rate wages of per hour.	Cost of labor, reduced to a comparable basis (rate of wage, $0.315 per hr.)	Cost of engineering and inspection.
(1)	(2)	(3)	(4)	(5)
Brookline	$0.80	$0.22	$1.15	$0.25
Portland	0.65	0.20	1.02	0.16
Providence	0.67	0.17	1.20	0.20
Somerville	0.90	0.22	1.29	0.24
Average	$0.75	$0.20	$1.17	$0.21
Boston**	$1.05	$0.25	$1.32	$0.40

*Exclusive of labor in manholes, but including loss on sheeting. It is estimated that these two items substantially balance each other so that the figures are directly comparable with the day-labor figures of Table II.

†It should be noted that contractors in Boston usually pay but $0.25 per hour for labor unless required to pay higher wages by the city.

**Advertised contracts only.

TABLE VI.—COMPARISON OF COSTS OF CERTAIN COMPARABLE PIPE SEWERS LAID IN BOSTON BY DAY LABOR AND BY CONTRACT.

Location.	How done	Date.	Length (feet)	Size.	Aver. cut (feet).	No. M. H.	Rock, cu. yd.	Cost per lin. ft.	Cost per ft. on equal terms.	Ratio of day labor to contr. costs, per cent.
Allston Pl. betw. Woodstock Av. and Cory Rd., Brighton.	Day.	Jan. 27 to Mar. 2, 1905.	$ 304.03	12	10.5	[illegible]	(?)	$5.79	$5.59	
Corey Rd. from Allston Pl., 400 ft. s. w. Brighton	Contr.	Aug. 23 to Sep. 17, 1907.	400.00	10	12.3		4.81	2.42	2.34	2.4
Willow St., betw. Dunbar and Weld Sts., W. Roxbury	Day.	Aug. 18 to Nov. 9, 1905.	1.126.57	12	11.6	5	(150)	7.74	7.74	
Maple St., betw. Addington Rd. and Weld St.	Contr.	Jan. 10 to May 25, 1906.	1.100.00	12	10.7	6	218	2.25	2.45	3.2
Dunboy St., betw. Hardwick and Bigelow Sts.	Day.	Sep. 16 to Oct. 1, 1904.	175.65	12	7.0	1	no	5.13	5.13	
Hardwick St., Bigelow to Dunboy St.	Contr.	May 2-18, 1904.	756.4	12	7.2	4	18.89	1.41	1.38	3.7
Revere St., betw. Charles and 136th St. West	Day.	July 28 to Aug. 16.	132.32	12	14.4	2	.....	13.98	13.98	
Tennyson St., betw. Church and Pleasant Sts.	Contr.	Oct. 26 to Nov. 10, 1906.	221.07	12	10.6	.	1.66	5.05	6.48	2.1
Charles St., betw. Revere St. and 230 ft. northerly	Day.	June 11 to 13, 1904.	230.6	12	10.5	.	....	5.96	5.96	
Hale St., betw. Green St. and Hale St. extension	Contr.	June 8 to July 3, 1903.	269.3	12	11.7	2	.....	3.35	2.98	2.0*
Charter St., betw. Phipps St. and Marshall Pl.	Day.	June 30 to July 20, 1905.	191.57	15 (12) (15)	10.6	.	....	7.79	7.79	
Hanover St., betw. No. Bennett and Charter St.	Contr.	Oct. 28 to Nov. 30, 1906.	333.33	(18)	9.3	.	.....	4.68	5.26	1.48
South St., Kneeland to Beach St.	Day.	Jan. 30 to May 2, 1903.	318.1	18	16.6	.	.....	21.39	21.39	
Fayette St., Church St. to Ferdinand St.	Contr.	Sep. 16 to Dec. 5, 1906.	384.7	18	13.1	.	.....	6.29	7.68	2.78
North St., Blackstone St. to No. Center St.	Day.	Nov. 4 to Dec. 17, 1903.	141.51	30x36 brick	12.6	.	.....	45.44	45.44	
Cooper St., betw. Washington St. North and Endicott St.	Contr.	Aug. 5 to Oct. 10, 1907.	210.1	30x36 brick	12.6	.	.....	16.54	16.54	2.74

*Rush job.

Note—These pieces of work were picked out by the District Engineers as substantially comparable. Lineal foot costs are based on total cost of labor, teaming, explosives and supplies, excluding engineering and administration, office and yard department, cost of materials—i. e., pipe, brick, cement, manhole covers and steps. In each comparison the lineal foot costs are reduced to terms of like diameter of sewers and like average depth of trench.

or in other words that enough more work would be done per hour under the higher wages and shorter hours so that at least as many feet of sewer would be laid for $1 as in cases where lower rates of wages prevailed. The following tabulation made up from Table IV shows the number of feet of sewer laid for $1 when the wages are reduced to a uniform basis of calculation. The percentage of efficiency is calculated on the assumption that the Brocton labor was 100 per cent efficient.

While it may not be fair to draw the conclusion from these figures that labor is less efficient *because* of higher wages, it does seem to follow that higher compensation does not *assure* greater efficiency. The greatest efficiency was apparently obtained in the case of the city of Brockton where the nominal wage is $2.25 per day, although in Boston, where the same nominal wage is paid and holidays granted in sufficient number to increase the rate per hour over 12 per cent, the lowest efficiency was indicated. Averaging the results obtained in cities paying the same rate of wages, there appears to be a gradual decrease in efficiency as the rate of pay increases.

Holidays and Sick-Leave.—The effect of political influence is shown very clearly in the granting of holidays and sick-leave with pay to city laborers. The cost of holidays, half-holidays and sick-leave is an item, the magnitude of which is not very generally appreciated. The Boston Water Department has very carefully compiled statistics relating to this source of expense. During 1906 the distribution division expended upon pay-rolls about $450,000, and the amount charged to holidays, half-holidays and sick-leave amounted to over $34,000, or 7.7 per cent of the total pay-roll. The lowest percentage for any month was 5.3, and the highest was a little over 10 per cent of the respective pay-rolls.

During the first eight months of 1907 the money paid for holidays and sick-leave amounted to 8.3 per cent of the total cost of labor. During this entire period of 20 months, the pay-rolls amounted to $752,000, and nearly $60,000, or 7.95 per cent of the amount of the

TABLE VII.—STATISTICS CONCERNING THE DAY-LABOR FORCE OF THE SEWER DEPARTMENTS OF VARIOUS CITIES.

City.	Number of laborers	Length of day.	Rate of pay, nominal (per hour), cts.	Rate of pay, actual (per hour), cts.	Saturday half-holidays allowed.	Pay for Saturday half-holidays.	Allowance for sick leave.
Lynn, Mass.	101	8	28⅛	28.7	May-Oct.	Yes	None.x
Haverhill, Mass.		9	28⅛	28.7	June-Sept.	Yes	None.°
Fall River, Mass.	178	8½	28⅛	28⅛	Yes.	....**	None.
Brockton, Mass.	70-100	8	28⅛	28⅛	No.	....	None.°°
*New Haven, Conn.	...	9	27 7/9	27 7/9	No.	....	None.x
Cambridge, Mass.	21	8	25	26.1	May-Nov.	Yes	None.
Springfield, Mass.	78-153	8	25	25½	Work 7 hours.	Yes	None.°
Chicopee, Mass.	...	8	25	25	No.	....	None.x
Holyoke, Mass.	...	8	25	25	Yes.	....	None.x
Lawrence, Mass.	114	8	25	25	Yes.	....**	Half pay.
Lowell, Mass.	...	8	25	25	In summer.	....**	None.
Marlboro, Mass.	...	8	25	25	No.	....	None.
Medford, Mass.	...	8	25	25	No.	....	None.
New Bedford, Mass.	86	8½	25	25	Yes.	....**	None.x.
Newport, R. I.	...	8	25	25	No.	....	None.
Waltham, Mass.	...	8	25	25	No.	....	None.°
Newburyport, Mass.	5	8	25	25	No.	....	None.
Quincy, Mass.	...	8	23⅛	23⅛	No.	....	None.°°
Worcester, Mass.	168	8	23⅛	23⅛	No.	....	None.
*Hartford, Conn.	...	9	22 2/9	22 2/9	No.	....	None.
Waterbury, Conn.	14	9	22 2/9	22 2/9	No.	....	None.°
Bangor, Maine	4	9	22 2/9	22 2/9	No.	....	None.
Fitchburg, Mass.	...	8	22	22	No.	....	Full pay°
*Albany, N. Y.	...	8	21 8/9	21 8/9	No.	....	None.
North Adams, Mass.	28	8	21 8/9	21 8/9	No.	....	None.°
Newton, Mass.	75	8	21 8/9	21 8/9	No.	....	None.
Concord, N. H.	...	9	19 4/9	19 4/9	No.	....	None.x
*Portland, Maine	...	9	19 4/9	19 4/9	No.	....	None.°°
Hudson, N. Y.		8	18¾	18¾	No.	....	Full pay.
*Providence, R. I.	84	9	17	17.2	July-Aug.	Yes	None.°
New London, Conn.	40	9	16⅔	16⅔	No.	....	None.°
*Somerville, Mass.	8-15	8	....	....	In summer.	....	None.
Boston, Mass.	2000	8	30¾	31½	Yes.	Yes	Full pay.°

*Maintenance only; construction by contract.
xIn case of injury, submitted to a committee.
°°°Full pay may be allowed not to exceed 60 days when approved by Mayor.
°Full pay if injured on work.
°°Unless injured on work.
**Work 48 hours per week, but time divided so that Saturday is a half-holiday.

TABLE VIII.—WAGES OF LABORERS EMPLOYED BY CITY OF BOSTON.

Period.	Nominal time worked, hours per week.	Nominal Rate of Wages Per day.	Per hour.
1878-1883.....	60	$1.75	17½ cts.
1883-1891.....	60	2.00	20 cts.
1891-1897.....	54	2.00	22½ cts.
1897-1900.....	50	2.00	24 cts.
1900-1907.....	44	2.00	27½ cts.
1907-date.....	44	2.25	*31½ cts.

*Allowance made for legal holidays, for which full pay is allowed.

TABLE IX.—NUMBER OF FEET OF SEWER LAID FOR $1 WHEN WAGES ARE REDUCED TO UNIFORM BASIS.

	Rate of wages actually paid—per day.	Rate of wages actually paid—per hour.	Number of feet of sewer laid for $1, figured on uniform basis.	Per cent efficiency assuming 100% eff. in the one case when wages=$0.281.
Brockton	$2.25	$0.281	$0.746	100
Seven cities	2.00	0.254	0.529	70.9
Worcester	1.85	0.231	0.613	82.1
Three cities	1.75	0.219	0.694	93.0
Boston	2.25	0.315	0.286	38.3

*Allowance made for legal holidays for which full pay is allowed.

pay-rolls, was expended for holidays and sick-leave.

Age of Laborers.—Perhaps one of the most frequent criticisms by the public of day-labor departments, is that the men employed are too old for the work they are required to do, and consequently that the amount of work done per man per day is ridicuously small. This appears to be the universal opinion, and unfortunately in many cases there is much to substantiate it. An investigation of the Boston Sewer Department furnishes considerable interesting information pertinent to this criticism. Of the employes of this department, the investigation included 715 connected with the labor service. The ages of the various employes, as well as their terms of service, were obtained from the State Civil Service records, and are classified in Tables X and XI.

TABLE X.—LABOR EMPLOYED IN BOSTON SEWER DEPARTMENT CLASSIFIED ACCORDING TO AGE.

Present age.	No. of men.	Per cent of force.	No. of men above ages designated.	Per cent of force above ages designated	Term of service, years. Average.	Maximum.	Minimum.
Below20	1	0.1	.....	0			
20-24	5	0.7	20-714	20-99.9	3.2		
25-29	19	2.7	25-709	25-99.2	3.8	12	
30-34	53	7.4	30-690	30-96.5	6.1	15	
35-39	101	14.1	35-637	35-89.1	7.5	18	
40-44	127	17.7	40-536	40-75.0	9.9	22	
45-49	136	19.1	45-409	45-57.3	13.0	28	
50-54	95	13.3	50-273	50-38.2	12.7	32	
55-59	81	11.3	55-178	55-24.9	15.3	33	
60-64	65	9.1	60- 97	60-13.6	14.8	35	1
65-69	21	2.9	65- 32	65- 4.5	13.6	21	1
70-74	9	1.3	70- 11	70- 1.6	17.3	23	11
75-79	2	0.3	75- 2	75- 0.3	32.0	40	24

Note—Investigation made in 1907.

Considering these tables as of the date of their preparation (1907), it is found that of the 65 men who were from 60 to 64 years of age, four had seen less than 5 years of service in the department; six had seen from 5 to 9 years' service; 20 between 10 and 14 years; 28 between 15 and 19 years; *and only seven had served the department 20 years or more.* Of the 21 men from 65 to 69 years of age, two had worked less than 5 years; two others from 5 to 9 years; six from 10 to 15 years; five from 15 to 20 years; *and only six had been employed in the department 20 years or more.* Of the 9 men from 70 to 74 years old, two had labored from 10 to 14 years; four from 15 to 19 years, and *three only for 20 years or more.* There was one man over 75 years of age and he had labored *40 years or more for the department.* Sixty-one (9 per cent) of the 715 employes had worked 20 years or more. *There were 97 employes over 60 years of age but only 18 of them (18.5 per cent) had served the department for 20 years or more.*

Many will maintain, and with much justice, that men who have worked for the city for 20 years are entitled to consideration, but from the following statement of facts it appears that few are in need of charity. Of the 56 men who were over 40 years of age, and who had served 20 years, 9 were employed as watchmen, which work they could perfectly well do. Four were filling position for which they were not suited, and three were filling absolutely useless position, leaving 40 men out of 56 men who were performing laborious work. Stating this matter in a different way, it appears that out of 715 laborers there were only 16 who were 40 years of age or older, who had served the city 20 years, and who were incapacitated for laborious work, and of these 16, nine were able to serve as watchmen. This condition leads to doubt as to the necessity for establishing a pension system for the labor force unless such system is to be established for the benefit of employes who have passed their years of usefulness in the service of other employers, and who have late in life received probably through political influence, positions upon city work.

The policy of appointing men upon the labor service after they have passed their years of usefulness in the service of other employers had turned the department into a semi-charitable institution, where aged and infirm men were employed when they should have been the charges of relatives or of the public, and not placed upon the city pay-rolls at wages higher than first-class able-bodied laborers at similar work could command from other employers.

Experiment to Test the Efficiency of the Day-Labor Force.—All of the work upon which the previous comparisons and comments as to efficiency have been made was work done prior to the investigations which were consequently studies of records of work already completed. It was not, therefore, possible to know accurately the conditions under which the work was done. At the request of the Mayor of Boston a test was made at the Chestnut Hill stone-crusher (a municipal plant which had been shut down) to determine whether or not it was possible for the day-labor force to produce broken stone at a cost fairly comparable with that of similar stone purchased by contract. The test covered a period of three months during the summer of 1908, and was under the observation of a disinterested engineer, who kept accurate record of what was done, but who did not in any way supervise or direct the forces. The work consisted of stripping and quarrying the stone, hauling it to the crusher and breaking it.

The test lasted a sufficient length of time to demonstrate with accuracy the cost of producing broken stone by day-labor under the existing conditions. The force consisted of men apparently as skillful and competent as could be selected from the employes of the Street Department, and certainly gave evidence of being reasonably skillful and competent. So far as could be observed, the foreman in charge was given an absolutely free hand to organize his force as he deemed best, and to adopt such methods of handling the work as he might desire. With slight and unimportant exceptions, tools and supplies were promptly furnished, so that there is no reason to think that the output could have been increased by the improvement of conditions depending upon the co-operation of the superior officers of the department. The net result of this test appears to be that broken stone was produced at a cost of $1.075 per ton. These figures make no allowance for the cost of clerical service at the office or for the cost of administration, which items are estimated at $0.05 per ton; and no allowance was made for the cost of the quarry. Depreciation of plant and the rental of tools were included in the cost of producing the stone.

TABLE XI.—CLASSIFICATION OF LABOR BY TERM OF SERVICE AND AGE. BOSTON SEWER DEPARTMENT.

Present age.	Years of service. 0-4	5-9	10-14	15-19	20-24	25-29	30-34	35-39	40-44	Total.
19	1	..	..	..	..	..	..	..	..	1
20-24	3	2	..	..	..	..	..	..	..	5
25-29	18	8	1	..	..	..	..	..	..	19
30-34	19	25	8	1	..	..	..	..	..	53
35-39	32	28	38	7	..	..	..	..	..	101
40-44	26	26	41	30	4	..	..	..	..	127
45-49	8	20	52	43	9	4	..	..	..	136
50-54	7	11	25	31	7	1	..	..	..	95
55-59	2	11	18	34	11	4	..	..	..	81
60-64	4	6	20	28	3	3	..	..	..	65
65-69	2	2	6	5	3	2	..	..	..	21
70-74	0	0	2	4	3	0	..	..	..	9
75-79	0	0	0	0	1	..	..	..	1	2
Total	119	149	212	183	44	8	6	2	1	715

The quarry and crusher selected were the most favorable of any of the eight which the city had worked in the past, and in 1895 produced broken stone more cheaply than any other of the city crushers. It is only fair to add that during the second and third periods of the tests, the time being divided into three periods, there was a marked increase in the efficiency of the force. A fair estimate of the cost of the output of broken stone during these latter periods was $0.95 to $1 per ton, no allowance being made for administration nor for owning and maintaining of the quarry. For comparison, an instance was found where the operations of a large broken stone company were started with certain temporary machinery, which was rented to a contractor, who crushed stone for a period of four or five months. The physical conditions were fairly comparable with those at the Chestnut Hill plant. The crusher was similar, the output was smaller, and rental was paid for the machinery. The cost to the contractor for this work was $0.45 per ton, not including interest and depreciation, which would bring the cost up to $0.50 per ton. It therefore seems fair to conclude that the work which cost the city practically $1.12 per ton, including administration expense, would have cost a competent contractor about $0.50 per ton. It should be borne in mind that this does not include any profit upon the work.

Resumé.—The foregoing discussion of a small proportion of the studies made under the direction of the late Finance Commission is very brief, for many of the studies required months of work. For the full reports, 59 in number, made by Metcalf & Eddy, reference may be made to Volume III of the report of the Boston Finance Commission.

While the difficulties of such investigations are many, it is believed that the results recorded represent very conservatively the conditions existing. It is apparent that municipal work done by day labor is in general, under the conditions of today, much more expensive than similar work done under the same conditions by contract. It is also apparent that the labor force in city departments where work is done by the day labor system, is very inefficient as compared with similar forces employed by contractors and has, during the last 10 or 15 years decreased greatly in efficiency, at least in the city of Boston.

There are many causes of the excessive cost of day labor work and of the inefficiency of the day labor forces, all of which may be grouped under the one great evil—the entrance of politics into municipal business. These causes include abnormal rates of pay, the granting of holidays and half-holidays, the employment of aged and physically incompetent laborers, absence of discipline, a lack of incentive, and the inexperience of those in executive positions. It would further appear that the number of men growing old in the service of the city, who were at the time of their original employment young and vigorous, is not a material cause of inefficiency. On the other hand, the employment of men in city departments who have passed their years of usefulness in the service of other parties, has a demoralizing effect upon the labor forces and has undoubtedly been the cause of much of the inefficiency noted in municipal day-labor forces.

Average Cost of Laying Water Mains at Washington, D. C.—The following table rearranged from the report of the Engineer Department of the District of Columbia for the last fiscal year, shows the average cost per lineal foot for laying water mains of various sizes (including repairs to improved pavements) during the year ending Jun 30, 1909:

Size.	3 in.	4 in.	6 in.	8 in.	12 in.
Lineal feet laid..	919	1,281	586	58,200	5,135
Cost of labor per lin. ft.....	$0.377	$0.423	$0.485	$0.386	$0.600
Materials, per lin. ft.	.401	.588	.601	.910	1.480
Repairs to pavements per lin. ft. .	.441	.328	.097	.037	.137
Total ...	$1.219	$1.339	$1.183	$1.333	$2.217

Unclassified and General Articles

Note: This section is devoted to methods and cost articles on construction work not properly coming under any of the preceding classifications.

Methods and Cost of Constructing a Concrete Lock and Timber Crib Dam With Appurtenant Structures Employing Day Labor.

I.

The following figures give the itemized unit costs of excavation, timber crib, mass concrete, riprapping, grading, filling and building work in constructing a concrete lock and timber crib dam involving a total expenditure of $288,072.

Several years ago the United States Government began the construction of a series of locks and dams for the improvement of the Upper White River from Batesville to Buffalo Shoals in Arkansas. The project aimed to secure slack water navigation, giving 4 ft. depth, between the two places, a distance of 69 miles, by means of 10 fixed timber dams, with concrete locks, having an average lift of 14½ ft. The construction of the first lock and dam of the project was described in ENGINEERING CONTRACTING for May 6, 1908. Complete costs of the work as well as drawings of the lock, dam and minor structures were given in this article. The construction of the second lock and dam is described in the present article, the descriptive matter being taken from the report of Maj. Graham D. Fitch, corps of engineers, as given in the annual report of the chief of Engineers, U. S. A., for 1904, and the cost data being compiled from the personal records of Maj. Fitch which were loaned to us for that purpose. The general plan of the lock and dam was similar for both structures; the dam reached straight across the river and the lock was located at one end.

CONCRETE LOCK.

Lock No. 2 is located 7.8 miles above Batesville, Ark., in a straight reach of the river where there was ample spillway, but where the foundations were unusually deep and the bed of the river was covered with large boulders. No better location could be found, however, though two surveys were made for the purpose. The lock chamber is 175 ft. long between hollow quoins and 36 ft. wide; the lift is 14 ft. The depth of water on the lower miter sill is 5 ft. The lock is founded on sandstone bed rock, crib cofferdams being used to lay dry the foundation site. This type of cofferdam was used mainly because the foundation bed afforded no hold for piles, but incidentally the further advantage resulted of permitting excavation closer to the dam walls.

Construction of Cofferdam.—The cofferdam cribs were constructed of 10x10-in. x 20-ft. timbers. The end sections of the dam were built and sunk in place, but the sides were built four timbers high on barges, then launched, towed to the site and the building continued. During the building 2x12-in. plank were spiked over the openings between timbers of the outer wall; after the crib was sunk double lap vertical sheeting of 1-in. boards was driven along the inner wall and spiked to the timbers as far down as the water would permit. A sump hole was located at one of the upper corners of the pit. At this place there was no beam, the material standing almost vertical; elsewhere a beam of 6 ft. was left. There were 480 lin. ft. of 14x19-ft. cofferdam and its cost was as follows:

Materials.	Per unit.	Total.	Per lin. ft. of dam.
Timber [illegible]	[illegible]	[illegible]	[illegible]
182.9 m. ft. B. M. timber	[illegible]	[illegible]	[illegible]
41.5 m. ft. B. M. timber	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]
Labor.			
Towing 165.6 m. ft. B. M timber	$ 1.94	$ 323	$0.67
Handling and storing 165.6 m. ft. B. M.	4.33	717	1.49
Inspecting 165.6 m. ft. B. M.	0.51	85	0.18
Framing and placing 165.6 m. ft. B. M.	4.65	1,044	2.18
Total labor		$2,169	$4.51
Grand total		$4,428	$9.21

Counting in the lumber not charged for, we have 224.4 M. ft. B. M. and at a total cost in place of $4,428, or $19.73 per M. ft. B. M. If we figure the 41.5 M. ft. B. M. old lumber not charged for as worth half price, the cost of lumber in place was $20.78. Adding the cost of puddling and pumping to the above, we have:

Item.	Total.	Per lin. ft. of dam.
Timberwork	$4,428	$ 9.21
8,723 cu. yds. puddling at 46 cts.	3,976	8.29
Pumping pits (labor)	175	0.36
Preparing foundations (labor on bridge)	91	0.19
Total	$8,670	$18.05

The itemized cost of puddling was as follows:

Digging (8,723 cu. yds.).	Per unit.	Total.	Per lin. ft. of dam.
Labor	$0.05	$ 460	$0.96
Fuel and oil		123	0.25
Towing (2,250 cu. yds.).			
Fuel		30	0.06
Labor on towboat	0.56	127	0.26
Unloading Puddle.			
Labor unloading	0.354	3,080	6.42
Miscellaneous labor		156	0.33
Total (8,723 cu. yds.)	$0.46	$3,976	$8.28

Some of the labor items can be summarized as follows so as to show the amount of work done per man per day:

	Work done.	Labor time in days.	Work done per man-day.
Handling and storing timber	165.6 m. ft.	384	0.43 m. ft.
Inspecting timber	165.6 m. ft.	30	5.50 m. ft.
Framing and placing timber	224.4 m. ft.	545	0.41 m. ft.
Digging puddle	8,723 cu. yds.	215¾	40 cu. yds.
Unloading puddle	8,723 cu. yds.	1,678	523 cu. yds.

Excavation for Lock Foundation.—In excavating for the lock foundation a 1¼ cu. yd. Bucyrus dipper dredge was used to remove from the bottom, before the cofferdam was closed, such material as it could handle, but owing to the large boulders encountered most of the excavating had to be done by hand after the cofferdam had been pumped out, the material—clay, boulders and cemented gravel—being removed by wheelbarrows and derrick skips. The lock wall foundations averaged 12 ft. in depth with a maximum depth of 13 ft. In excavating for the land wall of the lock which was at the foot of a sliding bank, the excavation was made in sections about 20 ft. in length, and each section filled with concrete before excavating for the next section. As both the chambers at miter walls are founded on bed rock no water can penetrate into the chambers from below, and no excavation was necessary below the elevation for the lock floor which is the natural surface of the ground. The excavation for the lock foundations required the removal of 3,304 cu. yds. of earth and 2,280 cu. yds. of rock and hard pan. The cost was as follows:

Material.	Total.	Per cu. yd.
Fuel	$ 217	$0.039
Dynamite, fuse and caps	148	0.026
Labor	8,601	1.540
Total	$8,966	$1.605

The labor time in days was 4.624⅛ and as 5,587 cu. yds. were excavated the output per man per day was 1.21 cu. yds.

Forms for Concrete Work for Lock.—The forms consisted of horizontal lagging of 2x12-in. plank dressed on all four sides, held by 4x6-in. studs spaced 4 ft. apart and supported at 8-ft. vertical intervals by 4x6-in. inclined braces. Yellow pine was used. The posts and braces were erected complete before concreting was begun and about half-way up the wall horizontal struts were fastened between opposite studs to brace them apart and also to support a track for dump cars. The lagging was erected gradually as the forms were filled; when the concreting reached the horizontal struts they were removed and the track was raised and supported on cross-wall timbers resting on top of the studs. The forms were left in place four or five days after concreting was completed. The cost of the formwork was as follows:

Materials.	Unit Cost.	Total.	Per cu. yd. conc
150.2 m. ft. B. M. lumber	$15.61	$2,345	$0.199
97.6 m. ft. B. M. lumber (no charge)	....	....	....
Nails, bolts, etc.	....	98	0.008
Fuel	....	50	0.004
Total materials	....	$2,493	$0.211
Labor			
Hauling 76.2 m. ft. lumber 8 mi.	$ 2.90	$ 221	$0.018
Towing 84.1 m. ft. lumber	2.44	205	0.018
Handling and storing 84.1 m. ft. lumber	4.39	370	0.031
Inspecting 126.9 m. ft. lumber	0.53	68	0.006
Erec. and rem'v'l 247.8 m. ft. lumber	15.80	3,918	0.331
Total labor	....	$4,782	$0.404
Grand total	....	$7,275	$0.615

As 247,800 ft. B. M. of lumber was used for the forms the cost per 1,000 ft. B. M. was $29.35, A further analysis of some of the items shows the following:

Item.	Work done.	Labor time days.	Work done per man per day.
Handling and storing lumber, m. ft.	84.1	198	0.425
Inspecting lumber, m. ft.	126.9	24	5.300
Erect. and removal of forms, m. ft.	247.8	1,863	0.133

Concrete Work.—The concrete mixer was a 4-ft. cubical box of ½-in. rivetted steel securely fastened at diagonally opposite corners to a 3-in. steel shaft bored for about half its length with a 1-in. hole for the admission of water. Near one corner was a 15x20-in. hinged door for charging and discharging the batch. The mixer was operated by a 6x7-in. center crank engine. It was located on the bank approximately opposite the center of the lock. About 40 ft. from the mixer on the downstream side was a bin 100x16 ft. x 14 ft. high with two 50-ft. compartments, one for stone and one for gravel. A trestle incline 200 ft. long ran from the top of the bin to the river whence the gravel received on barges was hauled in side dump cars of 2½ cu. yds. capacity to the top of the gravel bin by a double-cylinder, single-drum hoisting engine on the bin. The total length of track on trestle and bin was 310 ft., of which 128 ft. at the lower end was double track. An elevated roadway on the land side of the stone bin enabled the stone to be shoveled from wagons directly into the bin, and an extension of the roadway toward the mixer allowed the sand to be unloaded within a few feet of the sand hopper platform at the upstream end of the bin. A track was laid beneath the bin and the hopper platform and then up an incline trestle 48 ft. long to the top of the mixer, the total length of the track being 167 ft. The required amount of stone or gravel having been fed through steel doors into a bottom dump car, it was pushed to beneath the hopper for sand and cement and then pulled up the incline to the mixer by a single-cylinder, single-drum hoisting engine located on the upstream side of the mixer. Steam for the various engines was supplied by a 50 hp. boiler located on the land side of the mixer. An incline trestle with track connected the mixer with tracks laid along and above the site of each lock wall as described above and after mixing, each charge was emptied into a bottom dump car and dumped where needed.

For the concrete Lehigh Portland cement only was used; the cement varied in price from $1.82 to $2.70 per barrel delivered in cars at Birds Point, Mo. It was transported thence over a land grant railway as far as Newport, Ark., and from that point to Batesville; the freight charges per barrel was 11 cts. From Batesville the cement was towed to the work

at a further cost of about 26 cts. per barrel.

The sand for the work was taken from the White River in the vicinity of the work. The sand cost $1.25 per cu. yd. delivered at the lock.

The gravel used was dredged by hand labor from the river near the work. It consisted of a mixture of pebbles of all sizes with about 19 per cent sand. It did not require washing. The voids were from 17 to 21 per cent. The gravel cost delivered in the bins about 25 cts. per cu. yd.

The stone was limestone from a quarry in the vicinity of the work. It cost $2 per cu. yd., broken to pass a 2-in. ring. The voids averaged 51 per cent. The stone was required to be screened, but it is stated that run of crusher would have been preferable.

The composition of the concrete was carefully determined, the materials being measured loose. Each mixer batch was composed of the ingredients shown by Table I:

TABLE I—PROPORTIONS FOR CONCRETE USED IN LOCK WORK.

Crushed stone concrete.	Cu. ft.	Proportion.
Added water (average)	2.88	..
Cement (Lehigh Portland)	4.19	1.00
Sand (wet)	12.00	2.88
Stone (wet)	25.00	5.97
Total	41.19	..
Gravel concrete.		
Added water (average)	2.00	..
Cement (Lehigh Portland)	4.19	1.00
Sand, direct, wet, 4.50; sand in gravel, wet 4.75 (19 per cent of 25 cu. ft.)	9.25	2.21
Gravel	23.00	5.56
Total	38.44	..

From each of these mixtures was secured approximately 1 cu. yd. of concrete in place.

The mixer was revolved 15 times at an average speed of 11 revolutions per minute. The minimum number of batches mixed per hour was 12 and the maximum 23, the average number being 15. Work was carried on for 16 hours in two shifts of 8 hours each. The minimum amount of concrete placed in eight hours was 95 cu. yds. and the maximum 184, the average amount for the season, including boulders, being 140 cu. yds. The concrete, which was wet, quaking mixture, was placed in even layers of 6 ins., and tamped with a 25-lb. tamper until water appeared on the surface. The gravel core was kept as near up with the crushed stone outside as possible, generally within 15 ft. The maximum drop of the concrete was about 15 ft. The walls being sufficiently thick to permit of their use, boulders of from 1 to 50 cu. ft. in size were placed in the concrete, care being taken to lay each stone on its largest base and never at a less distance than 1 ft. from another boulder or from an exposed surface. The concrete was sufficiently wet to prevent the formation of voids. The total concrete in the lock is 11,824 cu. yds., of which boulders constitute 549 cu. yds. A facing 1 to 3 mortar, 1½ ins. thick, was placed on the sides, and of 1 to 2 mortar, 2 ins. thick, on the top of the walls. The facing templates were of dressed plank 6 or 8 ins. wide, 2 ins. thick on the top edge and 1¼ ins. thick on the bottom edge. They were provided with eyebolts for lifting.

The inside edges of the coping of the land and river walls sharp were rounded off not only to prevent chafing of the mooring lines, but also on account of the liability of chipping.

The itemized cost of the cement delivered at the work was as follows:

Materials.	Unit.	Total.
11,293 bbls. cement	$1.92	$21,762
140 bbls. natural cement	0.80	112
Rent of warehouse	....	15
Total		$21,889
Labor		
Hauling 181 bbls. 8 mi.	$0.429	$ 78
Loading 11,293 bbls. on barges	0.039	440
Towing 11,293 bbls. 8 mi.	0.100	1,183
Storing 11,293 bbls. at lock	0.090	980
Testing	0.027	316
Total	$0.676	$ 2,997
Grand total 11,433 bbls.		$24,886

This makes the cost of the concrete delivered on the work about $2.17 per bbl.

The sand, as previously stated, cost $1.25 per cu. yd. A total of 3,170 cu. yds. was secured at a total cost of $3,804, or $1.20 per cu. yd.; the additional 5 cts. was for inspection.

The itemized cost of the crushed stone was:

Item.	Unit.	Total.	Per cu. yd.
3,505 cu. yds. stone	$1.98	$6,940	$1.980
Inspecting 3,505 cu. yds.	0.28	101	0.028
One-half cost of bins	..	165	0.047
Elevated wagon road	..	129	0.036
Total	..	$7,335	$2.091

The cost of quarrying riprap and of boulders for the concrete was $252 for 549 cu. yds., or 46 cts. per cu. yd.

The itemized cost of the gravel was as follows:

Dredging (Orange Peel).	Total.	Per cu. yd.
Fuel and oil	$ 480	$0.071
Labor	666	0.096
Total (6,940 cu. yds.)	$1,146	$0.170
Hoisting to Bin.		
Fuel, etc.	$ 111	$0.020
Hoisting	1,921	0.270
Total (6,940 cu. yds.)	$2,032	$0.290
Miscellaneous Items.		
One-half cost bin	$ 165	$0.023
Incline to river	335	0.048
Building dump cars (3)	110	0.016
Sundry items	94	0.013
Total	$ 704	$0.100
Grand total	$3,882	$0.560

The itemized cost for materials and labor for mixing and placing concrete in the lock was as follows:

Material.	Unit.	Total.	Per cu. yds.
11,373 bbls. cement	$ 2.17	$24,886	$2.104
8 bbls. cement for finishing work	3.00	24	0.002
3,170 cu. yds. sand	1.25	3,978	0.337
3,505 cu. yds. crushed stone	2.09	7,335	0.620
549 cu. yds. riprap and boulders	0.46	252	0.021
6,940 cu. yds. gravel	0.56	3,883	0.328
Fuel	....	504	0.043
1,030 gals. oil for Wells Light	0.13	136	0.011
Miscellaneous supplies	....	119	0.010
Total materials	....	$41,117	$3.456
Labor.			
Inclines, tracks, car rep., etc.	.....	$ 1,076	$0.091
3 bottom dump cars	$32.22	97	0.008
Mixer frame, etc.	.....	97	0.008
Mixing and transporting	0.623	7,369	0.623
Tamping	0.222	2,625	0.222
Finishing top of walls	.....	130	0.011
Dressing face of walls	.....	136	0.011
Total labor	.....	$11,529	$0.974
Grand total (11,824 cu. yds.)	.....	52,646	4.43

The labor time for tamping was 1,461½ days, making 8.9 cu. yds. tamped per man per day. Table II shows the proportions of concrete and boulders in different portions of the lock.

TABLE II.—SHOWING RELATIVE PROPORTIONS OF CONCRETE AND BOULDERS IN LOCK.

	Below foundation. C.Y. conc.	Below foundation. Boul.	Below foundation. C.Y. conc.	Below foundation. Boul.	Total C. Y. conc.	Total C. Y. Boul.
Upper miter wall	230	25	234	...	464	25
Lower miter wall	237	...	8	...	245	...
Breast wall	....	...	77	10	77	10
Upper wing wall	....	...	177	27	177	27
Lower wing wall	....	..	307	145	307	145
River wall	2,073	103	3,278	115	5,351	218
Land wall	1,820	114	3,383	10	5,203	124
Total	4,360	242	7,464	307	11,824	549
Total concrete in lock						11,824
Of which boulders and riprap constitute						549
Leaving of mixed concrete						11,275

The height of the lock walls is 15 ft. above the upper miter sill, 29 ft. above the lower sill, and 30 ft. above the lock floor. Being founded on solid rock, each wall acts separately and the design is that of a retaining wall. The land wall is slightly stronger than the river wall, but its top is narrower; opposite the chamber it is stepped in the rear with 1-ft. affects every 3 ft. 6 ins. while the river wall is battered. Both walls are 14 ft. 6 ins. thick at bottom; at top the thickness of the river wall is 6 ft. and of the land wall 4 ft. 9 ins. The ends of the lock walls are necessarily thicker than the side walls of the chamber, as they must not only support the pressure from the gates, but also provide work room for the lock tenders, and the thickness of the lock walls at the heels of the gates is accordingly 16 ft. The walls are, in conformity with the usual practice, without batter inside, though battered walls have been recommended because vertical walls in course of time receive unsightly scars from the rubbing of boats against them. The available length of the lock chamber is 147 feet. The length of the wall below the lower quoin is 25 ft. and above the upper quoin 37 ft. The total length of the lock is 237 ft.

The hollow quoins are shaped directly in the concrete, a form being used as for any other special surface. The shape is that of an arc of the same radius as the heel of the gate, namely, 10 ins.; they are 110° in length, with tangents at either end 6 ins. long. The gate recesses are 22 ft. long and 2 ft. deep.

The miter walls are without batter. Part of the lower miter wall is prolonged downstream to the lower end of the lock so as to protect the tail bay from being scoured out by the discharge from the culverts.

The upper coffer wall, the function of which is to support a simple movable dam across the head of the lock when the upper gates or valves need repairing, has its sill 1 ft. below the upper miter sill. In coffering the head bay this sill forms the lower support for the needles used, the top support being a trussed beam, the ends of which rest in slots in the main walls at such an elevation that the trussed beam will be as low as possible without being immersed at ordinary low-water stages. A similar arrangement of slot and sill is provided for coffering the tail bay.

With the object of preventing the water from cutting behind the land wall, its upper and lower end is provided with a wing wall running perpendicularly back into the bank far enough to join the rocky bluff which is from 20 to 30 ft. in the rear. The thickness of these walls is 4 ft. 9 ins. on top, increasing downward by offsets until rock foundation is reached.

Culverts and Valves.—There are two filling culverts each 3 ft. 3 ins. by 7 ft., which are placed in the gate recesses to keep them from filling with mud; these culverts discharge into a large cross culvert in the upper miter wall and thence through eight small lateral openings into the lock chamber, thus dividing the water into small streams emptying near the lock floor so as to cause little disturbance to boats.

For emptying the lock there are two side culverts, each 4x5 ft., which pass around the heels of the lower gates entering near the gate recesses and discharging below the miter wall into the tail bay, thus serving to prevent deposits there.

The valves are in the culverts, and are butterfly or balanced valves of steel plates and angles turning on vertical shafts.

There are two valves to each filling culvert because the valves had to be of low height in order to remain submerged during low water. They are 3 ft. 2 in. by 3 ft. 2 in. in size, though ordinarily the height would be somewhat greater than the width. The wicket is set in a cast-iron frame bolted to the concrete and is protected from debris by a movable screen sliding vertically in guides bolted to the wall. The valves are inexpensive, simple in design, and that they leak is of no consequence, as the minimum discharge of the upper White River is 1,200 cu. ft. per second.

The valve operating gear, which is set in a covered recess in the coping, consists of a gear sector keyed to the top of the valve shaft

and geared with a pinion turned by a socket wrench and wheel. This simple gearing answers well for the filling valves, which can be operated by one man, but two men were required in opening the emptying valves, so that when one of the valve shafts broke the operating gear for all of the emptying valves was altered by increasing the diameter of the valve shaft from 2 3/16 in. to 3 5/16 in. and by adding two gear wheels and pinions so as to increase the velocity ratio between the first driving pinion and the sector.

The time of complete lockage is 13½ minutes for downstream boats and 14 minutes for upstream boats, to which figures should be added one minute for passing in and out between the guide cribs.

The cost of the valves, ladders, etc., was as follows:

Original valves:	Total.
20,722 lbs. iron	$1,128
Towing 15,667 lbs. iron	20
Total	$1,148
247½ days' labor	567
Grand total	$1,715
Cofferdam for new gear and shafts for lower valves:	
10.5 M. ft. B. M. timber at $8.38	$ 88
600 lbs. iron at 2.15 cts.	13
Fuel	13
Total	$ 114
257½ day's labor	504
Grand total	$ 618
Removing mud from lock pits, setting valves, etc.	
Materials:	
New shafts and gear	$ 495
Miscellaneous	61
Total	$ 556
Labor:	
Pumping and cleaning pit	$ 337
Setting valves	95
Total	$ 432
Grand total	988
Grand total for valves	$3,320

Lock Gates and Sills.—The gates are of the standard form, namely, mitering gates of the girder type with straight front and back. Though timber gates have a shorter life than metal ones and their buoyancy when submerged is a disadvantage, yet owing to their smaller first cost, greater ease of repair and simpler construction, small gates are almost invariably made of wood, which was the material adopted in this case. The gates are horizontally framed and without quoin or miter posts, the main timbers extending from edge to edge of the gate and the ends, which are built up solid with filling blocks, being shaped to fit the hollow quoin and miter, respectively, thus avoiding the weakness of beams jointed into vertical heel and toe posts. The rise is a compromise, the less the rise the greater the thrust upon the masonry, the greater the rise the longer the gate, and hence the longer the lock. In this case the rise was taken as one-sixth of the span, which is equivalent to a miter angle of 18 degrees 26 minutes, though usually the miter angle is taken between 19 degrees and 21 degrees.

The gates are of white oak, 20 ins. thick throughout, each arm consisting of a built-up beam composed of two 10 by 10 in. timbers bolted together with 1-in. bolts and extending in one length from toe to heel. The tops of the gates are flush with the tops of the lock walls, so that the lock can be used until the walls are submerged. The lower gates, which are 29 ft. 5 ins. in height, are built solid for 10 ft. from the bottom. For the upper gates these figures become 15 ft. 5 ins. and 20 ins., respectively. By making the lower portion of a gate solid, the gate may be made thinner, thus reducing under pressure. The upper portions of the gates are paneled; the arms are all made of the same scantling as below, but are spaced inversely as the maximum loads; the arms are separated by five blocks (including the two at the heel and toe), and the intervals are closed with a sheathing of 2-in. oak plank made water tight by calking. The beams are held together by seven pairs of long 1⅛-in. bolts running vertically through the center lines of the main timbers as well as through the filling blocks in the upper part of the gate. The weight of the gate is taken up by two diagonal tie straps of 3½ by ¾ in. wrought-iron eyebars provided with turnbuckles; one end of each eyebar passes over a pin in the journal strap and the other over a similar pin held in place near the lower end of the toe by a stirrup strap and a nose strap. The bottom beam is fitted at the quoin with a cast-iron heel piece which rests on a forged steel pivot shrunk into a cast-iron pivot plate having sufficient bearing. This bedplate is bolted to the concrete. The top gudgeon is a 3-in. steel pin supported at both ends by journal castings, between which the collar works. In order that the leaf may, in opening and closing, swing clear of the quoin without friction, the rotation axis of the pivot and gudgeon is on the upstream side of the center of figure of the hollow quoin when the leaf is closed, the eccentricity being 1¾ ins. The upstream half of the toe is rounded off so that the surface of contact when the gates are mitered shall fall upon the downstream timbers of the built-up beams. Thus the compression due to the end reactions is thrown on the downstream timbers where it will relieve the tension from the direct loading, and is removed entirely from the upstream timbers to avoid increasing the compression from the direct loading.

The anchorage for the gates consists of four wrought-iron bars with cast-iron washers or anchor plates embedded in the concrete and connected in pairs at their exposed ends to a wrought-iron forging, to which the ends of the wrought-iron gudgeon strap or collar are fastened, the gudgeon pin being held in place by two cast-iron plates worked into the gate timbers. This arrangement was difficult to fit and the design for Lock No. 5 provides for two embedded bars with slotted ends for gib and cotter connection with the gudgeon strap. For the double-plate arrangement used at Lock No. 2 for holding the pin was substituted a cast-steel headpiece or bonnet. The anchorage connections fit in a recess below the coping and are covered with a cast-iron plate.

The method of building and placing the lock gates was as follows: A small hand-power derrick was erected on a level spot and so as to command the ways, which were built of long heavy timbers laid perfectly level about 2½ ft. from the ground and close enough together to support without deflection the weight of an entire gate. On each side of the derrick were placed two sets of ways, between which ran a track for carrying the timbers. The gate timbers were delivered as needed to the derrick and placed on the ways, the built-up beams framed and bolted, and the heel and toe worked to pattern. The arms and blocks were then juxtaposed in position so as to get the alignment of the long bolts and then separated for the holes to be bored. This was a tedious procedure, as no matter how carefully the measurements for the holes were made, it was found impossible to bore all of them in the different pieces so as to avoid slight errors of alignment, hence burning the holes out with long rods of hot iron had to be resorted to. The gate was then assembled, the bolts inserted and tightened, the irons fitted on, the heel and toe worked to pattern, and each arm and block numbered to avoid any displacement later. The gates were then taken apart and transported to the lock pit to be erected piece by piece, by means of derrick boat. As each beam was put into position its top was given a heavy coat of white lead, and the position of its bolt holes tested by thrusting down an iron rod. After the gate had been thus built up to the required height, the long perpendicular bolts were raised by the derrick and put into place, the various irons, fitted, the anchor bars and tie straps tightened, and the gate swung. The gates were then given two coats of red lead.

The gates are operated by hand power. The maneuvering gear consists of a spar, to each end of which is fastened one end of a chain; the hight of this chain is led through a chain guide consisting of two sheaves to a chain capstan worked by a crank. The gate is opened or closed according as the chain is pulled in one direction or the other.

As wooden lock gates subject to varying lifts, unless made too heavy at low water, are too buoyant at high water, it is necessary at the approach of floods to ballast them, which was done by filling the panels with large stones.

The miter sills, which provide an elastic cushion for the bottom of the gates, consist of 12 by 12-in. timbers well bolted to the miter wall, as they may sometimes be subjected to a lifting pressure from the gates, and when once started the upward water pressure is of course added. The miter sills are 2 ins. higher than the miter walls so as to act as a guard for the masonry. The miter sills are 1 ft. below normal 4-ft. depth so as to permit the pool level to be reduced without affecting navigation. The sills, like the gates, are of white oak and were set when the concrete was placed in the miter walls. The gates do not, when shut, extend over the sill, as is sometimes the case, for a difficult joint then becomes necessary. In this instance the gates lap the sill by 5 ins., the under pressure being counterbalanced by the weight of the gates. The cost of the gates and sills was as follows:

Materials:	Total.	Per M. ft.
40.4 M. ft. lumber at $17.13	$ 692	$ 17.280
24,351 lbs. grate irons at 4.96 cts.	1,208	21.900
Gas pipe	3	0.080
Pattern material	4	0.100
Fuel	50	1.237
Paint, oils, etc.	102	2.525
Miscellaneous	42	1.039
Total materials	$2.101	$ 44.161
Labor.		
Unloading lumber	$ 12	$ 0.297
Towing 9.5 M. ft. timber at $3.09	29	0.717
Handling and storing 9.5 M. ft. timber	23	0.569
Inspecting 14.6 M. ft. timber at 51 cts.	7	0.174
Framing 40.4 M. ft. timber at $55.68	2,249	55.668
Towing 15,666 lbs. grate irons at 0.12 cts.	20	0.495
Placing gates, 40.4 M. ft. at $22.90	925	22.096
Yard derrick	65	0.569
Total labor	$3.330	$ 81.385
Grand total		125.546

Filling and Paving Behind Land Wall.—Loose stone was placed by hand back of the land wall to form a drain for the seepage. This drain, which was about 2 ft. by 3 ft. in cross section, connected with a 6-in. cast-iron pipe leading through the lower end of the land wall into the guide crib. The space behind the land wall and between the wing walls was then filled with gravel. The cost of the fill behind the land wall was as follows:

Dredging gravel.	Total.	Per cu. yd.
Fuel and oils	$155	$0.03
Labor on dredge	354	0.07
Total (4,856 cu. yds.)	$509	$0.100
Building inclines to bins.		
Lumber and iron	$ 44	$0.009
Labor erecting and removing	381	0.078
Total	$425	$0.087
Hoisting to bins.		
Fuel and oil	$ 60	$0.02
Labor hoisting	866	0.17
Total	$926	$0.190
Grand total		$0.377

The cost of paving behind the land wall was as follows:

Materials.	Total.	Per sq.yd.
479 cu yds. riprap at 70 cts	$ 336	$0.235
Labor.		
Inspecting riprap	$ 14	$0.010
Dressing riprap	328	0.229
Laying pavement	691	0.482
Total	$1,369	$0.956

In connection with the work a ban revetment was constructed below the lock, the cost of this being as follows:

Item.	Unit.	Total.	Per lin. ft.
Labor grading bank (575 cu. yds.)	$0.37	$ 213	$1.06
Paving bank:			
881 cu. yds. riprap	$0.70	$ 616	$3.08
Labor inspecting (881 cu. yds.)	0.03	25	0.12
Labor paving (881 cu. yds.)		367	1.83
Total		$1,221	$6.09

The cost of the paving proper was $1.15 per cu. yd. An average of 4.61 cu. yds. of riprap was placed per man per day.

In the preparation of the upper approach to the lock the excavation of 30 cu. yds. of rock was required. This was done by hand labor, and cost $2.05 per cu. yd. The amount of work done per man per day was 0.88 cu. yd. In the preparation of the lower apporach to the lock the excavation was done by dredge

at a cost of 9 cts. per cu. yd. for 310 cu. yds.

Guide Cribs—Permanent guard of guide cribs are placed at the head and foot of each lock wall. The upper-river crib is a solid crib, continuing the line of the river wall. This was substituted for two detached triangular cribs, proposed in the original project, in order to avoid the troublesome outward draw of the currents that would result through the open spaces. This upper-river crib is 150 ft. in length and 8 ft. in width on top; its inside face is vertical from the top to 1 ft. below the upper miter sill, below which it is stepped as is the outside face throughout, so that the width of the base 30 ft. below the top is 20 ft. The lower part of the cribwork connects with the lock wall, but above a level 2 ft. below the upper miter sill there is a gap 19 ft. wide between the crib and the lock wall for the passage of drift. The top of the crib is level with the coping. The lower-river crib, which is 120 ft. long, is similar except that no gap exists between the crib and lock wall, and that the top of the cribs is not level with the coping throughout, but drops 20 ins. after the first, the second, and the third 20 ft., so that the proportion farthest downstream is 5 ft. below the coping in elevation. The land cribs, as originally proposed, were parallel to the axis of the lock, but have been built flaring so as to give wider approaches to the lock; the upper one is 55 ft. long and the lower one 80 ft. All these cribs were built of 10x10-in. timbers, framed and drift-bolted together, pine being used below pool level and oak above. They were filled with "one-man" stone, large selected stones being set on edge with their flat faces against their side openings and the top being covered with large, well-shaped stones set level with the timbers.

The itemized costs of the various cribs are shown below.

The upper land crib contained 24,139 ft. B. M. of timber and was 55 ft. long, so that the first board measure per lineal foot of crib was 439. The preparation of the foundations for the crib required 110 cu. ft. of excavating which cost $81.96 or 71 cts. per cu. yd. The cost of the cribwork proper was as follows:

Materials:	Total.	Per M. ft. in crib.
4,372 ft. B. M. pine at $11.95 per M.	$ 52	$.215
4,834 ft. B. M. timber (no charge)	...	.....
14,933 ft. B. M. oak at $14 per M.	209	8.65
1,119 lbs. iron, spikes, etc.	30	1.24
Total	$291	$12.04
Labor:		
Handling and stacking 19,305 ft. B. M. timber at $2.56	$ 50	$ 2.07
Moving 19,300 ft. B. M. timber across river at $2.55	49	2.06
Framing and placing 24,139 ft. B. M. timber at $14.45	349	14.45
Total labor	$448	$18.58

Assuming the 4,834 ft. B. M. of old lumber for which no charge was made to cost $10 per M. ft. B. M., we have an additional cost of $2 per 1,000 ft. B. M. in the crib or a total cost of $20.58 instead of $18.58. The total cost of cribwork was therefore as follows:

Item:	Total.	Per M. ft. in crib.
Materials	$291	$12.04
Labor	496	20.58
Total	$787	$32.62

The cost of filling the crib with ripings and of filling behind the crib with earth, paving, etc., was as follows:

Riprap Filling:	Total.	Per cu. yd.
238.6 cu. yds. riprap	$167.	$0.70
Inspecting riprap (238.6 cu. yds.)	7	0.03
Filling in 238.6 cu. yds. riprap	114	0.48
Total	$288	$1.21
Quarrying and filling 65 cu. yds.	$158	$2.43
Earth backing, 42 cu. yds.	57	1.35
Quarrying and paving 26 cu. yds.	50	1.93
Total (304 cu. yds.)	$265	$0.87
Grand total (304 cu. yds.)	$553	$1.82

In framing and placing timber in the crib the average was 137 ft. B. M. per man per day. In filling with riprap the average was 3.86 cu. yds. placed per man per day.

The upper river crib contained 71,729 ft. B. M. of timber or 478 ft. M. M. per lineal ft.; its cost was as follows:

Excavation:	Total.	Per cu. yd.
Fuel	$16	$0.30
Labor exc. 52 cu. yds. boulders	82	1.570
Total	$98	$1.87

The cost of the cribwork proper comprising 71,729 ft. B. M. of timberwork was as follows:

Materials.		Per M. ft. in crib.
44,012 ft. B. M. pine at $12.34 per M.	$ 544	$ 7.58
27,717 ft. B. M. oak at $14.37 per M.	398	5.55
33,395 lbs. iron at 2.46 cts.	82	1.15
Fuel	16	0.23
Miscellaneous	9	0.11
Total	$1,049	$14.62
Labor:		
Handling and stocking 71,729 ft. B. M. at $2.65	$ 191	$ 2.66
Transp. 71,729 ft. B. M. across river at $1.47	106	1.48
Framing and placing 71,729 ft. B. M. at $9.90	710	9.88
Total	$1,007	$14.05
Grand total	$2,056	$28.64

The cost of filling the crib with riprap was as follows:

Material:	Total.	Per cu. yd.
1,475 cu. yds. riprap at 70 cts.	$1,033	$0.674
56 cu. yds. riprap picked of cofferdam	...	.....
Fuel	10	0.007
Total	$1,043	$0.681
Labor:		
Inspecting 1,475 cu. yds. riprap at 3 cts.	$ 43	$0.028
Filling 1,531 cu. yds. riprap at 39 cts.	612	0.399
Total	$ 655	$0.427
Grand total	$1,698	$1.108

In framing and placing timber 192 ft. B. M. were averaged per man per day; in filling the cribs the average per man per day was 4.7 cu. yds.

The lower land crib contained 69,872 ft. B. M. of timber; its cost was as follows:

Excavation (earth and gravel):	Total.	Per cu. yd.
Fuel	$ 27	$0.06
Labor, 445 cu. yds.	289	0.65
Total	$316	$0.71

The cost of filling the crib with 1,632 cu. yds. of riprap was as follows:

Materials:	Total.	Per M. ft. in crib.
9,000 ft. B. M. oak at $15.94 per M.	$ 144	.....
44,455 ft. B. M. pine at $13.66 per M	607	.....
16,417 ft. B. M. pine (no change)	...	.....
5,269 lbs. iron at 2.09 cts.	110	.....
Total	$ 861	.....
Labor:		
Hauling and stacking 53,455 ft. B. M. at $2.63 per M.	$ 141	.....
Framing and placing 69,872 ft. B. M. at $11.04 per M.	771	.....
Total	$ 912	.....
Grand total	$1,773	.....

The cost of backfilling and paving behind the crib was as follows:

Materials:		
1,632 cu. yds. riprap	$1,156	$0.71
Labor:		
Inspecting 1,632 cu. yds. riprap	$ 48	0.03
Filling 1,632 cu. yds. riprap	451	0.28
Total labor	$ 499	$0.31
Grand total	$1,655	$1.02

The cost of back filling and paving behind the crib was as follows:

Item:	Total.	Per cu. yd.
Fuel	$ 19	.....
70 cu. yds. backfilling	125	$1.78
62 cu. yds. quarrying and paving	101	1.68
Total	$245	.....

The total cost of the crib was $3,989.

Partial costs only are given for the lower river crib and they are therefore, omitted. Including excavation cribwork and filling but not including backing the costs per lineal foot of the three cribs was as follows:

Item.	55 ft. of U. land.	150 ft. of U. river.	80 ft. of L. land.
Excavation (150 lin. ft. crib)	$ 1.49	$ 0.653	$ 3.95
Crib construction (150 lin. ft. crib)	14.11	13.707	22.16
Filling with riprap	5.24	11.307	20.68
Total per lin. ft.	$20.84	$25.667	$26.79
Cost per M. ft. B. M.	$47.92	$53.07	$53.58

The succeeding article will give methods and costs of constructing the dam portion of the works.

LETTERS TO THE EDITOR.

Information On Stucco Work.

Sirs: I am looking for good information on stucco work, of late date. H. B.

Roanoke, Va., Jan. 15, 1910.

The latest and best information on stucco work will be found in ENGINEERING-CONTRACTING, Aug. 11, 1909, and Jan. 12, 1910, both articles having been written by men of experience.—Eds.)

A Bag of Cement Is One Cubic Foot of Cement.

Sirs: If you will permit me to take a little more of your space, I desire to say a little further in regard to an article in your paper of Dec. 22, and to a communication from me in regard to that article. I see now that I did not understand the purport of your article, and seemingly that I am entirely at variance with you in the matter.

My position in the matter is simply this: That when a contractor bids on a piece of work he wishes to know how much that work is going to cost him, and how much of each kind of material he must use in the mix. In our section of the country we buy cement, as do you, by the barrel; we buy sand by the cubic yard and stone by the cubic yard. We mix these materials generally either in one yard batches or one-half yard batches. Now, my idea of a specification for such work is that the contractor should know from the specifications how much material he must buy, and how much he must put into a batch without having to get out his paper and pencil and figure, without having to run to the city engineer or to the inspector representing the engineer to know what the engineer meant when he said "proportions are so-and-so." I get this by specifying the number of barrels or parts of a barrel of cement that the contractor shall mix with one yard of stone and a certain part of a yard of sand. He knows on the face of his specification what he has to buy, and he and the inspector can never disagree as to what must go into the mix. Now, as to whether you should say bags of cement or barrels, that cuts no figure so far as I can see. A barrel is four sacks, and it is what the contractor buys, so I prefer the use of the barrel, even though no cement is shipped in that kind of a package. I would just as soon, though, put in the sack of cement instead of the barrel, as the contractor would have no trouble in that case in figuring out what he had to do. I may be wrong, but it seems to me my point of view has some merit and is worthy of consideration.

Yours truly,
J. H. WEATHERFORD.
City Engineer.

Memphis, Tenn, Jan. 15, 1910.

(We are glad to give space to the above communication. The point of view of our correspondent certainly has merit and it is this personal equation in all matters that so often leads to apparent misunderstandings and tends to defer agreement. When we discussed the bag of cement as a unit we had in mind the average user with the average size batch concrete mixer, with capacity given in cubic feet per batch. Very few contractors own mixers in which one-yard or one-half yard batches are mixed. Mixers of those sizes are not portable to the proper degree and must of course be used on large jobs. Mixers in common use are the ¼ cu. yd. to ⅛ cu. yd. size. Proportions for concrete are generally given, as 1:2:4 or 1:3:5, etc., without a unit of measurement being fixed. Our suggestion was that the 1 stand for 1 foot and the present commercial bag or sack of cement be considered as one cubic foot. When it comes to purchasing materials there are published tables showing quantities per cubic yard of concrete and the purchasing is generally done by men more intelligent than those who do the mixing. Let the purchaser do the figuring with fractions and let the men who measure the batches get the easy work. Eds.)

Sirs: I have taken a good deal of interest in the recent discussion in Engineering-Contracting in regard to proportioning concrete materials. It has been my practice to specify the quantity of cement to be used for each cubic yard of concrete in place, the unit of measure specified being a barrel of four sacks. Suppose you specify that one sack of cement shall be used with so many cubic feet of sand and so many cubic feet of stone or gravel, the degree of looseness used in measuring the material will vary the amount of cement actually used say for a given number of yards of concrete in place. I think it is a good idea to use the sack as the unit of measure.

Yours truly,
VERNON H. SMITH.

Wooden Bridges in New Brunswick.

Sirs: Referring to a report on page 19 in Engineering-Contracting for January 5th relative to the use of wooden bridges in New Brunswick, permit me to state that no report has ever been made by the Department of Public Works in favor of the abandonment of steel bridges.

The many references in periodicals, to such a report may have arisen from the fact that in many localities throughout this province suitable bridge timber is still standing. In such localities and in other districts adjacent thereto this Department is constructing designs of covered in wooden superstructures up to 185 ft. in length between centers of end bearings, placed on concrete substructures.

In such instances they are found to be very much cheaper than steel structures in first cost, as well as in future maintenance, owing to the fact that no painting for preservation is required from time to time. A hardwood floor system is preserved for many years owing to protection from exposure; and, owing to the adopted design of covered in protection from the elements, the superstructure may generally be preserved for an indefinite period. We have existing wooden structures in this Province that in the past were constructed on some such covered in basis, where their superstructures, although now 40 and 50 years old, are yet in a good state of preservation.

With improved designs of covered in wooden superstructures placed on permanent concrete substructures, I believe a class of highway bridge is being constructed through certain sections of this Province, well adapted to the many conditions that exist. Under these conditions they will compare very favorably with highway steel truss construction work, not only in cost but in permanency.

Yours truly,
A. R. WETMORE.

Fredericton, N. B., Jan. 18, 1910.

[Mr. Wetmore is Provincial Engineer in the Public Works Department of New Brunswick and we thank him for his letter. These bridges have been illustrated in a number of wood workers' periodicals and while they may be cheap they are no ornament. No paint is used and they are completely housed in for protection from the weather. The comparison between wooden and steel structures is interesting.—Eds.]

Bidding Prices of Wooden Stave Pipe.

Sirs: I note the request made by a correspondent in your issue of Dec. 29, 1909, p. 577, for costs of wooden stave pipe. The following are some figures bid for constructing a wooden stave pipe line of 60 ins. internal diameter and 2,300 ft. long, the pressure head varying from 5 to 65 ft., and averaging about 35 ft. The bids were for completed pipe.

(1) For 60 in. pipe, 2½ in. thickness of staves of Oregon fir, and ¾-in. round two-piece steel bands, three separate bids were, respectively, $4.70, $5.75 and $5.60 per lin. ft.

(2) Same as No. 1, but with ⅝-in. bands the price bid was $4.30 per lin. ft.

(3) For 60 in. pipe, 2 1-16 in. No. 2 fir sleeves; and ⅝-in. steel bands, the price bid was $4.87 per lin. ft.

(4) For 60 in. pipe, 2½ in. redwood staves and ¾-in. steel bands the price bid was $6.37 per lin. ft.

(5) For 60 in. pipe, 2-in. staves of first class redwood, and ⅝-in. two piece steel bands the price bid was $5.12 per lin. ft.

These bids were all for furnishing the pipe materials, and constructing the pipe. The grading was let under a separate constract, and has cost $0.50 per lin. ft., exclusive of the bridges. The total cost, including backfilling over the pipe, will be about $6 per lin. ft. of pipe. The location of the pipe is near Olmstead in Provo Canyon, Utah.

Very respectfully,
CLARENCE S. JARVIS,
Engineer for Provo Reservoir Co.

Provo, Utah, Jan. 1, 1910.

Observations on the Panama Canal Work.

Sirs: I have noticed your late editorial on the high costs of day labor work on the Panama Canal. For the purpose of criticising the doings of those in, or who have been in, charge of this work, or with hopes of securing at this late date any material change in the proceedings, no discussion of the proposition is justifiable. The work will no doubt go on to a successful completion on about the present basis, and no one at all familiar with the diligent and honest efforts of those in charge should find fault with results.

However a discussion of the proposition may help settle some questions so we can know what is best to be done in carrying on public work in the future. The suggestions I offer are based on a close study of official reports and criticisms, together with information gained on two visits to the Isthmus. I stopped at the government boarding quarters and was there long enough to go many times over the entire work, making a close study of everything relating to it. My last trip was in April, 1909, and I expect soon to make a third trip.

I do not claim to be specially fitted to criticise this undertaking, although I have made a special study of, and have had a long experience in, the carrying on of construction work. Certain facts however, with the attendent conditions must come to the notice of everyone in connection with the Panama Canal work.

We will all concede that a wise selection was finally made when the men now at the head were placed there. Many believe several mistakes were made in previous appointments, but no one criticizes the wisdom of the appointments. That any difficulties, delays or disagreeable things occurred came from the unfortunate method adopted to try and select men to carry on the work. Can we believe the very best man in America has been selected? Thousands of possibly good men were not prominent enough to be considered. It is not alone at the top but farther down the line. Have the methods of selection adopted succeeded in securing the best men from the thousands of applicants? In every place there is some best man but do we get the best by offering salary and no more?

Nearly every construction job advertised brings out some man who has the means and knows the ways to gamble that he can make material reductions on hitherto known costs. The majority of these men make good and the beneficial results from their ability to make good would not have been realized had not some substantial inducement produced the good man.

Under the present system at Panama each man does his best to earn his salary, or at least hold his job. If inducements had been offered costs would have been reduced by securing experienced men who would have a free hand in developing methods on which their material well being depended.

Are the conditions under which a salaried employe must work and proceed, to safeguard the nation from graft and loss, such as will admit of him delivering desired results at minimum cost? Every one knows, without a discussion, that the only answer is "No." The increased cost is every minute and every move. There probably has not been a piece of machinery or a pound of supplies bought for the canal that would not have come cheaper to any other responsible purchaser. Many reasons exist for the same, well known to both the seller and every other person at all familiar with such doings. Then again, it likely costs Uncle Sam fully double what it would cost a contractor, to conduct his business, inspect, oversee, take care of, and pay for; also such employe is not at liberty to do his will, and work his ways. The whole system is so subdivided that each man has a very small part. If any individual devises a specially productive method the resulting gain is very small, measured against the whole; and a failure is very big judged on his little section. There must be a strong sense of loyalty on the part of the individual to the organization to lead a man to risk sacrifice. Can a man do the best that is in him without the incentive of great reward or the fear of results from failure? I do not believe a man gives his best for a salary. He must have some contingent fee.

However, the conditions exist. The organization is there and I believe we are getting all we can expect under this system. The men are loyal and absolute integrity is evidenced in every act connected with this great enterprise. A more earnest and faithful lot of men was never brought together. From the head man to the wage earner there is no useless pomp, no improper overtime, no apparent loafing. No better selection could have been made and the men are doing the best that can be done, but I believe the Government is losing millions because of undertaking the work by salaried employes instead of awarding it by contract.

I cannot compare present costs with what a contractor might do as that is merely a matter of opinion and I do not see my way clear to convincing conclusions. If the method of doing things or the organization back of the method is wrong then costs, results and progress cannot be good. The present good organization has only lately been made a perfect machine and the work is half done before this highly desirable result has been achieved. Engineers formerly received their whole education at the employer's expense. Now the technical part is paid for by themselves and they pick up the practical part while working in subordinate positions. In the present instance, however, the Government has had to pay high for educating its employes. The organization is now good, but why was it not as good from the start? The new methods of cost keeping and reports enables comparisons to be made of the work of each gang so that new spirit is being infused. Contractors would not have been five years getting daily reports and cost records into shape.

The equipment in general is good and sufficient yet will be out of date before the work is completed. Before affairs were in shape a start was made and old worn out, broken and in many cases obsolete French machines were used. At the present time with the new machines we see only what we are accustomed to. No new ideas seem to be developed as they would be in the case of contract work. The job was about one-third done before modern cars and engines were supplied to the shovels. A contractor would have gone broke trying to use the old patched French cars and engines. At the present time the service is excellent, but not so very long ago I could stand in Culebra Cut and see from 10 to 15 steam shovels idle waiting for cars, not for an hour or two only, but half to three-fourths of them as a regular proposition.

A long, long time ago it was known that large quantities of broken stone must come from Porto Bello hill and a crusher plant was ordered and installed long before it was required. Some one blundered and a No. 6 crusher was installed. It was hardly more than a coffee mill and its insufficiency was seen from the day it commenced work. Strenuous work was done and yards of red tape unreeled with the result that it was in use nearly a year before a larger crusher was ordered, and it will be a long time before it is in operation. Why did not the Commission advertise for bids to furnish this stone by contract? If a contractor made a mistake in the size of a crusher he would telegraph to the maker and it would be there on the next steamer. In the first place he would not be likely to make the mistake, and in the second place he would not have to work through bureaus, each checking the other. These checks are to prevent waste and stealing. Have we proof that they prevent waste, and is there proof that they are needed to prevent stealing? From the class of men one sees on the work it is certain better results

could be secured if their hands were more free.

Porto Bello hill was not stripped in advance of working the rock. The output of rock was not started when needed and expected, although the plant was started hastily when half completed. This is directly chargeable to lack of experience of the men in charge. It would have been easy to find contractors who would have backed their bid by a bond and who might have worked the quarry in a vastly different way. Why not have received bids and not permitted the day labor work unless the men in charge could show the lowest bid was too high? There are many opportunities to do better work on the Panama Canal, but no chances for the best men to be brought out and allowed to do it.

Lately some attention has been paid to letting a few small contracts with excellent results and considerable saving. This is really no measure of what can be done for there are practically no contractors there and the jobs are too small to be attractive to men in the States. If some large general contractor, or an association of contractors, had the work and followed the usual practice of subletting the Isthmus would be full of small contractors and there would be a big saving on past costs. I have seen many instances of extremely high costs not reported for lack of proper field supervision. In many cases jobs handled by inefficient foremen are large enough to be very attractive to the average sub-contractor in the United States. I have seen it cost over $2 per cu. yd. to move soft dirt 150 ft. and $3 to get rid of dirt within 300 feet simply because the foreman met each thing as it came. The jobs were small compared with the canal, but would look big to some contractor, and how many jobs are there like these on the canal?

In short, in the Canal Zone I found cases of individual waste that one can find in all large enterprises public or private. They are bigger on the canal because the proposition is so big. Work is judged by reports instead of field supervision. Men are paid salaries instead of being given a chance to participate in profits. I think many of your criticisms are partly justified, but they are a trifle severe.

C. L. BARTLETT.

Cedar Rapids, Ia., Dec. 29, 1909.

Comment on the Results of Tests of Certain Water Proofing Compounds Obtained at the Engineering Experiment Station of the University of Wisconsin.

Sirs: In an article published in the Jan. 5 issue of Engineering-Contracting concerning tests of commercial waterproofing compounds for concrete, some very strange results were obtained, which are not in accordance with the tests made by the most eminent engineers and chemists along the same line. This article is so manifestly unfair to Aquabar that we feel called to comment upon it. We regret that one of your editors did not take up this matter with our engineering department prior to the publication of the article.

On Feb. 13, 1907, Mr. Richard K. Mead of Nazareth, Pa., a noted cement chemist and member of the Committee for Standardizing Cement Tests, reported that discs of 1:3 standard sand ½ in. thick allowed no water to percolate through when subjected to a head of 50 ft., and that small vessels of the same mixture, cylindrical in shape and 8 ins. deep, with walls and bottom ¼ in. thick, which were hand moulded on the inside of porcelain or glass cups, were watertight.

These vessels were loaded with lead slugs so that they were immersed in water, and at the end of six weeks they were still dry. It was also found that 1:3 briquetts gaged with Aquabar showed 298 and 400 lbs. in 7 and 28 days, respectively, which Mr. Mead reports "is strong enough for the most exacting concrete work."

His conclusions are that Aquabar is an efficient waterproofing agent, not only for concrete building blocks, cement bricks and cement roofs, but also for cisterns, stand-pipes, deep reservoirs, conduits, etc., when concrete work must be waterproofed under pressure of water.

Dr. Chas. F. McKenna, 50 Church street, New York, N. Y., reports that discs 10 ins. in diameter and 1 in. thick showed the following results:

Mixture	Failed at lbs.	Mixture	Failed at lbs.
Cement 1		Cement 1	
Ottawa Sand 3	50	Ottawa sand 1	40
Water	20	Water	50
Cement 1		Cement 1	
Ottawa sand 3	50	Ottawa sand 1	70
Aquabar 1 to	50	Aquabar 1 to	80
Water 24 parts		Water 24 parts	

In this case you will notice that 1:1 discs without Aquabar broke at an average of 45 lbs. per sq. in., while 1:1 discs with Aquabar broke at an average of 75 lbs. per sq. in. In neither case did the water penetrate entirely through the discs, nor did the Aquabar show a decrease in strength.

The significance of a mortar composed of 1:3 sand, and standard sand at that, resisting these water pressures is not to be lightly estimated, as standard sand being of a uniform size has a greater percentage of voids than any sand used in actual work.

However, single and isolated instances in laboratory tests are apt to be misleading in conclusions. There is much wisdom in the old saying that "The proof of the pudding is in the eating," and the staunchest supporters of Aquabar are those who have used it.

The value of a test wherein 1:3:5 concrete is submitted to a water pressure equal to 46 to 92-ft. heads is problematical, and is a condition almost never met in actual practice, and would require a slag which could resist a pressure of 1½ to 3 tons per sq. ft. Concrete can be used, however, and made waterproof by integral waterproofing against all pressures encountered in engineering practices, but no engineer would attempt it against high pressures with 1:3:5 concrete, as same is not dense enough to make intimate connection with the reinforcing steel necessary, as reinforced concrete would have to be used under such conditions.

We have an instance in Atlantic City, N. J., wherein the basement slab of a boardwalk rest pavilian is 15 ft. below high tide. A strong east wind will bring the water up to and sometimes past this place. The concrete was mixed and put in place by ordinary labor, and it is absolutely watertight. There is at no time less than 5 ft. of water pressure at the slab.

Experiments on a laboratory scale will show that plain cement mortar is practically waterproof against high pressure if the surfacing is carefully done and the mortar applied in two or more layers each denser than the preceding one, with the surface of the last troweled smooth and fine. I have yet to see this miracle accomplished on a job of any size. It will not work. I have traveled considerably; I have seen the men who have relations and friends who did it; I have seen the man who said he did it—but I have never seen such a job.

On the other hand, I have seen cases of a very difficult nature handled by contractors with poor equipment and poor labor, and with every condition against them, finish absolutely waterproof by using Aquabar, while in no other way could they have accomplished the result without a great deal of expense.

The case I have in mind is that of a garage basement built 5 ft. below the water level. The condition of the work was such that it was necessary to build the walls little by little, a piece here and a piece there instead of a continuous piece of work as nearly monolithic as possible. The work was interrupted by some heavy storms, the walls were built a small piece at a time and hand mixed, ordinary proportions being used without reinforcing.

The elevator pit was 12 by 24 ft., and there was a considerable pressure which brought with it a quicksand composed of clay, sand and silt. It was necessary, owing to the inadequate equipment on hand, to lay this slab a little bit each day. Bleeder pipes were inserted to relieve the water pressure so that the mortar finish could be bonded to this slab. The same had to be done to apply the finish to the balance of the floor, which was about 8 ins. thick and reinforced with wire mesh; one of these bleeder pipes was sealed in cement mortar and a stop-cock put in the top. The basement is entirely dry, but the garage was drawing a considerable part of its water supply by opening the stop-cock and taking the water supply from the pressure beneath.

The manufacturers of Aquabar are willing to give a surety bond guaranteeing the contractor's concrete impervious to water, provided he will have the work done under supervision from the factory, which is merely to see that the Aquabar is used in the proper proportion and the materials used so as to obtain the maximum density.

In the last few years we have waterproofed the structural mass as well as the cement mortar wearing surface of a great many suspended reinforced concrete floors, in which, if the strength of the concrete were affected as reported, there would be some failures and collapses but such is not the case. On the contrary, there are quite a number of floors waterproofed with Aquabar which are carrying considerable overloads, which wear excellently and are still waterproofed, with every prospect of continuing waterproof indefinitely.

There has been no call as yet upon the surety bonds furnished by the manufacturers guaranteeing any waterproofing on a piece of work. There have been a considerable number of these bonds furnished covering all conditions of work, and there has been ample time for percolation to occur.

In conclusion, I would like to say that experience has shown much in favor of integral waterproofing in general and Aquabar in particular. The advantages of such a system are quite obvious. This system is growing faster than any other. Day by day new converts are made to its use. It has already stood the test of all sorts and conditions met in waterproofing and passed them successfully. That it will ultimately be the only system of waterproofing there is no doubt. There only remains the education of the public to the use of integral waterproofing. This is readily accomplished, for it appeals to every one as both the simplest and the best possible method to use, making the structural mass itself form a continuous line of impervious concrete.

J. F. NACHOD.

Philadelphia, Pa., Jan. 19, 1910. Vice-Pres. Girvan-Nachod Co.

(We are glad to give space to this communication. The suggestion that our editors should have consulted with the manufacturers of Aquabar or of any of the other water proofing compounds tested before publishing the original article seems poorly founded. The article was an abstract from an officially published report of tests made by an investigating laboratory having no purpose to subserve except the discovery of the truth in so far as that might be possible. That these tests are absolutely conclusive no one will claim, least of all, we believe, the laboratory authorities under whose direction they were made. It must be plain that no alteration of the results as given was permissible to the editors either with or without consultation with interested parties. The editors' sole right was to present the results exactly as given as being of interest to their readers. We give space to the above communication for the same reason.—Editors.)

The company has recently placed on the market town sites in Prince Rupert, and has realized excellent prices for the same. It is interesting to note that 80 new town sites have been opened along the main line of the prairie section, between Winnipeg and Edmonton. The work is being hurried with all possible despatch.

The school board of Chicago recently invited a well known firm of contractors of that city to bid on some contracts for new school buildings. The contractors replying to the invitation wrote: "We regret to say that we cannot figure on the general contract when you are taking bids from masons and carpenters who can figure more cheaply on account of having their offices in their hats."

Technical Society Meetings.

The list following names those technical societies in which engineers and contractors are most interested, whose meetings are to be held within three months of the date of this issue. There are given for each society listed the date and place of meeting and the name and address of the secretary, to whom all communications and inquiries should be addressed.

American Railway Engineering and Maintenance of Way Association.
March 15-17, 1910. Annual convention at Chicago, Ill. Secy., E. H. Fritch, 962 Monadnock Block, Chicago, Ill.

American Society of Engineering Contractors.
Feb. 24-26, 1910. Annual convention at Chicago, Ill. Secy., Daniel J. Hauer, Park Row Building, New York, N. Y.

Connecticut Society of Civil Engineers.
Feb. 8, 1910. Annual meeting at New Haven, Conn. Secy., J. Frederick Jackson, Box 1304, New Haven, Conn.

Illinois Association of Municipal Contractors.
Feb. 24-26. Annual meeting at Chicago, Ill. Secy., Orie T. Dunlap, Edwardsville, Ill.

Illinois Lumber Dealers' Association.
Feb. 16-18. Annual meeting at Chicago, Ill. Secy., Geo. K. Hotchkiss, 315 Dearborn St., Chicago.

Illinois Masons' Supply Association.
Feb. 16-18. Annual meeting at Chicago, Ill. Secy., Geo. K. Hotchkiss, 315 Dearborn St., Chicago.

Illinois Society of Engineers and Surveyors.
Jan. 26-28, 1910. Annual meeting at Cairo, Ill. Secy., E. E. R. Tratman, 1636 Monadnock Block, Chicago, Ill.

Interstate Mantle and Tile Dealers' Association.
Feb. 15-19. Annual meeting at Chicago, Ill. Pres., Joseph W. Lantry, Wm. H. Jackson Co., Union Square, New York City.

Iowa Association of Cement Users.
March 9-11, 1910. Annual meeting in Cedar Rapids, Ia. Secy., Ira A. Williams, Iowa State College, Ames, Iowa.

Iowa Engineering Society.
Feb. 16-17, 1910. Annual convention at Cedar Rapids, Ia. Secy., A. H. Ford, Iowa City, Ia.

National Association of Cement Users.
Feb. 21-25, 1910. Annual meeting at Chicago, Ill. Secy., Geo. C. Wright. Address all communications to Edw. E. Krause, Asst. to the President, Harrison Bldg., Philadelphia, Pa.

National Brick Manufacturers' Association.
Feb. 7-12, 1910. Annual convention at Pittsburg, Pa. Secy., T. A. Randall, Indianapolis, Ind.

Ohio Engineering Society.
Feb. 8-10. Annual meeting at Columbus, Ohio. Secy., C. J. Knisley, New Philadelphia, O.

Northwestern Cement Products Association.
Feb. 18-21, 1910. Annual meeting at Chicago, Ill. Chairman of Executive Committee, O. U. Miracle, Minneapolis, Minn.

Western Drainage Contractors' Association.
Feb. 17, 1910. Fort, Dodge, Ia. Secy., S. F. Moeller, Knierim, Ia.

Personals.

Mr. Benjamin Chatfield, for a number of years in the City Engineer's Department of Waterbury, Conn., has been appointed Superintendent of Streets and Sewers of that city.

Mr. F. C. Finkle, Consulting Engineer, has removed his office from rooms 230-231 I. W. Hellman Bldg., to 628½ South Spring St., Los Angeles, Cal.

Mr. R. W. Valls, who for some time has been assistant chief engineer of the Case Crane Co., of Columbus, O., has been appointed chief engineer of the company, to succeed C. H. Tucker, who resigned to go to the Toledo-Massillon Bridge Co.

Robert W. Gay, formerly with Viele, Blackwell & Buck, of New York City, has entered upon his new duties as assistant superintendent of construction for Hunt & Hunt, Architects, of New York. Mr. Gay will be located at Port Washington, Long Island, N. Y.

Mr. M. J. Butler has resigned his position as Deputy Commissioner of Railways and Canals of the Canadian Government with offices at Ottawa, Ont., to become General Manager and Second Vice President of the Dominion Iron & Steel Co. and the Dominion Coal Co.

The U. S. Civil Service Commission, Washington, D. C., will hold an examination on March 9-10, 1910, at various cities throughout the country, to secure eligibles from which to make certification to fill two vacancies in the position of topographic draftsman (male) in the Coast and Geodetic Survey, one at $1,000 and the other at $900 per annum, and vacancies requiring similar qualifications as they may occur in any branch of the service. The salary of the position of topographic draftsman ranges usually from $1,000 to $1,500 per annum, and for copyist topographic draftsman from $900 to $1,500 per annum.

Clifford Buxton, Chief Engineer of the Toledo & Ohio Central Ry., with headquarters in Toledo, died Jan. 12 in that city. He was graduated from Rensselaer Polytechnic Institute in 1865. In 1879 he became connected with the Ohio Central Ry., which later became the Toledo & Ohio Central Ry.

Mr. H. K. Barrows, Associate Professor of Hydraulic Engineering at the Massachusetts Institute of Technology, and Mr. C. B. Breed, Assistant Professor of Civil Engineering at that institution, have entered into a partnership under the firm name of Barrows & Breed and will engage in a general civil engineering practice.

Major George P. Howell, Corps of Engineers, U. S. Army, now on duty in Washington, has been assigned to take charge of the river and harbor and fortification works in the Galveston district, effective Feb. 10, to relieve Captain John C. Oakes, Corps of Engineers, assigned to take charge of the river and harbor works in the Second Cincinnati district.

Leroy M. Harvey, Sales Manager of the Milwaukee District office of Allis-Chalmers Co., died Jan. 19. Mr. Harvey had been in poor health for the past five months and a short time ago went to Augusta, Georgia, with the hope that the change in climate would benefit him. He died at the New Partridge Hotel in that city from diabetes and brights disease. Mr. Harvey was born in Oak Park, Ill., about 37 years ago and was graduated from the University of Michigan, in 1898, from the course in Electrical Engineering. After graduation Mr. Harvey entered the employ of the Westinghouse Electric Co. and was with that company for about a year. From there he took up experimental work for the Siemens & Halske Co., in Chicago. Later he was in the Chicago sales office of the Northren Electric Mfg. Co. Six years ago he accepted a position in the sales department of Allis-Chalmers Co. and about three years ago was made manager of the Milwaukee District office, which position he held until his death.

Mr. I. W. McConnell, until recently Supervising Engineer U. S. Reclamation Service, has become Chief Irrigation Engineer of the J. G. White & Co., Inc., of New York City, and will have general supervision of all matters relating to the irrigation undertakings of the company. His headquarters will be at the main offices of the company, 43 Exchange Pl., New York City. Mr. McConnell was born in 1871 and was graduated from Cornell University in 1897. In 1897 and 1898 he was employed on the United States deep waterways surveys and in the United States navy yard, Brooklyn. During a part of 1898 he was engaged as contractor for the North Tarrytown sewerage system, and in the fall of that year returned to Cornell University as instructor in Civil Engineering, remaining there until 1900 when he became superintendent of construction for the Indianapolis water works. In 1901 Mr. McConnell entered the employ of Nash & Dowdle, general contractors, Chicago and New Orleans, as superintendent on the construction of the Chicago Clearing Yard which involved a large amount of railroad work and on the New Orleans drainage works. From January to June, 1903, he was professor of Civil Engineering at the Missouri School of Mines, going from there into the United States Reclamation Service as project engineer on the Uncompahgre, Colorado project, the principal items of which were the Gunnison Tunnel Canal construction, unification of old canals and water rights and general administration of the entire project, involving the expenditure of over $6,000,000.00, and on which work he was engaged from 1903 to 1907. During the past two years he has been supervising engineer of the Central District, United States Reclamation Service, having general supervision of all government irrigation work in South Dakota, Southern Wyoming, Nebraska, Colorado, Kansas, Oklahoma, and Northeast New Mexico, the principal projects being the Pathfinder Reservoir, Interstate Canal on North Platte River, Belle Fourche Project, South Dakota, involving a large earth dam and canals, Garden City Project, Kansas, a steam electric plant for recovery of underflow, Uncompahgre Project, Colorado, tunnels and canals, and the Grand Valley Project, comprising large canal works, the annual expenditure of the district was about $1,500,000.00, and the ultimate cost of the work under construction will involve an outlay of over $25,000,000.00.

The active work of locating the line of the Hudson Bay Railway commenced October 18 at the Pas Mission. Other parties will be sent out later. The preliminary survey of the road, which was completed this year, has given the engineering staff weeks of labor to figure on grades and the facilities of various routes. Lakes and other difficulties in the formation of the country will furnish engineering problems, but it is the intention to push the location line as fast as possible. The party will work out all winter, receiving supplies by dog trains.

Catalogs Worth Having.

Engineers and contractors should have on file the latest catalogs of machines, tools and supplies that they use. In sending for catalogs reviewed or advertised in this paper, you will confer a favor on us if you will write directly to the advertisers and state that you saw the catalog mentioned in ENGINEERING-CONTRACTING. If you are in the market for tools, machinery or supplies, tell us and we will notify promptly the leading manufacturers.

Sewers, Tanks and Walls.—Paper 3½x6 ins. 16 pp. Northwestern Expanded Metal Co., Old Colony Building, Chicago, Ill.

For the past two years this company has been issuing booklets on reinforced concrete prepared by an engineer of experience. The last booklet contains a discussion on the reinforcement of sewers, tanks and retaining walls with expanded metal, giving tables containing full data on size of fabric to use and proper amounts in each case.

Weber Chimneys.—Paper, 6x9 ins. 24 pp. Weber Duller Co., Pacific Electric Bldg., Los Angeles, Cal.

This catalogue describes the reinforced concrete chimney patented by Mr. Carl Weber, C. E., and gives a partial list of firms (500) for whom Weber chimneys have been built in many states and countries.

Sewage Disposal in Detached Houses.—Paper, 4x6 ins., 8 pp. Ashley House-Sewage Disposal Co., 6515 Normal Blvd., Chicago, Ill.

The Ashley Septic Tank System is fully described in this pamphlet. It is written by Walter H. Harrison, C. E., of Philadelphia.

Gasoline Storage.—Paper, 3x6 ins., 8 pp. Janney, Steinmetz & Co., Philadelphia, Pa.

Gasoline storage outfits of 55 gals. and 110 gals. capacity for automobiles, are here described with prices. Tanks are seamless welded steel.

Conveyors and Elevator Buckets.—Paper 3x6 ins. The Jeffrey Mfg. Co., Columbus, Ohio.

This firm sends Booklet 33 of 24 pp. ill., describing wire cable conveyors and Booklet 34 of 24 pp. ill. describing elevator buckets. The date of publication of each booklet is Dec. 1909, so contains the latest information.

Connelly Street Flushing Machines.—Paper, 6x9 ins., 12 pp. The Barron & Cole Company, Franklin St. and West Broadway, New York, N. Y.

On paved streets it is becoming general these days to do the cleaning with flushing machines instead of brooms. The Connelly flusher is described in this catalogue.

Measuring Tapes and Rules.—Paper, 3½x5 ins. 96 pp. The Lupkin Rule Co., Saginaw, Mich.

Each man who uses a tape or rule is surprised when he learns that a 96 page catalogue is necessary to adequately illustrate the output of one manufacturer. This catalogue therefore not only gives descriptions and prices of measuring tools but has an educational value in showing men something about other lines of business.

Mallett Locomotives.—Paper, 8x11 ins., 12 pp. American Locomotive Co., New York, N. Y.

The detailed information here given on the Mallett Articulated Compound Locomotive should be of value to bridge designers and railroad engineers.

Sidewalk Science.—Paper, 6x9 ins., 12 pp. Hotchkiss Lock Metal Farm Co., Binghamton, N. Y.

This booklet describes the Hotchkiss metal sidewalk farms consisting of channels connected by interlocking cross pieces used to make expansion joints.

Oil Pull Tractor.—Paper, 7x10¾ ins. M. Rumely Company, La Porte, Indiana.

A few weeks ago Engineering-Contracting described some traction engines and locomotives in which oil was used instead of steam as a motive power. This catalogue describes another of the same class. It is well written and has a colored frontispiece of "The Spaders," by Millett.

Centrifugal Pumps, Gasoline and Steam Engines.—6x9 ins., 36 pp. Erie Pump & Engine Co., Erie, Pa.

This catalogue describes centrifugal pumps, single and multi-stage, direct connected to steam engines, oil engines and electric motors. Tables of sizes and capacities also given.

Cement Production in 1909.—It is estimated that the total production of cement in the United States in 1909 was 63,500,000 bbls., an increase of nearly 10,000,000 bbls. over 1908. The high price for the year was $1.53 per barrel, the low price was $1.33 per barrel and the average price was $1.39 per barrel.

Contract News Section

of

ENGINEERING-CONTRACTING

A Consolidation of ENGINEERING-CONTRACTING—CONTRACT NEWS—ENGINEERING WORLD—THE DIRT MOVER.

Containing Items of Interest to Railroad, Public Works and Other Contractors.

The Doings of the Week.

Two large municipal contracts are now being advertised. One of these, bids for which will be received by the City Commissioners of Dallas, Tex., on Feb. 16, calls for the construction of the dam, spillway, pumping station foundations, etc., on the White Rock reservoir site in that city. The total estimated cost of this water supply development is $730,840. Another large contract is the one now being advertised by the City of Tacoma, Wash. This contracts calls for constructing the headworks and tunnel for a hydro-electric power plant on the Misqually River. The work includes a concrete diverting dam and a concrete lined tunnel, 10,015 ft. long. Bids will be opened Feb. 21, by H. J. McGregor, Commissioner Public Works, Tacoma, Wash.—The State Superintendent of Public Works, Albany, N. Y., is calling for bids until Feb. 16, for a large contract in connection with the construction of the State Barge Canal. This is contract No. 49 and calls for constructing 6.18 miles of the Erie Canal from a point 500 ft. east of Yellow Mills bridge to the Wayne-Monroe County line. Bids will also be received at the same time for constructing guard gate, superstructures under contract No. 75, Erie Canal.—Announcement has been made that the U. S. Senate committee on irrigation will report a bill providing for a $30,000,000 bond issue to complete irrigation projects.—Among the larger railroad contracts of the week are the following: Lorimer & Gallagher, Chicago, Ill., for filling in bridges on the line of the Chicago, Milwaukee & Puget Sound Ry., in Washington west of the Columbia River; The Flick Construction Co., Chicago, Ill., was awarded the contract for filling in the bridges east of the Columbia river. The J. A. Ware Construction Co., St. Louis, Mo., secured the contract for raising the grade of the Santa Fe between Pauls Valley and Dougherty. Okla.—The National Railways of Mexico has opened bids for grading, tunnel and masonry work on the proposed line from Durango to Llano Grande, State of Durango, Mexico, and probably has by the time this is written awarded contracts for the work. The line will be approximately 100 kilometers long.—The Connecting R. R. Co. which is to build a $25,000,000 line in New York City to connect the terminals of the Pennsylvania and N. Y., N. H. & H. R. R.'s, has secured practically all right of way and is only awaiting approval of its plans for the Hell Gate bridge before beginning work.—As was expected, the stockholders of the Missouri Pacific R. R. have voted to increase the bonded indebtedness of the company by $175,000,000. Eleven subsidiary lines are to be taken over by the company.—The Alberta & Great Waterways Ry. is going ahead with preparations for beginning work on its line from Edmont on to Fort McMurray in Canada, and is reported to have placed orders for the steel rails and other supplies.

A Long Projected Project.

It is now announced that construction work on the Cape Cod Canal will be completed in 1912. The matter of constructing this canal across the eight mile neck of land between Barnstable, Mass., and Buzzards Bay holds all records for long time discussion. Generation after generation of promoters have promoted the project and gone their way, and now after over 230 years of talk it seems that the canal is to become a reality. In 1670, just 50 years after the pilgrim fathers landed at Plymouth on the rock celebrated in history as the trade mark of the pants that never rip and the breed of fowls that never scratch, the first charter for the canal was granted by the colonial authorities of Massachusetts. Nothing came of this grant, although the holders of the charter made vigorous attempts to secure funds in England. For many years afterward the matter was under discussion, but it was not until 1776 that anything definite was done. In that year the general court of Massachusetts appointed a committee to investigate the feasibility of the project. The committee reported in favor of constructing a 14-ft. deep canal and estimated the cost at $175,000. Money went farther in those days, as George Washington's feat of throwing a silver dollar across the Potomac River shows, and the general court of Massachusetts found it impossible to raise the $175,000 to carry out the work. Another reason for the abandonment of the project at this time was the presence of a hostile British fleet. During the period of the revolutionary war nothing was done regarding the canal and it does not seem to have come to general attention again until 1791, when surveys were made. These were repeated in 1818 and in 1824 the U. S. government took hold of the matter and had surveys made. At this time the president of the United States recommended that the canal be constructed. In 1860 the matter came up again, but the civil war made it impossible to raise funds for the work. In 1880 work was actually started, but was stopped in 1885 after about 1 mile of canal had been excavated and about $1,000,000 expended. Since that time there has hardly been a session of the general court of Massachusetts when some company did not ask a charter to construct the canal. In 1899 a charter was granted to the Boston, Cape Cod & New York Canal Co., which company undertook the work. On May 8, 1907, the joint board of railroad and land commissioners of Massachusetts approved the final location of the route, and one month later the first shovelful of earth was thrown.

Making Things Simple.

It is always good policy in writing for a paper, or in making reports, to use language the average reader will understand. Sometimes an engineer may use technical language, but it is well to follow it with terms the ordinary man will appreciate.

A very good illustration of this has been called to our attention in a report by a British engineer on tests made on reinforced concrete slabs. First he speaks of the load being "1054 lbs. per sq. ft. = 9 cwt. 1 qr. st. 4 lb." The stress in steel he gives as, "74,527 lbs. per sq. in. = 33 tons, 5 cwt., 1 qr., 1 st. 5 lbs."

An engineer would understand fully what he meant by "lbs. per sq. ft." or "lbs. per sq. in.," but the report was to be read by others than engineers so he proceeded to make it plain for other readers, a thoughtfulness worthy of commendation. American engineers have always been unnecessarily rude in talking and writing about lbs. per sq. in. or ft. without worrying about their auditors who find it necessary to forget about yards, perches, stones, quarters, bushels, etc. Some American engineers even advocate using the metric system so things will be still more simple and the laymen will have more to forget.

Such of our readers who may wish to check the report of the British engineer will be assisted by remembering the ton he uses weighs 2240 lbs., a cwt. is 112 lbs., a qr. is 28 lbs. and a st. 14 lbs.

Sporting Notes.

Some time ago it was announced in the daily press that the well known knight of the padded mit, Packie McFarland of Chicago, was to give up pugilism and engage in the more lucrative (sometimes) business of sewer contracting. This report was evidently premature, for, like Alexander, Mr. McFarland has gone to England to spread his conquests further. And now comes a report from New York stating that baseball fans in that city are much alarmed over a report that the New York Nationals may lose Christy Mathewson. It is said that the pitcher has refused to sign with New York because of objections to the new major league contract, which binds a player to his club all the year. Mathewson, it is said, has saved up considerable money and is only awaiting a favorable opportunity to enter a contracting business in Maine.

The Georgia Railway & Electric Co., Atlanta, Ga., is planning to build several miles of double track.

Confirmed Reports by Engineers and Contractors

RAILROADS, POWER DEVELOPMENTS, LEVEES, DRAINAGE AND IRRIGATION WORKS.

Railroads—Steam and Electric.

CALIFORNIA.

The City Council of Los Angeles has granted a franchise to Fred W. Forrester for a street railway line on Vermont avenue from Muth street to 8th street. The franchise has been assigned to the Los Angeles Ry. Co., which will construct the line as an extension to its present system.

The San Jose Railroads Co. recently incorporated with a capital stock of $5,000,000 to take over the 1st street line at San Jose, has had surveys partly made for the construction of several additional lines in San Jose. The projected length of the line is 15 miles. L. E. Hanchett, Merchants' Exchange Bldg., San Francisco, Cal., is President and W. R. Lamson, San Jose, Cal., is Chief Engineer.

IDAHO.

The Twin Falls-Salmon River Land & Water Co. has not as yet, owing to the severe weather, completed surveys for the projected railway line from the Salmon River Dam to Jarbridge. It is the intention to follow the most feasible route to Jarbridge and yet top the West End Twin Falls Irrigation project, either by electric or a steam road, also to put in a power line from the Snake River power plants. Alex. McPherson, of the Twin Falls-Salmon River Land & Water Co., Twin Falls, Idaho, is interested.

INDIANA.

The Columbus, Greensburg & Richmond Traction Co. has completed one survey for its projected 80-mile line and proposes to let construction contracts within 90 days. The road is to extend from Columbus through Greensburg and Connersville to Richmond. M. A. Peoples, Kingman, Ind., is chief engineer and August M. Kuhn, Indianapolis, Ind., is president. C. Frank McCallie, Columbus, Ind., is also interested.

Surveys have been made, capital has been secured and grading has been started on the 55 mile line of the Fort Wayne & Toledo Electric Ry. Co. The route is from Fort Wayne to Harlan, Ind., Hicksville, Farmer and Bryan, O., with a spur to Montpelier, O. The contract for constructing the road has been let to the Keystone Construction Co. W. H. Cost is Chief Engineer, E. A. Tennis is President and R. T. Bastress, Harlan, Ind., is General manager.

KANSAS.

The Kansas Northwestern Railway Co. desires correspondence with strong construction company with financial connections enabling them to place large portion of the bond issue. Particulars can be obtained from O. W. Dawson, secretary, Great Bend, Kas.

Surveys have been made and located and the grading work has been over half completed for the projected 68 mile electric line of the Kansas City, Lawrence & Topeka Ry. Co. The route is by way of Edwardsville and Lawrence to Topeka. W. E. Winner, 426 Rialto Bldg., St. Louis, Mo., is President, and J. G. Hughes, 424 Rialto Bldg., St. Louis, is Chief Engineer.

KENTUCKY.

The Louisville, Lincoln Farm & Mammoth Cave Traction Co., has completed surveys in part for the construction of its projected 60-mile line on the L. & N. Turnpike from Glasgow, Ky., via Lincoln Farm to Hodgenville, Ky. The capital for construction has been secured but construction contracts will not be let before Feb. 21. Chas. Van den Burgh, Glasgow, Ky., is President.

MAINE.

Surveys have been made and capital has been secured in part for the construction of the projected 13¾ mile electric line of the Skowhegan & Athens Electric R. R. Co. The road is to extend from Skowhegan to Athens and will connect with the Maine Central R. R. It will be used principally for carrying freight. The company which is to control the line has not effected its permanent organization as yet but expects to do so shortly. It is expected that contracts for constructing the line will be let in the early spring. John Jones, Lewiston, Me., is Engineer, and Charles R. Oliver, Athens, Me., is the promoter.

MONTANA.

Surveys have not been completed as yet for the projected 30-mile extension of the Gallatin Valley Electric Ry. Co., and it will possibly be 60 days before construction contracts are let. N. C. Van Natta, Bozeman, Mont., is Chief Engineer.

OREGON.

The Board of Portage Railway Commission will receive bids until Feb. 1, at the office of Newell, Gossett & Walsh, 32 Washington building, Portland, Ore., for the grading, bridging and tracklaying necessary in the construction of the extension of the Portage Railway from Big Eddy to The Dalles, a distance of 4.05 miles. Specifications and profiles showing approximate quantities can be obtained from the engineers at the above address.

TEXAS.

The St. Louis, Paris & Gulf R. R. has completed surveys for its projected 78 mile line from Paris, Tex., to Winnsboro and Quitman to Mineola, and wishes to get in touch with a general contractor or construction company that can complete the first ten or twelve miles. M. J. Healy, Mineola, Tex., is interested. Mr. Healy will also be glad to hear from parties on the T., N. M. & P. Ry. deal, which calls for the construction of 75 miles of line from McTuney, Tex., to Bridgeport, Tex.

As stated in our last issue the Grigsby Construction Co., Dallas, Tex., has been awarded the contract for constructing the 30 mile line of the Henrietta Southwestern Ry., from Scotland City, Tex., to Archer City, Tex. The contract includes 80,000 cu. yds. of excavation and embankment. The sub-contractors now finishing their work on the Gulf, Texas & Western Ry., will be used on this work. M. B. Mobberly, Henrietta, Tex., is Chief Engineer of the Henrietta Southwestern Ry.

WASHINGTON.

Lorimer & Gallagher, 217 La Salle St., Chicago, Ill., have been awarded the contract for filling in the bridges on the line of the Chicago, Milwaukee & Puget Sound Ry. west of the Columbia River. The Flick Construction Co., Old Colony Bldg., Chicago, Ill., secured the contract for filling in the bridges east of the Columbia River. The latter contract calls for the moving of some 2,000,000 cu. yds. of dirt.

WISCONSIN.

The Milwaukee Western Electric Ry. Co. is now arranging to secure the capital for the construction of its projected 74 mile line from Milwaukee to Beaver Dam and Fox Lake by way of North Lake, Hustesford and Juneau. Surveys for the line have been made and the contract for its construction was let last year to W. D. Chapman, Sr., Chicago, Ill. The Wisconsin Railroad Commission has recently granted the company a certificate of necessity and convenience for the construction of the line. C. A. Chapman, Marquette Bldg., Chicago, Ill., is Chief Engineer; Val Zimmerman, Jr., Milwaukee, Wis., is President and J. W. Barber, Milwaukee, Wis., is Secretary.

Power Developments, Levees, Drainage and Irrigation Works.

ARKANSAS.

Bids are asked by the board of directors, Woodson Levee District, at office of Lund & Hill, engineers, 201½ W. 2d St., Little Rock, Ark., until 10 a. m., Feb. 9, for the following work: Nine miles of levee, containing 165,700 cu. yds.; 8 culverts, 8 gates and a reinforced concrete floodgate. The estimated cost of the work is $45,000.

CALIFORNIA.

Plans and specifications for the excavation of the ditch of The Tarr Mining Co. have been issued, and bids will be received by The Tarr Mining Co., Smartsville, Yuba Co., Cal., until Feb. 5. The Tarr Mining Co. also has offices at Room 12, Stoll Bldg., Sacramento.

COLORADO.

J. H. Nations, Contracting Co., Box 81, Montclair, Colo., has been awarded the contract for constructing the earth dam and outlet canal for Reservoir No. 1 of the Holbrook Irrigation District. The contract for the earth dam, outlet gates and tunnel for the Dye Reservoir of the same district was not let and the work will be readvertised in the near future. Bids for both pieces of work were opened Jan. 10. J. E. Lewis, LaJunta, Colo., is Secretary of the District.

Bids are asked by the Costella Estates Development Co., 56 Bank Bldg., Colorado Springs, Colo., until noon, Feb. 21, for the construction as a whole or separately of the following work, located in Costella County, Colorado: The Sanchez Dam, containing about 500,000 cu. yds. of earth work; the Sanchez Dike, containing about 250,000 cu. yds. of earth work, and the Culebra-Sanchez Canal, containing about 250,000 cu. yds. earth work, together with necessary controlling works and about 15,000 cu. yds. rock excavation. O. V. P. Stout, Lincoln, Neb., is the engineer. Official advertisement will be found elsewhere in this issue.

LOUISIANA

Bids are asked by the Board of Commissioners of Red River and Bayou des Glaizes Levee & Drainage District, A. E. Gremillon, Secretary, until Feb. 1, for the construction of the Davids Ferry South No. 2 levee on the right bank of Red River in Avoyelles Parish. The levee is to be about four miles in length and will contain about 350,000 cu. yds. of material.

MISSISSIPPI.

Contracts for 230,000 cu. yds. of levee work in the Mississippi Levee District have been let as follows: Stations 600 to 715, 90,000 cu. yds., to Dulaney, Foote & Shields, Greenville, Miss., at 16.9 cts. per cubic yard; Stations 715 to 862, 140,000 cu. yds., to George Miller, Longwood, Miss., at 25 cts. per cubic yard. Bids for the above contracts were opened Jan. 10, by the Board of Mississippi Levee Commissioners, C. H. West, Chief Engineer.

WASHINGTON.

Preliminary surveys have been made for the proposed canals of the Inland Waterway & Canal Co., of South Bend, Wash., and much of the right of way has been secured. Final surveys are to be started in the near future. As proposed the canals are to connect Grays Harbor with Willapa Bay and are to extend from the

latter place through to the Columbia River. The first canal, the one leading from Grays Harbor into Willapa Bay, at a point near North Cove, will have a length of about eight miles, where it enters Willapa channel. However, in order to secure a more protected route this intersection may be extended from North Cove through the Georgetown and Tokeland sloughs, making the real entrance into Willapa Bay at Toke's point near Tokeland, about four miles farther than the North Cove entrance, which would make a total length of this first canal about 12 miles, about half of which distance would be very light excavation—widening, deepening and straightening sloughs, etc. The second canal begins at the southern head of Willapa Bay, occupying about two miles of the mouth of Portage Slough thence running a general direction of S. 45° E. about 1¼ miles, entering the Wallicott river about one mile above its entrance into Baker's Bay, at a point about one mile E. of Ilwaco. These two canals would open an inside water route from Portland, Ore., to Montesano, Washington—a distance of about 200 miles. The original design was to cut these canals merely for the passage of launches and scows—a width of 24 ft. and a depth of 6 ft. of water and on these dimensions the engineer based his estimate of the amount of excavation as being within 500,000 cu. yds and at a cost of about $60,000, plus the cost of locks at either end of each canal. But since the formation of the Inland Waterway & Canal Co. it is proposed to cut the canals 30 ft. wide with a depth of 12 ft., which of course will materially add to the original estimate. Also the additional four miles from North Cove to Toke's point was not included in original estimates. Altogether and on both canals there is about 15 miles of excavation and as it is now arranged will total about twice the original estimates. The idea of cutting these canals was conceived first by Mr. J. N. Hudson, Tokeland, Wash., and he is the Chief Engineer of the company.

WISCONSIN.

P. J. Hurtgen, City Engineer of Burlington, Wis., has completed the preliminary survey, and commissioners have been appointed for the Hoosier Creek drainage district, which includes lands in Racine and Kenosha counties. The area to be drained includes about 13,000 acres and will reclaim about 3,000 acres of land that is now practically useless for cultivation. The length of the main ditch will be about 12 miles, and there will be constructed about 40 miles of laterals. Bids may be called on this work early next summer.

TEXAS

Bids are being asked by the City Commissioners of Dallas, Tex., until 3 p. m., Feb. 16, for constructing the foundation for the pumping station, building the dam, spillway and other appurtenances at the White Rock reservoir site. The dam to be erected is to have a clay-filled trench from end to end. Before the filling with clay sheet piling of pine is to be driven in the bottom of the trench to hard pan, or white rock. The earthen dam is to be 2,100 ft. long and about 42 ft. high at its greatest height. It is to be 211 ft. wide at the base and 16 ft. wide at the top. From the top to a line about half way to the bottom of the upstream side there is to be a concrete apron from end to end of the dam. The spillway of concrete at the western end of the dam will be 450 ft. wide. The spillway will have over it a reinforced concrete walkway and the upstream end of the piers of this walk will be furnished with cast iron guides for flash boards. These flashboards are to be removed in times of floods and will at other times raise the water level in the reservoir two feet above the crown of the spillway. The drainage area of the basin the dam will form is estimated at 114 square miles. The reservoir will flood 1,429 acres. The holding capacity of the dammed-up reservoir is estimated at 5,785,000,000 gallons. The estimated cost of all of the improvement, including the purchase of the land, the 15,000,000-gallon pump, the three boilers and the six miles of mains 18 and 36 in. in size, respectively, is $730,840. The plans for the work were prepared by J. M. Preston, City Engineer of Dallas.

The Minneapolis, St. Paul & Sault Ste. Marie Ry. has two surveying parties in the field laying out a line from Thief River Falls northeast to the Rainy River in the vicinity of Beaudette and thence along the south shore of the river to International Falls.

The Elkhorn Southern R. R. Co. recently incorporated has filed maps to reach coal lands in Dickenson County, Va. This road is reported to be backed by the Carolina, Clinchfield & Ohio Ry., which will build the extension under the above name. M. J. Caples, Johnson City, Tenn., is Chief Engineer, C. C. & O. Ry.

Bids are being asked by the New River Collieries Co., L. E. Yoder, Chief Engineer, Eccles, W. Va., for building one mile of railroad and yards at Eccles.

The Alabama & Vicksburg R. R. is preparing to build double tracks through the city of Jackson, Miss., and this is taken to mean that the line is to be double-tracked at no far distant day from one end to the other—from Vicksburg to Meridian. The rights of way are said to have been secured through the city. C. Dougherty, Cincinnati, O., is Engineer Maintenance of Way of the Queen & Crescent Route which controls the Alabama & Vicksburg R. R.

The Atchison, Topeka & Santa Fe Ry., C. A. Morse, chief engineer, Topeka, Kan., is stated to have awarded a contract for double tracking its line from Ash Fork, N. M., to Winslow, Ariz., a distance of 90 miles. It is said that the next section to be double tracked will extend from Albuquerque, N. M., to Gallup, a distance of 150 miles.

The New York, New Haven & Hartford R. R. has purchased five acres of land in Stratford, Conn., on which to locate a power station. This leads to the conclusion that the railroad will continue the electrification of its line from Stamford, Conn., to New Haven, Conn.

Construction work on the standard gage line projected from Twin Falls, Ida., to connect with the Southern Pacific near Cobre, the northern terminus of the Nevada Northern road, will soon be completed. The line is now completed from Twin Falls to Rogerson, a few miles north of the Nevada-Idaho state line, and within 30 miles of Contact. The entire road is expected to be in operation by the end of August, 1910.

The Tampa & Gulf Coast R. R., which projects a line from Tampa, Fla., to Tarpon Springs, Fla. is now laying steel at Keystone Park Colony. The Tampa & Gulf Coast R. R. leaves the main line of the Tampa Northern railway at Lutz station, and passing through Odessa enters the Keystone Park Colony tract at the northern edge.

The Madisonville, Hartford & Eastern R. R. was formally opened for traffic at Madisonville, Ky., on Jan. 6. The road has been in course of construction for the past three years.

Good progress is being made by the U. S. government engineers in the surveys for the projected 30-mile sea-level canal from Taunton, Mass., to Bridgewater and thence to the south shore at either Plymouth, Hingham or Scituate. While the engineers refused to estimate the cost of the projected water way, unofficial figures place it at about $30,000,000, or five times that of the Cape Cod canal, now being built from Buzzard's Bay to Cape Cod by private capital. The canal, if completed, would enable vessels to lessen materially the time required for passage from Narragansett Bay to Boston. The geological character of the land is said to be favorable. The canal is planned to be 25 ft. deep at mean low water and 250 ft. wide at the bottom.

The Norfolk & Western Ry. is to build about 4,500 ft. of track near Keystone, W. Va., which will extend company siding at Keystone to Eckman. It is expected that work will be commenced on the additonal track at once.

A bill is before congress to authorize the Baltimore & Washington Transit Co. of Maryland to extend its street railway line in a number of streets in the District of Columbia.

Francis E. Warren, Cheyenne, Wyo., is planning to build ten reservoirs in northern Weld county and southern Wyoming for converting his sheep ranch into farm land.

The Beaver Dam R. R. Co. of Damascus, Va., has been incorporated with a capital stock of $1,000 to $5,000 and proposes to build a railroad 1.6 miles long in Washington County, Va. The officers are: J. E. Rooney, president, Buffalo, N. Y.; H. M. Cox, vice president, Damascus, Va.; J. U. Weisz, secretary, Damascus, Va.

The Greenville, Spartanburg & Anderson Ry. Co. of Greenville, S. C., recently incorporated to build an electric line from Anderson to Spartanburg, has started surveys for the proposed line and contracts for the construction work will be let soon. J. B. Duke, Somerville, N. J., and Ellison A. Smyth of Greenville, S. C., are among the incorporators. This line was mentioned in our last issue.

J. H. Barrett, electrical and construction engineer, Pittsburg, Pa., is at Albuquerque, N. M., to get data preparatory to making plans and estimates for the proposed electric line in the Highlands.

According to a statement reported to have been made by Minor C. Keith, United Fruit Co., 17 Battery place, New York, N. Y., construction will be started shortly on the Guatemala Northern R. R. from Zacapa, Guatemala, to Santana, Salvador.

The Aberdeen (S. D.) Railway Co. has applied to the city council for a franchise for electric lighting. The company will start construction on its proposed street car lines, involving the laying of 4 miles of track, in the spring.

Active work on the rehabilitation of the Boston & Maine R. R. has begun, under direction of the New York, New Haven & Hartford interests. The board of directors at a recent meeting authorized an expenditure of $2,000,000 for the improvement and betterment of the road, which will include straightening the line and double tracking 15 miles between Salem and Gloucester, Mass. J. P. Snow, Boston, Mass., is chief engineer, Boston & Maine R. R.

The Southern Pacific Ry. Co. has under consideration the construction of new shops at Tucson, Ariz., at the "Circus Grounds," where the Twin Buttes extension will cut into the main line. Nothing definite has as yet been decided. W. H. Whalen, Tucson, Ariz., is division superintendent.

The Chicago, Milwaukee & Puget Sound Ry. is preparing to begin work as soon as the weather permits on laying steel on the two branch lines of the railroad out of Mobridge, S. D., through the reservation country. Grading on the Moreau line is all done with the exception of cutting a new channel for the Grand river in one place, and that portion of the grade from the bridge to the junction of the Moreau and Cheyenne lines is all ready for the iron. W. H. Molchoir, Marmath, N. D., is superintendent

Items Concerning Contractors and Their Work

RAILROADS, POWER DEVELOPMENTS, LEVEES, DRAINAGE AND IRRIGATION WORKS.

Arkansas Notes.

FROM CORRESPONDENTS AND OTHER SOURCES.

The Arkansas, Oklahoma & Western R. R., which was built from Rogers to Siloam Springs, a distance of 35 miles, by W. R. Felker, of Rogers, Ark., has been sold to Eastern capitalists. J. D. Locke of St. Louis has been elected president and general manager of the road. The Missouri Pacific Ry. is said to be back of the deal and it is believed that the road will be extended east to Bald Knob to connect with the Missouri Pacific road at that point. The short line road from Monte Ne to Lowell, a town five miles south of Rogers, which was recently bought by Senator F. F. Freeman from W. H. Harvey, is also said to be a Missouri Pacific trade. The extension of this road east from Rogers will mean much for that town, as it will open up a fine timber territory, which heretofore has not been touched on account of being inaccessible to a railroad.

The Fort Smith Light & Traction Co., J. Walter Gillette, General Manager, Fort Smith, is planning to extend its park line to the Arkansas River opposite Van Buren.

Citizens of Arkadelphia have raised a bonus of $60,000 to secure the entrance of the Memphis, Paris & Gulf R. R., to that city. At present the road is in operation from Texarkana to Murfreesboro and surveys are being made for the Texas extension, which will run to Dallas. The route east from Arkadelphia will probably be by Pine Bluff and Marianna to Memphis. It is possible that the line may take over the old lumber road of the Arkadelphia Lumber Co. which runs through Dallas County for a distance of about 30 miles. This road is of standard gage and has been put in good condition during the past few months, which fact is taken by some to mean that it will become a part of the new line. H. C. McCluer, Nashville, Ark., is Chief Engineer.

At a recent election held in Munroe, La., it was voted to extend the time granted the Arkansas, Louisiana & Gulf R. R., for the completion of that line north from Hamburg to Pine Bluff, Ark., and also for the line projected south of Monroe, La. J. M. Parker, Hamburg, Ark., is General Manager of the company.

The Manilla & Southwestern Ry., at present in operation between Herman on the Frisco and Lunsford, is to be extended five miles to Lake City. F. W. Taylor, Lunsford, Ark., is President.

California Notes.

FROM CORRESPONDENTS AND OTHER SOURCES.

Councilman E. B. Bullock, of Alameda, is advocating the erection of a municipal wharf on the property owned by the city at the foot of Grand St. in that city. His plans call for a dock, either of concrete or teredo-proof piling, extending to deep water, lined with warehouses and equipped for discharging and unloading cargo.

The construction of a dam across Putah Creek just below Coyotte Valley for the purpose of forming a reservoir to irrigate land in Yolo and Solano counties is proposed by a company of which A. N. Fairchilds, Los Angeles, is President. Surveys for the reservoir site were made some time ago.

The stockholders of the San Jose Railroad, the corporation which recently merged the street railways in San Jose, have decided to issue bonds to the amount of $1,500,000, and the action was ratified by the stockholders. The 1st St. line in San Jose will be entirely reconstructed.

Negotiations are reported under way for letting grading contracts for the construction of the Fresno-Hanford Interurban Ry., Fresno National Bank Bldg., Fresno. It is reported that George W. Elder, San Francisco, has been awarded some of the work.

The Sierra Irrigation Co. has been incorporated with a capital stock of $3,000,000. The incorporators are H. C. Swain, O. C. Combs, Alva Dennis, W. L. Bransford and J. J. Wells, all of Red Bluff. The purposes of the corporation, besides irrigation, are the generation and sale of electricity and gas. The principal place of business is San Francisco, but the company's operations will be carried on from offices in Red Bluff. This corporation is the reorganization of the Valley Irrigation Co., whose incorporation was recorded a short time ago.

The Southern Pacific Co. has applied to the County Supervisors at Oakland for a franchise for a small connecting line in Albany and Berkeley, to form part of the extension into that part of Berkeley known as Northbrae.

The Atchison, Topeka & Santa Fe Coast Lines Co. is reported to have secured right of way for the construction of a 6-mile line from Angiola to Alpaugh in the southern part of Tulare County. Surveys are under way and the proposed line, owing to encroachments of Tulare Lake upon the right of way, will be constructed on an embankment. H. C. Phillips, Los Angeles, Cal., is Chief Engineer of the company.

According to reports, Leo C. Lennon, 625 Market St., San Francisco, Cal., and H. E. Gilmore, have petitioned the supervisors for a franchise to construct a standard gage railroad from Fresno to Coalinga, Cal.

The Southern Pacific Ry. Co., has started surveys for the construction of a railroad from Arbuckle, Cal., to Calusa, Princeton, Glenn, Jacinto, St. John and Hamilton City, Cal., connecting at the latter place with the present Wyoming branch, near Orland. William Hood, San Francisco, Cal., is Chief Engineer of the company. The Northern Electric Ry. Co., as stated in our last issue, also has under consideration the construction of a similar line.

Board of Public Works of Los Angeles, Cal., has ordered the Los Angeles-Pacific Ry. Co. to tear up its tracks at Occidental Blvd., where it crosses Sunset Blvd., and relay them according to the plans first submitted by the company to the city engineer.

The Pacific Light & Power Co., of Los Angeles, has taken out new articles of incorporation, the capital stock now being $40,000,000. This increase of capital stock will be used in part for improvements, and work will begin at once on the Redondo plant, and $1,500,000 will be spent in adding three more units to those already installed. At the present time the Redondo plant is composed of three units of 7,500 h. p. More water power will be developed, not only at Kern River, where the company's power is now generated, but new water will be harnessed and extensive improvements will be made in the operating end.

The State Engineering Department, N. Ellery, chief engineer, Sacramento, has started the revetment work on the San Joaquin River near Banta at what is known as the Lorenzen whirlpool. The work of preventing the river from eating into the bank will cost nearly $10,000.

Stock subscriptions are being raised in Sonoma and Lake counties for the projected Highland Pacific R. R. The road is to be a standard gage electric line starting from Santa Rosa, its route being as follows: Out past Mark West school house, through the Coffey tract, past Chisholm's winery, thence through the heart of Alexander Valley to the town of Preston; from there, keeping to the east side of the Russian River, the road will climb a grade of not to exceed 2½ per cent and tunnel through the divide, separating Sonoma and Lake counties. This tunnel, 2,900 ft. in length, will cost $200,000, and after leaving it Highland Springs will be reached, with a spur three miles in length extending to the town of Kelseyville, thence to Lakeport and Upper Lake. Dr. A. E. Dickinson, Ukiah, Cal., is president. J. E. Fulton, Lakeport, is also interested.

The city wharf at Sacramento is to be extended for a distance of 100 ft. The estimated cost is $5,000. M. R. Beard is mayor of Sacramento.

The California Corporation, of Sacramento, has taken over a majority of the stock of the Stockton & Mokelumne Canal Co. The main canal and laterals are more than 100 miles long, comprising one of the largest irrigation systems in California.

The Atchison, Topeka & Santa Fe Ry., H. C. Phillips, chief engineer, Los Angeles, has secured all of the right of way for its cutoff from Richfield to Fullerton, via Placentia, and it is said that construction work will be started at an early date.

The Southern Pacific Ry. is to build a subway under its tracks at New Castle. The work will be done under the direction of A. J. Barclay, assistant engineer, Auburn, Cal.

Dr. G. W. Dwinnell, of Montague, has purchased 1,500 acres of timber land about five miles from Macdoel, including a mill site and water rights. It is stated that he will begin immediate operations and will employ 50 men from the start. A railroad will be built from the millsite to Macdoel, five miles, and a large saw mill and box factory will be built.

Engineers of the Southern Pacific Co. have been over the route of the projected extension of the electric line from Oakland to San Jose. Announcement has been made that the old steam road lines of rails will not be used for the extension of the electric system, but that an entirely new track will be constructed. This work of electric extension is to be undertaken as soon as the electrification of the suburban and interurban system of the Southern Pacific about the east bay shore cities is completed.

Colorado Notes.

FROM CORRESPONDENTS AND OTHER SOURCES.

The Chicago, Burlington & Quincy Ry. has purchased land at a cost of $160,000 in the vicinity of 20th St., Denver, to be used presumably to facilitate connections between that line and the Colorado & Southern. It is believed that additional switches and sidetracks will be built to handle the increased traffic.

Engineers of the Denver & Rio Grande R. R. are stated to have driven stakes for a permanent survey up the Chama River from Chamita, following the old survey, which is partly graded. The line is to be standard gage and the stakes are now in as far as Abiqui, whence the line will go to Elvado, there connecting with the line from Lumberton. J. G. Gwyn, Denver, Colo., is chief engineer.

The Denver & Rio Grande R. R. has secured the material for standard gaging its line between Montrose and Salida.

The Maybell Valley Reservoir & Development Co., of Denver, has been incorporated with a capital stock of $150,000 by Kurt Grunwald, John J. Munzer and George N. Robinson.

The Denver & Rio Grande Ry., according to reports current here at Denver, has decided to soon build a double track from Denver to Pueblo through Colorado Springs, making such other changes in the track as may be found necessary. At present the road has double tracks out of Pueblo, Denver and Colorado Springs, but these only total about 40 miles of the distance between the three cities.

The Denver & Clear Creek District Ry. has increased its capital stock from $80,000 to $500,000 and the Hall Construction Co., Los Angeles, Cal., which is building the new road

from Pactolus, a point 25 miles west of Denver on the Moffat road, to Black Hawk, is preparing to proceed at once to complete it. The line will be 17 miles to Black Hawk, with a branch eight miles long.

The Colorado Southern Irrigation Co. has offered the DeWeese-Dye Ditch & Reservoir Co. of Canon City the sum of $10,000 for the privilege of erecting a dam across Grape Creek canon a mile below the DeWeese-Dye reservoir in the Wet Mountain Valley. Directors of the latter company will take the matter under advisement until Feb. 5, at which time they will submit a report for the acceptance or rejection of the stockholders.

Advices from Greeley state that the Farmers' Reservoir & Irrigation Co. will build a canal in the district south of Greeley to be 17½ miles long, cost $56,000, and irrigate 25,000 acres. It will be a part of the Standley lake system and secure seepage from Beebe draw, the East and West Hudson laterals, the Speer and Neres canal.

The proposed irrigation system to be constructed for the Henrylyn and Golden-Littleton irrigation districts by the Camfield Development Co., of Denver, as mentioned in our Jan. 12 issue, will be one of the largest constructed in Colorado. The work will include a tunnel 14,725 ft. long, and the further transportation of this water 110 miles to reservoirs for distribution. The principal source of the water supply will be the Williams fork of the Grand river and its tributaries. Some 700 second-feet of water will be conveyed from this stream, on the western slope of the continental divide by means of the tunnel, to Clear Creek, on the eastern slope. This water will be taken out of Clear Creek, near Denver, and diverted to the Platte river by a short ditch. It will be taken out of the Platte near Sand Creek, and conveyed by ditch to the reservoirs near Hudson.

The Colorado Railway, Light & Power Co. of Denver has filed a $5,000,000 mortgage. This money will enable the company to make the promised improvements of service in Trinidad and vicinity, and machinery will immediately be ordered which will increase the capacity of the Trinidad plant from 1,400 to 15,000 hp. The current will be extended to Walsenburg and surrounding coal camps, and the service in Trinidad improved greatly.

The Highland Power Co., recently incorporated with a capital stock of $3,000,000, proposes to begin work in the spring on a reservoir on the west branch on Middle Boulder Creek above Eldora. The plant will supply electricity for mining, agricultural and domestic purposes. The company will take over the holdings of the Highland Mary Mining & Milling Co. J. H. Bair, the president, is a Philadelphia broker. The incorporators are H. O. Andrew, Boulder attorney, and I. N. Bair and H. W. Brougher, both of whom were formerly officers of the Highland Mary Co. The directors are: H. O. Andrew, H. W. Brougher, J. H. Bair, E. A. Austin, J. E. Slothower and J. Frank Turner.

F. D. Patterson, a mine owner of Rowena, Colo., has been appointed resident manager of the Boston-Colorado Power Co., a concern that is to develop the electric power of Jim and Leftband creeks in the mountains west of Boulder.

Illinois Notes.

FROM CORRESPONDENTS AND OTHER SOURCES.

It is reported here in Chicago that both the Chicago, Burlington & Quincy Ry. and the Illinois Central R. R. are considering purchasing the Illinois Southern Ry., owned by John R. Walsh. The Burlington and the Central both have shops and terminals at Centralia, Ill., which is but a short distance from the northern terminus of the Illinois Southern. Both roads desire the line for southwest development, for which it would be admirably adapted.

The Rock Island Southern Ry. has secured all right of way for its Aledo stub line with the exception of one property and has begun condemnation proceedings to secure this.

City Engineer Stevens of Joliet has been instructed by the city council to make a careful examination of the bed of Hickory creek and report to the council such changes and improvements as he believed would insure the community against the danger of flood.

Grading work for the Kankakee & Urbana Traction Co.'s line will probably be started early this spring. Contracts for the grading work are said to have already been let. W. J. Brock, Kankakee, is president.

Advices from Alton state that owners of 1,250 acres of land on Missouri Point have about made arrangements for building a levee that will protect their land from flood. The levee will be raised and a levee district will be created.

Advices from Golconda state that the Toledo, St. Louis & New Orleans R. R. Co. has been letting contracts for clearing a right of way through the counties of Gallatin, Hardin and Pope, with a view of having all the right of way ready for grading by April 1, so as to facilitate the construction of that part of the road from Golconda to the south approach of the terminal in Gallatin County, and put that part of the line from this point to the spar mines in operation as soon as possible. N. M. Burns of St. Louis is interested.

The Decatur-Southern Traction Co., which proposes to build an interurban line from Decatur to Pana, has been incorporated with a capital stock of $25,000, the incorporators being William S. Carter, George H. Winson and Henry R. Davis.

Petitions are being circulated at Moline asking for the doubletracking of the Moline, East Moline & Watertown interurban from 23d St. to the east city limits of Moline.

President R. R. McCormick of the Sanitary District of Chicago, has requested of the Secretary of War an additional flow of 1,000,000 cu. ft. of water per minute when the Calumet branch of the sanitary canal shall be opened. If the consent of the department is secured it is announced that immediate plans will be made for beginning the Calumet canal.

It is expected now that the Washington St. tunnel at Chicago will be completed by July 1, five months ahead of the contract time. Work on the main section of the tunnel was begun Nov. 1, and at present there are employed 300 men, working in three eight-hour shifts of 100 men each. The tunnel will be 1,800 ft. in length, and the total contract, which includes the west approach, which was let first, amounts to $750,000. The work is being done by the George W. Jackson Co. of Chicago.

Officials of the Baltimore & Ohio Ry. Co. are collecting data in view of constructing a branch line from O'Fallon to Belleville, Ill., a distance of 9 miles.

Indiana Notes.

FROM CORRESPONDENTS AND OTHER SOURCES.

Petitions are to be filed in the Gibson County Circuit Court at Princeton asking for the construction of a levee along the Wabash to be built along the eastern bank of the river, beginning at New Harmony, Posey County, and extending through Gibson County to the mouth of Patoka. A levee will also be built along both banks of the Patoka through Gibson and Pike counties. The total length of the two levees will be about 80 miles and will cost about $4,000 per mile.

Farmers below Vincennes are considering building a levee from the end of the present levee to Little Rock, thence east to Decker, thence up to Purcell, about 25 miles. William H. Brevort, Vincennes, Ind., is interested.

The capitalization of the Pittsburg & Lake Erie R. R. is to be increased by a stock issue of $6,000,000. The stock will be issued in $50 shares to stockholders at par.

The construction of a dam in Pigeon Creek at a point above Evansville Packing Co.'s plant for the purpose of abating the stench nuisance in the summer months has been suggested by Edward Stickleman, member of the Board of Public Works of Evansville.

Iowa Notes.

FROM CORRESPONDENTS AND OTHER SOURCES.

The directors of the Iowa & Omaha Short Line R. R., now under construction, have decided to extend the line from Treynor to the vicinity of Oakland. The survey of the company's line now runs between Carson and Oakland, but will probably be changed so as to bring it into Oakland or to the immediate vicinity of that town. Plans are now being made by President George Adams, Council Bluffs, to have the line between Treynor and Oakland cross sectioned as soon as the weather will permit field work, and it is expected contracts will be let in time to build the extension in connection with the completion of the Council Bluffs-Treynor division of the road this spring.

The Iowa & Illinois Electric Ry. has asked the city council of Davenport, Ia., for a franchise to lay a track along the river front. P. P. Crafts, Clinton, Ia., is general manager.

Bids were opened Jan. 18 by the supervisors of Woodbury and Monona Counties at Sioux City for constructing the West Fork ditch, Forrestall & Feyen, St. Paul, Minn., being the low bidders at about $80,000.

It is reported that the Illinois Central R. R. has completed surveys for 180 miles of the proposed line from Sioux City, Ia., to some point in Idaho and that work will begin on the new project in the Spring. A. S. Baldwin, Chicago, Ill., is Chief Engineer of the company.

According to reports from the vicinity of Charles City, Ill., the Chicago, Rock Island & Pacific Ry. Co. is considering the construction of a line from Rockford, Ill., to Charles City and to Mason City, Ia. W. H. Peterson, Chicago, Ill., is Assistant Chief Engineer of the C. R. I. & P.

Kansas Notes.

FROM CORRESPONDENTS AND OTHER SOURCES.

The Illinois Traction System, H. E. Chubbuck, General Manager, Peoria, Ill., is planning extensive improvements to its traction system in Wichita, Kan. These improvements include a number of extensions and the erection of a new power house.

The Missouri Pacific R. R. Co. is reported to have ordered a large amount of 85-lb. rail for the improvement of the Central Branch and Omaha Division in Kansas and Nebraska. The work will include the replacing of many old bridges with new steel structures. C. A. Chandler, Atchison, Kan., is Assistant Division Engineer.

Towns along the Lincoln Branch of the Union Pacific have been petitioning the company to improve its roadbed between Salina and Oakley, Kan. R. L. Huntley, Omaha, Neb., is Chief Engineer of the Union Pacific.

The Hutchison Interurban Ry. Co., Hutchison, Kan., has decided to extend the line on North Main St. to the fair grounds and construct an extension to the soda ash plant in the Spring. Emerson Cary is President of the company and W. A. Scothorn is General Manager.

Preliminary surveys have been completed from Beloit, Kan., to Kearney, Neb., for the projected line of the Dakota, Kansas & Gulf R. R. Baxter L. Brown, St. Louis, Mo., is Chief Engineer.

Michigan Notes.

FROM CORRESPONDENTS AND OTHER SOURCES.

Steps are being taken to secure the necessary legal permission to build one or more water power dams on the River Raisin in the vicinity of Dundee and Petersburg. Ex-Senator Charles A. Ward, formerly of Ann Arbor, is one of those back of the proposition. A hearing has been asked from the state railroad commission for permission to issue bonds to develop power on the Raisin.

Capitalists residing at Yale and Avoca have secured options on property in Kimball, Clyde and Grant townships, along the shores of Black River between Wadhams and the upper end of Grant township, and it is said that a power dam will be constructed at Wadhams. The dam will probably be built below the place where Milk creek runs into Black river.

The Chippewa River Power Co. has renewed its application for a franchise in Bay City. The company proposes the construction of a dam on the Chippewa River to develop 7,500 hp., the development involving the ex-

penditure of about $760,000. Wilbur F. David son, Port Huron, Mich., is interested. Charles O. Lenz, 71 Broadway, New York City, is the Engineer.

Plans have been submitted to the Board of Public Works of Grand Rapids, Mich., by L. W. Anderson, city engineer, for diverting Coldbrook creek north of the Grand Trunk R.R. The plan contemplates the construction of a culvert about 15 ft. wide and 10 ft. high on the interior from the east line of Emerald avenue west and north to within Highland Park north of the south driveway. The remainder of the creek to be an open channel to the north line of Highland Park. The approximate estimate of the cost is as follows:

Excavation, backfilling, etc.	$25,615
1,530 in ft. culvert (3,140 cu. yds. at $10)	34,100
4 wing walls (75 cu. yds. at $10)	750
Lowering concrete bridge in Highland Park	200
2 manholes at N. East St. and pipe under culvert	200
2 manholes at Grand Ave. and pipe under culvert	200
Total	$61,065

Work is now under way on the first dam to be constructed on the Au Sable River by the Eastern Michigan Power Co. This dam is known as the Cooke dam and is located about 16 miles from Oscoda. About 60 men and 10 teams are at present employed on the work. Work has been started on cribs for turning the river and an excavator has been set up. The work is in charge of J. F. Eaton of Flint, superintendent, and Grant Cochran of Jackson, superintendent of construction. Mr. Cochran has held a similar position in the building of four other dams. George Johnson of Reves Station, F. B. Taylor of Jackson, Frank Howe and Jos. Sachs are carpenter foremen on the job.

Frank Wixson, Saginaw, is reported to be promoting a project for the construction of a series of seven dams developing thousands of horsepower, on the Tittabawassee River between Edenville, in Midland County, and a point in Gladwin County, during the coming summer. It is planned to use the power developed for concerns in these two counties and a few in Saginaw and Bay counties.

The Grand Rapids Electric Co. has filed a map with the State Railway Commission at Lansing, Mich., of the proposed route of the projected electric line from Mt. Pleasant to Gladwin, via Clare.

Business men of Coldwater, Mich., have pledged $10,000 for purpose of preliminary work on the proposed electric line between Battle Creek and Coldwater. Milo D. Campbell, Battle Creek, Mich., is interested.

Thomas Handy, Handy Bros., Bay City, Mich., has prepared all details for the construction of a steam railroad from Bay City to Caro, a distance of 42 miles and is arranging with the State Railway Commission for a hearing on the plan for the organization of a company to take up the project. The estimated cost of the road is $500,000.

The Dundee Hydraulic Power Co. has been authorized to issue bonds amounting to $10,000 to be used in the construction of a water power station at Dundee, Mich. As the development proceeds the company will be allowed to increase the issue to $20,000.

Missouri Notes.

FROM CORRESPONDENTS AND OTHER SOURCES.

Grading for the Missouri Pacific railway cross-over south of the stock yards at St. Joseph was practically finished early in January. This is the first step in bringing about the road's new terminal arrangement in St. Joseph, whereby all its trains will be detoured west of the stock yards along the river front as they enter St. Joseph. The Missouri Pacific track south of St. Joseph is east of the Burlington right of way, and the present grading is to provide a place for building a new Missouri Pacific track west of the Burlington, with a crossing to it.

Missouri River farmers in the McBaine bottoms near Columbia are organizing a levee district. The McBaine bottoms comprise 1,400 acres that have been overflowed by the Missouri River almost annually. It is estimated that $10,000 will be needed to construct the six miles of levee.

J. H. Van Brunt, general manager, St. Joseph Street Ry. Co., has applied to the county court at St. Joseph for a franchise to extend the North St. Joseph car line to the Andrew County border. The proposed improvement would be part of the St. Joseph-Savannah interurban line.

Grade stakes for the line of the Hannibal & Kirksville R. R. have been set between Palmyra and Bethel, and the work of getting out the blue prints is now under way at the office of the Roberts-Abbott Co., the engineer, in Cleveland, O.

Stockholders of the Missouri Pacific R. R. Co. have voted to increase the bonded indebtedness of the company $175,000,000. It is planned to use the money to purchase $25,000,000 of Iron Mountain bonds and to take over eleven subsidiary lines, as follows: Carthage & Western; Joplin & Western; St. Louis, Oak Hill & Carondelet; Sedalia, Warsaw & Southwestern; Nebraska Southern; Omaha Belt Line; Omaha Southern; Pacific Ry.; Pueblo & State Line; Kansas & Arkansas Valley and to lease the Boonville, St. Louis & Southern. George J. Gould, 195 Broadway, New York, N. Y., is President of the Missouri Pacific Ry.

St. Louis Items.

BY A. E. KOENIG.

L. J. Smith, L. A. Nutter, R. C. Stripp and Z. C. Mitchell of the L. J. Smith Construction Co. spent three or four days in town getting lined up and ready to begin work on their ballasting contracts for 1910.

Judge Herman Hackman of the St. Louis County Court informs us that the year 1910 will be a banner year in road building in St. Louis County. Judge Hackman said the county court will probably spend in the neighborhood of $200,000 improving and building new roads this year. St. Louis County now has some of the best thoroughfares in the state, and is widely known for its excellent roads. Judge Hackman said: "Outside of the regular annual road fund of about $100,000, the county court has an extra $100,000 at its disposal, derived from the special road tax levy of 20 cents on the $100 valuation. The latter sum is to be used entirely in building new roads; that is, making rock roads out of dirt roads, macadamizing them." According to figures in the office of County Collector Fred L. Kerth, the special road tax is distributed as follows: On real estate, $79,064.82; personal property, $11,698.22; and railroads, $13,296.85. On the real estate assessment $52,225.20 and on the personal property $7,632.31 has been collected to date, while the railroads have paid their taxes in full, making a total collected thus far of $73,154.36, or more than 73 per cent of the total amount, with two months' time to collect the balance. Judge Hackman said: "The showing made this year by the collector's office was very pleasing and gives assurance of improved conditions among our residents. The county court has already under advisement road improvements which will cost nearly $80,000 to be made during the present year. About twenty-two miles of new road have already been determined on, contracts having been let for a portion of the roads." Following is a list of the roads to be improved. Where the price is stated the contract has been let and where no price is given no bids have as yet been called for: Bonhomme Township—Woods Mill road, 1 mile, $810; Mason road, 1,500 feet, $360; Ross avenue, ½ mile, $400; Kehr's road, 8,875 feet. Total, 3½ miles. Carondelet Township—Reaves Barracks road, 1 mile, $965.50; Mattese School road, 1½ miles, $1,000; Becker road, ½ mile, $350; Ringer road, ½ mile, $350; Page avenue, 7,133 feet, $2,000. Central Township—Ballas road, 8,800 feet, $1,310; Jackson road, 5,222 feet; Denny road, 9,575 feet, $1,252; Walton road, 2,800 feet, $565.50; Link road, 2,485 feet, $500; Woodson road, ⅜ mile, $416.50; Pendleton avenue, 400 feet; Elmwood avenue. Total, 6⅛ miles. Meramec Township—Olive street road, ½ mile, grading at $4.58; Hanna road, ¾ mile, petitioners to furnish gravel; Eatherton road, 2,000 feet, $460; Old State road, 19,547 feet. Total, 5¼ miles. St. Ferdinand Township—Trampe road, ½ mile; Old Hall's Ferry road, grading, 3,500 feet; Parker road, grading, ½ mile; McLaren avenue, 1,500 feet, at 20 cents for macadam and $7 for grading; Parker road, Florissant to Hall's Ferry road, 1½ miles, $1,260; Fee Fee road, cemetery to Midland railway, 1¼ miles, $1,110; Redman avenue, 4,200 feet, grading, Links road, 1 mile, grading; Chambers road, ½ mile, $705. Total, 7 miles. Judge Hackman said in improving new roads not all the expense is borne by the county, but the petitioners in most cases are required to furnish a portion of the money needed. County Roads and Bridge Commissioner Wm. Elbring stated the cost of road building has increased about 35 per cent within the last few years. He said: "Although all work in the county is given out by contract to the lowest bidder, the cost of feed and the scarcity of farm labor so close to the city have increased to such an extent that the contractors naturally have to charge more for their work, grading especially costing a great deal more than it did eight years ago." The greatest number of miles of new road built in a single year in the county was in 1904, the extra money coming from the extra road tax levy of 15 cents, which was declared unconstitutional by the legislature. The amount spent for new roads in that year was $127,512.08, of which $18,351.55 went for masonry and $109,160.53 for road work.

McCann Bros. came in from Murphysboro, Ill., looking for four or five second hand dump cars.

Work will begin on the new Kansas City union station in about 60 days. That is the announcement made by officers of the company after making the preliminary financial arrangements. H. L. Harmon, president, and S. W. Morroe, general counsel, for the Kansas City Terminal Company, returned from New York Saturday night. Mr. Harmon confirmed the report that he has obtained a loan of 2½ million dollars from Kuhn, Loeb & Co. to begin work on the new union passenger station. Arrangements were also made by Mr. Harmon and Mr. Moore to place a bond issue of 15 million dollars on the New York market. "While in Chicago on the return I attempted to get the directors together for a meeting to authorize this bond issue," Mr. Harmon said. "I will return to Chicago Tuesday or Wednesday, when this meeting will be held and the bonds issued, then I will go on to New York and complete all the preliminaries with the bankers there to take the bonds. Very few things remain to be done before actual work on the station will be started. I should say that we will begin active operations within two months." Before the station ordinance can be made binding the company must file with the city an application for the vacation of streets and alleys that are provided for in it. This will be done, Mr. Harmon said, about February 1 and then the council must approve of the vacations by February 9. The work for the excavating for the station building will be one of the first things done by the terminal company after every preliminary has been finished. John V. Hanna, chief engineer for the company, said that it was the plan now to start work on the main building at the same time other improvements begin. He said that the closing of O. K. creek as a sewer and the grading of land to be used for tracks near the station site also would be started this spring.

Pat Hannon of Hannon & Hickey returned from the south. Nothing new.

Jas. Downey of Hodges, Downey & Co. reports their ballasting work on the Iron Mountain R. R. in Arkansas as getting along nicely.

By unanimous vote the stockholders of the Missouri Pacific-Iron Mountain system approved Tuesday a proposed bond issue of $175,000,000 to be used for the consolidation of 11 connecting lines and the improvement of the company's main railroad properties. Vice President C. S. Clark presided at the meeting and former Gov. Lon V. Stephens and Chas. P. Stanley of St. Louis acted as tellers. The shares of George Gould and other New York stockholders of the company were

voted by proxy, Mr. Gould being unable to come to St. Louis at this time. No other business was transacted at the meeting, the annual election of directors not being held until later. Of the proceeds from the new bond issue $9,000,000 will be used for the physical improvement of the Missouri Pacific system and $5,000,000 for the St. Louis, Iron Mountain & Southern. The execution of the big mortgage, according to officials of the company, provides the necessary financial machinery to develop the western territory of the Missouri Pacific and its branch lines.

J. A. Ware Construction Co., Houser Bldg., St. Louis, Mo., was awarded the contract for raising of the grade of the Santa Fe R. R. between Paul's Valley and Dougherty, Okla.

Geo. B. Vaughan of Kirkwood, Mo., is going to do all of the work secured by the J. A. Ware Construction Co. on the Santa Fe R. R. between Paul's Valley and Dougherty, Okla. Vaughan left here for Texas the other day to ship his outfit on to this work and expects to open an office at Paul's Valley about Feb. 1. He has 300,000 yards of rock and 500,000 yards of earth, quite a lot of it steam shovel work, to sublet.

A special election to vote upon an issue of $500,000 in bonds for the improvement of the water works system in Kansas City, Kas., will be called in the near future. The money is to be used in extending water pipes and mains. The city council and the water commissioners will meet one week from tonight to decide upon a date for the election. Various amounts, aggregating $36,438, were transferred by ordinance at last night's meeting of the council from the general fund and the extension and betterment fund to the contingent fund. The recent annexation of Argentine, the extension of the city limits on the west from Eighteenth street to Forty-fourth street and on the north to the Missouri river makes it imperative that the commissioners have more money. At present a large portion of these annexed districts are without protection from fires.

Costello Bros. report their work on the Big Four R. R. in Ohio getting along as well if not better than could be expected in this kind of weather.

The United States senate on Jan. 18 passed a bill extending the time for building the Edgewater bridge across the Kaw River at Kansas City. The Edgewater Terminal Railroad Co., a subsidiary corporation of the Missouri Pacific, was granted the right by congress two years ago to build a steel bridge across the Kaw River near its mouth and work was to begin this winter. The plans were approved by the War Department engineers for a structure to cost about ½ million dollars. A delay in starting work on the bridge, however, was caused by high water and also by the time consumed in financing the Missouri Pacific improvements now under way. The bridge is to be used in connection with the river front terminal system now building from a point on the Missouri Pacific near Quindaro to Gooseneck near the Hannibal bridge.

R. J. Lynch is at work every day that the weather permits on his Missouri Pacific job near Kirkwood, Mo.

Montana Notes.

FROM CORRESPONDENTS AND OTHER SOURCES.

The Northern Pacific Ry. is stated to have seven corps of engineers in the field between Mott, N. D., and a short distance west of Miles City. There is one party working east and south from Hathaway, two between Marmarth and Tongue river, one in the Fallon creek country and the others east of the Little Missouri. These parties are independent of the Northern Pacific engineers working in the north side country west from Glendive and last heard of in the vicinity of Jordan, in the vicinity of which party a Great Northern outfit is also at work.

The Great Northern Ry. Co. has filed the plats for its Poplar branch in the U. S. land office at Glasgow, Mont. The plats are for that part of the proposed line north of the Fort Peck reservation, commencing about eight miles south of the Scobey post office and extending to the Canadian line. The plats of the balance of the line from Poplar to the reservation line have been filed with the Indian department, as the reservation does not come under the work handled by the U. S. land offices.

The Big Blackfoot Ry. Co. has filed its articles of incorporation at Missoula and will have its principal place of business in that city. The capital stock is $250,000, of which $500 is actually subscribed. The directors are John Gillie, L. O. Evans and C. F. Kelley of Butte and John R. Toole and Kenneth Ross of Missoula.

Huntley, Church, Boyington & McCoy, of Spokane, Wash., who have the contract for doubletracking the Northern Pacific Ry. between Billings and Huntley, have opened offices in the Stapleton Block, Billings, preparatory to beginning work. H. W. Church of the above company will be in charge. The contract is said to involve the expenditure of about $1,000,000 and will require considerable rock cutting as well as the construction of three tunnels.

The Boise-Butte Ry. Co. has been incorporated with a capital stock of $24,000,000, of which $500,000 has been subscribed, and proposes to build 418 miles of line from Boise, Idaho, to Butte, Mont. The stock subscriptions have been made by S. H. Bracey of Chicago, who pledges himself for $234,000; Fred A. Dolph, Chicago, $150,000; J. W. Giebert, New York; $50,000; John P. Hornaday Pittsburg, $50,000; J. E. Bell, Addison, Mich., $10,000; G. T. Wiswell, Chicago, $10,000; Charles Blackburn, Chicago, $1,000; Frank Weeks, Boston, $1,000; John M. Haines, $1,000; T. F. Holverson, $1,000; E. H. McAuley, $1,000. Shares are valued at $100 each. The company will maintain its principal office in Boise, Idaho.

The city of Lewiston will vote Feb. 1 on granting a franchise to John L. Bright for a new electric plant on Spring Creek.

The Board of Directors of the Great Northern R. R., have passed a resolution and filed it with the Secretary of State in Montana, announcing the intention of the company to build a line from Vaughn Station, 10 miles west of Great Falls, Mont., to the base of the Rocky Mountains. Construction work on the line, which was located last Fall, will begin at once. J. C. Patterson, St. Paul, Minn., is Assistant Chief Engineer of the company.

New York Notes.

FROM CORRESPONDENTS AND OTHER SOURCES.

The following bids were received Jan. 11 by the Board of Water Supply of New York city for the construction of portions of the White Plains division of the Catskill aqueduct, the work to include three tunnels, aggregating 16 miles in length, and about 2.8 miles of cut and cover aqueduct. The work is located in the towns of Mount Pleasant and Greenburg, Westchester county, and 36 months are allowed for its completion: Pittsburg Construction Co., $2,205,852.50; Carter Construction Co., $2,435,628.75; J. F. Cogan, $2,326,530; Breuchard-Winston Co., $2,479,155; and David Peoples, $2,497,750.

According to a statement of D. C. Salverds, Rochester, N. Y., president of the proposed electric line to be known as the Rochester, Scottsville & Caledonia, actual work will be started soon. Capitalists who have been interested in the financing of the line are soon to make a report, their representatives having recently been over the proposed route. The original proposed route of the line was from Rochester to Caledonia, but the promoters were unable to get financial backing on account of the shortness of the line. It is now proposed to extend the line westward.

The consolidation agreement merging the New York, Westchester & Boston Ry. Co. and the New York & Portchester R. R. Co. into the New York, Westchester & Boston Ry. Co., capitalized at $5,000,000, was filed Jan. 18 with the secretary of state at Albany. The officers and directors are: President, Leverett S. Miller, New York; vice president, Thomas D. Rhodes, East Orange; treasurer, Augustus S. May, Bridgeport, Conn.; secretary, John G. Parker, New Haven, Conn.; directors, Leverett S. Miller, George H. Miller, J. Pierpont Morgan, Lewis Cass Ledyard, William Rockefeller, New York; Thomas D. Rhodes, East Orange; Charles F. Brooker, Ansonia, Conn.; Charles S. Mellen, James S. Hemingway, A. Heaton Robertson, New Haven; John H. Whittemore, Naugatuck, Conn.; Edwin Milner, Moosup, Conn., and Robert W. Taft, Providence, R. I.

The State Public Service Commission will hold a hearing on Feb. 9 on the application of the Manhattan Bridge Three-Cent Line for a certificate giving permission to construct and operate a trolley line from Flatbush and Fourth avenues, Brooklyn, to and over the Manhattan Bridge and through Canal St., Ne York, to the Hudson River, a distance of about five miles.

The Connecting R. R. Co., which is to build a line connecting the New York, New Haven & Hartford R. R. and the Pennsylvania R. R. terminals in New York City and which is controlled by the above companies, has acquired a clear right of way, varying in width from 80 to 100 feet, from the shore line, opposite Ward's Island, to the Glendale section, a distance approximating five miles. On the Westchester side sufficient land for the connection of the projected railroad with the New Haven & Hartford system has been purchased by the New Haven interests, and as soon as new plans for the bridge across Ward's Island have been approved by the Municipal Art Commission of New York City, work will be begun on the $25,000,000 improvements which will furnish facilities for residents of Jamaica, Flushing, Malba, Whitestone and eastern Long Island points to reach, from their home towns, all places on the Pennsylvania and New Haven roads. The first plans for the Hell Gate Bridge submitted by the Connecting company were rejected by the Art Commission on esthetic grounds. In the designing of new plans the points of objection will be considered by the architects. After the passenger connections between the two systems have been effected the freight road will be constructed to Bay Ridge.

Announcement has been made by Theodore P. Shonts, President of the Inter-borough Metropolitan Ry. Co., of New York City, that J. P. Morgan & Co. were ready to extend all the financial aid needed to the Interborough Rapid Transit Co., which operates the existing subways at New York, for new subways and other improvements that might be needed. Mr. Shonts said that the bankers were prepared to back the company to the extent of $100,000,000.

The State Board of Water Supply will give a hearing Feb. 10 to hear objections to the amended plans of the Board of Water Supply of New York City providing for a tunnel under the Borough of Manhattan, to connect with the new Catskill aqueduct. The amended plans will involve the expenditure of $25,000,000, although the engineers declare that the final cost will be kept within the appropriation for the new supply.

The Catskill Electric Ry. Co. of Catskill, has been purchased by W. C. Wood, and a new company will be formed to improve the road and make extensions. The first extension will be to Cairo and it is expected to have the line completed to that place by July 1. A new power station will also be erected and new cars secured. Among those interested with Mr. Wood are F. N. Du Bois, W. B. Fiero, Judge Emory A. Chase, Robert F. Story, Dr. Wilbur F. Lamont and George W. Holdridge of Catskill, manager of the trolley road.

It is reported that there is a plan under consideration to consolidate the Buffalo, Lockport & Rochester Ry. with the Rochester, Syracuse & Eastern and other holdings of the Beebe syndicate. If the road should be acquired by this syndicate, it would give control of the through electric service from Syracuse to Buffalo and probably result in the double-tracking of the Buffalo, Lockport and Rochester road. John M. Campbell, Rochester, N. Y., is General Manager of the Buffalo, Lockport & Rochester Ry.

Ohio Notes.

FROM CORRESPONDENTS AND OTHER SOURCES.

The City Railways Co. of Dayton has accepted the council ordinance for the construction of a curve at the corner of 5th and Main Sts. This will permit the railway company to make an extension of its Kammer Ave. line or "Orange" line north on Main St. to Third and then east.

An allotment of $15,000,000 has been made by the New York Central lines for the Cleveland district.

The Cincinnati Traction Co. of Cincinnati will add two miles of new track to its line in the next few months.

The Washington Traction Co. of Springfield is considering extending its line to Clifton, Cedarville and Jamestown and possibly to Washington C. H. Steps are being taken to finance the extension and if successful construction work will be started in the spring. George W. Baker is president.

The Baltimore & Ohio R. R. is planning to start work in the spring on the elimination of grade crossings at Broad St., Town St., McKinley Ave., Sullivant Ave. and Central Ave. in Columbus. Paul Didier, Pittsburg, Pa., is principal assistant engineer, B. & O. R. R.

Right of way is being secured for the projected 51 mile line of Fostoria, Napoleon & Defiance Ry. Co., the incorporation of which was mentioned in our last issue. The road is to be operated by gasoline motors. Chas. A. Bliss and R. T. Betts, Toledo, O., are the principal promoters.

The town of Tiro has subscribed for $25,000 of stock for the proposed electric line of the Sandusky, Norwalk & Mansfield Ry. Co. and steps are being taken to secure stock subscriptions in other cities along the route. It is claimed that if the bonds are sold work on the line will be started early in April. As proposed the road is to extend from Norwalk to Bucyrus, Sulphur Springs, New Washington and Tiro. G. A. Bartholomew, Norwalk, is president.

The Toledo & Indiana Electric Ry. was purchased at receiver's sale at Toledo on Jan. 18 by S. C. Siehnck of Toledo, representing the majority bond holders, including the Knickerbocker Trust Co. of New York. D. J. Cable of Lima, O., supposed to represent the W. Kesley Schoepf syndicate, bid $1,058,000, supposedly with a view of obtaining a connection between Toledo and the Indiana property of that syndicate. The previous sale to the minority bond holders at $1,006,000 was set aside on technical grounds. The company operates from Toledo to Bryan, Ohio, a distance of 56 miles. Details of intended reorganization have not been announced, but are believed to include an extension to Fort Wayne, Ind.

At a meeting of the stockholders of the Lake Erie, Bowling Green & Napoleon electric road at Bowling Green the following directors were elected: Dr. S. W. Rogers, A. E. Boyce, F. H. McKnight, C. W. Solother, B. C. Harding and H. G. Hanky. It is stated that with ten days of good weather all the rails can be laid for the extension to Tontognay.

The city council of Cleveland has repealed the subway franchises passed as almost the last act of Tom L. Johnson's administration as mayor. The scheme for a $75,000,000 subway system was voted down by the people in November, but the franchises, in slightly altered form, were passed again by the Johnson administration.

The Findlay Interurban Ry. Co., Chas. F. Smith, General Manager, Findlay, has negotiations underway looking to the financing of an extension to Kenton.

The Cleveland, Cincinnati, Chicago & St. Louis Ry. is stated to be having surveys made for a proposed cut-off to run from Ridgeway to a point near Sidney, the idea being to do away with the hills and curves on the main line between Rushsylvania and Bellefontaine.

The Demay Construction Co. of New York has been awarded the contract for building the line of the Ashtabula Electric Street Railway Co., work to be begun within 60 days, and to be completed next summer. The proposed line will be about five miles long. The project is promoted by Ashtabula men and financed by eastern concerns which bought the bonds.

The Sylvan Dell Park Passenger Ry. Co., Williamsport, O., has applied to the city council for a franchise .

The Leetonia & Cherry Valley R. R. Co., of Leetonia, has been incorporated with a capital stock of $10,000, Warren E. Thomas being one of the incorporators.

Oklahoma Notes.

FROM CORRESPONDENTS AND OTHER SOURCES.

The Kansas City, Mexico & Orient Ry., W. W. Colpitts, chief engineer, Kansas City, Mo., is said to be planning to put engineers in the field shortly to make surveys for a branch line across southern Oklahoma to tap the coal fields in the southeastern portion of that state. The proposad branch will leave the Orient line at Cambridge, Kiowa County, and will be constructed southwest through Hobart and Lawton and across the Chickasaw Indian country. It is expected that active construction will be commenced during the present year.

Surveys for the Osage & Western R. R., a "Katy" extension, westward across northern Oklahoma, have been completed, running westward from Vinita through Nowata, Bartlesville, Pawhuska and Enid. According to a reported statement of F. G. Costello, one of the engineers for the company, construction work will be started within 30 days, building first into Bartlesville.

The Oklahoma City Junction Ry. Co., which proposes a belt line to the packing plant of Morris & Co. at Oklahoma City, is securing right of way for its line. The railway company is incorporated for $100,000, and according to the charter is to be ten miles long, reaching from Oklahoma City to the site of the new packing plant. Among the incorporators are C. B. Ames and D. T. Flynn of Oklahoma City.

A bill is now before congress to give the right of way across public lands in Arkansas for the projected Standard Oil Co.'s pipe line from the Oklahoma oil fields to the gulf of Mexico.

The Shawnee Electric Ry. Co., which plans to build an interurban line from Oklahoma City to Shawnee and on east to Muskogee, has filed with the secretary of state amended articles of incorporation increasing its capital stock from $100,000 to $1,300,000. The proposed line is to run northeast from Shawnee through Prague and Okmulgee to Muskogee and west from Shawnee through Dale, McLoud, Harrah, Choctaw City and Spencer to Oklahoma City. The directors are C. T. Edwards, A. Hargrave, J. W. Rubey, J. C. Chrisney, C. E. Easterman, R. E. Pugh and W. S. Pendleton, all of Shawnee.

Attorney Wm. M. Mellette, of Muskogee, has been appointed special master for the Monett Southwestern Construction Co. Announcement has been made by counsel for the construction company that a new company was being organized for the purpose of buying the assets of the defunct company and completing the building of the road which was started several years ago. The road was surveyed from Honey Grove, Tex., to Monnett, Mo., and part of the grading was done when it ran short of funds and was thrown in the hands of a receiver.

Officials of the Mountain, Valley & Plains R. R. Co., which projects a line from Cimmarron, N. Mex., to Guthrie, recently went over the proposed route and report everything favorable to the construction of the line. J. M. Cogan, Canton, O., is President of the company and D. W. Harrington, Dalhart, Tex., is Treasurer.

Permanent surveys are under way for the interurban road projected by Wood Bros. of Oklahoma City. As proposed the road will leave Oklahoma City on 4th St., pass near the state fair grounds through one of the canyons, under the Frisco and on to Jones or Spencer, perhaps both, thence southeast, coming down the valley beyond Choctaw and on to McLoud, missing Harrah by 1½ miles. From McLoud it goes to Dale, crossing the river at that point, thence to Rose Garden, a northern suburb of Shawnee. It enters the latter city over the city railway. It is proposed to go from there on to Fort Smith, Ark.

It is expected that construction work on the Cherokee Belt Line R. R. to extend from Skiatook to Pryor Creek, a distance of 45 miles, will be under way in a very short while. Already the right of way has been secured and practically every township along the proposed road has voted its assistance in the way of a bonus. It is believed the Cherokee Belt Line is backed by some trunk line traversing Oklahoma, presumably the Missouri Pacific.

According to reports from Guthrie, Okla., surveys have been completed for the Osage & Western, the Missouri, Kansas & Texas branch line, and construction work will be started in about three weeks. As projected the route will pass through Vinita, Nowata, Bartlesville, Pawhuska and Enid. S. B. Fisher, St. Louis, Mo., is Chief Engineer of the Missouri, Kansas & Texas R. R. Co.

The Kansas City, Mexico & Orient Ry. Co. is contemplating the construction of a branch line in Southern Oklahoma, from Cambridge in Kowwa County and through Hobart and Lawton across the Chickasaw Indian country to the coal fields in the southeastern portion of Oklahoma. Surveys for the line will be started in the Spring. W. W. Colpitts, Kansas City, Mo., is Chief Engineer of the company. A. E. Stilwell, Kansas City, Mo., is President.

According to a report, stated to have been made by A. Hargraves, General Manager, Shawnee Electric Ry. Co., work will be started at once on the active construction of the proposed line from Shawnee, Okla., to Oklahoma City.

The Tulsa Street Railway Co., of Tulsa, Okla., has decided to use a portion of the $100,000 allotted for improvements during 1910 for the construction of a complete loop to Owen's Park probably out Third and back North Cheyenne Ave. The Union Traction Co., of Tulsa, Okla., has also announced its intention of extending its Fourth St. Line to the Frisco track and north to Owen's Park.

The stockholders of the Oklahoma & Golden City Ry. at a meeting in Pawhuska recently elected directors and authorized the sale of the bonds so that actual construction work could begin this spring. This line will pass through Bartlesville from the northeastern part of the state.

Oregon Notes.

FROM CORRESPONDENTS AND OTHER SOURCES

Bonds are being placed in New York for the proposed east and west extensions of the Pacific & Eastern Ry., of which J. R. Allen, 49 Wall St., New York, is president.

Advices from The Dalles state that S. Sarry will shortly commence work on his contract on double tracking the O. R. & N. between The Dalles and Biggs. Camps to accommodate 400 laborers have been erected at the mouth of Three Mile creek above The Dalles. Biggs is the northern terminus of the Columbia Southern.

Porter & Clarkson, who have the contract for constructing the Oregon Trunk up Willow creek, have three camps fully established between Madras and Deschutes, although they are not yet carrying very large crews, as it is difficult to get laborers to come in during the cold and somewhat uncertain weather. At the present time there is a force of about 150 men.

At the beginning of this month the first 10 miles of the new railroad to Brogan is practically graded, and finished ready for the ties and rails. Five camps are established along the line, with about 250 men and 400 horses on the work. The first camp is in charge of Hamilton, the second is McCue's, the third Hurley's, the fourth Yoackum's and the fifth Wells'. These have practically finished all their work on their first contract section and have moved up towards Brogan to take charge of another division on the road. About 10 teams are running from Vale with supplies to feed the men and stock and furnish materials needed.

Twohy Bros., Spokane, Wash., have been assembling crews for the work of double tracking the O. R. & N. line between Portland and The Dalles. This work, which covers 16

miles, includes a number of track changes and the elimination of many curves with the reduction of grades.

The Northern Pacific Ry. is reported to have purchased the holdings of the Oregon Coal & Navigation Co. on Coos Bay, contiguous to Marshfield. By its purchase the Northern Pacific acquires entry into Marshfield over what is termed the Boise-Roseburg survey. The survey, the engineers claim, does not exceed 3 per cent grade between Roseburg and Marshfield.

The Seaside Manufacturing Co., a lumber concern of Seaside, Ore., has filed a bond mortgage for $175,000 preliminary to building a railroad from Seaside up the Necanicum River to a junction with the P. R. & N. line now under construction between Hillsboro and Tillamook.

Smith & Jones, Portland, Ore., and Caughren, Winters, Smith & Co., Spokane, Wash., are making good progress with their contracts for constructing the Celilo Canal for the U. S. Government. The purpose of the canal is to form a waterway around Celilo Falls, about 100 miles east of Portland, making possible through river transportation for vessels of six feet draft to Wallula, Pasco and up the Snake River to Lewiston, Idaho. The canal plans call for five locks, one of which has been completed. Two of these locks will be at Big Eddy, arranged tandem plan and similar in construction, although much smaller, to those to be constructed on the Panama canal. About 350 men are now engaged in the work, which progresses night and day. The canal is being cut through basaltic rock and heavy blasts of dynamite are set off to break up this rock, so that it can be lifted by steam shovels into dump cars. An electric light plant supplies illumination so that the trains of dump cars and the steam shovels need not cease work when darkness comes.

The Oregon Electric Ry. Co., of Portland, has had surveys completed for a number of extensions and the engineers are now preparing maps and estimates. The surveys completed are for extensions aggregating 65 miles. The distance from Salem to Albany is about 27 miles, and from Tigard to McMinnville about 25 miles. The extension to North Yamhill from Forest Grove would be 13 miles. The latter is part of a proposed line from Forest Grove to McMinnville, but surveys have been completed only to North Yamhill. The Tigard-McMinnville and Forest Grove McMinnville surveys are not for alternative routes to McMinnville, but for independent lines to serve separate districts.

Active steps are being taken by the Nevada-California-Oregon Ry. Co., toward extending their line to Lakeview, Ore., and it is reported that a contract for grading 50 miles of the road has already been let to Nugent & Richardson.

The Oregon Railway & Navigation Co., it is announced, will soon start work on the long pending Coyote-Echo cut-off in Oregon and an appropriation of $707,946 has been made for the purpose. The line which will run from Coyote to Echo, via Stanfield, Ore., will eliminate 8.8 miles of present trackage. The work will include the construction of a 10-stall roundhouse at Coyote, which will be made a terminal. As stated in our last issue the company is to make an expenditure of $1,020,000 for straightening the line between Yoakum and Pendleton, Ore. G. W. Boschke, Portland, Ore., is Chief Engineer of the company.

Surveys, etc., for the Bandon & Port Orford Ry. which was projected to be built from Bandon down to Port Orford, in Curry County, has been sold to Seattle and Tacoma men, who intend to start actual work early in the spring. The road was promoted by Steven Henderson of Marshfield, Ore.

Pennsylvania Notes.

FROM CORRESPONDENTS AND OTHER SOURCES.

The Pittsburg & Lake Erie R. R., J. A. Atwood, Chief Engineer, Pittsburg, is planning extensive improvements along its lines between Beaver and Pittsburg. These will include the rebuilding of the passenger and freight terminal at Beaver and the construction of freight yards at Woodlawn. Considerable grading has been done in connection with the new yards at Aliquippa, which will eventually be the largest on the Pittsburg and Lake Erie system.

Stell Bowman has been secured as Bookkeeper by D. J. Carson, Contractor, Du-Bois, Pa., for Parkwood work, on the Buffalo, Rochester & Pittsburg mine line.

The Pittsburg Subway Co., represented by Attorney Arthur O. Fording, Pittsburg, is to again apply to the city council for a franchise. The subway company's ordinances, which failed of passage after a fight lasting nearly two years, gave the company the right to build an underground railroad beginning at Oliver Ave. and Smithfield St. and extending to a point in the vicinity of Luna Park, near Center Ave. From there the road was to emerge from the hills and operate over proposed surface lines. Another spur was to be run under East End Sts. to a point near Fifth and Penn Aves. The downtown loop of the proposed subway carried it under Oliver Ave. to Liberty, to Ferry, to Third, to Smithfield St. and to the point of beginning.

The New York Central Lines are considering acquiring the Western Maryland R. R. which is planning the construction of a line to New Haven, Pa., from Cumberland, Md., making a connection with the Pittsburg & Lake Erie R. R., a subsidiary company of the New York Central, thus giving the W. M. Ry. system a direct connection with Pittsburg, Pa. The Pittsburg & Lake Erie R. R. is also considering the construction of an extension of its line to Belton, W. Va., where it will again connect with the Western Maryland R. R. J. A. Atwood, Pittsburg, Pa., is Chief Engineer of the Pittsburg & Lake Erie R. R.

Stockholders of the Indiana County Railways Co., at a meeting held Jan. 6, elected the following directors: D. H. Clarke and Benjamin M. Clarke, Punxsutawney, Pa.; George W. Kipp, of Towanda, Pa.; Harry E. Clarke, of Glen Campbell, Pa.; Hon. T. Larry Eyre, Chester, Pa.; W. F. Elkin and J. A. Klingensmith, Indiana, Pa. The board then organized as follows: D. H. Clarke, President; B. M. Clarke and T. L. Eyre, Vice Presidents; J. A. Klingensmith, Secretary and Treasurer. It is believed that the company will shortly let the contract for the construction of an extension from Clymer to Dixonville, Pa. It is also understood that the company is negotiating with the West Penn Railways Co., and that a link will be constructed from Derry to Blairsville, Pa., connecting the two systems.

The Hanover & Plymouth Street Ry. Co., has applied for a charter and proposes to build and operate a street railway, from Oxford street, in Hanover Township, Luzerne County, Pa., at the intersection of Lee Park avenue, thence in a westeerly direction along Oxford street to a public road leading from Wilkes-Barre to Nanticoke, commonly called the River Road; thence in said township on and along the River Road in a southwesterly direction to the Ferry Road leading to the Susquehanna River; thence in a westerly direction on and along the Ferry Road and Fellows avenue, to its terminus at the Susquehanna River; thence returning by the same route to the place of beginning, a distance of three miles.

Tennessee Notes.

FROM CORRESPONDENTS AND OTHER SOURCES.

The surveyors for the Dyersburg Northern R. R. have finished making the survey from Tiptonville, Tenn., to Hickman, Ky., and have been surveying different routes around Hickman, Ky., to the east side. R. M. Hall, Dyersburg, Tenn., is president.

The Clarksville Railway & Light Co., of Clarksville, contemplates a number of improvements and the extension of the railway lines to New Providence and Dunbar's Cave. A. C. Murray is Manager.

Texas Notes.

FROM CORRESPONDENTS AND OTHER SOURCES.

Business men of Childress have organized the Childress & Northeastern Ry. and propose to build a road from Childress, Tex., to Mangum, Okla., through Hollis, Okla. The road is to be about 70 miles in length. The promoters intend to offer the road to the Katy or Rock Island at Mangum for operation, but it is possible that another line will ask for the lease. The new road will pass through the thickest settled portions of the Panhandle and southwestern Oklahoma. The country traversed is strictly a farming country, but mineral lands can be reached with no extra expense for tap lines. Six miles northeast of Childress is located one of the richest gypsum deposits in Texas. Surveyors will be put in the field as soon as possible and work of grading will begin within a few months, it is claimed.

Surveys are now under way for the Temple & Northwestern Ry., with Thurber as the objective point, via Hamilton. Walter S. McGregor, Temple, Tex., is right of way agent.

F. E. Jonah, chief engineer in charge of construction of the St. Louis & San Francisco R. R., has gone to Brady to take active charge of the construction of the Menardville extension. Mr. Jonah's first work in connection with the Menardville extension will be the selection of a route beyond the 17½ miles already selected and upon which the graders are at work. Three surveys have already been made into Menardville, and it is expected that one of the routes already surveyed will be chosen, although it is possible that an altogether new route might be selected.

According to a statement of Ben B. Cain, vice president and general manager of the Gulf, Texas & Western R. R., steel for the line has been laid 17 miles northwest from Olney in the direction of Seymour, and most of the grade for the entire distance has been completed. From Seymour westward the plans of the company are not matured as regards the route, and will not be until another survey is completed. Three towns are in competition for the railroad. These are Benjamin, Truscott and Crowell, all on the line of the Kansas City, Mexico & Orient. Mr. Cain states that it is the purpose of the company to build westward to a connection with the Santa Fe or to some point on the plains, but definite decision will be reached probably at the meeting of the directors and stockholders in Dallas the first Tuesday in February.

The James Black Masonry & Construction Co. of St. Louis, Mo., has been granted a permit to do business in Texas, with office at Austin. The capital stock is $5,000.

J. C. Dumont, the engineer who built the dam at Marble Falls, has submitted a proposition to the Business League of Austin for rebuilding the Austin dam. He proposes to finance the proposition, estimating the cost of rebuilding at about $350,000, and will ask the city to give him a lease of the water power and permit him the exclusive privilege of manufacturing electricity.

The city of Austin and the county are to expend about $12,000 in the permanent improvement of the South Austin dyke, each to pay one-half of the cost. A meeting of the city and county commissioners has been held to consider the plans and specifications. The work will be let to contract.

Cablegrams from Rotterdam to families of the crew of the dredge Holm at Galveston announce the safe arrival of that vessel in the home waters. The Holm steamed from Galveston Nov. 10 after several attempts to get to sea with a full crew. Two boats of the original fleet of four which engaged in the big grade raising contract still remain in Galveston. One of these, the Nerus, is still engaged in filling the canal made by the dredgers, and the other, the Triton, has been leased to the Bowers Southern Dredging Co. and is in use filling in new docks in the western part of the city. It is understood that the Nerus will soon follow the Holm back to the home of the company owning her.

The Atchison, Topeka & Santa Fe Ry. is stated to have perfected arrangements to come into Orange at an early date over the tracks of

the Orange & Northwestern R. R., the connection being made at Buna, where the two railroads are only a few hundred feet apart.

The Rockport & Port Aransas Channel & Dock Co. of Rockport has been incorporated with a capital stock of $2,500.

Application has been made for a charter for an electric line to connect Penn City and Houston. Grading for the line has already been started. C. C. Waller, Houston, is interested.

Surveys have been started at Belton under the direction of M. D. Parlow, Kansas City, Mo., for the projected Waco, Belton and Georgetown Ry.

J. W. McDaniel and associates have submitted a proposition to the Commercial Club of Temple, offering to build a line of railroad from Temple to Hamilton, provided the citizens would subscribe to bonds in the sum of $150,000, give right of way in the county and terminals in the city. The proposition will probably be accepted. The line is to be completed within two years and work will start within 30 days after the ratification of the contract.

Business men of Weatherford are advocating the building of a north and south railroad from that city. Joel W. Hicks, Weatherford, is interested.

The Picton Co., of Galveston, which has the contract for constructing the jetties at Sabine Pass for the U. S. Government, is preparing to begin active construction work.

The Bowers Southern Dredging Co., of Galveston is reported to have been awarded the contract for dredging a 30 ft. deep turning basin and slip for the private company at Texas City. Capt. A. P. Woolvin is at the head of the company which also projects a $40,000 hotel and a 500,000 bushel elevator at Texas City.

Good progress is being made by State Levee and Drainage Commissioner Styles, of Austin, for a comprehensive levee system for the state. Four plane table topographical parties are to be immediately placed in the field, and these additional parties are to commence work on the upper part of the Trinity river at Rockwell. These four additional parties will be under the supervision of Charles Hardeman, New York; Richard D. Evans, Washington, D. C.; J. E. Jenkins, Alabama; P. W. McMillan, Colorado. All of these experts are now connected with the U. S. Geological Survey. The rodmen and others who are to accompany these four parties will be taken from the parties that have been working on the base lines, which work has been completed. It was also announced by Commissioner Stiles that there will soon be started some new parties in the lower Brazos and will work up to Waco and also from Cameron along Little river. The rodmen for these parties will be obtained from the many applications now on file with Captain Stiles. The work of locating the surveys for the levees will begin at an early date.

The citizens of Bryan have accepted the proposition of O. E. Gammill, Contractor, of Gueydan, La., to build the Bryan College trolley line. Mr. Gammill has moved his grading outfits from Caddo, Okla., to the Bryan work.

Citizens of Midland have subscribed $100,000 bonus to secure a railroad for that city.

The Texas Central R. R. is planning to have grading work started by March 1 on its proposed 40 mile branch from De Leon through Sipe Springs and Rising Star to Cross Plaines. Definite locations for the line have been run. The Texas Central has ordered 5,000 tons of 80-lb. open hearth steel rails which will be placed in the present main line from Hico (to which point 80-lb. rail are now laid) to mile post 123, 18 miles west of Dublin. The present 60-lb. rail now in that track will be taken out and used in the construction of the 40 mile branch. C. N. Sharman, Waco, is chief engineer.

Complete surveys and cross sections are reported to have been made for a line of railroad from Paris to Palestine and the matter of constructing such a line is said to be under consideration by B F. Yoakum of the St. Louis & San Francisco. The project includes a joint trackage arrangement with the International & Great Northern from Palestine to Houston. The distance in an airline from Paris to Palestine is, approximately, 140 miles. The proposed route would cover an unoccupied territory in several places and be the only north and south line in that section.

A local company is being organized at Greenville to build a street car system in that city. A. R. Nicholson, Attorney, is working on the proposition. The construction of an interurban line for Greenville to Wolfe City is also proposed. Joseph F. Nichols is Mayor of Greenville.

At a recent meeting of the stockholders of The Trinity Valley & Northern R. R. Co., of Dayton, Tex., the Directors were authorized to issue first mortgage bonds amounting to $150,000 on the entire property of the company. The money will be used in the improvement and extension of the road and to repay money already thus expended. The line operates between Dayton and Fouts and connects with the Texas & New Orleans and the Beaumont, Sour Lake & Western roads. L. Fouts, Dayton, Tex., is President of the company, and A. J. Wise, Houston, Tex., is Chief Engineer of the road.

The Gulf Coast & Provident City Railway Co. has been chartered in Texas, with a capital stock of $50,000 and principal offices at Houston, Tex., and proposes the construction of a railroad 35 miles long from Pierce, in Wharton County, to Provident City, Colorado County. The incorporators of the company are Louis H. Scurlock, Emil Reinbold, T. J. Coughlin, Edward L. Walsh, all of Kansas City, Mo.; Carey Shaw, E. W. Townes, James T. Reaves, John T. McCarthy, A. Schlafli, Houston, Tex.; Friench Simpson, Hallettsville, Tex.

Citizens of Rising Star, Tex., have subscribed a bonus of $50,000 for the proposed line from Waco to Abilene, of the recently chartered Abilene Central R. R. Mogan Jones, Abilene, Tex., is one of the incorporators of the company.

At a recent mass meeting of the citizens of Pecos, Tex., a bonus of $100,000 was raised and guaranteed to Dallas capitalists promoting the construction and operation of a railroad from Pecos to Balmorhea. Construction work will begin at once.

Utah Notes.

FROM CORRESPONDENTS AND OTHER SOURCES.

Advises from Salt Lake City state that the mining interests of the Dolly Varden, Kingsley, White Horse and Ferguson districts in Nevada are taking steps toward the construction of a branch railroad from the camp of Proctor down the Antelope valley. Maps covering the territory along the line of these districts and as far south as Red Mountain have been prepared, together with statistical information as to the ore production and the possibilities of the districts. A preliminary survey was made some time ago, for the purpose of determining the general contour of this valley, which is in fact almost as level as a floor. The proposed branch will leave the main line of the Western Pacific railroad at or near Proctor, making this point a base of supplies for that part of Nevada.

The contract for tunnel No. 2 of the Kanab dam rebuilding project was let Jan. 11 to Sorenson, Averett and Ford Bros. of Kanab. The tunnel is to be 250 ft. long, 6 ft. wide in the bottom, 2½ ft. perpendicular walls and arched so as to make it 5 ft. high in the center. The formation is all sand rock, and the contract price is $2.45 per foot. The work must be completed by April 15. This tunnel will form the connection between the canal proper and the weir.

Plans are being prepared by Joseph West, Engineer, Ogden Rapid Transit Co., Ogden, Utah, for the construction of a railroad from the Utah Hot Springs north to Brigham City. Right of way will be secured and grading will commence at once. The company is also planning the extension of the Ogden Canyon line from Hermitage east through the great gorge to Huntsville, Utah.

The following statement regarding the recent washout on the San Pedro, Los Angeles & Salt Lake R. R., was given out by J. Ross Clark, Vice President, on Jan. 17: "The report that we were damaged to the extent of $14,000,000 by the flood waters is overdrawn. We suffered heavily, but not nearly to that extent. Repairs, construction and betterments together with loss of patronage sustained during the period of the break may, however, run the total up to something like that sum. The story that we lost 94 miles of track is also exaggerated, although a good portion of the track is gone for a distance of 60 miles. In places it is intact and can be replaced. It is hard to say when traffic will be resumed as the weather is too bad at present to attempt reconstruction. We have had one report on the damage and expect to send out two more engineering parties." E. G. Tilton, Los Angeles, Cal., is chief engineer.

The Southern Pacific Ry. Co. is taking steps toward raising the grade of their line across the Great Salt Lake in Utah. The work includes the raising of the trestle across the lake made necessary by the rise of the lake level. The work which will be in the vicinity of Ogden, Utah, will require an expenditure of about $1,000,000. William Ashton, Salt Lake City, Utah, is Chief Engineer of the lines east of Sparks.

Washington Notes.

FROM CORRESPONDENTS AND OTHER SOURCES.

The Great Northern Ry., A. Stewart, assistant chief engineer, Seattle, is reported to be planning to discontinue the present division headquarters at Skykomish and to remove the roundhouses, shops and coal bunkers to Monroe. It is also proposed to construct switch yards, a mile in length, at Monroe.

The Anacortes Lumber & Box Co., L. D. Rogers, general manager, Anacortes, is to have work started at once on a dock, 725 ft. in length and 83 ft. wide, for the accommodation of freight and passengers. There will be coal bunkers, warehouses, a passenger station and electric hoisting machinery. A spur track of the new English railway will be built onto the dock.

The Commercial Dock Co., Carl L. Stebbins, president, Tacoma, Wash., is planning to have work started shortly on a new dock.

Twelve car loads of steel rails for the extension of the North Yakima & Valley R. R. into the Moxee country arrived in North Yakima on Jan. 10. Eight other cars of construction material are expected in a few days and work upon the extension will be pushed.

The Bellingham Warehouse Co. of Bellingham is planning to enlarge its dock at that city.

The Columbia River Orchard Co. has awarded a contract to Kilbourne & Clark, Seattle, for the construction of a pumping plant with which to irrigate a 15,000 acre tract near Wahluke. The contract calls for an electrically driven pumping plant consisting of four units of 10,000 gallons per minute capacity each, or a total capacity of 40,000 gallons per minute.

N. W. Miller, Engineer formerly employed on construction of the North Bank Road, has reported to Gov. Hay that the plans prepared for the Fidalgo quarry by State Highway Commissioner H. L. Bowlby of Olympia, are correct. As a result Mr. Bowlby will continue in charge of installing the machinery at that quarry. This settles the dispute between the state board of control and the highway department as to which should have charge of the work.

The Oregon & Washington R. R., according to an announcement of J. D. Farrell, general manager, Seattle, has work started on the construction of a terminal yard and shops at Tacoma which will cost $1,000,000. The creation of the yards, cutting down the edge of the bluff and filling in the swamp, will necessitate the handling of about 700,000 cu. yds. of earth.

Advices from Ellensburg state that a rough estimate made by W. S. Gamble from the report submitted by Harry Riddell places the cost of improvements and construction of the proposed tunnel on the Cascade canal, about five miles west of Ellensburg, at a little less than $300,000. Mr. Gamble's estimate and Mr. Riddell's report were read Jan. 10 before

the annual meeting of the stockholders of the canal company, in the Chamber of Commerce at Ellensburg. The estimate for the construction of the tunnel also included the removal of about 150,000 yds. of dirt on the hill above the proposed tunnel for the purpose of straightening the channel of the canal. The tunnel as estimated by Mr. Gamble is to be 2 1-6 miles in length.

Surveyors for the North Coast Ry., with E. S. Clark, locating engineer, are running a line from Camas Prairie and Gilmer valley, twelve miles north of Husum, down Gilmer creek to the White Salmon river toward Husum. Another North Coast survey crew of 30 has already arrived at Klickitat river on the way from Toppenish to Camas Prairie.

C. A. Kilbourne, Seattle, Wash., the eastern representative of the Wagner Electric Manufacturing Co., which proposes the installation of a $600,000 water power plant on the Columbia river near Seattle, is reported to have stated that providing the project proves a success, other plants will be installed in the United States and hinted that the Mississippi river in Missouri would be a favorable location for such a plant.

Wisconsin Notes.

FROM CORRESPONDENTS AND OTHER SOURCES.

Right of way for the Maplehurst & Black River R. R. has been secured from a point at the junction of the Ladysmith branch of the Soo to Maplehurst, and construction work will be discontinued until March 1. According to a statement of an officer of the Saginaw Creek Lumber Co., which is building this road, the 15 miles will be completed and equipped by Jan. 1, 1911.

The Soo is stated to have acquired the Dalryample logging railroad, extending from Bayfield to within a few miles of Cornucopia, a distance of about 30 miles, and is said to be planning the line from Ashland to Superior via the logging road to Cornucopia and from the latter point to Superior by a new right of way which will soon be decided upon by the engineering department of the road. The new line, it is said, will follow the south shore of Lake Superior, touching at Port Wing, Orienta and other points along the lake which at the present time have no railroad facilities.

The common council of Sheboygan has passed an ordinance granting the Northwestern the right to construct a sidetrack in the Driving park addition in that city.

The Chicago & Northwestern Ry. has let a contract for cutting 20 miles of right of way through the Soo crossing north of the Wabeno branch, work to begin at once.

The stockholders of the Milwaukee Western Electric Ry. Co. have taken steps to amend its charter so as to permit of a 30 miles extension from Beaver Dam to Green Lake, in addition to the line from Milwaukee to Beaver Dam. The extension will take in Fox Lake, Markesan and Green Lake. The state railroad commission will be asked for a certificate of public necessity and convenience. It was also decided to increase capital stock from $200,000 to $1,000,000 and to ask permission for a bond issue to cover the stock.

The special committee of the city council of Milwaukee has approved the report of Isham Randolph, Consulting Engineer, Chicago, Ill., for the improvement of Jones Island, utilizing the present unoccupied frontage for dockage purposes. The committee approved the board of estimate's action authorizing a bond issue of $250,000 as a start on the Jones Island lock improvement. Assurance was expressed that the other funds would be forthcoming as the needs demand. Charles J. Poetsch is City Engineer of Milwaukee.

Frank Bainbridge, at present resident engneer of the Chicago & Northwestern Ry. at Clinton, Ia., has been placed in charge of the construction of the west end of the Milwaukee, Sparta & Northwestern Ry., the new Chicago & Northwestern line to connect Milwaukee and Sparta. As previously announced in this paper John R. Marsch, Chicago, Ill., has the contract for constructing the east end of the line. The Cleary-White Construction Co. has the sub-contract for the bridges on this section. Winston Bros. Co., Minneapolis, Minn., have the contract for the west half of the line.

Wyoming Notes.

FROM CORRESPONDENTS AND OTHER SOURCES.

The Union Pacific R. R., R. L. Huntley, chief engineer, Omaha, Neb., has filed plats in the U. S. land office at Cheyenne, Wyo., outlining the route from an extension of the company's Northport, Neb., line westward through Laramie and Albany counties to a connection with the main line at Medicine Bow, in Carbon County, Wyo. The route of the cutoff, as outlined on the plats, passes 60 miles north of Sidney, Neb., 85 miles north of Cheyenne and 20 miles north of Laramie. If the line is built, the construction of many tunnels will be necessary, the length of some of the contemplated bores being as follows: 15,500, 3,100, 800, 600 and 500 ft.

Canadian Notes.

FROM CORRESPONDENTS AND OTHER SOURCES.

It is expected that the dominion government will make an announcement shortly in reference to the proposed Hudson Bay railway and that construction work will start in the spring on that part of the proposed line from the Pass to Port Nelson. This line will, it is understood, be extended to Melville and make connection there with the Grand Trunk Pacific. A survey party is now at work in the district locating the line and a report is expected to be in the hands of the government at an early date.

Application has been made to the Canadian parliament by the Pacific and Northwestern Ry. Co. for incorporation, the project being to build a line from the vicinity of Chilkat Pass to the boundary of Yukon territory and Alaska, near the 63d parallel.

Wm. Mackenzie and D. D. Mann, president and vice president respectively of the Canadian Northern Ry. Co., are stated to have reached an agreement with the provincial government in connection with the contract for the construction of the line through British Columbia.

Phelan & Shirley of Omaha, Neb., who have an 80-mile contract on the G. T. P. west of the McLeod River, in Alberta, have started hauling in supplies. Six hundred men will be required to carry on the construction in April.

Orders for steel rails and other supplies for the construction of the Alberta & Great Waterways Ry. from Edmonton to Fort McMurray, are reported to have been placed with firms in Montreal and New York. The rails and supplies will be shipped to Edmonton early in the spring. The location of the first 50 miles of road has been completed, and the final location party to lay out the line from Lac La Biche to McMurray left Edmonton Jan. 11. The final location of the whole road will be completed by March. W. R. Clarke, Kansas City, Mo., is President and J. A. L. Waddell, Kansas City, Mo., is Chief Engineer.

Application is to be made to the Canadian parliament for a private act incorporating a railway company which intends building and operating a line to be known as the Howe Sound, Pemberton Valley & Northern Ry., and to amend the act of 1907 in respect to the company so styled.

Officials of the Canadian Pacific and the Minneapolis, St. Paul & Sault Ste. Marie Ry. Companies have decided to improve the old Wisconsin Central line, now known as the Chicago Division of the Soo. The line between Chicago and the Twin Cities will be shortened about 40 miles. The division between Menasha and Owen will be improved in order to make it capable of handling its traffic. Bonds for the improvements will be issued and all surplus earnings of the Wisconsin Central will be turned back into the property. Thomas Green, Minneapolis, Minn., is Chief Engineer of the Minneapolis, St. Paul & Sault Ste. Marie.

The Algoma Central & Hudson Bay Ry. Co., according to a statement reported to have been made by W. G. Franz, general manager, Sault Ste. Marie, Ont., will extend its line 200 miles northward to connect with the transcontinental line of the Canadian Pacific R. R., and surveys for the work are already under way.

The Pacific & Northwestern Ry. Co. is applying to the Canadian Parliament for incorporation, the project being to build a line from the vicinity of Chilkat Pass to the boundary of Yukon territory and Alaska, near the 63d parallel.

A traverse survey for the proposed line of the Canadian Northern Ry. through the Fraser river valley, between Hope, at the west slope of the Hope mountains, and New Westminster bridge, a trifle under 70 miles, has been completed and location work has been started. Further reductions in grades are expected after the completion of the location work. The maximum grade amounts to four-tenths of 1 per cent between Hope and a point farther down the valley, a distance of 14 miles, and even this grade occurs at only two or three places in two miles of that distance. The grade for the remainder of the route is virtually a river grade, equivalent to one-tenth of 1 per cent. Two small tunnels may have to be driven, one fifteen miles below Hope and the other at Sumas mountain. The river bank is followed nearly all the way down. The only exception is between Rosedale and Chilliwack, where the route has been located at a distance of about two miles from the Fraser. The entire line between Hope and the Yellowhead pass, via Kamloops, has been located with the exception of a stretch of 50 miles between Tete Jaune Cache and Yellowhead pass. Thomas H. White, Vancouver, B. C., is Chief Engineer.

Mexico Notes.

FROM CORRESPONDENTS AND OTHER SOURCES.

Bids were opened Jan. 11 by James M. Reid, chief engineer, National Railways of Mexico, Buenavista, Mexico, D. F., for the grading, tunnel and masonry work on the proposed line from Durango to Llano Grande, state of Durango, approximately 100 kilometers.

The Franco-British syndicate of Mexico which was recently organized for the purpose of building the Guadalajara and Chamela R. R. is making good progress with its preliminary plans. The concession granted by the Federal Government for the proposed line is very favorable.

The Mexican Federal Government has formally approved the recently completed survey for the proposed Teziutlan & Nautla R. R., and it is said that grading work will soon be started. Leopoldo Villarreal and Ernesto Zorrilla, City of Mexico, have the concession. The road will run from Teziutlan, State of Vera Cruz, to the port of Nautla, situated about midway between Vera Cruz and Tuxpam. The road will be 100 miles long and will penetrate a region of great natural resources, including extensive coal fields, mahogany and other hardwood timber, oil and other valuable products. It will also afford an outlet for the vanilla and coffee plantations of that part of Mexico. The road will connect with the interoceanic line at Teziutlan. The government has under consideration plans for the development of the harbor at Nautla, with the view of making that place one of the chief ports on the gulf coast. It will be brought as close to the City of Mexico as Vera Cruz when the road is finished. The only rough country that the road will traverse is between Teziutlan and Tialpacoyan, about twenty miles. The survey calls for a maximum grade of 3 per cent.

The Tehuantepec National R. R. Co. has decided to double track its 193 mile line from Salina Cruz, the Pacific port, to Puerto Mexico, the Atlantic port, and has adopted plans for the work. The road is now operated by the firm of S. Pearson & Son, contractors, City of Mexico. W. B. Ryan, Rincon Antonio, Oaxaca, Mex., is vice president and general manager of the company.

The Louisville & Nashville R. R. Co. has appropriated $654,000 for the new shops that will be erected at Boyles, near Birmingham. Construction on the plant will be started at once, the site being cleared off already. T. E. Brooks, Birmingham, Ala., is Superintendent.

BIDS ASKED.

Bids are asked on following work, the notes being arranged alphabetically by states:

Bridges.

Baltimore, Md.—Until 11 a. m., Feb. 2, by Board of Awards, City Register's Office, for the delivery of timber for repairs to Light street draw bridge. J. Barry Mahool is President of the Board.

Edina, Mo.—Until 2:30 p. m., Feb. 8, by County Clerk, for the construction of three bridges as follows: 60 ft. span on 16-ft. steel tubes filled with concrete; 48 ft. span, bedstead pattern with 14 ft. approach; 44 ft. span bedstead pattern. The first two structures are to be in Fabius Township and the latter in Salt River Township. E. M. Randolph is Highway Engineer.

Oxford, N. C.—Until March 7, by County Commissioners for the raising an 85 ft. steel span 16 ft. higher and for constructing two 75 ft. steel spans one on either end of the present bridge. James Osborn is County Engineer.

Niagara Falls, N. Y.—Until 7:30 p. m., Feb. 1, by Board of Public Works, for the construction of an old Fourth St. bridge over Gill Creek at East Falls St.

Pendleton, Ore.—Until Feb. 3, by County Court for the construction of four steel bridges as follows: Across the Walla Walla river at McCoy's ranch, length 110 ft.; across Dry creek at Blue Mountain station, length, 50 ft.; across Butter creek near the mouth of Butter creek, length 40 ft.; across the Walla Walla river at Milton, length 90 ft. Frank Saling is County Clerk.

Vancouver, Wash.—Until 10 a. m., March 1, by M. B. Kies, County Auditor, for the construction of a 200 ft. steel span and two concrete piers and also for the construction of a 1,100 ft. trestle work over the Washougal River between the towns of Camas and Washougal.

Buildings.

Bids are asked on following work, the notes being arranged alphabetically by states:

Denver, Colo.—Until 3 p. m., March 15 (extension of date from Dec. 29), by James Knox Taylor, Supervising Architect, Treasury Department, Washington, D. C., for the construction (including plumbing and drainage), of the U. S. Post Office and Court House at Denver, Colo.

Washington, D. C.—Until noon, Jan. 27, by the District Commissioners, for the construction of an engine house No. 23, on G St., between 21st and 22d St.

Americus, Ga.—Until 3 p. m., Jan. 26. by James Knox Taylor, Supervising Architect, Treasury Department, Washington, D. C., for supplying lighting fixtures for the U. S. public building to be used in the U. S. Building at Americus, Ga.

Athens, Ga.—Until 3 p. m., March 9, by James Knox Taylor, Supervising Architect, Treasury Department, Washington, D. C., for the extension, remodeling, etc. (including plumbing, gas piping, heating apparatus, electric wiring and conduits), of the U. S. Post Office and Court House at Athens, Ga.

Savannah, Ga.—Until Feb. 14, by J. deBruyn Kops, Architect, Savannah, Ga., for plaster and terra cotta work on the Cathedral of St. John the Baptist in Savannah.

Boise, Idaho.—Until 2:30 p. m., Feb. 17, by Constructing Quartermaster, for constructing, plumbing, hot air heating and electric wiring of a single set of Non-Commissioned Officers quarters, brick with slate roof, at Boise Barracks, Ida.

Grand Rapids, Minn.—Until 10 a. m., Feb. 5, by County Commissioners, for the construction of a county jail at Grand Rapids and for furnishing all necessary labor and material for the erection of cell work. M. A. Spang is County Auditor.

Sandstone, Minn.—Until 8 p. m., Feb. 7, by Harry Madison, Secretary of the School Board, for the construction and completion of a school building. Separate bids will be received for heating, plumbing and clock work.

Meridian, Miss.—Until 3 p. m., March 2 (extension of date from Feb. 8), by James Knox Taylor, Supervising Architect Treasury Department, Washington, D. C., for the extension, remodeling, etc. (including plumbing, gas piping, heating apparatus, electric conduits and wiring and standard clock system), of the U. S. Post Office and Court House at Meridian, Miss.

Broken Bow, Nebr.—Until 7 p. m., Feb. 7, by L. H. Jewett, Secy., for the construction of a high school building.

Goldsboro, N. C.—Until 3 p. m., Feb. 25 (extension of the date from Jan. 31) by James Knox Taylor, Supervising Architect, Treasury Department, Washington, D. C., for the construction (including plumbing, gas piping, heating apparatus, electric conduits and wiring) of the extension to the U. S. Post Office at Goldsboro, N. C.

Eugene, Ore.—Until 3 p. m., Feb. 10, by James Knox Taylor, Supervising Architect, Treasury Department, Washington, for the supply of lighting fixtures for the U. S. Public Building at Eugene, Ore.

Pawtucket, R. I.—Until 3 p. m., Feb. 21 (extension of date from Jan. 25), by James Knox Taylor, Supervising Architect, Treasury Department, Washington, D. C., for the extension, remodeling, etc. (including plumbing, gas piping, heating apparatus, electric conduits and wiring) of the U. S. Post Office at Pawtucket, R. I.

Lead, S. Dak.—Until 3 p. m., March 4 (extension of time from Feb. 4), by James Knox Taylor, Supervising Architect, Treasury Department, Washington, D. C., for the construction complete of the U. S. Post Office building at Lead, S. Dak.

Lynchburg, Va.—Until 3 p. m., March 3 (extension of date from Feb. 10), by James Knox Taylor, Supervising Architect, Treasury Department, Washington, D. C., for the construction of an extension, etc., except elevator (including plumbing, gas piping, heating apparatus, electric conduits and wiring and standard clock system), at the U. S. Post Office and Court House at Lynchburg, Va.

Madison, Wis.—Until noon, March 15, by Lew F. Porter, Secretary Capitol Commission, for the following branches of work for the finishing of the South Wing and South East and South West corner pavilions of the capitol building: carpenter work; mason work; stone and marble work; plumbing work; interior iron and metal work; elevators; ornamental glass work.

Milwaukee, Wis.—Until 4 p. m., Jan. 29, by Board of School Directors, Milwaukee, Wis., for furnishing all materials and labor necessary for the construction of a new school building on the north side of Scott St., between 25th and 26th Aves., in the 23d Ward.

Sheridan, Wyo.—Until 3 p. m., Feb. 10, by James Knox Taylor, Supervising Architect, Treasury Department, Washington, D. C., for supplying light fixtures for the U. S. Public Building in Sheridan, Wyo.

Winnipeg, Man.—Until Feb. 15, by M. Peterson, Secretary Board of Control, for the erection of the power terminal station at Winnipeg.

Toronto, Ont.—Until noon, Feb. 1, by H. F. McNaughten, Secretary Public Works, for the completion of the court house at Kenora. J. O. Reaume, Minister of Public Works, Department of Public Works, Ontario.

Monterrey, Mex.—Until Feb. 1, by Alfred Giles, Architect, San Antonio, Tex., for the construction of a reinforced concrete building for Edo. Bremer y Cia, Sucs. Monterrey, Mex.

Roads and Streets.

Bids are asked on following work, the notes being arranged alphabetically by states:

Collinsville, Ill.—Until Feb. 2, by Board of Local Improvements of tnis city for the construction of paving district No. 2, which includes about 10,000 sq. yds. of brick paving on 4-in. concrete foundation, and 5,000 ft. of natural stone curbing. The estimated cost of the work is $23,400. A. C. Powell, Collinsville, Ill., is Engineer.

Cherryvale, Kan.—Until 4 p. m., Feb. 7, by City Clerk, for about ½ mile of concrete curb and 1,500 yds. of brick pavement on cinder or gravel foundation. E. E. Bellamy is City Clerk.

Kirksville, Mo.—Until Feb. 7, by J. C. Carothers, City Clerk, for 6,000 sq. yds. of brick paving on five ins. of concrete base and 4,500 lin. ft. of concrete curb and gutter. Official advertisement will be found elsewhere in this issue.

St. Paul, Minn.—Until 10 a. m., Feb. 7, by Board of County Commissioners, for the following road improvements in Ramsey County: Grading and improving Manomin road from the Centerville road west to the Rice Street Cutoff; grading, claying and graveling the New Brighton road from the Long Lake road north and west to Station 35, to the south end of the gravel road; grading, claying and graveling Rice St. road from the Manomin road north and west to the Turtle Lake road; grading and macadamizing the Centerville road from the Manomin road north to the Anoka county line; grading and macadamizing the Lexington Ave. from the Manomin road north to the Turtle Lake road. Edward G. Krahmer is County Auditor.

Oxford, N. C.—Until March 7, by County Commissioners, R. W. Lassiter, Chairman, for the construction of 20 miles of county road. The work will include about 3,000 cu. yds. to the mile and vitrified pipe culverts.

Sewers.

Bids are asked on following work, the notes being arranged alphabetically by states:

Hebron, Neb.—Until Feb. 18 (readvertisement of bids called Jan. 12), by O. P. Hess, City Clerk for the construction of lateral sewers in Sanitary District No. 1, the work including 13,000 ft. 8-in. vitrified clay pipe, 12 flush tanks, 25 manholes, etc. C. H. Meeker, McCook, Neb., is engineer.

Hebron, Neb.—Until Feb. 18 (readvertisement of bids called Jan. 12), by O. P. Hess, City Clerk, for labor and material for the construction of a main and outlet sewer. The work includes 1,300 ft. of 15-in. vitrified clay pipe; 1,750 ft. of 10-in. vitrified clay pipe, etc. C. H. Meeker, McCook, Neb., is Engineer.

Washington, N. J.—Until noon, Feb. 14, by A. J. Craft, Borough Clerk, for furnishing all necessary labor and material for the construction of about 8 miles of vitrified pipe sewers from 8 to 18-in. in size, with Y branches, flush tanks, manholes and other appurtenances. Also for the construction of a sewerage disposal works, including piping, grading, etc. Charles B. Smith is Mayor. Official advertisement will be found elsewhere in this issue.

Niagara Falls, N. Y.—Until 7:30 p. m., Feb. 1, by Board of Public Works, for furnishing of material and construction of the following sewers: A tunnel trunk sewer in Cleveland Ave., from River Bank to Tenth St.; A sewer in Tenth St., between East Falls St. and Erie Ave.; a sewer in Portage Road, between Cedar Ave. and Buffalo Ave. Thomas H. Hogan is City Clerk, and R. A. McClanathan is City Engineer.

Louisville, O.—Until noon, Feb. 7, by Harry L. Rebrassier, Village Clerk, for furnishing all necessary labor and material for the construction of sewers and sewage disposal works. F. E. Myers, Canton, O., is Engineer.

El Paso, Tex.—Until March 3, (extension of time from Feb. 3,) by City Council for the construction of sewers and garbage disposal plant. Percy McGhee is City Clerk. Official advertisement will be found elsewhere in this issue.

Toronto, Ont.—Until Feb. 8, by G. R. Geary, Chairman Board of Control, for the construction of feeder conduit runs and manhole at Terminal Station.

Water Supply.

Bids are asked on following work, the notes being arranged alphabetically by states:

Haswell, Colo.—Well.—Until noon, Feb. 26, by Charles W. Comstock, State Engineer, Denver, Colo., for sinking an artesian well near Haswell, Colo. Official advertisement will be found elsewhere in this issue.

Cortez, Colo.—Well.—Until noon, Feb. 26, by Charles W. Comstock, State Engineer, Denver, Colo., for sinking an artesian well at or near Cortez. All proposals must be accompanied by a $200 certified check. Official advertisement will be found elsewhere in this issue.

Erie, Kan.—Until 3 p. m., Feb. 17, by City Council for the construction of a water works system, electric lighting plant and sewers. Burns & McDonnell, 804-23 Scarritt Bldg., Kansas City, Mo., are the Engineers.

Burlington, Ia.—Until 2 p. m., Feb. 17, (extension of time from Feb. 2) for furnishing necessary labor and material for the construction of a pumping station. Official advertisement will be found elsewhere in this issue.

Hebron, Neb.—Until Feb. 18 (readvertisement of bids called Jan. 12), by O. P. Hess, City Clerk, for the construction of improvements, extension and enlargement of the city water works system. C. H. Meeker, McCook, Neb., is Engineer.

Fort Robinson, Nebr.—Until 11 a. m., Feb. 19, by Capt. Malvern Hill Barnum, Constructing Quartermaster, Fort Robinson, Nebr., for furnishing all necessary labor and material for the addition to and repairing pump house, new boilers, new pump, etc., at Fort Robinson, Nebr. Official advertisement will be found elsewhere in this issue.

Dallas, Tex.—Reservoir.—Until 3 p. m., Feb. 16, by City Commissioners, for the construction of the White Rock Reservoir. The work includes a dam, pumping station, conduits and suction wells. Plans and specifications were prepared for the work by J. M. Preston, City Engineer. Work is also noted under Confirmed Reports.

Fort Mackenzie, Wyo.—Reservoir Lining.—Until 2 p. m., Feb. 14, by Constructing Quartermaster, for lining with waterproofing felt and vitrified brick a million gallon concrete reservoir near this post.

Miscellaneous.

Bids are asked on following work, the notes being arranged alphabetically by states:

Washington, D. C.—Light Vessel.—Until 2 p. m., Feb. 10, by Light House Board, Washington, D. C., for furnishing material and labor for the construction, equipment and delivery of a single screw, wood steam light house tender, Woodbine.

North Chicago, Ill.—Coal Handling Plant.—Until noon, Feb. 15, by Bureau of Navigation, Navy Department, Washington, D. C., for the construction of a coal crushing plant and an ash handling plant at the Naval Training Station, Great Lakes, North Chicago, Ill.

Kirksville, Mo.—Bonds.—Until 7 p. m., Feb. 7, by J. C. Carothers, City Clerk, for $10,000 of bonds.

Red Bank, N. J.—Bell Tower.—Until 4:30 p. m., Feb. 7, by W. A. Shoemaker, Architect, Red Bank, N. J., for the construction of a 65-ft. bell tower for the borough of Red Bank, N. J.

Blauvelt, N. Y.—State Rifle Range.—Until noon, Feb. 10, by State Board of Armory Commissioners, Albany, N. Y., for the construction, grading, telephones and scorers' desks for the New York State Rifle Range.

Madison, Wis.—Terrace Wall.—Until noon, March 15, by Lew F. Porter, Secretary of Capi-

tol Commission, for furnishing all necessary labor and material for the construction of a Terrace Wall of reinforced concrete about the North, South and East wings of the capitol now under construction.

Excavation, Earth and Rock.

Bids are asked on following work, the notes being arranged alphabetically by states:

Woodson, Ark.—Levee.—Until 10 a. m., Feb. 9, by Board of Directors, Woodson Levee District, at the office of Lund & Hill, 201½ W. Second St., Little Rock, Ark., for the following work: 9 miles levee including 165,700 cu. yds.; 8 culverts; 8 gates; flood gate, reinforced concrete. The work is estimated to cost $45,000. Work is also noted under Confirmed Reports.

Smartsville, Cal.—Ditch Work.—Until Feb. 5, by The Tarr Mining Co., Smartsville, Cal., for the excavation of the ditch of the Tarr Mining Co. Work is also noted under Confirmed Reports.

Colorado Springs, Colo.—Earthwork, Dam and Canal.—Until noon, Feb. 21, by Costilla Development Co., 56 Bank Bldg., Colorado Springs, Colo., for the construction as a whole or separately in Costilla County, Colorado, of the following: Sanchez Dam, about 500,000 cu. yds. earth work; Sanchez Dike, about 250,000 cu. yds. of earth work; Culebra-Sanchez Canal, about 250,000 cu. yds. earthwork; necessary controlling works and about 15,000 of rock excavation. Work is also noted under Confirmed Reports and an official advertisement will be found elsewhere in this issue.

Chicago, Ill.—Dredging.—Until 10 a. m., Feb. 23, by Maj. Thomas H. Rees, U. S. Engineers, Chicago, Ill., for dredging and rock excavation in the Chicago River, Ill. Official advertisement will be found elsewhere in this issue.

Anderson, Ind.—Until 10 a. m., Feb. 12, by County Surveyor, for the construction of an open ditch, including 4,826 cu. yds. of excavation. The cost of the work is estimated at $1,300.

Marksville, La.—Levee.—Until Feb. 1, by the Board of Commissioners of Red River and Bayou des Glaizes Levee and Drainage District, Marksville, La., for the construction of Davids Ferry South No. 2 Levee; Red River Right Bank; length of line, four miles; including 350,000 cu. yds. of material. A. E. Gremillon is Secretary of the Board. Work is also noted under Confirmed Reports.

Albany, N. Y.—Erie Canal Work.—Until noon, Feb. 16, by F. C. Stevens, Superintendent State Public Works, for Contract No. 48 Erie Canal, Sec. 8, including the construction of the canal from a point about 500 ft. east of Yellow Mills bridge to Wayne-Monroe county line 6.18 miles in length; for Contract No. 75. Secs. 9 and 10, including the construction of a guard gate superstructure as follows: About 1.3 miles east of Spencerport, near west line of Brockport, 1.5 miles east of Middleport.

Charleston, S. C.—Drain.—Until 11 a. m., Feb. 19, by Bureau of Yards and Docks, R. C. Holliday, Chief, Navy Department, Washington, D. C., for the construction of an intercepting drain at the navy yard in Charleston, S. C.

Tacoma, Wash.—Power Plant Tunnels.—Until Feb. 21, by H. J. McGregor, Commissioner of Public Works, for the construction of a tunnel for the municipal power plant at LaGrande on the Nisqually River. The tunnel will be 8 ft. in diameter and 10,000 ft. in length.

Materials, Machines, Supplies, Etc.

Bids are asked on following work, the notes being arranged alphabetically by states:

Washington, D. C.—Motor Repairs.—Until Jan. 29, by Capt. F. C. Boggs, General Purchasing Officer, Isthmian Canal Commission, Washington, D. C., for furnishing repairs for motor cars.

Washington, D. C.—Lumber.—Until Jan. 27, by Capt. F. C. Boggs, General Purchasing Officer, Isthmian Canal Commission, for furnishing 25,000 ft. of lumber, 4x4 S4S, 35,000 ft. of 4x12 S4S, and 50,000 ft. 12x12 rough. The material to be long leaf yellow pine or Douglas fir.

Washington, D. C.—Black Powder, Boilers, Rubber Belting, Etc.—Until 10:30, Feb. 4, by Capt. F. C. Boggs, General Purchasing Officer, Isthmian Canal Commission, Washington, D. C., for black powder, electric blue printing machine, vertical fire tube boilers, horizontal tension carriage, idler wheels, rubber belting, valves, pipe fittings, machinists' taps, pipe cutting and threading machine, steel filing cabinets, etc.

Chicago, Ill.—Transformer.—Until noon, Jan. 26, by Sanitary District of Chicago, I. J. Bryan, Clerk, for furnishing testing transformer and oil circuit breaker switches.

Columbus, O.—Power Equipment.—Until noon, Feb. 11, by the Board of Managers of the Ohio State Penitentiary for power equipment as follows: Two direct connected exciter units consisting of 75 h. p., simple horizontal automatic high speed engines, and 50 K. W., 125-volt direct current generator. George U. Marvin is Secretary.

CONTRACTS LET.

The following contracts have been let recently:

BRIDGES.

Russellville, Ala.—Bridge.—Joliet Bridge and Iron Works, Joliet, Ill., for the erection of a steel bridge across the head waters of Little Bear creek, in the southwest corner of the county.

Downieville, Cal.—Bridge.—George Grant, Quincy, for the erection of the new steel bridge across Canyon Creek between Plumas and Sierra counties.

Stockton, Cal.—Bridges.—M. B. White, Stockton, Cal., at $5,360, for the construction of the Mowry Ferry bridge, to be a 2-span pony truss, each span 75 ft. Western Bridge and Construction Co., Charles Ross, agent, Sacramento, Cal., at $11,060, for the construction of a bridge having 4 spans, pony truss, each span 70 ft. Both bridges are to have concrete abutments and steel tube piers. Bids were opened Jan. 3.

Buckley, Ill.—Bridge.—Joseph Klein, Freeburg, Ill., at $1,915, for the construction of the Kaufmann bridge on the line between Loda and Artesia townships.

Indianapolis, Ind.—Bridge.—American Construction Co., at $4,400, for the erection of a bridge over Pogues run at Commerce Ave. Bids were opened Jan. 14.

Stirlingville, Mich.—Bridge.—A. Y. Bayne & Co., Minneapolis, Minn., at $1,830, for the construction of a bridge across the Munoskong River at this place.

Bemidji, Minn.—Bridges.—Barabau & Hickcox, Minneapolis, Minn., for building bridges and culverts along the Moose Lake-Plummer line of the Soo railway.

Elmira, N. Y.—Bridge. — Lane Bridge Co., Painted Post, N. Y., is reported to have received the contract for furnishing the structural iron work to be used in repairing the hospital building at the reformatory in this city and Notebook.

Cincinnati, O.—Bridge.—F. J. P. Brackett, at $3,187, for the construction of a bridge over Bloody Run at Beech St., near Spring Grove Ave., Millcreek Township. Bids were opened Jan. 14.

Woonsocket, R. I.—Bridge.—J. C. Napoleon Bouvier, at $5,350, for the building of the bridge over the Blackstone River from a street running from River St. to the river. The bridge will be 100 ft. long and 25 ft. wide, and will be of wood with concrete abutments. A sidewalk will be constructed on one side of the bridge.

Nashville, Tenn.—Bridges.—Following contracts were awarded to the Joliet Bridge and Iron Works, Joliet, Ill., for the construction of five bridges: Cassatot bridge, $3,333; Saline bridge, $1,399; Mine Creek bridge, at $645; Brushy Creek bridge, at $476; Plum Creek bridge, $475.

ROADS AND STREETS.

San Diego, Cal.—Paving.—Fairchild-Gilmore-Wilton Co., at $.16.3 per sq. ft. or $1,896, for paving Union St., and at $.16.4 per sq. ft. or $2,293, for paving Front St. The paving on Union St. will cover 11,631.5 sq. ft., and on Front St. 14,060 sq. ft.

Palatka, Fla.—Road.—J. R. Emmerson, Gainesville, Fla, for the construction of a hard road 6 miles long from Palatka to Rice Creek. Bids were opened Jan. 6.

East St. Louis, Ill.—Paving.—Myers Construction Co., at $16,300, for the construction of pavement on 25th St.

Lake Forest, Ill.—Paving.—Edward M. Laing, Park Ave., Highland Park, Ill., at $12,699, for the following street improvements on Illinois Ave.: 4,400 cu. yds. excavation; 5,300 lin. ft. 6-in. drain tile; 2,300 lin. ft. 4-in. drain tile; 800 lin. ft. 8-in. drain tile; 200 lin. ft. 10-in. drain tile; 150 lin. ft. No. 2 sewer pipe; 30 catch basins; 50 cu. yds. masonry end walls; 25 lin. ft. masonry; 9,150 sq. ft. macadam; 9,000 ft. sod edge. Bids were opened Jan. 12.

Moline, Ill.—Sidewalks.—Anton Swenson of this city, at $4,790, for laying sidewalks in the city.

Springfield, Ill.—Paving.—Richard Egan, for the construction of pavement on College St., between South Grand Ave. and Laurel St., at $1.48 per sq. yd. for brick pavement and $.47 per ft. for curbing. Asphalt filler will be used.

Urbana, Ill.—Paving.—George E. Peter, Sycamore, at $6,450, for the construction of pavement on South Goodwin Ave., from Green St., to Nevada St.

Ishpeming, Mich.—Road.—Gust Fredin, at $4,240, for the construction of a little less than two miles of road north from the Michigamme River to the county line near Witch Lake. The contract includes the removal of the timber and the grading to a certain width.

Oxford, N. C.—Roads.—T. W. Chandler & Co., Virgilina, Va., for the construction of 11 miles of county road in Granville county.

Atlantic City, N. J.—Paving.—Bryant Reilley, at $196,000, for paving the Shore road, between Absecon and Somers' Point. The specifications call for an 8-in. macadam foundation and 4 ins. of amesite.

Gainesville, Tex.—Roads.—J. W. Maxey Engineering Co., Houston, Tex., at $100,000, for the construction of good roads in Precinct No. 1.

SEWERS AND WATER SUPPLY

Winslow, Ariz.—Sewer System.—American Light & Water Co., Kansas City, Mo., at $36,940, for the construction of a sewer system.

San Francisco, Cal.—Sewer.—Robert C. Storrie & Co., Fort Worth, Tex., at $168,700, is reported to have received the contract for the construction of the Hunter's Point sewer.

San Francisco, Cal.—Sewer.—Metropolis Construction Co., at $58,937, for the construction of the sewer in Fulton St., from 20th to 45th Aves.

Quincy, Fla.—Sewer System.—Sullivan & Long, Bessemer, Ala., at $18,994, for the construction of a sewer system in this city. The work includes 7½ miles of pipe sewers, 72 manholes, 20 flush tanks and one septic tank. Bids were opened Jan. 12.

Collinsville, Ill.—Sewers.—A. W. Eisenmeyer, at $15,300, for the construction of the improvement of Sanitary Sewer District No. 2, including septic tank, and the following approximate quantities: 10,727 lin. ft. of 8-in. vitrified pipe sewer, 4,017 lin. ft. of 10-in. vitrified pipe sewer, 1,379 lin. ft. of 12-in. vitrified pipe sewer, 120 lin. ft. of 12-in. standard cast iron pipe sewer, 36 brick manholes, 16 flush tanks, 10 vitrified pipe lampholes, 210 cu. yds. of concrete. Bids were opened Jan. 15.

Moline, Ill.—Water Mains & Sewers.— E. R. Harding, Racine, Wis., at $25,800, for laying water mains, and at $27,150, for the construction of sewers.

Rock Island, Ill.—Filter Plant.—Pittsburg Manufacturing Co., at $16,000, for the construction of the new 6,000,000 gal. filter plant.

Rock Island, Ill.—Sewer.—Pete Trenkenschuh, for the construction of the sewer on 14th Ave., between Sixth and Seventh Sts.

Indianapolis, Ind.—Sewer.—John E. Sullivan, at $1.73 per lin. ft., or $35,000, for the construction of the Parkway boulevard sewer. The work includes a main sewer in Parkway boulevard, from 18th to 30th St., with laterals in several cross streets.

Holton, Kan.—Sewer System, Disposal Plant. —Bids were opened Jan. 12, by this city, Wm. C. Bryant, Engineer, for constructing a sewer system and disposal plant, the contract being let to S. M. Kerns, Denver, Colo., at $41,366. The itemized bids received on this work were as follows:

	Disposal Plant.	Drop M. H.	Flush M. H.	Tanks.	C. I. Pipe.	Vit. 12″	Sewer 10″	Pipe 8″	Total.
P. A. Johnson & Co., Kansas City, Kans.	$12,750	$30	$40	$60	1.75 12″ 1.25 10″	.60	.50	.40	$53,753
General Constr. Co., Bartlesville, Okla.	10,000	33	35	59	1.75 1.35 10″	.75	.69	.50	51,839
G. O. Skilbred, St. Joseph, Mo.	.....	30	45	75	4.00 3.00	.64	.60	.59	43,776
Land Construction Co., St. Joseph, Mo.	10,450	48	58	75	1.45 1.25	.78	.69	.45	53,926
Meredith & Erler, Terre Haute, Ind.	12,447	28.50	38	65	4.50 4.00	.61	.48	.48	51,887
McKay & Cothroe, Omaha, Nebr.	7,300	54	75	85	2.50 2.00	.89	.79	.56	62,974
McGuire & Stanton, Leavenworth, Kans.	8,858	30	32	70	2.50 2.00	.67	.61	.50	49,843
R. J. & W. M. Boyd Constr. Co., Kansas City, Kans.	10,500	40	45	70	5.00 5.00	.93	.87	.55	57,388
W. H. Harris, Terre Haute, Ind.	11,500	3	10	60	1.00 .75	.87	.82	.52	57,756
D. T. Johnson Co., Kansas City, Mo.	12,000	27	42	60	2.70 1.92	.70	.65	.50	55,545
S. M. Kerns, Denver, Colo.	7,235	30	34	60	1.75 1.25	.60	.50	.40	41,366
H. C. Gass, Belleville, Ill.	8,500	35	50	70	2.00 1.50	.90	.86	.55	55,066
J. W. Smith & Son, Webb City, Mo.	5,000	25	30	60	2.00 1.50	.65	.60	.50	45,056
Reed & Tripp Co., Clay Center, Kans.	9,450	40	45	75	Lump bid.				64,799
H. E. Maynard, Kansas City, Mo.	12,400								
Hartman Bridge Constr. Co., St. Joseph, Mo.	6,830								

Plaquemine, La.—Water Plant.—T. W. McDonald of Casey & Hedges' Boiler Works, Chattanooga, Tenn., for the construction of a new water works plant, consisting of two 80-horsepower boilers and a 50,000-gal. steel tower and tank, the tower to be ninety ft. high.

Muskegon, Mich.—Sewers.—Northern Construction Co., Elkhart, Ind., at $45,000, for the construction of eight miles of sewer in this city.

Saginaw, Mich.—Sewer.—W. N. Sager, at $8,622, for the construction of the Ellsworth St. sewer.

Gloversville, N. Y.—Sewage Disposal Plant.—A. L. Willey, Binghamton, N. Y., at $200,000, for the construction of a sewage disposal plant at this city.

Alliance, O.—Sewer.—In our issue of Jan. 12 we stated that the contract for constructing two miles of pipe sewer for this city had been let on 20, 24 and 30-in. vitrified pipe. This was incorrect, as the 30-in. pipe sewer, the largest item, was awarded on reinforced concrete pipe of the type of the Reinforced Concrete Pipe Co. of Jackson, Mich.

Sapulpa, Okla.—Sewer.—Summers & Stone, Oklahoma City, Okla., at $44,718, for furnishing all labor and materials for the construction of brick trunk sewer in this city. The work includes the following approximate quantities: 10,800 cu. yds. excavation, 1,100 ft. of 42-in. two ring brick sewer, 9,700 ft. of 66-in. two ring brick sewer, 850 ft. of 69-in. two ring brick sewer, 670 ft. of 78-in. three ring brick sewer, 600 ft. of 84-in. three ring brick sewer, 11 manholes and 9 inlets, 300 ft. of 24-in. vitrified sewer pipe, 52 yds. of concrete. Bids were opened Jan. 10.

Brownsville, Tex.—Sewer System.—N. E. Rendall, Brownsville, and P. D. Haley, Harlington, at $28,747, for the installation of a sewer system.

EXCAVATION, MISCELLANEOUS, MATERIALS.

San Francisco, Cal.—Police Station.—Board of Public Works awarded the following contracts: E. W. Elliott, at $38,396, for the construction of the Ingleside police station; William S. Snook & Son, at $2,976, for plumbing work in the Park police station, and at $3,095, in the Ingleside police station.

Jeffersonville, Ind.—Lumber.—E. W. Bartley, Racine, Wis., for furnishing the office of quartermaster with lumber as follows: 3,000 ft. ash, at $355; 10,000 ft. poplar, at $925. Delivery is to be made at Seattle, Wash.

Omaha, Neb.—Shutters.—Omaha Safe and Iron Works, at $1,160, for putting 38 fireproof shutters on the city hall.

Pittsburg, Pa.—Fixtures.—F. K. Montgomery at $5,000, by M. H. Dickinson, architect, Renshaw Bldg., Pittsburg, for the installation of the store fixtures and other alterations to the building at 418 Wood St., for the Union Electric Co.

Fort Sam Houston, Tex.—Sink, Pipe, Etc.—Following contracts were awarded by Capt. Fred H. Gallup, at the office of the Constructing Quartermaster: Federal-Huber Co., Chicago, Ill., at $453, for furnishing 6 kitchen sinks, type H-4; four type H-5; William G. Schuesirth & Co., San Antonio, Tex., at $6.40, for furnishing 8 brass ferrules; Jas. B. Clow & Sons, Chicago, Ill., at $20, for furnishing 24 ft. 2-in. lead pipe; 24 ft. of 1½-in. lead pipe; 20 lbs. metal wiping. Bids were opened Jan. 10.

Orange, Tex.—Foundation.—T. W. Ellis West Orange, for the cement foundation work for the electric power plant of the Yellow Pine Paper Mill Co., to be constructed in the southern part of the city between the two saw mills of the Lutcher & Moore Lumber Co.

Richmond, Va.—Electric Transmission Line.—Carolina Electrical Co., Raleigh, N. C., at $8,995, for furnishing all materials and labor for the construction of an electric transmission line. Bids were opened Jan. 17.

Aberdeen, Wash.—Water Pipe and Fittings.—The Crane Co., at $35 per ton for pipe, and $.03½ for fittings, for furnishing the following f. o. b. Aberdeen, Wash.: 250 lengths of Class C, 10-in. diameter cast-iron pipe; 12 lengths of Class C, 6-in. diameter cast-iron pipe; 2 10-in. cast tees; 1 10-in. by 8-in. cast tee; 6 10-in. by 6-in. cast tees; 3 10-in. non-rising steam hub end gate valves; 6 6-in. non-rising steam hub end gate valves; 6 6-in. ells hub and spigot ends; 200 lbs. first quality oakum; 5,000 lbs. pig lead. Bids were opened Jan. 5.

Dodgeville, Wis.—Cypress & Steel Tanks.—Following bids were received on cypress and steel tanks for this city: Cypress tank, 22'x24', Wendnagel & Co., Chicago, Ill., $1,950; Flint & Walling Mfg. Co., Kendallville, Ind., $1,450; Olson Bros., Chicago, $2,350; Minnesota Tank Co., Minneapolis, $2,000; American Tower & Tank Co., Elgin, Ill., $1,900. (A) Steel tank flat bottom, 22'x24', and steel tank 16'x35', hemispherical bottom (B). S. Freeman & Sons, Racine, Wis., A—$3,700, B—$3,000; Optenberg Iron Works, Sheboygan, Wis., A—$2,885, B—$2,838; Chicago Bridge & Iron Works, Chicago, A—$2,800, B—$3,290; Kennicott Water Softener Co. (awarded contract), Chicago Heights, A—$2,051, B—$1,738; The Canton Boiler & Engine Co., Canton, O., A—$2,721, B—$2,510.

Winnipeg, Man.—Wire, Gates, Posts.—Following contracts have been awarded for furnishing wire fence, posts and gates for fencing the Power Transmission line between Winnipeg and the Brokenhead River: Canadian Steel and Wire Co., Winnipeg, at $3,348, for wire fence and gates; Messrs. Weatherby & Eklund, Winnipeg, at $3,399, for cedar posts.

Hull, Que.—Pumps.—The William Hamilton Co., Ltd., at $14,850, for the construction of one set of Duplex and Triplex Power pumps, capacity 6,000,000 U. S. gals. per day, and turbine wheels for the operation of same. Bids were opened Jan. 12.

PROJECTED WORK.

Bridges.

Items Arranged Alphabetically by States.

Los Angeles, Cal.—City Council Committee is taking up the matter of constructing a viaduct over the Pacific Electric System on Mission road at Rosehill, and at the next meeting will recommend that the Board of Public Works make an estimate of the necessary expense. It is believed that $80,000 will be sufficient for the improvement, and that the electric railway company will share one-half the cost.

Woodland, Cal.—Board of Supervisors have under consideration the new contract submitted by the railroad company in relation to the combination bridge proposed to be constructed between Sacramento and Washington.

Montrose, Colo.—County Commissioners have decided to construct immediately a bridge over the Dolores River at Bed Rock to replace the one recently washed out by high water. The new structure will be about 125 ft. long and will cost about $4,000.

Washington, D. C.—District Commissioners have applied to Congress for an appropriation of $12,000 for repairing and strengthening the highway bridge across Rock Creek at Calvert St. The street railway using the structure will supply a like sum.

Savannah, Ga.—County Commissioners have adopted the plans of W. F. Brown, County Engineer, for the construction of a steel bridge across the Herb River on LaRoche Ave., above the Isle of Hope. The structure will be 108 ft. in length consisting of 6 panels with an 18-ft. roadway paved with 6-in. reinforced concrete and 5 ins. of macadam. The supports of the bridge will be reinforced concrete piers and the estimated cost of the work is $7,000.

Couer d'Alene, Idaho.—A delegation of property owners of Roselake, Ida., have petitioned the county commissioners for a bridge across the Coeur d'Alene River at Roselake.

Cambridge, Ill.—Board of County Supervisors have decided to take up the matter with the Board of Supervisors of Rock Island county of constructing a bridge across the Rock River at Colona. It is expected that an agreement will be made soon between the two boards.

Fisher, Ill.—Commissioners of East Bend and Condit Townships have taken up the matter with the County Commissioners to construct a new bridge over the Sangamon River at Newcomb Ford. The structure is estimated to cost $5,000, of which the county will pay one-half.

Jacksonville, Ill.—T. S. Davy, Chief Engineer of the Springfield-Jacksonville Traction Co., has decided to construct 17 bridges along the road which is now under construction. The structures will range from 100 to 500 ft. in length.

Moline, Ill.—Bill has been introduced into the House of Representatives asking for a charter for a new bridge between Bettendorf and Moline, Ill., for Edward VanPatten, Davenport, Ia. The structure will cost $1,000,000 and is planned to be about 1 mile long and constructed for the use of pedestrians and railway traffic.

Indianapolis, Ind.—Paul Julian, County Surveyor has recommended to the county commissioners that bridges costing $400,000 be erected this year. Among the bridges recommended are the following: Over Fall Creek at Delaware St., estimated at $100,000; over White River at New York St., estimated at $200,000; over Little Eagle Creek at Washington St., at $30,000.

Manhattan, Kan.—Board of Blue Township have called a special election for the purpose of voting bonds for the construction of a permanent wagon bridge across the new blue channel about 2 miles east of Manhattan, Kan.

Louisville, Ky.—The Kentucky & Indiana Bridge Co. is considering the reconstruction of the bridge at 32d St., linking the shores of Kentucky and Indiana on the Ohio River. Alexander P. Humphrey is Attorney for the company.

Shreveport, La.—City Council has passed an ordinance providing for the construction of a free bridge across Red River between Shreveport and Bossier Parish to cost about $200,000.

Millsdale, Mich.—Village Council and Township Board have adopted the plans submitted by the committee for the construction of a steel bridge with a cement foundation, and it was voted to appropriate $3,500 for the work.

Halstad, Minn.—Committees have been appointed to take charge of the matter of constructing a bridge across the Red River at this place. C. L. Sulerud is a member of the finance committee.

Minneapolis, Minn.—Bill has been submitted to Congress Committee authorizing the construction of bridges over the river at Third and Twentieth Aves., South. The estimated cost of the structures as planned will be $400,000 and $200,000, respectively.

Greenwood, Miss.—Board of Supervisors of Leflore county have authorized the County Treasurer, W. T. Chapman, to advertise for sale county bridge bonds for the purpose of constructing two steel bridges, one across the Yazoo River at a point near Shell Bluff, Miss., and one across the Tallahatchie River near Money.

Omaha, Neb.—Douglas County Commissioners have decided to spend about $50,000 for the construction and maintenance of county bridges.

Rochester, N. Y.—City Council is to pass upon the ordinance providing for the construction of a new bridge over the river at Central Ave. The proposed plans for the work involve the construction of a bridge of reinforced concrete 66 ft. wide to conform with the width of the street.

Cincinnati, O.—Preliminary work for the construction of the proposed Gilbert Ave. viaduct will be commenced early in the Spring. Bond issues for $540,000 have been provided by the Council for acquiring the land and constructing the viaduct.

Lima, O.—The question of constructing a viaduct over the C. H. & D., the Lake Erie & Western and the C. & E. tracks at South Main St. has been revived and steps are being taken to call a meeting of all parties who would be directly benefited by such an improvement.

Astoria, Ore.—County Court has been petitioned to construct a bridge across the Nehalem River between Jewell and Elsie. Surveys are to be made and estimates of the cost secured before action will be taken.

Portland, Ore.—A bill was introduced by Senator Heyburn Jan. 10, authorizing the construction of a bridge across the Kootenay River by the Bonner's Ferry Bridge Commission.

Beaver, Pa.—Promoters of which J. L. Holmes, Beaver, Pa., is chief, have submitted plans to the War Department for approval for the construction of a bridge over the Ohio River between Baden and Aliquippa. The structure as planned is estimated to cost $300,000. Ordinances from Baden and Aliquippa Councils are now being sought.

Gainesboro, Tenn.—Committee has been appointed to select a site, draw up specifications and to let the contract for the construction of the bridge across Martin's Creek at Granville, Tenn., for which the county granted an appropriation of $6,000. Another appropriation of $8,000 will soon be asked for the construction of a bridge across Roaring River at a point near its mouth about 2½ miles from Gainesboro.

Salt Lake City, Utah.—Jacob T. Raleigh Street Supervisor, has suggested that the old wooden bridge at Ninth St. be replaced by a modern steel structure. George F. McGonagle, City Engineer, estimates the cost of such a structure at $6,250. Raleigh also recommends that the Utah Light & Railway Co. be made to put in a steel structure across the Jordan River at Second South St.

Pasco, Wash.—Residents of Palouse Orchard have petitioned the Commissioners of Adams and Franklin counties to construct a bridge over the river at Palouse Falls.

Seattle, Wash.—Property owners and the Commercial club interested in the construction of the bridge over the Duwamish River at First Ave., are devising plans for starting work immediately on the structure. Board of Public Works rejected bids for the work several months ago. The bridge will be of steel and 16 or 30 ft. in width and is to cost not more than $35,000.

Spokane, Wash.—City Council has decided to authorize the Board of Public Works to advertise for bids for the construction of the Munroe St. bridge on the plan which eliminates the hump in the center of the structure.

Tacoma, Wash.—Committee of Streets and Alleys have recommended the City Council to reject all bids for the North 23d St. bridge and to have the Commissioner of Public Works readvertise for bids for the work.

Parkersburg, W. Va.—It is reported that the Board of Government Engineers have decided to allow the promoters to construct a new bridge over the Ohio River at this place. Hearing was held upon the proposition last month.

Ladysmith, Wis.—Common Council is considering a proposition made by the Menasha Woodenware Co. to construct a $12,000 bridge across the Flambeau River at Third St., providing the city reimburse the company before the expiration of 6 years. The proposed structure is to have a 16-ft. roadway and a 6-ft. walk.

Milwaukee, Wis.—Residents of the North Side are to hold a meeting to urge the aldermen to override the mayor's veto on the proposed bond issue for a bridge connecting Wright and Bradford Sts.

New London, Wis.—Plans are being submitted by a number of bridge contractors for the construction of a bridge over the Embarrass River. One plan calls for a concrete structure of 4 spans with 20 ft. roadway and 150 ft. in length.

Roads and Streets.

Items Arranged Alphabetically by States.

Huntsville, Ala.—City Council has passed an ordinance providing for the paving of Meridian St. from its present paving terminus to the city limits.

Montgomery, Ala.—An improvement association has been organized for the purpose of improving Lee St. It is planned to pave with

some material that will minimize the traffic noise.

Pine Bluff, Ark.—The rock macadam road contemplated to be built by Jefferson county will extend from Pine Bluff to a point east for about 20 miles.

San Diego, Cal.—Property owners have petitioned the city council to fix the width of the sidewalks on Randolph St. from Lewis to Hunter at 12 ft. instead of 10; also asking for permission to grade Randolph St. from Lewis to Hunter by private contract.

Fort Pierce, Fla.—J. E. Filtz, clerk of St. Lucis County, will sell bonds Feb. 7th in the amount of $200,000 for road improvements.

Pensacola, Fla.—Board of Public Works has ordered advertisements for a minimum of 20 and a maximum of 30 miles of new cement sidewalks prepared.

Tampa, Fla.—County Commissioners have appointed a committee to lay out the Tampa short line road to St. Petersburg.

Atlanta, Ga.—The street and road committee has been asked to appropriate enough money to grade and pave a block on Fourth St., between Juniper and Peachtree Sts.

Boise, Idaho.—Ada county is to hold an election in a few months to vote on a bond issue for the purpose of constructing good roads. The county recently accepted the enabling act making the County Commissioners a board of highway commissioners with large powers, including the employment of a road engineer, etc. R. L. Nourse, Boise, is President of the Ada County Good Roads Association.

Soldier, Ida.—The Commercial Club of this city is back of a movement to construct a wagon road to Atlanta at an estimated cost of $10,000.

Aurora, Ill.—The following thoroughfares are to be paved with asphalt this summer: Stolp Ave., Downer Place from Harrison Ave. to the city limits, Walnut and Benton Sts.

Chicago, Ill.—President Kolacek of the West Park Improvement Board has recommended to that body the improvement in the various parks and boulevards of the West Park system during the present year.

Pekin, Ill.—The Park Board has ordered the macadam driveways in the park extended to the eastern limits of the park, and the southeast part of the park improved.

Marion, Ia.—City Council has passed a resolution to pave the following streets: Ninth St., Sixth Ave. to Seventh Ave.; 10th St., Seventh Ave. northward to the corporate limits of the city of Marion; Central Ave., 10th St. to the westerly line of Seventh St.; 11th St., Seventh Ave. to 11th St.; the avenue extending from the north end of 11th St. to east line of 10th St.; 12th St. from Eighth Ave. to 14th Ave.; Eighth Ave., 12th St. to 10th St.; 10th Ave., Tenth St. to 12th St.; 13th St., Seventh Ave. to Eighth Ave.; Sixth Ave. from east line of 10th St. to east line of First St.; Fifth Ave., Eighth St. to 12th St.; 14th St., 12th St. to 11th St.; 11th St., Sixth Ave. to the railway track in First Ave.

Newton, Ia.—City Council has directed the city solicitor to draw resolutions for about 45 blocks of new paving to be laid next summer.

Vinton, Ia.—City Council has decided to pave a few blocks in the business section of the city. A commitee has been appointed to investigate the material to be used and the width that the street should be paved.

Louisville, Ky.—City Council has passed an ordinance to improve the unpaved portions of the sidewalk on the south side of Maple St., between 22d St. and 23d St., with brick.

Lynn, Mass.—Alderman Walter W. Pyne, chairman of the committee on street sprinkling, advocates the establishment of a municipal street sprinkling plant.

Saginaw, Mich.—Board of Supervisors of Saginaw county has ordered the Graham road in the township of Thomastown macadamized from the point where the road crosses the Pere Marquette railroad north a distance of two miles.

St. Paul, Minn.—Following estimates have been made by J. H. Armstrong, County Surveyor, to the Ramsey county board of commissioners for road improvements: For grading and macadamizing Lexington Ave. north from Manomin road to Turtle Lake road, at a cost of $13,285; improving Manomin road from the Centerville road to the Rice St. cutoff, at a cost of $5,042; graveling Rice St. road from Manomin road to Turtle Lake road, at a cost of $9,364; macadamizing and grading Centerville road from Manomin road to the Anoka county line, at a cost of $22,500; improving New Brighton road from Long Lake road to the end of the present grading, at a cost of $2,100. Bids will be advertised for soon.

Independence, Mo.—The county court has ordered the county highway surveyor to make an estimate of the cost of grading the road running from Lonejack 2¾ miles north and 2½ miles east.

Jefferson Barracks, Mo.—Bids for the construction of roads and walks, etc., have been rejected. Work will be readvertised. Capt. Stanley H. Ford, Quartermaster, is in charge.

St. Louis, Mo.—Senator Warner has introduced in the Senate the bill calling for an appropriation of $100,000 to build a national highway from the city limits of St. Louis to the cemetery in Jefferson Barracks Reservation.

Hastings, Neb.—City Council has ordered an election to be held on March 8 to vote on the issuance of $50,000 worth of paving bonds.

Omaha, Neb.—Commissioners of Douglas county have estimated the cost of the improvement of the road to be done during this year at $100,000.

Lakewood, N. J.—An automobile race course is planned for this city, to be about eight miles in length. Work is to be started at once. The estimated cost is more than $500,000.

Mays Landing, N. J.—A. L. Hilpott of Red Bank was the lowest bidder for the building of the county boulevard from Mays Landing to Tuckahoe, a distance of 12 miles, at $24,943.

Buffalo, N. Y.—Petition has been filed with the common council for the paving of North Division St., between Michigan and Spring Sts.

Syracuse, N. Y.—Commissioner of Public Works is prepared to submit to the common council estimates of the cost of paving Oxford St. from Cortland Ave. to Onondaga Creek with the different materials included in the general paving specifications. The estimates follow: Sandstone block, creosoted wood block or Hassam pavement with granite top, stone curb, $10,900; same materials, with cement curb or gutter, $10,200; asphalt sheet, vitrified brick or block, bitulithic bituminous macadam or Hassam cement concrete pavement, stone curb, $8,080; same materials with cement curb and gutter, $7,600; macadam, stone curb, $5,580; macadam, with cement curb and gutter, $5,300.

Rocky Mount, N. C.—Bunn & Spruill, attorneys, will sell bonds Feb. 7th amounting to $20,000 for road improvements.

Milton, N. Dak.—City will hold an election Jan. 25, to vote on the issuance of $4,000 worth of municipal bonds.

Akron, O.—City Council has declared it necessary to improve Spicer St., from Exchange St. to Wolf Ledge Run, by grading, curbing and paving.

Dayton, O.—Plans have been made for the construction of 12,487 sq. yds. of asphalt pavement. About 16,520 cu. ft. of combined curb and gutter of cement will be laid. The estimated cost of this improvement is $30,790. T. G. Cellarius is city engineer.

Springfield, O.—An estimate is being prepared by Engineer M. J. Bahin for the paving of South Limestone St., from Rice St. to the corporation line.

Zanesville, O.—City Auditor L. R. McCadden will sell bonds on Feb. 5 in the amount of $15,000 for street paving in this city.

Marshfield, Ore.—Petition is being circulated providing for the construction of a wagon road from Coos Bay to Roseburg, by way of Coquille and Myrtle Point. This improvement will mean an expenditure of $50,000.

Newport, Ore.—City Council has decided to improve Beach St., in Nye Creek, as soon as it is feasible.

Portland, Ore.—Property owners living on the Cornell road have filed a petition in the city auditor's office asking that the portion of that thoroughfare lying between Lovejoy St. and the west boundary of the city be taken over as a city street so that it may be improved.

Portland, Ore.—A movement has been started by the Waverly-Richmond Improvement club to form a hard-surface district between Division St., Powell Valley road, East 26th and 41st Sts., petitions being circulated in this district. The estimated cost of the pavements is $400,000.

Salem, Ore.—Marion county is planning on improving many roads this year.

Allentown, Pa.—Ordinance has been introduced in the city council for the paving of 16th St. from Turner to Gordon, and Third St. from Union to the bridge across the Little Lehigh.

Harrisburg, Pa.—A bill has been signed by the Mayor carrying $1,041,000 for parks, sewers, paving and other improvements. It will be submitted to the voters at the February election.

Pierre, S. Dak.—A movement has been started in this city for the construction of good roads.

Rogersville, Tenn.—J. R. Sanders, secretary of the pike commission of Hawkins county, will sell bonds Jan. 28 amounting to $40,000 for pike improvements.

Beaumont, Tex.—The village of Vidor, in Orange county, has plans for a wagon road from that place to Beaumont. The route will probably be surveyed in the near future.

Brownsville, Tex.—City Council has called a special election to be held March 8, to vote on the issuance of $30,000 worth of public improvement bonds.

Richmond, Tex.—County has voted the issuance of $150,000 road bonds to build macadamized roads to connect with the Harris county roads. A road will be built to furnish a driveway from this city to Houston.

Rotan, Tex.—City has voted the issuance of $15,000 worth of street improvement bonds.

Sherman, Tex.—Grayson County Commissioners have taken up the matter of passing on the orders for the bond issue in Road District No. 1, consisting of the Denison Precinct; $250,000 is to be expended for improvements in that district.

Aberdeen, Wash.—County Commissioners are planning on expending $100,000 on building and improving roads in Chehalis county in 1910.

Bellingham, Wash.—City Engineer Troutman has estimated the cost of repairing the roadway and bulkhead on West Holly St., between E and G Sts. at $1,000.

Olympia, Wash.—Commissioners of Thurston county have $37,100 to expend on the improvements of county roads during the year 1910.

Seattle, Wash.—The Orillia to the Pierce county line section of the macadamized highway, which is being constructed between this city and Tacoma, is to be built this spring at an estimated cost of $100,000. This section is 11 miles long.

Vancouver, Wash.—Petition has ben laid before the War Department asking for an appropriation of $25,000 for putting down a macadam pavement on the extension of Fifth St., passing through the Vancouver military reservation.

Burlington, Wis.—City Council has ordered the following streets paved with brick on a 6-in. concrete base: Chestnut St., from Geneva St. to the Soo Line railway; Pine St. from Geneva St. to Madison St. Board of Public Works, P. J. Hurtgen, chairman, will soon call for bids on this work.

Wausau, Wis.—Plans and specifications are being prepared for about 22,000 sq. yds. of brick or creosoted wood block paving. Contracts will be let early in the spring. O. A. Wennberg is Assistant City Engineer.

Sewers.

Items Arranged Alphabetically by States.

Colton, Cal.—Plans are being prepared by Will L. Brown, San Bernardino, Cal., for the construction of new sewers in this city. The work is estimated to cost $65,000.

Los Angeles, Cal.—Board of Public Works has recommended to the city council the construction of a storm sewer in Marmion Way at a cost of $10,297.

Roseville, Cal.—City is preparing to expend large sums for street improvements and the installation of a sewer system.

San Francisco, Cal.—No bids were received for the construction of the Yerba Buena sewer, for which $600,000 of bonds issue funds is available. Bids will be readvertised.

San Leandro, Cal.—The Western Pacific Railroad and the Best Manufacturing Works are planning on constructing a storm sewer along Alvarado St.

Atlanta, Ga.—The council committee on sewers has decided to petition the finance committee for appropriations as follows: For construction of lateral sewers as are not taken care of in the proposed bond issues, $20,000; for the extension of the Kennedy St. sewer, $8,000; for the proper drainage of Chestnut and Simpson St., $1,000.

Bushnell, Ill.—City is planning on constructing a sewer system. Septic tanks will be constructed on the east and west side of town.

Elgin, Ill.—Board of Local Improvements has passed resolutions for the Locust St. and Villa St. sewers. Both sewers will be constructed this spring. The engineer has estimated the cost of constructing the former at $9,140 and the latter at $5,786.

Rockford, Ill.—Board of Public Works has introduced in the city council an ordinance providing for the construction of a sewer in portions of the following streets: Sixth Ave., 15th, 16th, 17th, 18th, Charles, Shaw and State Sts., Rome Ave., Pearl St., South Chicago Ave., Baker St., Hutchins Ave., Third and Second Aves. and McCaughey St. The sewer will be about 15,000 ft. long and will be constructed of 12, 10 and 9-in. pipe. The cost is estimated at $14,801. An ordinance was also introduced providing for the construction of a sewer in Rockton and Garfield Aves., at a cost of $4,475.

La Porte, Ind.—Prof. R. L. Sacket, sanitary engineer of Purdue University, has submitted to the city council plans and specifications for the construction of a sewer system in this city. The sewer will be constructed of reinforced concrete, including the following sizes: 5,870.2 ft. of main trunk sewer, 78 ins. in diameter; 3,885 ft. of Fox St. sub-trunk 54 ins. in diameter; 897.3 ft. of Fox St. sub-trunk 48 ins. in diameter; 3,826 ft. of Kingsbury road sub-trunk 60 ins. in diameter; 1,031.5 ft. of Yellow River road sub-trunk 54 ins. in diameter; 363.5 ft. of Yellow River road sub-trunk 50 ins. in diameter. The sewer will be three miles in length and will cost approximately $126,947.

Corydon, Ia.—City is contemplating on installing a sewerage system at a cost of about $20,000.

Davenport, Ia.—City Engineer Murray has presented to the city council specifications and estimates for the new sewer that the city contemplates building between Marquette and Ripley Sts. along the levee front. The sewer will be 8 or 9 ft. in diameter and will be built of reinforced concrete. It will be about 4,400 ft. in length and will cost about $90,000.

Saginaw, Mich.—Board of Public Works has been petitioned by the Sommers Match Co. to lay a sewer in Rust Ave. to its new factory at Wilkins St.

Springfield, Mo.—City Council will again shortly consider the construction of a sewer in the district bounded by Center, Campbell, Pine and Boonville Sts.

Crete, Neb.—City is contemplating on installing a sewerage system.

Binghamton, N. Y.—City Engineer John A. Giles has submitted to the alderman plans for sewering the west end of the First ward.

Utica, N. Y.—City Council has ordered plans drawn for the construction of a sewer in North Genesee St. from its present termination in the old river channel to the intercepting sewer.

Bellefontaine, O.—City will soon engage an engineer to draw plans and prepare specifications for the construction of a sewerage system and disposal plant.

Bucyrus, O.—City has engaged a sanitary engineer to draw plans for the intercepting sewer and sewage disposal plant ordered by the state board of health.

Cincinnati, O.—Following approximate estimates of the cost of intended improvements were submitted to Public Service Director Sundmaker: Sewer in Baltimore Ave. and rights of way from the end of the sewer at Cummins' run, and in Casper St. to Yoast Ave., $36,823; sewer in Otte Ave. from Hamilton Ave. to the ravine east of Kirby road, $6,453; sewer in Cheviot Ave. between Daytona Ave. and Mozart St., $16,570; sewer in Irwin St. from McGregor Ave. to its southern terminus and the right of way south of and east of Reading road, $1,380; Beechwood Ave. from Cinnamon St. to Madison Ave., opposite Beechwood Ave.; sewer Madison Ave. from Beechwood Ave. to Vista Ave. in the ravine and right of way from the culvert under Madison Ave. north of Beechwood Ave. to the proposed sewer in Duck creek, also in O'Brien and Lavinia Sts., $15,925.

Cincinnati, O.—City Council has declared it necessary to construct a sewer in University court from Straight St. to a point 500 ft. north of Straight St., and Straight St. from University court to a point 100 ft. west of University court.

Middletown, O.—City Council has decided to proceed with the improvement of Garfield Ave. from Philadelphia St. to Fourth St. by constructing a sanitary and drainage sewer. Also by constructing a sanitary and drainage sewer in North St. from Charles St. to Grimes St.

Hominy, Okla.—City has sold $36,000 bonds voted for the construction of a water and sewer plant. Work of construction is to begin soon.

Lebanon, Pa.—Dr. E. H. Gringrich, health officer for this city, has recommended in his annual report for the city council the installation of a house sewerage system.

Parsons, Pa.—City Council has decided to hold an election in February to vote on the issuance of $50,000 bonds for the installation of a sewer system.

Pittsburg, Pa.—City Council has authorized the construction of a sewer on Warsaw St. from a point near McKee St. to the present sewer on Nimick place.

Memphis, Tenn.—Survey is being made of the southern and eastern portions of the city for a sewerage system. The territory covered by the survey is as follows: From Nonconnah creek, on the south, to Trigg Ave. on the north; from the Mississippi river on the west to Highland Ave. on the east. Plans are being prepared by City Engineer Weatherford.

Lubbock, Tex.—Plans have been made for the construction of about 15 miles of sewers. Contracts will be let about March. E. L. Datton, Juanita Bldg., Dallas, Tex., is engineer.

Houston, Tex.—Plans for the construction of the sanitary sewers to be constructed in the Second ward have been completed by Consulting Engineer F. L. Dormant. The main sewers are to run along portions of Runnels, Shepherd and York Sts. and Commerce Ave

Huntsville, Tex.—City Council has decided to construct a sewerage system.

Edmonds, Wash.—City Council has passed an ordinance providing for a system of trunk sewers, to cost about $17,000. City will hold an election Feb. 8 to decide whether the city shall be bonded to construct the sewers.

Garfield, Wash.—E. C. Murray of Colfax has submitted plans and specifications to the city council for the construction of a $15,000 sewage system. The plans call for the installation of over two miles of pipe, 3,270 ft. of 12-in., 3,140 ft. of 10-in., 3,800 ft. of 8-in. and 2,700 ft. of 6-in.; the construction of a tank 24x45 ft., 6 ft. deep, and two filter beds, 50x100 ft. each, the septic tanks to dispose of all night soil and other solid matter.

Seattle, Wash.—Plans are being completed for the lateral sewers for the Green Lake district by Engineer W. D. Barkhoff.

Burlington, Wis.—City Council has ordered plans drawn for the construction of sanitary sewers in the following streets: Chandler Blvd. from Wilmot Ave. to Edward St.; Edward St. from Chandler Blvd. to Perkins Blvd.; Chestnut St. from Origen St. to James St.; Herman St. from Chestnut St. to Lewis St.; James St. from Chestnut St. to Storley Ave.; Pine St. from Jefferson St. to Washington. Work will be commenced in the spring on the extension of the storm sewer system as planned and recommended by P. J. Hurtgen, city engineer.

Oconomowoc, Wis. Board of Public Works has been authorized to have storm sewers on Collins St., Main St. from the tracks to Milwaukee St., South St. and West Ave. laid so as to drain to Lake La Belle.

Water Supply.

Items Arranged Alphabetically by States.

Imboden, Ark.—City has decided to extend its water works system in the spring. No plans have as yet been made, but the work proposed is estimated to cost several thousand dollars.

Sacramento, Cal.—The American Canyon Water Co. has submitted to the Board of City Trustees a proposition to furnish the city with water from the north fork of the American City at $400,000 a year for 150,000,000 gals. daily and $2,500 for each additional million gallons.

Glenwood Springs, Colo.—City has voted to issue bonds for the purpose of purchasing the water system now owned and operated by the Glenwood Springs Light & Water Co.

New Britain, Conn.—Percy M. Blake, Engineer Water Department, has recommended the increasing of the water supply system.

Kissimmee, Fla.—City Council has passed an ordinance calling an election to bond the town for $43,000 for the purpose of installing a system of water works and sewerage.

Meridian, Ida.—An election is to be held Feb. 12 for the purpose of voting on the question of authorizing an issue of $20,000 for the construction of a water works system.

Centrallia, Ill.—City Council has authorized the making of preliminary surveys and estimates for water site at the Martins Branch.

Oakland, Ill.—An election is to be held soon to vote on the installation of a water works system.

Cherokee, Kan.—A special election is to be held to vote on issuing $6,000 of bonds for the extension of the water works system.

Missoula, Mont.—The proposition to issue $26,000 worth of water works bonds was carried.

Havelock, Neb.—City Council has approved plans and specifications as revised for the new sewer and water works systems and will vote on holding a special election for voting bonds amounting to $75,000 or $80,000 for the work.

Farmington, N. Mex.—The Town Board has decided to call a special election for the purpose of voting on a proposition of issuing $25,000 worth of water works bonds.

Cortland, N. Y.—Board of Water Commissioners have made arrangements to take over the water works system.

Fort Erie, N. Y.—Plans for the installation of a complete water works system for this place have been made and although the measure was beaten at the last election strong hopes are maintained for carrying it this time.

Binghamton, N. Y.—Plans for the new reservoir to be erected by the Water Board upon the side of Mount Prospect at North Mygatt St. are under way. The work is estimated to cost $2,000.

El Reno, Okla.—J. LaBryaer, Mayor, is to sell on Jan. 26 the following bonds: $50,000 city hall bonds, $20,000 fire station bonds, and $10,000 water works bonds.

Krebs, Okla.—The proposition to issue $50,000 worth of water works bonds was carried.

Cottage Grove, Ore.—J. W. Roberts, Consulting Engineer, has completed an estimate of the cost of the proposed gravity water system. Including the construction of a 300,000 gal. reservoir, the system will cost $103,319. The supply will be piped from a mountain stream 18 miles distant.

Portland, Ore.—Residents of the Mount Scott District have held a meeting to take steps toward securing the construction of a 20-in. water main from the Mt. Tarbor reservoir through the entire Mt. Scott and Woodstock District.

Salem, Ore.—George F. Rodgers, Mayor, has decided to have plans prepared to submit to the U. S. Engineers at Portland, Ore., for raising the intake pipe of the Salem Water Company above the slough.

Coudersport, Pa.—Borough is to submit to the voters at the February election the proposition of municipal ownership of its water works.

Harrisburg, Pa.—The Northern Cambria Water Company has been granted an increase of capital stock from $10,000 to $125,000. The company which operates in the north section of Cambria county is planning the construction of many improvements and the extension of its present system. The offices of the company are at Johnstown, Pa.

Huron, S. Dak.—City will hold an election Feb. 1 to vote on the question of issuing $30,000 of bonds for the installation of an adequate water works system.

White Lake, S. Dak.—City is to decide on definite plans at once for the installation of a municipal water works system. The work will include the erection of a 85,000-gal. tank on an 80-ft. tower.

Bristol, Tenn.—City is taking steps to get a new and more bountiful water supply and will expend $400,000 if necessary. It is planned to then use the old supply as an auxiliary source.

Tremonton, Utah.—Citizens of this town are considering the advisability of installing a water works system in that place.

Woodland, Wash.—The Woodland Water and Power Co. of Woodland, Wash., has been incorporated with a capital stock of $40,000. S. A. Burns, E. L. Burns and G. F. Gilluly are the incorporators.

Burlington, Wis.—City Engineer P. J. Hurtgen is preparing plans for the extension of the water works system on several streets in this city.

Tofield, Alta.—Engineer Tait of the Grand Trunk Pacific is preparing plans and making surveys for the proposed water supply plant from Beaver Lake to Tonfield, a distance of two miles.

TRADE NOTES.

The Wood Drill Works of Paterson, N. J., has shipped another No. 5 drill to be used in the quarries of the Luzerne County Crushed Stone Co., Luzerne, Pa., with a guaranteed capacity of 50 ft. with a 4 in. hole at the bottom.

Henry J. Siewert and Christian Callsen have purchased the entire stock of Hans Blase in the H. Blase Co. and hereafter the business of this firm will be conducted under the name of the Siewert-Callsen Co. The present location at 3863 Milwaukee Ave., Chicago, Ill., will be retained, as Messrs. Siewert & Callsen have also purchased from Mr. Blase his holdings in this property. The company will carry on a cement contracting business.

The Good Roads Machinery Co., Inc., Kennett Square Pa., which has been actively engaged in the sale of road building and contractors' machinery since 1896, has recently concluded arrangements whereby it will hereafter have the exclusive sale of the entire output of the road and street making machinery, contractors' tools and supplies manufactured by the Climax Road Machine Co., Marathon, N. Y.; the Monarch Road Roller Co., Groton, N. Y., and the Indiana Road Machine Co., Fort Wayne, Ind., in addition to that of the American Road Machine Co., of Kennett Square, Pa.

CONTENTS OF JANUARY 19, ISSUE OF ENGINEERING-CONTRACTING.

EDITORIAL:
Commission Government in Cities..... 49
Selection and Proportion of Aggregates for Portland Cement Concrete..... 50
John W. Alvord, President of Western Society of Engineers..... 51
CONCRETE SECTION:
Economical Selection and Proportion of Aggregates for Portland Cement Concrete.. 52
Comparative Cost of Constructing Two Identical Reinforced Concrete Buildings, One of Separately Molded Members and One of Members Molded in Place..... 55
EARTH AND ROCK SECTION:
Earth and Rock Filled Dam with Concrete Core Wall, Patillas Irrigation Project, Porto Rico..... 57
Cost of Stripping a Gravel Pit..... 58
A Special Hand Auger for Test Boring and Method of Using It in Prospecting for Coal..... 58
Method of Making a Blast Displacing 180,000 Tons of Rock, with Some Costs..... 59
ROADS AND STREETS SECTION:
Data on Street Work at New Bedford, Mass. 61
Concrete Pavement Construction at Boise, Idaho 61
RAILWAY SECTION:
Reports on Interurban Lines by Engineers and Promoters..... 62
Appraised Value of the Steam Railways of Wisconsin 62
Methods of Determining Relative Economy 63
GENERAL SECTION:
Methods of Filing Books, Pamphlets, Trade Catalogs and Periodicals for Small Private Libraries or Information Departments 65
Annual Meeting of the Illinois Society of Engineers and Surveyors..... 66
Processes for the Preservative Treatment of Timber and Approximate Costs of Treatment 66
The Fortieth Annual Meeting and Diinner of the Western Society of Engineers..... 67
The Reinforced Concrete Girder Bridge at Florence, Arizona..... 68
LETTERS TO THE EDITOR..... 69
COMING TECHNICAL MEETINGS..... 70
PERSONALS 70
CATALOGS WORTH HAVING..... 70

OFFICE OF THE CONSTRUCTING QUARTERMASTER. — Fort Robinson, Neb., January 19, 1910. Sealed proposals for furnishing all material and labor for addition to and repairing pump-house, new boilers, new pump, etc., at Fort Robinson, Neb., will be received here until 11 a. m., February 19, 1910. Plans and specifications may be consulted at the office of the Chief Quartermasters at Denver, Omaha, Chicago and St. Paul, Depot Quartermaster at St. Louis, and at this office. Blank proposals and instructions to bidders may be obtained at the same offices. Plans and specifications furnished upon receipt of certified check for $15.00 to insure their return. Envelopes containing proposals should be indorsed "Proposals for Improving and Repairing Water System," and addressed to CAPTAIN MALVERN HILL BARNUM, Constructing Quartermaster, Fort Robinson, Neb.

Proposal Advertisements Continued on Page 50.)

POSITIONS WANTED

Cards under this heading cost only

One Cent a Word

Count 6 words for address.

WANTED—POSITION — Timekeeper, thoroughly experienced, desires position anywhere in the United States. A No. 1 credentials. Frank Rogers, 83 Schermerhorn St., Brooklyn, N. Y. 4-1t

WANTED—POSITION with some contractor or railroad company as general foreman of track laying or surfacing. Can give good reference as to my ability in working large gangs of men. I have had 25 years' experience in track work. Address John Steinhour, Ottawa, Putnam Co., Ohio. 4-1t

WANTED—POSITION—Technical graduate (28) desires position as transitman, levelman or masonry inspector. Has one and one-half years' experience. Open for position February 15. References furnished. Address Box 242, care of Engineering-Contracting, 355 Dearborn St., Chicago, Ill. 4-3t

WANTED—POSITION as rodman. High school graduate; two years' experience. Will go anywhere on any work, but western location preferred. Address Box 243, care of Engineering-Contracting, 355 Dearborn St., Chicago, Ill. 4-1t

WANTED—POSITION by young civil engineer (27); technically educated; one year's experience as instrumentman on municipal, subdivision and river surveys; will consider engagement in any line of civil engineering work; salary consideration of less importance than permanency of position and opportunities for experience; any location. Address Box 240, care of Engineering-Contracting, 355 Dearborn St. Chicago. 4-4t

WANTED—POSITION as steam shovel engineer; eleven years' experience with Marion, Bucyrus and Vulcan; can repair and keep up any class of machinery. Am not afraid of work; always ready to assist. Sober and reliable and can furnish references. Please state salary per month. Five days' notice if possible. Address W. M. Steel, Gary, W. Va. 4-2t

WANTED — POSITION — Superintendent building construction. Young man, fourteen years' practical experience in office and outside work. University education. Can design, detail, write specifications and superintend construction; able to take off quantities from plans and make estimates. Experienced in reinforced concrete. Desire position with architect or contractor. Only permanent position considered. References. Location southwest, west or south. Address Box 241, care of Engineering-Contracting, 355 Dearborn St., Chicago, Ill. 4-4t

WANTED — POSITION by an experienced locomotive crane and skid excavator operator; can give references. Address Ulysses G. Cook, Martinsville, Ill., P. O. Box 366. 4-1t

WANTED—POSITION—Engineer (47); 27 years' experience on location and construction of railways, grading, masonry, trestling, tunneling and track laying, desires position as foreman, superintendent or engineer with contractor or railroad on concrete construction, piers, abutments, culverts and pavements; south or west preferred. Have instruments. Moderate salary. Address W. B. H., 1015 Bullitt Ave. S. E., Roanoke, Va. 4-6t

WANTED—POSITION—Engineer or superintendent of track, 6 years' preliminary location, instruction, land and municipal work, paving, drafting, estimates, etc.; 2 years' charge of street and suburban railway construction, maintenance, repairs and renewals. Can organize and handle work at minimum cost. Address Box 244, care of Engineering-Contracting, 355 Dearborn St., Chicago. 4-2t

WANTED—POSITION—Young man, graduate civil engineer, two years in charge of steam shovel work and concrete construction; one year building construction; two years instrumentman on railroad location and construction; office and field work. Will consider proposition for other connections where successful results will be recognized. Address Box 245, care of Engineering-Contracting, 355 Dearborn St., Chicago, Ill. 4-1t

WANTED—POSITION with company laying underground cable conduit. Am 31 years old. Have executive and managing experience. Capable, reliable; best of references. Address Box 237, care of Engineering-Contracting, 355 Dearborn St., Chicago, Ill. 3-4t

WANTED—POSITION with contractor doing reinforced concrete or drainage work by young engineer, aged 23. Six years' general experience. Can go at once. Address E. L. B., care of Engineering-Contracting, 355 Dearborn St., Chicago, Ill. 3-3t

WANTED—POSITION in North or West by engineer. Seven years' experience. Five years of it on railroad work, doing location, construction and maintenance. At present engaged on levee proposition. Ready to make change any time after Feb. 1. 28 years of age. Address Box 232, care of Engineering-Contracting, 355 Dearborn St., Chicago. 2-4t

WANTED — POSITION — By experienced timekeeper. Will go anywhere. Address H. C., care of Engineering-Contracting, 355 Dearborn St., Chicago, Ill. 2-3t

WANTED—POSITION as office engineer with large engineering or contracting firm. Position to be permanent. Correspondence solicited. Address "East," care of Engineering-Contracting, 355 Dearborn St., Chicago, Ill. 2-4t

WANTED—POSITION—Contractors' superintendent and engineer (34) with ten years' experience in building bridges, tunnels and all kinds of massive and reinforced concrete construction, location and grading for electric and steam railroads; able to organize and handle large forces. Open for immediate employment. Address Box 238, care of Engineering-Contracting, 355 Dearborn St., Chicago, Ill.

WANTED—POSITION as superintendent or tie and timber inspector for cross tie work. Have had experience in cutting white oak, post oak, cypress and long leaf pine, for construction and repair, and the latter for export; fifteen months' experience in operating the improved cross tie machine. Desire to locate west of Mississippi River. As to character, etc., guarantee satisfaction. Address Hunter Bowen, Pinckard, Ala. 26-6t

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WANTED—Stenographer, draftsman, general superintendent and other help. Each must be thoroughly capable. Can't use the ordinary kind. Good pay and opportunity to the limit of your ability. No reply until something of interest is presented. Bartlett & Kling, Builders and General Contractors, Cedar Rapids, Iowa. 4-1t

WANTED — Young graduate civil engineer for a position on the editorial staff of Engineering-Contracting. The position is one which calls for energy and push and the disposition and ability to work hard, quite as much as for technical training and literary ability. The opportunities are good for a man who can handle the work. Editor, Engineering-Contracting, 355 Dearborn St., Chicago.

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WANTED—POSITION as cook for man and wife in camp. Years of experience. White. State wages. Mrs. Sarah Babcock, Sullivan, O. 2-5t

WANTED—EXPERIENCED TIMEKEEPER for work in southern Illinois. Give experience and references. Carter Construction Co., Room 218, 184 La Salle St., Chicago, Ill. 2-2t

SUPERINTENDENT on big work wishes to go into the contracting business. Have had experience on railroad construction, dam construction and heavy concrete work. Can use pick, shovel and spike maul and show how to use them. Graduate civil engineer. Age 32. Have $2,500 to invest on the co-operative plan and am willing to handle gang, take charge of work, draft or make estimates. Correspondence solicited. Address Box 230, care of Engineering-Contracting, 13-21 Park Row, New York, N. Y. 1-5t

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WANTED—Address of firms who build mole or underground ditches. Address J. A. Campbell, Vermillion, S. D. 4-1t

WANTED—Would like to invest some capital, plant and services with some good wideawake contract firm to do concrete work; experienced as engineer and contractor; where work is right can produce results, but do not profess to do the impossible. Wire or write James Dickey, Covington, Va. 4-1t

WANTED—Work for two good concrete outfits with capacity of from 75 to 100 cubic yards per day; plants in good condition and can move on work at once. Personal attention given any and all work. Wire or write James Dickey, Covington, Va. 4-1t

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We have 150 miles of fine grader, fresno and wheeler work to let on the C. & N. W. Ry. in South Dakota. This is fine work in a good country. We can use both small and large outfits. Free transportation for teams, outfits and men over the C. & N. W. Ry.
E. A. Wickham & Co., Council Bluffs, Ia.
Roberts Bros. & Wickham, 123-125 La Salle St., Chicago. 2-3t

WANTED—An experienced railroad man to take from $5,000 to $10,000 stock in an incorporated company and act as superintendent with salary. Address P., care of Engineering-Contracting, 355 Dearborn St., Chicago. 1-4t

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Sealed proposals will be received at the office of The Costilla Estates Development Company, 56 Bank building, Colorado Springs, Colo., until 12 o'clock noon, February 21, 1910, for the construction as a whole, or separately, in Costilla County, Colo., of

The Sanchez Dam, about 500,000 cu. yds. earthwork.

The Sanchez Dike, about 250,000 cu. yds. earthwork.

The Culebra-Sanchez Canal, about 250,000 cu. yds. earthwork. Together with necessary controlling works and about 15,000 cu. yds. of rock excavation.

The company reserves the right to reject any and all bids.

Plans and specifications may be obtained upon the deposit of $10.00 (which sum will be returned upon the re-delivery of plans and specifications in good condition) by applying to the above company or to O. V. P. Stout, Engineer, Lincoln, Neb.

THE COSTILLA STATES DEVELOPMENT CO.,
By FRANKLIN E. BROOKS,
President.

O. V. P. STOUT, Engineer.

STREET PAVING.

Kirksville, Mo.

Bids will be received until Monday, February 7, 1910, for 6,000 sq. yds. of brick paving on 5 inches of concrete base. Also for 4,500 lin. ft. of concrete curb and gutter.

J. C. CAROTHERS,
City Clerk.

ARTESIAN WELL.

State Engineer's Office,
Denver, Colo.

Sealed proposals will be received at this office until noon, Saturday, February 26, 1910, for the sinking of an artesian well near Haswell, in Kiowa County, Colo.

All proposals must be accompanied by a certified check for the sum of two hundred and fifty dollars ($250.00).

For further information, forms for proposal, plans and specifications, apply to this office or to the County Clerk at Eads, Kiowa County, Colo.

CHARLES W. COMSTOCK,
State Engineer.

PAVING.

Norfolk, Va., Jan. 10. 1910.

Sealed proposals will be received by the Board of Control at its office in the City of Norfolk Va., until 12 o'clock noon on the 8th day of February, 1910, for regulating and repaving with some smooth material, parts of Granby and Chapel Streets in the said city.

Bids must be made for each street separately.

Specifications with all other information may be obtained on application to the City Engineer, Norfolk, Va.

Certified checks for ten per cent of the amount bid must accompany each separate proposal, under the conditions set forth in "Instructions to Bidders."

The right to reject any or all bids is reserved by the Board of Control.

THE BOARD OF CONTROL.
Norfolk, Va.

W. T. BROOKE,
City Engineer.

ARTESIAN WELL.

State Engineer's Office,
Denver, Colo.

Sealed proposals will be received at this office until noon, February 26, 1910, for the sinking of an artesian well at or near Cortez, Montezuma County, Colo.

All proposals must be accompanied by a cashier's check for the sum of two hundred dollars ($200.00).

For further information, forms for proposal, plans and specifications, apply to this office or to the County Clerk at Cortez, Montezuma County, Colo.

CHARLES W. COMSTOCK,
State Engineer.

CEMENT BRIDGES AND CULVERTS.

Montezuma, Iowa.

The Board of Supervisors of Poweshiek County, Iowa, will meet at their room in the Court House at Montezuma, Iowa, Feb. 23, 1910, to let the contract for building cement bridges and culverts in Poweshiek County for the year 1910.

The Board wishes those interested in that kind of work to meet with them on that date.

J. W. ROSE,
County Auditor.

U. S. ENGINEER OFFICE.—Chicago, Ill., Jan. 20, 1910. Sealed proposals for dredging and rock excavation in Chicago River, Ill., will be received here until 10 a. m., Feb. 23, 1910, and then publicly opened. Information on application. THOS. H. REES, Major, Engineers.

Proposal Advertisements Continued on Page 52.)

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CHAS. S. HILL
ERNEST McCULLOUGH
C. T. MURRAY
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CONTENTS.

EDITORIAL Page
$350,000 Spent, $228,000 Wasted . . . 95
How to Increase the Efficiency of the Civil Service . . . 95
Annual Meeting of the Illinois Society of Engineers and Surveyors . . . 96

CONCRETE SECTION:
Method and Cost of Reinforced Concrete Highway Bridge Construction Under the Direction of the Illinois Highway Commission . . . 97
Design of and Method of Constructing a Reinforced Concrete Aqueduct Lining with Some Data on Cost . . . 98

EARTH AND ROCK SECTION:
Design and Construction of Open Ditches to Reduce Maintenance with a Description of Methods of Maintenance and Some Costs . . . 100
The North River Tunnels of the Pennsylvania R. R. Tunnel Entrance, New York City . . . 101

ROADS AND STREETS SECTION:
Detail Cost of Constructing 200,000 sq. yds. of Brick Pavement at Carlisle, Pa. . . 106
Notes on State Highway Work in 1909 107
Sidewalk Construction in Chicago 108
Report of State Engineer on the Progress of the New York State Barge Canal Work in 1909 109

WATER WORKS AND SEWER SECTION:
Some Construction Details on Costs of Scioto River Storage Dam and Reservoir, Columbus Water Works 110

GENERAL SECTION:
Cost of Constructing a Service Telephone Line in Cuba 111
Is the Engineering School Necessary? 112
Methods and Cost of Constructing a Concrete Lock and Timber Crib Dam with Appurtenant Structures, Employing Day Labor 113
The Doctrine of Adverse Possession and Its Significance to the Surveyor 115

LETTERS TO THE EDITOR 117
COMING TECHNICAL MEETINGS 118
PERSONALS 118
CATALOGS WORTH HAVING 118

$350,000 Spent; $228,000 Wasted.

To waste $228,000 out of an expenditure of $350,000 is something of a record even for politician department heads employing day labor. According to the report of B. F. Welton, civil engineer, who has investigated the workings of the Chicago Bureau of Sewers for the Merriam commission, appointed to search into that city's financial affairs, "a most conservative estimate of the existing pay roll waste would not be less than 65 per cent of the labor pay roll expenditures. The records of the Bureau of Sewers show that over $350,000 was expended for the year ending Dec. 1, 1909; 65 per cent of the amount is approximately $228,000, which represents the annual waste in 1909." This waste is charged wholly to inefficiency of the working force, lack of experience of labor and plain loafing on the job, and a wealth of detailed evidence is presented to substantiate the charge. In commenting three weeks ago on the appointment of engineers as department heads by Mayor Gaynor of New York city, we called attention to the disclosures of incompetency among politician heads of departments made by the Boston Finance Commission and prophesied that when the findings of the Merriam commission now working in Chicago were made known, an even more astounding state of affairs would be indicated. Since that writing the Merriam commission has made public two reports of its findings. One report shows the unwarranted, if not fraudulent, payment of $46,000 to a contractor for public work for rock excavation where no rock existed and demonstrates this payment to have been the result of the gross incompetence if not of the actual connivance of the city heads of departments. The other report is the one which we have quoted above. Of the two reports it indicates a condition of affairs which is the more serious. Straightforward steals or mishandling of public funds in large single amounts are easily discovered and readily made plain to public censure, but the cumulative waste resulting from the day labor system of doing public work under lazy and incompetent managers is too insidious for general notice although ten-fold more damaging. We have been accused of harping too much on this string. Is there not warrant enough for it in such disclosures of the inefficiency of the city day labor system as this of the Merriam commission?

How to Increase the Efficiency of the Civil Service.

The civil service is a term borrowed from England and originally meant the civil branch of the government as distinct from the military. Corruption and inefficiency marked the conduct of affairs because positions in the Civil Service were considered a proper reward for political services. About the middle of the last century Civil Service Reform was a vital issue in Great Britain and after many years of strenuous work on the part of reformers, examinations to prove fitness were substituted for party fealty as a test before appointment and permanency in tenure of office was assured. Shortly after the reform was accomplished the movement spread to the military services; purchase of appointments was abolished, the system of purchase and sale of commissions stopped by a financial settlement with officers holding commissions; cramming schools conducted by half-pay officers disappeared and cadet schools were established, to which appointments were made regardless of rank or station in life. To accommodate however young men of means, commissions can be secured in high-class regiments after a certain number of years' service in a yeomanry or militia command without going through a cadet school. The principle however was fixed of putting in the public service, civil or military, men who after due examination showed their fitness to perform the duties connected with the position, in a competitive examination.

In 1816 the United States established tests for admission to West Point and only graduates of that school, or men as well prepared, were given commissions in the army. About 20 years later similar methods were adopted by which to obtain officers for the navy but it was not until 30 years after the reform of the Civil Service establishment in Great Britain that Civil Service Reform became a live issue in the United States. The adoption of the principle of a preliminary test of fitness has so improved matters that no good citizen would willingly return to the old political regime. Civil Service Reform really was a reform but in the practical administration of the system some grave defects have shown up so that to the average man the words "Civil Service" stand merely for a man appointed to a position who has conformed to certain rules and who has passed a more or less practical examination in a technically legal way. A great many appointees cram for an examination, impelled thereto by the bait of a "life job" held before their view. The uninformed claim the examinations are foolish and theoretical, such stories being generally started by those who fail to pass.

ENGINEERING-CONTRACTING stands firmly for the principle of demanding that all men be competent who hold public office; the principle upon which our government is supposed to be organized. There are defects however in our present civil service establishment and the friends of the principle of competency must permit honest criticism or be prepared to some day find that blind adherence to the rules and regulations will produce an organization of marked costliness and inefficiency. There must then be more Civil Service Reform.

The question of the sufficiency of examinations is of no moment. At first there was a tendency to move along lines of least resistance with examinations of too general a character in which the personal element was eliminated. Today much greater care is exercised and oral examinations are not uncommon as a supplement to written examinations. The question of examinations is one that is being rapidly settled and each examination is more practical than any of those preceding it. The method of appointment is generally conceded to be one of the bad features of the present system. At present the head of a department has a choice of the three men whose examination marks are highest. It is well known that the best man for a position is not always the one who passes the best examination. It frequently happens that the very best man for a particular position stands at the foot of the list of those who pass. The examination being one to determine fitness it

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is to be presumed that all who pass are fit. This being so why should not the head of a department be allowed a choice from all the men certified by the examiners? He will certainly select a man of whom he has personal knowledge and when he is satisfied is fit, examination or no examination.

Such proposals have been made before and the objection made that politics will enter in. This does not seem to be good reasoning; no political test is applied at the examination. The examinations are open to all comers so it is hard to see how politics can enter. We must always remember as a starting point that this selective proceeding is not a method but is a principle; the principle of fitness. Extreme advocates are too prone to forget the underlying principle and make a fetich of regularity and red tape, the two things that are at present hurting the civil service organization.

An examination is announced and a number of men proceed to cram for it. The prize goes to the best crammer and he is appointed to a life position simply as a result of a few strenuous hours of preparation, perhaps the last real strenuous work he does in connection with the position. This is no fancy picture and everyone who has had to do with some offices filled with men selected by civil service examinations knows this to be true. There are some splendid men serving our cities and the general government as civil service employes but it is common knowledge that many thousands are lazy and a drag on the industrious ones. Many departments are heavily over-manned because of this fact. It is also well known that many are really incompetent but not to a degree that will warrant charges being preferred against them for this reason.

Should not heads of departments have the right to discharge employes without going through present formalities? At present it is generally necessary to file charges and the accused is furnished a copy, being permitted to employ counsel to defend him at a hearing before the Civil Service Commissioners. If his defense is so good that he is returned to work the effect upon the morale of the department is bad. There is an efficiency record kept but it is a perfunctory thing as a poor efficiency record causes annoyance and an inquiry which may not sustain the keeper of the record. To permit the head of a department to discharge men brings up of course the bogey of "Politics." Could this not be effectually settled by remembering that new appointments can be made only from the eligible list?

To cause as little trouble as possible and secure highest efficiency why should not all original appointments be for one year only? Each month an efficiency card for each employe could be sent to the Civil Service Board and this board could send a copy to the employe. Failure to maintain a certain per cent would result in dismissal and of course would count against the employee in future examinations. A higher per cent of efficiency would give the department head a choice of selecting some one else for the position, the employe who failed to give entire satisfaction being returned to the eligible list with the privilege of another trial by some one else. It sometimes happens that a man may be first-class under one employer and second-class under another. An employe who serves the first year with proper efficiency grading might then be appointed to his job for five years, subject always to automatic self-dismissal because of lack of efficiency. Upon the completion of this five years' service satisfactorily he could be appointed for life, thereafter to be removed only upon charges as is the present custom. No man could then be head of a department until he had served this six years probationary term except that during the first ten years of civil service regulations in a city this requirement could be waived. Five or more years' service in a similar capacity in another city operating in the same way could be counted in case it is found advisable to bring in an outside man.

Pensions could be provided with compulsory retirement at the age of 70 years, or sooner, for disability. Five per cent of salaries could be placed in the pension fund and if an employe resigns he would be entitled upon reaching the age of 70 to the pension his years of service entitle him to, or his money be returned to him with interest at the rate of four per cent and he will thereafter have no claim for a pension. The amount of pension could be governed by length of continuous service.

To summarize, do not the present faults of the civil service organization lie in the lack of a probationary period of service to supplement the first examination to determine fitness; the deadening effect on ambition of a life job secured through a cram examination; the lack of control over subordinates; and, the lack of pension provisions so new blood can be introduced and old men and women removed when their efficiency begins to lessen? We should be glad to hear the opinions of our readers on these questions.

The Twenty-Fifth Annual Meeting of the Illinois Society of Engineers and Surveyors at Cairo, Ill.

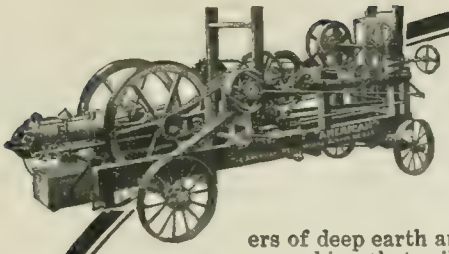
The program of papers read at the Cairo meeting of the Illinois Society of Engineers and Surveyors, published in ENGINEERING-CONTRACTING, issue of January 19th, was substantially adhered to. The convention was called to order on the afternoon of Jan. 26, and from 2 p. m. of that day until the adjournment at 9 p. m. of Jan. 28 there was a struggle between the men who believed their duty required them to listen to papers, and the citizens of Cairo who made the city free to the delegates and saw no reason for the reading of papers. The citizens finally won and a banquet followed the last session.

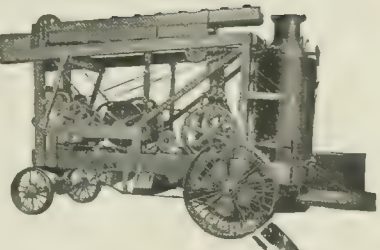
There was a very large attendance from all parts of the state and the papers presented were of a high order. Those of general interest will appear in early issues of ENGINEERING-CONTRACTING and all will be printed in the 1910 Proceedings of the Society. The officers elected for the ensuing year are as follows: President, A. N. Johnson, State Highway Engineer of Illinois; Vice President, J. W. Dappert of Taylorville, Ill. Mr. Johnson being a Trustee his election as President left a vacancy, which was filled by electing Mr. J. G. Gableman as Trustee for 1910. For Trustees to serve 2 years the society elected Mr. Geo. C. Habermeyer and Mr. A. B. Alexander. The choice of a majority for the next place to meet in 1911 was East St. Louis.

At such a convention interest is naturally divided between the papers, with attendant discussion, and the social features. It is the one opportunity many have of meeting with men working along similar lines and the interchange of experiences. Sometimes experience meetings on excursions are far richer than the more formal ones in the convention hall. Mayor Parsons of Cairo held this idea strongly and he was energetically backed by the citizens. On the afternoon of the 27th a special train took the members on a trip to the Illinois Central R. R. bridge at Cairo and to the famous Thebes Bridge. At Thebes nearly all the delegates visited the old Court House where Abraham Lincoln and other noted lawyers of his day conducted cases. In the evening Mr. M. O. Eldredge of the U. S. Bureau of Road Inquiry gave a most interesting talk on roads, illustrated by lantern slides, and Mr. F. O. Dufour, Professor of Bridge Engineering at the University of Illinois, gave an illustrated talk on interesting bridges in Europe. Following these talks a smoker at the Alexander Club was tendered the delegates by the Cairo Commercial Club and the Board of Trade. A bountiful collation was served, followed by songs by the Cairo Maennerchor and speeches by good speakers. The delegate's badge insured free rides on the street cars. On the afternoon of the 28th the Mayor personally conducted a steamboat excursion on the river to give the delegates an opportunity to see the junction of the Mississippi and Ohio Rivers. At noon on the same day one of the moving picture theatres was given to the convention and Mr. Eldredge presented moving pictures showing all the operations of road building and also moving pictures of rock quarrying in France and the blasting of 150,000 tons of rock in one shot, in that country. Until the recent blast whereby 180,000 yards were removed in Southern California this French blast was held to be the record.

In the evening after the excellent paper by Mr. J. W. Woermann on the "St. Louis and Cairo Deep Waterway," Professor Dufour finished his illustrated talk on "Observations of Engineering in Europe" and Mr. Johnson (President-elect) gave a talk on "Developments in Road Construction." an illustrated paper on reinforced concrete bridge construction in Illinois. The meeting then adjourned to the banquet at the Halliday Hotel, tendered by the citizens of Cairo.

On the last afternoon upon the return from the boat trip the delegates held an experience meeting of several hours to discuss topical questions suggested by members and printed on the program. This informal meeting was one of the most enjoyable features of the convention and was participated in very generally by delegates. The report of the committee on registration and licensing of surveyors brought up considerable discussion. The committee was continued, although not hopeful of success in securing a license law for surveyors as the members of the State Legislature were opposed to it, and it did not have the support of all engineers. Mr. Chamberlain, as a railroad engineer, based his objection to the proposed law on the ground that under it every man who made a land survey must have a license. He believed this was a hardship and that it should be sufficient to permit a licensed surveyor to employ unlicensed instrument men provided he was held personally responsible for the work of his assistants. It was shown that this was not the intention of the law and only the poor English employed would warrant the reader in so construing it. The report of the committee on surveying advocated the necessity of having monuments established on which to base town and city resurveys and after some discussion a Committee on Publicity was added to the special committees, the members to be appointed by the President. This committee is to give publicity to those parts of the proceedings that affect most largely the engineer in his relations with the public. The committee on the metric system presented an interesting report on the history, advantages and present disadvantages of this system of weights and measures. The paper and the discussion following it indicated that the society does not believe it advisable at the present time to advise legislation on this subject but believes the whole world will ultimately adopt a uniform system of weights and measures, the process being evolutionary rather than revolutionary. The committee on measures of length reported against the project of having standards fixed at county seats for the reason that for a small fee the Bureau of Standards in Washington will test tapes.





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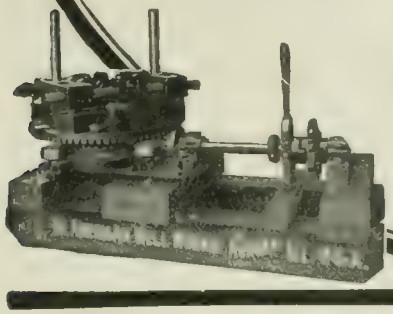

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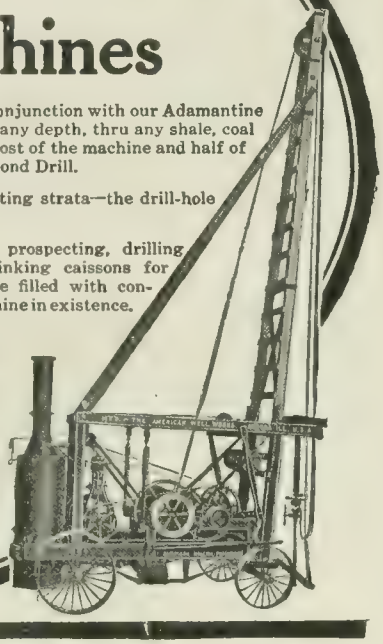

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REFUSE INCINERATOR, STEEL STACK AND SEWAGE PUMPING STATION EQUIPMENT.

El Paso, Texas, January 1, 1910.

Sealed proposals for furnishing all labor and materials for the construction and erection of a refuse incinerator, steel stack and sewage pumping station equipment, with appurtenances, in the city of El Paso, Texas, will be received by the City Clerk at his office at the City Hall, El Paso, Texas, until 12 o'clock noon, standard time, Thursday, March 3, 1910, in accordance with the plans and specifications on file at the office of the City Engineer of the city of El Paso, Texas, from whom copies may be obtained on payment of $10. Plans and specifications may also be seen at the office of Hering & Fuller, Consulting Engineers, 170 Broadway, New York, N. Y.

The equipment to be installed consists of one three grate top charged incinerator of a capacity of 48 tons of wet weather refuse per 24 hours, two horizontal 125 horse power water tube boilers, two direct connected engine driven direct current 65 K. W. generating sets, three direct connected motor driven vertical centrifugal pumping units each of a capacity of 2 million gallons per 24 hours, one one-ton three-motor electric traveling crane, one self supporting steel stack 4 feet 6 inches in internal diameter and 70 feet high above the base, a four ton platform wagon scale, a ventilating apparatus, a pre-heater for the incinerator, together with the necessary refuse boxes, flues, tools, instruments, valves, pipes, wires and other appurtenances.

Proposals shall be made on the blank forms to be obtained from the City Engineer, and shall be sealed and filed with City Clerk before the hour above stated, when they will be opened by him and publicly read in the Council Chamber in the City Hall.

All proposals will be considered informal and rejected which contain bids not asked for, or which do not contain prices in words and figures for all items given in the Form of Proposal, or which otherwise are not in conformity with this notice.

Each proposal shall contain the full name of every person, firm or corporation interested in the same and the address of the person, firm or corporation and secretary of the corporation bidding, and shall be accompanied by a certified check upon a national bank drawn to the Treasurer of the city of El Paso in the sum of Five Thousand ($5,000) Dollars.

The bidder to whom the contract may be awarded shall attend at the office of the City Clerk with the sureties offered by him (or them) within 12 days (Sundays excepted) after the date of the notification by the city of the acceptance of his or their proposal and there sign the contract in triplicate for the work. In case of the failure so to do he or they will be considered as having abandoned the same and the certified check accompanying his proposal shall be forfeited to the city.

The checks of all unsuccessful bidders will be returned upon demand and also the check of the successful bidder upon the execution of the contract and the furnishing of the required bond.

A bond in the sum of twenty-five (25) per cent of the amount of the contract with sureties satisfactory to the City Council will be required for the faithful performance of the work.

The refuse to be burned will be a mixture of vegetable and animal matter, bones, paper, rubbish, cans, bottles, ash, dust, floor sweepings, manure, dead animal and street sweepings, as these constituents are defined in Article II of the contract.

No tests have been made to ascertain the calorific value of the refuse. The bidder must make for himself such investigations as he may deem necessary and after he has made his proposal to the city of El Paso he shall not make any claims or complaints as to the character of the refuse because of any failure on his part to properly fulfill the specifications and required guarantees. It may be stated, however, that at the present time refuse is commonly burned on the dump or in piles in the back yards of the houses. On account of the dry climate, evaporation of water from the refuse is rapid.

Each bidder shall furnish all of the drawings, specifications and statements called for under this contract and they shall accompany and form a part of his proposal to the city of El Paso.

All bids will be compared on the basis of the Engineer's estimate of the work to be done as outlined in the five items given below:

Item.

I. Furnace, combustion chamber, preheater, refuse boxes, tools, flues, instruments, duplicate materials and tests. Lump sum.

II. Generators, motors, pumps, valves, piping, ventilating apparatus and tests. Lump sum.

III. Electric crane, platform scales, float gage and tests. Lump sum.

IV. Boilers, feed pumps, feed water heater and steam piping. Lump sum.

V. Self supporting steel stack and foundations. Lump sum.

The quantities in these items are not given in detail and are only to serve as the basis of a uniform comparison of bids. The City Council reserves the right to increase or decrease the amount of any class or portion of the work as may be deemed necessary and according to the specifications and contract.

The City Council reserves the right to reject any or all bids.

PERCY M'GEE,
City Clerk.

F. H. Todd,
City Engineer.

CONSTRUCTION OF REFUSE INCINERATING AND SEWAGE PUMPING STATION, FORCE-MAIN AND SEWAGE DISPOSAL WORKS.

El Paso, Tex., January 1, 1910.

Sealed proposals for furnishing all labor and materials for the construction of a refuse incinerating and sewage pumping station, force-main and sewage disposal works, with appurtenances, but not including furnaces, pumps and machinery, in the city of El Paso, Texas, will be received by City Clerk of said city at his office at the City Hall, El Paso, Texas, until 12 o'clock noon, standard time, March 3, 1910, in accordance with the plans and specifications on file at the office of the City Engineer of the city of El Paso, Texas, from whom copies may be obtained on payment of $10. Plans and specifications may also be seen at the office of Hering & Fuller, Consulting Engineers, 170 Broadway, New York, N. Y.

Proposals shall be made on the blank form to be obtained from the City Engineer, and shall be sealed and filed with the City Clerk before the hour above stated, when they will be by him opened and publicly read in the Council Chamber in said City Hall.

All proposals will be considered informal and rejected which contain bids not asked for, or which do not contain prices in words and figures for all items given in the Form for Bids, or which otherwise are not in conformity with this notice.

Each proposal shall contain the full name of every person, firm or corporation interested in the same and the address of the person, firm or corporation and secretary of the corporation bidding, and shall be accompanied by a certified check upon a national bank drawn to the Treasurer of the city of El Paso in the sum of Five Thousand ($5,000) Dollars.

The bidder to whom the contract may be awarded shall attend at the office of the City Clerk with the sureties offered by him (or them) within twelve days (Sundays excepted) after the date of the notification by the city of the acceptance of his or their proposal and there sign the contract in triplicate for the work. In case of the failure so to do he or they will be considered as having abandoned the same, and the certified check accompanying his proposal shall be forfeited to the city.

The checks of all unsuccessful bidders will be returned upon demand and also the check of the successful bidder upon the execution of the contract and the furnishing of the required bond.

A bond in the sum of twenty-five (25) per cent of the amount of the contract with sureties satisfactory to the City Council will be required for the faithful performance of the work.

All bids will be compared on the basis of the Engineer's estimate of work to be done, as follows:

Item.

1. Earth excavation at site of incinerating and pumping station.2,770 cu. yds.
2. Earth excavation for force-main and disposal works.....5,800 cu. yds.
3. Rolled embankment.....6,700 cu. yds.
4. Rock excavation.....50 cu. yds.
5. Seeding.....1 acre
6. Roadways and walkways.....
7. 24-inch force-main and main distributor exclusive of trench...2,850 lin. ft.
8. 30-inch cement pipe exclusive of trench.....120 lin. ft.
9. 24-inch cement pipe exclusive of trench.....395 lin. ft.
10. 18-inch cement pipe exclusive of trench..... 45 lin. ft.
11. 14-inch cement pipe exclusive of trench.....250 lin. ft.
12. 12-inch cement pipe exclusive of trench..... 44 lin. ft.
13. 8-inch cement pipe exclusive of trench.....640 lin. ft.
14. 4-inch cement pipe exclusive of trench..... 10 lin. ft.
15. Gate valves and shear valves..... .....lump sum.
16. Concrete—1:2½:5—in sprinkling filter (except slabs), settling basin, manholes, foundations to laboratory and other concrete of similar nature required.....1,425 cu. yds.
17. Concrete—1:2:4—in foundations, walls, columns and floors in the incinerator and pumping station building below the top of the incinerator floor..... .....625 cu. yds.
18. Concrete—1:2:4—in sedimentation tank and concrete slabs over the main and lateral collectors of filter..... .....202 cu. yds.
19. Steel reinforcement....41,450 pounds
20. Lateral distributors.....lump sum.
21. Risers.....lump sum.
22. Nozzles.....lump sum.
23. Dosing Apparatus.....lump sum.
24. Miscellaneous wrought iron and steel work.....10,000 pounds
25. Miscellaneous cast iron work..... .....3,000 pounds.
26. Wooden appurtenances.1.2 M. ft. B. M.
27. Laboratory.....lump sum.
28. Superstructure of incinerating and pumping station.....lump sum.

Concrete and Reinforced Concrete Section

Note: This section is devoted to methods and cost of constructing concrete and reinforced concrete structures. It will cover the selection, testing and proportioning of concrete materials; laboratory tests of concrete; concrete mixing, transportation and placing; fabrication and placing of reinforcement, and form construction and erection. It will also contain articles on new and interesting developments in the design of reinforced concrete.

Method and Cost of Reinforced Concrete Highway Bridge Construction Under the Direction of the Illinois Highway Commission.*

This paper presents some cost data of highway concrete bridges built in 1909 under the specifications and supervision of the Illinois Highway Commission.

It is well to explain first just what control the State Highway Commission in Illinois has over bridge work. Under the law creating the commission it can upon request of local officials give advice concerning roads and bridges. The work therefore is purely advisory and can be undertaken only at the invitation of the local officials, who may or may not accept the advice offered, as they see fit.

The inspection, plans, estimates, specifications, and supervision given to the work by the state commission where requested by the local officials is all done without charge to the township or local community. The fact that in the past they have built so many poor bridges at a price oftentimes too great has induced many of the township officials, as well as county boards, to seek the aid of the commission in designing and erecting bridges, and the more this work has become known over the state the greater has been the demand, until at present 502 bridges have been inspected and reported upon, complete plans for 383 made, and 202 bridges completed or under contract, of which 137 are of reinforced concrete.

Probably a majority of the bridge sites in Illinois has a low clearance or headroom. Foundations usually must rest on earth; in many instances it becomes necessary to drive piles in order to give sufficient bearing. It is exceptional that the rock approaches near enough to the surface to found the abutments on it. It became necessary to adopt such a design as would give maximum clearance and waterway, at the same time adapted to an earth foundation. We therefore developed a through girder concrete bridge—that is, a bridge supported by two girders to which the floor is hung—in this way using a minimum of clearance and giving a maximum waterway for a given distance between abutments.

This type of bridge has its limitations. A bridge supported by two girders to which the floor is hung is limited as to width of roadway for a given span and also as to length of span. It is found, however, that where the roadway is not required to be over 18 or 20 ft. this type of bridge has proved economical up to spans of 40 to 60 ft., as compared with arches having the same area of waterway and designed to carry the same loads. While the tops of the girder bridges are heavier than would be required for arches, yet owing to the fact that there is no horizontal thrust developed, the abutments do not need to be as extended or made as heavy. There is therefore less concrete for the width of roadways named, taking the abutments and superstructure as a whole, in the through girder design than for arches, giving the same area of waterway and capable of supporting the same loads. In appearance the girder bridges are massive and well adapted to their apparent purpose, having in general a not unpleasing outline.

Perhaps the greatest advantage possessed by the girder type over the arch is the slight damage, if any at all occurs, to the former due to uneven settlement of the abutments, as is very apt to occur in many of the soil conditions encountered, while on the other hand such displacement of the abutments of an arch is extremely hazardous to its stability. These are the reasons that we have designed nearly all our concrete bridges of the through girder type, not that this type is necessarily to be preferred in all locations or under all conditions, but merely that it has proven most economical in nearly all instances in our practice.

Method of Design.—The formulas used in the design of these bridges have been deduced from the general formulas developed by Prof. A. N. Talbot and others. The form in which we use them is that most convenient for purposes of bridge design. The first fact to determine is the stress to be allowed in the concrete and the steel, which, when once fixed, determines the percentage of steel reinforcement. The compression allowed in the concrete has been taken at 750 lbs. per sq. in. for concrete 60 days old with a corresponding stress in the steel in tension of 16,000 lbs. per sq. in. This corresponds to practically 1 per cent reinforcement.

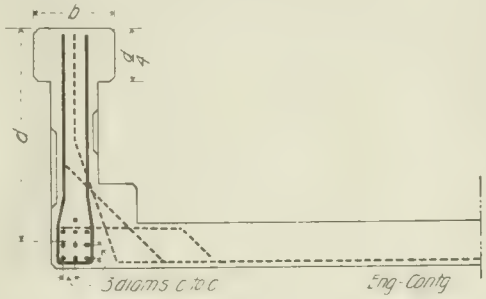


Fig. 1—Half Transverse Section of Standard Girder Highway Bridge, Illinois Highway Commission.

To compute the dimensions of a girder to withstand a given bending moment, M, where b is the breadth and d the depth, from the top of the beam to the center of gravity of the steel, using the above stresses in the concrete and steel, we will have $M=0.853\times16.000\ bd^2\times0.01$. As we usually assume b and desire d, this reduces to the simple form:

$$d=\sqrt{\frac{M}{136b}}$$

For computing the depth of T beams, see Fig. 1; the width of the flange b is assumed, and the depth is then computed by the above formula, but always making the depth of the flange not less than one-fourth of the value found for d.

To provide against diagonal tension in the webs of beams, U stirrups are used where the shear in the concrete exceeds 30 lbs. per sq. in. The amount of steel to be provided is found thus: Let V be the total shear in a given section of the beam. The steel, stressed at 16,000 lbs. per sq. in., necessary to carry 0.6 V is distributed along the beam for a distance equal to the height of the beam $= d$. For example, if $V = 200,000$ lbs., 0.6 $V = 120,000$ lbs., which would require 12.5 sq. ins. of steel. If the value d of the beam is 60 ins., there is required 12.5 sq. ins. of steel for 60 ins., or 0.208 sq. ins. of steel per inch of girder. A U-shape stirrup of ¾-in. square section rods would have in both legs 1.12 sq. ins. of steel, which divided by 0.208 will give the spacing for the U stirrups, which in this case would be about 5 ins. for the first 60 ins. along the beam. In the next section a new value for the shear would be computed and the rods and stirrups spaced accordingly, as we usually compute the shear for sections which are arbitrarily spaced along the beam equal to its depth d.

The thickness of the web of the T beams should be investigated for horizontal shear. Usually, however, the governing factor in determining the thickness of the web is the space required for the reinforcing rods.

The loads for all concrete bridges are taken thus: Dead loads concrete at 144 lbs. per cu. ft., crushed stone at 90 lbs., and earth at 100 lbs. per cu. ft. Live loads are uniform 125 lbs. per sq. ft. and concentrated live load of 24 tons distributed on two axles 10 ft. apart, 8 tons on the front and 16 on the rear axle. The load is taken as applied over a width of 12 ft. The moment for both uniform and concentrated live loads is computed, and the greater combined with the dead load moment to determine the girder and floor dimensions.

Character of Concrete.—The character of concrete employed in the bridges under discussion is a factor governing the cost. The specifications provide for a 1:2½:4 mixture for reinforced work. This proportion was determined upon after considerable experience with a 1:2½:5 mixture, which did not secure an altogether satisfactory finish. As much of the surface of the concrete is exposed in bridges, a smooth, close grained surface is particularly desirable. If a smooth finish is to be secured in concrete work, it is necessary first that the forms be carefully made and kept true to alignment; second, that the concrete shall contain sufficient mortar to more than fill all voids in the aggregate. This is not secured satisfactorily when the proportion of mortar to the aggregate is one-half, as is the case in a 1:2:4, 1:2½:5, or 1:3:6 concrete. The specifications were therefore changed so that the proportion of mortar to the aggregate varies with different classes of concrete, according to the purpose for which it is to be used. In reinforced work we have endeavored to use a concrete which will have a volume of mortar about equal to 60 per cent of the volume of the aggregate. Such an amount of mortar is not necessary where the concrete is placed in large masses, but in most reinforced work the concrete must be placed around the reinforcing rods and molded closely against the forms, which are not a great distance apart. Under these conditions, if a honey-combed effect is to be avoided with the workmanship ordinarily secured, concrete with more than 50 per cent mortar should be used. In gravel concrete the amount of cement to be used is proportioned according to the amount of sand; the amount of aggregate that may then be allowed depends upon the voids in the aggregate, mortar being supplied to at least 60 per cent of the voids for use in reinforced work. Aggregate for this class of construction moreover should not exceed 1 in. in size if it is to be satisfactorily placed about the reinforcement.

While the specifications do not call for any particular kind of reinforcement, other than it must have some means of rigid mechanical bond at frequent intervals as a matter of fact nearly all the work so far done has employed square, twisted rods.

Forms.—The specifications and drawings provide for rigid forms. Particular attention is paid to the bents supporting the structure during construction. It is evident that great care must be exercised to prevent any settlement of the girders while the concrete is hardening, when it is borne in mind that, for spans of 40 to 60 ft., the girders and floor weigh 6 to 7 tons per running foot. The plans for the longer spans require that the bents supporting the forms shall rest on piles firmly embedded, unless the stream bed is of such a character to make this unnecessary. But such a condition is the exception. In a number of instances the contractor has put in concrete footings flush with the bottom of the stream bed and placed the bents on them.

Costs.—The cost data here given, Table I, were collected by the resident inspectors in the employ of the State Highway Commission. They kept a daily record of all labor for each

*Rearranged from a paper by A. N. Johnson, State Highway Engineer, Springfield, Ill., read at the annual convention of the Illinois Society of Engineers and Surveyors, Cairo, Ill., Jan. 26-28, 1910.

TABLE I. SHOWING DIMENSIONS, QUANTITIES AND COSTS OF REINFORCED

Bridge No.	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(15)
Dimensions:														
Clear span in feet	7	8	10	12	12	12	13	14	14	14	14	14	14	16
Width of roadway in feet	18	20	16	14	16	18	16	16	16	19	16	16	16	16
Height of abutments in feet	7	14	14	..	9.5	13.5	8.5	12	15	85	9	22	11	12
Quantities:														
Concrete in substructure, cubic yards	22.71	61.74	46.55	.....	35.60	52.87	37.60	33.28	27.07	34.74	23.74	139.00	29.82	38.84
Concrete in superstructure, cubic yards	6.91	7.42	11.45	.....	11.85	17.13	34.20	13.31	14.93	17.38	14.93	15.44	13.31	21.28
Total concrete	29.62	69.16	58.00	16.00	47.45	70.00	71.80	46.59	42.00	54.85	38.67	154.44	43.13	60.12
Steel in substructure, pounds	850	2,927	1,652	.....	1,290	1,926	.....	1,027	724	1,593	700	10 633	790	1,400
Steel in superstructure, pounds	670	741	1,041	.....	1,223	1,554	4,120	1,924	1,647	1,938	1,647	1,688	1,926	2,454
Total steel	1,520	3,668	2,693	1,800	2,513	3,480	4,120	2,951	2,371	3,831	2,347	12,321	2,716	3,854
Cost:														
	Per cu.yd.	Per cu.yd.	Per cu.yd.	Per cu.yd.	Per cu.yd.	Per cu.yd.	Per cu.yd.	Per cu.yd.	Per cu.yd.	Per cu.yd.	Per cu.yd.	Per cu.yd.	Per cu.yd.	Per cu.yd.
Cement	$1.35	$1.81	$1.51	$1.30	$1.85	$1.46	$2.25	$1.74	$2.05	$1.34	$1.56	$1.48	$1.74	$1.56
Stone (*) or gravel (†)	*2.44	*0.77	†2.05	*3.23	†1.19	†1.72	†1.00	*2.61	*2.71	*3.06	*1.64	*1.99	*2.78	*2.45
Sand	0.61	0.80	1.06	0.32	....	0.86	....	1.10	1.46	0.75	0.72	0.65	1.23	1.09
Forms	1.50	1.71	1.59	2.07	2.16	2.39	1.70	1.37	2.50	1.01	1.44	2.38	1.58	2.82
Steel in place	1.16	0.81	0.80	2.41	1.53	0.84	1.28	1.13	1.26	1.72	1.44	1.89	1.24	1.51
Mixing and placing concrete	1.61	1.56	1.16	0.95	1.23	1.46	0.80	1.77	1.81	0.84	2.05	1.95	1.93	1.60
Excavation	1.28	0.41	1.16	....	1.09	2.16	1.09	0.50	1.70	1.06	1.00	3.91	0.81	3.49
Total	$9.95	$7.87	$9.33	$10.28	$9.05	$10.89	$8.12	$10.22	$13.50	$9.80	$9.85	$14.25	$11.31	$14.52

portion of the work, together with the quantity and cost of all materials. The cost of materials was generally obtained from the bills, and the prices secured from the contractors. The amounts given therefore do not contain any allowance for the office maintenance of a contractor's organization, no traveling expenses of the contractor, nor any allowance for profit. Also, in the cost for forms, deduction has been made for the actual salvage on all lumber, but as most of the work was in the country there was little opportunity for the contractor to dispose of this material to advantage.

All the data presented are from work done during 1909. There were a number of other jobs handled, but sufficient data were not collected on them to embody in this table. The various bridges have been arranged in order of length of span, and all data available collected together in tabular form.

In a number of instances it proved that the actual cost to the contractor was greater than his contract price. It is perhaps well to consider what were some of the causes that produced such results. First, I should ascribe incompetency on the part of the foreman as the most usual cause of loss to the contractor, or, if not an actual loss, at least a great reduction in the profit reasonably to be expected. The loss usually occurred in the foundation portion of the work. Sufficient protection would not be taken to prevent a cave-in, with the result that a large amount of extra material would be shoveled from the bottom of the trench to the top. Good sheeting well braced is usually required.

In a few instances increased cost to the contractor was occasioned by doing part of the work twice, owing to the use at first of poor materials which had to be replaced. In some instances foremen were found who could scarcely read the plans and except for the assistance of the inspector, would have had a sorry time of it. Others had no control over their men, who loafed or worked much as they pleased.

It is evident that under such conditions no profits could be expected. Probably all the contractors intended to send competent men, and possibly sent as good as they could get, but when good men are scarce it is not to be expected that they will be attracted by a poor salary. An adequate wage will usually secure competent foremen.

Money was also lost on some jobs through ignorance on the part of the contractor in making his bid. In a few cases contracts were taken at prices 30 to 40 per cent below the estimate. The bids from experienced contractors at the same letting would be for a rational sum. There should be some way by which a manifestly too low bid for public bridges or other public works for that matter could be rejected as readily as too high bids. To accept a bid too low is unfair to the reasonable bidders, takes unfair advantage of the contractor making the low bid, and by putting a premium on poor work is unfair to the tax payers.

The cost data here presented should afford some guide in making bids on similar work. Owing to the great variance in conditions it is impossible to state what price should be secured for reinforced concrete bridges to insure in a given instance a reasonable profit. It will be noticed that the cost of cement in a cubic yard of concrete varied from $2.35 to $1.25; for stone, from $3.23 to $1.30; for sand, from $1.47 to 38 cts., excluding gravel concrete; for gravel, from $2.43 to 70 cts.; for forms, from $3.95 to 83 cts.; for placing steel, from $3.10 to 80 cts.; for mixing and placing concrete, $2.72 to 72 cts.; for excavation per cubic yard of concrete, $3.91 to 21 cts.; and that the total cost per cubic yard of concrete varies from $17.51 to $6.54.

From such a wide variation it becomes apparent that averages will mean but little to estimate the cost of a particular job. One of the most uncertain features of this class of work is the cost of the excavation. It would probably be a more exact method of distribution if the cost per cubic yard for the foundation were given separately from the superstructure, and charge all of the excavation against the concrete going into the foundation. This, however, was practically impossible from the data at hand, but the amount of concrete in each portion of the structure is given, which will assist in determining the proper distribution of the cost.

It generally may be said that unless materials were exceptionally near at hand and obtained consequently at much lower cost than usual, there has been little profit to the contractor in this class of work at a price much les than $10 to $12 per cu. yd. It does not follow, however, that all of the work let at a less figure has been at a loss to the contractor, or that all jobs let at a higher figure have been at a profit, as some of the work which was let at a good figure was so badly managed as to cut all the profits and cause an actual loss to the contractor. Inasmuch as the data here given include both well and badly managed work, this fact should be borne in mind in attempting to draw any too exact conclusions. But if used with judgment it is believed that these data should be of considerable help to engineers and contractors in making estimates on similar work.

Design of and Method of Constructing a Reinforced Concrete Aqueduct Lining, with Some Data on Costs.

The Illinois and Mississippi Canal has in all nine aqueduct bridges with a total length of 1,820 ft. The matter of lining for the aqueduct trunks was therefore of considerable importance. So far as the writer is aware no concrete lined aqueducts existed in 1905 or at the time these lining were built

The bridges vary in length from 140 ft. to 350 ft., but are uniformly built in spans or bays of 35 ft., making one type of lining applicable to all of the bridges. Hence the design and general method of construction were the same for all the bridges. The construction details described, however, were those used on Aqueducts Nos. 4, 5 and 6, which were under the personal supervision of the writer. Plans were originally drawn for the trunk to be built of steel I beams with a wooden lining. Under these plans the steel beams were bought in the winter of 1904, as it was expected that the contractors would have the piers ready the following summer. The wooden linings were not to be placed until near the opening of the canal. In January, 1905, Mr. L. L. Wheeler, assistant engineer in charge of the feeder and western section of the canal, designed a reinforced concrete lining to take the place of the wooden one. This design was approved and the linings built in accordance therewith.

As above stated, the bridges are 35 ft. c. to c. of piers. The clear width of channel is 40 ft. The normal depth of water is 7 ft., but the stresses were computed under a maximum loading of 7 ft. 5 ins. The steel frame work in the floor consists of nineteen 20-in., 90-lb. I beams, 34 ft. 11 ins. long and spaced 2 ft. 3 ins. c. to c. The beams rest directly on the concrete at the piers. Three 1-in. rods carrying cast iron cylindrical separators pass through the webs of the beams, giving them lateral rigidity and unification. The side frame work consists of two of the above sized I beams placed horizontally one 6 ft. above the other. They are united by web members, forming a three panel truss to support the dead load of the beams themselves and the side lining. The upper edges of the flanges of the top beam are 7 ft. above canal bottom. On this steel frame work the linings were built.

In considering the adoption of reinforced concrete linings in preference to the wooden lining, consideration was had of the fact that should the canal be unwatered at any time the wood would be exposed to drying out, checking, and warping. As a matter of fact portions of the canal have been practically unwatered three times in the two years of its operation. Another consideration leading to the adoption of concrete linings lay in the deflection of the beams. Under the maximum loading the deflection in the bo[illegible] the bottom beam of the [illegible] tion is ⅞ in. Under [illegible] ficulty of caulking the junction of the sides with the bottom is apparent. A third important consideration in the matter developed through the local conditions existing at some of the aqueducts, particularly at Nos. 4, 5 and 6, where the water in the streams crossed, at times rises several feet above the floor of the aqueducts, the maximum recorded being 5.7 ft. at Aqueduct No. 5. Should the canal be empty, the upward and inward presure thus produced would be a serious matter which wooden linings would be unfit to resist. These contingencies and stresses, not provided for in the wood design, were readily cared for in the concrete design. In addition the first cost of the concrete lining was estimated to be 20 per cent less than the wood, with a probable much greater durability.

To meet the above conditions the design was worked out as follows: The bottom was made 6 ins. thick, with ½-in. corrugated bars spaced 6-in. centers transversely and 9-in. centers longitudinally or two between each two I beams, the tops of the beams taking the place of every third rod. The tops of the I beams were imbedded 2 ins. in the concrete of the floor, thus thoroughly anchoring the lining to the steel beams. The transverse rods were laid upon the tops of the I beams and the longitudinal rods were wired to the under side of the transverse rods. The sides were made of

CONCRETE HIGHWAY BRIDGES BUILT BY THE ILLINOIS HIGHWAY COMMISSION IN 1909.

(16)	(17)	(18)	(19)	(20)	(21)	(22)	(23)	(24)	(25)	(26)	(27)	(28)	(29)	(30)	(31)	(32)	(33)	(34)	(35)	(36)	(37)	(38)
16	16	17-12	18	20	20	20	20	20	20	22	24	25	25	25	30	34	35	35	40	40	50	60
16	16	c'l'vrt	16	16	16	16	16	16	16	16	16	16	16	14	16	16	16	16	16	16	16	16
11	7.5	..	12.5	15	13	13	18	15.5	14.5	14	8.5	11.5	7	13	11	13	15	10	12	16	15	16
37.52	30.35	....	.....	92.21	56.79	60.05	91.68	64.97	39.55	60.35	32.10	38.35	60.12	44.62	51.62	59.30	71.40	57.40	71.60	64.23	73.75	109.00
21.28	21.28	....	.....	25.12	25.12	25.12	25.12	25.12	25.12	30.89	30.89	26.18	26.18	24.20	41.61	62.70	52.40	52.40	63.60	62.35	65.00	97.07
58.80	51.63	48.37	84.25	117.33	81.91	85.17	116.80	90.09	64.67	91.24	62.99	64.53	86.30	68.82	93.23	122.00	123.80	109.80	135.20	126.58	138.75	206.07
1,546	546	.....	.....	1,845	1,428	1,955	4,323	2,760	1,501	2,484	1,194	1,355	1,936	1,799	1,849	2,200	2,756	2,536	2,213	2,271	2,328	3,620
2,454	2,454	....	.....	3,910	3,910	3,910	3,910	3,910	3,910	5,006	5,006	5,416	5,416	5,085	6,786	11,044	8,956	8,956	13,784	10,925	14,172	20,333
4,000	3,000	6,307	6,050	5,755	5,338	5,865	8,235	6,670	5,411	7,490	6,200	6,771	7,352	6,884	8,635	13,334	11,712	11,492	15,997	13,196	16,500	23,958
Per cu.yd.	Per cu.yd.	Per cu.yd.	Per cu.yd.	Per cu.yd.	Per cu.yd.	Per cu.yd.	Per cu.yd.	Per cu.yd.	Per cu.yd.	Per cu.yd.	Per cu.yd.	Per cu.yd.	Per cu.yd.	Per cu.yd.	Per cu.yd.	Per cu.yd.	Per cu.yd.	Per cu.yd.	Per cu.yd.	Per cu.yd.	Per cu.yd.	Per cu.yd.
$1.61	$1.30	$1.72	$1.74	$1.44	$1.87	$1.68	$2.24	$2.20	$1.25	$1.96	$2.31	$1.62	$1.45	$1.87	$1.43	$1.76	$1.90	$1.85	$1.47	$1.70	$2.35	$1.31
			†1.20		†0.88	*1.75		†2.42				†1.65					†0.72	*0.90				
*2.50	*1.30	†1.83	*1.92	†0.85	*0.88	†0.70	†0.96	*1.93	†1.96	†1.65	†1.91	*0.49	*2.12	*2.97	*1.83	†1.43	*1.45	†2.06	*1.49	†2.43	†1.60	*1.50
1.11	0.35	0.73	0.29	....	0.40	0.28	....	0.05	....	....	....	....	0.94	1.47	1.24	....	0.14	1.41	0.47	0.70	....	1.11
2.47	0.98	1.36	2.20	1.36	1.74	1.51	1.37	3.95	0.83	2.37	1.97	2.72	2.31	2.57	1.84	2.25	1.34	1.41	2.60	2.15	3.24	1.62
1.25	1.34	2.64	1.44	1.04	1.37	1.57	1.52	1.61	1.73	2.24	1.95	2.48	2.75	1.90	2.43	2.08	2.23	2.59	3.10	2.01	2.32	2.43
1.09	0.83	0.98	1.50	1.36	1.27	1.16	0.90	2.72	0.86	1.07	0.72	2.07	0.90	1.14	1.70	0.96	1.02	1.44	2.01	1.55	1.53	1.14
1.69	0.43	0.47	0.95	3.30	1.45	1.18	1.33	2.63	0.59	1.00	1.52	1.67	0.21	1.13	1.85	1.12	0.73	1.64	2.57	2.56	2.02	2.33
$11.72	$6.54	$9.73	$11.24	$9.35	$9.86	$9.86	$8.32	$17.51	$7.22	$10.29	$10.38	$12.70	$10.68	$13.05	$12.38	$9.60	$9.33	$13.10	$13.71	$13.10	$13.08	$11.43

concrete 9 ins. thick, placed with the inner face 4 ins. inside of the inner edge of the beams in the side truss; ¾-in. vertical reinforcing rods were used, spaced 6-in. centers, and bent to an irregular shape so as to come inside of the beams at the top and bottom and to within 2 ins. of the outside of the concrete in the center.

The side trusses are not sufficiently anchored to the piers to resist any great amount of inward pressure, so it was necessary to transfer the horizontal thrust, from external heads of water, to the floor system and to provide for the bending moment at the junction of the sides and bottom. To accomplish these purposes and also to prevent separation of the bottom and sides due to the deflection of the beams, a triangular piece of solid concrete was built in the angle formed by the junction of side and bottom. This triangular piece extended 3 ft. onto the floor and 3 ft. up the sides. The vertical reinforcing rods in the sides were bent out into the triangular piece and the bottom transverse sides were also carried entirely across it, thus binding the sides and floor rigidly together. The bending moment, due to the inward pressure, would then be a maximum at the top of the 3-ft. triangular piece, and the 9-in. wall there is sufficiently strong to withstand the pressure due to any external head that can occur.

The binding of the floor and sides rigidly together transfers some of the water load from the sides to the floor and from the floor to the sides, thus causing them to act in a measure as beams. The floor would of course have ample rigidity, and in order to develop the strength of the side, including the triangular piece, as a beam, and also to care for the temperature stresses, thirteen ¾-in. and nine ½-in. longitudinal reinforcing rods were used. These were spaced about uniformly throughout the section, the ¾-in. rods being placed at the bottom.

The combined weight of concrete in the floor and the submerged floor beams is sufficient to counteract the upward presure due to about 2 ft. of external head, but as heads of nearly 6 ft. had been recorded, it was very necessary to provide additional safeguards. This was accomplished primarily by bolting the floor to the piers. For this purpose nine 1¼-in. anchor bolts spaced 4 ft. 6 ins. were set along the center line of each pier. These bolts extend to the bottoms of the piers and upward between the floor beams 18 ins., so that the ends of the anchors are just below the bottom of the floor lining. The anchors were capped with nuts and large cast washers. The space between and around the ends of the floor beams and anchor rods was then filled with concrete to a depth of 18 ins. and for nearly the full width of the piers, thus thoroughly anchoring the floor beams. The floor lining at the piers rested directly on this bed of concrete, which was troweled smooth and allowed to harden in every case before the floor lining was placed. Should any expansion or contraction in the floor occur, the lining is expected to slide on this surface.

As an additional precaution against upward pressure, inlet valves with small, collapsible dams at each end of the aqueduct were provided. The valves, two in number, consist of 6-in. cast iron pipe set in the anchor concrete at each abutment, their inner or upper ends being covered with flaps which are closed against internal pressure, but which will open under external pressure and allow water to fill the aqueduct to the top of the dams. The dams consist of ten angle iron brackets, triangular in shape, to the aqueduct side of which 2-in. plank are nailed by means of nailing strips bolted to the brackets. The tops of the dams are 3 ft. above the floor of the aqueduct. The brackets are anchored to the concrete of the abutments by two small cast iron pillow blocks. A rod passing through the two legs of the bracket and both pillow blocks serves as a hinge about which the bracket can rotate laterly, when the planking is removed, to a horizontal position upon the bottom; and as the concrete to which they are anchored is 6 ins. below bottom grades, the brackets, in this position, are entirely below the surface of the aqueduct floor, and hence free from contact with any passing boat. The bracket on one end of each dam will not fall completely down owing to contact with the side wall of the abutment, but falls sufficiently far to be protected by the triangular piece of concrete in the aqueduct lining. Occasion for the operation of these inlets and dams has arisen once since their completion and their operation has been satisfactory.

To protect the concrete lining against shock and injury from passing vessels, heavy timber fenders were provided running from pier to pier. These are made up of 12x12-in. and 6x12-in. timbers bolted solidly together so as to be 30 ins. from front to back and 12 ins. from top to bottom. They are anchored to the inner face of the piers by horizontal anchor bolts and set with the upper surface 2 ft. above the normal water surface, leaving an opening of 6 ins. between the bottom of the fenders and the top of the concrete lining, through which water can overflow whenever the stage reaches 7.5 ft. It might be noted in passing that during the past year portions of the lining at each aqueduct have been cut down to the 7-ft. level to afford additional precaution against abnormal stages of water which might endanger the canal embankments. The fenders with their 30-in. top make an excellent walk along each side of the aqueduct. As a further protection against boats or projecting irons from vessels a 6x12-in. wall was bolted flush with the top of the lining by bolts passing through the concrete to the flange of the top I beam of the side frame.

The proportions of the concrete for the lining were 2 parts cement, 3 parts sand and 5 parts fine crushed stone or 1 part cement to 4 parts well proportioned gravel. At Aqueducts Nos. 4, 5 and 6 gravel was used entirely. The mixture for the anchor concrete at the piers were not quite so rich. The concrete was mixed very wet and considerable care was taken with the spreading and tamping. The floor was deposited in two courses and in sections running the length of a bay and covering two or three floor beams in width. The sections joined over the center of an I beam and no section was allowed to set before its adjoining one was deposited. Concreting the floor and the sides to the top of the 3-ft. triangular piece constituted a day's work of 8 hours during the early part of the work. The remaining top portion of the sides was placed after the lower portion had set and a part of the forming removed. The yardage in these top portions was small, and owing to the limitations of forming and the moving of runways and staging, this was not an economical method of operation, besides rendering necessary a horizontal joint at the 3-ft. point on the sides. Later authority was granted to work 10 hours and by using a different method of forming, the whole lining for one bay was deposited in a day. The surface of the floor was covered with ½ in. of mortar and troweled smooth. No finishing was done on the sides other than to exercise care to secure a dense, hard face.

The matter of forming is oftimes not given sufficient consideration in laying out concrete work, frequently being left to the carpenter foreman to work out as best he can, resulting in extra work, waste of material, and delays to the concrete gang. This loss particularly happens when the forming is anyways complex and must in part be carried on simultaneously with the concreting, and also when the forms are to be used repeatedly. On this work the floor forms were very simple, consisting of a 2-in. plank placed between the I beams and supported by brackets resting on the lower flanges of the I beams. The brackets consisted simply of a horizontal piece supporting the plank and two vertical pieces extending to the I-beam flanges, with a spreader to keep the bottom ends from slipping off the flanges. To remove these forms it was only necessary to drive out the spreaders when the brackets and plank would come out without drawing a nail. The back plank for the side forms were nailed to posts fitted between the I beams of the side truss. Between the side bottom beam and the bottom side beam a plank was specially fitted and beveled and held in place by wires passing through to the inside. On the inner face of the sides it was necessary to carry up the planking as the concreting progressed. The planks were nailed to triangular brackets extending to the full height of the sides and held in place by wires and spreaders to the back forms. The tie wires were spaced so as to come in cracks between planks. Specially sied and beveled plank were used on the triangular piece at the bottom.

As soon as the sections of the floor adjacent to the sides were deposited, they were covered 3ft. in width with plank on which was laid a runway for wheeling concrete to the sides and when these were carried up to the top of the triangular pieces, the runway was elevated and widened for a shoveling platform for completing the sides. The weight of these plank, runways, and platform was sufficient to prevent the hydrostatic pressure from the sides being transmitted under the lower edge of the form and raising the floor concrete. While the carpenters were building platforms, runways, extending forms, etc., the concrete crew was engaged on the opposite side or on a section of the floor so that the concreting progressed without delay. Between bays a board ½ in. thick was placed. This was afterward cut out with a chisel and the joint poured full of pitch.

For mixing the concrete a ½ cu. yd. Smith mixer was used. The mixer was set in the ca-

nal trunk near one end of the aqueduct and charged from the embankment above by one-horse dump carts. For filling the nearest bay the concrete was usually taken direct from the mixer in wheelbarrows, but for the remaining bays a track was laid and a side dump car pushed by hand was used to convey the concrete to a shoveling platform, adjacent to the bay being filled, from which it was shoveled into wheelbarrows and wheeled to place.

An interesting feature of the work was the methods used for protection against freezing. Owing to delay in the foundation and pier work some of the lining could not be placed until late in the season and the local conditions were such that it was very urgent that the work be finished without delay. The last concrete was deposited Dec. 28 and the temperature during the final weeks dropped as low as 12° or 15° F., barely rising to the thawing point in the middle of the day. Owing to the thinness of the lining, its exposed position, and the importance of the work, considerable care was necessary. To heat the concrete materials the exhaust steam from the mixer engine was turned into the drum of the mixer. This was accomplished by conducting the exhaust pipe to a point in front of the discharging opening of the drum, so that the drum when tilted for discharging would just clear the end of the pipe. The force of the exhaust then carried the steam into the revolving drum, where complete mixture with the dropping particles of concrete utilized practically all of the heat remaining in the steam. This method of heating concrete is unique in the writer's experience and when it is considered that the expense was absolutely nothing the results were really surprising. The temperature of the deposited concrete averaged probably 70° F., while if a batch were left in the mixer 3 minutes or more its temperature would 90 to 100° F.

[One of the editors of this paper on a piece of concrete work executed in 1906-7 had a ⅛ cu. yd. Smith mixer operated by a steam engine and the exhaust steam was discharged into the drum after passing in a coil through the water barrel on days when the temperature fell below freezing. The steam was conveyed about 125 ft. from a power house in a 2-in. pipe placed in a wooden box 6 ins. square filled with plasterer's hair. The following winter, 1907-8, he had charge of another piece of work on which a Chicago improved cube concrete mixer was used, operated by an electric motor. Steam was conveyed about 200 ft. from a power house with connections so steam hose could be attached for the purpose of cleaning the surface of set concrete and warming the concrete and forms. Branches went through the sand and stone piles and in a coil through the water barrel, ending in the mixer drum. It was found advisable to have canvas flaps over the openings of the mixer drum to confine the steam, as otherwise it bothered the men working close to the mixer.—Editors.]

To protect the deposited concrete, the inside of each bay at the close of the day's work was roofed over with 1-in. boards laid loosely on "horses," the ends being closed with pieces of canvas, and into the room thus formed, live steam from the boiler was conducted through a hastily laid pipe line. The night watchman kept up the steam, the amount needed being very small. Steam was kept on the concrete for two nights or for about 40 hours after being laid. It was considered that the outside was sufficiently protected by the 2-in. forming. On the third day the forms if needed were removed and the concrete left exposed. The cost of this protection was about 12 to 15 cts. per cubic yard of concrete and the results were perfect. As an illustration of the need of protection, it may be noted that the feed pipe for the boiler froze one night about midnight and steam was shut off from the concrete for about 7 hours. The concrete froze some and about ½ in. of the surface afterwards shelled off.

The average cost of the lining for aqueducts 4 to 9 inclusive was as follows:

Cost of concrete per bay	[illegible]
Cost of reinforcement per bay	[illegible]
Total cost per bay	[illegible]
Cost of concrete per cu. yd.	[illegible]
Cost of reinforcement per lb.	[illegible]

Earth and Rock Section

Note: This section is devoted to methods and costs of excavating earth and rock and building embankments. It will cover the grading of roads and railroads, diking and canal work, dredging, building reservoirs and earth dams, sewer and water pipe trenching, quarrying, etc.

Design and Construction of Open Ditches to Reduce Maintenance with a Description of Methods of Maintenance and Some Costs.*

A great deal of attention has been given to the design and construction of open ditches, but comparatively little to their maintenance. In fact, in many counties of the Mississippi valley where drainage work is just commencing there seems to be quite a general idea that a ditch once properly constructed will require no maintenance. Unfortunately this is not true, and open ditches, like roads, bridges, and all other engineering structures, will need more or less attention from time to time in order to keep them up to their highest state of efficiency. The amount of repair work necessary will vary with the conditions, but will be very largely reduced by careful designing.

In establishing the grade line of a ditch the ideal to be aimed at is a uniform rate of fall from source to outlet. The gradient should be flat enough to prevent erosion, yet steep enough so that at times of maximum flow loose material which has settled into the bottom of the ditch will be washed away. This ideal gradient can very seldom be used, on account of other rigid determining conditions, but the nearer it can be approached the better.

Humps in the grade line can not be considered objectionable from a maintenance standpoint, but sags are very objectionable and should be avoided wherever possible. It is a great mistake to break up the grade line into short sections for the purpose of saving a small percentage of yardage, except in the somewhat rare case of the ditch being through soil which will not erode under the most extreme conditions, because if a stream of water containing suspended matter passes down a ditch over a sag to a flatter slope, the coarser particles will be deposited, and the ditch will give trouble at that point. For the same reason curves should be as flat as possible, in order that the velocity of the water may not be checked and deposits occur.

A ditch should not be much less than 8 ft. wide at the bottom, especially if it is to be constructed by a machine which leaves rough slopes, as nearly all types of machines do. If an 8-ft. ditch looks to be very much larger than necessary, the use of large tile should be considered. If due weight be given to the question of maintenance, as well as the damage of an open ditch to the land crossed, one or more lines of large tile will be resorted to in a great many cases where narrow bottom open ditches are now used, and this is for the reason that in a narrow bottom ditch a small amount of material deposited from suspension or from the sides will have a great deal more effect in raising the grade of the ditch and obstructing the flow of water than the same amount of material in an 8-ft. ditch.

Another reason why 2, 3 and 4 ft. ditches should not be used appears from the manner in which they are usually constructed. With most types of ditching machine the banks can not be left as smooth as can be done by hand or team work, and it is expected that more or less loose material will roll or be washed down the sides to the bottom of the ditch. Operators aim to cut the center of the ditch from 1 to 2 ft. below grade, so that when this loose material fills in, the ditch will still be below grade. In a ditch much less than 8 ft. wide, however, if he carries out the usual program, he must either steepen the slopes or make a roughly rectangular shaped cut 1 to 2 ft. deep and as wide as the bottom of the ditch, either of which is likely to cause caving of the slopes. The practical result is that it is very difficult to construct a narrow bottom ditch with the common types of machine.

The ideal slope of banks would seem to be that made by nature during the erosion of streams under similar circumstances to those of the case in hand, because in the course of years an artificial channel will, by the process of erosion and weathering, tend to become shaped by nature into the form best suited to the purpose of carrying away the water, just as in natural channels, and the nearer to this form the ditch is originally constructed, the less the amount of erosion which is likely to occur. This shape will vary under different conditions, but in sedimentary soils will usually approach that of the letter U, with the legs slightly inclined. This form gives a large hydraulic mean radius and consequent high velocity.

From these considerations it would appear that it is better to design ditches with steep rather than with flat slopes, although many engineers take the opposite view. At any rate the slope specified should be such as can be made by the type of machine to be used, nature being expected to adopt them afterwards to her ends if necessary.

Ditches with low rate of fall should be designed with a cross sectional area in excess of that required to take care of the flow, and should be put deeper into the ground than otherwise called for, lest erosion may not take care of the loose material which will be washed down from the slopes during the first year after construction.

The bermes between the edge of the spoil banks and the ditch if made unnecessarily wide, will add unduly to the cost of construction. If there is to be any danger from the banks sliding in on account of the weight of the spoil banks, it will be at its maximum at any particular point just after the spoil bank at that point is completed. After the machine once passes and the spoil banks as well as the ground commence to dry out, there is not usually much danger of the weight of the spoil banks causing slides.

Narrow bridge openings often cause more or less filling up of a ditch, due to the eddies which are formed; the minimum clear width between abutments should be no less than the width of the ditch at the elevation to which the water is expected to rise in times of maximum flood.

Concrete bridges should not be used across ditches which are likely to have to be cleaned out later on with a floating dredge unless they be of such span and height as to allow a dredge to pass under without a great amount of dismantling. Otherwise it will usually be cheaper to use steel bridges, which can be removed and replaced. But if a ditch is to be maintained in the most economical way, mentioned further on, bridges will not have to be removed, and concrete or any other type may be used.

Attention should be given to the design of outlets for the tile and open branches to the end that erosion at such points may be prevented and the flow of water in the main ditch disturbed as little as possible. Branches should form an acute angle with the main line at their junctions.

The method of construction or the means by which a ditch is constructed has a bearing on its maintenance, the amount of which is disputed and probably will vary under different circumstances. It will seldom be possible, however, to select a method with a view to reducing maintenance charges, because such a

*A paper by E. H. Cowan read before the Illinois Society of Engineers and Surveyors, annual convention of 1910, Cairo, Ill.

method will most likely exceed in first cost the usual methods by a sum which, capitalized, would amount to more than enough to maintain the ditch. It will almost always be true economy to allow the contractor to select the means to be used, and to write the specifications in such a manner as to call for the best work possible to be obtained by such means.

As stated at the beginning, in spite of the most careful designing and constructing, all ditches will need more or less repair work from time to time in order to keep them at their maximum efficiency. Economy requires that this work be done annually during the dry months of summer and fall, but how rarely is this attended to. Just as roads in a great many localities are allowed to become almost impassible before being repaired, and bridges almost to collapse before receiving any attention, so ditches are left gradually to fill up until they will no longer carry off the water. Then there is a spasm of general agitation and condemnation of all parties who had anything to do with the construction of the ditch, followed by perhaps several years of strife among otherwise friendly neighbors, and finally a dredge is installed and the ditch cleaned out and enlarged or a new drainage district is formed and a new ditch constructed at large expense which is expected to remedy the supposed defects of the original one.

Railway companies and other business organizations realize that maintenance work must be done at regular intervals on all their physical structures. Nowhere except in the case of municipalities, including counties and drainage districts, do we find the general policy pursued of a periodical reconstruction of engineering structures rather than their regular maintenance. Is it not possible to devise a system under which the physical property will be as well looked after as that of business organizations? Such a system is needed because experience has shown that reliance can seldom be placed on the initiative of public officials.

As to the methods and costs of doing such work, there is an extremely small amount of recorded experience. Mr. E. E. Watts, a civil engineer of Princeton, Ind., in a paper read in 1902 before the Indiana Engineering Society, estimated that the expense of maintaining a 10-mile ditch running 25,000 cu. yds. per mile, in operation 5 years, need not exceed $10 per mile per year. This is a very small amount compared with the benefit to be obtained from keeping the ditch always in good condition.

As to the best methods of doing such work, little of value can be said until more work has been done and more experience gained and recorded. If ditches are gone over every year, hand and team work will be likely to be principally relied on. The former is to be preferred, even in places where the cost would be considerably greater, for the reason that the dragging of scrapers up the banks harrows them up and leaves much loose material on the slopes which will be washed back in by the next rain. The writer once undertook to clean out a narrow, deep canal leading to a water works intake. Each year or two during the previous 10 years this canal had been cleaned out by teams and scrapers, but it would soon fill in again. The method the writer used involved the lifting of the scrapers out with a derrick, thus not disturbing the slopes, and the result was that the canal stood at least 6 years without any further repairs.

Annual maintenance work should consist not only of the removal of sedimentary deposits, but also of tall grass, weeds, brush, willows and floating debris, as all these obstruct the flow and are a fruitful source of silting.

As indicated above, the principal maintenance work which has heretofore been carried out consists rather of reconstruction or redredging of ditches which have been neglected. The amount of work to be done is sometimes large enough to justify the installation of some type of dredge, but often it is so small that cheaper methods are desired. Many types of machine have been suggested, but few tried out. Such work is likely to always be rather expensive per yard of material moved as compared with other classes of excavation, although not so as to the value of the work done to the lands affected.

The North River Tunnels of the Pennsylvania R. R. Tunnel Entrance to New York City.*

GENERAL PLAN OF WORK.

The final decision to extend the Pennsylvania R. R. into and through New York city by a system of tunnels, and erect a large station in that city, was not reached in a hurried or off-hand manner, but after years of painstaking study and a full and extended investigation of all routes, projects and schemes, whether originating with the company or suggested by others.

The question of tunnels under the North River was an uncertain factor in the scheme, owing to the nature of the ground composing the river bed in which the tunnels would be constructed. It is well known that about 35 years ago an attempt was made to construct a tunnel under the North River by using a "Pilot" system under compressed air and forming the tunnels in brick masonry. Owing to the very soft nature of the materials through which it passed, several serious accidents occurred, and the work was abandoned after about 2,000 ft. of tunnel had been constructed. Later, this work was taken up again, when a shield was installed and an additional 1,800 ft. was built with cast-iron segmental lining, but the work was again abandoned, owing principally to financial difficulties while coincidentally before entering a rock reef which presented another serious difficulty in construction. The experience then in the construction of this tunnel led capitalists and engineers to believe that, owing to the very soft nature of the ground, a tunnel could not be built that would be sufficiently stable to withstand the vibration due to heavy traffic, and for this reason tunnels under the North River were not looked upon as practicable. The writer devised a scheme to carry within the tunnel the rolling loads on bridging supported on piers or piles extending from the tunnel invert down to hard material. These would be attached to the tunnel itself or would pass into it independently through sliding joints in the tunnel shell. This scheme gained the confidence of the management, as it was believed that, by adopting such a plan, tunnels could be built in the soft material underlying the Hudson River and remain stable under all conditions of traffic. After thus feeling assured that by this method the tunnels could be made safe beyond question, orders were given to proceed with the great work of the extension. The work was divided into three residencies:

(1) The Terminal Station-West, under the charge of B. F. Cresson, Jr., M. Am. Soc. C. E., Resident Engineer, comprising the work from the east side of Ninth Ave. to the east side of Tenth Ave., including excavation, retaining and face walls, and the extensive work of underpinning Ninth Ave. with its surface and elevated railroads and other structures.

(2) The River Tunnels, under the charge of B. H. M. Hewett, M. Am. Soc. C. E., General Resident Engineer, and Mr. H. F. D. Burke and William Lowe Brown, M. Am. Soc. C. E., Resident Engineers, including the land tunnels from the east side of Tenth Ave., New York city, to the commencement of the iron-lined tunnels, and extending westward from there to the Weehawken Shaft, New Jersey.

(3) The Bergen Hill Tunnels, under the charge of F. Lavis, M. Am. Soc. C. E., Resident Engineer, including the rock tunnels from the Weehawken Shaft to the Hackensack Portal on the west side of the Palisades, all in New Jersey.

Table I shows the quantities of certain materials and other statistics regarding this division.

The grade adopted was approximately 2 per cent descending westward from Ninth Ave., which would place the tunnel well below the government dredging plane of 40 ft. below mean low water at the pier head line; thence westward on a lighter grade still descending until the deepest portion of the river was

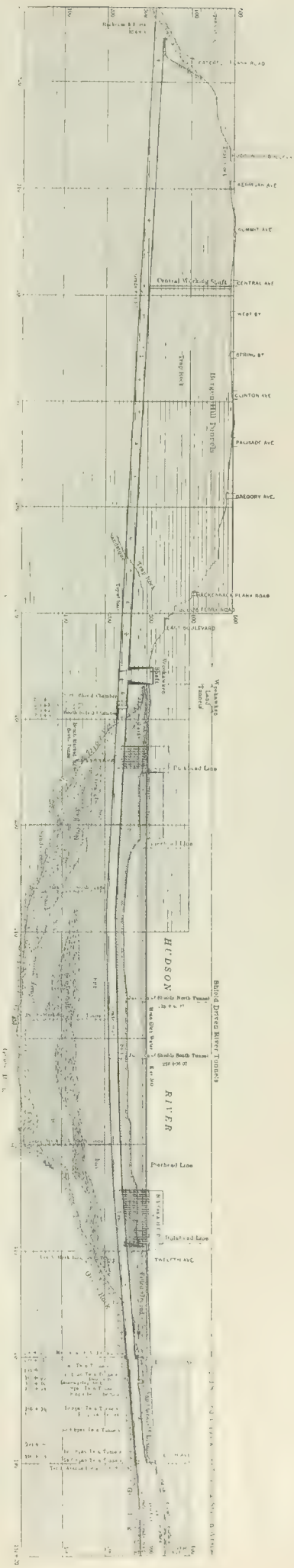


Fig. 1—Profile of North River Tunnels of the Pennsylvania R. R., New York City.

*Abstracted from a paper by Charles M. Jacobs, published in Proceedings, American Society of Civil Engineers, Vol. XXXVI, No. 1, p. 134.

reached where the top of the rail would be about 90 ft. below mean high water, this location giving sufficient cover over the tunnels to insure stability and guard against the possibility of shipwrecks settling on the tunnels. From this point to the portal an ascending grade of 1.30 per cent was adopted, which gave the lines sufficient elevation to cross over the tracks of the New York, Susquehanna and Western and the Erie Railroads, which run along the westerly base of the Palisades. Owing to the exigencies of construction, these grades in the river were very slightly modified. Fig. 1 is a profile of the tunnels as constructed.

The Board of Engineers early in 1902 took up the question of supports for the tunnels under the North River, and various plans and schemes were considered. It was finally decided to support the tracks on screw-piles carried through the lining of the tunnels, as originally proposed by the writer.

In order to know something of the capacity of the screw-piles in the actual material to be passed through, it was resolved to test them. A caisson was sunk at the end of one of the Erie R. R. piers on the New Jersey side near the line of the tunnels, and, to obtain parallel conditions as much as possible, the excavation was carried down to the proposed grade of the tunnel. Various types of screw-piles were sunk therein and tests were made, not only of the dead load carrying capacity, but also with the addition of impact, when it was found that screw-piles could be sunk to hard ground and carry ground and carry the required load. The final part of the test was the loading. The screw-pile, having a shaft 30 in. in diameter and a blade 5 ft. in diameter, was loaded with 600,000 lbs. with the result that, for a month—the duration of this loaded test—there was no subsidence.

Again, and after the iron tunnel lining had been constructed across the river, tests were made of two types of supports: One a screw-pile 29½ ins. in diameter with a blade 4 ft. 8 ins. in diameter and the other a wrought-iron pipe 16 ins. in external diameter. Tests were made, not only for their carrying capacity, but also for their value as anchorages, and it was found that the screw-pile was more satisfactory in every way; it could be put down much more rapidly; it was more easily maintained in a vertical position, and it could carry satisfactorily any load which could be placed on it

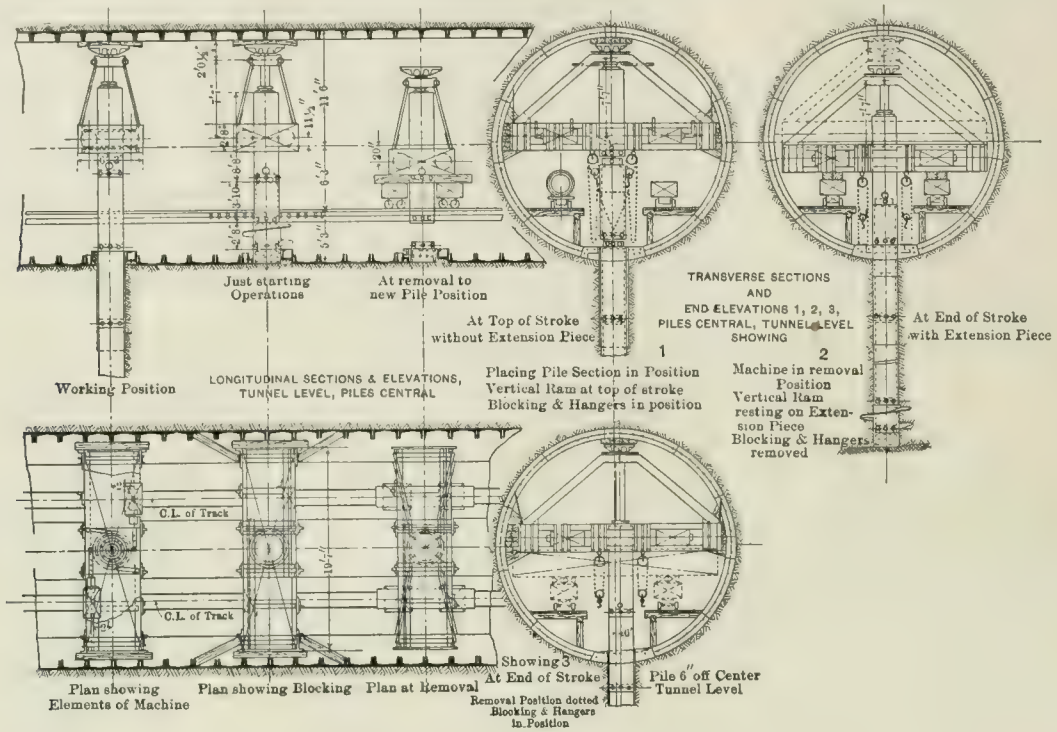

Just starting Operations
At removal to new Pile Position
At Top of Stroke without Extension Piece
TRANSVERSE SECTIONS AND END ELEVATIONS 1, 2, 3, PILES CENTRAL, TUNNEL LEVEL SHOWING
At End of Stroke with Extension Piece
Working Position
LONGITUDINAL SECTIONS & ELEVATIONS, TUNNEL LEVEL, PILES CENTRAL
Placing Pile Section in Position Vertical Ram at top of stroke Blocking & Hangers in position
1
Machine in removal Position Vertical Ram resting on Extension Piece Blocking & Hangers removed
2
C.L. of Track
C.L. of Track
Showing 3 At End of Stroke
Pile 6" off Center Tunnel Level
Plan showing Elements of Machine
Plan showing Blocking
Plan at Removal
Removal Position dotted Blocking & Hangers in Position

Fig. 2—Hydraulic Srewing Machine with Ratchet Drive and Vertical Jack.

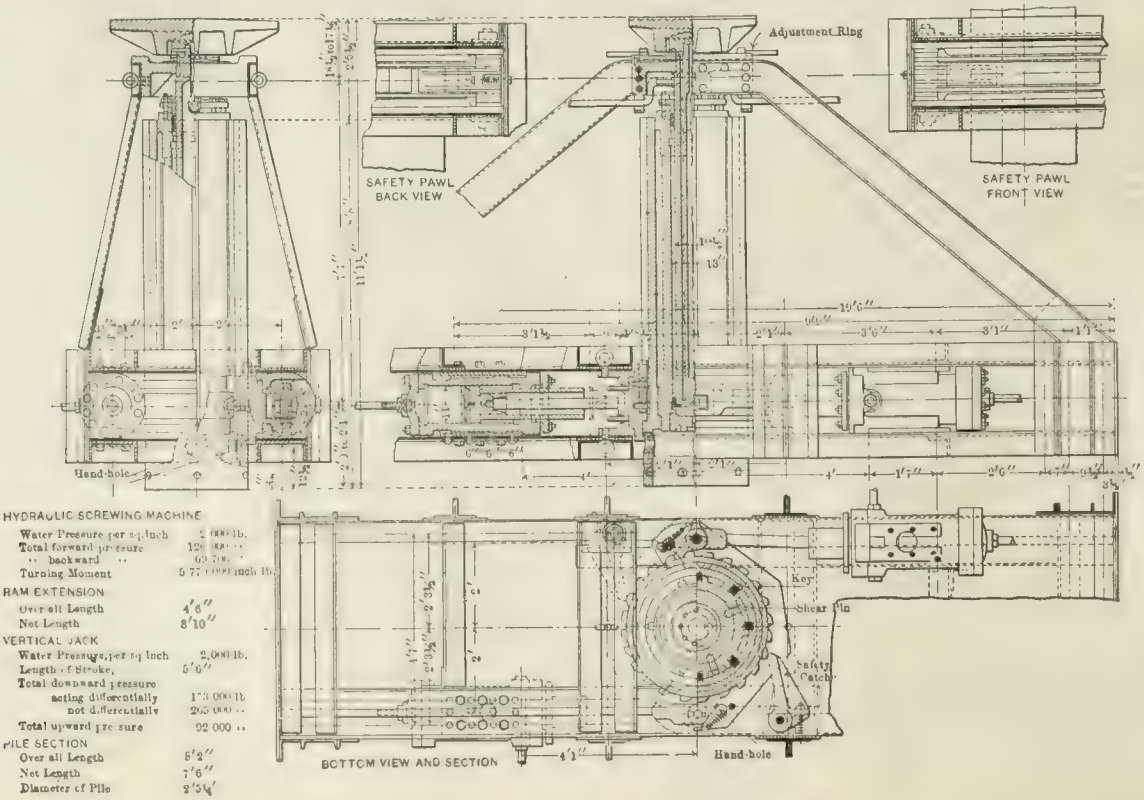


Fig. 3—Details of Hydraulic Screwing Machines.

as a support for the track. The 16-in. pipe did not prove efficient either as a carrier or as an anchorage. Figs 2 and 3 illustrate the general arrangement and details of the machine designed by the writer and used for sinking the test piles in the tunnels. This machine had been used originally on the New Jersey side on the test pile at Pier C, and the the pile-driver. Each boring was continued, and the depth of several was more than 250 ft. below the surface of the water. The borings on land were mostly core borings, and were generally made with the chilled shot boring machine.

Base lines, about 2,250 ft. in length, were measured on each side of the river, and ob-

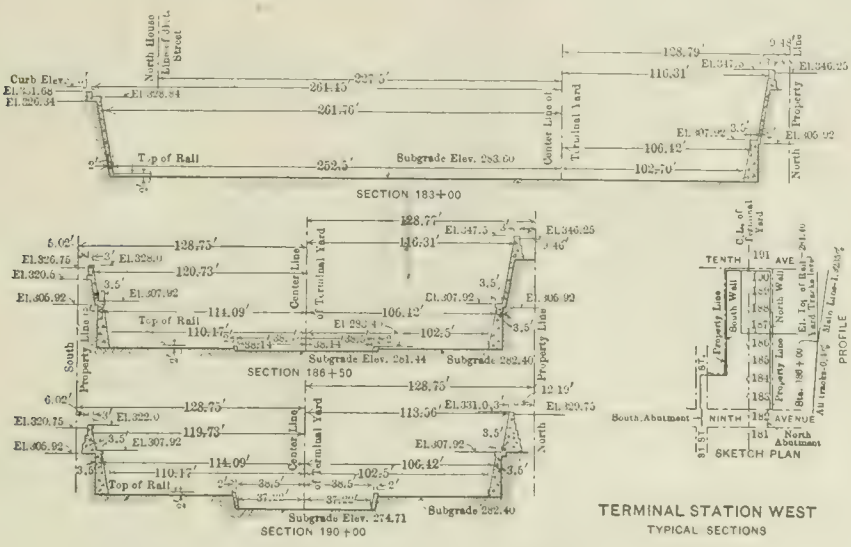


Fig. 4—Typical Sections of Terminal Station Excavation.

adaption was not exactly as shown on these drawings, but if the screw-piles had been placed in the tunnels, the arrangement shown would have been used.

Surveys, soundings and borings were commenced in the latter part of 1901 on an assumed center line of tunnels which was the center line of 32d St. extended westward.

The soundings were made from a float stage fastened to a tugboat, the location being determined by transit on shore and the elevation by measuring from the surface of the water, a tide gage being continually observed and the time of soundings and gage readings kept.

In the river wash-borings were made from a floating pile-driver on which was installed a diamond-drill outfit of rods, pump etc. Fourteen borings were completed in the river. Considerable difficulty was found in holding the pile-driver against the current, the material in the bottom being very soft, and several borings were lost owing to the drifting of

servation points established. It was necessary to build a triangulation tower 60 ft. high on the New Jersey side as an observation point. The base lines were measured with 100-ft. steel tapes which were tested repeatedly, and the work was done at night in order to obtain the benefit of uniform temperature and freedom from traffic interruptions. From the base line on the New Jersey side, which passed over the Weehawken Shaft, an elevated point on the assumed center line of the side of Bergen Hill was triangulated to, and from this point westward a closed polygon was measured along the streets to the top of the hill on the west side and thence along the assumed center line to the portal. The level transfer across the river was made by sighting across in opposite directions simultaneously, and also by tide gages.

The decision as to the locations of the shafts on both sides of the river, for construction purposes and finally for permanent use, was a comparatively simple matter, and, all circumstances considered, they are unquestionably in the most suitable places. On the New York side the shaft was as near as practicable to the line dividing the subaqueous iron-lined tunnels from the land tunnels, and on the New Jersey side the shaft was placed centrally on the line of the tunnels and on the nearest available ground to the river, while at the same time beyond the other end of the river tunnels, thus necessitating driving the subaqueous tunnels only from east and west to meet under the river. A caisson shaft on the New York side, on the line of the tunnels near the river bulkhead, was at one time considered, but was not adopted, as it entailed the driving of two shields both east and west, in addition to the two from New Jersey, adding to the plant out-

TABLE I.

	Bergen Hill.	River Tunnels.	Term. Sta.-W.
Excavation disposed of (or displaced), in cu. yds.....	263,000	238,995	517,000
Cast metal used in tunnel, including cast iron and cast steel, tons.....	.....	64,265	.....
Steel bolts used, tons	.....	2,606	.....
Cement used (concrete and grout), bbls...	95,000	145,500	33,000
Concrete, in cu. yds.	95,000	75,000	18,500
Dynamite for blasting, in lbs	600,000	100,400	206,000
Brickwork, cu. yds.	.....	4,980	.....
Structural steel (including Pier 72), lbs..	50,000	3,141,000	1,475,000

lay while not affording any material saving in the time of construction.

It was thought desirable to construct the shafts on the two sides of the river in advance of letting the main contracts for the tunnels. The Manhattan Shaft is north of the line of the tunnels, on the north side of 32d St., east of Eleventh Ave. The Weehawken Shaft is on the line of the tunnels in the yards of the Erie R. R. on the New Jersey side, and the distance between the shafts is about 6,575 ft. The contracts for these shafts were let in June, 1903, to the United Engineering and Contracting Company, and they were completed and ready for use at the time of letting the main contract for the tunnels, thus saving considerable time.

The Terminal Station-West, Between Ninth and Tenth Avs.—In the original design it was contemplated to have a four-track tunnel un-

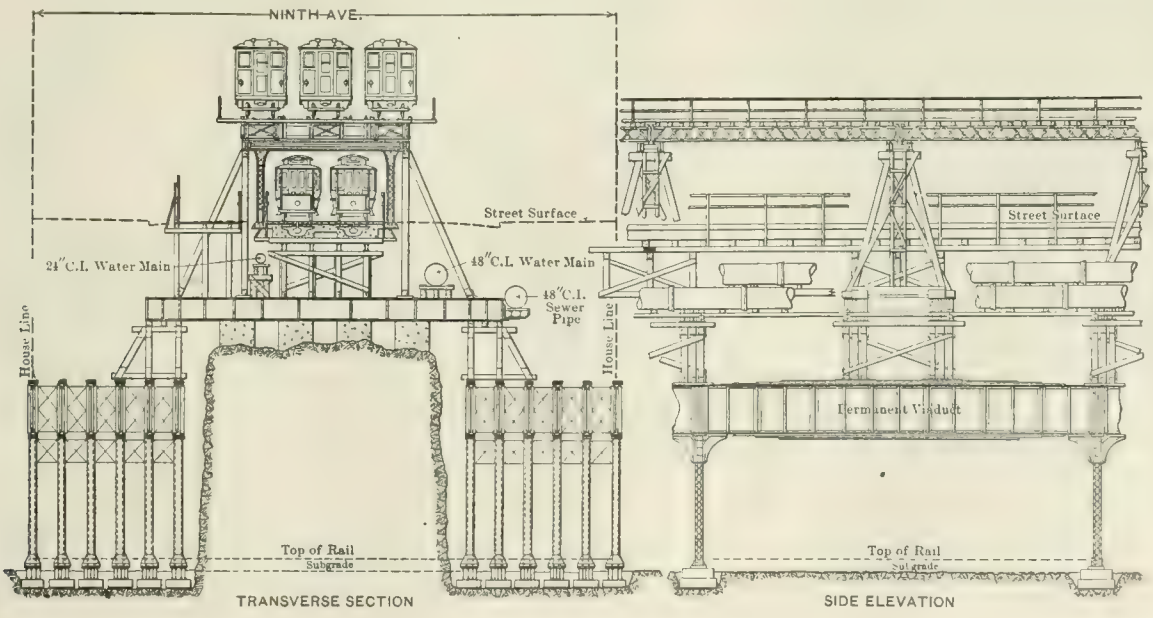


Fig. 5—Arrangement of Structures Supporting Ninth Ave. Elevated Railroad.

der 32d St. from Ninth to Eleventh Aves., but owing to the necessity for having additional yard facilities, property was bought for about 100 ft. north and 100 ft. south of 32d St., between Ninth and Tenth Aves., and an open excavation, lined with concrete retaining walls and face walls, was made. Between Ninth and Tenth Aves., 32d St. was closed, and the property formerly the street was bought by the tunnel company from the city of New York. The church, rectory and school of St. Michael's, which was located on the west side of Ninth Ave., between 31st and 32d Sts., was acquired by the tunnel company after it had acquired property for and had built a similar institution on the south side of 34th St. west of Ninth Ave.

Probably the most interesting feature of this contract was the support and maintenance of Ninth Ave., which has a three-track elevated railway structure and a two-track surface railway structure, on which it was necessary to maintain traffic while excavation was made to a depth of about 60 ft., and a viaduct was erected to carry Ninth Ave. The length of this viaduct is about 375 ft., and the steel work and its erection was done apart from the North River division work, but all excavation and underpinning was included in this division. The contract for this work on the Terminal Station-West was let to the New York Contracting Co. on April 28, 1906, and included about 517,000 cu. yds. of excavation, about 87 per cent being rock, the construction of about 2,000 lin. ft. of retaining and face walls containing about 18,500 cu. yds. of concrete, and a large quantity of structural steel (1,475,000 lbs.) for temporary use in underpinning Ninth Ave. Fig. 4 shows cross-sections of the Terminal Station-West yard, and Fig. 5 shows the general method of underpinning the Ninth Ave. structures.

River Tunnels.—In the original plan a four-track tunnel was contemplated from the east side of Tenth Ave. to the east side of Eleventh Ave., but, owing to the extension of the Terminal Yard, previously noted, this plan was changed, and a two-track structure was built having a central wall between the tracks. This was constructed in tunnel, with the exception of 172 ft. about midway between Tenth and Eleventh Aves., where the rock dipped below the roof of the tunnel, and there the construction was made in open cut. These tunnels were lined with concrete with brick arches. This work was executed by the O'Rourke Engineering Construction Co.

It was possible to excavate in full rock cover about 250 ft. of the tunnels eastward from the Weehawken Shaft and 225 ft. westward from the Manhattan Shaft. At these points the rock cover was very thin, and there shield chambers were made for the erection of two sets of shields, about 6,100 ft. apart.

The Board of Engineers decided, and it was so stated in the contract and specifications, that the river tunnels should be constructed by means of hydraulic shields, but bidders were permitted to present to the board any scheme on which they might desire to bid, but, of course, the decision as to the practicability of such plans rested with the board.

Inasmuch as the shield method of construction was required, the writer designed a shield for use in the North River tunnels. The shield was about 18 ft. long, over all, and was provided with a rigid but removable hood extending beyond the normal line of the cutting edge, for use in sand, gravel and ballast, to be removed when the shield reached the silt. The shields were thrust forward by 24 rams, capable of exerting a pressure of 3,400 tons at a hydraulic pressure of 5,000 lbs. per sq. in. Taking into account 30 lbs. air pressure, this pressure was increased to 4,400 tons. The

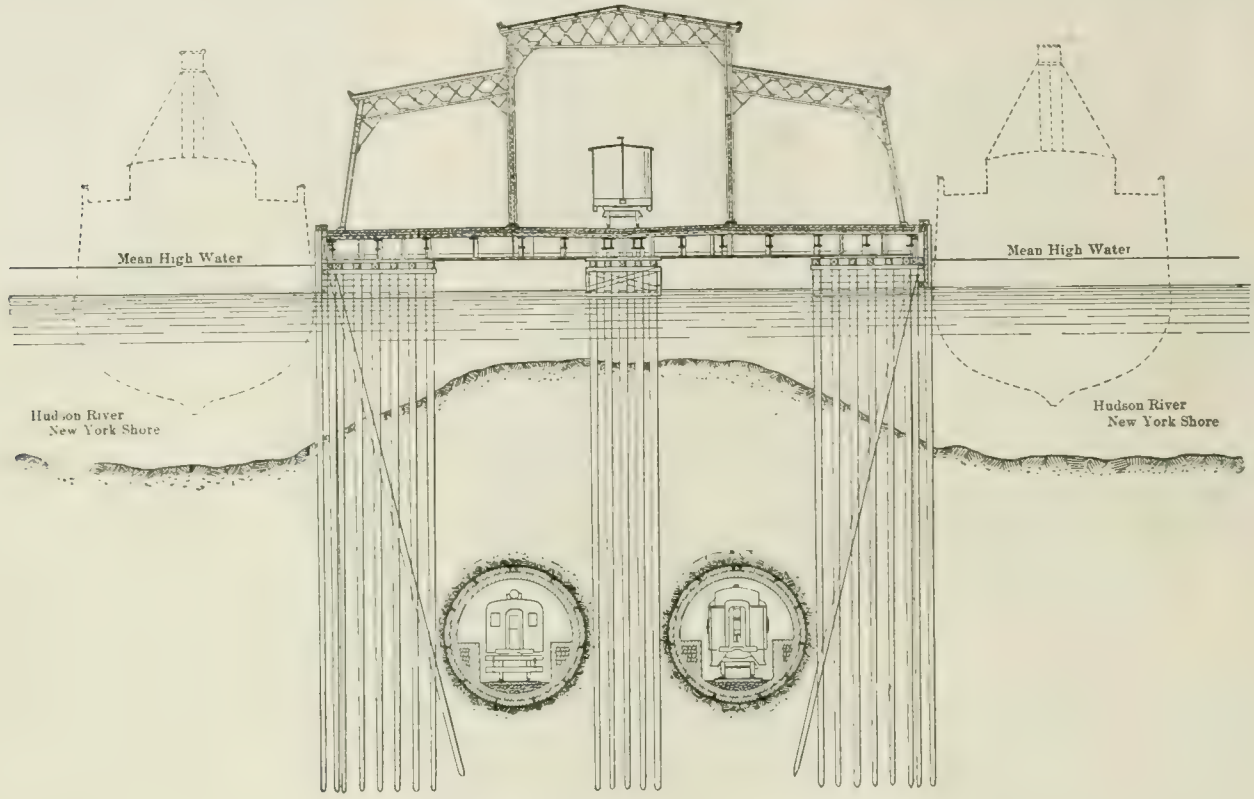


Fig. 6—Transverse Section Showing Construction of Pier Over Tunnels.

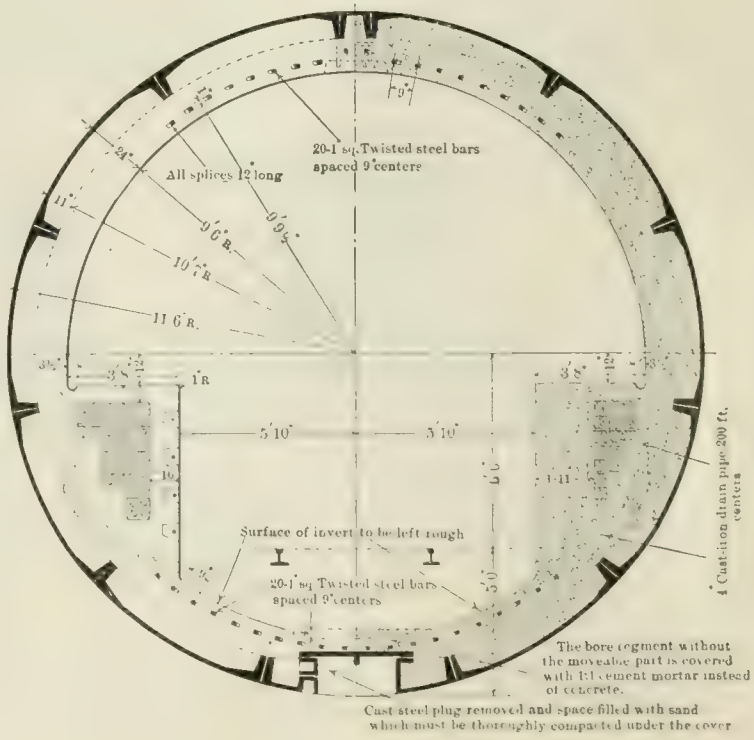

20-1 sq. Twisted steel bars spaced 9" centers
All splices 12' long
11'
9'6" R.
10'1" R.
11'6" R.
3'8"
1' R
5'10"
5'10"
Surface of invert to be left rough
20-1 sq. Twisted steel bars spaced 9" centers
4 Cast-iron drain pipe 200 ft. centers
The bore segment without the moveable part is covered with 1:1 cement mortar instead of concrete.
Cast steel plug removed and space filled with sand which must be thoroughly compacted under the cover

Fig. 7—Cross-Section of Tunnel as Actually Constructed.

shield was fitted with a single hydraulic erector and hydraulic sliding platforms, and when complete weighed 194 tons. The shields were built in accordance with the design previously referred to, and proved entirely satisfactory. Generally, the materials passed through were as follows: Starting out in full face rock, from it into a mixed face of rock and sand, thence into sand and gravel, full face of sand, piles, rip-rap and the Hudson silt; and all were fully charged with water. The contract for the river tunnels was let to the O'Rourke Engineering Construction Co.

Compressed air, at an average gage pressure of about 25 lbs. and a maximum of 40 lbs. per sq. in., was used in the tunnels from the time the shields emerged from full rock face until the tunnel lining had been joined up and all calking and grummeting had been done.

Contractor's plants were established at the Weehawken Shaft and at the Manhattan Shaft, including at each, low-pressure air compressors of a capacity of 13,000 cu. ft. of free air per minute and also high-pressure air compressors for drills, hydraulic pumps, electric generators, etc.

The river tunnels passed under Pier 72, North River (old No. 62), which was occupied by the New York Central and Hudson River Railroad Co. The tunnel company leased this pier and withdrew all the piles on the lines of the tunnels prior to the commencement of construction, and on the remaining piles constructed a trestle for the disposal of the excavation from the tunnels and the terminal. At the completion of the work this pier had to be restored, and Fig. 6 shows the general arrangements of the location of the piles and the pier structure with reference to the tunnels.

In the tunnels which were constructed in silt farther down the river, by the writer as Chief Engineer for the Hudson Companies, it had been possible to shove the shield through the silt with all the doors closed, displacing the ground and making great speed in construction owing to the absence of all mucking. It was thought that this procedure might be pursued in the larger tunnels of the Pennsylvania R. R., and it was tried, but it was almost immediately found to be impossible to maintain the required grade without taking a certain quantity of muck into the tunnels through the lower doors, the tendency of the shield being to rise. By taking in about 33 per cent of the excavation displaced by the tunnel, the grade could be maintained. It was considered desirable, owing to this rising of the shields, to increase the weight of the cast-iron lining, and this was done, making the weight of the completed tunnel more nearly equal to the weight of the displaced material. The weight of the cast-iron lining (with bolts) was increased from 9,609 to 12,127 lbs. per lin. ft. of tunnel. The weight of the finished tunnel with this heavier iron is 31,469 lbs. per lin. ft. The weight of the silt displaced per linear foot of tunnel, at 100 lbs. per cu. ft., is 41,548 lbs. The weight of the completed tunnel with the maximum train load is 41,869 lbs. per lin. ft.

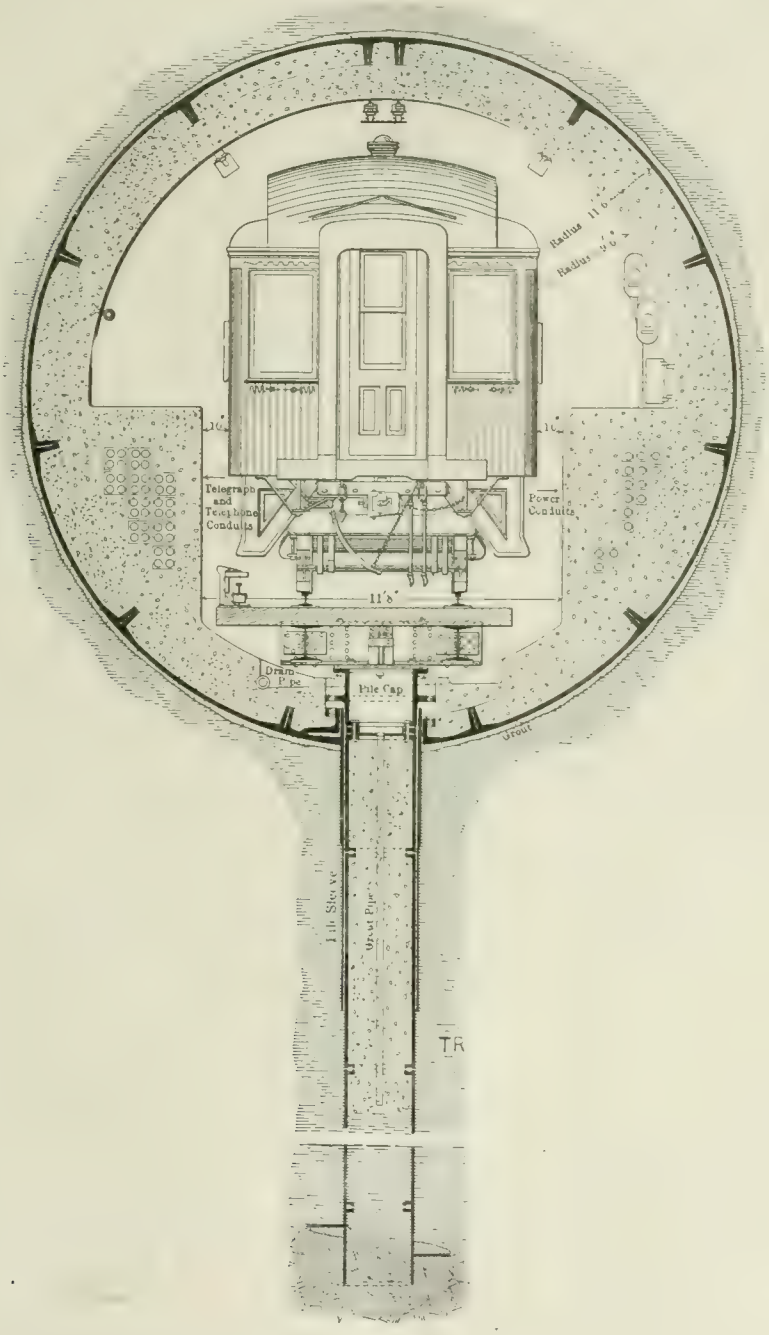


Fig. 8—Designed Cross-Section of Tunnel with Screw Pile Supports.

The maximum progress at one face in any one month was 545 ft., working three 8-hour shifts, and the average progress in each heading while working three shifts was 18 ft. per 24 hours; while working one shift with the heavier lining referred to above, the delivery of which was slow, the average progress was 11 ft. per 24 hours.

In order to permit the screw-piles to be put in place through the lining, cast-steel bore segments were designed, and placed in the invert at 15-ft. centers; these are of such a design as to permit the blade and shaft of the screw-pile to be inserted without removing any portion of the lining. Figure 8 is a typical cross-section of the river tunnel, as originally planned, with these pile supports.

After the shields had met and the iron lining was joined up, various experiments and tests were made in the tunnel; screw-piles and 16-in. pipes, previously referred to, were inserted through the bore segments in the bottom of the tunnel, thorough tests with these were made, levels were observed in the tunnels during the construction and placing of the concrete lining, an examination was conducted of the tunnels of the Hudson and Manhattan Railroad Co. under traffic, and the result of these examinations was the decision not to install the screw-piles. The tunnels, however, were reinforced longitudinally by twisted steel rods in the invert and roof, and by transverse rods where there was a superincumbent load on the tunnels; it might also be noted that on the New York side, where the tunnels emerge from the rock and pass into the soft material, the metal shell is of cast steel instead of cast iron. Figure 7 is a typical cross-section of the river tunnels as actually constructed.

During the investigations in the tunnels, borings were made to determine exactly the character of the underlying material, and it was then found that the hard material noted in the preliminary wash-borings was a layer of gravel and boulders overlying the rock. When the borings in the tunnels reached this material it was found to be water-bearing and the head was about equivalent to that of the river. Rock cores were taken from these borings, and the deepest rock was found at about the center of the river at an elevation of 302.6 ft. below mean high water. Rods were then inserted in each bore hole and thereby attached to the rock and used as bench-marks in the tunnels. From these bench-marks, using specially designed instruments, very accurate observations of the behavior of the tunnels could be made, and from these the very interesting phenomenon of the rise and fall of the tunnels with the tide was verified, the tunnels being low at high tide and the average variations being about 0.01 ft. in the average tide of about 4.445 ft.; the tidal oscillations are entirely independent of the weight of the tunnels, since observations show them to have been the same both before and after the concrete lining was in position. There was considerable subsidence in the tunnels during construction and lining, amounting to an average of 0.34 ft. between the bulkhead lines. This settlement has been constantly decreasing since construction, and appears to have been due almost entirely to the disturbances of the surrounding materials during construction. The silt weighs about 100 lbs. per cu. ft. (this is the average of a number of samples taken through the shield door, and varied from 93 to 109 lbs. per cu. ft.), and contains about 38 per cent of water. It was found that whenever this material was disturbed outside the tunnels a displacement of the tunnels followed. The tunnels as above noted have been lined with concrete reinforced with steel rods, and prior to the placing of the concrete the joints were calked, the bolts grummeted and the tunnels

rendered practically water-tight; the present quantity of water to be disposed of does not exceed 300 gal. per 24 hours in each tunnel 6,100 ft. long.

Bergen Hill Tunnels.—These are two single-track tunnels, 37 ft. from center to center, and extend for a distance of 5,940 ft. from the Weehawken Shaft to the Hackensack Portal. They were built almost entirely through trap rock. The contract was let on March 6, 1905, to the John Shields Construction Co., but was re-let on January 1, 1906, to William Bradley, the Shields Co. having gone into the hands of a receiver. About 1,369 ft. of the tunnel excavation was done by the Shields Co., but no concrete lining. The maximum monthly progress for all headings was 622 ft., and the average progress was 338 ft. A working shaft 216 ft. deep was sunk from the top of the hill, to facilitate construction. The tunnels are lined with concrete throughout.

Inner Harbor at Balboa.—Tentative plans have been prepared for an inner harbor at Balboa, the Pacific end of the Panama Canal, and the resident engineer at Balboa has received authority to begin preliminary work by removing the partly submerged French machinery that is now scattered over a large part of the area of the proposed basin. The total area will be approximately 176 acres, and the greater part of it outside of the Canal channel, will have to be dredged, the estimated amount of material required to be removed aggregating 10,000,000 cu. yds. At the present time, a long spit of land, showing above water, extends down to about opposite the shipways at Balboa, separating the Canal channel from the river entrance, and this will involve the heaviest part of the dredging within the basin. The harbor will have a uniform depth of about 40 ft. at mean low tide. When the basin is completed, plans will probably be considered for a permanent system of piers, or docks, extending from the sand dock along the east side of the harbor, and if the shipping business at that time shall appear to justify such construction, along the north end of the harbor, as well. The Rio Grande channel will be eliminated by the formation of Lake Miraflores, and much of the ground in the immediate vicinity of the harbor, now low and partly covered by water at high tide, will be reclaimed. It has been proposed that the piers be constructed to extend directly out from shore, at distances of about 500 ft. apart, which will enable ships of any tonnage to berth alongside, two to each dock.

Notes on Cleaning Sewers at Washington, D. C.—The total length of sewers in the District of Columbia on June 30, 1909, was 541 miles. Of this amount 424 miles were pipe sewers and 117 miles were main sewers. In addition there were 3 340 storm water receiving basins and ten general catchment basins. The maintenance of all these comes under the direction of the Superintendent of Sewers and in the report of the Engineer Department of the District of Columbia in the last fiscal year he gives some data in the cleaning of the sewers and basins. The following shows the cost of cleaning the sewers:

Cleaning the sewers.	Amount lin. ft.	Cost per lin. ft.
Main sewers cleaned	11 624	$0.255
Pipe sewers cleaned	1 [illegible] 115	.0042
Pipe sewers flushed	1 873 142	.0006

A total of 114 miles of main sewers was inspected at a cost of $8.61 per mile. In audition 52,634 storm water receiving basins were cleaned. the total amount of sludge removed being 188,460 cubic feet. The cost of cleaning the basins was $13.841,08 or about $2 per cubic yard of sludge removed. Nine gravel catchment basins were cleaned, the total of sludge removed being 4,968 cubic feet. The cost of cleaning the catchment basins was $576.71 or about $3.14 per cubic yard of sludge removed.

Roads and Streets Section

Note: This section is devoted to methods and costs of road and street construction. It will cover road building in all its details, the construction of pavements, sidewalks and gutters, the testing and use of paving materials and the machinery and tools used in road building and paving.

Detailed Cost of Constructing 2,070 Sq. Yds. of Brick Pavement At Carlisle, Pa.

BY C. A. BINGHAM,* ASSOC. M. AM. SOC. C. E.

Over 3,000 sq. yds. of vitrified brick pavement were laid in Carlisle, Pa., during the past season by the Street Department under the direction of the writer, the street department being in full charge of the City Engineer. Fortunately during the past 160 years the streets have been filled with subsequent layers of macadam until there is a foundation of at least 18 ins., so that it was not considered necessary to lay a concrete base.

To procure subgrade it was necessary to remove from 2 to 5 ins. of the old macadam by spiking with the roller and scarifier. This was hauled to outlying streets to make temporary surfaces. About 400 sq. yds. were graded in a day by the roller, one foreman, three laborers and three carts, hauling about three-quarters of a mile. The resulting surface was then raked, leveled and additional crushed limestone applied to give the proper contour. It was then thoroughly wet and compactly rolled with a 13-ton steam roller and allowed to dry out for a couple of days. In short, a finished macadam surface was constructed 5¼ ins. below grade. Iron grade pins were then placed every 8 ft. each way by the "shooting" method with a transit. The next operation was to place screeds along these grade points, and with a straight edge level off the cushion, which was 1½ ins. of crusher dust. This dust was cheaper than sand and did not become disturbed if stepped upon for any unavoidable reason. By keeping a considerable amount ahead of the straight edge it was found to pack and give a very firm bed. One cubic yard of this dust covered about 30 yds. of surface.

As to the method of storing the blocks, it was found to cost exactly the same whether they were stacked at the freight yard and hauled to the street as needed, or hauled directly from the cars and stacked along the street until used. This cost was $1.74 per thousand blocks and the haul was one-half mile. The first method will be pursued in the future because by the other way the sidewalks are congested both to merchants and pedestrians.

A gang of five men laid an average of 8,500 bricks per day, the foreman and one helper laying and the others carrying and wheeling blocks. The best day's work was 12,000. After a careful inspection the bricks were rolled with a 4-ton horse roller, the steam roller being too heavy. Part of the rolling was done by horses and part by eight men. There was very little difference in the costs, but while pads on the horses' feet prevented the disturbing of the blocks, it was found impossible to do the cross rolling as could be done by hand. The cement grout used was a 1 to 2 mixture, and it was found that it required one bag of cement for each 14 yds. of pavement, and one foreman and three men could grout 700 sq. yds. a day. Wedge shaped strips were placed along each curb for pitch expansion joints, but before the strips could be removed the weather became unfit for working and the joints will not be completed until next season.

The following cost data are on 2,070 sq. yds., on which very accurate account was kept on time and material. The street was 55 ft. between curbs and a trolley track covered 135 sq. yds. of the center. This portion did not require grading, because when the traction company retimbered it was laid with concrete to the proper subgrade. The cost of laying bricks between the tracks was found to be practically the same as in the open street and is all included in the following data. The total cost of the completed pavement per square yard was $1.09.

The detailed cost of this 2,070 sq. yds. of brick pavement was as follows:

	Total.	Per sq. yd.
SPIKING UP AND CARTING OFF OLD MACADAM.		
Roller engineer, 45 hrs. at $0.20	$ 9.00	$0.0046
Foreman, 55 hrs. at $0.17	9.35	.0048
Laborers, 261 hrs. at $0.14	36.54	.0188
Carting, 192 hrs. at $0.25	46.08	.0238
Coal, 2.5 tons at $4.00	10.00	.0052
Total (1,935 sq. yds.)	$110.97	$0.0572
RAKING, LEVELING, ROLLING, ETC., MACADAM BASE.		
Foreman, 34 hrs. at $0.17	$ 5.78	$0.0029
Roller engineer, 39 hrs. at $0.20	7.80	.0040
Laborers, 56 hrs. at $0.14	7.84	.0041
Crushed stone, 69 cu. yds. at $0.98	67.62	.0349
Coal, 2 tons at $4.00	8.00	.0041
Total (1,935 sq. yds.)	$ 97.04	$0.0500
DUST CUSHION.		
Foreman, 25 hrs. at $0.17	$ 4.25	$0.0020
Laborers, 50 hrs. at $0.14	7.00	.0033
Crusher dust, 66 cu. yds. at $0.98	64.68	.0312
Total (2,070 sq. yds.)	$ 75.93	$0.0365
UNLOADING, HAULING, STACKING BLOCKS.		
Foreman, 45 hrs. at $0.17	$ 7.65	$0.0037
Laborers, 390 hrs. at $0.14	54.60	.0264
Carting, 363 hrs. at $0.24	87.12	.0421
Total (2,070 yds.)	$149.37	$0.072
BLOCK.		
85,660 at $19.00 M	$1,627.54	or $0.786 yd.
LAYING BLOCKS.		
Foreman, 127 hrs. at $0.17	$ 21.59	$0.0104
Laborers, 402 hrs. at $0.14	56.28	.0271
Total (2,070 sq. yds.)	$ 77.87	$0.035
ROLLING AND INSPECTING.		
Team, 15 hrs. at $0.20	$ 3.00	$0.001
Laborers, 63 hrs. at $0.14	8.82	.004
Total (2,070 sq. yds.)	$ 11.82	$0.005
GROUTING.		
Cement, 44 bbls. at $1.20	$ 52.80	$0.0254
Sand, 11 tons at $1.40	15.40	.0074
Foreman, 32 hrs. at $0.17	5.44	.0071
Laborers, 106 hrs. at $0.14	14.84	.0091
Sand covering, 5 tons at $1.40	7.00	.0034
Total (2,070 sq. yds.)	$ 95.48	$0.0459

RECAPITULATION.

	Per sq. yd.
Excavation	$0.057
Grading	0.050
Cushion	0.036
Haul, etc.	0.072
Blocks	0.786
Laying	0.037
Rolling	0.005
Grouting	0.046
Grand total	$1.089

*City Engineer, Carlisle, Pa.

Method of Repairing Openings in Pavements.*

That two workmen with tools and materials of equal value may, when working to the same end, produce very different results is acknowledged. If we apply this principle to any construction which by its nature is of constantly recurring necessity, such, for instance, as street pavements, the importance of attaining the maximum efficiency in workmanship becomes at once apparent.

The repairing of holes in pavements seems to offer the best field for developing to the fullest extent the value of first class workmanship. This has recently been brought home to those interested in street paving in Chicago by Mr. John B. McInerney, superintendent of repairs and maintenance. Before he took hold the repair of an opening was usually made in the

*From a paper by W. W. Marr, Division Engineer Board of Local Improvements, Chicago, Ill., read before the annual meeting of the Illinois Society of Engineers and Surveyors.

cheapest way possible and with little or no regard for how long it would stay in place or give satisfaction in any form. Now repairs are made with great care under the eye of an inspector skilled in this sort of work. A careful record is kept of repairs made and at the first signs of failure the contractor is required to make the repair again at his own expense. Mr. McInerney has demonstrated that an opening can be repaired in such a way that it cannot afterward be found. This requires great care, but it is worth all the time and money it takes.

The results of Mr. McInerney's efforts are particularly noticeable in asphalt repairs, which are made in the following manner: The dirt from all openings is tamped back in shallow layers and care is taken to see that the top of the opening is larger in horizontal area than any other part. The dirt is crowned up slightly over the trench or opening and the old asphalt laid on top. This is allowed to remain in place for several weeks if the traffic conditions do not make such a course seriously objectionable. The material above sub-grade is then removed and the concrete (nearly all asphalt pavements in Chicago are laid on concrete) is trimmed with a bevel edge so that the size of the opening in the concrete is 1 or 2 ins. less at the bottom than at the top in each direction. This edge is then thoroughly cleaned, wet, and sprinkled with neat cement. The concrete is then well rammed in place, no allowance being made for settlement and no crown on the top above the grade of the original concrete. After the new concrete has set the asphalt is cut to a sharp line with a vertical edge and three or four inches larger than the opening. This edge is very carefully painted with asphaltic cement after the binder has been well tamped in place. The surface mixture is always rolled with both a light and a heavy roller in such a way that it is finally brought to the even and unbroken surface of the original pavement.

Notes on State Highway Work in 1909.

NEW CASTLE COUNTY, DELAWARE.

During the year 1909 a total of 15 miles of macadam road was completed under the direction of Francis A. Price, New Castle county state highway commissioner. All except two miles of this road was macadamized for a width of 12 ft., the two miles being macadamized for a width of 16 ft. The thickness of completed pavement was 4 ins., 6 ins., and 8 ins., and the average cost per mile was $7,000. About 0.35 mile of bituminous macadam road, 12 ft. wide and 6 ins. deep, was constructed, the average cost per mile being $6,260. In addition 700 lin. ft. of Amiesite road was placed under construction. The average width of this type of road was 12 ft., the thickness of completed pavement was 6 ins., and the average cost per mile was $10,000. About $249,000 is available for road construction in 1910, and it is expected that about 27 miles of improved roads will be built.

KENTUCKY.

At an election last fall this state voted to amend its constitution so as to provide for improved roads. A bill is now before the state senate providing for a state roads department, with a competent engineer at the head. The bill also provides for county engineers to be elected by the fiscal court. The engineer at the head of the State Roads Department is to receive a salary of $2,400 a year, provided the bill as at present framed is enacted, and county engineers are to receive not less than $300 nor more than $1,800 a year. The bill provides for special elections in each county to determine whether a special tax shall be levied in that county for good roads. Fifty tax payers of a county may petition the county court to call an election on the good roads proposition. The bill provides state aid to the extent of 5 cts. on every $100 of taxable property in the state, this aid to be given each county in proportion to the amount raised in that county for good roads.

MARYLAND

The work of road improvement in Maryland is carried on under the direction of two commissions, the highway division of the Maryland Geological and Economic Survey Commission and the State Roads Commission of Maryland. Mr. W. W. Crosby, Baltimore, Md., is chief engineer of both of these commissions. The following table shows the mileage and average cost per mile of roads completed in 1909 under the direction of the Maryland Geological and Economic Survey Commission:

Kind.	Total miles built.	Av. width paved, feet.	Av. thickness of completed pavement, inches.	Av. cost per mile.
Gravel	1.31	12	8	$6,138.26
Macadam	30.45	12&14	6&8	9,898.66
Brick	None.			
Sand clay	1.00	18	9	3,120.50
Oyster shell	4.57	11	9	5,384.46
Pitching macadam	.75	24	*4	9,041.70

*Resurfacing.

The average unit prices in 1909 for road work were as follows:

Gravel, per sq. yd., in place	$0.42
Broken stone, per sq. yd., in place	.78
Shell, per sq. yd., in place	.69
Excavation, per cu. yd.	.51
Concrete masonry, per cu. yd.	8.14
Stone masonry, per cu. yd.	6.97

The prevailing daily wages in 1909 per 10-hour day were as follows:

Common labor	$1.50
Two-horse team and driver	4.00

The road work projected for 1910 by the Maryland Geological and Economic Survey Commission is as follows:

Kind.	Miles to be built.	Estimated cost.
Gravel	2.06	$ 10,186.53
Macadam	26.75	240,035.45
Oyster shell	11.44	*103,190.21
Pitching macadam	5.25	28,193.73
		$381,610.92

*Includes steel draw bridge.

None of the roads being built under the direction of the State Roads Commission of Maryland was completed and accepted in 1909. The average unit prices for road work in 1909 under this commission were as follows:

Gravel, per sq. yd., in place	$0.45
Broken stone, per sq. yd., in place	.917
Brick, per sq. yd.	2.13
Excavation, per cu. yd.	.425
Concrete masonry, per cu. yd.	8.14
Stone masonry, per cu. yd.	6.97

The road work projected for 1910 by the Maryland Roads Commission is as follows:

Kind.	Miles to be built.	Estimated cost.
Gravel	4.64	$ 31,351.55
Macadam	87.83	888,873.98
Brick	1.088	59,217.17
Pitch macadam	6.45	96,464.77
Grading and draining only	7.74	24,924.25
	107.748	$1,100,831.72

In addition to the work noted above, the highway division of the Maryland Geological Survey is carrying on extensive investigations regarding road preservatives and dust preventives, both in the laboratory and outside. One particularly interesting piece of work was the treating of about four miles of macadam, adjacent to Baltimore city, with ten different varieties of bituminous materials applied in contiguous stretches to two different sections of this road, the sections being separated by an interval of about two miles of untreated macadam. Each car load of material used was analyzed according to the forms and methods of the special committee of the American Society of Civil Engineers on "Bituminous Materials Used in Road Making." A careful record of these analyses has been kept as well as of the costs of the various items, other than the material itself, entering into the expense of this work.

MASSACHUSETTS.

During the fiscal year ending Nov. 30, 1909, a total of 35.09 miles of road was completed under the direction of the Massachusetts Highway Commission. These roads were of the gravel and macadam type of construction, the number of miles built and the average cost per mile being as follows:

Kind.	Total miles built.	Av. width.	Av. thickness.	Av. cost per mile.
Gravel	2.53	15	5	$3,729.45
Macadam	32.56	15	5	8,177.38

The average unit prices for work in 1909 were as follows:

Gravel, per cu. yd., in place	$ 0.90
Broken stone, per ton, in place	1.70
Earth excavation, per cu. yd.	0.50
Rock excavation, per cu. yd.	1.75
Concrete masonry, per cu. yd.	12.00
Stone masonry, per cu. yd.	6.00

The prevailing daily wages for an 8-hour day were:

Common labor, per day	$2.50
Two-horse team and driver	5.00

It is estimated that 50 miles of state highway will be constructed in 1910.

Arthur W. Dean, Boston, Mass., is chief engineer of the Massachusetts Highway Commission.

NEW HAMPSHIRE.

During the year 1909 a total of 58.44 miles of road were completed under the direction of the state engineer. The amount, type and average cost of the roads built were as follows:

Kind.	Total miles built.	Av. width paved, feet.	Av. thickness of completed pavement, ins.	Av. cost per mile.
Gravel	46½	15	8	$3,450
Macadam, trap rock	4.6	15	6	6,900
Macadam, native stone	6.04	15	6	5,300
Bituminous macadam	1.3	15	6	7,800

The average unit prices in 1909 were as follows:

Gravel, per cu. yd., in place	$0.98
Broken stone, per ton, in place	1.81
Telford, per sq. yd., in place	0.33
Earth excavation, per cu. yd.	0.55
Rock excavation, per cu. yd.	2.45
Concrete masonry, per cu. yd.	7.72
Stone masonry, per cu. yd.	4.82

The prevailing daily wages in 1909 for a 9-hour day were as follows:

Common labor	$1.75
Two-horse team and driver	4.00

H. C. Hill, Concord, N. H., is state engineer.

NEW YORK

On Feb. 17, 1909, the State Highway Commission was formed and took over the highway work which had previously been under the charge of the state engineer and surveyor. The present highway law brings the entire system of public highways in the state, outside of the four counties which constitute the city of Greater New York, under the direct charge and supervision of the State Department of Highways and provides for their improvement, maintenance and repair under three separate and distinct heads:

(1) State highways, composed of through routes running north and south and east and west across the state, aggregating about 2,800 miles in length, to be improved solely at the expense of the state.

(2) County highways, being the system of main market roads designated on the maps of the various counties approved by the legislature of 1907 as the system of roads to be improved at the joint expense of the state, county and town in the same manner as was provided by the Higbie-Armstrong act, the main provisions of which are incorporated in the present law. These aggregate about 7,500 miles.

(3) Town roads, embracing all roads not to be improved as state or county highways, and amounting to upwards of 70,000 miles. They are to be maintained and repaired as earth roads at the expense of the town plus the aid donated by the state, substantially in the manner provided by the money system acts hereinbefore described.

During the past year the commission has been engaged in locating the 38 state through routes. It was impossible to locate any of these routes in their entirety and prepare plans and specifications for improvement, advertise for proposals and award contracts in time for work to be commenced during 1909, but a sufficient location has been made in each county to take up $2,500,000 now available for state

routes, and contracts for that amount will be awarded during this winter and work commenced promptly in the spring of 1910.

The improvement of county highways was continued under the present law along virtually the same lines as under the former Higbie-Armstrong act. Up to Jan. 1, 1909, 1,787 miles county highways had been improved by state aid and 520 miles under contract were turned over by the state engineer and surveyor to the commission when it assumed control in February, 1909. The majority of this work has been already completed or will be early in 1910. Plans for the improvement of 1,038 miles had also been approved by the various boards of supervisors prior to Jan. 1, 1909. These roads are on the list from which they must be taken for construction in their regular numerical order, and they form the nucleus of the upwards of 300 miles of county highways designated for improvement in 1910, and for the payment of the state's share of which there is available the remaining $2,500,000 appropriated by chapter 439, laws of 1909.

The State Highway Commission in its preliminary report, from which these notes have been taken, makes a number of suggestions for the amendment of certain points of the highway law. Two of these suggestions refer to automobile traffic and experimental roads. Regarding these the commission states:

It is impossible with the data before the commission to determine the damage to the highways accruing from automobile traffic. This traffic, however, has compelled more expensive methods of construction which will in general aggregate at least $2,500 per mile, and this construction upon 500 miles of road will cost annually over $1,000,000. This does not take into account the large additional amount made necessary for repairs on the other roads, and it seems to us that an annual registration fee which will collect not less than $500,000 should be enforced, and that the entire proceeds of the same should be devoted to the care and maintenance of improved highways. A study of traffic conditions has convinced the commission that one kind of roadbed is neither suitable nor economical for all locations. Roads over which pass daily a thousand or more vehicles, of which one-half are swiftly moving and self-propelled, surely require a different form of construction than those over which pass daily 100 vehicles or less, mostly horse drawn. It is suggested that an appropriation of $80,000 be made for use by the commission in developing, through experiment, economical forms and methods of road construction which will be suited to various weights and classes of traffic. The money to be used as the commission deems best, in the purchase of suitable equipment and materials and payment for necessary labor. An appropriation so made will enable the commission to begin experiments and vary them to meet the different conditions encountered, until a satisfactory solution of each case has been reached.

UTAH.

The road laws in this state were enacted during the early part of 1909, and during that year no construction work was commenced. Caleb Tanner, Salt Lake City, Utah, is state engineer and has charge of the state highway work.

WISCONSIN.

At present all road building in this state is done by the towns and counties. The last legislature, however, appointed a special committee to consider the question of state aid and prepare a bill. This bill is about ready to be reported, and it is probable that a special session will be called in the near future. The highway division of the Wisconsin Geological Survey acts in an advisory capacity regarding the construction of improved roads. The division does not take complete charge of work for towns and counties, but is only with them for a longer or shorter time as their particular needs seem to require. Its work consists in assisting the towns and counties by laying out their roads for them, making estimates, and helping them to let contracts, or, as is more common, instructing the town chairman or some other person selected as foreman to build the road, as to what he should do. If possible an expert from the division stays with him until he becomes reasonably proficient in his duties, but it frequently happens that there are so many calls upon the small force that they cannot stay as long as they should on one piece of work. A very interesting and valuable part of the highway division's work is in assisting towns and counties in their bridge letting. The division makes standard plans for superstructures and when any town or county desires its assistance it makes an inspection of the bridge site, designs proper foundations, and notifies all bridge contractors of the time of the letting, and that all bids will be upon the standard plans prepared by the division. It has introduced the system of considering only sealed bids upon a single set of plans for the purpose of permitting proper competition and of preventing competition from resulting in inadequate structures. While there is no compulsion for the towns to call upon the division for this assistance, it is constantly in receipt of applications. W. O. Hotchkiss, Madison, Wis., is chief of the highway division, and A. R. Hirst is highway engineer.

Methods and Costs of Sidewalk Construction in Chicago.*

As cinder and cement walks are practically the only kind now being constructed in Chicago they will be the only ones given consideration in this paper.

CINDER WALKS.

Cinder walks are suitable as a safe walk for outlying and sparsely settled territory. They can be recommended only for cheapness in initial cost and for the fact that the cinders can later be used as a foundation for cement walks when the character of the territory will warrant same. Cinder walk consists of not less than 12 ins. of cinders, usually deposited in two layers between two rows of 2x6-in. hemlock plank or curbs, nailed to split cedar posts set 4 ft. apart from centers and driven not less than 15 ins. into the ground. The top of the curbing is set at the grade at which the walk is to be built (3 ins. below cement sidewalk grade) and backfilled with earth. The first layer of about 9 ins. can be either coarse cinders or slag. The second layer of 3 ins. should be of finer cinders. After these have been compacted a "crown" of fine, clean cinders is put on and the entire walk rolled with a roller of not less than 500 lbs. in weight. Some contractors prefer tamping with a regulation concrete tamper to rolling. These walks are objected to in districts which are built up to any extent on account of the cinders being "tracked" into the houses, destroying floors, carpets, rugs, etc., and are not recommended for any except vacant or sparsely settled districts.

The average cost of cinder walks in Chicago from 1901 to 1908 inclusive, based on the total cost ($2,375,359.10) divided by the total mileage 1,312.12, was 34.3 cts. per lin. ft. This includes many walks requiring a fill of 2, 3 and sometimes 4 or 5 ft. and can hardly be taken as a fair "average cost" for the ordinary cinder walk requiring only 15 ins. of cinders, including "crowning." The following itemized cost per lineal foot based on Chicago conditions and Chicago prices would be more nearly correct. Average depth of cinders 1.2 ft. by 6 ft., or 7.2 cu. ft. in place. Allow for 20 per cent shrinkage, 7.2÷ .8=9. cu. ft. loose.

Item.	Cents.
9 cu. ft. or 1/3 cu. yd. at 50 cts., in place	16.67
Lumber at $17.50 per M. 2 ft.	3.50
Stakes at 1 ct. per lin. ft. of material	1.12
Nails	1.
Waste on materials 1/2 of value	.71
Labor and excavation	4.50
	26.10
Add for supt., ther expense and profit 1 1/2	3.91
	30.01

Note.—The cost of labor is based on an average of prices obtained from several contractors.

CEMENT SIDEWALKS.

Cement sidewalks, consisting of a concrete base 4¼ ins. thick, composed of 1 part Portland cement, 2½ parts sand and 5 parts of broken limestone, washed gravel or crushed blast furnace slag, with a wearing surface ¾ in. thick, consisting of a mortar composed of 2 parts of Portland cement and 3 parts of screened torpedo gravel or granite screenings, giving a completed walk 5 ins. in thickness laid on a 9-in. foundation of broken slag, crushed stone, sand, cinders or other suitable material, are being laid on residence streets and on business streets where no use is made of the subsidewalk space, and concrete walks on standard I beams or of reinforced steel construction, wherever sub-sidewalk space is used, are being laid as the standard to the almost entire exclusion of walks of other materials. This can probably be accounted for by the fact that all necessary materials for their construction are produced or manufactured practically within the boundaries of the city. Within her borders or immediately adjoining, Chicago has mills which produce the necessary cement and steel, with a by-product of slag and cinders for use in foundations, quarries which produce crushed stone in unlimited quantities and pits which furnish all sand and gravel needed for concrete, while brick, tile and other sidewalk materials, such as are used in other cities, would have to be shipped in by rail at a considerable extra expense in freight charges and then would not be suitable for "vault" construction.

Location.—Under the terms of the ordinance of March, 1902, all walks except full-width walks must be laid on a line parallel to and 1 ft. from the lot line, except where otherwise ordered by special ordinance. Often, however, it is found necessary to change from the prescribed line in order to save shade trees. Again, on some streets, especially those on which the lots and buildings "side," the City Council, usually on petition from the property owners, passes an ordinance for laying the walk adjoining the curb—the plea being that this change in line is necessary to save the buildings from being defaced by children. The writer does not favor the laying of walks adjoining the curb, because it brings pedestrians in closer contact with the dust and dirt from the street, sprinklers, etc., and because there is more liability of interference from street traffic and from horses hitched or standing near the curb. Also more dust and street dirt is blown on the walk by reason of its closeness to the roadway.

Foundation.—Where filling is required to bring the sub-foundation to proper grade to receive the foundation, it should be deposited in layers not over 12 ins. in thickness; and each layer should be thoroughly compacted before the succeeding layer is put on. If clay is used for a filling, it should be deposited in layers not over 6 ins. thick. Soft and spongy places should be dug out and replaced with suitable material, which should be thoroughly compacted. Where excavation is necessary, it should be done to a depth of 14 ins. below sidewalk grade; and when required, suitable drainage should be provided for. The foundation or sub-base should be of clean, hard cinders, slag, crushed stone, sand, gravel, broken bricks or other similar materials, and should be of a depth of 9 ins. after being thoroughly compacted. The foundation should be kept wet while the concrete is being laid.

Materials.—The cement should be finely ground, uniform as to quality and color, delivered on the work in original packages, and kept dry until used; lumpy cement should not be allowed.

The sand should be clean, sharp, free from foreign substances, of sizes ranging from ⅛ in. down to the finest, and in such proportions as to give a maximum of density and a minimum of voids.

Granite screenings are too expensive except for the wearing surface, and when used for that purpose should be clean, dry, well graded, free from excessive dust and of sizes similar to those specified for sand. The use of limestone screenings in sidewalk concrete is not advised. The writer is well aware that screenings have shown very high in laboratory tests,

*Slightly condensed and rearranged from a paper by N. E. Murray, Superintendent of Sidewalks, Chicago, Ill., presented at the annual convention of the Illinois Society of Engineers and Surveyors, Cairo, Ill., Jan. 26-28, 1910.

both in crushing and tensile strength, but unfortunately they have not shown the same high efficiency when put to a practical test in sidewalks actually constructed, but have proved an almost complete failure. Thousands of feet of concrete walks in Chicago which were laid from 8 to 12 years ago, with a cement, limestone screenings and crushed limestone base, were torn out and relaid this year, having failed completely. This may have been due partly to the quality of screenings used, and, to some extent, to an insufficient amount of cement. At any rate, when the top composed of torpedo sand and cement was removed, the base could in almost every instance be shoveled out without being picked; and while limestone screenings may have proved a success in concrete used in foundations and underground work, they certainly have not been a success in sidewalk concrete where they were more exposed to the elements and to extremes of heat and cold.

The stone or gravel should be clean, sound, free from dust, loam, dirt and other foreign substances, of sizes not less than ¼ in., nor more than 1 in. in any dimension, and graded in such proportions as to give a maximum of density and a minimum of voids. For reinforced concrete, the stone should be not more than ¾ ins. in any dimension.

For the past few years the writer has done more or less experimenting with crushed blast furnace slag as a substitute for crushed limestone or gravel, as the coarse aggregate in concrete, and to date has not recorded a single failure. The city ordinance has recently been amended to allow the use of this material in concrete both in sidewalk and pavement construction.

Forms.—The wooden forms should be smooth, free from warp, and not less than 2 ins. thick and 5 ins. deep. They should be set to the lines and grades given by the engineer, their upper edges conforming to the grade of the finished walk, which should provide for a fall from the lot line to the curb line of 1 in. in 3 ft. to allow for proper drainage. The work should be blocked out in sections about 5x6 ft. in size, the cross forms 5 ins. in depth, extending full width of the walk and set at right angles to the side forms. For walks 5 ins. thick the blocks should not be over 6 ft. in any dimension. Expansion joints 1 in. wide should be provided for at least every 100 ft. and at all street and alley returns.

Proportions.—To obtain a proper mixture and the best results, materials for concrete should be proportioned according to the voids in the aggregate which varies with different materials. Owing to the many sources from which the different materials for walks were received, and the large number of gangs (over 300) using them, it was found impossible to follow this method in Chicago. This forced us to adopt an arbitrary mix proportioned as follows. For base: Cement 1 part, sand 2½ parts, and stone or gravel 5 parts. For wearing surface: Cement 2 parts, screened torpedo gravel or clean granite screenings 3 parts, as the one that would come the nearest to meeting all conditions. These proportions have been incorporated in our specifications as a part of our sidewalk ordinance.

Mixing and Laying—Base 4¼ ins. thick: The sand for a "batch" should be spread evenly on a water-tight platform and the proper proportion of cement spread on the sand. These materials should be mixed dry until the mass is of a uniform color and no streaks of cement show. Water should then be added and the mixing continued until mortar of an even consistency is obtained. Then the required stone or gravel, previously drenched, should be added and the mixing continued until each particle of the aggregate is thoroughly coated with mortar. If additional water is needed during the mixing, it should be added in the form of a spray. A medium "dry" mix is considered better than a "wet" mix for sidewalk concrete. Machine mixing is preferable to hand mixing, whenever a mixer can be used to advantage. After being mixed, the concrete should immediately be deposited on the foundation and tamped or rammed until solid and a film of moisture appears on the surface. The top of this course when completed should be a plane parallel with and ¾ in. below the grade of the finished walk. The cross forms should then be removed and the material for the next block deposited to preserve the joint.

Wearing course, ¾ in. thick: The mortar composed of 2 parts cement and 3 parts torpedo sand or granite screenings should be mixed in the same manner as the mortar for the base, with sufficient water to obtain a consistency that will not require tamping but will be readily floated with a straight edge. When partially set, the surface should be troweled until a smooth, even surface is obtained.

Backfilling.—Where walks are laid on a fill, they should be backfilled with earth or sand in such a manner as to leave a berm of 1 ft. on each side of and flush with the top of the finished walk, with a slope to the surface of the ground of one-half horizontal to one vertical.

Cost.—The cost of cement walk will vary with the cost of the materials delivered on the work, the cost of labor, the experience of the workman, the location and size of the piece of work to be done, the depth of filling, etc. It costs much more to deliver mixed concrete on a foundation raised 5 ft. above the ground than it does on a foundation ½ ft. above the ground. The average cost of cement walks laid in Chicago from 1901 to 1908 inclusive, based on the total cost ($8,918,278.77) divided by the total mileage (1,862.95), was $4,787.18 per mile, or 15.11 cts. per square foot. This price was for walks complete, including filling, which in many instances was from 2 to 6 ft. in depth and is not a fair average cost for the ordinary cement walk. Taking 1909 Chicago prices for labor and material, and using Taylor and Thompson's tables for quantities of cement and aggregates, we have the following as the average cost of material delivered on the work:

Cinders per cu. yd., delivered	$0.50
Cement per bbl., delivered (3.8 cu. ft.)	1.20
Sand per cu. yd., delivered	1.75
Gravel per cu. yd., delivered	1.50

The ordinary concrete sidewalk gang in Chicago is usually composed of six men paid as follows:

1 finisher, 8 hours at 62½ cts.	$ 5.00
1 helper 8 hours at 47½ cts.	3.80
4 laborers 8 hours at 37½ cts.	12.00
Total	$21.00

Under favorable conditions this gang will construct 900 sq. ft. of walk per day. From information furnished me by several of the leading contractors, each employing on an average of six gangs of men, a gang of six men will average only 600 sq. ft. per day for an entire season. This figure will be used as a basis for computing the cost of labor in the following table:

Cinders (allow for 20% shrinkage). 20.83 cu. yds. at 50 cts.	$10.42
Base 4¼ inches thick—Mix 1-2½-5:	
Cement, 9.77 bbls., at $1.20	$11.72
Sand, 3.47 cu. yds., at $1.75	6.07
Gravel, 6.85 cu. yds., at $1.50	10.28
Total	$28.07
Wearing coat ¾ in. thick—Mix 2-3.	
Cement, 5.56 bbls., at $1.20	$ 6.67
Sand, 1.17 cu. yds., at $1.75	2.04
Total	$ 8.71
Water at 1 mill per square foot	0.60
Labor, one gang one day	21.00
Use of tools, waste of material, etc., at 2%	1.37
Supt. and office exp. at 5%	3.51
Profit at 10%	7.36
Total	$81.04

The average cost per foot when 600 sq. ft. per day are laid divided into unit cost per sq. ft. is as follows:

Cinders	$0.0174
Base:	
Cement	$0.0195
Sand	.0101
Gravel	.0171
Total	$0.0468
Top:	
Cement	$0.0111
Sand	.0034
Total	$0.0145
Water	$0.0010
Labor	0.0350
Tools, waste, etc., 2%	0.0023
Supt., 5%	0.0058
Profit, 10%	0.0123
Total	$0.1351

In the above the cost of materials and water amounts to 7.97 cts. per sq. ft., which will remain constant, while the cost of labor, superintendent, etc., will vary according to the number of square feet laid per day per gang:

Av. sq. ft. per day	500	600	700	800
Cost of labor, supt., etc.	$0.1291	$0.1248	$0.1213	$0.1185

Report of State Engineers on the Progress of the New York State Barge Canal Work in 1909.

At the end of 1909 there are 314.2 miles of canal under contract at prices aggregating $54,138,329. Additional plans for 67.7 miles are completed, while the plans for 9 miles more are over 75 per cent finished and the plans for the remaining 20.5 miles are well under way. With some 22 miles of additional lake navigation, not included in this enumeration, a total of about 433 miles is reached, which is the whole length of the Erie, Oswego and Champlain branches of the Barge canal system, exclusive of the Niagara River, which is being improved by the federal government, and the Hudson River below Waterford, the improvement of which it is anticipated the government will undertake. Thus it will be seen that 76 per cent of the total length is under contract, and it is expected that the whole of it will be let by April 1, 1910, with the exception of some minor structures and operating machinery which it would not be advisable to put in place at this time, on account of expense of maintenance.

Fifteen of the 53 new locks are now completed, with the exception of gates and operating machinery, and in some of the structures these are now being installed. By a year from next spring the 8 movable dams in the Mohawk River will be in operation and will be used to aid in the dredging of the channel, by retaining water for the floating of dredging machinery. The large fixed dam across the Mohawk River near Crescent will be finished during next summer, as well also the concrete dam impounding the waters of the upper Mohawk at Delta in a reservoir having a flooded area of 2,860 acres.

At the close of 1909 the total value of all construction work equals $16,291,315. As the record to the end of 1908 was $8,701,323, it appears that nearly half of all the work done thus far has been performed during the past year. It should be noticed also that several contracts were let so late in the year that they have contributed but little to the record, complete plants not having yet been installed.

When compared by years, the excellence of this year's record is manifest. At the end of 1905 $330,120 had been expended; by the close of 1906 the total was $1,042,926, while the sum had reached $3,257,461 and $8,701,323 at the end of 1907 and 1908 respectively.

Of the 314 miles of canal under contract 120 miles, or 38 per cent, have been awarded during 1909. If the money value of these contracts is considered, the ratio is about the same. The total of contracts let during the year amounts to nearly $19,000,000, or more than one-third of the whole under contract.

It is a pleasure to state that the work of construction is being done within the original estimates. This is determined by comparing the contract prices with the estimate made in 1903, upon which the appropriation was based. With three-quarters of the work under contract, it seems assured that all the construction contemplated by the Barge canal act will be entirely completed within the original appropriation.

The 1903 estimate for construction on the portions of the canal now under contract amounted to $56,791,537, while the contract price for this work, as revised by alterations to date, is $54,138,329. This is a saving of $2,653,208.

Officials and engineers of the New Mexico Central R. R. were recently over the route of the proposed 100-mile extension from Torrance to Roswell, N. Mex. C. J. Landry, Contractor of Kansas City, Mo., accompanied the officials. W. S. Hopewell, Albuquerque, N. Mex., is president.

Water-works and Sewer Section

Note: This section is devoted to methods and costs of constructing sewers and water-works. It will cover the construction work for all details of water supply and sewerage, including sewage purification and water filtration.

Some Construction Details and Costs of the Scioto River Storage Dam and Reservoir, Columbus Water-Works.*

The Scioto River Storage Dam is a concrete structure about 1,006 ft. long, consisting of two abutment sections, one on each bank of the river, with an overflow or rollway section between. The dam is of the curved or arched type, with the convex side up stream, the vertical up-stream face for a length of 810 ft. being built in plan to a radius of 800 ft. It was recommended that a 52-ft. dam, or so called high dam, be built—that is, a dam which would raise the water level 52 ft.—but owing to reasons purely local and having no relation to the design of the structure, the 30-ft. or low dam was built. The foundations and abutment sections, however, have been constructed so that at a future date the dam can be raised 22 ft. to the full height recommended. The crest of the present overflow is at Elevation 73.0, or 30 ft. above former mean low water, the abutment sections on either side rising to Elevation 95.0, or 22 ft. above the crest of the overflow. With the high dam, the crest of the future overflow will be at Elevation 95.0 and the top of the abutment section at Elevation 117.0. Although the dam is of the curved type, it has a gravity section, and in the design no consideration was given to the effect of any possible arch action.

The foundation on which the dam is built is Columbus limestone, the depth of the excavation being governed largely by the character of the rock. Under the overflow section, the rock was excavated to a depth sufficient to protect the foundation from the action of water moving at a high velocity, the rock here being hard and free from clay pockets; seams, however, are found at various angles. Under the west abutment, between Elevations 53.0 and 62.0, the rock was softer than that either above or below, and some large vertical cracks filled with clay and extending back into the hillside were found. The excavation therefore was carried to greater depths than was contemplated originally. The stratum of softer rock was also found on the east bank.

A cut-off trench, varying in depth from 3 to 5 ft. and about 5.5 ft. wide, was excavated under the up-stream portion of the dam. A part of the trench was excavated by a drill mounted on a horizontal bar, light charges of powder being used to loosen the rock, but satisfactory results were not obtained until an Ingersoll-Sergeant channeling machine was installed.

The dam was built mainly of concrete, but large stones were bedded in it to a certain extent, the percentage of such stones in the whole, however, being small. Lehigh Portland cement was used throughout the work and was furnished to the contractor by the city. The ballast for the concrete was crushed limestone screened into three sizes: No. 1, 0.25 to 0.75 in.; No. 2, 0.75 to 1.5 ins.; and No. 3, 1.5 to 3 ins.

During the fall of 1904, when about 6,300 cu. yds. of concrete were placed, the materials were mixed in the proportion of 1 volume of cement, 3 volumes of sand, and 2 volumes each of Nos. 1, 2, and 3 ballast. During 1905, when the remainder of the concrete was placed, the proportions were changed to 1 of cement, 2.71 of sand and 2.29 of each of the three grades of ballast. The two mixtures above mentioned were used in the main body of the dam. On the face of the present and future overflows and on the vertical sides of the abutment sections next to the present overflow for a depth of 1 ft. and on the top of the abutment sections for a depth of 6 ins. a richer mixture was used, the concrete containing 50 per cent more cement than that in the main body of the dam.

The total volume of concrete placed in the dam was 56,330 cu. yds., in which 56,870 bbls. of cement were used, giving a ratio of 1.01 bbls. of cement per cubic yard of concrete, and agreeing almost exactly with the specifications, which stated that "in general, not less than one barrel of cement will be used in each cubic yard of concrete."

The reservoir formed by the construction of the dam is peculiar in shape, as it is very long and narrow, the total length being about 5.8 miles and the mean surface width about 516 ft.; the maximum width is about 820 ft. and the minimum about 200 ft. The area of the water surface is about 363 acres and the mean depth about 14.5 ft.; the maximum depth, about 35 ft., is just above the dam. The total volume of water impounded by the present or 30-ft. dam up to Elevation 73.0 is 1,720,000 gals., of which 1.487,000,000 gals. are available, taking low water at Elevation 55.0. The total volume which would be impounded by the 52-ft. dam would be 5,681,000,000 gals., of which 5,448,000,000 gals. would be available.

Inasmuch as the water was to be purified by filtration, it was not considered necessary to strip the surface of the reservoir. All trees were cut down and all stumps and roots 1 in. or more in diameter were grubbed out to a depth of at least 1 ft. below the surface, after which the material was burned. The surface of the ground was then burned over. There were a few buildings on the site of the reservoir, one of which would have been submerged. Some of these buildings were moved to higher ground, the others were burned or torn down. One old bridge was removed and a new one, 540 ft. in length, was built to replace it. The new bridge was designed and erected under the direction of Mr. Walter Braun, county surveyor, the city paying 70 per cent of the cost. In addition to the above, about 3.9 miles of roads were relocated and constructed.

Table I gives the cost of the reservoir and dam and Table II gives the cost per million gallons of capacity. In order that the figures may be understood clearly, one or two items need explanation. In the reconstruction of the bridge and the approaches, as previously stated, the city bore 70 per cent of the cost, but the figures in Tables I and II give the total costs, and not the proportionate part paid by the city. Similarly the figures given for the cost of engineering include the cost of engineering chargeable to the bridge, although this work was not done under the direction of the city.

TABLE I—COST OF SCIOTO RIVER STORAGE RESERVOIR AND DAM.

Reservoir:	
Land, 452 acres at $334	$150,850
Clearing and grubbing 256 acres at $79.	20,200
Moving buildings	2,440
Reconstruction of roads, 3.9 miles at $12,670	49,400
Reconstruction of bridge	65,800
Conveyance deeds, 2 at $880	1,760
Keeper's house, repairs, and grading	1,760
Total cost of reservoir	$292,210
Dam:	
Excavation:	
Dry earth, 10,850 cu. yds. at $0.40	$ 4,240
Wet earth, 7,250 cu. yds. at $0.80	1,270
Rock, 29,000 cu. yds. at $1.40	41,870
	$53,480
Masonry and Steel.	
Concrete, 55,710 cu. yds. at $4.94	$275,340
Steel rails and splices, 28.7 tons at $35	1,009
Structural steel, 11,460 lbs. at $0.045	520
	$276,860
Gate Chamber:	
Concrete, 620 cu. yds. at $4.94	$ 3,060
Steel and cast iron, 18,430 lbs. at $0.045.	820
48-in. sluice gates, 2 at $600	1,200
36 by 60-in. sluice gates, 4 at $600	2,400
48-in. cast-iron pipe, 28.5 tons at $26.84	770
Screens, stop-planks and lifters	580
	$8,830
36-in. Sluice Pipes:	
Steel and cast iron, 5,270 lbs. at $0.042	$ 220
36-in. sluice gates, 6 at $263	1,580
36-in. cast iron pipe, 65.3 tons at $24.96.	1,630
	$3,430
Power tubes, 3	3,640
Railing, 1,000 lin. ft. at $1.75	1,750
Total cost of dam	$347,990
Summary:	
Reservoir	$292,210
Dam	347,990
	$640,200
Total cost of construction, exclusive of land	$489,350.
Engineering:	
Pay roll	$ 27,540
Supplies	3,560
Expenses	2,230
	$33,330
Percentage for engineering	$6.81

The item for engineering needs further explanation. Prior to 1904, when the engineering force was organized for carrying on the work of construction, and extending over a series of years during which the preliminary studies of the dam, the surveys of the reservoir and explorations of the dam site were made, no separate account was kept of the cost of engineering, it being included in the general engineering expenses of the city. After the writer became connected with the work, he made an attempt to ascertain this preliminary cost, but was unable to do so. The cost of engineering given in Tables 5 and 6 therefore does not include ths preliminary work, but does include the preparation of all the contract drawings and specifications, and the engineering expenses during the full period of construction.

TABLE II—COST, PER MILLION GALLONS. OF SCIOTO RIVER STORAGE RESERVOIR AND DAM.

Items.	Total cost.	Cost, per Million Gallons. Total capacity, 1,720,000,000 gal.	Available capacity, 1,487,000,000 gal.
Land	$150,850	$ 88	$101
Reservoir, exclusive of land	141,360	82	95
Dam	347,990	202	234
Total, exclusive of engineering	$640,200	$372	$430
Engineering	33,330	19	22
Total	$673,530	$391	$452

Unit Prices in 1909 in North Yakima, Wash.—During the year 1909 the city of North Yakima, Wash., of which Mr. H. J. Doolittle is City Engineer, made improvements, all work being done by contract, at the following prices:

	Av. unit price.
10,032 ft. 6-ft. wooden sidewalk	$0.40
51,610 ft. 8-in. vitrified pipe sewers	1.40
1,809 ft. 10-in. vitrified pipe sewers	1.74
2,525 ft. 24-in. concrete pipe sewers	1.89

The 24-in. sewer was an outfall extension, and was laid at an average depth of 4 ft. in gravel formation, no sheeting being required. The 8-in.. sewers were laid at an average depth of 8 ft. in gravel soil and sheeting was required almost continuously. The 10-in. sewers required sheeting and were laid 10 ft. deep in gravel. For the sewer work the prices above include the cost of manholes and flush tanks. Manholes were placed every block or 480 ft. apart. Since suitable sand and gravel was found on all contracts, concrete manholes were built, collapsible forms being used and very creditable results obtained.

*Abstract from a paper by John H. Gregory on the Improved Water and Sewerage Works of Columbus, Ohio. Proceedings American Society of Civil Engineers, Vol. xxxvi, No. 1, p. 2.

Unclassified and General Articles

Note: This section is devoted to methods and cost articles on construction work not properly coming under any of the preceding classifications.

Cost of a Construction Service Telephone Line in Cuba*.

The following costs relate to a telephone line constructed in Cuba in 1908 during the building of the $800,000 water-works for the city of Camaguey. The line was constructed similar to the lines built by the U. S. Reclamation Service in the west for its irrigation projects. It was the intention to use the line to facilitate the construction of the pipe main and reservoir and on completion the telephone would serve as a permanent means of communication with the reservoir and pumping plant, the latter being located about 15 miles north of the city.

The labor consisted mostly of Spaniards, some Cubans and a few Jamaicans. The latter were used mostly in the pole raising gangs. One method of raising poles is shown in the accompanying engraving. As the poles were of hardwood, they were exceedingly heavy and on some sections of the line they were raised by means of a small gin-pole with block and tackle. The following description of the work is taken from the report made in the department at the time:

View Showing Method of Erecting Poles, Camaguey, Cube, Telephone Line.

The telephone line extends from a temporary station adjacent to the site where will be built the pump house for the Camaguey water-works to the office of the department of public works in Camaguey, a distance of about 25 kilometers or 15 miles. The portion of the line here considered comprises the main line, extending from the pump house site to station 1,040 of the pipe line, at which point the pipe line leaves the right of way and enters the road in the outskirts of the city, being a length of 20.934 km. It also includes two 4 wire branch lines, having an aggregate length of 0.283 km., which are considered, as required by the specifications, as equivalent to 0.566 km. of 2 wire line. The 4 wires on the branch lines are supported on hardwood cross arms, thus permitting the use of but one line of poles for each branch. From the pump house the line follows the right of way of the pipe line to a point about 15.7 km. distant, where it follows the public road for 1.1 km., again entering the right of way and following it to the above mentioned station 1,040.

The line is a two wire metallic circuit of No. 12 B. & S. gage hard drawn copper wire with a conductibility of 97 per cent, supported on oak brackets with glass insulators. The brackets are each nailed to the poles with two 6 in. galvanized iron cut nails.

The poles are of jiqui, arabo, tengue and jucaro prieto, all of which are durable hardwoods found in the country. A total of 131 jiuqui poles were shipped from Ciego de Avila, 60 miles west of Camaguey, by rail and delivered by sub-contract for $3 f. o. b. Camaguey. These poles were hauled from the cars and distributed along the line by mule teams, costing $6 per day with driver. The cost of $0.569 shown below was the actual cost per pole. A total of 333 poles were purchased from farmers living in the vinicity and were delivered along the line for $3 per pole. They were hauled on ox carts an average distance of about 10 miles.

The poles were spaced 46 ms. (161 ft.) apart except where road crossings required a 60 m. (197-ft.) span, or where angles in the line made it necessary to shorten the span. Guys of ⅝ in. steel cables were used to guy poles at angles in the line when the throw was more than 3 m. (10 ft.) and when the poles were not considered sufficiently firm. Short anchor posts 1.2 m. long were set in the ground 1 m. and the cable fastened by means of a threaded eye bolt passing through the post. The poles were 7.5 m. (25 ft.) long except at road crossings, where 9 m. (30 ft.) poles were used, and all were placed in the ground 1.5 m. (5 ft.) and thoroughly tamped in place, 3 men tamping to 1 shoveling. No poles whose least diameter was less than 5 ins. were used.

The holes for the poles were dug by subcontract, and as there was no foreman with the gang doing the original work, many holes were not dug in line and had to be redug. The majority of the holes were in hardpan and in earth filled with loose rock and boulders, a few being in rock requiring explosives, and some in earth. If the work had been done more rapidly and with a better organized gang it would have been possible to have reduced the labor charges by one-third.

The costs following are actual construction charges, covering all labor and materials necessary for the work as well as tools. They do not, however, include the contractor's charges for office expense, bond, insurance and other general expenses for the main contract. All prices are reduced to U. S. currency. The contract price for the work was $200 per km.

There were 464 holes dug for poles at the following costs:

Labor:	Total.	Per hole.
11 days superintendent at $150 per mo.	$ 55.00	$0.1185
6 days timekeeper at $2.31	13.86	0.0298
35 days foreman at $2.31	80.85	0.1742
1 day foreman at $1.50	1.50	0.0032
248½ days laborers at $1.15	285.77	0.6158
Total	$436.98	$0.9415

As there were 13.36 miles of line, the cost per mile of line for digging poles was $32.71.

The cost of squaring poles, roofing and painting roofs of poles was as follows:

Labor:	Total.	Per pole.
7 days superintendent at $150 per mo.	$ 35.00	$0.0728
8 days foreman at $2.31	18.48	0.0398
76½ days laborers at $1.15	87.98	0.1896
Total	$141.46	$0.3022
Materials:		
37 gals. paint and oil at $1.30	$ 48.10	$0.1040
Grand total	$189.56	$0.4062

The cost per mile of line was $10.59 for labor and $3.60 for materials, a total of $14.19.

The cost of setting poles was as follows:

Labor:	Total.	Per pole.
8 days superintendent at $150 per mo.	$ 40.00	$0.0859
3½ days timekeeper at $2.31	8.08	0.0174
7 days foreman at $2.31	16.17	0.0348
19 days foreman at $1.50	28.50	0.0614
220 days laborers at $1.15	253.00	0.5452
Total labor	$345.75	$0.7447
Materials:		
131 poles f. o. b. Camaguey at $3.	$393.00	
Hauling 131 poles at 56.9 cts.	74.56	
333 poles delivered on line at $3.	999.00	
Total	$1,466.56	$3.160
Grand total	$1,812.31	$3.9097

The cost of poles per mile of line was $25.88 for labor and $109.77 for materials or a total of $135.65.

The cost of stringing wire was as follows:

Labor:	Total.	Per mile.
2 days superintendent at $150 per mo.	$ 10.00	
18 days foreman at $1.50	27.00	
28½ days lineman at $2.25	64.12	
2 days lineman at $1.50	3.00	
86 days laborers at $1.15	98.90	
5 days mule cart at $1	5.00	
Total labor	$208.02	$15.57
Materials:		
2,965 lbs. No. 1 copper at 23.15 cts.	$686.40	
950 oak brackets at 4 cts.	38.00	
950 glass insulators at 7 cts.	66.50	
100 lbs. No. 6 galv. iron wire at 4 cts.	4.00	
250 lbs. cut nails at 5 cts.	12.50	
910 ft. steel cable guys at 1.51 cts.	13.74	
35 galv. iron clamps at 15 cts.	5.25	
35 iron eye-bolts at 10 cts.	3.50	
60 lbs. No. 14 soft copper wire at 23.15 cts.	13.89	
Total	$843.78	$63.16
Grand total		$78.73

The cost of tools was $38.26 or $2.86 per mile and general or camp expenses were $59.47 or $4.45 per mile. Summarizing the cost per mile of line was as follows:

Item:	Per mile.
Digging holes	$ 32.71
Squaring poles, etc.	14.19
Setting poles	135.65
Stringing wire	78.73
Tools	2.86
General	4.40
Total	$268.59

The work was done under the direct charge of Mr. E. K. Knight as resident engineer, with Mr. Henry A. Young as chief engineer.

*Rearranged from data furnished by Henry A. Young, late Chief Engineer, Camaguey Water Works, Cuba, 200 Warburton Ave., Yonkers, N. Y.

Contracts for Panama Canal Excavation.—Preparations are being made to let to contractors two pieces of excavation in the Panama Canal prism in the Gatun Lake region, one of about 166,000 cu. yds. near Bohio, and the other of about 36,000 cubic yards near Tabernilla. The tract near Bohio is on the west side of the Chagres river, and it was first intended to take it out by steam shovel, which would have involved the construction of a bridge across the river from the main line of the Panama railroad. A careful survey of the ridge that is to be cut down to elevation 40 feet above sea level, and a number of borings show that about 120,000 cubic yards of the material are earth, 42,000 cubic yards are soft rock, and 4,000 cubic yards are hard rock.

Is the Engineer School Necessary?*

A doubt having been expressed informally as to the usefulness of the engineer school or any service school, a few thoughts on the subject may not be amiss. This paper does not pretend to cover the whole question or to settle any part of it. It simply throws a few side lights on the matter.

When there is work of any kind to be done, it will be done best and most economically by a man who is properly equipped and trained for the purpose. This may be accepted as axiomatic; but to emphasize the point, as well as to determine what constitutes proper equipment and training, let us take a simple illustration.

You wish to have a set of shelves built in your office. You summon a carpenter, who comes and examines the contemplated job, gives you an estimate on it, goes and gets the necessary tools and material, and in a reasonable time completes the work. You find that your shelves present a neat appearance and show good workmanship. You are satisfied and pleased with the workman. You care nothing whatever about his ability as a mathematician, a writer, a theologian, or even an engineer. So far as your wants are concerned, he is a trained (that is, an educated) man.

A friend drops in and tells you that he wishes you to recommend a carpenter to build him a cupboard. You reply that you know a man who has just made a good job of a set of shelves. You have never seen him build a cupboard, but you feel sure that he has the necessary tools and skill to do so, and you confidently recommend him for the higher job.

Now this seems to be a very simple and sensible proceeding. There is nothing at all remarkable about it. Any one has sense enough to do the same thing. The same rule applies in all the walks of life. But does it? Do we select our trained men for the work of the army in this sensible way? Do we not proceed more as follows?

The carpenter arrives with nothing in his hands. We are astonished at this, and we ask if he has no hammer. He replies that it is in his tool chest, where it belongs. Dear, dear, it should be somewhere on his person. Has he no saws, no planes, no square, no screw driver, no chisels, etc.? He says that he has, but they are also in their proper places in the tool chest. We are grieved at this and fear that he is not properly equipped for the work in hand. Then, too, a friend of ours intends to build a cupboard which will involve the use of beading and molding. Has the carpenter the special tools for this? Has he a mortising machine? Why, no, certainly not. If he fills his chest with tools which are of infrequent use, he only makes it the more difficult to get at the more important tools in the chest; and besides it is more economical to have such work done at the mill. We fear that we cannot employ him, as he is not provided with all the tools required to meet possible needs. In vain he points out that when special cases arise he has sense and knowledge enough to go and buy the proper tools, and that if he were to carry upon his person all kinds of tools used in his business he would only crush himself to the earth and be unable to perform any work at all. But no, he is not fully equipped. We can not accept him.

This may appear to be overdrawn, but it is a close parallel to what is done in the army. Not two years ago the writer was ordered to report to a board for examination to determine his fitness for promotion. He began at once to prepare for the ordeal. How did he go to work? By inviting attention to the shelves he had built? Not at all. He made lists of all the tools which the board in similar cases had insisted should be carried upon the persons of all carpenters who aspired to the construction of cupboards, and he proceeded to attach them to himself for the inspection of the board. (Observe, please, that facts and knowledge are the tools of the engineer, just as woodworking implements are the tools of the carpenter.) Many tools fell off daily, but he hastily hung them on again, until on the appointed day he presented himself for inspection with the most absurd, ridiculous, and preposterous assortment of tools imaginable heaped upon him and dangling from all his parts.

Owing to distance, the board could not inspect him in person, but prepared a list of tools which he was to exhibit and describe under the direction of a designated officer, and which were to be accepted as representing the whole museum. (In other words, the examination was written.) For ten long weary days he exhibited and described the tools demanded. They formed but a small part of the collection that he had assembled and under whose weight he was barely able to stagger and entirely unable to work. At last the exhibition was over. The board solemnly pronounced him properly equipped to build cupboards. As a matter of fact he could not have built a cupboard then to save him. The load he had borne was too great and the exhaustion too severe. He threw away his burden, confident that most of it would never again be needed and that the rest could be picked up again when desired; but it was several weeks before he had recovered sufficiently to build as good a cupboard as he could have built before he overtaxed his back. There is nothing unusual about this case. It is perfectly typical.

Right here is the proper place for the reader to ask how it is possible then to be sure that a man has the proper education for his position. How can a military engineer be trained if he does not acquire all the tools of his profession and keep them always at hand?

To answer this question, let us again consider the carpenter. How did he acquire the skill which enabled him to make a good job of the shelves? Without doubt he began work in his youth under the guidance of an older and more experienced man. By seeing how his preceptor performed his work, he learned to do likewise. He also learned by experience just what tools it was best to keep always available in his tool chest, and how to keep them in the best condition for use. His tools were always a means to an end, never the end itself. Being a man of character and ambitious, he applied his inventive faculty to improving upon the methods of his teacher, and he naturally became interested in the ideas of others upon his trade. He was familiar with the various special tools which he saw in the hardware store or illustrated in catalogues, and he knew where to obtain such tools in case of need. There could be no question as to his ability to use them, for the knack of using tools is not confined to those alone which are most frequently used. He thus trained himself to perform not only those works which were of daily occurrence but also those which demanded resourcefulness. The moral is that the ability to do work is acquired by doing it, and doing simple work stimulates the worker and assists him to advance to higher undertakings. No amount of study and theory will produce this result.

Were it possible to take those graduates of the Military Academy who are assigned to the corps of engineers and place them at once under the care of older officers on works where they could see how the tools of the profession should be used and where they could themselves acquire the use of those tools, or were it possible to assign them to companies under experienced captains where they could acquire all the tools of the military branch of their profession, this would produce more efficient officers for both military and civil engineering duties than any amount of instruction in the best equipped school.

Again the reader bobs up with an inquiry as to why this is not done. Why equip and maintain an expensive engineer school if it is not the best way to train our officers?

The answer is prompt. It is the best way available. We are actually sending the young officers to duty under experienced men, but a year is about the longest time that can be spared, and is too short. We have too few officers to assign the young ones for several years to works already properly administered by older men. In many cases the young and inexperienced must control without the guidance of the experienced. Under present conditions our captains are themselves inexperienced and but little older than their lieutenants. That they acquit themselves as well as they do is highly creditable to them, but they are not old enough to undertake the training of young officers, and the system falls to the ground.

Let us suppose that our young carpenter finds himself at the outset called to a place far removed from the experienced man who was to have trained him. What can the latter do to increase the young man's chances of success? He would probably assist him to select an assortment of those tools which he should always have in his kit, at the same time giving such advice as to their use as the time would permit, and he would give him a catalogue of special tools which he could order later if necessary. This instruction would be very different from the full training which was to have been given, but the young man would go out into the world much better equipped than if he had been left entirely to his own resources. If he is the right kind he will succeed anywhere, but starting him on the right road makes his success easier and more certain.

The function of the engineer school should be exactly similar. The burden of the corps of engineers are steadily increasing, while the time available for the preliminary training of young officers is as steadily decreasing. A few years ago it was three years and it was then rarely broken into. Now it is only two years, and the students are assigned to all kinds of duties that interfere with their school work or interrupt it entirely. Today a young officer is apt, nay quite sure, to be entrusted with important duties. If he knows what tools to use he will be less apt to make mistakes. If he is the right kind, and most of them are, he will make good anyway; but he will succeed more surely and with less effort if he is given a proper start like the young carpenter. Mistakes in modern engineering are very costly, and good sense demands that every possible precaution be taken against them. If allowed to perform its proper function, the engineer school is of the highest value and practically indispensable.

The great danger to this school and to the army is thought to be the tendency toward the belief that the education of the army is in itself an important thing, whereas it is really of no importance whatever except in so far as it enables the army to do its work better, and that keeping the army always at school is the same thing as educating it. At the engineer school we should give to the student officer the kit of tools which he will need for every day use, show and explain the more intricate tools which he may have to use in special circumstances and tell him how to get these special tools, and then send him out into the life of the service to make good through his own character and energy. The business of life is work and accomplishment. A certain amount of preparation is wise and necessary; too much is a waste. A man could spend his whole life in the endeavor to learn everything bearing upon his profession and at the end of that life find that his object had failed and that he had accomplished nothing useful. Not only is this true, but after a certain amount of preparation the power to use the acquired knowledge is lost. Just as the carpenter who attempts to carry his kit all the time can do little work under such a burden, so the professional man can overload his brain so that it can not work. The musician who practises too much may becomes paralyzed. The athlete who trains too much may become stale. The student who attempts to learn too much may injure his mind. The same rule holds true in everything.

The whole army is now at school to the great detriment of its proper work. If every man is able to do his work and does it, what more can be asked? Why is it necessary that every private shall be trained to be an officer and every officer a general? What can be more appropriate than that every captain shall be engaged in training his company or troop and preparing it for service? This is a work that demands all the intelligence, energy, and time of an able man. How many captains are

*From a paper by R. R. Raymond, Instructor in Civil Engineering at the Engineer School, Washington Barracks, D. C., in "Professional Memoirs" of the Engineer Bureau, U. S. A.

permitted to do it, however? Are they not rather preparing themselves to be generals? What is wrong with the army? This is the oft repeated cry. The answer comes: There is nothing wrong with the army; it was never more efficient than at present. This sounds well, but it is not true. There is something wrong. Every one feels it, this spirit of unrest. The trouble is that we are staggering under our kit of tools and are not doing our work. What is worse, we are losing the power to do it. Would it not be wiser to take the army out of the perpetual school, put it on its own job without distraction, let it learn to use its tools through use and not by holding them up for inspection? Only then will it be a happy and contented army and a truly educated and efficient one.

Under no circumstances should a company officer be taken away from his company nor should he be nagged by any school or duties not directly connected with his command Every particle of his energy is needed to instruct and care for his men. This is the highest and most important duty of a captain. It is recognized in the army regulations, but is not in practice accorded its real weight. When the company goes into the field, which is the more important, that the captain shall be qualified to command the regiment (theoretically) or that the company shall do its work? If the captain spends two or three years detached from his command, listens to lectures, rides over historic battle fields, exhausts his energies in study, and learns to think himself It, how doth it profit the company? How many companies and troops are today captainless while their captains are at school?

Should we abolish the schools then? Not at all. They are very valuable if kept in their proper places, but it should never be forgotten that they are a means only. They are of absolutely no importance in themselves. A few officers can well be employed in recording, compiling, and publishing the advances in military sciences, but it will rarely be the case that any advance comes from an officer on duty at a school. This is not his fault; his brain has no opportunity for original work. The most certain way to prevent a man from inventing anything useful is to keep him busy with matters other than the problem in hand.

These observations apply to all arms of the service, but just now we are especially concerned with their application to the corps of engineers. We need trained officers. To train them we must occupy them with their own work and as little else as possible. Experience is by far the best of all teachers, but unfortunately we are expected to be trained in a field that is broader than any one man's experience can possibly be. The engineer school comes to our rescue here, but to be of real value it should give each man his outfit of knowledge and send him out to real life in the least practicable time. He needs a working equipment and not an encyclopædic education. To give him this equipment quickly so as to secure to the government the benefit of his useful services, the school should have every facility. Its instructors should be allowed to perform their functions without other duties. This is now provided for on paper, but the powers that be respect it not at all.

The school should have adequate buildings where the laboratories, model rooms, and library could be worked to their utmost capacity. An hour in a model room, such as we could have at the engineer school, is worth weeks of hard reading. With half a show we could have a school that would really fit our young officers for their life work. Under present conditions it may be doubted whether the results justify the effort. Both instructors and students are overloaded with extraneous duties or whisked away entirely for all kinds of jobs. The classes are not permitted to progress together throughout the course, but are broken up so that the members graduate months (sometimes years) apart. The engineer troops are sacrificed by taking their officers away to attend the school, and then the school is disabled by sending its instructors and students to duty with the troops. We are trying to serve two masters, each of whom independently expects to have all our time and energy.

The engineer troops are a vitally important part of the army. They should have their full complement of officers and every opportunity to perfect themselves in their own sphere of action. Nothing should be permitted to interfere with their training or the discharge of their proper functions. They should be supplied with officers regardless of other demands upon the corps of engineers. Other duties, civil duties, duties of high importance, have been assigned to the corps in order to make it possible to maintain a body of trained engineers for use in war. These duties afford a training which is of the greatest value, and the efficiency of the corps would be seriously affected if we were to be separated from them, for that would amount to taking us away from work and sending us back to school to keep us busy. It is manifest that in time of peace the military engineer can not find real employment for his profession, and it is equally clear that practice as a civil engineer is excellent training for the doing of any kind of engineering work. On the other hand, the school is of real importance and should receive its just consideration and dues.

The problem in a nutshell is this: Given a certain number of officers in a corps of engineers, is it possible by separating some of them from the proper work of the corps and placing them in a school, to improve the efficiency of the corps as a whole, so that the amount of work accomplished is increased or its quality bettered?

The writer believes that it is practicable and advantageous to do this. If this belief is correct, then there must be some definite relation between the corps and the school, which should fix the proportion of the corps to be employed at the school to give the maximum efficiency. If no officers go to the school, all will be available for work. If one man can be employed at the school in collecting, compiling, and publishing professional information, so that through such information the corps is enabled to accomplish more than it could do without the informatnon, but with that officer in his normal place, then the school is useful. If two men at the school can secure a still greater efficiency of the corps, then the school should be increased to two, and so on. After the proper number of officers to collect and dispense knowledge has been determined, a further problem arises. Can the efficiency of the corps be further increased by sending a number of officers as students to the school for a time? If so, how many should go, and for what time?

Great wisdom than the writer's is needed to answer these questions, but it is safe to say that the shorter the time necessary to impart the desired education the better for the work of the corps, and this time can be shortened for a given standard of education only by means of the best equipment and other facilities and by rigidly enforcing the principle of non-interference with the school by other interests.

Dump Cars at Panama.—One hundred all steel, side door dump cars of a rated capacity of 12 cu. yds. will be added to the equipment on the relocation of the Panama railroad. The Washington office has been directed to advertise for bids. The cars will be of about the same construction as the 300 added to the service during the year 1909, and will embody all the improvements suggested by the hard usage that dump cars have been subjected to on the Canal work. The first lot of the 12-yd. dump cars were put in service in 1905, when 100 were added to the equipment. The following year 300 were in the service; in 1908, there were 800, and in 1909 there were added 300 more. In addition to these 12-yd. cars there are 300 steel dump cars of a rated capacity of 25 cubic yards in service, and 250 more of this size are being advertised for in the states. When all the cars on order are added to those in the service there will be 1,200 steel, side door dump, 12-yd. cars, and 550 steel, side door dump, 25-yd. cars available, in addition to 1,765 wooden flat cars, and 500 steel flat cars in use on the work.

Methods and Cost of Constructing a Concrete Lock and Timber Crib Dam With Appurtenant Structures Employing Day Labor.

II.

The work consisted in constructing a timber crib dam across steam with a lock at one end for the passing of boats. Methods and costs of constructing the lock and the guide cribs to the lock were given in our issue of Jan. 26. In this issue we conclude with a discription of the dam, giving detailed costs.

DAM ABUTMENT.

The dam was connected to the shore by a concrete abutment. This abutment was T-shaped, the stem of the T running into the bank, and was founded on piles driven to bed rock. It is surrounded by triple-lap sheet piling. The concrete was deposited in shallow water from 1 in. to 18 ins. deep by skips, the main piles being embedded about 4 ft. in the concrete. The river face is 14 ft. long on top and 76 ft. long at the base. The land arm which enters the bank for its entire length is 60 ft. long. The abutment was built to the same height as the lock walls, namely, 10 ft. above the crest of the dam. At the land end of the abutment stem the natural surface of the ground is at the same level as the top of the abutment, but begins there to slope downward and drops 21 ft. in a distance of 125 ft. This slough immediately in the rear of the low narrow ridge to which the abutment is anchored is closed by a crib dam 250 ft. long, forming a timber extension to the abutment. A mattress of 15-in. fascines is placed below this extension and is covered with a 2-ft. layer of heavy stone. The concrete for the abutment was machine mixed in the following proportions: In the foundation, 1 bbl. of cement, 9 cu. ft. of sand, 8 cu. ft. of crushed stone and 16 cu. ft. of gravel; above the foundation, 1 bbl. of cement, 5 cu. ft. of sand and 27 cu. ft. of gravel. The top of the abutment was faced with a 1:2 mortar, no facing being used elsewhere. The timber extension, which consists of a double row of 10x10-ft. cribs for the middle 140 ft., and a single row at either end, is of the same height as the abutment, is founded on piles driven to bed rock, is sheeted to the top on its upper face, is filled with rubble, and is backfilled for 50 ft. with earth at a slope of 1½ on 1 covered with a paving of loose riprap. The main bank is revetted to its top for 50 ft. above and 100 ft. below the crib extension. Below the abutment only a sheet-pile revetment was originally provided for, but it was directed that a protection crib 150 ft. long be built instead.

Summarized, the work comprised first the construction of the crib dam at the rear of the abutment; second the construction of the abutment proper, and third the construction of an abutment protection crib. The crib dam and abutment were first completed to original plans and afterwards were increased in height 4 ft.; in the following, therefore, the original construction costs are first given complete and then the cost of the additional work.

Preparation of Site.—For the site of the dam and abutment 3.3 acres were purchased and cleared at the following cost:

Item.	Total.
3.3 acres purchased at $40	$132
3.3 acres cleared at $41.51	137
Total at $81.51	$269

Excavation.—The excavation amounted to 6,496 cu. yds., and cost as follows:

Item.	Total.	Per Cu. Yd.
Fuel	$ 25	
Excavation by hand and teams	1,150	
Excavation by dredge	378	
Total	$1,553	$0.239

Foundation.—The foundation work comprised the driving of 4,399 lin. ft. of piling and cost as follows:

Materials.	Total.	Per Lin. Ft.
4,388 lin. ft. piles	$440	$0.100
Fuel	13	0.003
Miscellaneous	47	0.017
Total materials	500	$0.120

Labor.		
420⅝ days' labor driving....	$747	$0.169
Grand total.....	$1,247	$0.289

Sheet Piling.—The cost of 58,263 ft. B. M. of sheet piling was as follows:

Materials.	Total.	Per M. ft.
58,263 M. ft. lumber.....	$708	$12.15
2,400 lbs. spikes at 2.84 cts.....	68	1.17
Fuel	4	0.06
Miscellaneous	8	0.13
Total materials	$788	$13.51
Labor.		
46 days towing lumber (58,263 M. ft.)	$ 115	$ 1.97
136 days handling and storing (58,263 M. ft.).....	253	4.35
11 days inspecting (58,263 M. ft.)	30	0.51
523⅜ days driving (58,268 M. ft.)	1,034	17.75
Total labor	$1,432	$24.58
Grand total	$2,220	$38.09

Crib Dam.—The crib dam was 250 ft. long and contained 115.777 M. ft. of lumber and 2,170 cu. yds. of riprap filling. The cost of the timber work was as follows:

Materials.	Total	Per M. ft.
115,777 M. ft. timber.....	$1,521	$13.13
Unloading timber	12	0.10
3,875 lbs. bolts at 2.41 cts.....	94	0.081
Total materials	$1,627	$14.04
Labor.		
73 days towing (90,721 M. ft. at $1.97)	$ 179	$ 1.55
212½ dys. handling and storing (90,721 M. ft. at $4.35).....	394	2.54
18 dys. inspecting timber.....	52	0.44
515 dys. building crib (115,777 M. ft.)	911	7.85
Total labor	$1,536	$12.38
Total labor and materials..	$3,163	$26.42
Add. miscellaneous	75	0.64
Grand total	$3,238	$27.06

The cost of the riprap filling, 2,170 cu. yds., was as follows:

Item.	Total	Per cu.yd.
2,170 cu. yds. rip rap.....	$1,584	$ 0.70
28 dys. inspecting 1,708 cu. yds. at 3 cts.....	45	0.02
172¾ days piling 2,170 cu. yds..	301	0.14
Total rip rap.....	$1,930	$ 0.89
Grand total for crib.....	$5,168	

The total cost of the crib per lineal foot was:

Item.	Total	Per lin. ft.
Crib construction	$3,238	$14.55
Rip rap fill.....	1,930	7.72
Total	$5,168	$22.27

Concrete Abutment.—The T-abutment contained 765 cu. yds. of concrete. The cost of the 757 bbls. of cement for this concrete was as follows:

Item.	Total	Per bbl.
757 bbls. cement	$1,461	$1.93
Inspecting cement	20	0.02
Loading on barges.....	30	0.04
Towing to dock.....	79	0.11
Unloading and storing.....	66	0.08
Total for 757 bbls.....	$1,656	$2.18

The cost of 25 cu. yds. of crushed stone was as follows:

Item.	Total	Per Cu. Yd.
Loading 24 cu. yds	$ 41	$1.56
Towing	29	1.13
Total for 26 cu. yds	$ 70	$2.69

The cost of 127 cu. yds. of sand was as follows:

Item.	Total	Per Cu. Yd.
127 cu. yds. sand	$121	$0.95
Loading 48 cu. yds. at 65 cts....	32	0.25
Towing 48 cu. yds. at 61 cts....	29	0.23
Inspecting 127 cu. yds.....	11	0.08
Total for 127 cu. yds.....	$193	$1.51

The cost of 720 cu. yds. of gravel was as follows:

Item.	Total	Per Cu. Yd.
25⅝ dys. labor	$ 57	$0.08
Fuel for dredge.....	68	0.09
Total for 720 cu. yds.....	$125	$0.17

The cost of mixing and placing 765 cu. yds. of concrete was as follows:

Item.	Total	Per Cu. Yd.
Cons. and removing forms.....	$ 59	$0.077
587 2-3 dys. mixing and placing	1,055	1.379
Fuel for mixing and placing....	24	0.031
Tamping	213	0.278
Finishing	4	0.005
Total for 765 cu. yds.....	$1,355	$1.770

Included in the total cost were the following miscellaneous items:

Item.	Total	Per Cu. Yd.
Miscellaneous materials .....$	14	
Erecting derrick	208	
Removing plant	62	
Total for 765 cu. yds.....	$ 284	$0.37

Summarizing we have the following cost per cubic yard of concrete:

Item.	Total	Per Cu. Yd.
757 bbls. cement at $2.18.....	$1,656	$2.19
26 cu yds. crushed stone at $2.69	70	0.09
127 cu. yds. sand at $1.51.....	193	0.25
720 cu. yds. gravel at $0.17.....	125	0.17
Mixing and placing 756 cu. yds. conc.	1,355	1.77
Miscellaneous charges	284	0.37
Total for 765 cu. yds.....	$3,683	$4.84

The grading and backfill about the abutment amounted to 4,183 cu. yds. and cost $1,299 or 31 cts. per cu. yd.

Protection Mat.—Below the crib dam there was constructed a protection mat of brush fascines covered with rip rap. There were 66 squares of mattress and 368 cu. yds. of rip rap. The cost of the mattress proper was as follows:

Item.	Total	Per Square
12 dys. labor burning brush..... $	29	$0.44
2,255 lbs. wire at 3.2 cts.....	72	1.09
104¼ dys. making and loading fascines	210	3.27
52½ dys. laying mattress.....	95	1.44
Total for 66 squares.....	$406	$6.24

The cost of the 368 cu. yds. of rip rap covering was as follows:

Item.	Total	Per Cu. Yd.
368 cu. yds. rip rap stone.....	$269	$0.73
6 dys. labor inspecting stone...	9	0.03
41½ dys. paving mattress.....	77	0.21
Total for 368 cu. yds.....	$355	$0.97

The total cost of the mattress per square was therefore as follows:

Item.	Total	Per Square
Fascine mattress in place	$496	$ 6.24
Paving with rip rap.....	355	5.39
Total for 66 squares.....	$761	$11.61

Bank Revetment.—The banks above and below the abutment were riprapped; the cost of 1,523 cu. yds. was as follows:

Item.	Total	Per Cu. Yd.
1,523 cu. yds. rip rap stone....	$1,112	$0.73
38 dys. inspecting rip rap.....	65	0.05
296 dys. placing rip rap.....	578	0.37
Total labor 1,522 cu. yds....	$ 643	$0.42
Grand total	$1,755	$1.15

The total cost of the original dam and abutment was from the above items $17,951. The cost of raising both dam and concrete about 4 ft. is given as follows:

The raising of the old dam 4 ft. for a length of 250 ft. involved taking up and relaying 2,200 sq. yds. of rip rap, placing 3,180 cu. yds. of earth backfill and 1,131 cu. yds. of new rip rap paving, building 110 squares of mattress, building 4x10x280 ft. of crib and filling in 332 cu. yds. of rip rap. As many of the labor items are not separated, we give only a summary, as follows:

Item.	Total	Per Lin. Ft.
Materials	$1,072	$ 3.83
Labor	3,409	12.17
Total	$4,481	$16.00

The raising of the abutment 4 ft. involved 35 cu. yds. of concrete work, which cost as follows:

Item.	Total.	Per Cu. Yd.
45 bbls. cement at $2.25	$101	$2.89
114 dys. mixing and placing....	216	6.17
Total for 35 cu. yds.....	$317	$9.06

The labor cost given includes forms, obtaining concrete materials, etc.

Placing Derrick Stone.—To protect the foot of the crib dam and the base of the abutment, 1,111 cu. yds. of derrick stone were placed at the following cost for quarrying, towing and placing:

Item.	Total	Per Cu. Yd.
Fuel ..... $	95	
842 cu. yds stone (royalty 3 cts per cu. yd.).....	25	
269 cu. yds. stone (no charge)..	....	
1,959⅜ dys. labor for 1,111 cu. yds.	3,623	
Total for 1,111 cu. yds.....	$3,743	$3.37

Abutment Protection Crib.—To protect the abutment a timber protection crib was built along the river bank above the abutment. The work involved 5,500 cu. yds. of excavation, 37.934 M. ft. of timber crib work and 831 cu. yds. of stone filling, besides grading and paving the brick behind the crib.

The cost of 5,500 cu. yds. of excavation by teams and orange peel was as follows:

Material.	Total	Per Cu. Yd.
Fuel ..... $	148	$0.027
Labor.		
200⅛ days erecting and maint. trolley way	402	$0.071
45 dys. pumping pit.....	87	0.016
1,352⅝ dys. excavating.....	2,676	0.488
Total labor	$3,165	$0.575
Grand total	$3,313	$0.602

The cost of 37.934 M. ft. of crib work was as follows:

Materials	Total.	Per M. Ft.
34.667 M. ft. timber at $11.21.....	$389	$10.25
3,236 M. ft. old timber at $5.....	16	0.42
1,050 lbs. iron at 2.2 cts.....	23	0.66
Miscellaneous materials	18	0.47
Total materials, 37.934 M. ft...	$446	$11.80
Labor.		
48 dys. hand and struct., 34.667 M. ft. at $2.63.....	$ 91	$ 2.39
269 dys. framing and placing 34.667 M. ft. at $14.79.....	513	13.52
Total labor, 37.934 M. ft.....	$ 604	$15.91
Grand total	1,050	27.71

The cost of 831 cu. yds. of stone filling placed in the crib was as follows:

Item.	Total.	Per Cu. Yd.
831 cu. yds. stone.....	$ 607	$0.73
13 dys. inspecting stone.....	25	0.03
276⅝ dys. filling stone into crib...	527	0.63
Total	$1,159	$1.39

The cost of grading and placing 539 cu. yds. of rip rap paving behind the crib was as follows:

Item.	Total.	Per Cu. Yd.
539 cu. yds. rip rap.....	$ 393	$0.73
8 dys. inspecting rip rap.....	16	0.03
335⅛ dys. grading and paving..	624	1.16
Total for 539 cu. yds.....	$1,033	$1.92

The grand total of the above items of work on abutment and abutment crib dam is $33,033.

DAM.

The dam crossing the river is 658 ft. long, 250 ft. of which is founded on piles and 408 ft. on rock. A level stratum of bed rock stretches across the river; near the lock this rock is covered with large boulders and beyond these with a layer of gravel. The portion of the dam on piles is over this gravel. As built, the section of the dam on piles is protected by rows of sheet piling along the upstream and along the downstream edges of the dam and also by a third interior row along the upstream edge of the apron. The upper row of water-tight sheet piling is, of course, necessary; the two lower rows were introduced to serve as guards to keep the reflex eddy below the dam from washing out the gravel around the piles, but being water tight are subject to a hydrostatic head from any leakage that enters the body of the dam. A better construction would have been a single row of close piles just above the downstream edge, which while acting as a guard would yet have allowed any leakage to escape without compelling it to rise above the piling.

Dam on Pile Foundation.—In constructing the dam the 250-ft. section on pile foundation was first built as a step dam and then changed from step dam to slope dam. The cost of the original structure will first be given and then the cost of changing it to slope dam.

To prepare the foundation for pile driving the gravel was first dredged out to 3 ft. below lower pool level. The excavation amounted to 8,097 cu. yds. and cost as follows:

Item.	Total.	Per Cu. Yd.
Fuel and oil	$ 90	$0.011
98¼ dys. labor on dredge and teams	218	0.027
Total for 8,097 cu. yds.	$308	$0.038

A total of 278 piles or 6,968 lin. ft. of piling was driven for the foundations to an average penetration of 14 ft. The cost of this pile foundation was as follows:

Item.	Total.	Per Lin. Ft.
6,968 lin. ft. piling	$ 697	$0.100
Fuel and oil	38	0.005
332 dys. labor driving	646	0.092
Total for 6,968 lin. ft.	$1,381	$0.197

This cost does not include cutting off piles, which is charged to timber work. The cost per pile in place was nearly $5.

There were 108.977 M. ft. of sheet piling driven, at the following cost:

Materials.	Total.	Per M. Ft.
42.712 M. ft. pine at $13.96	$ 596	
57.260 M. ft. oak at $19.42	1,113	
Total for 108.977*	$1,709	$15.68
4,561 lbs. iron, nails and bolts at 3.16 cts	144	1.33
Fuel	177	1.63
Total materials for 108.977 M. ft.	$2,030	$18.64
Labor.		
153 dys. handling and stacking, 108.977 M. ft.	$ 290	$ 2.66
943⅜ dys. driving, 108.977 M. ft.	1,820	16.70
Total for 108.977 M. ft.	$2,110	$19.36
Grand total	$4,140	$38.00

*Includes 9.005 M. ft. of old lumber for which no charge was made.

Assuming the 9.0055 M. ft. not charged for to cost $15 per M. ft. for old lumber, the cost per M. ft. in place would be $39.24 instead of $38. There were 667 sheet piles driven, so that the cost per pile was $3.16.

The construction of the crib work required 172.055 M. ft. B. M. of timber and cost as follows:

Material.	Total.	Per M. Ft.
113.065 M. ft. pine at $14.17	$1,602	
58.990 M. ft. oak at $14.48	855	
172.055 crib timber	$2,457	$14.28
12,316 lbs. spikes, iron, etc., at 2.54 cts.	339	1.97
Total for 172.055 M. ft.	$2,796	$16.25
Labor.		
241 dys. handling and stacking 172.055 M. ft.	$ 714	$ 2.65
1,366 dys. framing and placing 172.055 M. ft.	2,705	15.72
Total for 172.055 M. ft.	$3,419	$18.37
Grand total	$5,589	$34.62

The crib work was filled with 3,707 cu. yds. of rip rap stone at the following cost:

Item.	Total.	Per Cu. Yd.
3,707 cu. yds. stone	$2,706	$0.73
53⅜ dys. labor filling in stone	299	0.08
Total for 3,707 cu. yds.	$3,005	$0.81

The grading and paving above the dam comprised 1,600 cu. yds. of earth fill, 80.5 squares of brush mattress and 283 cu. yds. of rip rapping over the mattress. The cost of this work was as follows:

Earth Fill and Paving.	Total.	Cu. Yd.
283 cu. yds. rip rap	$198	$0.70
4 dys. inspecting rip rap	8	0.03
228¾ dys. filling 1,600 cu. yds., and paving 283 cu. yds.	505	
Total	$711	
Mattress Construction.	**Total.**	**Per Sq.**
400 lbs. wire at 2.5 cts.	$ 10	$0.124
67½ dys. obtaining brush and laying neat	125	1.540
Total for 80.5 squares	$135	$1.664

The protection below the dam comprised 87.5 squares of brush mattress paved with 76 cu. yds. of rip rap, and of a fill of 830 cu. yds. of derrick stone. The cost of the work was as follows:

Excavation (3,407 cu. yds.)	Total.	Per Cu. Yd.
42½ dys. dredge labor	$ 96	$0.028
35⅝ dys. teams grading	83	0.024
Total	$179	$0.052
Brush Mattress (87.5 squares).	**Total.**	**Per Sq.**
400 lbs. wire at 2.5 cts.	$ 10	$0.114
76 cu. yds. rip rap at $0.72	55	0.628
1 dy. inspecting rip rap	2	0.002
320⅜ dys. building mattress	857	9.790
Total	$924	$10.534

Derrick Stone Fill (830 cu. yds.).	Total.	Per Cu. Yd.
Dynamite, pure, etc.	$ 78	$0.094
Fuel	74	0.089
1,028⅜ dys. labor	1,991	2.398
Total for 830 cu. yds.	$2,143	$2.581

The changing of the step dam to slope dam cost as follows:

Item.	Total.	Per Unit.
88,171 M. ft. B. M. cribwork	$1,333	$15.12
429 cu. yds. rip rap filling	$ 371	$ 0.86
250 lin. ft. of dam	$3,124	$12.49

The total cost of the crib dam from the above figures was $86.96 per lin. ft.

Dam on Rock.—There were 408 lin. ft. of crib dam constructed on rock foundation.

To prepare the foundation rock for the crib work 6,733 cu. yds. of excavation were required and it cost as follows:

Item.	Total.	Per Cu. Yd.
Fuel for dredge	$278	$0.041
Labor dredging earth and boulders	694	0.103
Total for 6,733 cu. yds.	$972	$0.144

The construction of 849,409 M. ft. of crib work cost as follows:

Materials.	Total.	Per M. Ft.
618,036 M. ft. pine at $12.66	$7,828	$ 9.20
231,374 M. ft. oak at $16.73	3,872	4.55
58,984 lbs. iron, spikes, etc., at 2.19 cts.	1,293	1.52
Fuel	416	0.49
Miscellaneous	121	0.14
Total for 849,409 M. ft.	$13,530	$16.40
Labor (849,409 M. ft.).		
1,188 dys. unloading and stacking timber	$2,256	$ 2.65
3,530 dys. framing and placing timber	6,742	7.94
30 dys. clearing up yard	58	0.07
Total labor	$9,056	$10.66
Grand total	$22,586	$27.06

The cost of filling the crib with 12,992 cu. yds. of rip rap was as follows:

Item.	Total.	Per Cu. Yd.
12,992 cu. yds. rip rap	$8,437	$0.650
Fuel	268	0.020
15 dys. building wagon roads	25	0.002
147 dys. inspecting 9,863 cu. yds. at 3 cts.	287	0.021
104⅜ dys. towing 1¼ m., 3,129 cu. yds. at 7 cts.	233	0.017
3,813⅜ dys. filling 12,992 cu. yds.	7,139	0.550
Total	$16,389	$1.260

The cost of 1,939 cu. yds. of additional gravel filling was as follows:

Item.	Total.	Per Cu. Yd.
Fuel	$ 21	$0.01
517½ dys. dredging, towing ¼ m., and placing	971	0.50
Total for 1,939 cu. yds.	$992	$0.51

The cost of 13,054 cu. yds. of gravel backfill and of 529 cu. yds. of rip rap paving was as follows:

Gravel Backfill.	Total.	Per Cu. Yd.
Fuel	$ 404	
792 gals. coal oil	126	
Material for dump cars	248	
764⅜ dys. dredging, towing ¼ m. and placing	1,533	$0.12
Total	$2,311	$0.177
Rip Rap Paving.		
529 cu. yds. rip rap stone	$357	$0.675
8 dys. inspecting rip rap	15	0.030
136⅝ dys. loading and unloading	255	0.480
Total for 529 cu. yds.	$627	$1.185

The total cost of the dam on rock from the above figures is as follows:

408 lin. ft. per lin. ft.	$107.63
849,409 M. ft. B. M. timber per M. ft.	$51.70

The cost of the corner protecting crib built above the dam was as follows:

Cribwork.	Total.	Per M. Ft.
21,966 M. ft. pine	$306	$13.94
772 lbs. iron at 2.06 cts.	16	0.72
36⅝ dys. hauling and stacking timber	57	2.60
79⅜ dys. framing and placing timber	151	6.85
Total for 21,966 M. ft.	$530	$24.11
Stone Filling.	**Total.**	**Per Cu. Yd.**
292 cu. yds. stone	$ 204	$0.70
Fuel	9	0.03
4 dys. inspecting stone	8	0.03
129½ dys. filling in stone	242	0.82
Total for 292 cu. yds.	$463	$1.58
197¾ dys. placing derrick stone	$ 388	
3½ dys. excavation	7	
Total	$ 395	
Grand total cost of crib	$1,388	

The grand total cost of the dam was $67,043 for 658 lin. ft., or $102 per lin. ft.

The cost of general supervision and subsistence is included in the cost of labor as shown by the above account. General supervision includes the assistant engineer in local charge and his office force in the field. Subsistence includes cost of provisions, fuel and pay of cooks and helpers. Foremen and enginemen received from $50 to $90 per month and subsistence. Laborers received $1.20 with or $1.50 without subsistence, for days of 8 hours. A few laborers were employed by the month at from $30 to $40 per month, with subsistence.

The Doctrine of "Adverse Possession" and Its Significance to the Surveyor.*

It is a belief widely prevalent among laymen that a surveyor is a kind of dictator, or czar over land boundaries, who, armed with the authority of a deed description, has power to establish, modify or remove such boundaries, according as they fit the measures of his transit and his chain. Especially is this true if the surveyor be a county surveyor, invested in the additional awe of public office. Even among trained surveyors and engineers a similar belief in the supremacy of the calls of a paper description, when they come into conflict with old fence lines or other old boundaries, is far from uncommon. But *in the eyes of the law* it is not so. In the eyes of the law, by virtue of the doctrine of "Adverse Possession," the "old fence" becomes more or less sacred, venerable; an institution, in fact, not to be lightly overturned by the mere edict of a deed, however strictly such deed may conform to the legal requirements of its kind. The doctrine of "Adverse Possession" is thus an important one for the surveyor to understand, as many a surveyor's client has found to his cost. A surveyor, indeed, cannot estimate the value of his work without a knowledge of it. Yet, excepting in one instance, the subject is not even mentioned in the Manuals or Textbooks of Surveying with which we are acquainted, and it is with the object of filling in, however modestly, this hiatus in the literature of surveying, that the present writers have prepared this paper.

In order to be understood in its narrower relation to the surveyor, the doctrine must first be looked at briefly in its fuller and broader aspect. It is, in brief, in relation to land, what may be called a doctrine of legalized "squatter sovereignty." In virtue of it, the squatter upon land, if not ousted, becomes in time the true legal owner. A mere intruder at first, without the shred of a paper or other legal title, by simply squatting and sticking, he becomes at last firmly fixed. Writs of ejectment are powerless against him. He has struck legal root in the soil; you can no longer oust him. His arm at first single, has now behind it the arm of the law.

The squatter's title, to become thus legal, must satisfy certain requirements. It must be "open possession," visible and patent to anybody; "notorious," proclaimed by acts which unmistakably imply ownership. It must be "continuous" possession; there must be no break or lapse; and it must be possession "hostile" to the claim of the true owner, that is, possession not by allowance or permission of any kind, but with assertion in some way of ownership by the squatter. Such assertion of ownership, however, need not be by word. Acts may be quite sufficient. "The rule seems to be well settled that acts of notoriety, such as building a fence around the land, entering upon the land and making improvements thereon, raising crops and felling trees thereon, are presumptive evidence, and evidence of intention to assert ownership over and possession of the property; and taxation of the land for a series of years to the person claiming it, and the payment of taxes by

*A paper by Geo. L. Teeple and Leonard S. Smith, reprinted from the Wisconsin Engineer, Dec., 1909.

him, are competent evidence tending to show ownership."*

Finally and from the moral point of view, somewhat curiously, good faith is quite necessary. A scoundrel farmer can steal a strip of his good neighbor's land by simply building the division fence in the wrong place, knowing that he does so, and unless the good neighbor removes the fence in time, he will lose the stolen strip irrecoverably. The law will protect the thief.

Indeed by a curious interpretation in certain states, the law in those states seems to demand that the interloping fence-builder actually be a scoundrel before it will give him legal possession of the disputed strip. If he swallows his neighbor's land innocently, the law makes him "cough up." If he swallows it feloniously, with avarice aforethought, the law applies a digestive instead of an emetic. Thus may scoundrels fatten. Of this, however, more later.

The doctrine, thus, in certain cases and under certain interpretations, seems like a curious moral monstrosity. But looked at in its broader aspects, it takes on a different aspect.

It supports the claim of the real developer and user of property as against the speculator who would let it lie idle. It hits at the lax and the laggard, who does not look after his own. "Unto him that hath shall be given, and from him that hath not shall be taken even that which he hath." It hits also at the shyster attorney, who, raking up some stale claim, years after the evidence has become dim, and the witnesses dead and gone, would use it to blackmail and browbeat perhaps some widow or child, the innocent holder of real property. It quiets claims. It bars the re-opening of closed issues. It says that claims as well as persons are subject to death and dissolution, and that in land titles also, a live dog is better than a dead lion.

Before leaving this broader and more general view of the doctrine, it is proper to distinguish the two broad cases under which land may be adversely held. There may be (a) Adverse Possession "without color of title," and (b) Adverse Possession "with color of title."

The first case, that without color of title, is the case of the squatter pure and simple, who can produce no evidence whatever, written or spoken, that he ever held proper legal title to the land in question.

In this case (we believe in every state in the Union) twenty years possession, satisfying the requirements which have been mentioned, will ripen the squattership into perfect legal title.

The second class, wherein the Adverse Possession is said to be "with color of title," covers those cases in which, whether by fraud or by error, a paper title to the property in question has been given, but a paper title which is in some way defective, so that it fails of being legal or binding.

In all such cases, which constitute Adverse Possession with color of title, a period of ten years is sufficient to ripen the possession into a perfect claim.

With these general principles in mind, we may now turn to the circumstances which make this doctrine of interest to the surveyor. Suppose Mr. Brown's west line, which is Mr. Jones' east line, is marked by an old fence, which has stood for twenty years or more. Suppose now Mr. Jones wishes to sell his property to Mr. Robinson who, being a particular man, demands a survey, and monuments set, which the deed shall call for. The survey is made and it is discovered that the true line is four rods west of the old fence, cutting off also Mr. Jones' barn, which, in ignorance of the true bounds, he has built upon what by the terms of the deeds both of Brown and Jones, is Brown's land. What is to be done? Both Brown and Jones have always supposed the old fence to be the true line. They, in fact, twenty-one years preceding this time, by mutual agreement built the fence as marking the line. Now Jones wakes up to find that he has apparently surveyed himself out of a good barn and four acres of land, which he must deliver over to Brown.

But must he? It is a case of Adverse Possession. Jones has been an innocent squatter upon the land of Brown. He has been such an innocent squatter for a period exceeding twenty years, and in accordance with the principles enunciated, his barn is still safely his own, and he is owner also of Brown's four acres as legally as if he could produce the most perfect paper title. Brown has been the real Rip Van Winkle. He slept just one year too long. There was really no need for a surveyor. The surveyor has indeed already been on the ground—old Father Time himself—has measured it with his twenty year chain, and declared for the old fence line.

The Supreme Courts of all our states are in practically unanimous harmony regarding such cases as that just cited—the case of distinct agreement between two abutting owners upon a boundary, in ignorance that it is incorrect.*

And it should be noted that in this case the boundary may be established by monument as well as by "visible boundary."

But suppose Messrs. Jones and Brown, or either of them had built the fence not as a boundary line, but as a matter of convenience or necessity, recognizing distinctly that it was not the true boundary? The decisions of our courts are here again practically unanimous, but to the opposite effect;—the fence, however long the lapse of time, will not become the legal boundary, and a survey in such a case would be necessary to establish where the boundary lies.*

A third possibility remains, and one which includes by far the greater number of cases which actually occurs—that in which Brown and Jones, or either of them, builds the fence, supposing it to be on the true line, but under no distinct agreement to abide by it as the line,—the case of tacit consent. Upon this case, unfortunately, the agreement of the courts is not unanimous.

In by far the larger number of the states, the Supreme Courts have held that such cases belong in the same class as the case first discussed; the building of the fence line and the holding to it, constituting in the absence of evidence to the contrary, a virtual agreement that it is the true line, and therefore such a fence line, with the lapse of the necessary period, becomes the legal line.

The Supreme Courts of Maine and Missouri, however, followed at times by those of a few other states, have held a modification of this doctrine. And it is here that the curious twist is introduced already referred to, whereby it would appear that a man, in order to profit by the building of an erroneous fence, must confess himself a virtual land pirate. These courts held that where such an error had been made in marking and holding to a property line, through pure ignorance and mistake, and with no intent to go beyond the true line, the doctrine of Adverse Possession does not apply.*

The true line when discovered, holds; the erroneous fence line must yield. Thus our friend Jones, if there had been no specific agreement, and if he had built the erroneous fence line in pure innocence, would have had to give up his barn and the four acres.

But if he had *intentionally* built the fence line upon Brown's land, knowing that he did so, and sworn in a Maine court that he held to it as his line, without regard to Brown's real rights in the matter, the Maine court would say to him, "The land is yours."

Summing up, then, the results of our study in one general statement, we may say that by far the larger majority of our State Supreme Courts have held that unless the division fence has been built on the distinct understanding that it is not the true line, the building and maintaining of it as a division fence for the requisite period, will make it the legal line, whether in agreement with the calls of the deeds or not, the exceptional cases being those just discussed under what we have called the Maine-Missouri doctrine.

It is well at this point, perhaps, to discuss more fully the difference as to ownership of the disputed strip, between those cases where the adverse possession is with color of title and those in which it is without. Bearing in mind that in the vast majority of cases adverse possession with color of title means possession under authority of some written instrument, but a written instrument is in some manner defective so that it fails to make the title good, while adverse possession without color of title no legal sanction whatever can be shown for the holding of the land beyond the bare fact of the possession itself, the governing principle may be simply stated thus:

When in the case of two adjoining pieces of property, the calls of the two deeds, with reference to the common boundary, are identical, and the fence line or other visible boundary, conflicts with this identical description, then the adverse possession of the disputed strip must be without color of title. Both deeds call for the same line; neither sanctions any departure from that line by an erring fence; hence the adverse possession can have no color of title, and to be effective must run twenty years. But when the calls of the two deeds conflict in regard to the common boundary, in such a way that the two properties, as described, overlap, we shall have adverse possession with color of title along the disputed line. And in this case the adverse possession will give perfect title in a period of ten years.

Suppose, for instance, that in the case above discussed the land of both Brown and Jones had been originally owned by Robinson. Robinson sold first to Brown, the line eventually to be in dispute being described as so many rods west of, and parallel to a certain stone wall. But no fence at this time was built. A year later say, Robinson sells to Jones, the line to be disputed being now described as so many rods east of, and parallel to, a certain section line, the two descriptions being in conformity with an erroneous original survey. Jones, wishing to build his barn near Brown's land, measures the distance from the section line correctly with a sixteen-and-one-half-foot pole, in accordance with the calls of his deed, and builds the division fence. Later he wishes to sell; a survey discloses the shortage in the original survey, Brown's west line, measured in accordance with his deed, from the stone wall, falling four rods west of the fence Jones has built. The two descriptions over-lap. Brown's deed being of prior date makes him, as far as the deeds alone are concerned, the legal owner of the overlap, and Jones' holding of the four rods is thus evidently adverse possession with color of title, since his deed by its description apparently entitles him to hold to the fence he has built. If the mistake disclosed by the resurvey is discovered within ten years, Brown retains the overlap. But if the discovery is not made until the ten years has entirely elapsed, he loses it to Jones, the title by adverse possession in such a case becoming legal and perfect at the end of that period. One important addition should be made in reference to the entire preceding discussion, which is this: that during the twenty years or the ten years necessary to ripen the adverse possession into perfect title, the disputed strip need not have continued in the possession of one single adverse owner. Jones may have sold to Smith, Smith to Tom, Tom to Dick and Dick to Harry, all within the ten or the twenty years necessary to perfect title, and if the "possessory estates are connected

*See Ballard on Real Property

*See Burrell vs. Burrell, 11 Mass. 294; Makepeace vs. Bancroft, 12 Mass. 469; Darci vs. Enlow, 16 Ill. 77; Wilmarth vs. Woodcock, 66 Mich. 331; Wickwell vs. Adams, 7 Cow. 761; Goodhue vs. Magee, 9 Nerg. 155.

*See Fairfield vs. Barrette, 73 Wis. 663; Burnell vs. Maloney, 39 Vt. 583; Griscom vs. Murphy, 110 Ill. 274; Bunce vs. Bidwell, 43 Mich. 542; Cole vs. Parker, 70 Mo. 372.

*This was the view of the Wisconsin Supreme Court until about ten years ago.

and continuous," it is as if Jones held the disputed strip himself for the entire period.*

The above gives, we believe, the essence of the doctrine of Adverse Possession as between private individuals.

As regards Adverse Possession against the public, the case might be briefly treated by a paraphrase of the Irishman's essay on the Snakes of Ireland,—"There are no Snakes in Ireland."

Similarly, there can be no adverse possession against the public. The doctrine of common law. "Nullam tempus occurrit regi," (time does not run against the king) has long been accepted as applying here. Court decisions are practically unanimous in declaring that no occupancy of say, a portion of a public street or highway for however long a period, will give the trespasser legal title to the land so occupied. The same holds as regards any real estate owned by the public,—a school ground, a public park, a courthouse or jail lot. So also, of State or United States lands, forest reserves, etc.

The principle underlying this exception to the general doctrine is that in a public matter any one individual can be expected to feel but a slight interest. He is expected to defend his own property against possession, but not public property; nor, in the immense extent of public highways and other public lands can any public officer be expected to so defend it.*

Regarding corporations not public the doctrine is the same as it is regarding individuals. In the case of railways, however, court decisions are inconsistent and conflicting. The growing tendency to regard railway company as a public corporation, tends to give its Right-of-Way more and more the character of a public highway, against which adverse possession cannot run; while in the older view of it as a private corporation, its lands, like those of other private corporations, are as subject to adverse possession as those of an individual. But this is a branch of the doctrine which must be reserved for fuller treatment than is possible in the present paper.

The same plea must be entered as to the decisions of our Supreme Court regarding Adverse Possession in general, which in a paper like this, prepared for Wisconsin engineers, might be expected to receive full and careful treatment. It can only be said at this time, however, that in the main Wisconsin decisions have been in conformity with the general principles which have been laid down.

The exceptions have been so far as we have noted, in that treatment of what has been denominated above as "the Maine-Missouri doctrine." Regarding this doctrine, it is important to note that our court has executed a complete right-about-face. Its earlier decisions (down to and including the Fuller vs. Worth case, for which see below), were, we believe, universally in favor of the Maine-Missouri doctrine. Its later decisions have been squarely against it.*

The total aggregate of property lines which have become fixed by adverse possession is very great and is constantly increasing. The surveyor who has occasion to make re-locations of old lines should know the general provisions of the law on this subject both in his own and in his client's interest. By this it is not meant that the surveyor should usurp the place of judge and jury. His duty as an expert is to escertain and report the facts to his client. A knowledge of the force of adverse possession, however, should in many cases greatly assist him in sifting out and interpreting more or less discordant facts. The surveyor should never lose sight of the fact, that the court and jury have the final decision as to the proper location of the line. They at least are not likely to overlook the authority which the law gives to long continued possession.

In conclusion, the writers can only express again their sense that this subject is one of more importance to surveyors than the scant literature upon the subject would seem to indicate, and their hope that at some future time they may present a more complete treatment of the subject.

*See Stetousha vs. Lamb, 18 Neb. 619, 26 Nw. 374; O'Brien vs. Goslin, 20 Neb. 349, 30 Neb. 274.

*For cases supporting the above view see Charlotte vs. Pembroke Iron Works, 82 Me. 391; O'Connor vs. Pittsburg, 18 Pa. St. 187; Arundell vs. McCulloch, 10 Mass. 70; Milham vs. Sharp, 27 N. Y. 611. For contrary decisions, see Knight vs. Heaton, 22 Vt. 480; Beardslee vs. French, 48 Am. Dec. 507; Weber vs. Chapman, 42 N. H. 326, 80 Am. Dec. 111.

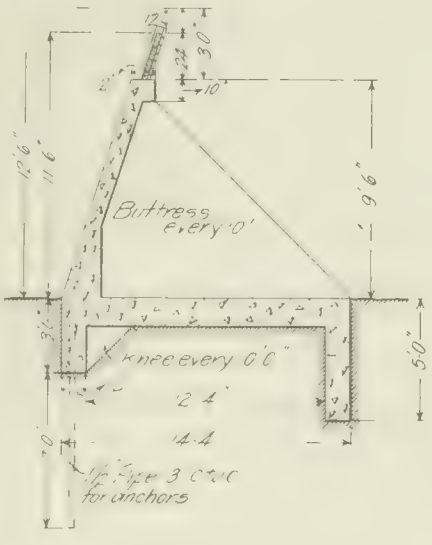
*See in favor of that doctrine: Graeven vs. Dieves, 68 Wis. 317; Fairfield vs. Barrette, 73-463; Dhein vs. Benscher, 83-316; Fuller vs. Worth, 91-406. And against it: Bishop vs. Bleyer, 105-330; Wollman vs. Ruehle, 104-693; Welton vs. Poynter, 96-406; Meyer vs. Hope, 101-123; Gilman vs. Brown, 91 N. W. 227, and the Jones Island case (Illinois Steel Co. vs. Various parties), of which references are not at hand.

LETTERS TO THE EDITOR.

What Caused the Failure of the Dansville Dam?

Editors: Descriptions of the failure of a dam at the plant of the George Sweet Manufacturing Co., near Dansville, N. Y., have appeared in the technical press and the only cause assigned has been poor workmanship. I enclose a sketch of the cross section from which all reinforcement has been omitted as not being necessary to elucidate my idea of the cause of failure.

The dimensions are as shown and the face slab reinforcement was designed to take care of the conditions raised by a flood level of 3 ft. over the top of the dam or 1 ft. over the top of the flash boards. The total length of the dam was 123 ft., and it cracked at a point 58 ft. from one end. This you will notice is very near the middle of the dam; in fact, about 3 ft. from the middle. I do not blame poor workmanship except as a contributing cause, for the design, in my opinion, is poor.



Sketch Section of Dansville Dam.

The face of the dam is nearly vertical, whereas with modern buttressed slab concrete dams the idea is to have the slab slope so the resultant pressures will serve to anchor the dam and strike the bottom slab within the middle third. In fact, the greater the flood height, within certain limits, the more stable the dam.

In a dam of the form here shown the pressure will be nearly horizontal and the bottom slab is turned into a girder 12 ins. thick and 14 ft. 4 ins. deep lying on top of the gravel and not supported at the ends so that proper reactions will be set up. Neither is it reinforced along the lower edge so it will act as a reinforced girder. It will be a nice little exercise in structural design for some of your readers to calculate the resisting moment of a plain concrete girder 12 ins. thick, 14 ft. 4 ins. deep, and having a span of 123 ft. The dam failed when the water reached a height of about 10 ft. above the floor slab. The pressure against the face of the dam can be calculated for such a condition and applied as a continuous load to find the bending moment exerted on the floor slab. The floor slab (thin, deep girder) can be assumed as resting on water-soaked gravel and therefore receiving little, if any, assistance from friction. My belief is that if reinforcement had been placed in the slab at its junction with the heel wall, sufficient in amount to properly reinforce the floor slab as a girder, the dam might be standing today. My sympathy is generally with the contractor in reinforced concrete failures. I have investigated many and while certain defects in workmanship were grave enough to make the structures dangerous, even though not unsafe, I have found too great a proportion due to defective design.

Q. E. F.

Chicago, Ill., Jan. 27, 1910.

The Reinforced Concrete Girder Bridge at Florence, Arizona—a Correction.

Sirs: I wish to thank you for your very friendly criticism of my plans for the reinforced concrete girder bridge at Florence, Arizona, in your issue of Jan. 19, 1910. I note that you give my address as Tucson, Arizona, and would appreciate your making the correction to the above address, as I have never lived in Tucson.

Thanking you again for your courtesy, I am

Very truly yours,

RICHARD R. RYAN,
Designing Engineer.

230 North Third St., Phoenix, Arizona, Jan. 24, 1910.

Reimbursing Contractors for Expense and Time Involved in Submitting Bids.

Sirs: We have been informed that in some places in the United States the custom obtains of reimbursing contractors for expense incurred and time involved in submitting bids. Can you give us any information about this?

H. C. McL.

Toronto, Ont., Jan. 20, 1910.

(If the custom referred to is in operation anywhere we hope to hear from such of our readers as possess knowledge concerning it. We know that nearly all contractors hope something of this sort will come to pass, but we do not know where the custom has been adopted. In Great Britain on certain classes of work, generally building operations, quantity surveyors take off quantities and contractors base their bids on these quantities, the surveyors being under heavy bonds to guarantee the accuracy of their work. This cuts down very largely the expense of estimating and mistakes are largely avoided. One man can take off the quantities very accurately at one-twentieth the expense of 20 men employed by 20 contractors, all of whom are hurried and likely to overlook some important items. This custom has not been established in the United States, although we know quantity surveyors from England who have tried to establish themselves in American cities. They have ended by becoming estimators for contractors or adjusters for insurance companies. A comparison of costs seems to indicate that it makes very little difference to the owner whether 20 men figure a job independently or whether the 20 men pay one man to figure quantities. This being the case it would look like common sense for the 20 men to get together and employ quantity surveyors under bonds to take off quantities. The bids would then be based on each bidder's idea of his own ability to buy material and handle labor. The cost of estimating is at present too high.—Editors.)

Sawdust Roads.—Sawdust roads are being constructed in Leon County, Florida, as follows: Two ridges of earth are thrown up with a road machine at the required width from each other and the space between is filled with a 6-in. bed of sawdust. This is followed with a smaller machine, which plows up and mixes the earth with the sawdust. The cost of construction is about $397 a mile.

Technical Society Meetings.

The list following names those technical societies in which engineers and contractors are most interested, whose meetings are to be held within three months of the date of this issue. There are given for each society listed the date and place of meeting and the name and address of the secretary, to whom all communications and inquiries should be addressed.

American Railway Engineering and Maintenance of Way Association.
March 15-17, 1910. Annual convention at Chicago, Ill. Secy., E. H. Fritch, 962 Monadnock Block, Chicago, Ill.

American Society of Engineering Contractors.
Feb. 24-26, 1910. Annual convention at Chicago, Ill. Secy., Daniel J. Hauer, Park Row Building, New York, N. Y.

Connecticut Society of Civil Engineers.
Feb. 8, 1910. Annual meeting at New Haven, Conn. Secy., J. Frederick Jackson, Box 1304, New Haven, Conn.

Engineering Society of Wisconsin.
Feb. 23-25. Annual meeting at Milwaukee, Wis. Secy., W. G. Kirchoffer, 31 Vroman Bldg., Madison, Wis.

Illinois Association of Municipal Contractors.
Feb. 24-26. Annual meeting at Chicago, Ill. Secy., Orie T. Dunlap, Edwardsville, Ill.

Illinois Lumber Dealers' Association.
Feb. 16-18. Annual meeting at Chicago, Ill. Secy., Geo. K. Hotchkiss, 315 Dearborn St., Chicago.

Illinois Masons' Supply Association.
Feb. 16-18. Annual meeting at Chicago, Ill. Secy., Geo. K. Hotchkiss, 315 Dearborn St., Chicago.

Interstate Mantle and Tile Dealers' Association.
Feb. 15-19. Annual meeting at Chicago, Ill. Pres., Joseph W. Lantry, Wm. H. Jackson Co., Union Square, New York City.

Iowa Association of Cement Users.
March 9-11, 1910. Annual meeting in Cedar Rapids, Ia. Secy., Ira A. Williams, Iowa State College, Ames, Iowa.

Iowa Engineering Society.
Feb. 16-17, 1910. Annual convention at Cedar Rapids, Ia. Secy., A. H. Ford, Iowa City, Ia.

Missouri Highway Engineers' Association.
Feb. 17-18. Annual meeting at Kansas City, Mo. Secy., Curtis Hill, Columbia, Mo.

National Association of Cement Users.
Feb. 21-25, 1910. Annual meeting at Chicago, Ill. Secy., Geo. C. Wright. Address all communications to Edw. E. Krause, Asst. to the President, Harrison Bldg., Philadelphia, Pa.

National Brick Manufacturers' Association.
Feb. 7-12, 1910. Annual convention at Pittsburg, Pa. Secy., T. A. Randall, Indianapolis, Ind.

Ohio Engineering Society.
Feb. 8-10. Annual meeting at Columbus, Ohio. Secy., C. J. Knisley, New Philadelphia, O.

Northwestern Cement Products Association.
Feb. 18-21, 1910. Annual meeting at Chicago, Ill. Chairman of Executive Committee, O. U. Miracle, Minneapolis, Minn.

Western Drainage Contractors' Association.
Feb. 17, 1910. Fort, Dodge, Ia. Secy., S. F. Moeller, Knierim, Ia.

Notes from Technical Societies.

New England Water Works Association.—The officers of the New England Water Works Association elected for the ensuing year are as follows: President, George A. King; vice-presidents, Allen Hazen, Erman M. Peck, Michael F. Collins, Leonard Metcalf, Irving S. Wood, Frank A. McInnes; secretary, Willard Kent; treasurer, Lewis M. Bancroft; editor, Richard K. Hale.

American Society of Civil Engineers.—The following officers were elected at the 57th annual meeting of the American Society of Civil Engineers on Jan. 19: President, Mr. John A. Bensel, New York; vice-presidents to serve two years, Col. John T. Fanning, Minneapolis, Minn., Mr. Hunter McDonald, Nashville, Tenn.; directors, to serve three years, Mr. William E. Belknap and Mr. Horace Loomis of New York City, Mr. George A. Kimball, Boston, Mass., Mr. Percival Roberts, Jr., Philadelphia, Pa., Mr. Charles F. Loweth, Chicago, Ill., Mr. Arthur D. Foote, Grass Valley, Cal.

Nebraska Cement Users' Association.—The fourth annual convention of the Nebraska Cement Users' Association will be held in Lincoln, Neb., Feb. 1-3. In addition to the regular committee reports, the following papers and addresses will be presented: The Cement Block, Thos. Dougherty; Waterproofing Cement Blocks, Prof. Elmer E. Blackman; Art in Cement Stone, C. R. Lininger; Practical Hints to Develop the Cement Industry, Chas. D. Warner; Concrete Culverts and Country Bridges, C. A. P. Turner; Concrete Roadways B. F. Dippold; Ten-Minute Talk on Cement Tile, G. F. Lillie; Concrete Paving for Nebraska, H. C. McCord. There will be an exhibition of tools, machinery, etc., at the Auditorium. Mr. L. E. Porter, York, Neb., is president and Mr. Peter Palmer, Oakland, Neb., secretary-treasurer.

Indiana Engineering Society.—At the 13th annual convention of the Indiana Engineering Society in Indianapolis, Ind., Jan. 13, 14 and 15, the following officers were re-elected for another term: President, Mr. Edwin E. Watts; vice-president, Mr. C. C. Brown; secretary-treasurer, Mr. Charles Brossman; trustees, Messrs. D. B. Luten, W. S. Moore, W. K. Hatt, C. A. Tripp. The principal papers and discussions were on the subject of road and street improvements, and the society passed resolutions favoring the creation of a state highway commission. The subjects of stream pollution and sewage disposal were next in importance to highway work. A number of papers were presented which will shortly be printed in the proceedings.

The report of the Board of Directors for 1909 gave the membership of the society as 5,292, on Jan. 1, 1910, of whom 2,567 are members, 1,829 associate members, 701 juniors and the remainder are divided among associates, fellows, corresponding and honorary members. From 1895 to 1899, inclusive, the increase in membership was 24 per cent; from 1900 to 1904, inclusive, the increase was 45.6 per cent, and from 1905 to 1909, inclusive, the increase was 65.2 per cent. It is believed that at the present rate of increase the total membership will exceed 10,000 in less than seven years. In the past seven and one-half years the membership has doubled. The library now contains 65,751 individual pieces, of which 18,593 are bound and 36,243 are unbound volumes.

Engineers Society of Western Pennsylvania.—The 30th annual meeting of the society was held in Pittsburg Jan. 18, Mr. E. K. Morse, who succeeded to the presidency on the death of Geo. T. Barnsley in October, presiding. The annual report of the Board of Directors, including the reports of committees, sections and the treasurer, was read, indicating the general prosperity of the society during the past year. The membership of the society at the close of the year was 835. The following officers were elected for the ensuing year: President, E. K. Morse; vice-president, J. O. Handy; treasurer, A. E. Frost; directors, A. R. Reymer and Willis Whited. The annual banquet was held Jan. 29 at 6 o'clock in the Fort Pitt Hotel. Among the speakers were Geo. H. Neilson, toastmaster; President E. K. Morse; Dr. J. A. Holmes, director technologic branch of the U. S. Geological Survey; the Rev. Dr. Maitland Alexander; Geo. C. Johnston, and Frederick L. Bishop, the new head of the physics department of the University of Pittsburg.

Personals.

Mr. George T. Bolton has been appointed City Engineer of Cohoes, N. Y.

James W. Fuller, President of the Lehigh Car Wheel & Axle Works, Catasauqua, Pa., died Jan. 15.

Mr. Christopher Harrison has been appointed City Engineer of Everett, Mass., for the 12th consecutive time.

Samuel R. Probasco, Chief Engineer of the Department of Bridges of New York city, from 1898 to 1901, died Jan. 19, at his home in Burlington N. J.

Mr. Chas. T. Main, Mill Engineer and Architect, Boston, Mass., has moved his offices to Rooms 817-833, Boston Safe Deposit & Trust Co. Bldg., Boston, Mass.

Mr. Samuel Whinery, Consulting Engineer, New York city, has been retained by the city of Trenton, N. J., to investigate the street railway conditions in that city.

Mr. B. M. Laughead has been appointed Locating Engineer of the Buckhannon & Northern R. R., with headquarters at Morgantown, W. Va. The Buckhannon & Northern R. R. will extend from the Pennsylvania-West Virginia state line up the Monongahela River to Rivesville, W. Va.

Mr. Julius M. Bischoff was recently elected an Associate Member of the American Society of Civil Engineers. Mr. Bischoff is at present engaged on the reconstruction of the east approach of the Merchants' Bridge under traffic at St. Louis. He is Assistant Engineer of the Terminal Railroad Association of St. Louis.

Walter A. Brown, formerly Assistant City Engineer of Springfield, Mass., died Jan. 15, at the home of his father in that city. Mr. Brown was connected with the City Engineer's Department until 1907, when he removed to Greenfield, Mass., to go into an engineering business for himself.

Mr. Alexander Johnson, heretofore Consulting Engineer in the Department of Bridges of New York city, has been appointed Chief Engineer, succeeding Mr. Lazarus L. Mayer, who was recently appointed Bridge Commissioner. During the construction of the Williamsburg Bridge in New York city Mr. Johnson was Assistant Engineer under Mr. L. L. Buck, and as Consulting Engineer he had charge of the erection of the Manhattan Bridge.

Randolph MacDonald, a well known Canadian Contractor, died suddenly Jan. 21 at his home in Toronto, Ont. He built several important links of the Canadian Canal system, including Sections 1 and 2 of the Lachine Canal, Section 13 of the Soulanges Canal at Coteau Landing and Section 9 at Coteau du Lac, the last two sections costing $1,200,000.

Fayette Brown, President of the Brown Hoisting Machinery Co., of Cleveland, O., died Jan. 20, at his home in that city, aged 87 years. In 1880 Mr. Brown, with his two sons, Harvey H. and Alexander E., organized the Brown Hoisting & Conveying Co., which has since been reorganized into the Brown Hoisting Machinery Co. At the time of his death Mr. Brown was also Chairman of the Stewart Iron Co. and President of the Union Steel Screw Co., and the National Chemical Co.

Mr. F. A. Hall, who for the past twelve years has been Manager of the Chain Block & Hoist Department of the Yale & Towne Mfg. Co., 9 Murray St., New York, has resigned his position in order to accept election as Vice-President and Treasurer of the Cameron Engineering Co., of Brooklyn, N. Y. Mr. Hall's successor will be Mr. R. T. Hodgkins, who for several years has been his chief assistant. In his new connection Mr. Hall expects to make a specialty of trolleys and appliances for overhead handling of materials.

Mr. Edward B. Richardson, formerly Assistant Engineer with Messrs. Hollis French and Allen Hubbard, Consulting Engineers, and Mr. Richard K. Hale, formerly Assistant Engineer with Mr. Robert Spurr Weston and Messrs. Metcalf and Eddy, Consulting Engineers, have formed a partnership under the firm name of Richardson & Hale, and will engage in practice as Consulting Engineers with offices at 85 Water St., Boston, Mass., making a specialty of Mechanical, Electrical, Hydraulic and Sanitary Engineering.

Catalogs Worth Having.

Engineers and contractors should have on file the latest catalogs of machines, tools and supplies that they use. In sending for catalogs reviewed or advertised in this paper, you will confer a favor on us if you will write directly to the advertisers and state that you saw the catalog mentioned in ENGINEERING-CONTRACTING. If you are in the market for tools, machinery or supplies, tell us and we will notify promptly the leading manufacturers.

Clinton Electrically Welded Wire.—Paper 9x12 ins. 48 pp. Clinton Wire Cloth Co., Clinton, Mass.

This handsome book shows examples of the use of Clinton electrically welded wire cloth and gives typical details of reinforced concrete floors, in which this wire cloth is used for reinforcement.

Parsons Trench Excavators.—The G. W. Parsons Co., Des Moines, Iowa.

A circular letter describes the Parsons Trench Excavator and is accompanied by half-tone views of the machine in operation in different cities.

Instruments of Precision.—Paper. 6x9 ins. 240 pp. C. L. Berger & Sons, 39 Williams street, Boston, Mass.

Part I of this book is a treatise on engineers' field instruments, their manufacture, adjustment and use, with description of gradientor, stadia, solar attachments, etc. Part II is a catalogue of the instruments made by this firm, with prices of same. Many of the illustrations are in color.

Engines, Pumps and Concrete Mixers.—The Fairbanks Co., Broome & Lafayette Sts., New York, N. Y.

Gas and gasoline engines are shown in many combinations in Bulletin 11; the Clover Leaf tilting concrete mixer in Bulletin 16 and the Albany Pump mounted for road contractors' use is described in a special circular.

Cost of Steam Shovel Work.—John Souther & Co., 185 Summer St., Boston, Mass.

This firm sends in a pamphlet full of useful data entitled "The Cost of Steam Shovel Work in Railway Betterment," and one entitled "Gravel and Hard Pan Steam Shovel," both circulars having special reference to the Souther shovel.

Ferro-Inclave.—Paper. 6x9½ ins. 40 pp. The Brown Hoisting Machinery Co., Cleveland, Ohio.

Ferro-Inclave is the name given to sheets of corrugated steel that fit by driving the ends together. It is used for roofs, sides of buildings and sides and bottoms of tanks. When put in place it is covered with plaster which is held in place by the corrugations. This booklet contains full instructions for use.

Koppel Railways for Contractors.—Paper. 6x9 ins. 18 pp. Orenstein-Arthur Koppel Co., Pittsburg, Pa.

This booklet describes and illustrates the use of small steel dump cars on contractors' work. This firm has a number of books, each devoted to some special piece of equipment for contractors and industrial plants.

Contract News Section

of

ENGINEERING-CONTRACTING

A Consolidation of ENGINEERING-CONTRACTING—CONTRACT NEWS—ENGINEERING WORLD—THE DIRT MOVER.

Containing Items of Interest to Railroad, Public Works and Other Contractors.

The Doings of the Week.

The Supreme Court of Indiana has reversed its former decision and has decided that the gravel road law is constitutional. This will result in the resumption of much gravel road work.—Two large contracts for levee and drainage work were let during the past week. One of these calling for the construction of 1,000,000 cu. yds. of earth work for the Burleson County Improvement District of Texas was secured by Roach & Stansell, Memphis, Tenn., at $176,000. The other contract, calling for 1,492,759 cu. yds. of levee work and 235,000 cu. yds. of ditch work near Carrollton, Ill., was secured by R. H. McWilliams, of Chicago, Ill., and J. A. McWilliams, of Mattoon, Ill.—Among the larger railroad contracts of the week are the following: J. W. Wright, Jr., Union Springs, Ala., for a 26-mile extension of the Union Springs & Northern R. R. in Alabama; the Electric Traction Construction Co., of Kansas City, Mo., for constructing the projected line of the Kansas Northwestern Ry.; the Electric Traction Construction Co. was also awarded the contracts for constructing the projected line of the Wheeling, Cadiz & Tuscarorus Traction Co.; the Utah Construction Co., Ogden, Utah, for grading 80 miles of the proposed Harriman road across Central Oregon; P. Welch of Foley, Welch & Stewart, for constructing 50 miles of the Victoria, Vancouver & Eastern R. R.—One feature of the week is the number of steam and electric railways which have advanced their preliminary work so far that it is only a question of a few days before construction contracts will be let. Among these companies are the following: Wichita Falls & Northwestern Ry., 60 miles of steam line to be let this month; the Raleigh & Southport Ry. steam line, extension to be let at once; San Diego, El Cajon & Escondito Ry., 60 mile electric line, to be let this month or next; Duluth, Winnipeg & Pacific Ry., 75 mile steam line, to be let this spring; the Pine Pass Ry., a 597 mile line in Canada, to be let soon; the Toledo, St. Louis & New Orleans R. R., 146 mile line, clearing contracts let and grading contracts to be let in March or April; and the Fostoria, Napoleon & Defiance Ry., a 53 mile line, contracts to be let early in April. —The contracts for the excavation of canals in the Everglades in Florida, bids for doing which were opened Sept. 22 last, is still hanging fire, the Trustees of the Internal Improvement Fund having not yet made a definite decision.—Jones Bros., of Cincinnati, have secured a large contract for excavation and foundation work for the new plant of the American Rolling Mills Co., at Middletown, O. The contract includes 60,000 cu. yds. of concrete masonry.—George W. Jackson, Inc., Chicago, Ill., and 46 Wall St., New York, was the low bidder, Jan. 24, for Contract 54, for constructing the Yonkers Siphon for the Board of Water Supply of New York City, his bid being $1,479,425.

The New York State Barge Canal.

Rapid progress was made during the past year in constructing the New York State Barge Canal. At the end of 1909 76 per cent of the total length had been placed under contract and it is expected that the whole of it will be let by April 1 next. The total length of the Barge Canal system, exclusive of the Niagara River, which is being improved by the federal government, and the Hudson River below Waterford, which it is anticipated the government will improve, is 433 miles. Of this amount at the end of 1909 314.2 miles were under contract at prices aggregating $54,138,329. In addition plans for 67.7 miles had been completed, plans for 9 miles more were over 75 per cent finished and the plans for the remaining 20.5 miles were well under way. Of the 53 new locks 15 had been completed at the end of the year, with the exception of gates and operating machinery. By a year from next spring it is expected that the eight movable dams in the Mohawk River will be in operation and will be used to aid in the dredging of the channel, by retaining water for the floating of dredging machinery. The large fixed dam across the Mohawk River near Crescent will be finished during next summer, as will also the concrete dam impounding the waters of the upper Mohawk at Delta in a reservcir having a flooded area of 2,800 acres. An important feature of the Barge Canal work is that it is being done within the original estimates. The estimates made in 1903 for construction on the portions of the canal now under contract amounted to $56,791,537, while the contract price for this work as revised by alterations was $54,138,329, or $2,653,208 within the original estimates.

Car Shortage in Iowa.

The state of Iowa has a car shortage at the present time and the following ingenuous explanation of the cause of it is being put forward by some of the papers of that state: This is the season of the year when the county assessors are beginning to make their assessments of the rolling stocks of railroad companies. These companies are required to pay an annual tax of 43 mills on the assessed value of their rolling stock in Iowa. It is now being argued that in order to reduce this tax as much as possible, the railroads are getting as much of their rolling stock out of the state as is possible and still have enough in Iowa to make an attempt to handle their business. Each county assessor fixes the valuation on the stock which he finds in his county. Hence there is every reason to believe, say those who have investigated the shortage, that just now the companies are getting their cars beyond the confines of the state in order to escape the assessment.

Gravel Road Work in Indiana.

There is great rejoicing among the road contractors, county commissioners, and bond buyers in Indiana over the recent decision of the state supreme court declaring the "3-mile gravel road" law constitutional. Since last November, when the court declared the law unconstitutional, there has been little doing in Indiana in the gravel road construction line. Many contracts under way were held up owing to the fact that county commissioners could not sell the bonds to pay for the work, and many contracts that were about to be let were held in abeyance. By the decision that the gravel road law is valid several million dollars is made secure to bond purchasers, to the contractors and to the various county authorities. In one county alone, Hamilton, work aggregating nearly $500,000 is affected. In another county, Madison, one construction company had contracts for 95 miles of gravel roads, work on which will now be started.

The man who stole a red hot stove will have a kindly feeling for the three men now under arrest at Binghamton, N. Y., charged with stealing a railway bridge. The bridge was a small, 40-ton structure, which had been replaced by a heavier one and was temporarily stored along the track near by. The three men are said to have carted the bridge to the city and sold it to a junk dealer for $18 and three drinks.

According to a report of the Secretary of State of Georgia ten railroads with a total capitalization of $2,227,000 and trackage of 424 miles were chartered in Georgia in 1909. Charters were also issued to two new electric railway lines with a total of 12 miles and a total capitalization of $200,000.

The prairie section of the transcontinental line of the Grand Trunk Pacific Ry. was completed on Jan. 22, when steel was laid to Wolf Creek at the foot of the Rocky Mountains, where the mountain section begins.

A bill is now before the Brazilian congress for extensive irrigation works, the cost to be defrayed by the issue of bonds, and the work to be done by railroad companies in whose zones the land to be improved lies.

Confirmed Reports by Engineers and Contractors

RAILROADS, POWER DEVELOPMENTS, LEVEES, DRAINAGE AND IRRIGATION WORKS.

Railroads—Steam and Electric.

ALABAMA.

J. W. Wright, Jr., Union Springs, Ala., has been awarded contracts to build an extension for the Union Springs & Northern R. R. from Fort Davis to Milstead, Ala., 26 miles. The contract provides for all grading, track laying and bridging, work to be completed in four months. Quite a good deal of this work will be let to station men.

CALIFORNIA.

The San Diego, El Cajon & Escondito Ry. Co. has completed surveys and has partly secured the capital for the construction of its projected 60-mile electric railway from San Diego to Escondido. Contracts for the construction of the railway will be let within 60 days. F. M. Fairchild, Oakland, Cal., is Chief Engineer, A. C. Riordan, San Diego, is President, and G. W. Pursell, San Diego, is General Manager.

We are advised that the contract for work north of Alturas on the Nevada-California-Oregon Ry. has not yet been let. Press reports stated that this contract had been let to Nugent & Richardson. Geo. S. Oliver, Reno, Nev., is Chief Engineer.

Grant Brothers Construction Co., 619 Security Bldg., Los Angeles, Cal., is working on a contract for about 4 or 5 miles of rock work on the Arizona Eastern R. R. The work includes a tunnel about 1,000 ft. long. The concrete work has been sublet, but the remainder of the work is being done by the Grant Brothers Construction Co. with its own equipment.

IDAHO.

The Pacific & Idaho Northern Ry. has completed surveys for a 16-mile extension from Evergreen to Meadows Valley, Idaho. The capital for the construction of this extension is available, but the date for awarding construction contracts has not been determined. E. M. Heigho, Weiser, Idaho, is President.

ILLINOIS

The Toledo, St. Louis & New Orleans R. R. Co. has completed surveys and has partly secured the capital for the construction of its projected 146-mile line. The route is as follows: Carmi, Ill., to Brookport, Ill., opposite Paducah, Ky., via Ridgeway, Lawler, Karbers Ridge and Golconda, with a branch to Thebes, Ill., via Big Bay, Oaktown and Tamms. Contracts for clearing the right of way have been let to P. J. Engles, Hicks P. O., Hardin County, Ill. The other contracts will be let in March or April. N. M. Burns, 948 Pierce Bldg., St. Louis, Mo., is President.

The Decatur, Illinois & Mattoon Transit Co., has asked a 2-year extension of its franchise in Sullivan. The company projects a 48-mile electric line through Sullivan, Dalton, City, and Mt. Zion to Decatur. Surveys for the line have been made, but the capital for construction has not been secured as yet and the time for awarding contracts is indefinite. A. M. Shaw, Dixon, Ill., is Engineer, and R. B. Starbuck, Mattoon, Ill., is President.

KANSAS.

Surveyors are now in progress for the projected 118-mile line of the Dakota, Kansas & Gulf R. R., from Beloit, Kan., to Kearney, Neb. W. H. Mitchell, Beloit, Kan., is President and Baxter L. Brown, St. Louis, Mo., is Chief Engineer.

The Electric Traction Construction Co., Commerce Bldg., Kansas City, Mo., has been awarded the contract for constructing the projected line of the Kansas Northwestern Ry., and has started work. Sub-contracts for the grading will be let on Feb. 10. The construction company is in the market for 60-lb. rails, spikes, cars, etc. The road starts from Great Bend, Kan.

The Garden City Gulf & Northern R. R. Co. of Garden City, Kan., will begin the construction of 75 miles of road south from Garden City by March 1. It is the intention to place all of this work under contract, but the company will likely award the work to the local contractors in sections of not exceeding five miles each. E. A. Tennis, Garden City, Kan., is interested.

KENTUCKY.

Sims Brothers, Railroad Contractors, Hanson, Ky., have some cart and car work to let. The work is suitable for small outfits and the prices are good.

MASSACHUSETTS.

The Engineering Department of the Boston & Maine R. R. has made estimates for building second track for about one mile at Gloucester, Mass., and has orders to make preliminary studies for eliminating grade crossings in Salem. This work if executed would mean rebuilding about ¾ of a mile through Salem.

MINNESOTA.

The Duluth, Winnipeg & Pacific Ry. has completed surveys and has secured the capital for the construction of its 75 mile steam line from Virginia, Minn., to Duluth. Construction contracts will be let in the spring. D. B. Hanna, Toronto, Ont., is President, and H. T. Hazen, 619 Lyceum Building, Duluth, Minn., is Chief Engineer.

MISSOURI.

Surveys have been made upon a 7½-mile electric railway to extend from Moberly, Mo., to Huntsville, Mo. The capital for the construction of the line has been secured and contracts will be let shortly. The work will involve the moving of 50,000 cu. yds. of material. C. B. Judd is Chief Engineer, and Calvin Manning, Ottumwa, Ia., is President.

MONTANA.

The Whitefish, Kalispel & Polson Electric Ry. Co. has been incorporated with a capital stock of $200,000 and proposes the construction of an electric railway from Kalispel northward to Whitefish and southward through Somers and Polson on the west shore of Flathead Lake. No work is to be done in the near future on the proposed line. G. H. Adams, Kalispel, Mont., is interested.

NORTH CAROLINA

The Raleigh & Southport Ry. Co. has arranged to extend its line south of Fayetteville, passing through Bladen County, but has not yet decided exactly where the construction will stop. It is expected to touch and perhaps cross the Seaboard Air Line Ry. between Clarkton and Wilmington, N. C. The line is now being surveyed and the location will begin next week, ties are being contracted for and grading will begin very soon. J. A. Mills, Raleigh, N. C., is President and General Manager.

NORTH DAKOTA.

The Great Northern Ry. has not yet definitely decided on the plans for its proposed cut off in this state. Ayr, Cass county, will be the eastern terminal and Surrey in Ward county, will be the western terminal. R. E. Taft, St. Paul, Minn., is Engineer of Construction, Great Northern Ry.

OHIO.

Peter McCave, Route 1, Washingtonville, O., is promoting a project for the construction of an electric railway from Youngstown to Salem, by way of Greenford and Lisbon. The total projected length is 34 miles.

The Electric Traction Construction Co., Commerce Bldg., Kansas City, Mo., has the contract for constructing the projected line of the Wheeling, Cadiz & Tuscarorus Traction Co., from Cadiz, O., and will sublet the grading, 46 bridges, trestles and culverts. A 60-lb. rail will be used and the construction company is in the market for rails, copper wire, poles, ties, etc.

The Fostoria, Napoleon & Defiance Ry. Co., which projects a 53-mile line, has secured the construction capital in part and his assurances of securing the remainder. Contracts will be let early in April. This company was recently incorporated and surveys for the line have not been made as yet. Chas. A. Bliss, 1047 Ohio Bldg., Toledo, O., is President. R. T. Betts, Toledo, O., is also interested.

OKLAHOMA.

The Wichita Falls & Northwestern Ry. has completed surveys and has secured the capital for the construction of its projected 60-mile steam line from Altus, Okla., west via Duke and Hollis, Okla., to Wellington, Tex. Contracts for the construction of the line will be let this month. J. A. Kemp, Wichita Falls, Tex., is President, and R. A. Thompson, Wichita Falls, Tex., is Chief Engineer.

OREGON.

The Union Traction & Terminal Co. of Coos Bay, has been formed and projects an electric railway from Marshfield, Ore., along the west shore of Coos Bay to North Bend, Ore. J. M. Blake, Marshfield, Ore., is president, and R. O. Graves, Marshfield, is secretary.

UTAH.

The Oregon Short Line R. R. has surveys under way for the construction of double tracks from Ogden, Utah, to Farmington, a distance of 21.4. The capital for the work has not been allotted as yet, and the time for letting contracts is indefinite.

We have received the following information under date of Jan. 23 regarding the recent flood damages to the San Pedro, Los Angeles & Salt Lake R. R.: "It is true that our road has experienced the worst flood in its history, in the Clover Creek Canyon and the Meadow Valley Wash, in the eastern part of Lincoln County, Nevada. The road-bed and track structures have been very seriously damaged and in part destroyed for a distance of 85 miles, and owing to the severe and unusual winter weather conditions, we are temporarily out of business as a through line. As yet nothing definite has been determined about the future procedure but investigations are on foot as to the advisability of rebuilding on the old line or seeking a new location not subject to the destructive floods which have been experienced in Clover Creek Canyon and Meadow Valley Wash."

WASHINGTON

The contract for the first 17 miles of the Toppenish, Simcoe & Western R. R. was let Jan. 17 to O. F. Leonard, railroad, canal and drainage contractor, North Yakima, Wash. Wm. H. Redman is Chief Engineer T. E. & W. R. R.

As stated in our last issue the J. H. Flick Construction Co., Old Colony Building, Chicago, Ill., has been awarded a contract for filling in a number of bridges on the line of the Chicago, Milwaukee & Puget Sound Ry. The contract calls for the filling in of a number of very large bridges, the work involving in the neighborhood of 2,000,000 cu. yards of material. The Flick Construction Co. will handle the work with about 70 12-yd. air dump

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MORRISON TENT & AWNING CO., 115-117 OLIVE STREET ST. LOUIS, MO.

Western Wheeled Scraper Co. cars, using locomotives of the Baldwin consolidation type, eight drivers, 128,000 lb. on drivers. Work will be begun immediately.

CANADA.

The Pine Pass Ry. Co. has completed surveys for its projected 597 mile railway from Edmonton, Alberta, to Peace River, thence west through Pine Pass and South to Fort George. The matter of securing the capital for construction is under consideration and contracts will be let soon. M. Kimpe, Edmonton, Alberta, is interested.

Power Developments, Levees, Drainage and Irrigation Works.

COLORADO.

The Kiowa Valley Reservoir & Irrigation Co. is planning the construction of an irrigation system in Arapahoe and Elbert Counties to include about 90 miles of ditch work and three reservoirs. There is no rock work in any of it, as all of the work is in ground easy to move. The company will be glad to have contractors figure on the work. Lee A. Reynolds, 211 McPhee Bldg., Denver, Colo., is Secretary of the company.

ILLINOIS.

R. H. McWilliams, Royal Trust Bldg., Chicago, Ill., and J. A. McWilliams, Mattoon, Ill., were awarded the contract for levee and ditch work, bids for which were opened Jan. 20 at Carrollton, Ill. The work includes the construction of a levee (1,492,759 cu. yds.), muck ditch (42,220 cu yds.), and a drainage ditch (192,730 cu. yds.).

IOWA

The Indiana Drainage Co., Thompson, Ia., has been awarded the contract for open ditch work for four county drainage districts, bids for which were opened Jan. 21, at Forest City, Ia. The contract for tile work was let to Chris. Axelson, Martnus Sorensen and R. J. Cox. The open ditch work was let at 12¼ cts. per cubic yard. The work includes the following: 176,000 cu. yds. of open ditch work and 240 rods of 12-in. tile drains in District No. 1; 32,400 cu. yds. open ditch in Drainage District No. 8; 685 rods 6, 8, 10 and 12-in. tile drains in Sub-District No. 1, Drainage District No. 3.

INDIANA.

Contracts will be let Feb. 12, at the office of G. F. Stinchfield, County Surveyor, Valparaiso, Ind., for constructing the Jones ditch. The proposed work will be the construction of a dredge ditch, 6.41 miles long, 10 ft. base, requiring 93,454 cu. yds. of excavation. The estimated cost is $6,530. The contract for the construction of the Swanson-Lamporte ditch will be let Mar. 1 at the office of Mr. Stinchfield. This ditch is to be 8 miles in length, with a base width from 2 ft. to 10 ft., side slopes 1 to 1, and depth from 3 ft. to 8 ft. The total excavation is 68,594 cu. yds., and the estimated cost at 15 cts. per cubic yard is $10,210. The ditch can be constructed by using orange-peel, drag-line, revolving steam shovel or floating dredge for different parts at option of contractor.

NEW YORK.

The Snare & Triest Co., 143 Liberty St., New York City, has been awarded the contract for dredging and the construction of quay walls at the U. S. Navy Yard, New York The contract price was $84,480. Bids for this work were opened Jan. 8, by the Bureau of Yards and Docks, Navy Department. The award was made on Item 1 of the specifications for the work complete.

Bids are asked by Isidore Wachsman, Secretary Board of Contract and Supply, Albany, N. Y., until 3 p. m., Feb. 21, for improving the State St. pier for that city. The work will include the razing of all the present buildings on the pier, the removal of 100 feet from the southern end, the construction of concrete walls and boat landings, the raising of the present elevation by filling, paving the surface with concrete, the construction of grass plots and the erection of platforms, shelters and lavatory structures. The concrete wall will be 899 ft. long, the entire length of the pier, and 84 ft. across the two ends. The concrete structure will rest upon piles driven into the water and will be from 6 ft. in thickness at the bottom to about 1 ft. in thickness at the top. The wall will extend nearly 3 ft. above the ground. It will be built in sections, each 40 ft. long, and at each intersection there will be a life ladder. The entire southern end of the pier will be made a landing for both large and small boats and along the river side there will also be landings and steps, well provided with snubbing posts for fastening boats. Numerous grass plots, shrubbery, raised platforms covered with canopies, flag poles and electric lights will beautify the pier. Walter Melius is City Engineer of Albany.

OHIO.

Jones Bros., Cincinnati, O., have the contract for all excavation, concrete work, foundations for buildings and macadamizing, brick coping, walls, etc., for the new plant of the American Rolling Mills Co., to be built at Middletown, O. The contract includes 400,000 cu. yds. earth excavation, the making of various fills to level off property at 60,000 cu. yds. of concrete masonry. The American Bridge Co. is to do all the steel work for the building.

TEXAS.

Bids were opened Jan. 22 at Caldwell, Tex., for construction work in Burleson county Improvement District, the low bidders being Roach & Stansell, Memphis, Tenn., who submitted the following bids:

Clearing 75 acres @ $45	$ 3,375.00
Grubbing 30 acres @ $77	2,310.00
Sodding 100 acres @ $10	1,000.00
Earthwork, 1,000,000 cu. yds. @ 16.8c	168,000.00
Bridging lumber, 30 M. ft., B. M., @ $45	1,350.00
Total	$176,035.00

There were four bids submitted for which the totals amounted to $176,035, $176,900, $177,275 and $179,647.50. J. C. Nagle, College Station, Tex., is engineer for the district.

WISCONSIN.

The La Crosse Water Power Co., W. J. Ferris, President and General Manager, La Crosse, Wis., proposes building a dam just as soon as spring opens on the east fork of the Black River, near Hatfield, Wis. It will be a concrete dam, approximately 300 ft. long, 30 ft. high, with six 4x5 sluice gates, located at the bottom, the gates to be controlled by suitable floor stands. This will be a storage dam, no power house being built for the present, the water being stored to tide over the exceedingly dry seasons and to be used through the present canal and power house of the company.

Peter A. Pugh, New Cumberland, W. Va., has been awarded the contract for constructing 32 miles of oil pipe line in Gilmore and Dodridge Counties, W. Va., for the Freehold Oil & Gas Co.

The Chesapeake & Ohio Ry. has had surveys made between Charlottesville, Va., and Orange, Va., for double tracking the line between those two points.

The Southern Pacific Ry. is said to be collecting men and material at Gallup, N. Mex., preparatory to beginning work on its line to Farmington, N. Mex.

The West Virginia, Pittsburg & Atlantic R. R. Co. has applied for a franchise in Parsons, W. Va. R. F. Whitmer, President of the Dry Fork R. R., is also President of the new road.

A charter is to be taken out for building a railroad from Steedman, S. C., to Aiken, S. C. The company is to be known as the Aiken-Columbia R. R., and the line will practically follow the survey made some years ago which was an air line from Columbia to Augusta. Sufficient capital has been secured to build the first 8 miles of the road. A. O. Yearan, Samaria, S. C., and J. D. Protho, Aiken, S. C., are interested.

The Louisville Street Ry. Co., T. J. Minary, president, Louisville, Ky., is said to be planning the construction of an interurban line to extend out the Brownsboro road for a distance of at least 10 miles from Louisville.

The Richmond & Henrico Ry. Co., of Richmond, Va., has awarded a contract to the Pennsylvania Steel Co., for rails for 8 miles of trade, delivery to commence at once. The contract for ties has been awarded to the Burton Construction Co., of Richmond, which has already begun delivery.

The drainage commission of McHenry and Bottineau Counties, N. Dak., as the result of a recent decision of the Supreme Court will now proceed with the construction of a drainage canal to run from the northern part of McHenry County and the entire length of Bottineau County and 14 miles into Canada. The work will cost $125,000 and will be started in the spring. Towner, N. Dak., is the county seat of McHenry County.

Advices from Jackson, Ga., state that Captain W. F. Smith, who is building the 5-mile railroad line from Indian Springs to Jackson, has announced that the line will be completed and in operation by Aug. 1. Part of the line has already been graded and work will be resumed with renewed force within a short time. The road will operate gasoline cars.

Reports received at the general offices of the Arkansas Central R. R. at Fort Smith, Ark., indicate that work on the extension of the Subiaco, Paris & Eastern R. R. from Subiaco Abby east, is progressing rapidly. Col. Henry Stroup, Chief Engineer in charge of the work, reports that about 4 miles of the right of way has been graded. A large number of men and teams are engaged in throwing the dirt. Rails have not been ordered. It is proposed to complete the grading before the steel gangs are put to work. It will require several months to put the right of way in condition for receiving the ties and rails.

Items Concerning Contractors and Their Work

RAILROADS, POWER DEVELOPMENTS, LEVEES, DRAINAGE AND IRRIGATION WORKS.

Alabama Notes.

FROM CORRESPONDENTS AND OTHER SOURCES.

R. L. Groome, who has been general agent for W. J. Oliver of Knoxville, Tenn., has accepted the position of superintendent of construction of the Cullman Coal & Coke Co., of Cullman, Ala. This company will construct a line of railroad 25 miles in length from Cullman, Ala., to Juliana, Ala.. The company owns 300,000 acres of coal and timber lands 52 miles north of Birmingham, and is building the line to develop this property.

The Board of Trade of Columbus, Ga., is taking steps to secure the extension of the Chattahooche Valley R. R., to Columbus from Jester, Ala., a distance of 18 miles. J. A. Avary, West Point, Ga., is General Manager C. V. R. R.

California Notes.

FROM CORRESPONDENTS AND OTHER SOURCES.

The North American Dredging Co., Merchants Exchange Bldg., San Francisco, has been awarded the contract for improving the San Pedro Harbor for the Outer Harbor Dock & Wharf Co., of Los Angeles. The work, which includes the digging out of the eastern and western channels of the Miner fill in San Pedro Harbor, will require 2,000,000 cu. yds. of excavation. Work will begun March 1 on both the eastern and western channels, the former being 400 ft. wide and 5,500 ft. long, while the dimensions of the latter are 600 by 6,000 ft. Two and possibly three machines will be kept constantly at work and employment given to more than 100 persons. About 7,000 ft. of wharfage probably will be ready for use within the next 18 months.

The Atchison, Topeka & Santa Fe Ry. has made estimates for widening its wharf at the San Diego end of the road. J. F. Parker, San Bernandino, is Superintendent of Bridges and Buildings.

The Los Angeles & Redondo Beach Ry. Co., of Los Angeles, is reported to be considering extending its line south to San Pedro. Right of way on bluff country lying north of Redondo Beach is stated to have been already secured.

The Sacramento-Riverside Bath & Park Co., H. A. McClelland, Director, Sacramento, is planning to erect a wharf and warehouse on the Sacramento River front.

A plan to build a concrete bulkhead 2,000 ft. long along the San Gabriel River near the Pacific Electric trestle at Los Corritos, between Long Beach and Los Angeles, is said to be favorably considered by the Carson brothers, owners of a ranch at that point. The bulkhead would cost $5,000.

Work is now under way on the reclamation of 30,000 acres of Colorado River bottom land opposite the city of Needles, Cal. The property is owned by the Cotton Land Co., composed of W. J. Hole, W. I. Hollingsworth, Louis Evans, H. V. Blenkiron, W. J. Burton and D. M. Martin, all of Los Angeles. The company has an authorized capital of $2,000,000, a large part of which will be used in development, and the same owners also control the Cotton, Water & Irrigation Co., capitalized at $1,000,000, to which will be entrusted the work of canaling and leveeing the tract. About 11 miles of canals and 15 miles of levees are in process of construction. Besides an extensive canal and levee system, many miles of good wagon roads, and a line of railroad 25 miles long are to be built through the property.

The Atchison, Topeka & Santa Fe Ry., H. C. Phillips, Chief Engineer Coast Lines, Los Angeles, is to build a 6-mile branch from Angiola to Alpaugh, to connect the former place with the main line.

The Southern Pacific Co. is securing land for the widening of its right of way between Tracy, Livermore, Stockton and Sacramento, so as to lay a 4-track system between the towns mentioned. The tracks of the company in Santa Cruz will also be doubled.

The Northern California Power Co. is employing about 350 men at Manton, most of these being engaged in constructing the tunels through which the water will be conveyed to the power plant at Inskip. About 500 men were laid off when the winter season began. The water ditch will pass through 4 tunnels, the longest of which is 4,300 ft. Another tunnel will be 1,500 ft. in length. Two shorter tunnels will each be 300 ft. long. The power plant at Inskip is rapidly approaching completion. All the machinery is on the ground and much of it is in place.

W. J. Baker of Chico is at the head of a company that proposes to build a $100,000 gold dredger to operate in Trinity River, five miles above Lewiston.

Realty holders in the territory between Sutter and Sacramento Sts., Grand Ave. and Dupont and Powell Sts. at San Francisco are to petition the supervisors to build a tunnel through between Bush and California Sts. The estimated cost is $350,000, and if the supervisors refuse to build the tunnel, it is probable the property holders will petition for the formation of an assessment district and in that way raise the money for the improvement. Dr. Hartland Law is interested.

Grading work for the Fresno, Hanford & Summit Lake Interurban line has been started between Fowler and Selma. This work is the filling in of two small arroyos, one located between Fowler and Selma and the other located between Selma and Kingsburg. As soon as these fills are completed the work of grading the remainder of the line will then start and everything will be in full swing. A power plant of 1,000 kw. capacity will be erected at Fowler, and a substation will be built at Laton. The estimated cost of the road is $890,000. George W. Elder, San Francisco, as stated in our last issue, has all of the grading contracts. F. S. Granger, Fresno National Bank Building, Fresno, is General Manager.

Business men of Dinube and Orosi are securing right of way for an extension of the line of the Visalia Electric Ry. of Visalia, from the present terminus to Naranjo to Orosi and on through Sultana to Dinuba.

The Link Belt Railway Co. has filed articles of incorporation at the office of the county clerk, at San Francisco, Cal., and proposes the construction of a standard gage line extending from Placerville, Cal., to the terminus of the Southern Pacific Branch, to the Breecher farm, east. The line will tap a virgin lumber district and will enter the mining country above Placerville. In addition to this railroad project the company is authorized to build wagon roads, acquire water rights and erect shops and section houses. The company is capitalized at $1,000 and the incorporators are L. T. Kitt, E. D. Kitt and W. S. Fox.

The Ontario & San Antonio Heights R. R. Co., a Huntington property, has filed with the County Recorder at San Bernardino a million-dollar trust deed. The bonds issued as a result of the trust deed will be used toward completing the Pomona-Upland loop, and when this is done the line is to be extended into the San Bernardino valley and connect with the San Bernardino Valley Traction system, which is also the property of the Huntington-Pacific-Electric interests. The Ontario-San Antonio line is to be rebuilt and connected with the Pomona lines of the Pacific Electric. William Kerckhoff, San Bernardino, is President of the Ontario & San Antonio Heights R. R.

Colorado Notes.

FROM CORRESPONDENTS AND OTHER SOURCES.

Advices from Greeley state that the Laramie-Poudre Irrigation Co. has selected the Stove-Prairie reservoir site instead of the Roosevelt or the Elkhorn reservoir site proposed for its irrigation system. The Denver Tramway Co. has interests in this reservoir, and it is understood that a contract has been entered into by the Tramway Co. and the Laramie-Poudre Co. by which the irrigation district is to be supplied with water from Stove-Prairie at all times needed. This, however, will not interfere with the use of the water for power purposes. The reservoir will be built in the Poudre River above Fort Collins at "Little Narrows" and will have a dam 200 ft. high. The capacity of the reservoir will be 1,500,000,000 cu. ft. and cost $500,000. The reservoir will be the largest of the 10 reservoirs of the system, will be 100 ft. deep and the outlet ditch will draw from the bottom of the reservoir, thus furnishing immense water power for generating electricity. A power plant will be erected at the place where the outlet ditch leaves the reservoir.

The Canon City, Florence & Pueblo Water Co. has filed preliminary maps covering sections 1, 2, 3, 4 and 5 of extensions 1 and 2 of the DeWeese canal in the office of the county clerk and recorder at Canon City. Extension No. 1 will be an alternative canal and pipe line, the canal being 10.8 miles in length and the pipe line 6.2 miles in length. The estimated cost of this portion of the work is $685,000. Canal extension No. 1 will be 10 ft. in depth, 32 ft. wide on top, 16 ft. wide at the bottom and will have a grade of 3 ft. to the mile. The extension of canal No. 1 from station 252 to 263, a distance of 18.8 miles, is computed to cost $140,000. The waterway will be 52 ft. wide on top, 40 ft. at the bottom, will be 7 ft. deep and have a grade of 1.25 ft. to the mile. Section No. 3 will be 6 ft. in depth and will cost $75,000. From station 363 to 424, a distance of 10.8 miles, the canal will be 7 ft. deep, 54 ft. wide on top and 40 ft. wide at the bottom. This portion of the work will cost $80,000. Section 4, extending from station 165 to station 290, the canal will be 52 ft. wide on top, 40 ft. wide at the bottom, 6 ft. deep and will have a grade of 1.25 ft. to the mile. The estimated cost of this part of the undertaking will be $225,000. Section No. 5 of the canal, extending from station 290 to station 355, a distance of 14.6 miles, will be 6 ft. deep, 52 ft. wide at the top, 40 ft. wide at the bottom and will have a grade of 1.25 ft. to the mile.

Members of the Chamber of Commerce of Trinidad have revived the project of building a railroad from Trinidad to San Luis valley. It is probable that the organization will take steps toward procuring the necessary information to lay before capitalists, with a view to raising money enough to carry out the project.

James F. Hadley has been elected president of the Lone Tree Ditch & Reservoir Co., succeeding James Taft of Longmount, and plans are being made to form an irrigation district 20 miles northeast of Denver, adjoining the Antero district. One reservoir on Box Elder creek already belongs to the company and preparations are being made to build another.

The Oregon Short Line R. R. has surveyors in the field surveying a road from Cisco into the Paradox and thence south to Durango, where it will connect with the north extension of the Southern Pacific from Lordsburg, New Mexico. It was previously reported that there surveys were being made by the Denver & Rio Grande.

The Grand Junction & Grand River Valley Ry. Co., which has under construction a line from Grand Junction to Fruita, has secured a lighting franchise from the latter city.

The Union Pacific Ry. is planning much construction work in Colorado this year. Orders are said to have been issued to have the line into Fort Collins completed by July 1. The establishment of construction camps has begun and it is expected that the weather will permit the work to begin by the time the camps are located. Arrangements have been made for throwing about 2,000 men and between 400 and 600 teams onto this job to rush it to com-

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pletion. Engineers are now making the final locations for a cut-off on the main line from Denver to Fort Morgan and this construction work will soon begin. This new line will be 74 miles long, will cut off 38 miles between Denver and the east and will cost between $3,000,000 and $4,000,000. Engineers are also locating an extension of the Crow Creek branch completed last year and $1,000,000 will be spent in the extension northeast toward Wyoming. This line is headed toward Grover, Colo., and will invade the territory to be reached by the proposed Burlington line between Hudson and Greeley and on north to form the gulf-to-coast route. R. L. Huntley, Omaha, Neb., is Chief Engineer.

Illinois Notes.

FROM CORRESPONDENTS AND OTHER SOURCES.

The construction of an interurban line from Carthage to Warsaw, Keokuk and Nauvoo is proposed. Chicago capitalists are stated to have offered to construct the road, which would cost about $200,000, providing the citizens of Carthage would take $40,000 in bonds or stock. In this plan the former right of way of the line, including a bridge that was started between Carthage and Hamilton two years ago, is to be acquired. A. W. O'Harra, Carthage, Ill., is interested.

The Burns Construction Co., Isabella Bldg., Chicago, Ill., which has the contract for building of the Dixon, Rock Falls & Southwestern Interurban line, has let the contract for all the steel rail needed to finish the line. The contract is for enough rail to cover a distance of 40 miles of roadbed. The rails are to be delivered at the nearest possible stations along the line while the work advances during the summer, and the contract provides that they shall be on the ground so as not to delay the work. The closing of the contract indicates that the building of the road has finally become assured. The Burns Co., which has charge of the construction, has already built the road from Tampico to Hoopole. Work on the road will commence as soon as weather conditions permit, and will be pushed as rapidly as possible during the summer.

Citizens of Fithian, Ill., are taking steps to secure the interurban company to construct a freight switch into that place.

The Peoria & Pekin Union Ry. Co. is reported to be planning a number of improvements for the coming year. The work includes the completion of its bridge at Peoria, Ill. W. E. Emery, Peoria, Ill., is Chief Engineer of the company.

At a recent meeting of the stockholders of the Taylorville Street Railway, Light & Power Co., of Taylorville, Ill., a new board of directors were elected, as follows: Grover Hoover, W. B. Adams, I. J. Perkins, Harry Cheney, J. H. Forrester, W. R. Richardson, T. H. Johnson, J. A. Adams and W. B. McBride. The company will at once rush to completion several extensions under consideration. Grover Hoover, President; Harry Cheney, Vice President; James A. Adams, Secretary.

Application has been made to the City Council of Elgin, Ill., for a franchise on city streets for the Elgin-Evanston Electric Ry., a proposed air line from the Chicago suburb to Elgin.

The Chicago Great Western R. R., W. H. Chadbourn, Chief Engineer, Chicago, is planning extensive improvements this year which will involve the expenditure of $12,000,000. The work scheduled includes the improvement of the roadbed on almost every section of the system. Much new track will be laid. Grades will be lowered and terminal facilities increased to such an extent that there will be no freight congestion in any of the large terminals in the northwest, where the company handles a large freight traffic. It is also planned to install automatic block signals on the eastern division between Chicago and Oelwein, Ia., 240 miles.

Indiana Notes.

FROM CORRESPONDENTS AND OTHER SOURCES.

The Indiana & Michigan Electric Co. has secured about 75 per cent of the land necessary to take care of the back water resulting from its proposed state line dam. Plans for the dam are now being prepared, but the structure will not be erected until early in 1911. The dam is to be one of a series erected by the company, chaining the St. Joseph River and furnishing electrical power and light for a large territory. F. A. Bryan, South Bend, Ind., is interested.

The townships of Union, Honey Creek and Princeton, in White county, will hold an election Feb. 14 to vote upon the question of a subsidy for the building of the Northwestern traction line. The sum of $15,000 is asked in each township.

Citizens of Brightwood, a suburb of Indianapolis, have asked the Indianapolis Traction & Terminal Co. to extend the Brightwood line from the present terminus at 25th St. north along Brightwood Ave. to 30th St. and west on 30th St. to Dearborn St.

The Shoals Power Co., of Shoals, Ind., has been incorporated with a capital stock of $50,000, and the following directors: Henry A. Mansfield, Samuel A. Teacher, Frederick M. Bachman, Frank T. Edenharter and William T. Mull.

R. J. Nooney, who has a 20-team outfit subbing from Lorimer-Gallager, of Chicago, Ill., on the Dublin & Bentonville cutoff, near Knightstown, Ind., has moved to Knightstown and will have a year's work at that place. He will start working as soon as the weather permits.

The Covington & Southeastern Traction Co., which started its construction work about a year ago at Kingman, has completed one mile of track and two more miles of grading and ties. When four miles of track are laid the company will then be entitled to the first installment of $65,000 from the trust company at Indianapolis, which has agreed to handle its securities.

The New York Central Lines is planning to double track between Shelbyville and Indianapolis. The work will probably be done this spring or summer.

Charles D. Kelso, of New Albany, who obtained the right of way for an electric railway from New Albany, Ind., to French Lick Springs, Ky., over the turnpikes of Floyd and Orange counties, it is understood, has secured the necessary financial backing to carry out the project.

Iowa Notes.

FROM CORRESPONDENTS AND OTHER SOURCES.

The Des Moines Railroad Promotion & Construction Co. of Des Moines is in correspondence now with people along the line from Des Moines to Centerville by way of Franklin township, Marion county, to find out what the sentiment is in support of an interurban service railroad. This line would be mainly along an earlier survey known as the Gates project. B. Schreiner, Des Moines, Ia., is engineer.

Business interests of Burlington have pledged $25,000 for the purpose of bringing to the city the extension of the Muscatine North & South R. R. The new owners are said to have promised not only to extend the line upon the payment of this bonus, but have indicated their intention of establishing a motor service over the entire road, which will give to Muscatine practically an interurban service on the line from that city to Burlington.

The Davenport Water Power Co., through its president, F. H. Griggs, has filed the formal acceptance of the franchise granted to it by the city of Davenport. By the acceptance of the franchise the city is said to be practically assured the water power plant which will cost in the neighborhood of $2,000,000 to $4,000,000 and on which work is expected to start as soon as preliminary arrangements can be completed.

The Tri-City Utilities Co., controlling the street railway system in Davenport, is reported to have stated that if the city council of Davenport will vote to give it a 25-year franchise from the present date they will guarantee to construct the Davenport-Muscatine interurban line. The present franchises in the city do not expire until the spring of 1924.

Promoters of the proposed railway from Waterloo, Ia., to a connecting point with the Northwestern and Milwaukee lines, have completed articles of incorporation and are to perfect a temporary organization at once. The southern terminus, however, has not yet been decided. Tama City, Belle Plaine and Marengo are favorable points, the latter city offering a large cash bonus for the line.

At the annual meeting of the stockholders of the Davenport-Manchester Interurban Ry. Co., Jan. 18, the following directors and officers were elected: Directors, George T. Baker, T. F. Halligan, Henry Vollmer and Sam T. White of Davenport; J. A. Voorhees and S. M. Murphy of Monticello; L. C. Matthews and F. B. Richardson of Manchester, and F. W. Rank of Moline. L. Matthews, Manchester, President; J. A. Voorhees, Monticello, Ia., Vice President; F. W. Rank, Moline, Ill., Secretary; T. F. Halligan, Treasurer. The company projects the construction of a line from Davenport, Ia., to Manchester.

Application has been made to the City Council of Albia by William A. Boland, 165 Broadway, New York, for a franchise to use the streets and alleys of the city for another interurban line. It is proposed to electrify the Albia & Centerville R. R., which Mr. Boland has purchased. Mr. Boland stated to the council that it was his intention, if the franchise was granted, to run electric cars between Albia and Centerville and later extend the line to the north.

An improvement fund of $20,000 has been subscribed for improvements on the Atlantic Northern & Southern Ry., and as soon as weather conditions will permit the work of ballasting and cutting down grades will be started. C. B. Judd, Atlantic, Ia., is Chief Engineer.

Kansas Notes.

FROM CORRESPONDENTS AND OTHER SOURCES.

The Wichita Terminal Association will have work started early in February on track improvements at Wichita, involving the expenditure of about $25,000. Other improvements will follow. O. J. Raymond, Roadmaster, will be in charge of the work.

The first allotment of new 85-lb. steel for the first 100 miles of the Central Branch of the Missouri Pacific will arrive in Atchison the middle of next month, the work of laying the new steel to be begun soon after. Eventually the entire division will receive new and heavier rails than those in use now.

Steps are being taken at Wichita to have the interurban line now being operated between Arkansas City and Winfield extended to

Wichita. The extension will be up the Walnut river to Douglas, and thence to Wichita. The city will be asked to vote $30,000 bonds for terminals.

The Topeka Ry. Co. of Topeka has decided that in case a proper ordinance is obtained from the city council of Topeka two extensions to the present street railway system will be put into effect as soon as the work can be done after the requisite permission is granted. One of the extensions is the much talked of road toward Shorey, which, it is expected, will intersect the present North Topeka line in the vicinity of Morse street, North Topeka, and may extend in the neighborhood of the city limits. The second extension will be built from Kansas avenue west to Central Park, taking in the scope of the city bounded on the north and south by West Seventeenth and West Twelfth Sts. F. G. Kelley, Topeka, is Secretary.

Michigan Notes.

FROM CORRESPONDENTS AND OTHER SOURCES.

The Lansing & Northeastern Construction Co. has filed an application with the State Railroad Commission for the approval of its plans of organization with $25,000 capital to build an electric road from Lansing to Owosso. The same men who composed the Northern Construction Co. compose the new company, which will build the road for the Michigan United Railroad.

The Muskegon Traction & Light Co., John T. Young, president and general manager, Muskegon, is planning a number of improvements on the steel car line and the gas and electric light plants and Lake Michigan parks. A large part of the Pine St. line is to be rebuilt. From the corner of Walton and Pine Sts. to the corner of Western Ave. and Pine St. the present 60-lb. rails are to be replaced with 70-lb. rails. This is to be done principally because the interurban traffic on this part of the line. On Pine St. south of Hartford St. and on Irwin and Nims Sts. the present 30-lb. rails are to be replaced with 60-lb. rails. Plans for the other improvements are now being considered and will be made public by the company as soon as definitely decided upon.

The Paw Paw Lake Interurban Co., controlled by the Benton Harbor & St. Joseph Railway Co., has secured a lease of the Pere Marquette Branch between Coloma and Paw Paw Lake. The interurban began building nearly a year ago and now has cars operating between Benton Harbor and Coloma. By securing the resort branch the local company have all the right of way between Benton Harbor and the lake, and in the spring will begin operating cars between the two points. From Coloma the interurban in the future may be extended to Watervliet, thence to Hartford.

The Benton Harbor & Paw Paw Lake Interurban Ry. Co. has secured additional right of way in Coloma, Mich., including the privilege to cross the yards of the Thayer Mill. This indicates that construction work will be pushed on to the lake in the spring.

Several petitions have been filed with the mayor of Detroit, Mich., requesting the extension of the Third Ave. car line out Hamilton Blvd.

The Bay County Construction Co. of Bay City, has been organized for the purpose of doing general engineering and railway construction business. The company consists of John H. Allerdyce of Detroit; Chas. W., Thos. L., Geo. W. and Frank S. Handy, and Chas. S. Ruttle, of Bay City. The new company will build and equip the new railroad which Handy Bros. of Bay City, are building from Bay City into the Thumb coal fields, grading for which is now progressing rapidly.

Minnesota Notes.

FROM CORRESPONDENTS AND OTHER SOURCES.

The Duluth & Iron Range R. R., W. A. Clark, Chief Engineer, Duluth, Minn., is to build a short spur into the mine on section 30.

The Minneapolis, St. Paul & Sault Ste. Marie Ry. is stated to have decided to improve the line of the Wisconsin Central Ry. between the Twin Cities and Chicago. The plan is to shorten the line about 40 miles by building several cutoffs and to increase the equipment of the middle division between Menasha and Owen, Wis., a stretch of track which, it is said, is incapable of handling the traffic at present existing. Grades in many places will be reduced and many curves straightened. Thos. Green, Minneapolis, Minn., is Chief Engineer, Minneapolis, St. Paul & Sault Ste. Marie Ry.

The Wapheton-Breckenridge Street Ry. Co., which projects a line between Breckenridge, Minn., at Wahpeton, N. Dak., has secured the necessary capital and is planning to have construction work started early in the spring. At a meeting at Breckenridge, F. L. Strum was elected manager and was instructed to secure the necessary material. The other officers of the company are: President, Math Braun, Wapheton; vice president, Frank Miksche, Breckenridge; secretary, F. R Barnes, Wahpeton; treasurer, J. H. Ehlert, Breckenridge; directors, Math Braun, N. Freidericks, Henry Connolly, F. Miksche and J. H. Ehlert.

General offices of the Virginia & Rainy Lake Ry. Co. have been moved from Duluth, Minn., to Virginia, Minn., and the city will pass an ordinance granting street railway franchises to the company. It is probable that all the range cities will be connected by an interurban system.

Duluth and the Ranges.

BY PETER E. MEAGHER.

F. J. Callaham of J. W. Callaham & Son, contractors, was a caller at this office a short while ago. They are not doing anything at present but are in the market for a contract.

John Runquist, the railroad contractor, was awarded a contract by the Duluth, Missabe Northern Ry. to strip a gravel pit. There is about 150,000 cu. yds. in this work, and the same is to be started immediately. Mr. Runquist has been quite successful lately in getting contracts. This is the second one that he has received from these people in the last two weeks.

W. A. Kimball, representing the Lansing Wheelbarrow Co., was a caller at this office recently. This is his first trip up in this territory, and he said that the outlook for business was very bright.

W. F. King & Co., Duluth contractors, are very busy at the present time. They have a very large concrete job for the erection of piers for a large railroad bridge to be constructed for the Minnesota Steel Co., near Duluth, and are using two concrete mixers, and a large number of men on the same. They have also four or five pretty fair sized concrete jobs for the Duluth, Missabe Northern Ry. Co.

J. A. Higgins of Higgins & McDonald, railroad contractors, was a caller recently. They have completed their work on the Northern Pacific near Mandan, N. Dak., and at the present time, are engaged on a contract on the Soo Line near Duluth. They contemplate working on the same all of this winter.

E. A. Wickham & Co., with general offices at Council Bluffs, Iowa, write us that they have about 120 miles of team work to be let on the Northwestern Ry. in South Dakota. There is free transportation for men, teams and outfits on this work. All contractors interested in this matter, by writing the contractors direct will secure whatever information they desire.

W. A. Sharp of Minneapolis, called at this office a short while ago. Mr. Sharp is engaged in the equipment business, and this is his first trip to Duluth. He came up to look the ground over. We wish Mr. Sharp success in his new venture.

John C. Greenway, who recently resigned as general superintendent in charge of work for the Oliver Iron Mining Co. in the Coleraine District, which district takes in a large number of the Iron Mines of this firm, and is located about 60 miles north of Duluth, has returned here and has taken up again his old position. Mr. Greenway is one of the most popular men in the Iron Range District, and was well liked by every one of his employes, and by all the people that came in contact with him either in a business or a social way. We are very well pleased to see Mr. Greenway again one of our citizens.

Owen McDonnell, General Superintendent for Patrick McDonnell, the contractor, was a caller here recently. They are very busily engaged at the present time on a large sewer contract at Grand Forks, N. Dak., and expect to be quite busy for about three months on the same.

G. A. Jones, of Jones Brothers, railroad contractors, Cincinnati, O., was a caller on us a few days ago. He reported that his firm had secured a very nice contract at Middletown, O. In the contract there was about 500,000 yds. of earth, 50,000 yds. of concrete, and 2,000,000 brick. They expect to start on the same immediately. On their contract at Nashwauk, Minn., they are at the present time working two shifts, and have engaged at the present time, one 90-ton Bucyrus steam shovel, one 70-ton Vulcan, and 4 yd. dump cars. They are making excellent progress on this work.

Dale & Bumgardner, steam shovel contractors on the Soo Line, have closed down all their work at the present time on account of frost, and do not expect to start again until some time later on in the season.

Richard Evans, steam shovel contractor on the Soo Line, has closed down his shovels on account of frost, and does not expect to start up until later in the season, when he will put four shovels to work.

E. P. Arsneau, one of the old-time Duluth contractors who is now located at Spokane, Wash., was a caller on the writer a few days ago. He says that the territory around here is pretty good, but that Spokane has got it beat a mile. He is getting along very well out there, and we are very glad to hear it.

John Butler, of Butler Brothers, was a caller in Duluth recently. They are engaged on stripping contracts in the iron country near Duluth at the present time, and have about 12,000,000 yds. of work under construction at present.

F. J. Mann, railroad contractor, has taken some more work from Foley, Welch & Stewart, and expects to start one steam shovel immediately.

C. C. Smith, railroad contractor, has taken a contract from Foley, Welch & Stewart on the Soo Line, and will start one shovel and a 4-yd. car outfit on this work at once.

There are some rumors circulating around up here at present about some very nice contracts to be let in the very near future, some for stripping iron mines, and others for railroad construction. As yet we have been unable to find anything authentic in regards to this new work. But we can say with perfect safety that inside of the next six weeks there will be a lot of new work let in this vicinity.

The labor market in Duluth at the present time is in quite a healthy condition. There is not a great many men here. The men seem to be hanging on to their jobs, and as there has not been very much new work let recently, there seems to be enough men to go around.

Missouri Notes.

FROM CORRESPONDENTS AND OTHER SOURCES.

The City Engineer, of Springfield, is considering the matter of constructing a concrete waterway through the property of R. E. Everett on the west side of Main street, just north of Water street, in that city.

The town of St. Peters is considering constructing a levee for flood protection purposes. Frank Taubler, St. Peters, is interested.

The promoters of the Hannibal & Northern Missouri R. R., now under construction, are reported to have decided to abandon Kirksville and to run their line from Sioux City southwest into the Macon County coal fields by way of Macon. A surveyor has been examining the roadbed built by the Missouri & Mississippi R. R. in the early 70s and says the greater part of it can be used if the title can be obtained.

Final surveys have been started for the projected line of the St. Louis & Kansas City Electric Ry. Co. The right of way has been

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secured and work is to begin on the east end, from Columbia to St. Louis. The first work is to be done between Columbia and Harrisburg, Boone county, in the coal fields. Twenty-five miles of the rails have already been bought for this section.

Subscriptions have been secured for practically $200,000 of bonds for building the projected line of the Mexico, Santa Fe & Perry Traction Co., of Mexico, Mo., and it is stated that construction work will be started at once. The first section of the line to be built will be 38 miles long and will extend from Mexico to Hereford, Callaway county, and north from Mexico to Santa Fe. There will be further extensions to Hannibal, Fulton and Jefferson City later.

It is expected that the Interstate Ry. Co., which projects a short line electric railway between St. Joseph and Kansas City will resume construction work in the spring. Ernest D. Martin, Marshall, Mo., is interested.

The Commercial Club of Macon is at work on a plan to induce the Chicago, Burlington & Quincy R. R. to complete its Iowa and St. Louis branch to Macon and to establish there its division headquarters between the Iowa terminal and St. Louis. Important municipal concessions will be offered the road and encouragement in the matter of right of way and yard space.

The franchise of the St. Joseph, Savannah Interurban Co. has been amended by the county court so as to cover the Savannah road for the remainder of the distance to the Andrew county line, from Industrial City, about a half mile. The contract for grading the roadbed will be let as soon as the frost is out of the ground.

The land owners a few miles east of Cedar City in Calloway County met recently at Jefferson City for the purpose of considering the project of forming a levee district. J. H. Nolan, Deputy State Labor Commissioner of Jefferson City, was present and spoke in favor of the proposition.

St. Louis Items.

BY A. B. KOENIG

The Board of Public Improvements' report on the abolition of grade crossings, expected to be submitted to the Municipal Assembly in the next week or ten days, will estimate the expense to the railroads at only $8,000,000 for the whole city. That sum includes several miles of track depression, a larger stretch of elevated tracks, and several viaducts. Missouri Pacific and Frisco tracks west of King's Highway are to be elevated, as are the Missouri Pacific's Oak Hill branch tracks south of the intersection with Morganfield road and the Terminal belt line west of King's Highway in the North end. The Wabash tracks through Forest Park, Poplar street tracks of the Iron Mountain from Seventh to the levee and the tracks crossing Tower Grove avenue, from about Grand to King's Highway, are to be depressed, including the Oak Hill line to Morganford road. In a number of places, including the stretch east of King's Highway on the North Terminal belt line and the Mill Creek Valley east of Grand, viaducts are to be required. With the exception of Ewing, Chouteau and Compton avenues these viaducts will be inexpensive. Union and King's Highway viaducts on the Terminal belt line, north, are to cost little more than $100,000 each, if that much, the streets and tracks now being at about the right grade for a short viaduct. A considerable part of the report is to be devoted to the Wabash tracks in Forest Park. About seven different solutions of that problem, each expensive to the railroad, are given. Depression of the tracks in the park and the approaches, King's Highway to Page, would cost the railroad, it is said, about $1,300,000. The board prefers the removal of the tracks from the park, and makes that plan one of the first of the seven. Poplar street is planned as a tunnel, and if the Iron Mountain wants to put its tracks under the street it will cost at least $500,000 to put them in a tunnel. It is expected, however, that because of the high cost the road will decide to abandon the tracks, or elevate them on private property to the south. The report discredits the claim of the railroads in relation to the Tower Grove crossing cost. A claim has been made that depressing the tracks would cost several million dollars, but the board's report figures it down to $1,300,000, which President Reber says is too high. Claims in relation to the switch tracks to the industrial plants along the lines also are considerably reduced, the aggregate for the three railroads being $210,000. The plans for each of the three roads are worked out separately, the cost to the Missouri Pacific for depressing its tracks 3,170 feet and paying its share of the bridging costs, being $255,000. The estimate for industrial track connections is but $25,000 for that road. The Oak Hill division of the Missouri Pacific, because of a longer depression of the tracks, 9,700 feet, and consequent greater expense would have to pay $810,000. The Frisco would be at an expense of $235,000, not including an estimate of $60,000 for a desirable but not indispensable viaduct over Park avenue. The depression of its tracks would be 292 feet. The following table, showing the expense to the Oak Hill road, shows how the costs were worked out by the board:

OAK HILL DIVISION EXPENSE.

	Amts.	Rate of cost.	Amt. of cost.
Main line, double tracks depression, linear feet.	10,200	$ 250	$ 25,500
Side track, depression, linear feet	3,800	125	4,875
Excavation, railroad tracks, cu. yds.	250,000	67	188,000
Excavation, retaining walls, cu. yds.	20,000	100	20,000
Back fill, retaining walls footing, cu. yds.	15,000	50	7,500
Concrete retaining walls, in footing, cu. yds.	12,000	500	60,000
Retaining walls, in forms, cu. yds.	32,000	750	240,000
For bridge floors, cu. yds.	730	1,000	7,300
Waterproofing, bridges sq. yds.	1,500	100	1,000
Roadway paving bridges, sq. ft.	20,000	20	4,120
Granitoid walks, bridges, sq. ft.	13,500	18	2,430
Granite curb, bridges, lin. ft.	1,100	100	1,100
Iron rail, bridges, lin. ft	630	100	630
Structural steel for bridges, in lbs.	485,000	4	19,400
Total cost			$558,853
Reconstruction Tower Grove storm sewer			7,147
Caring for industrial tracks			135,000
Four bridges reconstructing King's highway			87,000
Total cost			$810,000

Mr. Reber says the prices allowed for the excavation, concrete and other work per cubic yard, square foot, linear foot, etc., are higher than the work will really cost, thus raising the aggregate of the estimates beyond the necessary figures.

A. G. Taubert came in from Kansas City looking for concrete or pile driving work. 3118 E. 15th St., Kansas City, Mo., will catch him.

A bill introduced in the Council here on Jan. 25th on behalf of the Board of Public Improvements is intended to divide the cost of draining 2,581 acres of land between the city and the property owners. The land in question lies along the route of the South Harlem joint sewer district. There are 826 acres of the track outside of the city limits The entire cost of the improvement is estimated at $220,806. The amount it is proposed to tax the property owners for is $149,424 and the city $71,382. A second estimate places the total at $212,124, of which the property owners are to be assessed $143,549 and the city $68,575.

Farmers in Saline County, Missouri, have given right of way across that county to the St. Louis-Kansas City Electric Railway, which is now surveyed four miles beyond Arrow Rock. The road may branch at New Farnklin, according to W. B. Cauthorn, its chief engineer, who was in Columbia on Jan. 25 to close up right of way contracts. From New Franklin one route under consideration runs up the north side of the Missouri River near Arrow Rock crossing at that town. The other route crosses the Missouri at New Franklin and runs through the northern part of Cooper county into Saline. The survey of both branches has reached Arrow Rock. It will tap the undeveloped coal fields of Boone and Howard counties.

Improvements and additions costing approximately $400,000 are being made to the Granite City plant of the American Steel Foundries, which will double its capacity and will make it one of the largest steel plants in the world. The construction of buildings and installation of modern machinery will be completed by April 1, when 1,000 more employes will be needed than are now employed. Five years ago, what is known as the north plant of the Granite City foundry was abandoned. This building is now being enlarged 200 by 150 feet, making it 400 by 600 ft. in dimension. It will be the new home of the car wheel department and will be fitted with machinery of modern make. Up to date machinery for cleaning beams and mastings by an air-blast will be installed, together with entirely new machines for gardening steel core wheels. Two kneading furnaces will be constructed in the open hearth department. Two additional furnaces will be constructed in addition to the three furnaces now in use. Each furnace requires 500 employes in addition to 250 laborers about the various furnaces. The two new furnaces will add 1,000 workmen to the payrolls of the company. With the modern machinery and additional furnaces, the capacity of the plant will be doubled. The present plant in use is running at its full capacity and is behind in its orders. With the completion of the improvements this plant will be the most important in the group of seven plants owned by the company. At present 2,500 men are employed at the Granite City plant, and its payroll each two weeks is approximately $60,000. The appropriation made Jan. 1 for the improvement of the plant was $300,000. Up to this time $185,000 has been expended and it has been decided to ask for an additional appropriation of $100,000. The headquarters of the American Steel Foundries is in Chicago. The six other plants operated by the company are located at Sharon, Franklin and Pittsburg, Pa., Alliance, O., Indian Harbor, Ind., and East St. Louis.

J. Burke sublet a part of his work on the Burlington extension between Shoshoni and Powder River, Wyo., to N. Farlow, P. J. Fitzgerald, Jas. Riley, J. Pede. Burke's address after Feb. 1 will be Shoshoni, Wyo.

The river has receded, with but little prospect of a rise in time to interfere with the work on the eastern pier of the Municipal free bridge, and as a result the first caisson will be sunk in a few days, according to President Reber of the Board of Public Improvements. Henry W. Hodge, of the engineering firm of Boller & Hodge, of New York, who

are designing the bridge, was in conference with the Board of Public Improvements last week. The matter of acquiring lands for approaches on the east side was taken up during the discussion as the plans must necessarily be governed in accordance with the land to be acquired.

John Mahoney, his wife and his foreman, Thos. McQuire, were killed in Kansas City last Monday by Mahoney's automobile in which they were riding at the time plunging off the Cliff drive down a steep bank. In addition to the above, John O'Connor and Mahoney's two daughters were seriously injured and are not expected to live.

We welcome to our city King's Labor Agency, which opens on Feb. 1 at No. 11 S. 9th St. The well known T. J. Kincaid is going to be manager of same.

The Board of Public Improvements on Jan. 25 awarded contracts for twenty-seven streets to be improved at an aggregate cost of $335,289.34. Ordinances were also introduced in the Municipal Assembly for eight additional streets. Following are the contracts, streets, cost and contractors: Rowan avenue, Ridge to Easton, Parker Washington Company, $7,763.90; New Ashland Labadie to Ashland, same, $8,694.56; Shawmut, Wells to Easton, same, $2,861.34; Theodosia, Academy to Union, same, $5,827; same street, Union to Arlington, same company, $7,551; Alfred, Scanlan to Arsenal, P. J. Clifford Contracting Company, $8,418.90; Louisiana, Cherokee to Gravois, G. Eyermann & Bro., $3,873.51; Henrietta, Compton to Louisiana, same, $5,779.50; Twenty-first, Palm to Branch, Wm. H. Redemeyer, $2,947; same street, Penrose to Ferry, same company, $6,259.92; Potomac, Wisconsin to Jefferson, F. Ruecking, $11,030.60; Pestalozzi, Thirteenth to Jefferson, same, $21,611.94; Dakota, Nebraska to Minnesota, same, $4,256; Michigan, Dakota to Osceola, same, $6,685.19; Pennsylvania, Osage to Chippewa, same, $8,931; Grace, Fairview to McDonald, same, $2,784.42; Fassen, Virginia to Broadway, same, $11,326.92; Spring, St. Louis to Natural Bridge Road, Fruin-Bambrick Construction Company, $13,795.28; Twenty-second, Cass to Hebert, Jas. E. Perkinson, $37,410.11; Canaan, Newby to Broadway, same, $14,395.31; Natural Bridge road, Fair to Taylor, Skrainka Construction Company, $23,071.79; Connecticut, Russell to Morgan Ford road, Granite Bituminous Paving Company, $24,281.44; Scanlan, from Morgan Ford to Alfred, same, $5,927.30; Twenty-second, Washington to Cass, same, $37,270.84; Manchester, Barron to Sublette, Schneider Granite Company, $19,128.42; same street, Tamm to Prather, same company, $27,609.40; Arkansas, Winnebago to Miami, Barber Asphalt Paving Company, $5,764.88. Following are the eight ordinances: Brick—Palm, Broadway to Fourteenth; Coleman, Montgomery to Garrison; Penrose, Grand to Prairie; Gravois, Arsenal to Grand; Taylor, Ashland to Margaretta. Asphalt—Laurel, Ridge to Wells; Holly, Penrose to Carter, and High, Franklin to Biddle.

Jas. Skene & Son have finished their lock and dam work on the Big Sandy River in Kentucky. Skene spent the past week in town. He left here for New Orleans where he will be until after Mardi Gras and then go to his home in Huntington, W. Va.

Hickey Bros. are going to resume work in Dakota as soon as the weather will permit.

Montana Notes.

FROM CORRESPONDENTS AND OTHER SOURCES.

Surveys are to be started shortly for the proposed electric railway to be built by the Whitefish & Polson Electric Railway Co., of which J. A. Edge, Kalispel, Mont., is president. The corporation was formed several weeks ago with the purpose of connecting the northern and southern ends of the county by rail.

The citizens of Laurel at a recent special election voted to grant a franchise to the Eastern Montana Electric Railway company for a line extending from Billings to that city, up the Clark's Fork valley, terminating at Red Lodge. The people of Red Lodge are expected to be called upon soon to vote on the franchise question.

The Great Northern Ry., A. H. Hogeland, Chief Engineer, St. Paul, has filed in the Great Falls land office a plat showing the proposed route of the branch line from Great Falls up the Sun River to a point near Augusta, which is to be constructed during the present year according to the announcement recently made. The line as it is now surveyed will run through Sun River and will pass very closely to the towns of Fort Shaw, Simms, Hepler and Augusta.

Walkun Baldwin & Co., bankers, William St., New York, representing a French syndicate of capitalists, are to send their representative, Daniel Giles, to Red Lodge to complete preliminaries of the work of building an electric interurban line from Billings, through Laurel, up the Clark's Fork Valley, terminating at Red Lodge. Preliminary surveys have been made in some parts of the county already; but early in the spring the complete survey will be made and actual work of construction begin, according to the New York bankers. The citizens of Laurel have voted by special election, without dissent, to grant a franchise to the Eastern Montana Electric Railway Co., an auxiliary of the company headed by Mr. Giles. Work will soon begin between Billings and Laurel.

An electric railway is projected for the Flathead Valley, and advices from Kalispell state that State Senator Thomas D. Long, who is promoting the project, has secured practically one-half the sum necessary to assure the construction of the line.

The first fatality connected with the construction of the Blackfoot railway from Bonner to the Blackfoot landing occurred on Jan. 19, when Julius Nelson, a powder man, was accidentally caught in an explosion of giant powder and blown to pieces. Nelson had been in the employ of the construction company only eight days, coming from Denver as an experienced powder man. The accident occurred in camp No. 1 of Clifton & Appolonio, about two miles north of Bonner station, and it is said to have been due to the carelessness of the man who was killed. Nelson is said to have violated his instructions and while drilling holes for blasting filled one with a full charge. Later, his drill became stuck in a hole nearby and the man placed a light charge of dynamite in it to release the drill. After lighting the fuse he swung it against a keg of giant powder, which exploded, discharging three others. Nelson was driven against the first hole, which he had filled, the concussion exploding the charge there and tearing the body to fragments.

New York Notes.

FROM CORRESPONDENTS AND OTHER SOURCES.

Business men of Middletown, Conn., are signing petitions urging the New York, New Haven & Hartford R. R. Co. to begin as early as possible the task of double tracking the air line between Middletown and Willimantic. The railroad management has announced its intention of double tracking the road, but has not decided on any time for beginning the work. The company says that the improvement will be very expensive, and that the details of financing the operation must be worked out before construction can be undertaken.

The North Atlantic Dredging Co. of Brooklyn has been incorporated. The capital stock is placed at $25,000, and the directors are as follows: Sheldon C. Kniffin, John O'Connor and Thomas J. Muldoon of Brooklyn.

The Bolivar-Wellsville Construction Co. of Bolivar, N. Y., has been incorporated to build a trolley line from Bolivar to Wellsville, 19 miles long, at an estimated cost of $250,000. Franchises have been applied for in both villages. The company is composed of Benjamin F. Patterson of Brooklyn, N. Y., C. M. Van Curen and A. J. Matson of Bolivar.

The Lewiston & Youngstown Frontier Ry. Co. has filed an application with the City Board of Trustees for permission to construct, maintain and operate electric railway lines over certain streets in the village of Youngstown, N. Y.

Ohio Notes.

FROM CORRESPONDENTS AND OTHER SOURCES.

The Cincinnati, Hamilton & Dayton R. R., F. H. Alfred, Chief Engineer, Cincinnati, O., has begun preliminary work at Toledo on the construction of an ore dock and freight yards to cost about $1,500,000. The new freight yards which are to be built will have a storage capacity of 2,700 cars and will be constructed on the gravity plan. They will extend back from the new river frontage of the company to the road's Rossford yards. It is estimated that the yards alone will cost about $500,000. The ore dock will be of concrete on piling. About 350,000 cu. yds. of earth filling will be required for the dock. Contracts for the work are to be let early this month.

Plans for the re-organization of the Wheeling & Lake Erie R. R. and the Pittsburg Terminal Co. are reported to have progressed satisfactorily. The Wheeling & Lake Erie Co. will start out with a capitalization of $130,000,000, consisting of $40,000,000 preferred stock, $50,000,000 common stock and $15,000,000 outstanding of a new bond issue of $16,000,000, bearing 4 per cent interest. The road will connect Cleveland, Pittsburg and Erie, and will occupy a position where its influence in traffic matters will be felt. The Wheeling & Lake Erie is to be double tracked at a cost of $15,000,000 and $18,000,000 will be paid for equipment. H. T. Douglas, Jr., 509 Perry-Payne Building, Cleveland, O., is Chief Engineer of the W. & L. E. R. R.

Commissioners of Marion County, Marion, O., are considering estimates for widening, deepening and straightening the Little Scioto River. According to the estimates of Ed. S. Ault, County Surveyor, the work will cost about $65,000.

The Council of Bryan has granted the Ft. Wayne & Toledo Electric R. R. Co. a franchise to lay tracks and operate electric cars in Bryan, entering the town from the southwest over Center St. At Beach St. the tracks come north to High St., thence east on High St. to connect with the present tracks of the Toledo & Indiana. The franchise must be accepted by the company within 30 days, and becomes void if construction work is not begun within one year and the road in operation within two years. The Ft. Wayne & Toledo is being promoted by Indiana capitalists whose headquarters are at Maysville, near Ft. Wayne. As planned the road connects Bryan and Ft. Wayne, via Maysville, Hicksville Farmer and William Center. Some construction work was done near Maysville last fall.

The Pittsburg & Lake Erie R. R. has filed an amendment of its charter with the Secretary of State at Columbus, indicating that the arrangements for the connections between the P. & L. E., Lake Erie & Eastern and Pennsylvania railroad have been agreed upon at last and that the construction of the L. E. & E. will start in the near future. This amendment provides for the building of an extension at Struthers to connect the three railroads. J. A. Atwood, Pittsburg, Pa., is Chief Engineer.

To eliminate the disturbance with the canal at Dayton, Rubicon creek will be extended under the canal to the Great Miami river. City Engineer Cellarius of Dayton is in charge of the work.

An ordinance has been introduced into the city council of Dayton, O., providing for the extension of the City Railway Company's lines on certain streets.

Oklahoma Notes.

FROM CORRESPONDENTS AND OTHER SOURCES.

The Southwest Construction & Paving Co., of Muskogee, has been chartered with a capital stock of $25,000, the directors being Frank G. Mason, H. C. Davis, Marion White and C. F. Holderman.

The St. Louis, El Reno & Western Ry., W. M. Bushnell, general manager, Fort Smith, Ark., has surveys under way westward from El Reno for a mile for the extension of the

road to Cordell. It is said that actual construction work will be started about Feb. 15.

The citizens of Hollis have raised a $25,000 bonus for the Wichita Falls & Northwestern R. R.

Business men of Waurika have asked the Texas Southwestern Ry., W. B. Worsham, vice president, Henrietta, Tex., to extend its line to Waurika, with a view to securing a connection there with the Rock Island.

The Oklahoma Union Traction Co. which has just completed two miles of line in Tulsa, has announced that it is preparing to build lines to Sapulpa, Sand Springs and Bartlesville, in addition to a chain of extensions of track in Tulsa. The company has asked the City Commission of Tulsa for an amended charter, which will give it the right of several more streets not named in the franchise in order that a number of new lines may be laid at once.

Citizens of Okmulgee have subscribed $30,000 to build an electric line to what is known as the Preston oil pool, or "Hamilton Switch," a distance of six miles. The sum secured assures the building of the road at once.

The Enid, Ochiltree & Western R. R. has opened offices at Enid. The office is in charge of B. H. Tallmadge, Assistant General Manager. Liberal subscriptions to the stock have been made by citizens of Enid and assurances have been given in regard to the securing of rights of way, terminals, etc.

The Commercial Club of Muskogee has started a movement to secure the co-operation of clubs at Shawnee, Oklahoma City, Guthrie and Kingfisher, for the extension of the Fayetteville branch of the Frisco railroad running west from Okmulgee to the towns mentioned. This line now runs through Muskogee, from Fayetteville to Okmulgee, but it is considered highly desirable to have this cross section line extended.

The Cherokee & Oklahoma Western R. R. Co., which is contemplating the construction of a line from Clinton, Okla., to Butler, is now having surveys made for the extension of the line from Clinton to Chickasha to connect with the Rock Island and Oklahoma Central R. R.

Chickasha, Okla., has subscribed a $40,000 bonus to the Caddo Development Co., which proposes the construction of an interurban railway from El Reno, through Chickasha to Anadarko, Okla. Surveys for the projected line have already been completed and the work will be completed in two years, it is said.

The Oklahoma City and Fort Smith Traction Co. has been chartered to construct a 200-mile interurban railway line from Oklahoma City to Fort Smith, Ark. The company [illegible] City, Okla., [illegible] route as [illegible] counties: Oklahoma, Pottawatomie, Seminole, Okfuskee, Okmulgee, McIntosh, Muskogee, Haskell and LeFlore. The incorporators are V. C. Boilt, P. M. Moory, G. L. Wood, F. N. Wood, A. M. Gustie and John Wilds, all of Oklahoma City, Okla.

The Seaboard Air Line Ry., H. R. Artman, Assistant Engineer, Brimingham, Ala., is said to be planning to expend $160,000 in putting in a new concrete-lined tunnel at Rogers Gap, 20 miles east of Birmingham. The old tunnel was badly damaged by a recent fire.

Oregon Notes.

FROM CORRESPONDENTS AND OTHER SOURCES.

The Utah Construction Co., Ogden, Utah, is reported to have been awarded the contract for grading 80 miles of the proposed Harriman road across Central Oregon from Vale west into the Great Harney Valley. Construction work is to be started as soon as weather will permit and already several carloads of material have arrived at Vale, including three cars of dynamite, which will be used in blasting the roadbed in the Malheur canyon.

The Portland Railway, Light & Power Co. of Portland has completed surveys for the construction of an electric railway from West Oregon City to Oswego, a distance of four miles, in order to handle the logging business for the Willamette Pulp & Paper Co., the Crown-Columbia Pulp & Paper Co., and the Hawley Pulp & Paper Co. The line will be an extension of the Willamette Falls Railway, running south from West Oregon City past Willamette, and the surveys were made by Superintendent C. A. Miller, of the Willamette Falls Co. It is intended to have the road in operation within three months.

Robert Wakefield, Portland, Ore., who has the contract for constructing the Mount Tabor reservoirs for that city, has placed a 400-H.P. hydraulic sluicing plant in operation for sluicing away 500,000 cu. yds. of soil for the upper reservoir.

W. Hood, Chief Engineer Southern Pacific Ry., San Francisco, has been making estimates as to the cost of completing the Coos Bay branch of the S. P.

Twohy Bros., Spokane, Wash., have completed their contract for constructing 16 long sidings for the Oregon Railroad & Navigation Co. These sidings are scattered along a section of the line between a point just east of Pendleton and a point just east of Baker City.

The promoters of the Coos Bay & Boise R. R., which is being surveyed from Marshfield to Roseburg, are asking for a bonus of $150,000, the money not to be paid until 30 days after the road is in operation. The people of Coos Bay will be approached with subscription papers and an effort will be made to raise the nesessary bonus. Preliminary surveys for the line have reached Roseburg. F. A. Haines, Marshfield, is Chief Engineer.

Agreement has been reached between the Commercial Club of Pendleton and the Washington & Oregon Traction Co., assuring the line for that city. Construction work is to be started as soon as $50,000 is raised in Pendleton.

Ordinance is before the Common Council of Portland calling for a fill on East Second St. to Hawthorne Ave.

The Central Oregon & Pacific Ry. Co., incorporated a few months ago for the purpose of constructing a railroad up the Calapooia Valley from Brownsville, Ore., has secured seven miles of the right of way over which, according to the conditions, the line must be constructed within 12 months from Jan. 1, 1910. The proposed road will tap a rich timber country and will connect the Corvallis & Eastern line with the Curtiss Lumber Company's logging railroad.

The Street Railway Co. of Albany, Ore., is considering the improvement of its system during the coming year. The work includes the construction of a number of extensions and a loop throughout the southwestern part of the city.

The Craig Mountain Railroad Co. has started laying steel on its 5-mile line connecting with the Northern Pacific Ry., at the old government saw mill near Ruebens. A large concrete dam has been constructed for a storage basin for the logs and will also afford a lake for a summer resort planned by the company.

The Hood River Light & Power Co. has filed articles of incorporation at Portland, Ore., and proposes to develop water power, construct and otherwise acquire and operate transportation lines, including boats, steam or electric railways and airships and engage in packing, manufacturing, mercantile pursuits, express, telephone, telegraph and other public service branches of business. The papers provide for the construction of a railway from the mouth of Hood river to a point in the Mount Hood District and options in the right of way are to be secured at once. The principal offices of the company are at Portland and the incorporators are J. D. Wilcox, Portland, Ore., and Wirt Minor and R. Smith.

C. A. Miller, of the Portland Railway, Light & Power Co., has been ordered to start surveys for the construction of an electric railway from Oregon City, Ore., to Oswego, on the west side of the Willamette River. The road will connect with the Willamette Falls R. R., running from Oregon City to Willamette Falls and on to Tualatin River and probably on to a connection with the Oregon Electric at some point.

Pennsylvania Notes.

FROM CORRESPONDENTS AND OTHER SOURCES.

The Somerset and Cambria branch of the Baltimore & Ohio R. R., according to more or less reliable reports, is to be double tracked. Plans for laying the additional tracks are said to have been completed and to be now in the hands of the executives in Baltimore. This work is included in the 1910 construction program which is being considered by the executives of the Baltimore & Ohio, and which will mean an expenditure of more than $50,000,000. To make possible the through service from Johnstown it will be necessary to construct the extension of the Quemahoning branch into the Benscreek coal field in Somerset county. A. M. Kinsman, Baltimore, Md., is Chief Engineer.

The Scranton & Lake Shore Ry. Co., of Scranton, Pa., has been chartered with a capital stock of $18,000 and proposes the construction of a 5-mile line.

The Buckhannon & Northern R. R. has been granted a franchise by the Commissioners of Monongahela county, W. Va. Final locations for the line are to be started shortly. The road is to extend from the Pennsylvania, West Virginia state line up the Monongahela River to Rivesville, W. Va. B. M. Laughead, Morgantown, W. Va., is locating engineer.

The Bradford County Traction Co. has reached an agreement with the W., S. & A. Traction Co. and it is now expected that work on the trolley road in Towanda borough will be started soon. The franchise granted at Towanda to the Bradford County Traction Co., will expire on March 15, unless real work on the line is begun before than time.

Title has been taken by Henry A. Phillips of Philadelphia, to a tract of about 29 acres at 44th Ave. and 30th St., recently purchased by a syndicate of capitalists for the purpose of building a great terminal for steamship lines. It is reported that the syndicate will spend close to $2,000,000 on improvements, which will include the filling in of much of the ground and the building of several large piers.

W. C. Riffert of Harrisburg, was recently in Lebanon County laying out a prospective route for a street railway line. The company, in which Mr. Riffert is interested, intends running a line from Reading to Bernville, to Rehrersburg, Fredericksburg and Jonestown. The route will include Grantville and Palmyra, where it is proposed to connect with the lines to be built by M. S. Hershey, the chocolate manufacturer, from that place to Hershey. This will make a continuous route from Reading to Harrisburg. The promoters propose building a line from Palmyra to Campbelltown, a distance of about 2 miles. M. S. Hershey intends building several lines in western Lebanon County, which will drain the dairy section of milk to be used in the manufacture of his product.

Notice of reorganization of the Monongahela Short line, a projected steam railroad for operation in Allegheny County, has been filed at Harrisburg. The rights of way and other property of the company were sold recently at sheriff's sale. The new company will have $200,000 capital and the following directors: W. S. Moorehead, K. F. Rafferty, C. A. and W. S. McClintock, G. S. Ebbert and E. H. Dermitt. The Monongahela & Southwestern R. R. Co., also sold recently, has filed similar papers, the capital and directors being the same as for the other road. Both lines are projected for operation in the Homestead district, near Pittsburg. The first line is 12 miles in length, running from Homestead into Snowden township, and the other, also a short line, runs out of Homestead in another direction. The companies were formed originally by B. F. Rafferty. Both were sold not long afterward, and again sold in 1906. They were acquired only a short time ago by the present holders. It is now stated that enough money is in sight to build the new roads, and that construction of them will be started shortly.

Texas Notes.

FROM CORRESPONDENTS AND OTHER SOURCES.

The American Construction Co., of Knoxville, Tenn., has been granted a permit to do

business in Texas. The capital stock is $100,000 and the offices are to be in Houston.

Samuel Lazarus, of St. Louis, Mo., president of the Quanah, Acme & Pacific Ry., is reported to have announced that the road would be extended either to El Paso or Roswell, N. Mex. C. E. Ensminger, Quanah, Tex., is General Manager.

Col. R. A. Love, Miles, Tex., has made a proposition to the citizens of Brady to build a road from Coleman to Llano, with an ultimate destination to San Antonio. His proposition is for Coleman and Brady to subscribe for the stock and proceed at once with the building. It is the intention to begin grading from Brady to Coleman to connect the two towns as soon as possible.

The Galveston Wharf Co., of Galveston, is to at once rebuild its pier at Galveston which was damaged to the extent of $10,000 by a fire on December 30.

Advices from Brownwood state that John Meade, Chief Engineer of the Brownwood North & South R. R., has had a party of surveyors in the field locating the road between that place and May. The old Connell and Comer survey will be followed pretty closely almost the entire distance. It is believed now grading can be commenced early in February unless too much bad weather interferes with the work of locating the line.

The first survey for the Dallas-Terrell Interurban line has been completed to the North Texas Hospital for the Insane, one mile east of Terrell, which it is stated will be the terminus of the new line at present. Work on the second survey, which is to run north of the Texas & Pacific, between Terrell and Forney and probably via Chisholm, will begin soon. C. L. Wakefield, under whose direction the surveys are being made, is said to have estimated that the cost of constructing the new road will be about $30,000 per mile and that the line from Dallas to Terrell will cost about $1,000,000.

The citizens of Pecos have entered into a contract with W. L. Carwile of Dallas for the construction of a railroad from Pecos City south to the Davis Mountains, incorporated under the name of the Pecos Valley Southern Ry. Company. Mr. Carwile posted a bond for $25,000 as a guarantee that he will have the road completed to the town of Balmorhea, 36 miles, by June 1, 1910, and an additional bond in the sum of $75,000 to protect the trustees in the partial payments which they have agreed to make as the work of construction advances. The trustees agree to pay to Mr. Carwile $100,000 in installments as the road reaches given points. Grading work is said to have been started.

The Coleman, Llano & Southern R. R. Co. has been chartered with a capital stock of $500,000 and principal headquarters at Coleman. The company proposes to build a line from Coleman to Brady and ultimately to San Antonio. The directors are as follows: H. N. Beakley, J. A. B. Miller, H. R. Starkwater, J. E. Roog-Scott and R. A. Lane. Surveys have been made and right of way is now being secured.

The Chicago, Rock Island & Pacific Ry., according to a statement of President H. U. Mudge is to expend at least $1,500,000 for improvements to its terminal facilities at Galveston, Tex.

The U. S. House of Representatives has passed the bill introduced in the house last December by Representative Gregg authorizing the Lone Star Canal Co. of Anahuac, Chambers County, Texas, to erect a dam across the mouth of Turtle bayou.

The directors of the San Angelo Junior Methodist College have offered the San Angelo St. Ry. Co. a bonus to extend its lines to the college, which is about 1½ miles from the court house.

Mr. Lowrey of Poteau, Okla., with local capitalists, has been in conference at Quanah regarding the construction of a belt street car line in Quanah. The franchise was secured some time ago and the plan is to run out Johnson St. as far as the Perry property, then turning west, going through the Brixill, Du Puy, Harwell and Parson properties, entering the southern end of the city at or near McDonald St., coming up that street as far as the court house, making connection with Johnson St.

J. F. Edwards, of St. Louis, Mo., who has a contract with the chamber of commerce of San Antonio to build a railroad south to connect with the Simmons road at Medina River and eventually to Brownsville, has a gang of men already at work. He is stated to have financial arrangements whereby the work will be very greatly rushed.

It looks now as though nothing would be done for some little time regarding the construction of the railroad from Harlingen in Cameron county, to San Antonio. The road was projected by Lon D. Hill, of Brownsville, and his plans were well under way when the announcement came that Edwin Hawley, B. F. Yoakum, et. al. obtained a controlling interest in the Missouri, Kansas & Texas Ry. He was said to be depending on the Katy road for connections and the road could not be carried out under the present circumstances.

Advices from Alvin, Tex., state that the proposition to issue $193,000 worth of drainage bonds has been carried.

The St. Louis, Brownsville & Mexico Ry. Co. has filed an amendment to its charter providing for the construction of two extensions, including about 72 miles of track. The first is from Samfordyce to Roma, a distance of 35 miles and the other extension from Bloomington to Port O'Connor, a distance of nearly 40 miles. The main line of the company, which is now under construction, is rapidly nearing completion.

A second route for the proposed line of the Dallas-Terrell Interurban Ry., mentioned in a recent issue, is being made. It will run north of the Texas & Pacific Ry., probably passing through Chisholm, the citizens of that village having offered the company a bonus of $50,000 and land for terminal purposes.

F. G. Hammock, promoter of the Colorado & Concho, is to let contracts for the construction of 50 miles of the line from Colorado City to Robert Lee, Texas. The line will later be constructed from Robert Lee, 28 miles to San Angelo, Texas. The route will follow a fertile valley along the Colorado river.

It is reported in the vicinity of Fort Worth, Texas, that the Fort Worth & Denver Railroad Co., has acquired the entire control of the Trinity Valley and Brazos Valley Railway, the Chicago, Rock Island & Pacific Railway Co. having sold its interest in the line.

President of the Fort Worth, Texas, Board of Trade has appointed a subscription committee to solicit a $125,000 bonus for the Watkins Company, which is planning the construction of an interurban line between Fort Worth and Mineral Wells. J. O. Watkins, Little Rock, Ark.; Paul Hurley, and J. S. S. Hansford, Fort Worth, Texas, are members of the company.

B. C. Stegman of Brownsville, Texas, is organizing a company to be capitalized at $60,000 to construct a railroad from West Brownsville, a suburb, through Brownsville to Matamoras, Mexico, and also a belt line around Brownsville. One-third of the stock has been subscribed and as soon as the remainder can be disposed of, an application will be filed with the city council for a franchise.

Utah Notes.

FROM CORRESPONDENTS AND OTHER SOURCES.

City Council of Salt Lake City has voted to spend $25,000 for the enlarging of the surplus canal from the Jordan river to Great Salt Lake to take part of the flood waters in the Jordan during the spring floods. The work has been started by Street Supervisor Jake T. Raleigh. The purpose is to enlarge the surplus canal by deepening it about three feet and widening it 20 or 30 feet. Under the present plan the canal will be made to carry 1,400 second feet of water instead of 500, as at the present time.

The Spanish Valley Water & Land Co. has been incorporated with a capital stock of $300,000 and headquarters at Salt Lake City. The officers of the company are: W. H. Jones, president; W. W. Taylor, vice president; S. A. Jones, treasurer; George D. Winter, secretary; and Willard Hanson completing the board of directors. W. W. Taylor holds 2,996 shares, and each of the other directors hold one, making the 3,000 shares. Property of W. W. Taylor and water rights in Mill creek, San Juan and Grand counties, are taken for the full stock.

Washington Notes.

FROM CORRESPONDENTS AND OTHER SOURCES.

The Monroe Water & Light Co. of Monroe, Wash., has purchased a five-acre tract on the bench lands northeast of town and propose to build a reservoir for storage purposes.

The City Council of Tacoma, acting as a committee of the whole, has voted to recommend the passage of an ordinance submitting to the vote of the people at the coming spring election the proposition of a special bond and warrant issue of $1,000,000 to build and equip city traction lines. The ordinance will provide for the expenditure of $750,000 for the building of a network of cable and electric lines with an additional $250,000 for equipment. Power will be furnished by the city's new power station now being constructed.

Advices from Rainier state plans are being perfected for the building of 12 miles of railroad track, extending from the sawmill on Johnson creek to a connection with the Milwaukee road at Rainier. The mill was built by Mr. Farrell, formerly right of way agent for the Oregon and Washington branch of the Union Pacific and brother of J. D. Farrell, Seattle, General Manager of that road.

The Big Bend Waterpower Co. will shortly commence development work on a new power plant 30 miles down the Spokane river from Spokane. The object of the company is to furnish power for manufacturers in and around Spokane, and to develop mines in the Coeur d'Alene belonging to incorporators of the company.

The Seattle Lighting Co., S. R. Hutchinson, Superintendent, Seattle, is planning to spend $125,000 for a new gas distributing station in Georgetown. The gas holder is already ordered.

Advices from Centralia state that the contract has been let to J. M. Evans for the construction of six miles of railroad to connect the Johnston Creek Lumber Co. with the Chicago & Milwaukee at its intersection with the Deschutes river. This company has recently been reorganized, with an increased capital stock and will do a general logging and mill business. David McVay is president; J. M. Farrell, vice president and manager; and L. H. Johnston, secretary and treasurer. The principal place of business is Centralia, Wash.

The Mount Adams Railway Co. of Portland, Ore., is to take out incorporation papers in the state of Washington. The company proposes building an electric railroad through the White Salmon River valley. The town of White Salmon, at the confluence of White Salmon and Columbia rivers, and Glenwood at the base of Mount Adams have been selected as terminals. Power will be obtained from the White Salmon river. The power site selected is near the town of White Salmon, and it is estimated to furnish 10,000 hp. The capital stock of the company will be $500,000, and it is said most of it has already been subscribed. A bond issue of $1,000,000 will be made with the intention of beginning actual construction this spring. The officers of the company are: Rudolph Lauterbach, president; R. Weires, vice president; Herbert L. Simpson, treasurer; and T. F. Shepler, secretary, all White Salmon property owners. In addition to theabove, the board of directors is composed of J. S. Merrill of Wall street, New York; W. W. Swan, a lumber man of White Salmon; A. H. Jewett of White Salmon; C. L. Colburn, manager of a private bank at White Salmon; R. Field, a real estate dealer of White Salmon; and H. O. Coughlan of Jersey City, N. J.

According to reports from Husum, Wash., the high line preliminary survey of the big Klickitat Canal has been finished and final survey will be made in the spring. The company has established a reservoir site at Bear Springs. The directors of the Klickitat Irri-

gation & Power Co., are L. K. Moore, W. H. Phillips, Ira W. Carter, T. J. Stockdale and E. D. Mineah.

Further information is available regarding the improvements of the Oregon & Washington R. R., in Tacoma, Wash., mentioned in our last issue. The terminal plans are far more extensive than at first supposed and will include the dredging of the Middle waterway to a width of 300 feet and a low tide depth of 22 feet, all costing $250,000; building a passenger depot, costing $300,000; car shops at South Tacoma, costing $200,000; general freight yards, including a gravity yard at South Tacoma, costing $200,000; city freight yards at the foot of Fifteenth street, costing $200,000; steel viaduct from the eastern portal of the tunnel across the business district and the tide flats to the city waterway, costing $2,000,000; warehouses and ocean docks and track connections, costing $250,000; tunnel, costing $2,500,000. All told the road will spend $6,000,000 in terminals, and the terminal property bought by the system amounts to another $6,000,000. J. D. Farrell, Seattle, Wash., is general manager.

Surveyors of the Oregon Railroad & Navigation Co., operating in the vicinity of Wilcox and LaCrosse have been called in, and also those of the Spokane-Indland Electric Ry. Co., and it is reported that the two interests who have been contesting for the 50 miles of right of way down the Union Flat will compromise the route in Whitman County. It is reported in the vicinity the Chicago, Milwaukee & Puget Sound R. R. Co., which is running lines from Palouse, the present terminus of the Bovill-Palouse logging road, down Four-Mile Flat to strike the Union Flat survey southeast of Colfax, will get the right of way.

The Spokane Traction Co. of Spokane, has applied for several franchises in the city for extensions of its system. One franchise is for the extension of the Union Park line east on 5th Ave. to the new city limits, an extension of a mile or more and calling for the double tracking of the line already laid on 3rd Ave. east of Sherman St.

Wisconsin Notes.

FROM CORRESPONDENTS AND OTHER SOURCES.

The Two Rivers Dredge Co., of Two Rivers, Wis., has about completed its big dredging contract at Sault Ste. Marie, on which it has been working for the past three years.

Recent purchases of land in the so-called Belt line district east of the Great Northern ore docks at Alloney has given rise to reports here in Superior that the Minneapolis, St. Paul & Sault Ste. Marie Ry., Thos. Green, Chief Engineer, Minneapolis, Minn., was to construct ore docks and yards at Allouez.

The Wisconsin & Michigan R. R., one of the John R. Walsh properties, was sold at Menominee, Mich., on Jan. 26, for taxes by order of the Auditor General of the State of Michigan. The road was bid in by John Marsch, 181 La Salle St., Chicago, Ill., the contractor who built the road. The price paid was $67,990.08, the amount of the unpaid taxes, with interest to date. Mr. Marsch now owns part of the road from Quinnebec to Iron Mountain, which he built, but was never paid for. It is understood that he purchased the line to protect his interests.

City Council of Milwaukee, Wis., has granted the Milwaukee Electric Ry. & Light Co., a franchise to cross the 16th St. viaduct and to operate on several streets in the city. John I. Beggs, President of the company, has contributed $45,000 for the improvement of the bridge.

Commercial clubs of Washburn and other towns in northern Wisconsin and Minnesota are taking steps to induce the Northern Pacific Ry. Co. to construct a branch line from Grantsburg to a point in Bayfield County connecting with the line and giving direct route from Twin Cities to Lake Superior.

Barnett & Record, contractors, Minneapolis, Minn., have a crew at work driving piles for the Berwind Fuel Co.'s dock extension at St. Louis Bay, Superior. The cribs which have been built at Duluth this winter are completed and will be moved across the bay and sunk as soon as navigation will permit their moving. It is expected that the ice will be gone about the middle of April and work started on the sinking of the crib. A 600 ft. extension is to be added to the dock which will add a three-quarter million capacity. The dock is now 1,200 ft. long.

The Soo is reported to be negotiating for the purchase of the Abbotsford & Northeastern R. R., which extends from Abbotsford and Athens and thence north several miles into timber land. It is reported that the new owners will extend the line to Merrill, and possibly to Antigo. Wm. L. Erbach, Athens, Wis., is Vice President of the A. & N. E. R. R.

Canadian Notes.

FROM CORRESPONDENTS AND OTHER SOURCES.

The Canadian Pacific Ry. has made an appropriation providing for the construction this year of 50 miles of the Kootenay Central Ry.

J. A. MacCullough, who is promoting a scheme for building an electric railway line between Calgary and Chester lake, a sheet of water distant about eight miles to the east of the city, has asked the city commissioners of Calgary, Alberta, for permission for the company to run its cars over the city railway system into the city along 8th and 9th Avenues to the Alberta hotel corner.

The House of Commons railway committee has reported bills respecting the Esquimalt & Nanaimo Ry., Edmonton, Dunnegan & British Columbia Ry. and the Kettle River Valley Ry. Cos. The first two bills ask for an extension of time for construction. The third bill authorizes the construction of a line from Coldwater, near Ruby Creek.

Construction work is to be started shortly on the 18-mile section of the Victoria, Vancouver & Eastern R. R. (Great Northern R. R.) recently awarded to J. W. Stewart as noted in our issue of Jan. 19. Mr. Stewart is a member of Foley, Welch & Stewart, Grand Trunk Pacific Ry. contractors. The contract for the 50-mile section of the V. V. & E. R. R. between Abbotsford and Hope was let to P. Welch of the above firm. Mr. Welch will have general supervision of the construction work both west of Princeton and west of the Hope mountains between Hope and Abbotsford.

Work is reported to be progressing rapidly on the British Columbia Electric Company's line from New Westminster to Chilliwack, B. C. Grading has been completed from New Westminster to Sumas, Wash., and steel laid to a point eight miles west of Abbotsford. On the Chilliwack end 13 miles of track has been laid bringing the line within 12 miles of Sumas.

Mexico Notes.

FROM CORRESPONDENTS AND OTHER SOURCES.

Contracts on constructing the first section of the new railroad which is ultimately to extend from Monclova, Coahuila, to Chihuahua, Chih, a distance of 550 kilometers, is reported to have been let to Captain Scott of Coahuila. Construction work will be commenced out of Monclova at once as the concession has already been granted to Miguel Cardenas of Coahuila. The states of Coahuila and Chihuahua have both granted substantial subsidies, and it is also expected the government will vote a subsidy to aid the promotion of the line. It is estimated that the line will cost $25,000 per kilometer throughout the entire 550 kilometers. There are no difficult engineering problems to be encountered and the maximum grade will be three-fourths of one per cent. The line, for the greater part, will pass through a fertile valley.

A progress of about 83 ft. per day is being made in the construction of the tunnel in the City of Mexico for carrying water mains in several streets in that city. The following are the interior dimensions of the gallery or tunnel in which the pipes will be laid: 280 centimeters in width by 185 centimeters in height. The side walls are 6 in. thick, the floor is 10 in., and the roof 8 in., made of reinforced concrete. The main tube, which will carry the water, will be 4 ft. in diameter, and at the sides of the gallery will be compartments for electric light, power, telegraph and telephone line conduits. It is anticipated that the work of the gallery and the leveling of the streets will be completed by the end of April, another two months being required for the installation of the water piping. The work is in charge of Ing. Farando Arechavaleta, formerly for a long time in the service of the Central railroad, assisted by Ings. Manuel Jimenez Cincta, Emilo Subiaga, and Ioaquin Rivera. Some 800 men are at work, both in the streets and at the plant at San Lazaro, near the pumping station of the Grand Canal, where the concrete sections are being cast ready for placing in the tunnel. The sections are reinforced with lattice work of corrugated iron.

The Batopilas Mining Co., which has made a survey of the Batopilas River in the Batopilas district, state of Chihuahua, will erect a hydro-electric plant near Batopilas, for the purpose of providing power for operating its mines and reduction mill.

The Navidad Reduction & Mines Co. of San Francisco, Cal., which obtained a concession for the use of the water of the Ameca River, near San Sebastian, Jalisco, will soon be ready to start construction work.

The government of the state of Coahuila has granted a concession to the Kansas City, Mexico & Orient R. R. Co., to extend its proposed branch that is to run south from San Angelo, Tex., into Mexico. The route as described in the concession runs from Las Vacas, situated on the banks of the Rio Grande just opposite Del Rio, Tex., to Allende, where it will connect with the International division of the National Railways of Mexico. It is announced that final arrangements have been made by the company for the immediate construction of this branch from San Angelo to Allende. It is about 175 miles from San Angelo to Del Rio and another 75 miles from Del Rio to Allende. W. W. Colpitts, Kansas City, Mo., is chief engineer, Kansas City, Mexico & Orient Ry.

Gonzalez Trevino has begun the construction of a canal at Las Vacas that will be 26 miles long, with a storage dam, furnishing water to irrigate more than 30,000 acres of land. Las Vacas is on the Rio Grande river, just opposite Del Rio, Tex.

The Mayo River Power & Land Co. is planning to have construction work on the dams and hydro-electric plants upon the Mayo river in the states of Chihuahua and Sonora started soon after April 1. The first of these dams will be built near the line between the states of Chihuahua and Sonora, but in the latter state. Later two or more dams will be built across the river in the state of Chihuahua. Transmission lines will be built to all of the larger mining districts in that part of the country. W. O. Temple, Denver, Colo., is secretary.

The Compania Electrica e Irrigadora has over 2,000 laborers engaged in constructing its new canal near Pachuca, which is to afford power for its new hydro-electric plant to be erected at Tetepango. This canal will be about 25 miles long. It will be completed in about eight months. This company is furnishing power for a number of mines and mills in the Pachuca district. It is now operating two hydro-electric plants, each of 6,000 H. P.

The Mexican Northern Power Co., the Canadian concern which is arranging to erect hydro-electric plants in the state of Chihuahua, has obtained a new concession from the Mexican government, giving it authority to build two dams and hydro-electric plants upon the Conchas river. The site of one of these dams is at Boquilla, 17 miles above Santa Rosalia, and the other at La Joya. The construction of the dam at Boquilla is already in progress. The company is also building a railroad from Santa Rosalia to the site of the dam. This first dam will have a water supply sufficient to generate about 30,000 H. P. The plant at La Joya will have a capacity of about 40,000 H. P.

The Atlantic Coast Line R. R., E. B. Pleasants, chief engineer, Wilmington, N. C., has surveys underway for a branch line from Springhope to Raleigh, N. C., 30 miles.

BIDS ASKED.

Bids are asked on following work, the notes being arranged alphabetically by states:

Bridges.

Salinas, Cal.—Until 2 p. m., Feb. 8, by T. P. Joy, Clerk of the Board of Supervisors, for repairs to the Carmel bridge and the construction of small bridge near Carmel bridge in Carmel and San Road Districts.

Palatka, Fla.—Until 11 a. m., Feb. 12, by Board of Trustees, for the construction of a highway bridge across Etoniat Creek at Banana Mills. S. Worden is Clerk of the Board. R. S. Ensey is County Engineer.

Topeka, Kan.—Until Feb. 7, by C. B. Burg, City Clerk, for the construction of a bridge over the Shunganunga Creek on Fillmore St.

Topeka, Kan.—Until Mar. 7, by City Clerk, for the construction of an extension to the Melan bridge.

Fergus Falls, Minn.—Until Feb. 7, by City Clerk, for the construction of the proposed bridge on Mt. Faith Ave. The structure as planned will be 80 ft. in length with 20 ft. roadway.

Minden, Neb.—Until 2 p. m., Feb. 23, by J. H. Jensen, County Clerk, for the construction of all bridges of wood or steel to be built by Kearny County for the year of 1910.

Reading, Pa.—Until 10 a. m., Feb. 10, by A. L. Rhoads, County Controller, for the construction of a reinforced concrete arch bridge over the Wyomissing Creek in Cumru Township, Berks County, Pa., to be known as Ruth's Bridge.

Washington, Pa.—Until Feb. 23, by Board of County Commissioners, for the construction of a bridge over Ackley Creek. The structure will be 99 ft. in length connecting Rich Hill and West Finley Townships. J. H. Moffit, Washington, Pa., is County Surveyor.

Yankton, S. Dak.—Until 10 a. m., Feb. 3, by David M. Finnegan, County Auditor, for the construction of all bridges to be built by the County of Yankton, S. Dak., during the year of 1910.

Bristol, Tenn.—Until Feb. 8, by Street Committee, for the construction of a steel or concrete bridge over Beaver Creek. J. W. Mort is Chairman of the Committee.

Everett, Wash.—Until 10 a. m., Feb. 28, for the construction of a new draw span for the river bridge at Snohomish, Wash.

Tacoma, Wash.—Until 11 a. m., Feb. 14, by H. J. McGregor, Commissioner of Public Works, for the construction of a reinforced concrete bridge across Buckley Gulch between Oakes and Fife Sts. on the line of North 23d St.

Buildings.

Bids are asked on following work, the notes being arranged alphabetically by states:

Heber, Ark.—Until noon, Mar. 2, by Jail Commissioners, for the construction of a county jail for Cleburne County, Arkansas. W. C. Watkins is one of the commissioners.

Sacramento, Cal.—Until 3 p. m., Mar. 24, by James Knox Taylor, Supervising Architect, Treasury Department, Washington, D. C., for the construction, including plumbing, gas-piping, heating apparatus, electric conduits, and wiring and standard clock system, of and extension, remodeling, etc., to the United States Post Office and Court House at Sacramento, Cal.

Fort Logan, Colo.—Until 10 a. m., Feb. 21, by Capt. Chase Doster, Constructing Quartermaster, for the construction of a laundry building and the installation of plumbing, electric wiring, laundry machinery and equipment.

Washington, D. C.—Until noon, Feb. 3, by District Commissioners, for the construction of additions and making alterations to the Western High School, located at 35th St., between R. and Reservoir Sts., N. W.

Chicago, Ill.—Until 1:30 p. m., Feb. 7, by Board of County Commissioners, for fire escapes and alterations at the Cook County Hospital at Wood and Harrison Sts.

Frankfort, Ky.—Until 3 p. m., Mar. 14, by James Knox Taylor, Supervising Architect, Treasury Department, Washington, D. C., for the extension, remodeling, etc., including plumbing, gas piping, heating apparatus, electric conduits and wiring and standard clock system, of the United States Post Office and Court House at Frankfort, Ky.

Duluth, Minn.—Until 3 p. m., March 10, by James Knox Taylor, Supervising Architect, Treasury Department, for the painting and decorating of the United States Post Office, Court House and Custom House at Duluth, Minn.

New York, N. Y.—Until 3 p. m., Feb. 23, by James Knox Taylor, Supervising Architect, Treasury Department, Washington, D. C., for the installation of a double pneumatic tube service between the U. S. Custom House and the U. S. Appraisers' Warehouse, New York, N. Y.

Wards Island, N. Y.—Until 3 p. m., Feb. 16, by T. E. McGarr, Secretary of the State Commission in Lunacy, Albany, N. Y., for the construction of four cottages, including heating, plumbing and electric work at Manhattan State Hospital, Wards Island, N. Y.

Fort Wood, Bedloe's Island, N. Y. H.—Until 10:30, Feb. 26, by William W. Bessell, Constructing Quartermaster, for the construction of a cable store house at Fort Wood, N. Y. H.

Umatilla, Ore.—Until 2 p. m., Feb. 28, by Department of Interior at Office of Indian Affairs, Washington, D. C., for the construction, including materials, of one barn at the Umatilla School, Ore.

Danville, Va.—Until 3 p. m., March 16, by James Knox Taylor, Supervising Architect, Treasury Department, Washington, D. C., for the extension, remodeling, etc., including plumbing, gas piping, heating apparatus, electric conduits and wiring, of the U. S. Post Office and Court House at Danville, Va.

Richmond, Va.—Until noon, Feb. 7, by Charles M. Robinson, 10th and Main Sts., Richmond, Va., for the heating and ventilating for the church, parsonage and Sunday school room of the new church buildings at Monument Ave. and Lombardy Sts.

Montpelier, Vt.—Until noon, Feb. 7, by Sergeant at Arms, Montpelier Vt., for building, ventilating, plumbing and alterations of the toilet rooms of the State capitol. Charles H. Ferrin is Sergeant at Arms, Montpelier, Vt.

Roads and Streets.

Bids are asked on following work, the notes being arranged alphabetically by states:

Atlanta, Ga.—Until 3 p. m., Feb. 7, by City Clerk, J. P. Foste, for furnishing and setting granite curbing, furnishing material and laying concrete curbing, furnishing material and laying brick sidewalks, furnishing material and laying tile sidewalks, furnishing material and laying sheet cement sidewalks, for constructing such sewers as may be authorized by Council during the year 1910. R. M. Clayton is City Engineer.

Atlantic, Ia.—Until Feb. 14, by City Clerk, for the construction of brick and asphalt pavement estimated to cost $60,000. Charles P. Chase, Clinton, Ia., is Engineer.

Pekin, Ill.—Until 2 p. m., Feb. 3, by Board of Local Improvements, for the improvement of portions of Capitol, Elizabeth, St. Mary and Sabella Sts. The work includes the following approximate quantities: 15,000 sq. yds. of vitrified paving brick; 1,060 lin. ft.; 6,500 lin. ft. of removing, resetting stone curb; 1,000 lin. ft. concrete protection stone curb; 5,000 cu. yds. of excavation.

Peoria, Ill.—Until 2 p. m., Feb. 7, by Board of Local Improvements, George F. Simmons, President, for furnishing labor and material for the following: 860 cu. yds. of excavation of old asphalt pavement (cushion and surface coat) down to the present concrete; 207 cu. yds. of excavation of old foundation; 1,245 sq. yds. of new concrete to replace disintegrated concrete in the present foundation; 12,455 sq. yds. of binder course 1 in. thick; 12,455 sq. yds. of wearing course 1½ ins.; 14 barrels of natural cement swept in.

Marion, Ind.—Until 2 p. m., Feb. 17, by Board of County Commissioners, for the construction of a stone road on the line between Monroe and Jefferson townships, 12,292 ft. in length.

Mount Pleasant, Mich.—Until 8 p. m., Feb. 7, by H. H. Hunter, City Clerk, for grading and paving with brick on concrete foundation portions of Broadway and Main St.

Gibson, N. C.—Until Feb. 7, by County Road Commission for the construction of 2.6 miles of sand and clay roads. J. C. Mason is Chairman.

Toms River, N. J.—Until noon, Feb. 14, by Board of County Chosen Freeholders, for resurfacing with stone, a road in Township of Brick, known as the Western Section of Lakewood and Point Pleasant County Road, beginning at the intersection of the roads at Burrsville and extending westward toward Lakewood, a distance of 15,532 ft.

Tom's River, N. J.—Until noon, Feb. 14, by County Board of Chosen Freeholders, for resurfacing a gravel road in Township of Brick, known as the Eastern Section of Lakewood and Point Pleasant County Road from Westpoint Pleasant and extending westward to the intersection of the roads at Burrsville, a distance of 19,505 ft. James E. Otis is Director.

Albany, N. Y.—Until 1 p. m., Feb. 18, by State Highway Commissioners, for the improvement of the following highways:

County.	Road No.	Approx Length. Miles.
Dutchess	5009	1.50
Orange	5007	3.28
Suffolk	5008	1.56
Albany	5010	2.00
Cayuga	5012	2.75
Chenango	5013	4.13
Madison	5014	3.15
Onondaga	5016	3.09
Wayne	5017	3.00
Yates	5018	2.00
Erie	5019	1.89
Genesee	5020	3.46
Livingston	5021	3.98
Orleans	5025	2.46
Wyoming	5024	2.67
Broome	5022	3.00
Allegany	5023	2.67
Steuben	5026	3.56
Oneida	5034	1.5
Sullivan	5035	2.5

Albany, N. Y.—Until 1 p. m., Feb. 16, by State Highway Commissioners for the improvement of the following highways:

County.	Road No.	Approx. Length. Miles.
St. Lawrence	535	7.90
St. Lawrence	5023	5.00
Columbia	762	6.02
Columbia	5004	2.50
Clinton	776	7.26
Westchester	777	4.42
Westchester	780	2.91
Westchester	5003	3.44
Schenectady	789	5.75
Schenectady	5030	2.25
Greene	795	3.39
Greene	5031	2.00
Putnam	798	2.78
Putnam	5006	1.80
Warren	804	7.13
Franklin	820	6.52
Franklin	5032	3.00
Essex	821	5.58
Essex	5011	3.45
Essex	831	4.00

Albany, N. Y.—Until 1 p. m., Feb. 14, by State Highway Commissioners for the improvement of the following highways:

County.	Road No.	Approx. Length. Miles.
Seneca	323	3.86
Ulster	350	3.76
Ulster	5000	2.32
Ulster	5001	1.57
Montgomery	397	6.67
Montgomery	5028	3.73
Nassau	518	7.59
Saratoga	610	7.42
Saratoga	842	0.27
Jefferson	565	7.35
Jefferson	624	3.09
Jefferson	5003	4.84
Rensselaer	583	3.40
Rensselaer	631	2.25
Rensselaer	5029	2.00
Ontario	637	5.30
Ontario	5015	1.19
Ontario	638	1.02
Washington	724	3.98
Washington	5033	2.96
Rockland	728	2.82
Rockland	5002	1.61

New York, N. Y.—Until 11 a. m., Feb. 9, by Alfred E. Steers, President of the Borough of Brooklyn, for regulating, grading and paving various streets in Brooklyn, also for delivering binder stone, Portland cement, gravel, flagstone, pitch, sand, tar melting and gravel heating trucks, hardwood road oil, refined asphalt, etc.

Norfolk, Va.—Until noon, Feb. 15 (extension of date from Feb. 8), by Board of Control, for regulating and repaving with some smooth materials part of Granby and Chapel Sts. W. T. Brooke is City Engineer.

Sewers.

Bids are asked on following work, the notes being arranged alphabetically by states:

Perry, Fla.—Until noon, Feb. 8, by Board of Bond Trustees of the city, for the construction of a sanitary sewer system. The work will include 3 miles of 8-15 in. pipe, manholes, flush tanks, etc. John C. Calhoun is Secretary of the Board. Wm. W. Lyon, 205 Duval Bldg., Jacksonville, Fla., is Consulting Engineer.

St. Louis, Mo.—Until noon, Feb. 11, by Board of Public Improvements, for the construction of various sewers. W. B. Dryden is Clerk.

Washington, N. J.—Until noon, Feb. 14, by A. J. Craft, Borough Clerk, for the construction of 8 miles of vitrified pipe sewer 8-18 ins., with Y branches, flush tanks and sewage disposal works.

Hudson, N. Y.—Until 1 p. m., Feb. 12, by Charles H. Strong, President of the Board of Managers of the State Training School for Catskill Aqueduct at Mt. Vernon. contract beds for sewage disposal plant at the school. Franklin B. Ware, Albany, N. Y., is State Architect.

Youngstown, O.—Until noon, Feb. 4, by Director of Public Service, for furnishing necessary labor and material for the construction of sewers in Sycamore St. and Andrews Ave.

Charleston, S. C.—Until 11 a. m., Feb. 19, Bureau of Yards & Docks, Navy Department, Washington, D. C., for the construction of an intersecting drain at the navy yard, Charleston, S. C.

Houston, Tex.—Until noon, Feb. 7, by Dan. C. Smith, City Controller, for labor and material for the construction of sanitary sewers in the Fourth Ward. The work includes the following approximate quantities: 5,580 lin. ft. of 12-in. pipe, with necessary manholes, flush tanks, Y's, etc.

Salt Lake City, Utah.—Until Feb. 4, by Board of Public Works, for the construction of pipe sewers in sewer extensions Nos. 220, 249, 253 and 254. H. G. McMillan is Chairman of the Board and George O. Chaney is City Engineer.

Water Supply.

Bids are asked on following work, the notes being arranged alphabetically by states:

Milford, Ia.—Until Feb. 28, by City Clerk, for the construction of a water works, estimated to cost $11,000. Charles P. Chase, Clinton, Ia., is Engineer.

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CHAS. S. HILL
ERNEST McCULLOUGH } EDITORS
C. T. MURRAY
F. A. SMITH
MYRON C. CLARK . . . . . PUBLISHER
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CONTENTS.

EDITORIAL: Page
The Septic Tank, Its Place in Sewage Disposal Works 119
The Percentage System of Bidding on Contract Work 119
CONCRETE SECTION:
A Novel Method of Striking Steel Centers for 150-foot Concrete Arch Spans.....120
New Concrete Trunk Sewer at Cairo.....121
Some Records of Tests of Reinforced Concrete Girder Bridges of the Illinois Highway Commissions, Standard Type.....121
Methods of Constructing and Driving Combination Concrete and Timber Piles with Some Results of Tests.....122
Method of Making Water Tight by Grouting the Yonkers Pressure Tunnel of the Catskill Aqueduct 122
A Formula for Determining Crown Thickness of Arches.....124
ROADS AND STREETS SECTION:
Formulas for Sidewalk Construction Used by the Bureau of Sidewalks of Chicago, Illinois 125
Paving Along Street Railway Tracks.....125
Notes on the Construction of Macadam Pavements and a Table Showing the Amount of Stone Required.....126
Notes on State Highway Work in 1909.....126
WATER WORKS AND SEWERS SECTION:
Some Costs of the New Water Purification Works at Columbus, Ohio.....127
Design and Construction of the Improved Sewage Works at Columbus, Ohio, With Unit Costs 129
GENERAL SECTION:
Panama Canal Excavation for the Calender Year 1909 137
LETTERS TO THE EDITOR.....137
COMING TECHNICAL MEETINGS.....140
PERSONALS.....140
CATALOGS WORTH HAVING.....140

The Septic Tank—Its Place in Sewage Disposal Works.

At the Cairo meeting of the Illinois Society of Engineers and Surveyors, January 26-28, there was a discussion on sewage purification, during which it developed that there still exist strange ideas about septic tanks.

In some municipalities septic tanks have been built without means being provided for after treatment of the effluent, which is discharged raw into nearby water courses. The city engineers cannot induce their councilmen to provide filter beds or contact beds because when the septic tanks were built they were told that the tanks thoroughly purified the sewage.

As usual, the failure of the tanks to meet expectations leads the duped city officials to discredit engineers because engineers believe the septic tank a good thing. They refuse to acknowledge that the tank may be a good adjunct to a sewage disposal plant, but insist upon the engineer trying to make the tank do impossible things. It is one of the many cases in which scientific men are discredited by psuedo scientific promoters.

The septic tank merely lessens the production of sludge. The action is almost, if not quite, entirely anaerobic and aerobic treatment must be had on properly made filter or contact beds. A complete sewage disposal plant would properly consist of grit chambers to catch and hold suspended inorganic matter; a septic tank, in which organic matter may be broken up; and filter or contact beds on which the liquid from the septic tank may be rendered non-putrescible

Percentage Bidding on Public Works.

In our Letters to the Editor will be found a communication from the Secretary of the General Contractors' Association of New York city, commenting on an editorial in Engineering-Contracting, on the subject of percentage bidding. In a letter from the Aberthaw Construction Company some comments are also made on the same subject.

In reading the communications it seems plain that the contractor's objections are based principally upon the inability of engineers to state in advance the exact quantities. In building work it is hard to apply the percentage bidding system and to apply it to structures in which it is possible to compute quantities exactly if time enough is taken, is a case of overdoing a good thing. Such work can therefore be eliminated from the discussion.

In all public work where structures are buried much uncertainty must exist as to underground conditions. This uncertainty therefore, puts the engineer and contractor in the position of players in a game of chance. The engineer believing he possesses sufficient knowledge of conditions to prepare an estimate, prepares it and the contractor is given an opportunity to bid a certain per cent higher or lower than the engineer's estimate. Suppose the engineer believes a certain piece of work contains 100,000 yards of rock and this is estimated at $250,000. If the contractor believes it contains 200,000 yards and makes his bid 100 per cent higher than the estimate of the engineer, some attention will certainly be attracted to that item. In all likelihood all bids will be rejected and further examinations ordered by the council. Under an itemized system the engineer might make an estimate "Rock, est. 100,000 cu. yds. at $2.50 = $250,000." He might estimate on another item: "Earth, est. 300,000 cu. yds. at 75 cts. = $225,000." The contractor believing there will be much more rock and less earth bids $2.25 per cubic yard for rock and 80 cts. for earth. Based on the estimated quantities the city will have the work done below the estimated cost. The engineer is patted on the back because his unit costs were so close to those of the contractor, and everyone is satisfied.

When the work is completed the payments to the contractor read as follows: "Rock, 300,000 cu. yds. at $2.25 = $675,000;" "Earth, 100,000 cu. yds. at 80 cts. = $80,000." In this instance the engineer may have a very good idea of unit costs but a vague idea as to quantities. His total estimate for the work was $475,000, and the actual cost was $755,000. His ignorance of quantities cost his employers just $280,000, besides leaving a suspicion in the mind of the public that he stood in with the contractor. He is believed to be incompetent and doubt is thrown on his honesty. In the amounts involved the example may be extreme. As an instance, however, of how the percentage system might guard the people and put the contractor on the defensive, it is not overdrawn. Suppose the contractor had made his unit bid on earth only 50 cts., and on rock $1.75 per. cu. yd. His total payments on the final estimates would have been $525,000, or $50,000 in excess of the estimates of the engineer. The Council might have stood for a 12 to 15 per cent increase above the figures of the engineer, while the contractor would hope that the final estimates would show such an arrangement of quantities that no loss would be encountered by him.

The contractors object to the quantities estimated upon by the engineers as a basis for the engineer's estimate. This has always been something engineers have been unable to control. Public officials are notoriously averse to spending money on test pits and bore holes for testing. It has proven in many cases costly economy. Recently in Chicago the lack of the few dollars necessary to make proper investigations led to the payment of nearly $46,000 in extras; since claimed to have been unlawfully paid and which has led to the ruining of several reputations, the indictment of prominent men by the Grand Jury and the casting of a dark cloud of suspicion over every employe in the public works departments.

Since the general argument of the contractors seems to be directed against the engineer's lack of knowledge of underground conditions, have we not here a basis on which agreement may be reached and discussion ended? The obvious thing to do is for the engineers to make at least as careful borings and examinations as the contractors would make. Upon the result of this preliminary study base estimates and call them 100 per cent estimates. Contractors then who have different ideas on the subject of quantities, or who accept the quantities and differ on unit costs, may then bid a per cent above or below the engineer. No one will pretend that examinations, no matter how careful, will reveal exact conditions, so the percentage system might be held to even when apparently exact knowledge might be an argument for a return to unit bids. When a number of bids are read before a body of public officials who have little, or no real knowledge of the subject, the percentage bids are intelligible to them where unit bids would be wearisome

Plenty of good arguments may be presented for and against present methods of bidding. The letter referred to has not exhausted the case for the contractors and these editorial remarks are to be taken as intended to assist both sides to arrive at a mutual understanding.

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Concrete and Reinforced Concrete Section

Note: This section is devoted to methods and cost of constructing concrete and reinforced concrete structures. It will cover the selection, testing and proportioning of concrete materials; laboratory tests of concrete; concrete mixing, transportation and placing; fabrication and placing of reinforcement, and form construction and erection. It will also contain articles on new and interesting developments in the design of reinforced concrete.

A Novel Method of Striking Steel Centers for 150 ft. Concrete Arch Spans.

Steel arch centers having a wholly unique arrangement for lowering them away from the concrete arch ring are being used in constructing the Delaware River bridge for the new Slateford-Hopatcong cut-off for the Delaware, Lackawanna & Western Ry. This bridge consists of seven skew arch main spans, two end spans of 120 ft. and five intermediate spans of 150 ft. It carries a double track railway line, is 1,452 ft. long, 25 ft. wide between parapets, and contains 51,000 cu. yds. of concrete. The arches are solid ring arches supporting spandrel arches, which carry the roadway platform. The centers referred to are those for the 150-ft. spans; the 120-ft. spans and two 33-ft. approach arches were built on timber centers.

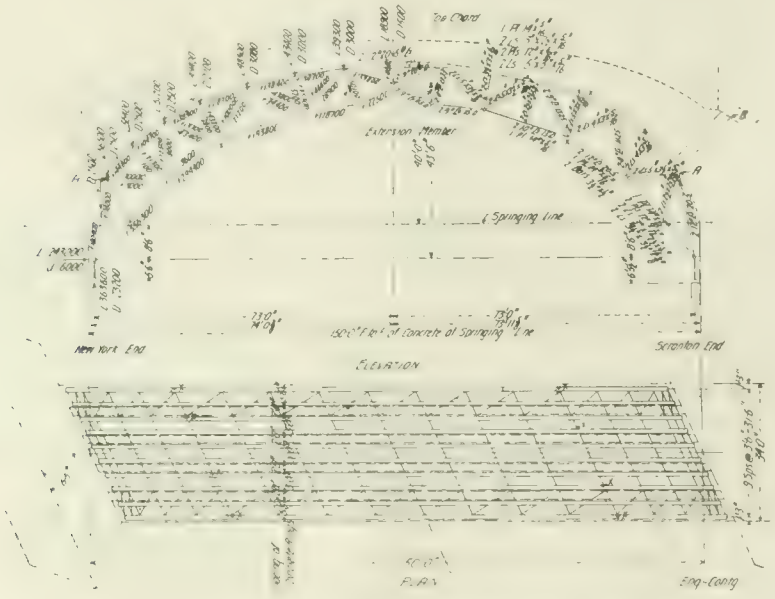


Fig. 1—Elevation and Plan of Steel Center for 150 Foot Arch.

Two sets of steel centers were built, each for a complete arch ring, and they are to be shifted from span to span. Each center (Fig. 1) consists of 10 parallel arch ribs connected by lateral bracing to form a rigid framework on which is laid the lagging forming the soffit of the arch. Each rib is a three-hinged arch, carried at its ends on reaction columns and having a peculiar arrangement of members about the crown hinge, as will be described later. The make up of the arch ribs is shown by Fig. 1. In designing the ribs concrete was assumed to weigh 150 lbs. per cu. ft., and the load at each panel point was considered to be the weight of the concrete vertically above. No allowance was made for initial arch action due to the setting of the concrete. The matter of the temperature stresses due to any rise in temperature after the arch concrete had taken its initial set was considered as follows: It was calculated that the steel would rise in temperature almost as fast as the surrounding air, while the larger mass of concrete would heat up very slowly. The result would be that the steel would expand and try to push up the concrete arch ring at the center and this up-thrust would be resisted by the initial set of the concrete, thus inducing stresses in the steel. The probable stresses so obtained were computed but are not shown on the drawing; the highest fell safely within the elastic limit of the steel and for this kind of stresses the elastic limit was taken as the limiting safe stress. The justification for this was found in the temporary nature of the construction and in the improbability of maximum temperature stresses being developed. For the stresses due to loads proper the safe stresses were taken at 16,000 per sq. in. in tension and 17,000 per sq. in. in compression. The computed deflections were as follows:

	Inches.
Live load (concrete) 150 lbs. per cu. ft.	1 11/32
Dead load, (steel, lugging, etc.)	3/32
Temperature change of 40° F.	17/32

It is stated that observation of the centers so far erected confirms these computed deflections very closely.

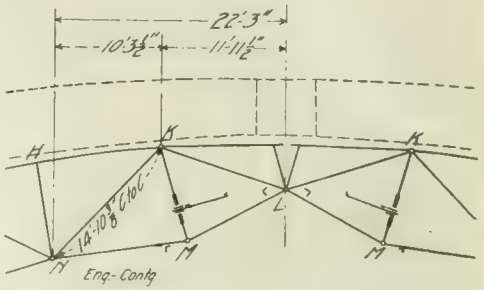


Fig. 3—Diagram Showing Arrangement of Extension Members at Crown.

Returning now to the construction of the centers, Fig. 2 shows the details of the end supports. In molding the piers a projecting step was left at ground level the full length of the pier. On this step was placed a grillage of 4 I beams and on this rested a post or column, into the top of which the end hinge of the arch rib connected as shown. Just back of this hinge connection for each rib there was molded in the concrete face of the pier a cerbel and between this cerbel and the post is inserted a wooden block to take the horizontal component of the thrust. The loads on the centers, as will be seen, are taken directly by the completed bridge piers.

The construction at the crown of the center is more intricate, it being the means by which the center is struck when the arch is completed. Figures 3, 4 and 5 illustrate the construction. Referring to Fig. 3 it will be seen that the first web member on each side of the center hinge is so built that it can be length-

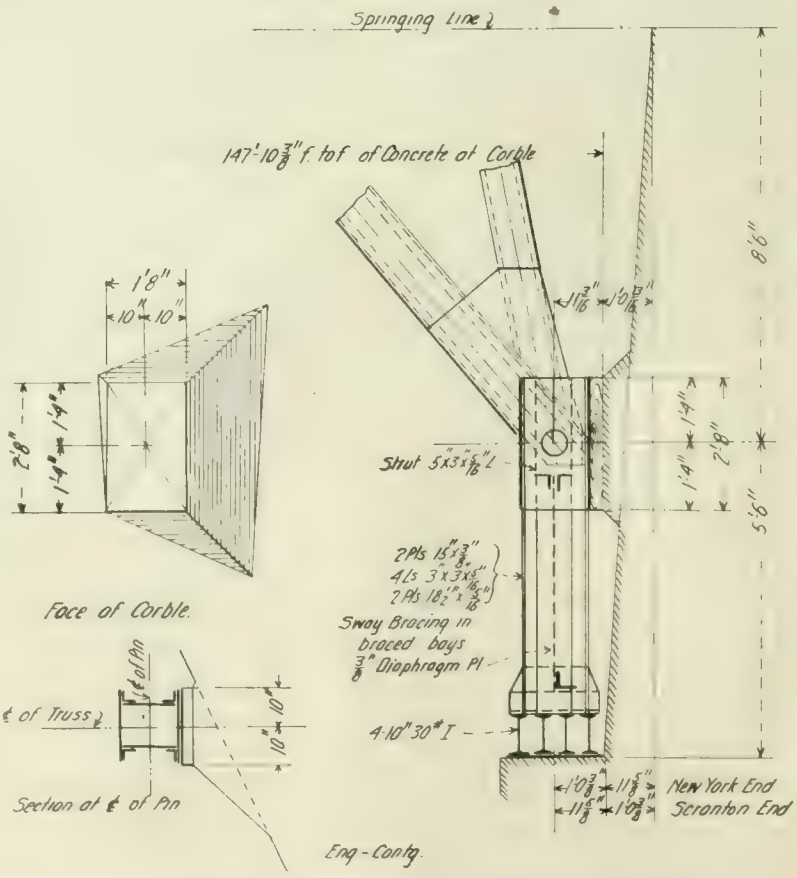


Fig. 2—Details of Support of Ends of Centers at Piers.

ened or shortened. It consists of a built up column, Fig. 4, carrying at its middle a double ended screw, Fig. 5. The connections of the member with the top and bottom chord members is a pin connection, as are also the connections of the next succeeding lower

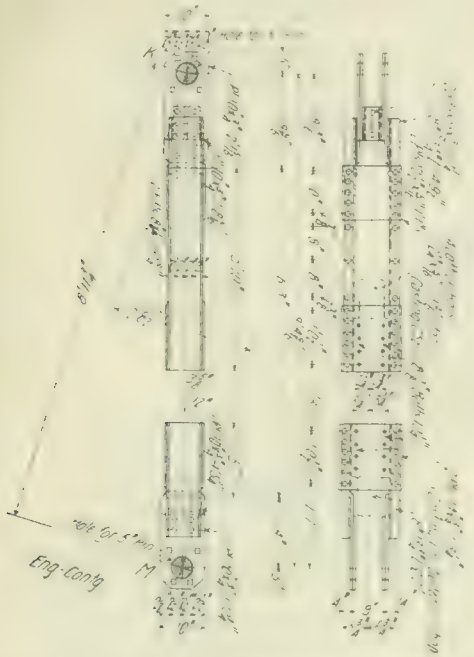


Fig. 4—Details of Extension Members at Crown.

chord panel points toward the end of the arch and, of course, the crown hinge. In effect there is formed a double toggle joint, operated by two levers, in each rib. Details of the operating lever are shown by Fig. 6. By lengthening or shortening the adjustable member the crown pin drops or rises.

In operation the arch ribs are erected and brought to uniform and exact elevation by the toggles. The lateral bracing and lagging are then placed and the arch built. To strike the centers the crown is dropped by simultaneously manipulating all the toggles. In the three arches so far constructed no difficulty whatever was experienced in slacking off the centers. The contractors state: "All ten ribs were slacked off simultaneously, thus obtaining no jar or unequal settlement, but a uniform receipt of the load by every portion of the concrete arch."

The arches so far built have been concreted, working from the skewbacks toward the crown simultaneously on both sides and for the full width of the arch, leaving a key space at the crown to be filled about a week later. The centers have been removed in 30 days.

The centers as described were designed and built by the McClintic-Marshall Construction Co., Pittsburg, Pa., to which we are indebted for information. The general contractors for the bridge are Smith & McCormick, of Easton, Pa.

Surveys are being made at Athens, Ga., for a new trolley line in that city.

New Concrete Trunk Sewer at Cario, Ill.*

The system of sewers consists of a main trunk sewer lying lengthwise with the city and 35 miles of vitrified pipe laterals. The main sewer is 9,700 ft. in length, varying in diameter from 4 to 6 ft., circular in section, and constructed of concrete of the proportions of 1 part cement, 2 parts sand and 4 parts limestone. This sewer was constructed in open cut with the exception of 100 ft. through the Ohio levee, which was tunneled. The interesting features of the sewer are a reduced submerged out-fall, a 72-in. automatic flap valve to protect against a back flow of river water and the difficulties encountered during construction, which were largely due to quicksand in the trench. So bad was this that in certain portions of the work the ordinary methods of plank sheathing had to be supplanted with steel piling and it was with difficulty that no buildings were damaged apparently along the building line 30 ft. away. The method of construction was as follows: The bottom of the trench was excavated and shaped to the required sub-grade and a layer of concrete was placed across the trench, the top of which was the flow line of the sewer; this course of concrete was allowed to set for 24 hours, then the forms for constructing the lower half set upon it. These forms were then filled and also allowed to set for 24 hours, after which the forms were pulled ahead and the arch forms set. After the arch had been turned and allowed to set for 24 hours these forms were pulled ahead for the same operation. Blaw steel centers were used and a Potter trench machine, the excavation and digging being done by hand. The best day's record for one gang was 74 ft. of 5½-ft. sewer.

The construction of this main sewer has

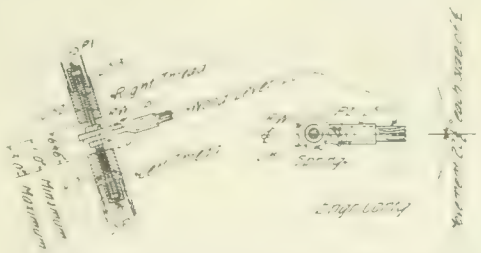


Fig. 5—General Arrangement of Extension Screw in Crown Members.

taken two and one-half years, 40 per cent of which time has been lost to work on account of the stage of water in the river. The various prices paid for the different sizes of concrete sewer were as follows:

6-ft. diameter, 9-in. shell, steel reinforced, $32 per foot.

6-ft. diameter, 9-in. shell, not reinforced, $12 per foot.

5½-ft. diameter, 8½-in. shell, not reinforced, $8.40 per foot.

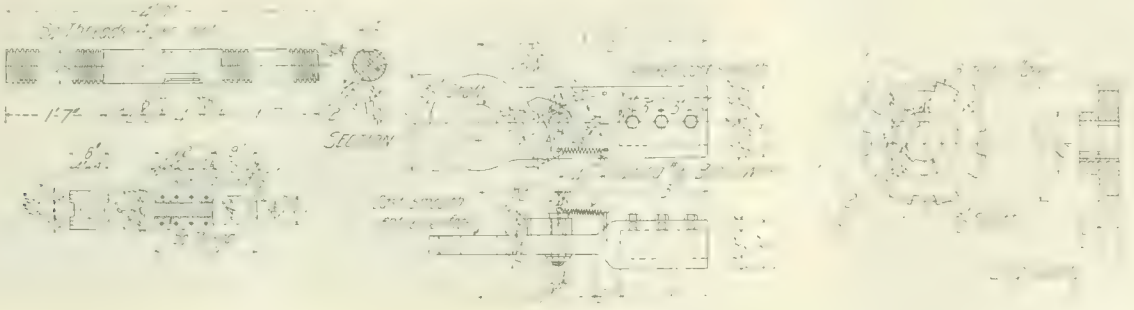


Fig. 6—Details of Extension Screw.

4½-ft. diameter, 7½-in. shell, $6.50 per foot.

4-ft. diameter, 7-in. shell, $5 to $6.50 per foot.

The total cost of the sewer was $108,813.

*Extract from a paper by W. B. Thistlewood, city engineer, Cairo, Ill., read at the annual convention of the Illinois Society of Engineers and Surveyors.

Some Records of Tests of Reinforced Concrete Girder Bridges of the Illinois Highway Commission's Standard Type.

The standard highway bridge of reinforced concrete girder type adopted by the Illinois Highway Commission was described in our issue of Feb. 2, in a paper by Mr. A. N. Johnson, state highway engineer. In the discussion following this paper Mr. Johnson gave an interesting account of tests made on a bridge constructed for the purpose. Everything was arranged in the most approved style for observing deflections and ascertaining the exact location of the neutral axis. When the bridge was loaded so the steel in the bottom of the girders was stressed to a point that would develop cracks in the bottom of the slab, no cracks appeared. The instru-

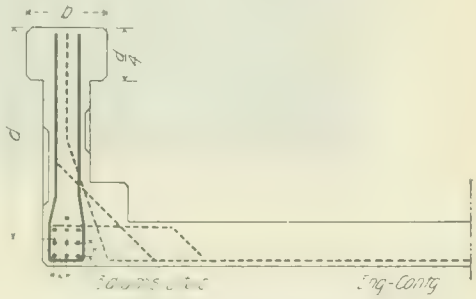


Fig. 1—Half Transverse Section of Standard Girder Highway Bridge, Illinois Highway Commission.

ments used indicated a position of the neutral axis far different from that used in the calculations. Mr. Johnson stated that the neutral axis was practically at the place it would be in a U beam of homogeneous material having the dimensions of the bridge. The factor of safety was therefore greater than had been assumed. The bridge when tested was over one year old.

This seems to confirm experiments of other men in testing slabs and beams. In studying a number of tests the writer has found that for concrete not over 60 days old a ratio of deformation between concrete and steel equal to 15 is best to use. On the four-month tests a ratio of 10 seemed to fit the case and at nine months 8 seemed to be about right, with a value near 6 for concrete 14 months old. Physical tests were made of the steel on test pieces cut from each end of the bars before making the slabs, so from the known strength of the steel the strength of the concrete was obtained after testing to destruction, and this was compared with crushing tests on pieces of concrete. Whether it would be wise to design these trough shaped highway bridges as U beams cannot be settled by these tests. It is likely the old concrete was pretty strong and the position of the neutral axis merely happened to be that of a beam with a ratio of deformation due to the age of the concrete. It is comforting to know that a bridge designed to carry certain loads after 30 days grows stronger as time goes on and is practically free from maintenance cost.

Methods of Constructing and Driving Combination Concrete and Timber Piles with Som e Results of Tests.

Piles made by rolling a timber pile in a blanket of concrete and steel mesh have recently been employed in a number of marine pile structures in waters infested by teredo and other marine borers. From information furnished us by the contractors for these piles we give the following description of the methods of constructing and driving them and also some results of tests made at the Watertown Arsenal to determine their strength.

Fig. 1—View Showing Concrete Covered Wooden Pile Being Rolled.

The plant required consists of a plank platform on which the rolling is done and a few carpenters' and plasterers' tools, besides the concrete mixing plant and such plant as may be necessary to handle the timber pile and the finished piles. The timber pile is placed along one edge of the platform and in front of it is spread the steel mesh. One edge of this mesh is nailed to the pile core and the other edge is anchored to cleats, as indicated by Fig. 1. The mesh used may be of any form, and it may be arranged to wrap the timber pile its full length or for any portion of its length, as also indicated by Fig. 1. With the timber pile and mesh in place, the next step is to cover the wire mesh with a thin blanket of concrete. The core is then rolled over the concrete and mesh blanket until two complete turns of the concrete and mesh are taken around the core. The outer edge of the mesh is then spiked to the core and the blanket is wound with two or three turns of wire. The final task is to cover the concrete and mesh envelope with a ⅛ to ¼-in. coat of cement mortar plaster. The pile is then rolled to one side to harden, being kept properly wetted during the process.

Turning to the illustrations, Fig. 2 shows the pile when the rolling is completed and the outer edge of the mesh is about to be brought up around it and fastened. In rolling the pile the free ends of the core are "held back" by ropes as the core is rolled forward, so that the concrete and mesh blanket is wrapped tight and close. This is shown by Fig. 2. In Fig. 1 the pile is completed and rolled forward out of the way and the mesh is stretched ready for rolling another pile. In some cases the mesh reinforcement is strengthened by steel rods, which are laid across the mesh parallel to the core and spaced so that they come at uniform intervals around the core when the wrapping is completed. In Fig. 1 the manner of beveling down the ends of the concrete covering to meet the core is clearly shown.

Regarding the cost of these piles, the makers state that until they have more data they cannot make definite statements, but say that "it will cost not less than $1 a foot, but how much less we cannot say."

The piles are driven like ordinary timber piles and it is stated that they have been driven until the wooden end was shattered without material injury to the concrete covering.

The following are results of tests made at the Watertown Arsenal. Two poles were tested as columns. The ends were cut off square through the concrete envelope and faced with plaster of Paris to secure even bearing in the testing machine. The dimensions of the tested piles and the crushing load at which they failed were as follows:

	Length.		Dimensions at small end. Max. diam.	Min. diam.	Sectional area at smaller end.		Ultimate strength. Lbs. per
	Ft.	Ins.	Ins.	Ins.	Conc.	Core.	sq. in.
1st Pile....	19	10.45	15	15 5-16	184.09	348,200	1,891
2nd Pile...	19	7.70	14.65	14	153.94	480,000	3,118

The first pile failed at the bottom end, opening oblique and longitudinal cracks in the concrete casing about 21 ins. up from the bottom end of pile. The second pile failed about 7½ ft. from the bottom end, opening oblique and longitudinal cracks in the concrete casing; also crushed fibers of wooden core at two 1-in. spikes.

The second test was made to determine the force necessary to push the core out of the concrete casing or to test the bond between the core and the casing. A 5-ft. section cut from the upper end of the first pile tested as a column was used and arranged as shown by Fig. 3.

Under a load of 145,000 lbs. applied to the wooden core, the bond between the core and concrete was disturbed, the core being forced along toward the larger end of the pile. The resistance increased to 159,000 lbs. when the core had been moved a distance of about 1½ ins. The core was pushed a distance of 8 ins. through the concrete sleeve, and test then discontinued. After the test the concrete was removed and sixteen ⅜-in. spikes were found driven into core to connect the wrapper.

Fig. 2—View Showing Completed Concrete Covered Wooden Pile.

This combination pile, as already stated, has been used in a number of works. In one job at Port au Prince, Hayti, 1,000 are being used for a pier nearly half a mile long. The deck of this pier will be concrete. The manufacture of this pile is controlled by the Robbins-Ripley Co., engineer and contractor, New York city.

Method of Making Watertight by Grouting the Yonkers Pressure Tunnel (Siphon) of the Catskill Aqueduct.

A number of pressure tunnels or siphons form parts of the Catskill Aqueduct for the new water supply of New York city. These siphons are at points in the line where topographical conditions require the conduit to be dropped far below the hydraulic gradient and they are therefore subjected to hydrostatic pressure of considerable intensity. Owing to this last condition particular attention has been devoted to means for securing water tightness and as the type of structure adopted for all heads exceeding 50 ft. is concrete lined tunnel in rock, the problem has been specifically to devise means for making concrete tunnel lining impervious. Broadly speaking, the means decided upon is grouting and the methods of doing this work have been worked out in considerable detail. They are described below for the Yonkers siphon.

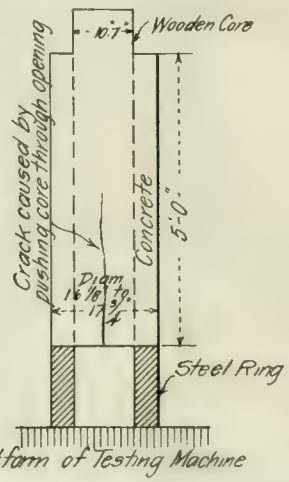


Fig. 3—Arrangement for Test of Bond of Concrete and Wood.

The Yonkers pressure tunnel connects at its north end with three steel pipe lines, which also form a part of the complete siphon, and at its south end it terminates in a vertical uptake shaft. This description refers to the pressure tunnel alone. This tunnel has an internal diameter of 16 ft. 7 ins., is circular in section and is concrete lined tunnel through rock. The total length between connections is 12,390 ft., of which about 11,800 ft. are full section tunnel and the remainder is bell mouth and special section to connect with the triple steel pipe line. The uptake shaft is 128 ft. deep. The grade of the tunnel is alternately level and 1 per cent. Several alternative sections of lining are permissible, depending on the nature of the rock and on other consid-

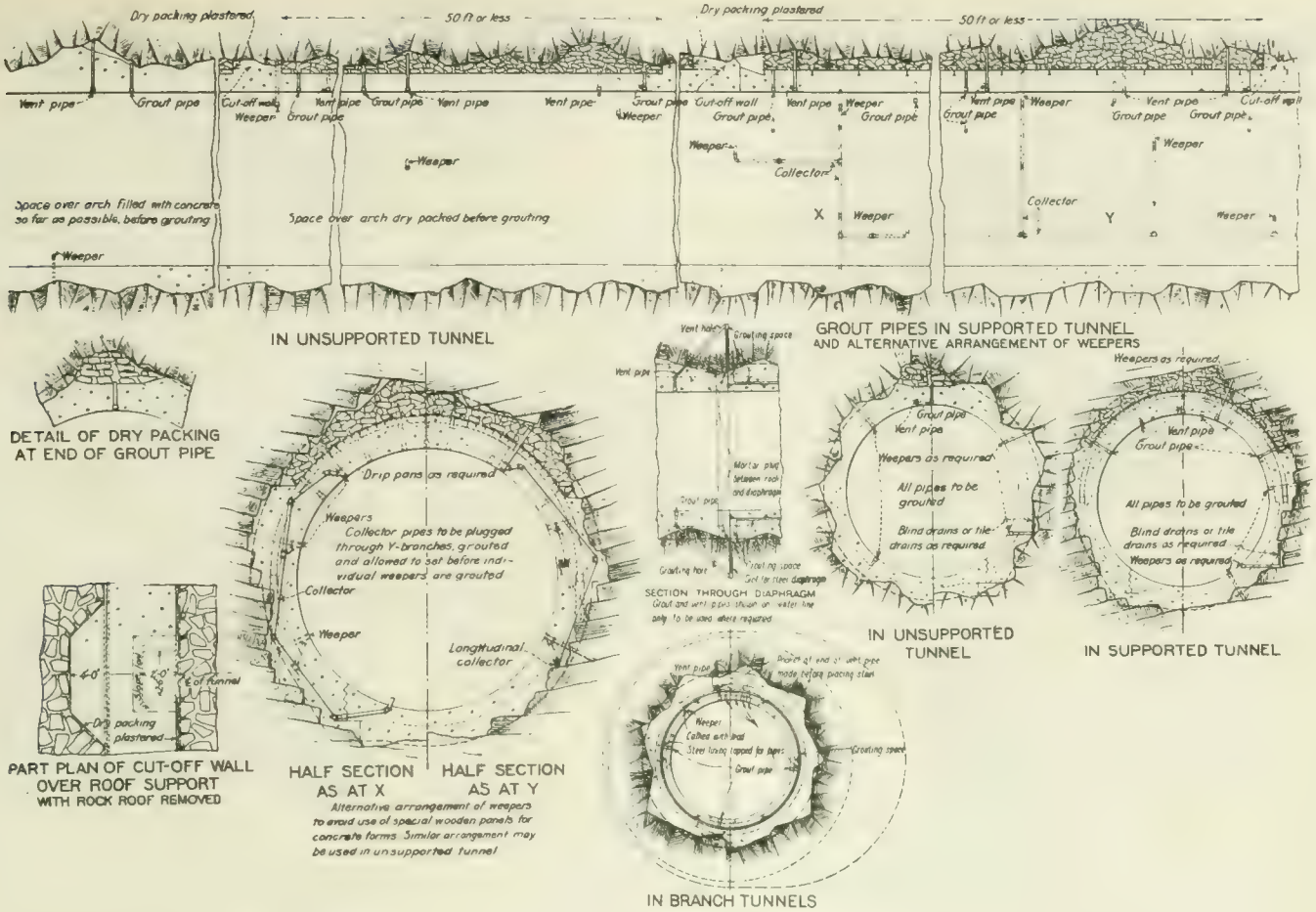

Dry packing plastered
50 ft or less
Vent pipe
Grout pipe
Cut-off wall
Weeper
Space over arch filled with concrete so far as possible, before grouting
Space over arch dry packed before grouting
Collector
IN UNSUPPORTED TUNNEL
GROUT PIPES IN SUPPORTED TUNNEL AND ALTERNATIVE ARRANGEMENT OF WEEPERS
DETAIL OF DRY PACKING AT END OF GROUT PIPE
Drip pans as required
Collector pipes to be plugged through Y-branches, grouted and allowed to set before individual weepers are grouted
Longitudinal collector
SECTION THROUGH DIAPHRAGM
Weepers as required
All pipes to be grouted
Blind drains or tile drains as required
IN UNSUPPORTED TUNNEL
IN SUPPORTED TUNNEL
PART PLAN OF CUT-OFF WALL OVER ROOF SUPPORT WITH ROCK ROOF REMOVED
HALF SECTION AS AT X
HALF SECTION AS AT Y
Alternative arrangement of weepers to avoid use of special wooden panels for concrete forms. Similar arrangement may be used in unsupported tunnel
IN BRANCH TUNNELS

Fig. 1—Sections of Aqueduct Tunnel Showing Arrangement of Pipes for Grouting.

erations, but general idea of the construction is given by the drawings of Fig. 1.

Grouting will be done to fill all voids in dry packing or elsewhere over the tunnel arch, to close cracks, seams and fissures in the adjacent rock, and to increase the imperviousness of the concrete proper of the lining. To permit this thorough filling grouting pipes, vent pipes, pipes for weepers and collectors were designed to be built into the concrete lining. Typical arrangements of pipes are shown by Fig. 1. All this piping is entirely within the lining, the ends terminating ½ in. inside the surface and being fitted with plugs to prevent the concrete from covering them.

Referring to Fig. 1, it will be seen that the tunnel is divided into sections for grouting. Each section is limited to 50 ft. in length and may be shorter if deemed necessary, but no longer, the purpose being not to demand a travel exceeding 25 ft. for the grout. This division into sections refers only to construction where dry packing is used outside the concrete ring. Where concrete backing is employed the grouting consists of filling individual cavities as indicated at the left end of the longitudinal section in Fig. 1. The grouting sections as shown by the drawings are formed by thickening the concrete lining at intervals to form cut-off walls extending close against the walls of the excavation. Each section is independent and an independent piping system is employed for each. Other details of construction are best studied on the drawings. Explanation may be made, however, that the branch tunnel details shown refer to the three tunnels into which the main tunnel is divided to connect with the triple steel pipe portion of the siphon. The steel diaphragms shown are water stops.

The grouting will be done by special apparatus designed by the aqueduct engineers. This apparatus comprises air compressors, grouting machines and so called grouting pads.

The compressors called for are light portable machines, the specifications limiting their weight to 550 lbs. They will be operated by compressed air at pressures supplied to the drills and will be capable of taking suction from this low pressure air and of raising it to 300

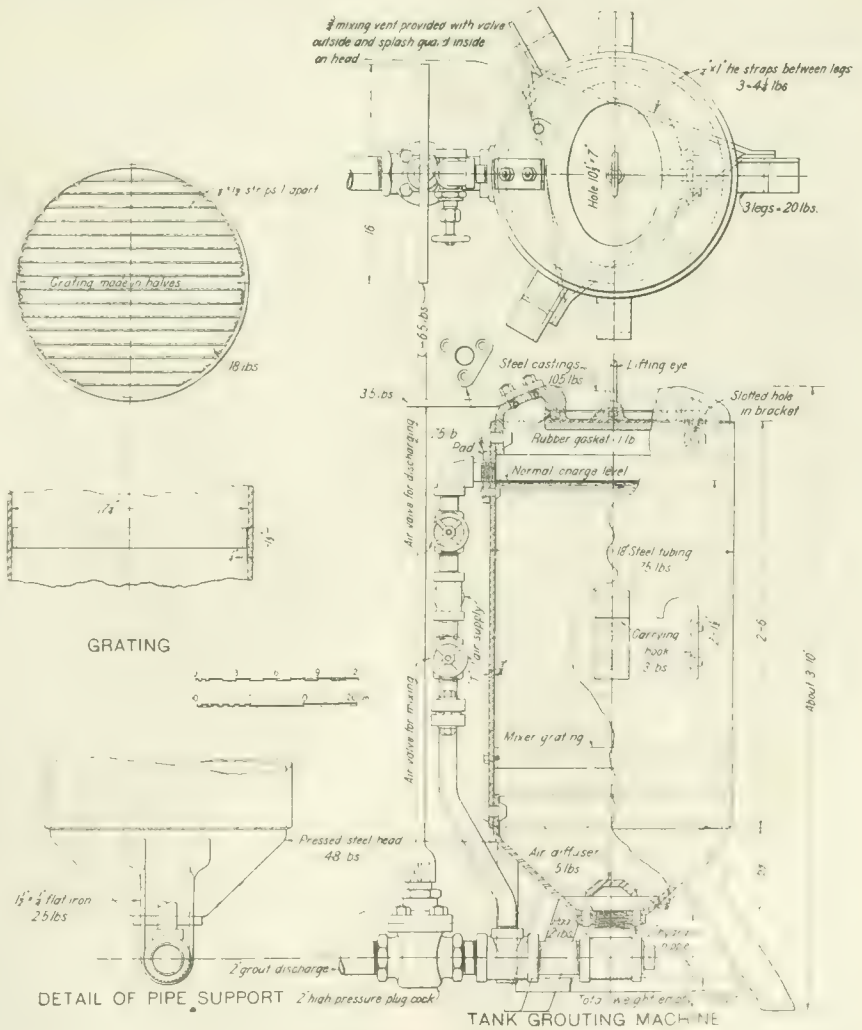


Fig. 2—Details of Grouting Machine.

lbs. per sq. in. at the continuous rate of 2 cu. ft. of high pressure air per minute. The compressor is to have a bifurcated discharge so as to operate two grouting machines.

The general design of the proposed grouting machine is shown by Fig. 2. It consists of a cylindrical metal tank with hopper shaped bottom, charging door at the top, and suitable pipe connections all mounted on legs and capable of being carried by hand. The specified weight is 500 lbs. The grout materials are charged into the tank at the top and are mixed by admitting compressed air at the bottom and forcing it up through the liquid to escape from a vent at the top. Notice should be taken of the air diffuser and the mixer grating. The mixed grout is discharged from the bottom by admitting compressed air at the top of the tank above the grout surface. It is planned that the grout shall be ejected at a pressure of 300 lbs. per sq. in. The air supply connects with a Tee about mid length of a vertical U pipe, the ends of which enter the top and bottom of the tank. A valve above and one below the Tee permit the air to be diverted to the bottom for mixing the grout or to the top for ejecting it. The grout discharge pipe is provided with a separate valve operated by a wrench stem and cross handle as shown. It will be noted that all air pipes are not less than 1 in. and all grout pipes not less than 2 ins. Owing to the pressures, 300 lbs. per sq. in., strong construction is necessitated, and the machines will all be subjected to a hydrostatic test of 600 lbs. per sq. in. The number of machines used will depend on conditions, but the minimum number will be four.

For filling behind the lining direct connection by hose will be made between the grouting machines and the various grout pipes. To solidify the lining concrete proper a supplementary device called a grouting pad will be employed. The construction proposed for grouting pads is shown by Fig. 3. Each grouting pad consists of a heavy 5-in. steel pipe column with head and base of cast steel and a steel bearing flange to distribute the pressure to the wooden blocking on which the apparatus is mounted. The base casting has two steel jack screws for raising and lowering the column and head. The head is a rectangular dished casting carrying a molded gum rubber gasket around its top edge, and with a nipple connection for hose passing up through one side.

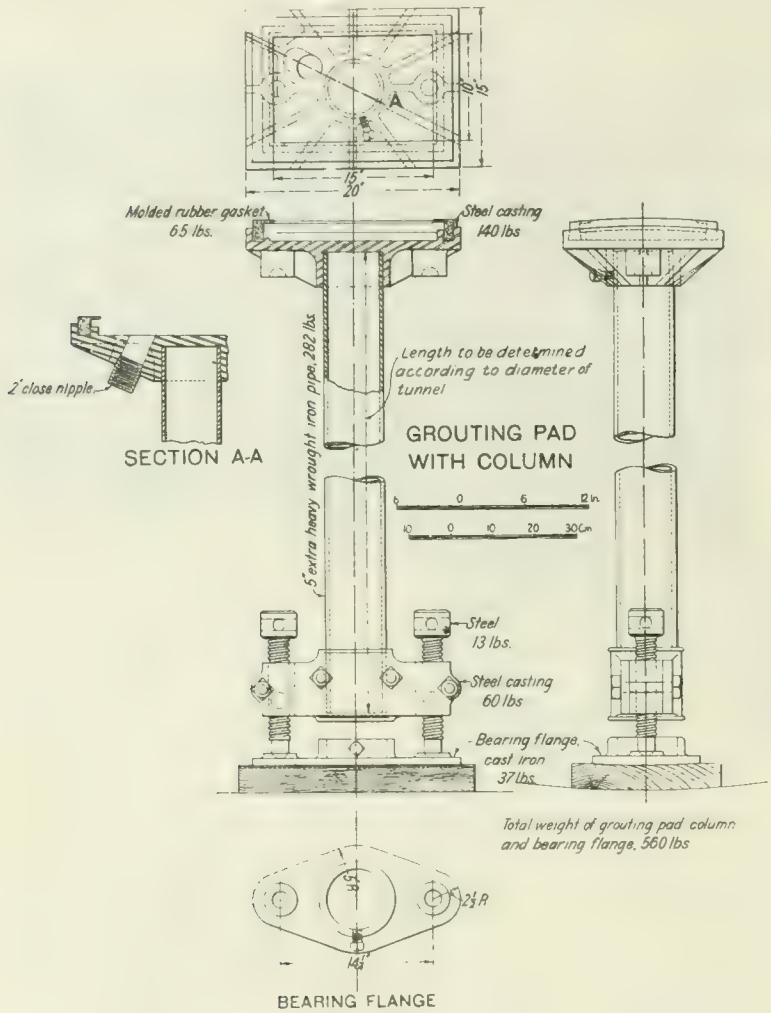

A
Molded rubber gasket 65 lbs.
Steel casting 140 lbs
2" close nipple
5" extra heavy wrought iron pipe, 282 lbs.
Length to be determined according to diameter of tunnel
SECTION A-A
GROUTING PAD WITH COLUMN
Steel 13 lbs.
Steel casting 60 lbs
Bearing flange, cast iron 37 lbs.
Total weight of grouting pad, column and bearing flange, 560 lbs
BEARING FLANGE

Fig. 3—Details of Grouting Pad.

The purpose of this grouting pad is to solidify porous places in the concrete lining. The mouth of the rubber gasket is brought over the porous spot and the column is screwed up until the gasket bears tightly against the concrete to be repaired. Grout from the grouting tank is then forced into the head and penetrates the pores in the concrete and fills them. It is intended that the possible pressures of grouting with these pads shall be 300 lbs. per sq. in., and that the grouting shall continue in each case until at this pressure no more grout is ejected, when the cock next to the pad shall be closed and the pad left in place until the grout has set. The number of pads to be used will depend on the conditions developing, but the minimum shall be twelve.

The grout used is intended to be a 1:1½ mixture or a richer mixture. The sand is specified to be of such fineness that 100 per cent shall pass a 64 mesh sieve and 45 per cent shall pass a 1,600 mesh sieve. If considered desirable it is intended to waterproof the grout by an admixture of commercial sulphate of alumina. This chemical will be added to the mixing water in the proportion of 2 lbs. of sulphate to 100 lbs. of water. It is intended that the grout shall be made as thick as can be counted upon to flow so as to fill completely the voids.

The general procedure to be followed in grouting will be as follows: In grouting behind the lining it is the purpose to make the operation continuous for each grouting section and to have the grout delivered uniformly and steadily and not in violent spurts or blasts. No grout is to be called upon to travel more than 25 ft. and the machines are to be shifted and other means taken to ensure this limit. In grouting a section or even individual cavities the work shall proceed upward; the bottom pipes will be connected first and the filling proceed until the pipes next above begin to discharge grout, then these will be connected and so on. Grouting will be considered completed in each section when no more material can be forced into the space under 300 lbs. per sq. in. pressure.

The preceding description outlines, we believe, the most carefully planned scheme for rendering tunnel lining impervious to water that has ever been undertaken and it should interest hydraulic engineers generally. One of the devices described, the grouting pad, is, so far as we are aware, unique.

A Formula for Determining Crown Thickness of Arches.

The design of an arch is tedious and an assumption must be made of the crown thickness as a trial. A number of formulas are in use, the one best known being the Weld formula. It is intended only for arches in which the rise is 1/10 to ⅛ per cent of the span. Mr. Ernest McCullough, one of the editors of this journal, while in private practice, developed a formula which gives very close results for all ratios of rise to span, for bending moments increase as the radii of the arches decrease. The formula is as follows:

$$t = \frac{(20-r)}{10} \div \frac{S}{5} + \frac{75}{2S}$$

in which

t = crown thickness in inches.
S = clear span in feet.
R = rise in feet.

$$r = \frac{S}{R}$$

(Note. When t is in inches and fractions, take the next larger inch.)

The loading conditions assumed were 2-ft. earth fill on crown with a 15-ton steam roller of standard dimensions, but a live load of 200 lbs. per sq. ft., when the effect would be greater than that of the roller.

The formula was derived after a study of a number of designs and of over 150 bridges built, of which details were published. It must be borne in mind that a general arch crown formula can never be used to supplant exact methods of calculation. The formulas for arch crown thickness are only closely approximate and intended by the authors to be merely guides, so trial thicknesses may be assumed in beginning the work of designing an arch.

Uniform Paving Specifications.—A movement has been started to hold from Feb. 21 to 26, during the Cement Show at Chicago, a convention of city officials to consider action looking toward the acception of uniform paving specifications. A committee has been organized and headquarters will be at the La Salle Hotel. All city officials interested are urged to take the matter up. The following letter has been sent to the Mayor of every city in the United States having a population of more than 100,000 (48 cities).

Dear Sir: The Board of Local Improvements, which has in charge the construction of pavements, suggests that a convention of city officials and engineers to be held here Feb. 21 to 26 inclusive for the purpose of standardizing specifications for asphalt, brick and creosoted block pavements. It is believed that a more prompt delivery and lower prices for these pavements will result.

I am heartily in favor of the plan and trust that you will delegate representatives from your city to be present at the convention. Please have your representatives advise Mr. Frank T. Fowler, temporary chairman, 302 City Hall, of their assignment as such.

Yours very truly,
FRED A. BUSSE, Mayor.

Chicago, Ill., Feb. 1, 1910.

Roads and Streets Section

Note: This section is devoted to methods and costs of road and street construction. It will cover road building in all its details, the construction of pavements, sidewalks and gutters, the testing and use of paving materials and the machinery and tools used in road building and paving.

Formulas for Sidewalk Construction Used by the Bureau of Sidewalks of Chicago, Ill.

In a paper presented at the last annual convention of the Illinois Society of Engineers and Surveyors, at Cairo, Ill., Mr. N. E. Murray, superintendent Bureau of Sidewalks of the Board of Local Improvements of Chicago, gave many data regarding the construction of sidewalks in Chicago. That portion of his paper relating to the methods and costs of constructing cinder and cement walks was given in our Feb. 2 issue. In his paper Mr. Murray gave the following formulas which are used in the Bureau of Sidewalks in field practice and in estimating cost of construction. The maximum grade or slope allowed for walks in Chicago is 6 per cent, and preferably not over 4 per cent. Where the sidewalk grade exceeds 6 per cent it is broken by using steps of wide tread.

The following formula for excessive slope is used when the grade exceeds 6 per cent, or $\frac{h}{L} = 0.06$:

$$S = \frac{L\ (Sp + R)}{h} \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (1)$$

in which

S = width or tread of step (not less than 6 ft.).

R = height or riser of step (6 ins. to 9 ins.)

p = per cent of slope, given S (from .02 to .04).

h = difference in grade between points.

L = distance between points (all in feet).

It is customary to assume values for R and p and solve for S.

Difference of elevation of top of steps $= R + Sp$ ..... (2)

In determining the cut and fill on a plat where it is proposed to construct cinder walks under city contract, surface elevations are taken over the line of the proposed walk. These elevations are properly equated according to certain adopted rules to the calculated inside grade, which is usually the established grade plus 6 ins. The total in lineal feet of average cut and average fill, including the 3-in. crown of fine cinders, is placed on the plat in a signed certificate. This average cut and fill, which includes the walk cross section, is advertised as the gross cut and fill. The following formula is useful in determining the probable cost of the construction.

The cross section of the complete cinder walk consists of a base of coarse cinders or slag 9 ins. thick and an upper course of fine cinders 3 ins. thick. After the walk is completed to grade a crown of fine cinders 3 ins. thick is spread. The total thickness of the walk below the grade of the top of the cut or fill (the top of the curbing) is 1 ft. The top of the curbing of cinder walk is set 0.2 ft. below inside grade.

Formula for cut or fill for a cinder walk with 6-in. or ½-ft. berm on each side and sides sloping 1 to 1:

Cu. yds. per lin. ft. of walk = 0.037 × width of walk in feet ..... (3)

Cu. yds. of cut or fill per lin. ft. of walk $= \frac{(\text{cut or fill})^2 + (\text{cut or fill}) \times (\text{width of walk} + 1)}{27}$ ..... (4)

Cut equals difference between natural surface and inside grade + 2/10. Fill equals difference between natural surface and inside grade — 2/10.

(a) Net fill per lineal foot of walk = formula (4) minus formula (3).

(b) Net cut per lineal foot of walk = formula (4) plus formula (3).

The cost of a cinder walk 6 ft. wide, properly constructed, is given in the following formula:

Cost per lineal foot equals net fill or cut (in cu. yds. per lin. ft.) × cost of (filling or cutting) per cu. yd. + 30 cts ..... (5)

The cross section of a complete cement walk consists of a foundation of cinders 9 ins. thick, a base 4¼ ins. thick of 1—2½—5 concrete, and a top or wearing course ¾ in. thick of 1 to 1½ mortar. The total thickness = 14 ins., or 1.17 ft.

Formula for cut or fill for cement walk with 1-ft. berm on each side and sides sloping 1 to 1½ horizontal:

Cu. yds. per lin. ft. of walk = .043 × width of walk in feet ..... (6)

Cu. yds. of cut or fill per lin. ft. of walk $= \frac{1.5\ (\text{cut or fill})^2 + (\text{width of walk} + 2) \times (\text{cut or fill})}{27}$ ..... (7)

Cut or fill equals difference between inside grade and natural surface of the ground.

(a) *Net* fill per lin. ft. of walk = formula (7) minus formula (6).

(b) *Net* cut per lin. ft. of walk = formula (7) plus formula (6).

The cost of a cement walk 6 ft. wide, properly constructed, is given in formula (8):

Cost per lineal foot = *net* fill or cut (in cu. yds. per lin. ft.) × cost of (filling or cutting) per cu. yd. + 81 cts ..... (8)

Paving Along Street Railway Tracks.*

The pavement in street railway tracks is subject to additional destructive conditions besides those encountered on ordinary streets. The concentrated wheel loads of the modern cars distort and deflect the rail. This breaks any contact the pavement may have with the rail and provides entrance for water into the body of the paving. Heavy, stiff rail with good fastenings and solid ballast reduce deterioration of the paving but do not prevent the vibration of the rail. This cannot be eliminated.

During the past year in Indianapolis several features in track paving have been studied. The reconstruction of track in the business center of the city presented opportunity for improving the track construction. Two blocks of track on Pennsylvania St. between Washington and Ohio Sts. were rebuilt, using every care to make the work as permanent as possible.

The 9-in. girder tram rail, 90 lbs. to the yard, was laid on 6x8-in. by 8-ft. white oak ties, spaced 2 ft. The subgrade was excavated to a depth of 10 ins. below the bottom of the ties and rolled till compact. The track was raised on blocking to the proper grade and line and the excavation filled with Portland cement concrete to within 5 ins. of the top of the rail and allowed to set for 10 days. Brick surface was applied on a sand cushion. At the street intersections where traffic could not be kept off, the brick was filled with asphaltum filler. The balance of the paving was grouted with Portland cement, every effort being made to fill the joints completely with grout.

The new features of this track construction are the increased thickness of Portland concrete base under the ties, and the use of the beveled edge Nelsonville stretcher brick outside of the track.

*From a paper read by Thos. D. McMath, chief engineer, Indianapolis Traction & Terminal Co., Indianapolis, Ind., at the Columbus, O., convention of the Central Electric Railway Association, Jan. 27, 1910.

Objection may be made to the use of the stretcher brick outside the rail, as this may start a rut along the rail. The bevel stretcher in combination with the wood strip under the head of the rail is intended to keep the rail from direct contact with the brick and to reduce the effect of vibration and prevent the paving being crushed by wide tread wheels.

Asphaltum filler has been used on brick paving in Indianapolis and has its advantages in cases where traffic cannot be kept off the paving or tracks for sufficient time to permit cement grout to fully set. Several makes of asphaltum filler have been tried, as well as coal tar pitch. Later we will have some data as to their relative merits.

About 8,000 sq. yds. of brick paving was filled with asphaltum filler during 1908. This paving is subjected to heavy traffic and great effort was made to do as good a job as possible. The work was done with every precaution suggested by the representative of the asphaltum, the city engineer, and the engineering department of the street railway to make it first class. Two blocks of the same stretch of track are grouted with Portland cement. A direct comparison of results can be made. At present both stretches of paving are in fine shape.

The wear on brick paving starts from the breaking of the edges of the brick at the joints, rounding the edges till the brick resemble cobble stones. This is noticed especially when the wear is from the shoes of the animals, the wear from wheels being practically uniform across the face of the brick. The round edge commonly used is a mistake. Brick should have as little rounding as possible on the edges.

The greatest possible effort should be made to fill the joints full with the best grout. Ordinary grouting is the ruin of a brick. Five cents a square yard spent on good grouting is the best investment on the job. In going over pavement it will be seen that the best paving is that in which the grouting is best. The city engineer and myself have seen parts of brick pavement that have kept smooth under heavy traffic when the balance of the paving was worn rough; the only explanation for the different condition was the grouting.

The following method is suggested for grouting: Mix 1 to 1 cement and sand in a box, using always a measured amount of sand, cement and water. Mix thoroughly and dump the box. Sweep the grout on diagonal lines and use a rubber squilgee instead of a broom, after the grout has settled down in the joint go over it again, repeating until the joint is full and flush after the initial set.

The price paid for brick is probably too low; a smaller brick more uniform in structure and burn is preferable. Such brick should be very closely inspected; possibly 40 per cent of the brick now classed as No. 1 should be rejected. If the size were smaller these brick would be used in building, thus providing against loss to the maker. The manufacturer should grade his product to give the customer the qualities needed and himself reject the poor brick.

Inspection for quality as the brick are laid is unjust to both parties. As the eye can only decide shape, color and possibly absorption of water, many brick that would be satisfactory are rejected and unsatisfactory brick are scattered throughout the paving. The inspector should have the advantage of judging the brick from their position in the kiln. A better market for second class brick will have to be found before the manufacturer can be expected to grade closer or else the price must be better. Both the manufacturer and his customer should be insured against the expense of freight, unloading, hauling and storage on rejected brick.

Up to the present time no granite or stone block pavement has been used in Indianapolis. The traffic, however, on several streets now paved with brick is so heavy that a block pavement is needed. The street railway has 8,000 sq. yds. of block pavement under construction on Kentucky Ave. south of White River.

The block selected is from quarries 60 miles east of Pittsburg and known as Ligonier

block. This is a very tough limestone. The block is laid on concrete foundation and the joints filled with pitch. The pitch to be used will be hydrolene 80 per cent and residuum oil 20 per cent. The stone blocks are smoothly cut and the pavement will not be materially rougher than brick. The block does not glaze nor get slippery under traffic. Block will eventually cobble where exposed only to horse travel, but if laid smooth will remain so under wheel traffic if fully grouted. The secret of a good block pavement is in the cutting of the blocks with smooth faces and square edges; the block must be laid close with the joints filled with filler. If the pavement be as smooth as brick the noise would be obviated largely and the pavement would continue smooth even when worn by traffic.

For railway track paving, stone block has the great advantage that the paving can be replaced after track repairs at small expense and the general condition of the street is not impaired as in asphalt or brick surface.

The maintenance of track and paving always presents the difficulty that a minor repair to track cannot be made without a large paving expense. In other cases reconstruction of the paving cannot be made because the condition of the track will not justify it and enough money to rebuild both is not at hand. In other words, a worn out pavement on a street with a two-thirds worn out track presents a difficult financial problem. There should be some cheap pavement invented to use for such short time work. This problem is frequently presented on interurban lines in small towns in which ordinary tee-rail construction should be paved.

The success of pavements of the bitulithic class seems to indicate that something can be expected in this direction. Assuming that the track roadbed is good enough for a foundation, if a 4 or 5-in. layer of bitumionus macadam could be cheaply laid and cheaply and easily be repaired by ordinary section men it would solve this trouble. The patents seem to tend to prevent the use of the usual forms of such pavements under these conditions.

One proposition of this kind is presented by an asphalt contractor. He suggests a layer of clean macadam laid and rolled in place with a light roller, then poured with a hot asphalt. This is to be followed with a layer of ¼-in. stone also poured with hot asphalt, then coated with sand and cement and rolled with a heavy roller.

For this proposition no great plant would be required. A closed heating kettle of two tons capacity with a hand agitator can be purchased for $700. The grading of the macadam can be cheaply done. It has been estimated that such a pavement could be laid at 50 cents per sq. yd., and subsequent patching could be done by section men at the same cost. This would give a pavement suitable for light traveled streets where the traffic largely avoids the car tracks. The cost of maintenance would be so small that it would not be neglected.

The need of today for small towns is a cheap yet reasonably durable pavement that can be repaired when necessary by ordinary labor with a small expenditure for plant. The macadam country road fails under automobile traffic. The need is now for a cheap cementing material.

Notes on the Construction of Macadam Pavements and a Table Showing the Amount of Stone Required.

BY GEORGE B. PIKE.*

Engineers and inspectors in charge of the construction of macadam pavements, by contract or otherwise, should not require the excavation to be carried down to the theoretical line dividing the pavement from the subgrade, but should allow the excavation to stop a certain distance above that line. This distance depends upon the amount of penetration of the stone into the subgrade and, perhaps, upon a further settlement of the soil under the weight of the roller and the influence of the water used in the construction of the pavement. No precise figures can be stated for the amount of this penetration and settlement, for it varies with different soils and depends upon the hardness of the subgrade. In most ordinary soils, however, it is perfectly safe to allow at least 1 in.

In the writer's opinion it is good practice in sandy soil to allow from 1 to 2 ins. to cover penetration of the stone and compression of the soil, and in addition to cover the subgrade with a layer of marsh hay to prevent as much as possible the intermingling of the stone and sand.

In clay soil, dry and hard, one might think that 1 in. would be entirely too much to allow, but after the stone is deposited and graded, comes the rolling and wetting, and the subgrade at the beginning of this operation certainly receives a share of the water used, thereby being softened, and there will be, it is safe to say, at least 1 in. of penetration of the stone into the subgrade.

On the other hand, if a contractor be required to excavate to this theoretical line of separation of pavement and subgrade, he certainly will have to furnish more stone to complete the pavement than would be necessary to complete a pavement of the thickness required by the plans and specifications. In other words, the contractor will actually build a pavement thicker than the plans and specifications require.

TABLE I.—MAXIMUM AMOUNT OF STONE REQUIRED, MACADAM PAVEMENT CONSTRUCTION.

Thickness of compacted macadam in ins.	Coarse Stone. Amt. required for each sq. yd. pavement, cu. yds.	Thickness of loose stone in ins.	Per cent of total.	Screenings. Amt. required for each sq. yd. pavement, cu. yds.	Thickness of loose stone in ins.	Per cent of total.	Total stone required for each sq. yd. pav't in cu. yds.	Number of sq. yds. laid with 1 cu. yd.
3	0.1083	3.9	78.25	0.0301	1.	21.75	0.1384	7.23
4	0.1445	5.2	79.61	0.0370	1.3	20.39	0.1815	5.51
5	0.1806	6.5	80.41	0.0440	1.6	19.59	0.2246	4.45
6	0.2167	7.8	80.98	0.0509	1.8	19.02	0.2676	3.74
7	0.2528	9.1	81.37	0.0579	2.1	18.63	0.3107	3.22
8	0.2889	10.4	81.68	0.0648	2.3	18.32	0.3537	2.83
9	0.3250	11.7	81.91	0.0718	2.6	18.09	0.3968	2.52
10	0.3611	13.	82.11	0.0787	2.8	17.89	0.4398	2.27
11	0.3972	14.3	82.25	0.0857	3.1	17.75	0.4829	2.07
12	0.4333	15.6	82.39	0.0926	3.3	17.61	0.5259	1.90

Of course these remarks apply particularly to macadam pavement constructed in connection with curbing or combined curb and gutter where the elevations of the surface of the pavement and gutters are definitely fixed, for in this case any loss of paving material at the bottom must be made good at the top.

It may be said the true thickness of a macadam pavement is shown by the amount of stone used in its construction. In this connection the writer presents the accompanying Table I, showing the maximum amount of stone required in macadam pavement construction. This table is based on data taken from page 139 of "Gillette's Handbook of Cost Data," from the section entitled "Quantity of Stone and Binder Required."

Without knowledge of these data the writer had previously deduced, from personal experience in the construction of macadam pavements, practically the same results as here shown for pavements varying from 6 to 10 ins. in thickness. The table is figured to include thicknesses from 3 ins. to 12 ins. The table itself will readily suggest its various uses to those interested.

*City Surveyor, Manistee, Mich.

Notes on State Highway Work in 1909.

In our issue of Feb. 2, 1910, we gave some data as to the highway work accomplished in 1909 under the direction of various state highway commissioners. We have since received the following additional information:

ILLINOIS.

The mileage of roads completed in 1909 under the direction of the State Highway Commission was as follows:

Kind.	Total miles built.	Av. width paved, feet.	Av. thickness of completed pavement, ins.	Av. cost per mile.
Macadam	55	10 to 30	8	$3,500*
Bituminous binder.	47	12 to 30	8	5,000*
Oiled earth	12	12	6	1,800

*Estimated on basis of 12-ft. width.

The average unit price for broken stone in place was 50 cts. per cu. yd. The crushed stone for road work is furnished from the penitentiaries, where it is crushed by convict labor and the cost of the roads, as given above, does not include any charge for this stone, which is furnished f. o. b. the cars at the penitentiary for road purposes.

The prevailing daily wages were as follows:

Common labor.....17½ cts. per hour
Two-horse team and driver.....$3.50 per day

The length of the working day was 9 hours. During the past year the Illinois Highway Commission has carried on some extensive experiments with bituminous binders for macadam and expects to continue the work. A complete record of every detail of the construction of each experiment and a complete analysis of the tar or asphalt binder that was used has been made. The roads will be inspected frequently and their condition compared with the analysis of the oil or tar to see if it is possible in this way to settle upon some standard specification for bituminous binder.

The road work projected for 1910 includes the construction of 80 miles of macadam road and 15 miles of road with bituminous binder. Mr. A. N. Johnson, Springfield, Ill., is state highway engineer.

MAINE.

The total length of state road of all classes constructed during 1909 was 424,373 ft., or 80.37 miles, this amount including 10,671 ft. of road not classified as to surfacing material. The following tabulation shows the amount and kind of work done during the past year:

No. of towns.	Nature of Improvement.	Square yards.	Length, in feet.	Total cost.	State aid.
1	Block paving	1,356	714	$ 2,197	$ 910
34	Macadam	107,480	11,411	62,515	18,580
9	Bituminous macadam*	20,110	5,065	23,045	6,980
335	Gravel	.....	290,385	150,970	69,743
84	Earth and drainage	.....	71,220	34,224	16,588
4	Earth and gravel	.....	4,907	1,686	854
8	Abutments and culverts	.....	.....	1,519	852
6	Bridges	.....	.....	2,344	701
477	Total	.....	113,702	$278,500	$115,208

*Not including Westbrook. Including 224 lin. ft. of granite block on Hassam base.

The average cost per mile of all types of road, including the cost of the bridge and culvert jobs, was $3,465. The average cost of the various types of paving was as follows:

	Per sq. yd.
Block paving	$1.62
Macadam	.818
Bituminous macadam	1.115

There were 55 miles of gravel road, the graved surface varying from 12 ft. to 21 ft. The average cost of construction was $2,474.90 per mile. The average cost of earth roads and drainage, a total of 13.49 miles being built, was $2,536 per mile.

The figures in the tabulation cover the work

done under the 1909 joint fund. Besides these completed jobs 24 other applications for state aid were received. Fifteen towns applied to the department to have their joint fund laid over to 1910 and in 9 towns work started in 1909 had not been completed and accepted at the end of 1909 and consequently no aid has been paid. It should also be noted that 7 jobs begun in 1908 were completed during 1909 at a gross expense of $9,983, and of this amount there has been paid $3,317 of 1908 aid.

Plans for the coming year, besides the regular state aid, which will be materially increased on account of the larger appropriations made by the last legislature, contemplate the reconstruction of several sections of main thoroughfare or trunk line. Surveys have been completed for 14 miles of this work and 5.4 miles located on the Rockland and Bangor trunk line will be prepared for letting early in March. The other trunk line work for the present year will be principally on the route leading from Portsmouth, N. H., to Portland, Me. The State Highway Department has available this year for general state aid $228,000, which will be supplemented by nearly an equal amount by the towns. The department also has for trunk line construction during 1910 about $120,000. Subscriptions have been made for this work and placed at the disposal of the department increasing this amount about $21,000, so that there will be available for both state aid and trunk line construction during 1910 approximately $500,000.

The only new form of construction tried during the year has been bituminous macadam, using the mixing method. For bituminous binder 50 per cent of refined coal tar and 50 per cent of asphalt, grade "J," from the Texas Co. have been used. The cost of the bituminous work has been from 35 cts. to 40 cts. additional per square yard over and above the price of plain macadam. The cost given in the table figures out $1.14, but this includes all grading, drainage, engineering, advertising and incidental expense in connection with the work. Wherever this work has been put in it has proved satisfactory. Paul D. Sargent, Augusta, Me., is state highway commissioner.

PENNSYLVANIA.

The total mileage of macadam and other improved roads completed in 1909 under the direction of the State Highway Department was 144.3 miles. The average width paved was 16 ft. and the average thickness of the completed pavement was 9 ins. The average cost per lineal foot on a 16-ft. wide basis was $2.37. There were 59,942 sq. yds. of brick pavement completed in 1909, the average width paved being 14 ft. and the average thickness of the completed pavement being 10 ins. The average cost on the basis of a 16-ft. wide road was $18,773.33 per mile. The average cost of all roads, including bridges, was $2.34 per foot. The cost of bridges completed in 1909 was $174,564.73. The average cost of all roads, without bridges, was $2.18 per lineal foot.

Some of the average unit prices for 1909 were as follows:

Telford, per cu. yd., in place, including excavation	$2.60
Brick pavement, per sq. yd.	2.00
Earth excavation, per cu. yd.	32 cts to 75 cts.
Concrete masonry, per cu. yd.	$6.25 to $10
Stone masonry, per cu. yd.	$5.50 to $7.00

The average prevailing daily wages for 1909 were as follows:

Common labor	$1.60
Two-horse teams and driver	$3.50 to $5.00

The length of the working day was 10 hours.

Joseph W. Hunter, Harrisburg, Pa., is state highway commissioner.

The newly elected directors of the Frederick R. R. Co., formed by the merging of the Frederick & Middletown, Braddock Heights and Jefferson and Washington, Frederick and Gettysburg roads, organized Feb. 2 at Frederick, Md., by the election of the following officers: President, Emory L. Coblentz; vice presidents, Dr. Franklin B. Smith, Harry E. Clark, Walter S. Taylor; secretary, Charles C. Waters; treasurer, Thomas H. Haller. Walter S. Taylor was made general manager, George F. F. Anderson superintendent and S. H. Bennett auditor.

Water-works and Sewer Section

Note: This section is devoted to methods and costs of constructing sewers and water-works. It will cover the construction work for all details of water supply and sewerage, including sewage purification and water filtration.

Some Costs of the New Water Purification Works at Columbus, Ohio.*

The Scioto River pumping station and water purification works are located on the high ground on the north bank of the Scioto River about 4.5 miles below the storage dam and about 1 mile above the old West Side Pumping Station. The raw water is drawn from the river through an intake and intake conduit to a raw-water suction well just south of the pumping station. From this well the water is pumped by low-lift pumps to the purification works where it is softened and filtered, passing finally through the filtered-water reservoirs and back to a filtered-water suction well just north of the pumping station. From this well the water is pumped by direct-service pumping machinery through two lines of 36-in. cast-iron pipe, about 4,900 ft. in length, to a point opposite the old West Side Pumping Station where connections are made with the existing distributing system.

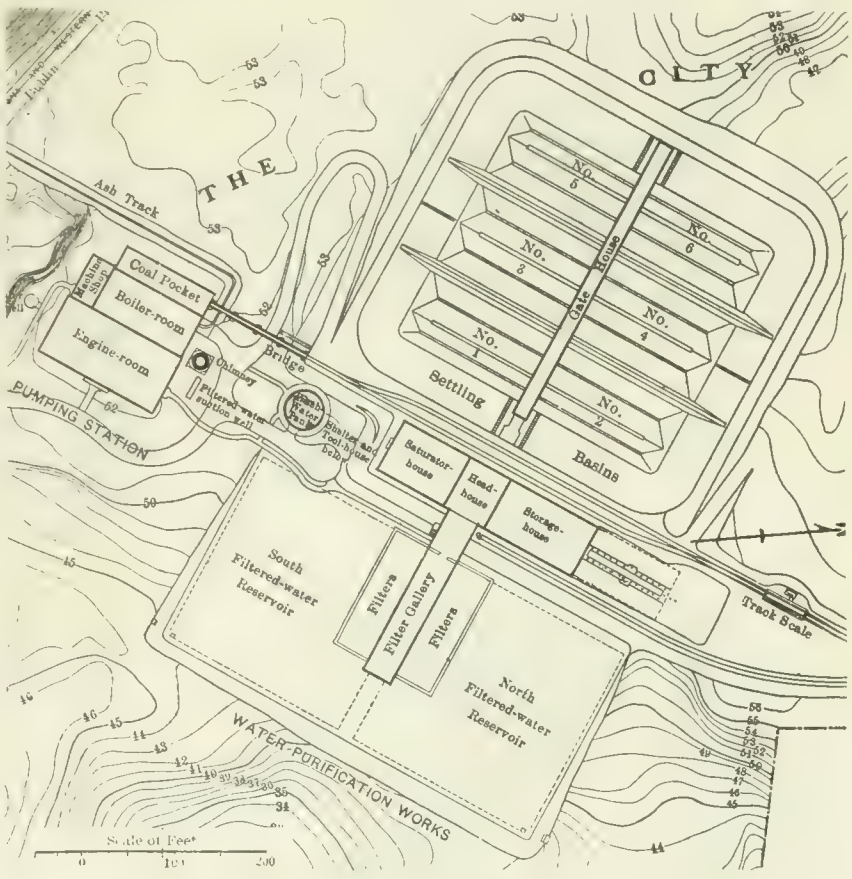


Fig. 1—General Plan of Water Purification Works at Columbus, Ohio.

The pumping station and purification works are designed for extension to an ultimate net normal capacity of 40,000,000 gals. per 24 hours. At present the pumping station has a net normal capacity of 20,000,000 gals. per 24 hours, but the building is of sufficient size for equipment having the ultimate net normal capacity. The purification works at present have a net normal capacity of 30,000,000 gals. per 24 hours, but have been arranged so that extensions may readily be made.

A small sewage disposal works consisting of a septic tank and two intermittant sand filters was installed to care for the sewage from the pumping station and water purification works. The unusually high flood in the winter of 1908-9 led to the abandonment of this plan and in lieu of operating the filters it is now proposed to sterilize the effluent from the tank before discharging it into the river.

Figure 1 is a general plan of the works and Fig. 2 shows sections of the head house giving an idea of the character of the buildings. All walls are of brick covered with red pressed brick; floors, stairways, etc., are of reinforced concrete. Roof trusses are steel, the covering being of slate laid on 3-in. hollow terra-cotta tile. The buildings are all electrically lighted throughout and the main building is heated with steam.

In the construction of the work, concrete, both plain and reinforced, was used extensively, the total quantity in the pumping station, purification works and adjacent structures amounting to 39,560 cu. yds. The average price paid for the above amount was $7.27 per cu. yd. The relative volumes of cement, sand and ballast in each mixture of concrete, and the corresponding character of work in which the mixture was used, were as follows:

1:2:4.—Water-tables, belt-courses, window-sills, lintels, etc.; filter, solution, dissolving, and wash-water tanks; reinforced floors, roofs, stairways, and steps.

1:2½:5½.—Columns in buildings and piers of wash-water tank; filtered-water reservoirs, lime saturators, mixing tanks, and substructure of head-house; settling basins, except lateral dividing and baffle walls; walls in general, conduits, and miscellaneous small structures.

1:3:7.—Lateral dividing and baffle walls of settling basins; footings, and foundations for machinery and chimney.

*Extracted from a paper by John H. Gregory in Proceedings American Society of Civil Engineers, Vol. XXXVI, p. 2.

TABLE IV.—UNIT COST OF MAIN FEATURES OF WORK.

Work.	Capacity.	Total cost.	Unit cost.
*Pumping station building, per cu. ft.	1,273,300 cu. ft.	$128,490	$ 0.10.1
†Main buildings, water purification works, per cu. ft.	534,000 cu. ft.	49,070	0.09.2
Settling basins, per 1,000,000 gals.	15,000,000 gals.	168,770	11.250
Lime saturators, per 1,000,000 gals. per 24 hrs.	6,750,000 gals. per 24 hrs.	24,410	3.620
Mixing tanks, per 1,000,000 gals.	1,270,000 gals.	44,230	34.800
Filtered-water reservoirs, per 1,000,000 gals.	10,000,000 gals.	98,300	9.830
Water Purification Works:			
Settling basins, per 1,000,000 gals per 24 hrs.		$168,770	$5.630
Head-house, per 1,000,000 gals. per 24 hrs.		39,660	1.320
Air-wash equipment, per 1,000,000 gals. per 24 hrs.		3,470	0.120
Lime-saturator house, per 1,000,000 gals. per 24 hrs.		32,550	1.080
Mixing tanks, per 1,000,000 gals. per 24 hrs.		44,230	1.470
Storage house, per 1,000,000 gals. per 24 hrs.		12,880	0.430
Office and laboratory, per 1,000,000 gals. per 24 hrs.	30,000,000 gals. per 24 hrs.	15,280	0.510
Filter gallery, per 1,000,000 gals. per 24 hrs.		102,710	3.420
Filtered-water reservoirs, per 1,000,000 gals. per 24 hrs.		98,300	3.280
Wash-water tank, pipe, and shelter, per 1,000,000 gals. per 24 hrs.		13,150	0.440
Supplies for preliminary operation, per 1,000,000 gals. per 24 hrs.		460	0.20
Expenses unclassified, per 1,000,000 gals. per 24 hrs.		1,020	0.30
Total		$532,480	$17.750

*Includes superstructure and substructure of building.
†Includes superstructure of head-house, saturator house, storage house, office and laboratory, and filter gallery.

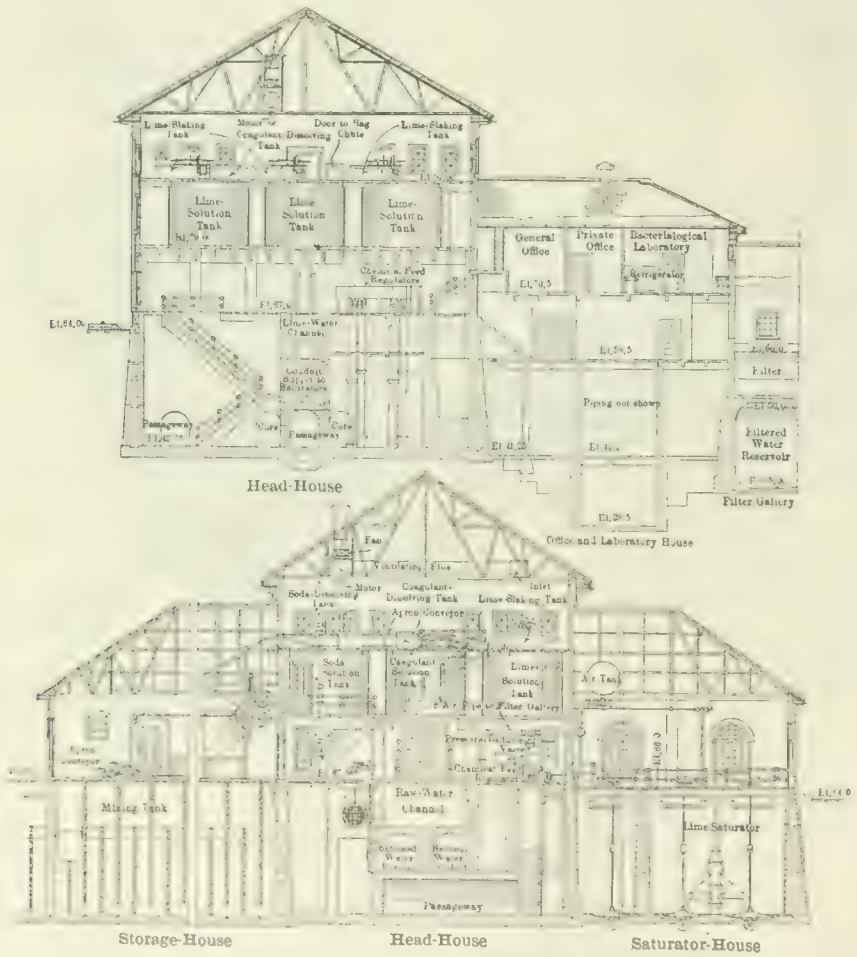


Fig. 2—Details of Headhouse for Water Purification Works at Columbus, Ohio.

The specifications permitted the engineer to change the relative volumes of the sand and ballast in each mixture, while keeping the aggregate of the two the same, and this was sometimes done, but in general the proportions as given above were used. Ordinarily, the concrete was mixed very wet.

The ballast was screened into three sizes: No. 1, ¼ to ¾-in; No. 2, ¾ to 1½-in., and No. 3, 1½ to 3-in. In ordinary work a mixture of the three sizes was used, but, in a considerable amount of the reinforced work the No. 3 ballast was omitted, and frequently only the No. 1 ballast was used, particularly in thin vertical work and in the lower parts of beams and horizontal reinforced work, in order to insure a good bedding of the square, twisted-steel rods.

Expansion joints were built throughout the work where necessary, Fig. 3. Where subject to the action of water which had been treated with lime and soda, the expansion joint consisted of a tongue and groove in the concrete, with a steel plate bedded and anchored on one side of the joint and greased on the other; in other places the tongue and groove only was used.

The filter gallery is in the wing of the main building east of the head-house, with the filter tanks ranged on either side of the gallery and supported on the roof of the filtered-water reservoirs. Between the filters there is a reinforced concrete operating floor, below which, and between the walls of the filtered-water reservoirs, is the pipe gallery.

The present installation includes ten filters, each having a normal capacity of 3,000,000 gals. per 24 hours. The filter tanks are of concrete heavily reinforced, each being constructed as a monolith. Their inside dimensions are 26 ft. 2 ins. wide, 46 ft. 8 ins. long, 8 ft. 10½ ins. deep at the center. Each has a net filtering area of 1,088.9 sq. ft., or 0.025 acre. The filters are designed on the basis of a normal rate of filtration of 2 gals. per sq. ft. per min., but can be operated at a rate 50 per cent greater than the normal, if desired.

The filter gravel, which was screened and washed, is placed in four layers, graded in size, the coarsest, No. 1, being at the bottom. The sizes and thicknesses of the layers of gravel are given in Table I. The material was brought from Cape May, N. J.

TABLE I.—FILTER GRAVEL.

	Size.	Thickness.
No. 1	½ in. to 1 in	2 in.
No. 2	¼ in. to ½ in	2 in.
No. 3	⅛ in. to ¼ in	3 in.
No. 4	1/16 in. to ⅛ in.	3 in.

The filter sand, which is supported by the filter gravel, has a total thickness of 2 ft. 6 ins. The material is a crushed sandstone, screened and washed, and was obtained from the Millwood White Sand Co., of Millwood, O. The analysis of the sand is given in Table II.

TABLE II.—FILTER SAND.

Effective size	0.415 mm
Uniformity coefficient	1.36
Amount finer than 0.2 mm.	0.15 per cent
Amount finer than 0.25 mm.	0.52 per cent
Amount finer than 0.8 mm.	95.0 + per cent
Amount finer than 1.0 mm.	98.5 + per cent
Specific gravity	2.63
Silica (SiO_2)	94.5 per cent
Lime (Ca O), finer than 0.36 mm.	1.43 per cent
Iron (Fe_2O_3)	0.5 per cent

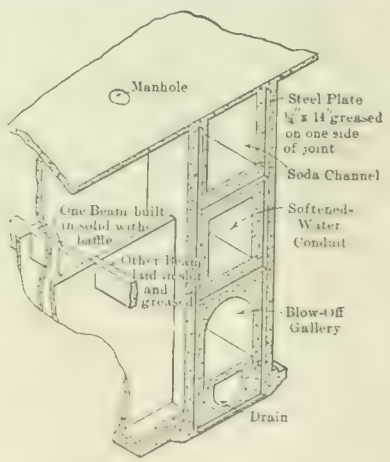

Manhole
Steel Plate ⅜ x 14 greased on one side of joint
Soda Channel
Softened-Water Conduit
One Beam built in solid with baffle
Other Beam laid in sand and greased
Blow-off Gallery
Drain

Fig. 3—Details of Expansion Joint in Concrete.

The first bond issue was authorized in November, 1904, and the preparation of the first drawings and specifications was commenced shortly after. The purification works were

TABLE V.—OPERATING AVERAGES BY MONTHS FOR YEAR 1909.

Month.	Applied Chemicals. Grs. per gal. Lime.	Soda ash.	Coagulant.	Color. River water.	Filt'r'd water.	Turbidity. River water.	Filt'r'd water.	Total Hardness. River water.	Filt'r'd water.	Total Alkalinity. River water.	Filt'r'd water.	— Bacteria per c.c. — River water.	Settled water.	Filt'r'd water.
January	[illegible]	[illegible]	[illegible]	16	0.4	[illegible]	0	417	109	[illegible]	43	143	11	3
February	9.1	6.6	1.8	54	7.0	256	0.5	288	105	149	51	33000	2146	82
March	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	244	82	119	47	18228	828	81
April	6.5	5.7	2.4	43	8.0	102	0.0	242	84	131	46	8500	8632	264
May	7.0	3.4	3.9	53	11.0	196	0.0	188	83	117	40	16309	3523	718
June	6.7	1.7	1.9	78	18.0	92	0.0	211	85	139	37	3952	180	121
July	6.8	0.4	1.8	54	13.0	86	0.0	192	86	139	32	4009	42	13
August	[illegible]	[illegible]	[illegible]	31	8.0	24	0.0	221	92	156	35	1888	83	29

Coagulant = sulphate of iron or sulphate of alumina.

placed under contract in June, 1905, the machinery and equipment for the pumping station in September, 1905, the pumping station and connection in July, 1906, and the force mains connecting with the city in October, 1907. Raw water was first pumped to the purification works on July 2, 1908, and on Aug. 17, 1908, a partial supply of filtered water was begun.

The cost of the entire works is summarized in Table III and unit costs are given in Table IV.

TABLE III.—SUMMARY OF COSTS.

Land	$ 45,410
Work, exclusive of pumping station and water purification works	76,490
Pumping station	366,240
Water purification works	742,480
Total cost of works, exclusive of connections to city and exclusive of engineering	$1,056,620
Connections to city	181,000
Total cost, exclusive of engineering	$1,237,620
Engineering	95,950
Total cost	$1,333,570

Design and Construction of the Improved Sewage Works at Columbus, Ohio With Unit Costs.*

Sewerage System.—The topography of Columbus is such that, in the collection of the storm-water and dry-weather sewage, the city is divided naturally into three districts: the East Side Sewer District, the Intercepting Sewer District and the West Side Sewer District.

The East Side District is sewered on the combined system, with an outlet sewer in East Main street emptying into Alum Creek, which in turn discharges into the Scioto River a few miles below Columbus.

The Intercepting Sewer District is sewered largely on the combined system, the outlets of the numerous main sewers being along the east bank of the Olentangy and Scioto Rivers. The dry-weather flow in the combined system, however, is intercepted and discharged into an intercepting sewer which starts at the north end of the city and runs south along the east bank of the two rivers, the outlet formerly being on the east bank of the Scioto River about 2¼ miles below the center of the city.

The West Side District is sewered largely on the separate system, the sewer outlets being along the west bank of the Scioto River. The dry-weather flow in the combined sewers, however, is intercepted and discharged into the sanitary system.

In the West Side District a portion of the ground is low, and, in the past, during periods of high water in the river, some of the sewers have overflowed, flooding certain of the streets and numerous cellars. The discharge of sewage into Alum Creek and the Scioto River during periods of low water had been the cause of offensive conditions.

Outline of Sewage Problem.—No public water supply is taken from the Scioto River below Columbus. At Portsmouth, O., 100 miles from Columbus, where the Scioto discharges into the Ohio River, however, the water supply is taken from the Ohio, but at a point some distance above the junction of the two rivers.

The sewage problem resolved itself first into the elimination of the direct discharge of sewage into Alum Creek and the Scioto River, which could be accomplished by the construction of purification works at one or more points, in which the treatment of the sewage would be such that the effluent, discharged into either Alum Creek or the Scioto River, would at all times be non-putrescible, and, second, the prevention of the overflowing of the sewers on the west side.

Preliminary Investigations.—A joint investigation was made by Julian Griggs and John W. Alvord and a report made in May, 1898.

Their recommendation, in brief, besides extensions and improvements to the sewerage system and the construction of pumping stations necessary to deliver the dry-weather sewage at the purification works, was the screening of the sewage and its double filtration through coke at a net rate of 500,000 gals. per acre per 24 hours. The works proposed were to treat 20,000,000 gals. of sewage per 24 hours, but it was advised that only 2 acres of the coke beds, practically contact filters, be built at the start, and that these beds be then operated for a year under expert supervision, after which, from the practical experience gained, the remaining beds were to be constructed.

In 1901 Mr. Rudolph Hering as Consulting Engineer, reported in favor of septic tanks followed by intermittent filtration through sand, endorsing the previous recommendation that a portion only of the works be constructed and operated for a year before designing and constructing the remainder. He also endorsed the recommendations relative to pumping stations and the revisions and extensions of the sewerage system. In November, 1903, the first funds were provided. After further thought and study it was decided first to make extended experiments for a period of at least one year, in order to determine the most efficient and economical method, and then to design the purification works accordingly. The City Council appropriated $46,000, a sewage testing station was built and operated from Aug. 16, 1904, to July 30, 1905, and the Report on Sewage Purification at Columbus, Ohio, 1905, by George A. Johnson, Assoc. M. Am. Soc. C. E., is now a classic.

The indications of the experimental work, namely, that, under the local conditions, the Columbus sewage could be treated most satisfactorily and economically in a purification works comprising septic tanks, sprinkling filters and settling basins, and this method was therefore adopted. While the investigation showed that satisfactory results could be obtained by preliminary clarification and subsequent filtration through sand, it also showed, for the first time in the United States, that sprinkling filters could be operated in a northern climate and produce a satisfactory effluent at less cost than any other type of filter.

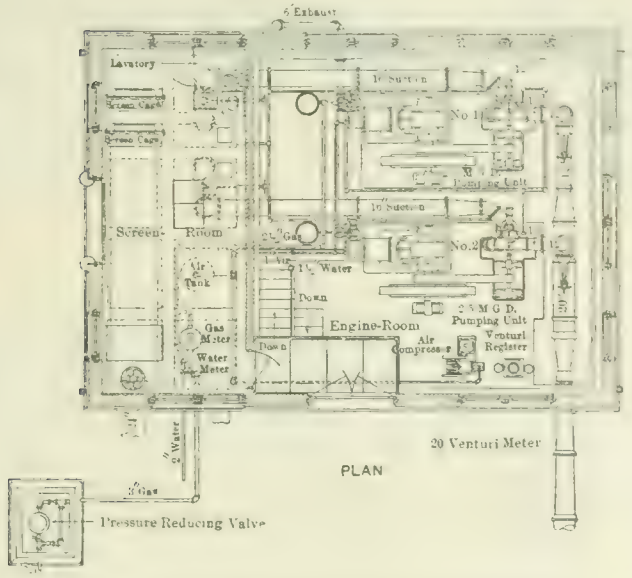


Fig. 1—Plans of East Side Pumping Station.

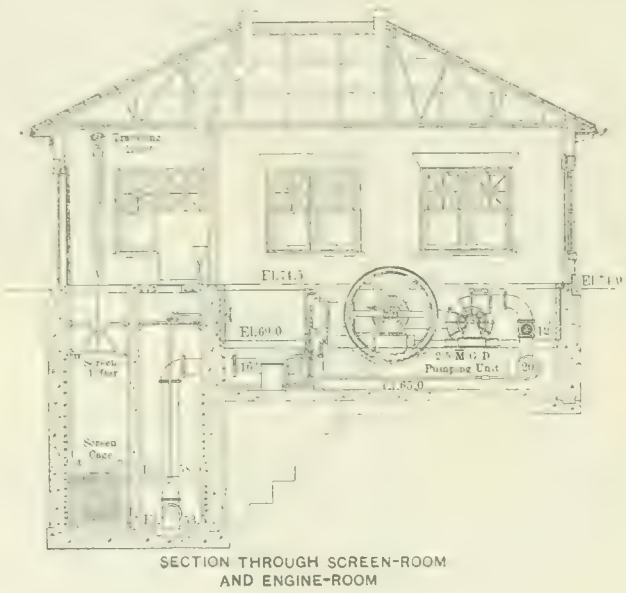


Fig. 2—Section Through Screen Room and Engine Room of East Side Station.

The river water is an unusually difficult one to handle. The problem of softening and filtering the Scioto River water is an exceedingly complex one, as the water is subject at times to rapid fluctuations in turbidity, color, alkalinity and incrustants, and in the portion of magnesia serving as a coagulant. Following heavy rains the turbidity rapidly increases while the hardness correspondingly decreases. Further, some of the turbidity in the settling basins is undoubtedly due to precipitates coming from the applied chemicals.

Table V is a summary of monthly averages of the plant in operation for the first eight months of operation during the year 1909.

The cost of engineering work, Table III, was $95,950, divided as follows: Pay roll, $84,340; supplies, $6,120; expenses, $5,490, amounting to 7.75 per cent of the cost.

The Pascagoula Northern R. R. Co., which has completed its new line from Pascagoula, Miss., northward to the crossing in Greene county of the Mobile, Jackson and Kansas City, is said to be considering changing its route and making its northern terminal at Laurel instead of Meridian, Miss. This would mean a swerving of the course of the road westward for several miles, and would shorten the total length of the line by 50 miles or more. The road now runs to Evanston, a distance of about 40 miles from Pascagoula, and the distance from there to Laurel would be about twice that distance.

*Abstracts from a paper by John H. Gregory, M. Am. Soc. C. E., published in the Proceedings of the American Society of Civil Engineers, Vol. XXXVI, p. 1.

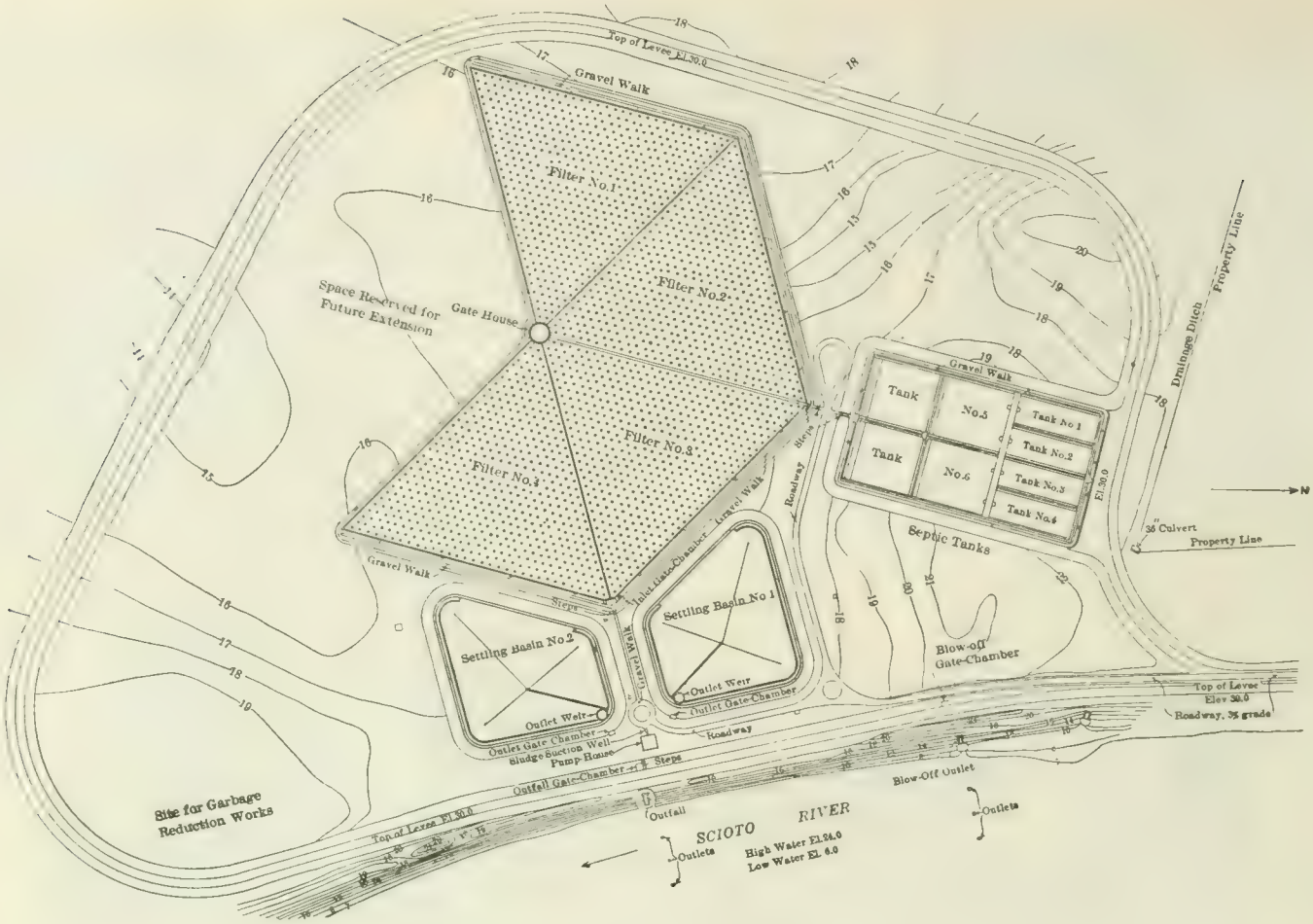


Fig. 3—General Plan of Sewage Purification Works.

Brief Outline of Works.—The preliminary investigations made by Messrs. Griggs, Alvord and Hering, and subsequent ones made by the engineering organization, indicated that it would be most advisable and economical to build and operate one purification works rather than two, and that the most feasible site for the works was on the Scioto River south of the city.

Briefly stated, the dry-weather flow of the whole city is brought to one point, where a pumping station, known as the Main Sewage Pumping Station, has been built. To accomplish this result, it has required the construction of a small pumping station near Alum Creek, known as the East Side Sewage Pumping Station, where the sewage from the East Side Sewer District is intercepted and pumped through a force main discharging into the upper end of one of the main sewers in the Intercepting Sewer District, the extension of the intercepting sewer across the Scioto River, and the construction of a new sanitary sewer connecting with the West Side Sewer District, and the reconstruction of a portion of the sewerage system in that district. From the Main Sewage Pumping Station the sewage is pumped through a force main to sewage purification works where the sewage is treated, the effluent from the works passing into the Scioto River. The Main Sewage Pumping Station is also arranged to pump storm-water from the West Side, one of the storm-water sewers having been extended to the pumping station. In addition, the work has included about 2.55 miles of levee construction, a railroad spur, 1.85 miles in length, and a single-track railroad bridge across the Scioto River.

The East Side Pumping Station is shown in plan in Fig. 1 and in section in Fig. 2.

A 9-ft. combined sewer passes in front of the building, serving as an outfall sewer for

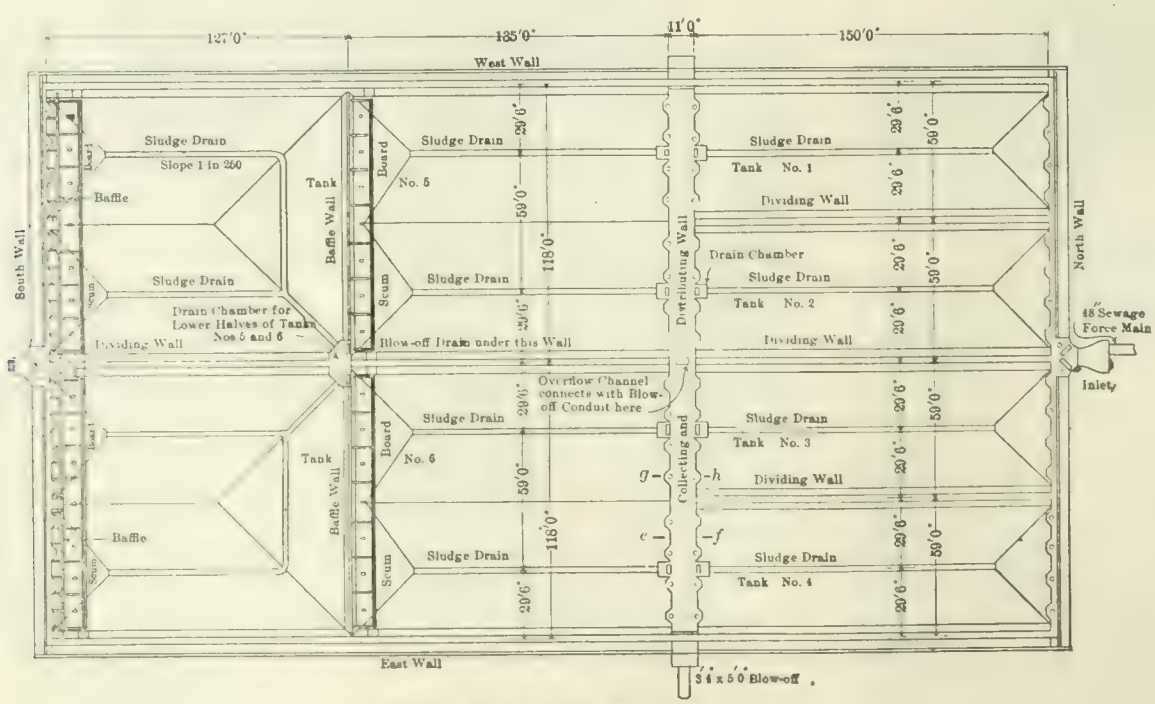


Fig. 4—Plan of Septic Tanks.

the East Side Sewer District. A low dam in the bottom intercepts and diverts into a 24-in. pipe the dry weather flow and first wash of the storm flow, taking them to a connection with the sub-structure of the pumping station. The sewage is screened before going into the suction well, the screen chamber acting as a sand-catcher. The substructure is of concrete, reinforced at various points, and the walls of the substructure of the engine room are lined with hard vitrified pressed brick. The walls of the superstructure are of brick, faced outside with red pressed brick. The engine room walls are lined with light-buff speckled pressed brick, and the screen room walls with hard red brick. The ceilings in both rooms are of plaster on metal lath fastened to the lower chords of the roof trusses. The roof is of 3-in. hollow terra cotta tile and slate carried by steel trusses and intermediate framing. The pumping machinery is in duplicate and shown in Figs. 1 and 2.

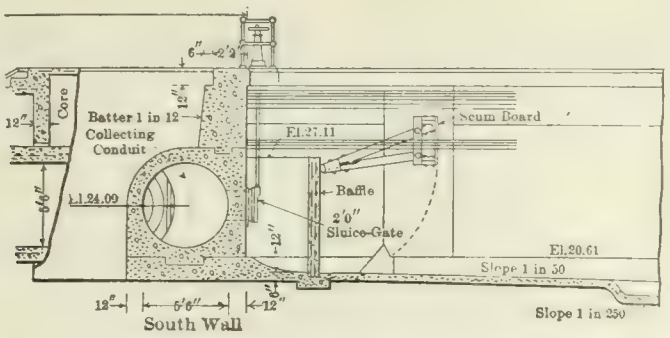


Fig. 5—Detail of South Wall of Septic Tanks.

The intercepting sewer has been extended across under the river, a distance of about 540 ft. to a sand catcher connected with the Main Sewage Pumping Station. The extension consists of a 48-in. cast-iron pipe surrounded by concrete. To bring the dry weather flow of sewage from the west part of the city to the pumping station, a new sewer, 1.85 miles in length, has been built. For a portion of the way it is brick and concrete and the remainder is concrete. At the upper end the diameter is 3 ft., enlarging to 3 ft. 6 ins. and the concrete section is 3 ft. 6 ins. by 3 ft. 6 ins. with vertical side walls. The Renick Run storm-water sewer has been extended 3,050 ft. to the pumping station and river. It is of concrete, with vertical side walls, 8 ft. by 7 ft. 4 ins., enlarging to 10 ft. by 9 ft. 3 ins. A 10-in. water main 2.05 miles in length has been laid, and also 1.65 miles of 2-in. high-pressure gas main.

The main sewage pumping station is of the same high class construction as the West Side pumping station and contains three 11,000,000-gallon daily capacity pumps. The station has a levee around it, although it is protected also by the new river levee. The chimney is 130 ft. high, 5-ft. diameter, radial hollow brick, with foundation carried by timber piles. The coal pocket has a capacity of 380 tons, about 40 days' supply at the present rate of consumption. High water in the river is about 6 ft. above the engine room floor, and in case of a break which would flood the pumping station lot the station itself would be flooded. To care for this emergency, stop plank grooves have been built in all the window and door openings, and a full set of stop-planks provided.

SEWAGE PURIFICATION WORKS.

The sewage purification works are on the west bank of the Scioto River, the upper end being about 1.2 miles below the Main Sewage Pumping Station and about 3.5 miles south of the center of the city.

Type and Capacity.—As previously mentioned, the purification works comprise septic tanks, sprinkling filters, and settling basins, the present installation having a net normal capacity of 20,000,000 gals. per 24 hours. The arrangement of the works, however, is such that they may be extended to an ultimate capacity of 30,000,000 gals. per 24 hours, and the main conduits will carry 45,000,000 gals. per 24 hours. A general plan of the works is given in Fig. 3.

Certain of the details, especially in the sprinkling filters, are somewhat different from what might be said to be current practice. The Columbus sewage purification works were the first designed, and at present are the largest of their type now under operation in the United States. When the works were designed in 1905 the only precedent was English practice, where the sewage treated was much stronger than is that at Columbus, and, while excellent results had been obtained from the English works, many of the details adopted there would hardly have been, and still would not be, suitable for works subject to periods of severe winter weather, as in Columbus.

During the last four years much thought and study have been given to improving the details of construction and operation of sprinkling filters in the United States, and while somewhat different details have been adopted in some of the more recent works, an examination of the designs seems to indicate that the details adopted and the experience obtained at Columbus have served as a basis from which to work.

Levee.—For protection from floods the works are surrounded by a levee about 6,100 ft. long, its top being 6 ft. above the highest recorded water level in the river and from 10 to 15 ft. above the ground. The levee is 16 ft. wide on top, and has side slopes of 1½ horizontal to 1 vertical, the inner slope being dressed with loam and seeded.

SEPTIC TANKS.

There are six septic tanks, four so-called primary tanks and two secondary tanks. They are shown in plan in Fig. 4, and some of the details are shown in Figs. 5, 6, 7, 8.

The primary tanks are 56 ft. 6 in. by 150 ft., and the secondary tanks are 115 ft. 6 in. by 262 ft. The tanks, throughout, are of concrete, are not covered, and are approximately 12 ft. deep to the high-water line. Each primary tank has a capacity of 710,000 gals. and each secondary tank 2,590,000 gals. The four primary tanks have a total capacity of 2,840,000 gals. and the two secondary tanks a total of 5,180,000 gals., making a grand total of 8,020,000 gals.

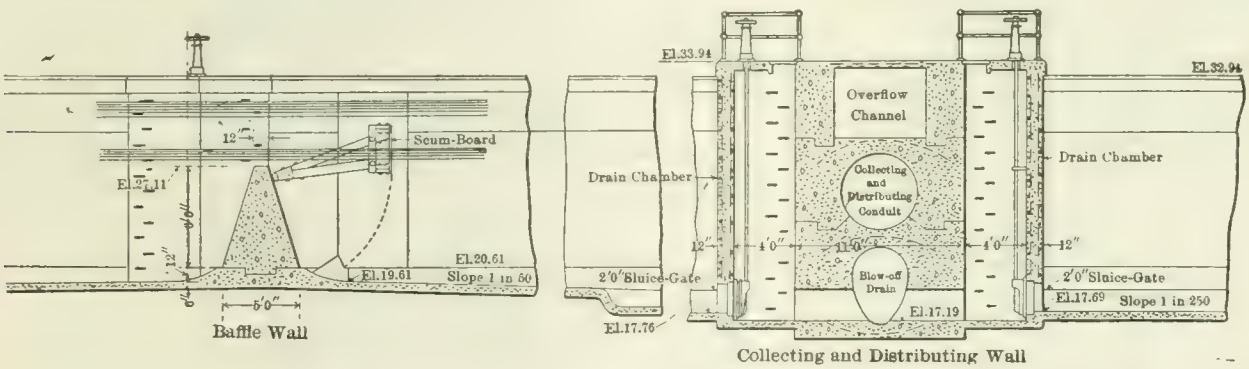


Fig. 6—Section Through Tanks Nos. 4 and 6.

Design.—The tanks were designed with the object of not only placing the outlets as far as possible from the inlets, but also of keeping the sludge as much as possible away from the outlets, this being accomplished by dividing the tanks longitudinally by transverse walls

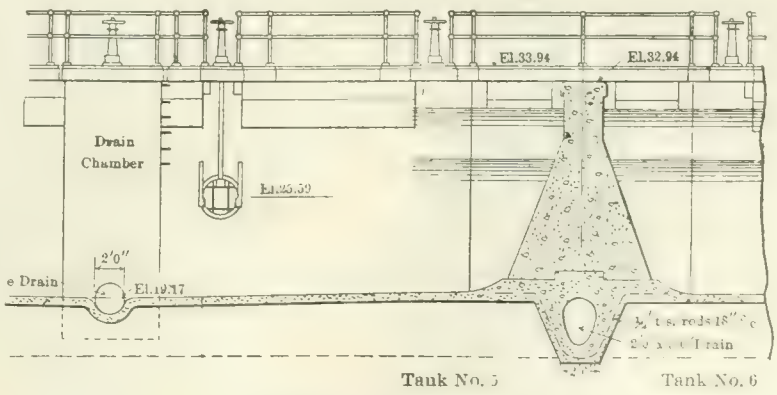


Fig. 7—Section Through Tank No. 5.

into three sections. To meet varying conditions in the character of the sewage and in the quantity treated, the design was made very flexible, it being possible to use any combination of one or more primary tanks with either or both secondary tanks.

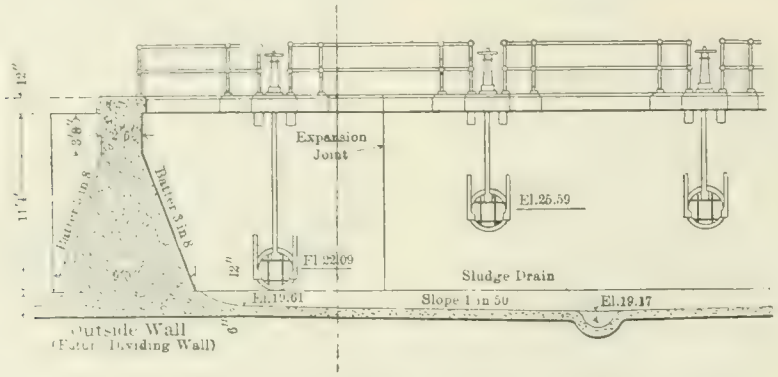


Fig. 8—Section Through Tank No. 1.

Operation.—As designed, the tanks were to be operated so that the rate of discharge from them would be practically constant during the 24 hours, the rate to be adjusted so that the total quantity drawn out would be as nearly as possible equal to the total quantity pumped in. As the rate of pumping varies from hour to hour, the surface level in the tanks, of course, fluctuates. With the mean hourly variation in the dry-weather flow, as determined during the experiments at the testing station, with the tanks all in service, and with a total flow of 20,000,000 gals. in 24 hours, the fluctuation would amount to about 3.1 ft., giving a minimum depth of about 8.9 ft. and a maximum depth of about 12 ft. in the tanks. On this basis, the average period of flow through the tanks would be about 8½ hours. In the operation of the works, however, it has been found that satisfactory results have been obtained by maintaining a constant level in the tanks, and the tanks are now operated in this way.

North Wall.—The 48-in. sewage force main terminates in a bell-mouth at the center of the north wall. The north wall is of a combined construction, consisting of a 5 ft. 6-in. reinforced distributing conduit carrying a small retaining wall above. Sewage is admitted into each primary tank from the top of the conduit portion through four 2-ft. sluice-gates, the center of the gates being about 2 ft. 8 in. below the low-water line in the tanks. By means of grooves and movable stop-planks, the distributing conduit may be divided into two sections, so that either half may be drained for inspection while the other half is in service.

Collecting and Distributing Wall.—The primary tanks are separated from the secondary tanks by a heavy wall of cored construction, called the collecting and distributing wall. In the middle of this wall there is a 5-ft. collecting and distributing conduit, sewage from each primary tank flowing into the conduit through four 2-ft. sluice-gates, and passing out into each secondary tank through eight 2-ft. sluice-gates. In the bottom of the wall there is a 3 ft. 4-ins. by 5-ft. blow-off conduit, and in the top there is an overflow channel which connects with the blow-off conduit below, sewage from the primary and secondary tanks flowing into the overflow channel over numerous weirs ranged along each side of the channel. These weirs would come into play only to prevent overflowing the outside walls of the tanks.

The sludge drains, in the primary tanks and in the upper section of each secondary tank, discharge, through small drain chambers, directly into the blow-off conduit in the collecting and distributing wall. In the lower section of each secondary tank the sludge drains discharge into a drain chamber located in the line of the dividing wall between the secondary tanks, and thence through a 2 by 3-ft. blow-off drain under the dividing wall into the blow-off conduit in the collecting and distributing wall. The arrangement of the sludge drains permits each primary tank and each section of each secondary tank to be drained independently.

Baffle Wall.—Each secondary tank is divided into two sections by a low baffle wall, to hold back the sludge at the bottom of the upper half of the tank, the top of the wall being about 1 ft. below low-water level. On the up-stream side of the wall, and hinged to it, there is a floating scum-board, of cypress, to hold back any scum which might form in the upper half of the tank.

Dividing Walls and Floors.—All the dividing walls have a gravity section. The east and west outside walls have the same section as the dividing walls, as they will become dividing walls when the tanks are extended. The floors are all 6 in. in thickness, and no special attempt was made to make them watertight, as it was thought that the joints between the floor-blocks would rapidly silt up and become tight.

Blow-off.—From the east end of the collecting and distributing wall a 3 ft. 4-ins. by 5-ft. blow-off conduit extends to a blow-off gate-chamber in the levee on the east side of the works, from which two blow-offs run to the river, the larger one, 4 ft. in diameter, having its outlet at the edge of the river. The smaller one, 16 ins. in diameter, extends out farther, and has three outlets in the center of and at the bottom of the river. All the outlets are protected by flap-gates, and in the gate-chamber each blow-off is fitted with a sluice-gate. The 4-ft. blow-off was provided to care for a large volume of sewage which might pass over the overflow weirs in the collecting and distributing wall, and the 16-in. blow-off is for use when the tanks are drained. For the present the sludge is disposed of in the river when the river rises and the dilution is sufficiently great, but the city has acquired a large tract of land, adjoining the works, and remote from buildings, which can be used for sludge disposal should this be found desirable or necessary at a later date.

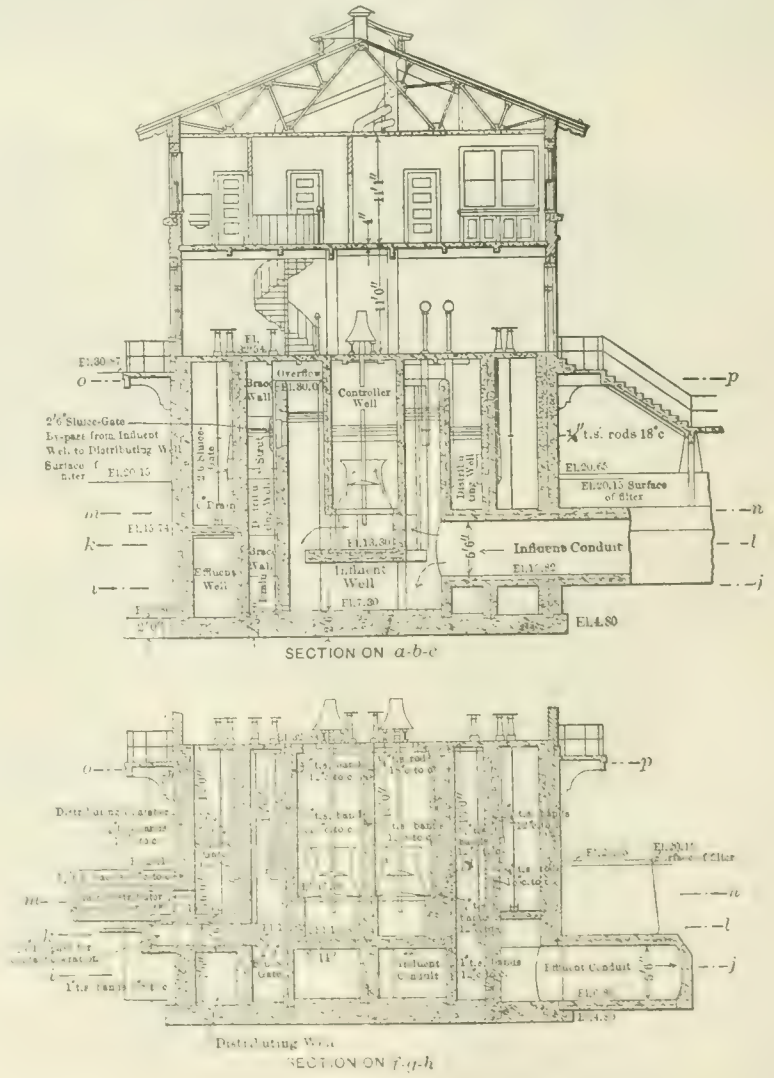


Fig. 9—Vertical Sections Through Gate House.

South Wall.—The south wall is similar in construction to the north wall, but the collecting conduit is not reinforced. The effluent from each secondary tank is drawn off through eight 2-ft. sluice-gates, a reinforced concrete baffle and a floating scum-board holding back the sludge and any scum which might possibly form.

GATE-HOUSE.

From the center of the south wall of the septic tanks the sewage flows through a so-called influent conduit to the gate-house. This conduit, 5 ft. 6 ins. in diameter, of reinforced concrete, is located under the dividing wall

between Filters Nos. 2 and 3. The flow from the septic tanks and to and from the sprinkling filters is controlled at the gate-house, some details of which are shown in Figs. 9, 10 and 11.

Substructure.—The substructure of the gate-house is of concrete, heavily reinforced, and its outside diameter is 38 ft. Sewage is first admitted from the influent conduit into an influent well, 15 ft. in diameter and 25 ft. 3 in. deep, located in the center of the substructure. The influent well encloses two controller wells, approximately elliptical in plan, each 6 ft. 6 ins. wide and 7 ft. long, through which the sewage flows out into an annular distributing well, 3 ft. in width, enclosing the influent well. From the distributing well the sewage passes into a series of distributing chambers connecting with the distribution systems in the filters. These distributing chambers are built in the upper portion of the outer annular well of the substructure, the lower portion being termed the effluent well, into which the effluent from the filters flow.

Fig. 10—Longitudinal Section Through Gate House.

Each controller well contains a specially designed controller, adjustable from a minimum capacity of 10,000,000 gals. to a maximum capacity of 22,500,000 gals. per 24 hours, and operating under a minimum loss of head of about 0.75 ft.

These controllers were installed to care for the fluctuating head in the septic tanks, but, on account of the change in the method of operating these tanks, with a constant level, the controllers are not at present in use. A description of them and their action, however, may be of interest.

The controller consists of a flaring tube in which a pressure disk, attached to a vertical stem, moves up and down. The rate of flow between the controller, therefore, is dependent on the annular area between the pressure disk and the flaring tube, and on the difference in head between the two sides of the disk. The upper end of the vertical stem is shouldered, and picks up successively, as it rises, a series of weights until the difference in head on the pressure disk is balanced. With a given position of the vertical stem relative to the nest of weights above, the controller maintains automatically a practically constant rate of flow, the pressure disk and stem rising as the level in the septic tanks rises, and falling as the level in the tanks falls. The rate of flow through the controller is varied by adjusting the position of the stem relative to the nest of weights.

With the quantity of sewage at present treated, only one controller ordinarily would be in service, it being set to discharge in 24 hours, as nearly as possible, the estimated quantity which would be pumped into the septic tanks during the 24 hours, but, in case the controller should be set too low and the septic tanks should fill up to the high-water line, and the rate of flow into the tanks should then continue in excess of the quantity discharged by the controller, this excess would pass over an overflow on the influent well into the distributing well and out to the sprinkling filters, by building up a greater head on the distribution systems. This overflow is set at a lower elevation than the overflows in the septic tanks, and would come into play before sewage would pass over the overflows in the tanks and out to the river.

In case of long-continued and excessively

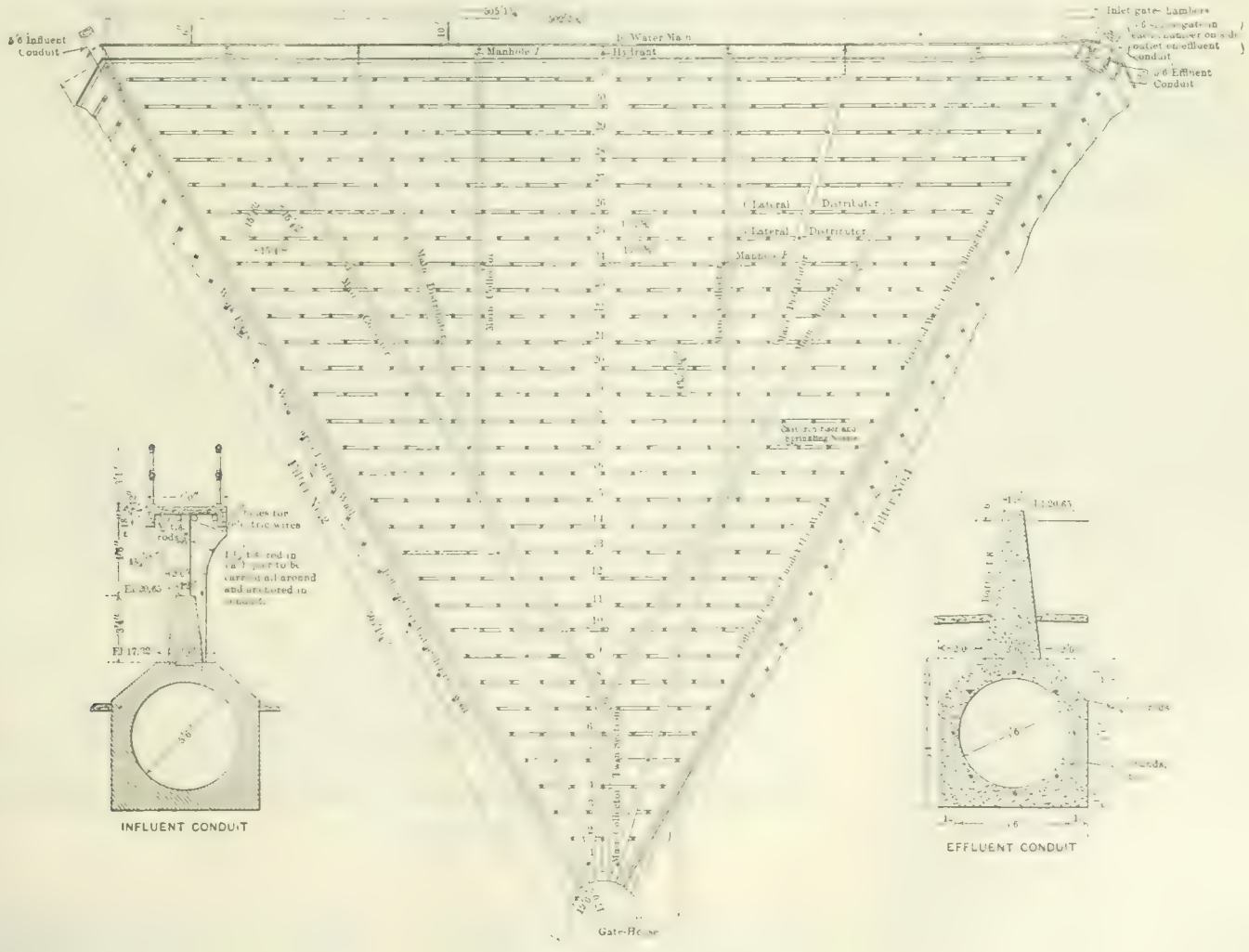


Fig. 11—Plan of Sprinkling Filter No. 3.

cold weather, provision has been made to operate the sprinkling filters as contact filters, if so desired. Under such conditions, the distribution systems would be shut off and drained, and the filters would be filled from below through by-pass gates and pipes leading from the distributing well. The main effluent gate of each filter, of course, would be closed while the filter was filling, and opened slowly during the period of draining. It is also possible to by-pass the filters entirely by shutting the outlet gates from the distributing well and opening the gates connecting the distributing well directly with the effluent well.

Superstructure.—The superstructure of the gate-house is also circular in plan, and is two stories in height. In the lower story are located the various stands for operating the sluice-gates and controllers, a chart recorder for showing the level in the septic tanks, an indicator for showing the head on the sprinkling nozzles in the filters, and a secondary indicator and chart recorder for giving the rate of flow through the 48-in. Venturi meter at the main sewage pumping station and thus through the force main into the septic tanks. The second story is divided into an office, chemical and bacteriological laboratories, a locker-room, and a lavatory containing a shower bath and sanitary conveniences. The character of the construction of the superstructure is similar to that of the superstructure of the main building at the water purification works, previously described.

SPRINKLING FILTERS.

There are four sprinkling filters, radiating from the gate-house, each being an equilateral

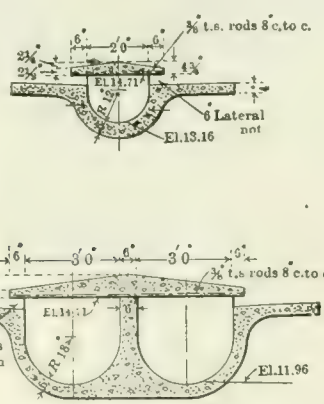


Fig. 13—Maximum Section of Main Collectors.

triangle in plan, 505 ft. 1¼ ins. on a side. With the construction of two additional filters, space for which has been reserved, they will form a hexagon with the gate-house at the center. Each filter has a net area of 2½ acres, making a total of 10 acres for all four, but as the distribution system in each filter has been designed so that one-half of the filter can be operated independently of the other half, the present installation, from the standpoint of operation, may be considered as consisting of eight filters of 1¼ acres each.

The filters are designed to yield normally 2,000,000 gals. per acre per 24 hours, resting one-half of the time, requiring therefore a rate of 4,000,000 gals. per acre per 24 hours when in service. It is possible, however, to operate them at somewhat higher rates. The details of the filters are shown in Fig. 11 to Fig. 15, inclusive.

Walls.—The outside and dividing walls were of concrete, and were designed simply as light retaining walls and not to resist water pressure on one side with no filtering material on the other. To provide access to the gate-house so that it can be reached when the two additional filters are constructed, without having to walk across the surface of the filters, an elevated reinforced concrete walk has been built above and is supported on the dividing wall between Filters Nos. 2 and 3.

Distributing System.—In order to provide protection from the frost, the distribution system is built below the surface of the filters, and consists of main distributors, lateral distributors, vertical risers and sprinkling nozzles. The main distributors, of which there are two in each filter, are of reinforced concrete, 2 ft. 6 ins. in diameter, and radiate from the gate-house. Connecting with the main distributors are the lateral distributors, which consist of lines of 5-in. and 6-in. vitrified sewer pipe supported by and bedded in the upper part of small concrete walls. From outlets in the top of the main distributor, and from sewer pipe branches set vertically in the later distributors, 3-in. cast-iron risers extend to the surface of the filters, the sprinkling nozzles being screwed into the upper ends of the risers. The joint at the base of each riser is made with lead caulked into the vitrified pipe socket. The distribution system in each filter is designed so that when shut off it can be drained out back to the gate-house.

The sprinkling nozzles are 15 ft. 4 ins. from center to center, and the arrangement being such that the straight lines connecting three adjacent nozzles from the sides of an equilateral triangle. The nozzle, Fig. 16, is of brass, and consists of a single orifice, 9/16 in. in diameter, with rounded edges, above which, held by two thin arms, there is an inverted 90° cone, the axis of the cone coinciding with the axis of the orifice. The jet on leaving the orifice impinges against the cone and is transformed into a thin sheet, spreading out radially and breaking into a shower of fine drops At the points where the sheet strikes the arms the latter are ground down to sharp edges on each side in order to permit the sheet to heal up after passing them. When the filters are operating at a rate of 4,000,000 gals. per acre per 24 hours each nozzle will discharge approximately 13.1 gals. per minute under a head of 5 ft. available at the nozzle. There are 2,108 nozzles in the 10 acres of filter surface, about 211 nozzles per acre, the area tributary to each nozle being 206.0 sq. ft.

The experimental investigation at the testing station demonstrated that satisfactory results could be obtained when operating nozzles under a constant head, and the works were designed with this in view. It has since been found that better results are obtained if the head is allowed to fluctuate, and the filters are now operated in that manner, the head on the nozzles being varied from hour to hour by hand, by throttling the sluice-gates in the gate chamber. Modifications in the gate-house are being contemplated whereby the head will be made to fluctuate automatically.

Filtering Material.—The filtering material consists of broken stone having a total average depth of about 5 ft. 4 ins., the lower 10 ins. being from 3 to 4 ins. in size. In Filters Nos. 1 and 2 the material above the lower course has a nominal size of from 1½ to 3 ins. The material was sampled carefully from time to time, and mechanical analyses were made from which it was found that the effective size was 1.4 in. and the uniformity coefficient 1.4, and that the average size of the stone was 1.7 ins., that being the diameter of a sphere of equal volume. In Filters Nos.

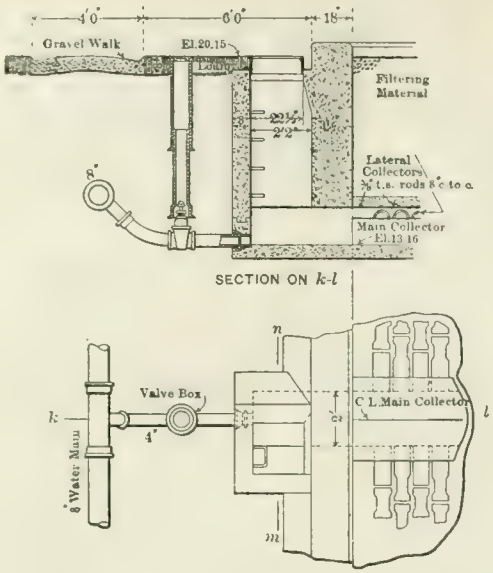


Fig. 12—Detail of Main Collector.

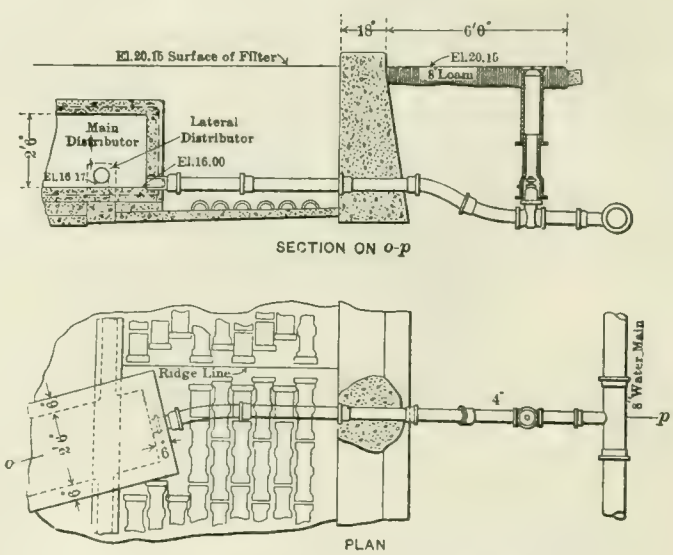


Fig. 14—Detail at End of Main Distributor.

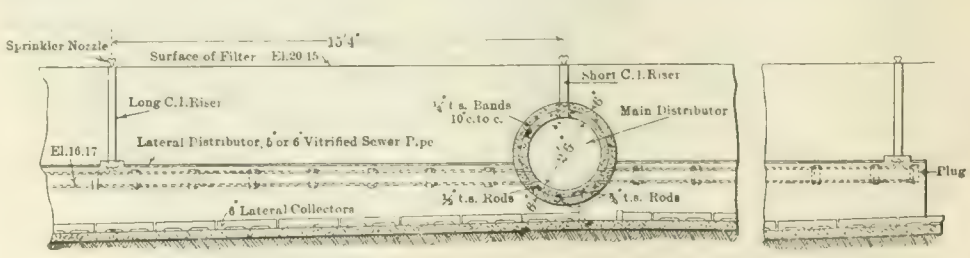


Fig. 15—Section Through Main Distributor.

3 and 4 the material has a nominal size of from 1 to 3 ins., an effective size of 1.1 ins., a uniformity coefficient of 1.6 in. and an average size of 1.5 ins. The material is all limestone, obtained partly from quarries near Columbus and partly from Marion, Ohio, and was screened at the quarries to remove the dust and fine particles and to obtain material of the right size.

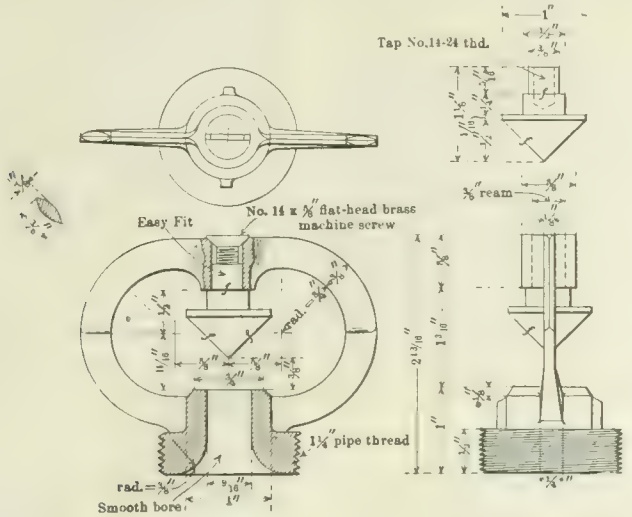


Fig. 16—Columbus Sprinkling Nozzle.

Collection System.—For removing the effluent from the filters, a very free-draining bottom has been provided, consisting of lateral collectors discharging directly into main collectors. The lateral collectors are 6-in. vitrified channel pipe, with the sockets left off, notched on both edges, and laid in parallel lines, a space of ¾ in. being left between each two pipes longitudinally. The floors of the filters, which slope to the main collectors, are of concrete, 4 ins. thick, the edges of the lateral collectors being bedded on the floor before the concrete had obtained its initial set.

The main collectors, which are of concrete, below the level of the floor of the filters, have a semicircular invert with vertical sides above and gradually increase in section toward the gate-house. The flow line is below the level of the filter floor, so that the ends of the lateral collectors will not be submerged. The main collectors in each filter discharge into a common sump and thence into the effluent well in the gate-house, the flow line in the sump being below the level of the invert of the lower end of the main collectors, so that when a main collector is not in use it will drain out completely. Manholes furnish access to the main collectors, for inspection.

SETTLING BASINS AND OUTFALL.

From the substructure of the gate-house the effluent from the sprinkling filters flows through a so-called effluent conduit, to an inlet gate-chamber, then through the gate-chamber and through two inlet conduits to the settling basins. The effluent conduit is of reinforced concrete, is 5 ft. 6 ins. in diameter, and is located under the dividing wall between Filters Nos. 3 and 4.

Inlet Gate-Chamber and Conduits.—The inlet gate-chamber is of concrete, and is all below the surface of the ground; that part in connection with the effluent conduit is heavily reinforced. The flow from the effluent conduit is controlled by two 5½-ft. sluice-gates. The inlet conduits are also 5½ ft. in diameter, and are of concrete but are not reinforced. The sewage is admitted from the inlet conduit into each settling basin through fifteen 21-in. vitrified sewer pipe inlets terminating in a low wall.

Settling Basins.—The effluent from the sprinkling filters is not perfectly clear, and, to remove the heavier particles in suspension, it is at times allowed to flow through one or both settling basins before passing out to the river. Each settling basin has a capacity of 2,000,000 gals. and, with one basin in use, and when handling 20,000,000 gals. of sewage per 24 hours, the average period of flow through the basin would be a little less than 2½ hours. The basins are from 4 to 4½ ft. deep, the water line being about 5 ft. above mean low water in the river.

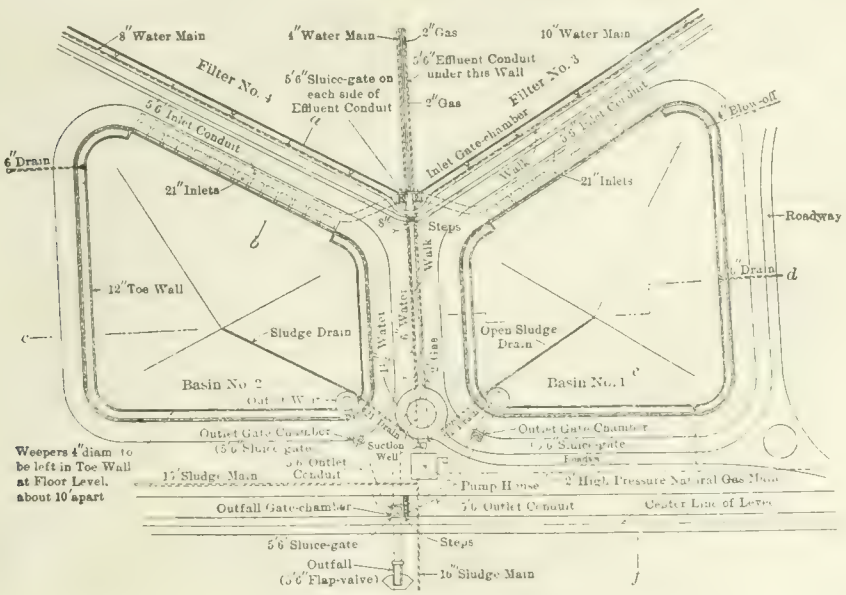


Fig. 17—Plan of Settling Basins.

The basins are not covered, and are all in excavation. As originally built, the side slopes were 3 horizontal to 1 vertical, and were not paved or otherwise protected, except that above the water line the slope was grassed; the berm at the foot terminated at a low toe-wall, 12 in. high. On account of lack of funds, when the works were designed, it was decided to omit retaining walls around the sides of the basins, but, funds having become available since the works were completed, the retaining walls were built during the summer of 1909. The floors are of concrete, 4 ins. thick, and simply provide a suitable surface for the flushing out of sludge. No attempt has been, or will be, made to exclude ground-water, on the contrary, weep-holes, 4 ins. in diameter and 10 ft. apart, have been left in the toe-wall, so as to admit ground-water and prevent an upward water pressure on the floor.

The effluent from each settling basin flows off in a thin sheet over a circular outlet weir, 19 ft. in diameter, floating matter being held back by an easily removable sheet-steel scum-board. Some details of the settling basins are shown in Figs. 17, 18 and 19.

Outlet Conduits and Outfall.—From the outlet weirs the effluent from the settling basins flows through the outlet conduits to the outfall gate-chamber and thence to the outfall on the bank of the river. The outlet conduits are 5½ ft. in diameter, and are of reinforced concrete. On each of these conduits

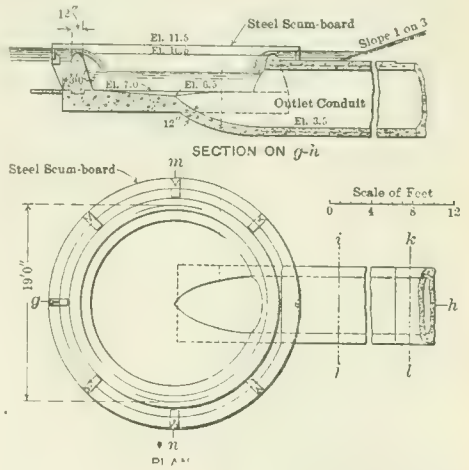


Fig. 18—Outlet Wier for Settling Basins.

there is an outlet gate-chamber containing a 5½-ft. sluice-gate, so that either or both basins may be shut off when desired. At the outfall a 5½-ft. flap-gate has been provided, and, in the outfall gate-chamber, there is a sluice-gate of the same size, for use in case the flap-gate should fail to seat tightly during high water in the river, when it might be desired to shut down the works. From the inlet gate-chamber the effluent conduit is extended to the outfall gate-chamber, and serves as a by-pass around the settling basins, by closing the gates in the inlet and outlet gate-chambers.

PUMP HOUSE AND CONNECTIONS.

A small suction well and pump house have been built to discharge the sludge accumulating in the settling basins. The pump is a horizontal, volute, with 12-in. suction and 10-in. discharge. The capacity is 3,000 gals. per minute against a head of 14 ft., and 2,000 gals. per minute against a head of 26 ft. when pumping a mixture weighing 75 lbs. per cu. ft. The well and the substructure of the house are of concrete, the superstructure being of the same first class construction as the gate-house. One 15-in. sludge main terminates at present at the site of the garbage reduction house. The other sludge main is 16 in. in diameter and extends out into the river.

Loss of Head.—The total loss of head through the works, from high-water line in the primary septic tanks to mean low water in the river, is 25.34 ft., and, without giving all

the individual losses through gates, conduits, etc., may be summarized as given in Table I. It should be stated that the losses are computed on the basis of the works handling a maximum quantity of 45,000,000 gals. per 24 hours.

TABLE I.—LOSS OF HEAD THROUGH WORKS.

Location.	Elevation, in feet above city datum.	Loss of head, in feet.
High-water line, primary septic tanks	31.34	....
Low-water line, primary septic tanks	28.24	3.10
Hydraulic grade at sprinkling nozzles	25.15	3.09
Surface of filter	20.15	5.00
Hydraulic grade, lower end of main collector	13.77	6.38
Hydraulic grade, effluent well in gate house	11.96	1.81
Water line, settling basins	11.00	0.96
Mean low water in river	6.00	5.00
Total		25.34

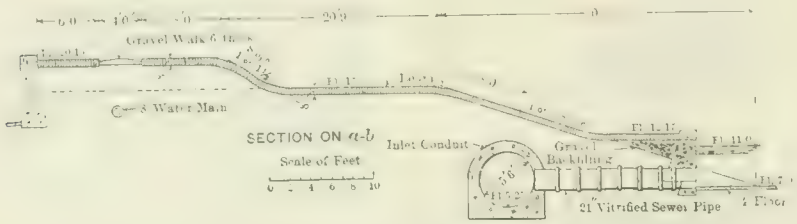


Fig. 19—Section Through Part of Settling Basin.

Operation During Freshets.—With a 5-ft. rise in the river, the settling basins would be shut off, but the filters could still be operated under normal conditions. With a total rise of 7 ft. in the river the filters would cease to be free-draining at the bottom, and would probable be shut off. It would be possible, however, still to operate the filters with a greater rise than 7 ft. in the river by allowing them to fill up with sewage sprayed on from the sprinkling nozzles until the filters were full up to the surface. Whether or not this method of operation would be satisfactory can only be determined by trial. At the best, however, operation at such times would require the most careful supervision, as the river may easily rise at the rate of 0.75 ft. per hour, and, unless the filters were shut off at the proper time, the outside walls would be overflowed. Again, if, for any reason, the flap-gate at the main outfall should become deranged at such a time, the river, which is highly turbid during freshets, might back up into the filters and deposit a large amount of mud, a result which would be simply disastrous, as in all probability the stone would have to be removed from the filters and washed, and the filters themselves would have to be cleaned and washed out. Assuming, however, that the filters are shut off with a 7-ft. rise in the river, the septic tanks can still be operated, even up to maximum high water in the river, the effluent from the tanks flowing to the gate-house, through the by-pass between the influent and effluent wells, and then out through the effluent conduit directly to the river.

CONCRETE.

In the construction of the sewage purification works, concrete, both plain and reinforced, was used extensively. The relative volumes of cement, sand and ballast in the several classes of work were as follows:

Mean low water in river..... 6.00 5.00

1 : 2 : 4.—Water-tables, belt courses, window-sills, lintels, etc.; sub-structure of gate-house (except foundation floor), and walk over influent conduit wall; reinforced floors, columns, stairways, and steps.

1 : 2½ : 5½.—Sprinkling filters, settling basins, collecting and distributing, and north and south walls of septic tanks; conduits and blow-offs, foundations and miscellaneous small structures.

1 : 3 : 7.—East and west outside walls, baffle walls, and dividing walls of septic tanks (except collecting and distributing wall).

The specifications for the concrete were similar to those for the water purification works, and the method of mixing and placing the material was practically the same. The expansion joints, which were built where necessary, consisted, however, only of a tongue and groove in the concrete, no steel plates being used. The tongues and the grooves were well reinforced, both vertically and horizontally, with twisted steel rods.

TABLE II.—UNIT COSTS OF MAIN FEATURES OF WORK.

Work.	Capacity.	Total cost.	Unit costs.
Buildings.			
East Side Sewage Pumping Station.			
Superstructure	25,700 cu. ft.	$ 5,480	21.3 cts. per cu. ft.
Main Sewage Pumping Station.			
Substructure	110,200 cu. ft.	25,710	23.4 cts. per cu. ft.
Superstructure	248,600 cu. ft.	29,010	11.7 cts. per cu. ft.
Total	358,800 cu. ft.	54,720	15.3 cts. per cu. ft.
Gate-House, Sewage Purification Works.			
Substructure	31,700 cu. ft.	23,439	73.9 cts. per cu. ft.
Superstructure	29,800 cu. ft.	7,620	25.6 cts. per cu. ft.
Total	61,500 cu. ft.	31,050	50.5 cts. per cu. ft.
Pump House, Sewage Purification Works.			
Superstructure	9,900 cu ft.	1,990	20.1 cts. per cu. ft.
Septic tanks	8,020,000 gals.	$66,730	$8,320 per mil.gals
Sprinkling filters	10 acres	240,400	24,040 per acre.
Settling basins	4,000,000 gals.	37,920	9,480 per mil. gals
Sewage Purification Works.			
Levee, railroad spurs and culvert		$15,530	$ 780
Roads, walks, grading and drainage of grounds		3,590	180
Water and gas mains		6,510	330
Septic tanks		66,730	3,340
Blow-off from septic tanks		6,710	340
Walk on influent conduit wall		1,620	80
Influent conduit		5,890	290
Gate-house		32,910	1,640
Sprinkling filters	20,000,000 gals. per 24 hrs.	240,400	12,020 per million gals. per 24 hrs.
Effluent conduit		14,380	720
Inlet and outlets to settling basins		14,030	700
Settling basins		37,920	1,900
Pump-house and suction well		7,660	380
Sludge force mains		1,610	80
Engineering and Incidental		860	40

PROGRESS OF WORK.

The first bond issue was authorized in November, 1903, and the preparation of the first drawings and specifications began early in 1904. The first work placed under contract was the testing station, in May, 1904. Additional contracts were let during 1904 and 1905, and in November, 1905, the purification works were placed under contract. The work was all practically completed by the fall of 1908, although the last contract, for the concrete walls around the settling basins, at the purification works, was not let until April, 1909. Sewage was first pumped regularly to the purification works on November 28, 1908.

The total cost, including the experimental investigation and all engineering, was $1,351,020. The cost of engineering was as follows: Pay roll, $90,280; supplies, $6,450; expenses, $10,280; total, $107,550; equivalent to 8.98 per cent of the cost.

Mr. Gregory was in direct charge of the design and construction of the work, with the titles, successively, of Engineer of Design, Principal Assistant Engineer and Engineer in Charge. Messrs. Rudolph Hering and George W. Fuller acted throughout as Consulting Engineers.

Water Service Costs.—The following figures are given in the Report of the Louisville, Ky., Water Co.: The average cost of ⅝-in. services in 1907 prior to May 1 was $18.23; at present the same services are being installed at an average cost of $11.05. Formerly the water company installed these services at its own expense, but since Jan. 1, 1908, the consumers have been charged with this cost, resulting in a saving to the company of $35,014.22. On the basis of material at the same price, in 1907 prior to May 1, the cost of laying 6-in. pipe was $1.07 per foot; the cost at the present time is 70 cts. per foot. The cost of labor and fuel per million gallons for pumping at the river station in 1907 was $5.56; in 1909 it was $2.45. At Crescent Hill station, which was a modern plant just started, it cost $4.20 per million gallons in 1907 and $2.35 in 1909.

The prairie section of the Grand Trunk Pacific, which extends from Winnipeg to Wolfe Creek, a distance of 917 miles with its branches, serves a large grain-growing and mixed farming country. In addition the railway's route is over the interior plain or plateau of northern British Columbia, between Fort George, on the Fraser River, and Prince Rupert; the entire area, with but few exceptions, being suitable for either farming or ranching to a distanc of within about 100 miles of Prince Rupert. The interior plateau referred to is approximately 400 miles long and stretches north to the Peace River and south an approximate distance of 75 miles, containing about 50,000 square miles of territory, 25 per cent of which is suitable for grain growing and the production of the hardier fruits. There are in this section also considerable mineral deposits and much coal of bituminous and some of anthracite character. The cost of the prairie section has been about $35,000 per mile (figures furnished by the Grand Trunk Pacific officials). There is $2,000,000 worth of heavy bridge work yet to be done in order to preserve the low grades throughout. The Grand Trunk Pacific claims that it will save approximately 500 miles, operating from Prince Rupert to Yokohama, over the present grain-carrying route to the Orient via the Suez canal.

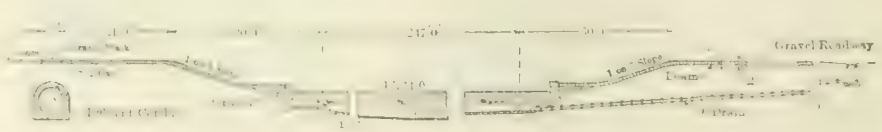


Fig. 20—Section Through Part of Settling Basin.

Unclassified and General Articles

Note: This section is devoted to methods and cost articles on construction work not properly coming under any of the preceding classifications.

Panama Canal Excavation for the Calendar Year 1909.

From figures given in the "Canal Record," the grand total of excavation on the Panama Canal for the calendar year 1909 was 35,096,166 cu. yds. This was 2,020,569 cu. yds. less than the grand total of 1908, for the reason that the field of operations in dry excavation had been narrowed by the completion of the work in certain sections, and because in wet excavation the dredges encountered more difficult conditions. While 1908 will stand in the record of canal work as the banner year, the highest point touched in a single month was that of March, 1909, when for the first and only time the 4,000,000 cu. yd. limit was reached and passed with a total of 4,062,632 cu. yds., including 182,295 cu. yds. of "plant" excavation.

The falling off in excavation from the total of 1908 was 1,241,467 cu. yds. in dry excavation work, and 779,102 cu. yds. in dredging.

Of the total dry excavation in 1909, there were taken out in the territory of the Central Division, which includes Culebra Cut and the Gatun Lake region, 18,299,526 cu. yds. The increase in the effectiveness of the steam shovel work is seen from the following comparison of the excavation per shovel day in 1908 and 1909:

Month.	—1908— No. shovels at work.	Cu. yds. per shovel day.	—1909— No. shovels at work.	Cu. yds. per shovel day.
January ..	51.53	1,040	51.80	1,183
February ..	54.00	1,112	56.05	1,260
March	53.65	1,159	56.93	1,328
April	53.04	1,191	55.40	1,284
May	53.24	905	50.60	1,185
June	53.15	1,011	45.65	1,243
July	52.58	1,071	45.08	1,207
August ...	52.58	1,123	46.73	1,133
September..	49.68	1,180	46.60	1,248
October	49.55	1,185	47.23	1,230
November..	50.91	1,155	41.75	1,161
December...	50.73	1,210	43.15	1,123

The work is affected by the rainy season from May to December.

In Culebra Cut, where the excavation was continued on practically the same scale as in 1908, the amount excavated was 14,579,838 cu. yds. in 1909, as compared with 13,914,326 cu. yds. in 1908. Although it is considered that the maximum excavation in the cut is that of March, 1909, it is also expected that there will be little, if any, falling off in the total excavation in this part of the work during the present year. The work of widening the channel between Las Cascadas and Paraiso, a distance of 4½ miles, from 200 to 300 ft. at the bottom, was authorized in October, 1908, and during 1909 the excavation was carried on with this end in view. The consequent opening up of new banks caused a number of slides that were a source of inconvenience during the rainy season. The completion of the drainage system by opening the Obispo Diversion and installing pumps at Bas Obispo was another feature of the work in Culebra Cut during 1909.

At the Atlantic and Pacific entrances to the canal the dredges have made, but not completed, a channel over 5 miles into the land, and the Pacific entrance was so far advanced on Feb. 1 that steamships began to use that portion of the canal.

At Gatun Locks, the preparatory work of installing the concrete mixing and handling plant was completed, and the laying of concrete with the permanent plant was begun on Aug. 24. Since then there has been a steady increase in the amount of concrete laid each week, due to increasing effectiveness in the plant and in its operation. Up to the close of the year 116,186 cu. yds. of concrete had been laid, and the daily average had increased from 459 cu. yds. in September to 1,672 cu. yds. in December, while in one instance over 2,000 cu. yds. were placed in one day of 12 hours. The estimated amount of concrete necessary for completing these locks is 2,096,000 cu. yds.

The hydraulic fill between the rock toes of Gatun Dam was begun on Dec. 24, 1908, and the results accomplished in this work belong, therefore, to the year 1909. From one to three 20-in. suction dredges have been engaged and they have pumped 2,044,992 cu. yds. of selected material into the dam. The dry fill now amounts to 2,515,524 cu. yds., the total being 4,560,516 cu. yds. The estimated fill to be made by the hydraulic method is 20,000,000 cu. yds. On Feb. 17, 1909, by order of President Roosevelt, the proposed height of the dam was reduced from 135 ft. above sea level to 115 ft., which will make the top 35 ft. above the normal level of the water impounded in Gatun Lake.

One week after the laying of concrete, with the permanent plant, was begun at Gatun Locks, a temporary plant was put in operation at Pedro Miguel and the laying of concrete in the locks at that point was begun. This temporary plant laid 33,994 cu. yds. of concrete between Sept. 1 and Dec. 31. The estimated amount to be placed at this point is 922,600 cu. yds. Work on the cantilever cranes for the permanent handling plant is in progress. The construction of the earth dam at Pedro Miguel was continued during part of the year.

At Miraflores, excavation in the upper lock chamber was practically completed during the year; excavation in the lower lock chamber was continued, and the work of building storage trestles for the cantilever concrete mixing and handling plant was begun. A total of 557,587 cu. yds. of filling had been placed in the dam at Miraflores Locks up to Dec. 31.

LETTERS TO THE EDITOR.

Utilizing Natural Gas from Artesian Wells for Fuel for Boilers.

Sirs:—The state of South Dakota has just completed an artesian well on the state capitol grounds at this place and a large flow of water has been obtained. From measurements made by this Department, the flow has been found to be approximately 5 cu. ft. per second of water at a temperature of 95°. This water is under a pressure of about 165 lbs., equivalent to a head of 380 ft. The water coming from this well carries a large proportion of natural gas, estimated to be of about one-sixteenth of the total flow. The city of Pierre has been using natural gas from two wells for a number of years for heating, lighting and power purposes.

On account of the large volume of water and the heavy pressure of same, it has been proposed to utilize the flow for generating electric current for lighting the new capitol building. In the process of passing through impulse wheels, it is expected that the gas will be liberated from the water and collected in a gas holder. The quantity of water thus furnished will be considerable and it is proposed to utilize this gas under our boilers in boiler room of power house for generating steam to run our generators in the engine room, the exhaust steam being utilized for heating the building. I am looking around for some efficient method of applying the natural gas to the boilers for heating same, thus doing away with the use of coal, which is a very expensive item in this locality.

If you can furnish me any information concerning manufacturers or dealers handling appliances by which the gas can be used in the method above designated, it will be appreciated.

Thanking you in advance for the courtesy, I am,

Yours very truly,

SAMUEL H. LEA,
State Engineer.

Pierre, S. Dak., Feb. 2, 1910.

The Action on Concrete of Salts in Mixing Water.

Sirs:—In the voluminous discussion of concrete much is said of cement, sand, gravel and the grading of ingredients, but nothing of water other than an occasional statement as to quantity. Do minerals and salts in water affect concrete? What is the action of alkali water on concrete?

My experience on three or four occasions has shown that concrete will not set satisfactorily when alkali water is present. In one instance which admits of comparison, I built two manholes less than four hundred feet apart, one on high and the other on low ground. Hole No. 1 contained no water. In Hole No. 2 there was six inches of seepage water. For mixing concrete for the floor of hole No. 1 I hauled water from a city hydrant. For Hole No. 2 I mixed the concrete dry and used the water in the hole for wetting. This water was alkali.

Twenty-four hours later the floor of Hole No. 1 was set and in good condition. The concrete in Hole No. 2, however, was still very soft. After six days, inspection showed that this concrete had not set. It should be stated that the water in the hole was below the flow line of the sewer and hence there was no action tending to wash cement out of the concrete.

On another occasion when I was in charge of the construction of a large vitrified pipe sewer, we were filling the joints with oakum and cement mortar, using the alkali water from the trench for mixing. I demonstrated to the satisfaction of the engineer in charge that the mortar did not set properly and he authorized the use of gumbo mud for calking joints.

It is often necessary especially in the Western States to place concrete where alkali water is present. If alkali affects cement what can be used to counteract it?

Yours truly,

F. B. INGERSOLL.

Belle Fourche, S. D., Jan. 28, 1910.

(Our impression is that practically every treatise on concrete and every text book mentions the necessity of using clean water and many of them warn against the use of alkali water. Compounds of many elements in nature dissolved in water form a compound known generally as alkali having the property of neutralizing acids. Sulphates in water seemingly improve the concrete. An excess of calcium or magnesia apparently hurts the concrete. The general opinion seems to be that the process is one chiefly mechanical in nature, the dissolved compounds continuing to expand and thus interferring with the setting of the concrete, acting in this way as frost when thawing out of partially set concrete. Some authorities believe there may be a chemical action as well. It is wise to avoid entirely the use of alkali water, but if it cannot be avoided then use as little as possible and increase the amount of cement, tamping the concrete to make it dense. So far the result of experiments indicate that rich dense concrete is not affected or is affected very slightly. A very small amount of soda ash will make cement set rapidly and rapid setting cement should be used where alkali water is the only kind that can be had, even if it is necessary to add soda ash to obtain this result. An over limed cement might be most readily attacked by alkali water so an analysis of the cement would be desirable. There being several kinds of alkali, a competent chemist should pass on the water before use, for some alkali water is harmless if judiciously used. Pamphlets on the subject of effects of alkali water on concrete have been issued by the agricultural colleges at Bozeman, Mont., and at Fort Collins, Colo. It was reported some time ago that the United States Geological Survey intends investigating the subject. A summary of the latest discoveries and investigations of the effects of alkali waters on concrete will be found in ENGINEERING-CONTRACTING for Jan. 5, 1910. It might be added that the laying of concrete in a hole containing six inches of water, even if the water is clean, is not first class practice. A small sump should have been dug and the hole pumped out. The sump

should be kept bailed out for an hour or two after the concrete was placed, when it could be filled with a dry, rich, tamped concrete.—Editors.)

Percentage Bidding and Forms of Building Contracts.

Sirs:—The editorial on percentage bidding and the paper by Mr. Bamford in your issue of Jan. 12, 1910, raise several points of interest to contractors on which we should like to comment briefly.

First, as to percentage bidding and bidding on engineers' units or quantities. The great difficulty and the cause of many unbalanced bids appears to us to be the fact that the engineers' units of cost are not the contractor's units. Until engineers' quantities represent item by item the actual operations of the proposed work, it will not be possible for competing contractors to make bids which compare closely with one another. For instance, in bidding recently on a bridge, four different classes of concrete (Class A, Abutments; Class B, Center Piers; Class C, Arches; Class D, Parapet) were given, and the contractor's price on these had to include cofferdams, pumping, excavation in river bed, dry excavation for abutments, forms, and surface treatment. No doubt it saves trouble for the engineer to decree that concrete only should be measured, but the contractor is invited to gamble on whether Class A concrete (abutments) would necessitate close sheeting to its excavation and pumping; and in Class B (center piers), each foot in depth below water line would enormously increase the cost of the units. On the same job, Class D (measured in linear feet) included cast stone balusters, concrete pedestals and coping, and cast iron lamps and glass globes.

On another similar job before the writer, Class D, concrete, includes granolithic paving, iron manhole covers, and concrete parapet walls and balusters.

In the case of concrete walls of, say, 12 ins. in thickness, to be paid for by the cubic yard, including forms and finish. If the engineer elects to reduce the thickness of the wall to 8 ins., the contractor has to do just as much form work and finish although he gets paid for only two-thirds the amount.

We could multiply instances, but these are typical of unit prices on which contractors are continually being asked to bid, and it is small wonder that the range in bids is very marked. In the writer's experience it is generally necessary to take off fifteen to twenty items to make up a unit price on one of an engineer's units, and it requires much more time and trouble to bid on unit prices than on a lumpsum, and the results to the contractor are much less certain, by reason of the fact that a small increase in yardage of concrete or excavation, as the case may be, may necessitate expenditure on his part which could not be foreseen or calculated; or a decrease may deprive him of remuneration for work necessary to the completion of the contract but not itemized on the engineer's schedule.

It would seem that if the engineer also priced his units before sending to the contractor, a further speculative element would be introduced, as it would be impossible to reconcile the engineer's unit prices with the contractor's, and the contractor must base his plus or minus percentage bid on the assumption that the quantities will turn out exactly correct or else "take a chance" on certain items being in excess and bid accordingly. The alternative to this would be to bid a different percentage on each unit.

Even if the engineer were to prepare an accurate bill of quantities with all the items set out therein that a contractor would price in estimating contractors' prices vary so largely, owing to differences of method, of equipment, of cost keeping, and of judgment in estimating, that no two would be likely to bid in like proportion on every item, and the engineer's bid would still be of no use.

The percentage system of bidding has been tried in England, where quantities are certainly accurately prepared and go into an immense amount of minute detail, but the system has never found favor and is very seldom used. Two public bodies, the War Office and the London School Board, have priced schedules running into hundreds of pages and thousands of items, but their use has been limited to jobs not exceeding $500, as they are not found to work satisfactorily.

Secondly, as to lumpsum contracts, Mr. Bamford in his paper expresses his preference for the lumpsum contract, which is gradually being superseded by the other types of contract he mentions in the jobs of many of the best contractors and most progressive building owners of the country; and Mr. Bamford himself says: "Such a system presupposes that the contract (specification?) defines the work to be performed and that the contractor, therefore, can determine accurately what the execution of such work shall cost." It is the writer's experience that this is never the case, and, however clear the drawings and specification may be, and however accurately the conditions of the work may be predetermined, the business experience of this company during the last 16 years shows that neither in any item or on the sum total of any contract is it possible to determine accurately what the execution of a job will cost, and we believe that our system of cost-keeping and methods of estimating are considerably more accurate and careful than those usually employed. Any contractor who keeps an accurate record of costs will bear out the truth of this statement in their experience.

The result therefore of working under a lumpsum contract is that at the end of a job the contractor either finds that he has made more profit than he would have been willing to take the job for; or, as is more usual, the job has cost more than he thought and his profit is less than he estimated. It is obvious, therefore, that as far as the owner's interests are concerned, the lumpsum contracts are usually the most economical, as Mr. Bamford states.

There is a growing feeling among building owners of the better class that "the laborer is worthy of his hire," and a growing desire on the part of the better class of contractors to take only those contracts which insure a fair profit on their work; and this is leading to a more general adoption among private owners of the various percentage and fixed-profit contracts enumerated by Mr. Bamford. The monetary advantage of "catching a sucker" on a lumpsum contract is usually more than offset by the trouble of making him perform his contract, vexatious claims for extras, poor work, scamping, delays and disputes; and in looking up work which we have failed to get, many owners, who have accepted low bids, have afterwards expressed to us their wish that they had let their contract to a better contractor at a higher figure. The owner will, after all, get only what he is paying for, and we do not hesitate to tell owners that they can probably get reinforced concrete buildings more cheaply than we would be willing to build them, by taking bids in open competition; and with these statements we are securing more and more of the better class of business for the best class of manufacturers.

Thirdly, we wish to relate some of our experiences in regard to use of copies of quantities and adjustment of variations as provided for in Sections XVI, XVII and VIII of Mr. Bamford's paper. This is almost always done in England and works well, but the system is full of pitfalls for the unwary and should be adopted with caution. It has been the practice of this company to be unusually frank and open in the matter of showing estimates to owners and engineers. Recently, in taking a contract for some large concrete mill buildings, we deposited the estimate with the architect that he might copy it for use in adjusting any variations. In making the estimate, we had only sketch plans of a brick-and-timber structure to work from, and had to assume all details necessary to give the same accommodation in a concrete building with brick curtain walls, and guaranteed that cost of same should not exceed a certain figure. The architect gave a copy of the estimate to the owner and he discovered by measurement that the estimated quantity of brickwork was largely in excess of that actually laid, and thereupon asked for an adjustment. The reason for the discrepancy was that we had figured on smaller windows than had been put in and more brickwork, and the amount we had saved in brickwork we had lost in windows, but we could not succeed in satisfying the owner on the point, as the number of windows was the same. The terms of the contract did not permit of this being considered a variation, and though our legal position was clear, we preferred to give way and remain in good standing with the owner rather than fight it out.

Again on another job gained in competition by a narrow margin, we deposited a copy of the estimate with the engineer. When the job was nearly finished, the owner decided to build another building close by. The engineer made plans and figured it upon our estimated prices. We had found that through unforeseen circumstances and unexpected difficulty in one portion of the work, some of our prices had not been remunerative, and when the new plans came to us to estimate upon, we raised the prices of these items, with the result that our bid was higher than the engineer's estimate. He offered to place the job with us at his figure or to put it out to open competition again, when undoubtedly those who had bid before would use the same prices again and bid below us, and we were faced with the alternative of practically declining a job for owners who had a lot more building work coming on, or taking the job at a price which would barely insure any profit.

In another instance when showing an estimate to an architect just before signing the contract, he discovered that the price we had figured on skylights and roofing was a good deal higher than a figure he had obtained. He promptly proposed to take this item out of the contract altogether and let the owner pay it direct, regardless of the fact that other items might have been figured too low, and it was with difficulty that we were able to turn him from his purpose.

Obviously from our practice we do not find that it is always to our disadvantage to give information as to our estimates. We have very frequently found it of very great benefit in conducing towards that state of mutual confidence and respect which always should, but frequently does not, exist between owner, engineer, and contractor; and in the adjustment of extras, we have found that it has often saved a lot of dispute and secured to us and the owner a just and fair settlement. We do not suggest that all engineers or owners would act in the ways we have indicated if furnished with priced quantities, but as Mr. Bamford's suggested agreement, if adopted would be used by all alike, whether reasonable or unreasonable, partial or impartial, we wish to point out some of the difficulties we have met with in following this practice.

We think that the depositing of quantities should remain a matter optional to both the contractor and the engineer. It is largely a matter of judgment whether they will be an advantage or not in any particular set of circumstances.

We would also point out that it is even more easy for an unscrupulous contractor to submit an unbalanced price schedule than to submit an unbalanced bid, with far more advantage to himself and loss to the owner, and the writer could quote several instances within his personal knowledge of English practice which have resulted in unfair profits to the contractor with no redress for the owner.

Fourthly, as to damages for delay, Sections II and XXIII: It is only fair that if the contractor should pay for delays caused by him, the owner should reimburse the contractor for delays caused by himself or his engineer. Such delays often cost the contractor large sums in fixed charges, plant rental, foremen's time, etc., and he has no redress whatever.

In a rush job recently, a factory erected during the winter months, with heavy forfeiture clause for non-completion within the contract period, the engineer stopped our concreting for a whole week (a warm week when work would have gone fast) in order that he might test a sample of two bars of the steel reinforcement; and later, owing to a mistake he made in testing cement, condemned three or four cars of cement (which three independent laboratories reported as first-class) and caused us a lot of delay and expense. He refused to grant any extension of

time and we had to spend a lot of money in night work to make up our lost time.

Fifthly, Arbitration; the English arbitration system generally works well, and if the procedure in this country were standardized on similar lines, we think it would prove beneficial. In general the submission after the completion of the work is fair to all, but it will be realized that cases do arise when leaving big disputes undecided may work real injustice to one of the parties. It should be a matter for the arbitrators to decide whether the dispute should be adjudicated upon during the progress of the work, during a cessation of the work, or at its close.

We think that Mr. Bamford's effort to produce a contract which recognizes the rights of both sides is a step in the right direction, and the thanks of contractors are due to him for the thoughtful care with which he has dealt with the subject. It is to be remembered that it is impossible to foresee and provide for every contingency which will arise between the parties of any contract, and the aim of a contract should be to secure equitable dealing between the parties and a mutually fair interpretation of what was in their minds at the time the contract was made.

Yours faithfully,
ABERTHAW CONSTRUCTION CO.,
By Leslie H. Allen.

Boston, Mass., Jan. 26, 1910.

Percentage Bidding from the Contractor's Point of View.

Sirs: The editorial in your issue of Jan. 12, 1910, concerning percentage bidding speaks of the evils of unbalanced bids.

What is the cause of these evils? First and greatest, the fact that the estimated quantities are often very erroneous and, as stated in most contracts are approximate only, and should be verified by the contractor before bidding.

Upon examination the contractor discovers, perhaps, a discrepancy in the estimated quantites and submits a bid on his judgment of them; and since these quantities differ from the engineer's estimate, the resultant difference in cost must be distributed throughout the advertised quantities which are used for the comparison of bids and on which the work is awarded.

It is obvious that if the original quantities were accurate, and there was no substantial variation on completion of the work, an unbalanced bid would not be harmful to the contractee, and its only advantage to the contractor would be in enabling him to finance his work by putting the profit on the items to be done first. This has been objected to on the ground that a dishonest contractor could thus skim the cream off the job and then abandon it; but most contracts contain a provision for a percentage payment on items which are excessively overbalanced, and this safeguard, together with the customary retained percentage on the work, will amply secure the employer.

It is apparent, therefore, that the evil, if any, must be placed at the door of the engineer, not because of fraud but by reason of the impossibility to accurately determine, in advance, the quantities of the various classes of work involved, due to physical characteristics of the location or to the necessity for change of plan as the work progresses. Why, then, place the burden of responsibility on the contractor?

The courts have held that though the contractor, in making his bid, knew that the estimate misstated certain items, and with intent to profit by the ignorance of the engineer, made an unbalanced bid, he has a right to the benefit of his own knowledge, honestly acquired and without fraudulent collusion with the engineer. (Wait, Engineering and Architectural Jurisprudence, Sec. 54.)

Now, there is the meat in a nut shell. Is not the contractor entitled to pit his judgment, based on his experience and knowledge of cost, against that of the engineer? And should he be denied the right to use such knowledge, his stock in trade, in making a bid because it disagrees with that of the engineer?

There have been, and are today, many instances where the preliminary estimate has been made up by a thoroughly posted and broad gauge engineer whose figures of cost and quantities are borne out by the bids received; but to offset these there are hundreds of cases where the engineer's estimate is either ridiculously high or low, and in cases where the quantities are incorrect the contractor is justified in unbalancing his bid.

Perhaps the greatest source of contention lies in the classification of earth and rock, and to avoid disputes arising from measurements to determine the class of excavation many contractors prefer to bid a straight price for excavation of both or all kinds, based on information furnished by the engineer and supplemented by their own investigation. The Catskill Aqueduct contracts, under the Board of Water Supply, invite bids for open cut excavation, the classification of which is indicated on the plans by a record of borings. Such bids are, strictly speaking, unbalanced in that they offer a price for rock which is not its true value considered separately; but thus far no objection has been raised as to their legality or their fairness to both parties.

Within the writer's experience several bids for sewer contracts have been submitted in which the item for rock was bid at one cent per cubic yard and the value of the estimated quantity placed in the item of the sewer structure. This has the advantage for the contractor of obviating the delays attendant on the frequent presence of the engineer in order to measure rock before it is removed, and for the city in that the contractor will adhere more closely to the minimum width of trench than if he were receiving a good rock price, in which event he would exert an effort to get every yard possible. The ultimate cost was no greater by reason of this unbalancing; so where is the evil?

Now, to speak particularly of the percentage system of bidding, the objections to which as cited in a recent brief your editorial says are not adequately stated. Under this method the contractor has not the opportunity to submit a bid based upon his own judgment, both of cost and ultimate quantities. He must bid a percentage of the engineer's 100 per cent basis, which ratio will apply to all items of work, and if his costs are higher on some items and lower on others than the engineer's he must compare his total cost, plus his profit, with the engineer's 100 per cent base and bid the resulting percentage, which on being applied to the several items will oblige him to bid less on some items than in his judgment they are worth. This would work out to a charm provided the engineer's quantities were substantiated, but if the items on which the contractor is compelled to bid less than cost exceed the estimated quantity and those in which the bid ratio equals or excels his cost, are less than the estimate, where would he be then? This is not supposing an extreme case, but one which might readily happen, and a further illustration of the unfairness of the system is afforded in the following instance of two contracts recently completed in this city which were awarded on the percentage bid.

In one the estimated quantity of timber for sheeting was 3,000 ft. The final estimate was 15,000. In another the engineer's price of sheeting was $40 per M. ft., but the city refused to pay the contractor his percentage price on the ground that the eugineer's cost was too high. So the contractor is between the devil and the deep sea between the inaccurate estimate of quantities and the erroneous costs assumed by the engineer.

With all deference to the cost data collected by the department engineers, they are not sufficiently accurate or reliable to warrant their use as a basis of cost throughout and on which a contractor's percentage of total bid shall apply per item.

It would be foolish to deny that there have been cases of fraudulent collusion between the contractor and the engineer, but fortunately they are rare. When such a combination does exist no system of bidding is infallible and the owner is bound to suffer; but to draw contracts and devise methods on the assumption that all contractors are frauds and that every unbalanced bid contains a "nigger" is deplorable and unwarranted.

In a recent discussion on contracts before the American Society of Civil Engineers a writer stated: "It is safe to say that in no other business relation between men are such one-sided agreements customary." (Graduation of Railroads, by W. F. Dennis. Transactions American Society of Civil Engineers, Vol. LVIII, p. 349.)

Contracting today is a business representing an investment of millions of dollars, in which men of intelligence and practical training predominate, and to require a contract to be entered upon without the free use of his own judgment is not extending the square deal to the party of the second part.

Yours very truly,
C. A. CRANE,
Secretary The General Contractors' Association.

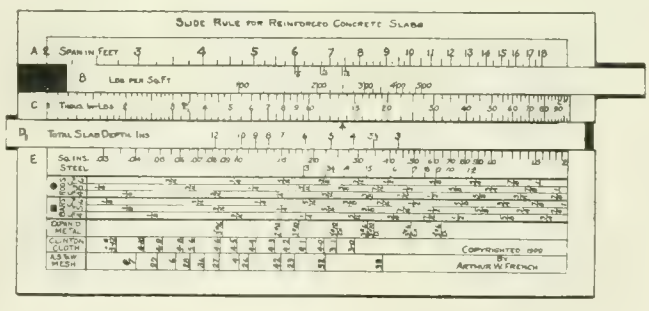
New York City, Jan. 24, 1910.

A Slide Rule for Reinforced Concrete Slabs.

A convenient slide rule for lessening the computations involved in the design of reinforced concrete slabs has been invented and copyrighted by Arthur W. French, Professor of Civil Engineering, Worcester Polytechnic Institute, Worcester, Mass.

The directions for use are as follows:

1. Under the span in feet, given on scale A, set ⅛ (if a simple span, or 1/10 or 1/12 if continuous spans) on scale *B*.
2. Under the line designating the total load per square foot on scale *B*, read on scale *C* the bending moment in inch pounds.
3. Set the arrow of scale D_1 under the given moment of scale *C*.


Slide Rule for Reinforced Concrete Slabs
A & Span in Feet
B Load per Sq. Ft.
C & Thickness of Slab
Total Slab Depth Ins
E Sq. Ins. Steel
Copyrighted 1909
Arthur W. French

Slide Rule for Reinforced Concrete Slabs.

4. Under the lines on D_1, designating the depth of slabs, read on E the cross section of steel required, in square inches.

NOTE.—Scale D_1 gives solution of the equation, $M = \ldots$, and should only be used when the ratio of steel area to concrete area is under .0068. When p exceeds .0068 the fact is indicated by the line of slab depth on scale D_1 passing to the right of the dotted line bearing the same number on scale *E*.

Steel area should *not* be taken off by use of *scale* D_1 when the line of depth on D_1 has passed to right of the corresponding line on *E*.

5. Should a thinner slab than allowed by scale D_1 be desired, turn up scale D_2 and set, under the bending moment on scale *C*, the same figure on scale D_2 (which scale reads from right to left).
6. The correct amount of steel is found on scale *E* under the slab depths on D_2.

On the lower lines of E are given three different spacings of round rods and square bars and also the trade numbers of three fabrics which may furnish the required areas. As areas are given on E, any make of cloth or mesh may be used and spacings of rods and bars altered to suit conditions. This slide rule was devised by Professor French for personal use, but it is now on the market on account of the publicity given it, the price being two dollars. The concrete fiber stress is 600 lbs., steel stress 16,000 lbs. per sq. in.; the ratio of deformation being 15.

Technical Society Meetings.

The list following names those technical societies in which engineers and contractors are most interested, whose meetings are to be held within three months of the date of this issue. There are given for each society listed the date and place of meeting and the name and address of the secretary, to whom all communications and inquiries should be addressed.

American Institute of Mining Engineers.
March 1-5. Annual meeting at Pittsburg, Pa. Secy., R. W. Raymond, 29 West 39th St., New York City.

American Railway Engineering and Maintenance of Way Association.
March 15-17, 1910. Annual convention at Chicago, Ill. Secy., E. H. Fritch, 962 Monadnock Block, Chicago, Ill.

American Society of Engineering Contractors.
Feb. 24-26, 1910. Annual convention at Chicago, Ill. Secy., Daniel J. Hauer, Park Row Building, New York, N. Y.

Engineering Society of Wisconsin.
Feb. 23-25. Annual meeting at Milwaukee, Wis. Secy., W. G. Kirchoffer, 31 Vroman Bldg., Madison, Wis.

Illinois Association of Municipal Contractors.
Feb. 24-26. Annual meeting at Chicago, Ill. Secy., Orie T. Dunlap, Edwardsville, Ill.

Illinois Lumber Dealers' Association.
Feb. 16-18. Annual meeting at Chicago, Ill. Secy., Geo. K. Hotchkiss, 315 Dearborn St., Chicago.

Illinois Masons' Supply Association.
Feb. 16-18. Annual meeting at Chicago, Ill. Secy., Geo. K. Hotchkiss, 315 Dearborn St., Chicago.

Interstate Mantle and Tile Dealers' Association.
Feb. 15-19. Annual meeting at Chicago, Ill. Pres., Joseph W. Lantry, Wm. H. Jackson Co., Union Square, New York City.

Iowa Association of Cement Users.
March 9-11, 1910. Annual meeting in Cedar Rapids, Ia. Secy., Ira A. Williams, Iowa State College, Ames, Iowa.

Iowa Engineering Society.
Feb. 16-17, 1910. Annual convention at Cedar Rapids, Ia. Secy., A. H. Ford, Iowa City, Ia.

Missouri Highway Engineers' Association.
Feb. 17-18. Annual meeting at Kansas City, Mo. Secy., Curtis Hill, Columbia, Mo.

National Association of Cement Users.
Feb. 21-25, 1910. Annual meeting at Chicago, Ill. Secy., Geo. C. Wright. Address all communications to Edw. E. Krause, Asst. to the President, Harrison Bldg., Philadelphia, Pa.

Northwestern Cement Products Association.
Feb. 18-21, 1910. Annual meeting at Chicago, Ill. Chairman of Executive Committee, O. U. Miracle, Minneapolis, Minn.

Western Drainage Contractors' Association.
Feb. 17, 1910. Fort Dodge, Ia. Secy., S. F. Moeller, Knierim, Ia.

Notes from Technical Societies.

Connecticut Society of Civil Engineers.—The 26th annual meeting of the Connecticut Society of Civil Engineers will be held in New Haven, Conn., Feb. 8 and 9, at which the following papers will be presented: The Hammond Laboratory, Sheffield Scientific School, Louis D. Huntoon, Professor of Mining and Metallurgy, Yale University; "Water Resources of the Navajo Reservation, Arizona," Herbert E. Gregory, Professor of Geology, Yale University; "Problems Handled by the Test Department of a Large Corporation," by Benjamin L. Hinckley, Engineer of Tests, N. Y., N. H. & H. R. R. Co.; "Dams and Reservoirs Built in Connecticut Under Supervision of Nelson J. Welton," by Nelson J. Welton, Mem. Conn. Soc. C. E.; "The Sea Wall in Connection with Power Stations and Manufacturing Buildings," by George A. Orrok, Mem. Conn. Soc. C. E.; "Eight Weeks Civic Study Abroad," by Frederick L. Ford, Mem. Conn. Soc. C. E.; "Dams Approved by Henry F. Potter" (deceased), by Charles E. Chandler, Mem. Conn. Soc. C. E. Mr. Frederick J. Easterbrook is president and Mr. J. Frederick Jackson, secretary, New Haven, Conn.

Personals.

Mr. R. A. Klein has been appointed a Supervisor of Division No. 1 of the West Jersey & Seashore R. R., with headquarters at Haddonfield, N. J., succeeding Mr. G. M. Ball, Jr., promoted.

Mr. Wm. Woodhall, Jr., of Berwyn, Ill., formerly with the United States Crushed Stone Co. at McCook, Ill., has accepted the position of Manager of the Indiana Sand & Gravel Co., Attica, Ind.

Mr. W. C. Calvert has resigned his position as an Assistant Engineer with the Oregon Short Line R. R. and has opened offices at Burley, Idaho, where he will engage in private practice as a civil engineer.

Mr. Eric H. A. Nordin, a civil and hydraulic engineer of Marysville, Cal., has sailed for Barranquilla, Colombia, South America, where he is to build a power plant for the Guggenheims. He expects to be gone a year and a half.

Mr. A. W. Campbell, heretofore Deputy Minister of Public Works of the Province of Ontario, Canada, has been appointed Deputy Minister of Railways and Canals, with office at Ottawa, Ont., succeeding Mr. M. J. Butler, resigned.

John B. Clifford, a railroad contractor and a member of the P. T. Clifford Construction Co., which has all the Pennsylvania company contracts for elevating the tracks into Chicago, died Feb. 5 at Valparaiso, Ind. He was 60 years old.

Mr. Charles R. Vannemann, formerly Engineer Examiner in the New York State Civil Service Commission, has been appointed Steam Railroad Inspector by the New York Public Service Commission to succeed Mr. Jefferson D. Shultz, resigned.

E. A. Smith, a civil engineer of Kansas City, Kan., died suddenly last week at Las Vegas, N. Mex. He was engaged in railroad construction work for the L. J. Smith Construction Co., of Kansas City, Mo., Mr. L. J. Smith of that concern being his brother.

Mr. B. A. Wood, heretofore Resident Engineer of the Mobile & Ohio R. R. at Mobile, Ala., has been appointed Chief Engineer, with headquarters at Mobile. Mr. A. H. Nichols has been appointed Division Engineer with headquarters at Meridian, Miss., and Mr. E. G. Murphy has been appointed Division Engineer, with headquarters at Murphysboro, Ill.

The New York State Civil Service Commission, Albany, N. Y., has announced examinations to be held Feb. 26 to fill the following positions: Junior Railway Engineer, State Public Service Commission, $1,201 to $1,800 per year; Topographic Draftsman, Kings County Service, $1,200 per year. The last date for filling applications for the above positions is Feb. 19. Further information can be obtained by addressing the State Civil Service Commission, Albany, N. Y.

James Keys, Assistant Engineer in charge of the Bridge Department of the Union Pacific R. R., died Dec. 27 at Excelsior Springs, Mo. He was a graduate of Lehigh University and his first work was with the American Bridge Co. at Pencoyd, Pa. He left that company to enter the bridge department of the Great Northern at St. Paul, Minn. In March, 1901, he was a designer in the bridge department of the Union Pacific and had charge of that department at the time of his death.

As the result of the retirement on account of the age limit of Brigadier General John G. D. Knight, Corps of Engineers, U. S. Army, and Lieutenant Colonel H. M. Chittenden, Corps of Engineers, the following promotions in the Corps have been made: Henry C. Newcomer has been made lieutenant colonel; Capt. Wm. D. Connor has been made a major; First Lieut. Robert R. Ralston has been made a captain, and Second Lieut. E. D. Ardery has been advanced to the rank of first lieutenant.

Catalogs Worth Having.

Engineers and contractors should have on file the latest catalogs of machines, tools and supplies that they use. In sending for catalogs reviewed or advertised in this paper, you will confer a favor on us if you will write directly to the advertisers and state that you saw the catalog mentioned in ENGINEERING-CONTRACTING. If you are in the market for tools, machinery or supplies, tell us and we will notify promptly the leading manufacturers.

Wire Rope. — Hazard Manufacturing Co., Wilkesbarre, Pa.

This company sends two booklets, each 3½x6 ins., describing iron and steel wire ropes with tables of strengths and other properties.

Johnston's Improved Reels and Tapes.—Paper, 3½x6 ins., 16 pp. Robert Johnston, 12 North Main St., Wilkesbarre, Pa.

This booklet gives descriptions with prices of steel tapes and reels for civil engineers and surveyors.

A Positive Feed Concrete Mixer.—Paper, 6x9 ins., 16 pp. Miracle Pressed Stone Company, Minneapolis, Minn.

The mixer described in this catalog proportions the material and also mixes it, the type being that known as "continuous." It is made by the Miracle Company as one of many tools for concrete workers.

Port Huron Road Work.—Paper, 9x12 ins. 32 pp. Port Huron Engine & Thresher Co., Port Huron, Mich.

This book describes roads constructed in many states with the aid of machinery made by this company, from rock crushers to road rollers and tar spreaders. Many handsome half-tones in the text.

Nitro Powders.—Paper, 5x7 ins. 16 pp. Nitro Powder Co., Kingston, N. Y.

This booklet describes blasting powders that do not freeze readily and are classed as a high power safety explosive. Full directions are given for use.

Coal Tar Products.—F. J. Lewis Mfg. Co., 1170 South Robey St., Chicago, Ill.

This firm sends in leaflets of envelope size describing coal tar products for tarring macadam roads and filling joints in block pavements. They announce that a large catalogue on good roads is almost ready for distribution.

Hauling Engines.—Paper, 7¾x10½ ins., 32 pp. The Russell & Co., Massillon, Ohio.

This handsome catalog is entitled "The General Utility Engine" and illustrates the engine of that name made by The Russell & Co., engaged in many different kinds of work for contractors.

Excavators and Conveyors.—Paper, 9x12 ins., 28 pp. The Potter Manufacturing Company, Indianapolis, Ind.

A catalog like this is a good manual for men engaged in trench excavation work. In addition to numerous illustrations there are valuable estimating tables for sewers.

Spiral Riveted Pipe.—Paper, 8x10 ins., 20 pp. American Spiral Pipe Works, Chicago, Ill.

Steel pipe is favored in many places because of the high tensile strength, combined with lightness, the latter affecting freight. This book illustrates some installations.

Second-Hand Contractors' Plant.—Paper, 3½ x6 ins., 24 pp. Willis Shaw Machinery Co., 171 LaSalle St., Chicago, Ill.

This booklet is issued monthly and contains a list of second-hand contractors' machinery and tools with prices.

The Hadsell Patented Slack-Cable Excavator.—Paper, 4x8 ins., 10 pp. The Hadsell Engineering Co., Scranton, Pa.

The principles involved in the design of this machine are a combination of those used in the scraper bucket and cableway. This circular illustrates a number of combinations.

The Lewis Ideal Tape Reel.—Kolesch & Co., 138 Fulton St., New York.

An envelope folder describing a tape reel containing high speed gear so a tape 100 ft. long can be wound up in 12 seconds. A practical thing for engineers and surveyors.

Ruggles-Coles Dryers.—Paper, 6x9 ins., 46 pp. Ruggles-Coles Engineering Co., Hudson Terminal, New York City.

This is Catalog G and describes dryers made for the drying of many kinds of materials in industrial works.

Concrete Waterproofing. — Harrison Waterproof Materials Co., Terminal Bldg., New York City.

This is a four-page small envelope folder describing a powder used for waterproofing concrete.

The History of Elaterite.—Paper, 6x9 ins., 32 pp. The Elaterite Paint and Manufacturing Co., Des Moines, Ia.

The common name of Elaterite is "mineral rubber." It is used principally for waterproofing purposes and this book describes its many uses.

No. 7 League Boots.—Paper, 3½x6 ins. 8 pp. Mulconroy Company, Inc., 722 Arch St., Philadelphia, Pa.

This is a new catalogue, No. 20, describing sewed leather soled rubber boots.

Spanish Clamp Booklet.—3½x6 ins. 16 pp. Batavia Clamp Co., Batavia, N. Y.

This book printed in Spanish contains the matter printed in English in a booklet noticed in these columns Oct. 27, 1909. It describes clamps for contractors and wood workers, and also illustrates wagon jacks sold by the same firm.

Sewer Pipe and Other Clay Products.—Paper, 3½x6 ins. 16 pp. Blackmer & Post Pipe Co., St. Louis, Mo.

This handy little pocket size book contains illustrations and list prices of all clay products made and sold by the company.

United Steel Sash.—Paper, 8x10 ins. 4 pp. Trussed Concrete Steel Co., Detroit, Mich.

This is a pamphlet that should be of considerable value to designers of fireproof buildings and industrial plants where wood should not be used in window openings.

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CHAS. S. HILL
ERNEST McCULLOUGH
C. T. MURRAY
F. A. SMITH
} EDITORS

MYRON C. CLARK . . . . . PUBLISHER
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CONTENTS.

EDITORIAL: Page
Sanitation of Contractors' Plant.....141
Hydraulic Filling of Low Lying Land 141
Seven Months' Work of the Permanent Finance Commission of Boston.....142

CONCRETE SECTION:
Method of Putting a Reinforced Concrete Jacket on a Cracked Chimney.....143
A Pneumatic Cushion Cap for Driving Reinforced Concrete Piles.....144
Reinforced Concrete Bridges on Track Elevation in Evanston, Ill., of Chicago, Milwaukee & St. Paul Railway.....144

EARTH AND ROCK SECTION:
Methods and Cost of Hydraulic Filling at Cairo, Ill. 151
Sanitary Conditions in the Establishment of Contractors' Camps 153

ROADS AND STREETS SECTION.
Direction for Working Steam Road Rollers and Steam Traction Engines.....155
Work of the New Asphalt Plant of San Francisco in 1909.....157
English Methods of Using Tar as a Binder in Macadam Road Construction.....158

WATER-WORKS AND SEWER SECTION
Depth of Water Pipe.....159

GENERAL SECTION:
Some Types of Sea-wall and Their Structural Characteristics and Cost.....161
Crude Petroleum as a Timber Preservative 162
LETTERS TO THE EDITOR.....163
COMING TECHNICAL MEETINGS.....164
PERSONALS 164
CATALOGS WORTH HAVING.....164

Sanitation of Contractor's Camps.

The sanitation of contractors' camps is a matter of exceeding interest and importance. In the article in this issue many points are brought out on which discussion is invited. Only men, like the author of the article, who have handled men in construction camps can appreciate fully the difficulties involved, and many of our readers, no doubt, can add much of value. Betterment work in connection with contractors' camps has lately been a feature of the Young Men's Christian Association labor bureau. In many camps this organization provides comfortable rooms supplied with reading matter, billiard and pool tables and other amusements. Facilities are provided for writing letters and even classes in certain subjects are conducted. Bath rooms are included and on pay day all checks are cashed. The effects have been good and an extension of this work is contemplated. When the contractor does his part in selecting his camp sites with care and gives some attention to sanitation, much less will be heard of the difficulty of keeping men on a job. At present three gangs are busy, one coming, one working and one going. When the men are treated like men, the working gang will certainly be evidence of the survival of the fittest.

Hydraulic Filling of Low Lying Land.

What is claimed to be the longest line of pipe for filling with sand, low lying lands by the hydraulic process, is described in this issue. The fact that the filling material is sand is the main point of interest in the article for the use of earth, as mud, is common and practice is well established. The Cairo plant is practically without precedent in the use of a booster plant and the very long line of pipe to convey the sand to the point of disposal.

The method used to build up the levees enclosing the dredged material is unique, and shows how the practical man makes use of opportunities. As stated in the article, the tendency of the sand to settle in the bottom of the pipe permits the building of levees having any desired slope ranging from that assumed by moist sand to the slope of a semi-fluid. It was observed at Cairo that the gravel dropped from the openings nearest the pump, the material being progressively finer with the increase in distance. The method used in ordinary hydraulic fills, of placing boards as retainers on the slope was first used until the discovery was made, as the fact realized, that as sand was less inclined to hold moisture than clay, with which previous experience was had, the boards were not required; for the regulation of the gate openings controlled the solidity of the fill. This should be a valuable fact to remember in connection with embankments, when dredged sand can be obtained for the purpose. Two side levees of sand with an interior fill of earth would lessen construction costs in many cases and the sand side slopes may later be covered with earth from construction trains of side dumping cars.

It has been noted in hydraulic fills made with clay that the tendency to settle is not so marked as when sand alone is pumped. This would indicate that colloidal matter added to the water would largely decrease the cost of pumping as the velocity would be lower. The work might be done by having two pumping plants deliver to the booster one for sand and one for mud. The resulting fill would likewise be improved. This idea should be particularly valuable in the construction of dams by the hydraulic process, failures having occurred in such dams through slow drying of the clay due to lack of sand or material which would have aided in drainage.

If it is desired to keep the sand in suspension instead of traveling along the bottom of the pipe, the velocity may be increased, which would have the effect no doubt of increasing the abrasion. A suggestion has been made that, since the sand travels in waves or bars, the introduction of a length of corrugated pipe occasionally would tend to raise the sand by preventing the bar formation. Corrugated sheets are sold for road culverts, shipped nested, and such sheets might be used, the upper and lower halves being so bolted that the depressions would alternate. This may not be feasible for the sand might pocket in the bottom of depressions and the high places between would wear rapidly. The experiment might be tried, however, at small expense. The effect of the corrugations will be to lessen the diameter and increase the velocity, but these corrugated sections can be made slightly larger than the sections of smooth pipe and the ends be crimped for connecting.

Some of the companies selling corrugated metal road culverts are now making them of three sheets, the bottom sheet being smooth. It was found that corrugated bottoms filled to the top of the corrugations, leaving a narrow exposed rib which wore rapidly under the abrasive action of silt carried in flood periods. The conditions in road culverts, however, might be different from conditions in a pressure pipe in which nearly all the solids will be in suspension near the center. There are few published data on the life of pipes used for hydraulic filling and the general impression is that such pipes depreciate through rust from exposure rather than from abrasion, about two years' use being all that is usually expected. In the Cairo work the pipes did not seem to wear because of the sand, but the rivet heads were abraded and the rivets dropped out. Instructions were given the men to turn each length when shifting pipe, to insure uniform wear on the rivets.

Seven Months Work of the Permanent Finance Commission of Boston.

On Jan. 31, 1910, the Finance Commission of Boston submitted its first annual report to the State Legislature. To engineers and contractors the part of this report which is of particular interest is that part in which it reviews the improvements made in handling city work following the reforms recommended by the first Finance Commission. This first Finance Commission, as we have before stated, was a temporary commission and its work ended with the presentation of its final report disclosing its findings and submitting its recommendations for a new city government. This new form of city government, which was adopted by popular vote at the November, 1909, elections, provided among other things for a permanent Finance Commission, and it is the first report of this permanent commission to which we refer above. This commission was organized on June 23, 1909, so that its first report covers its work for a period of approximately seven months only. As summarizing the work of these seven months it may be noted that the commission has held 56 meetings, conducted 108 hearings on various subjects, examined 212 witnesses and published 12 reports and communications.

One of the most severe criticisms made of city work management by the first finance commission was the awarding of contracts without competition. By the state laws of

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1890 the city of Boston was required to advertise only contracts amounting to $2,000 or more and could award without advertising contracts for even greater amounts if the mayor in writing authorized such action. It was found by the finance commission engineers that these privileges had been taken advantage of to reward political services and to the considerable financial loss of the city. It was a common practice to subdivide a large piece of work forming one contract in all essentials, into a number of small contracts each less than $2,000 in amount and to give these contracts without competition to favored contractors. A somewhat extended discussion of the results of this gift contract system was published in our issue of Oct. 27, 1909, and we shall confine our remarks here to presenting the evidence of the permanent finance commission of improvement in this matter. The commission says in substance

There has been a vast improvement in the method of awarding contracts. The practice of evading the law by awarding contracts for $2,000 or more, without advertisement for bids, has been abandoned. Under chapter 418, section 4 of the Acts of 1899, all contracts of the City of Boston for $2,000 or more were required to be advertised unless the mayor in writing authorized the award without advertisement. In 1892-93 and 1895-96, 81 per cent of the number of such contracts were awarded after public advertisement. In all the other years between 1890 and 1908 the percentage has been less. On and after September 9, 1909, by virtue of section 30, chapter 486 of the Acts of 1909, all contracts for $1,000 and upwards are required to be advertised, and as the limit has thus been changed the computation as to contracts for $2,000 or more should be carried only to Sept. 9, 1909. Between February 1, 1909, and September 9, 1909, 90.8 per cent in number and 95.2 per cent in amount of such contracts have been awarded after advertisement, which is the highest percentage in any year since 1890. In 1906-07 and 1907-08 the number advertised was 46 per cent and 48 per cent respectively.*

From January 1, 1906, to January 31, 1908, $1,473,663, out of a total of $5,046,730, or 29.2 per cent, were awarded without advertisement. Whereas, from February 1, 1908, to September 9, 1909, only $200,406, out of a total of $4,213,602, or 4.8 per cent, were awarded without advertisement.

In the three departments in which the practice of awarding gift contracts to favorites prevailed most extensively in former years—the Street, Water and Supply Departments—practically all contracts in the last two years were awarded after public advertisements for bids. A comparison of the record of these three departments in the period between Jan. 1, 1906, and Jan. 31, 1908, with the record of the period between Jan. 31, 1908, and Sept. 9, 1909, shows that in the former period 189 such contracts were made of which 66, or 34.8 per cent, were advertised. In the latter period 196 such contracts were made, 183 of which, or 93.3 per cent, were advertised. In the former period, the total amount of such contracts was $2,027,326, of which $846,096, or only 41.7 per cent, were advertised. In the latter period, the amount of such contracts was $2,120,820, of which $2,043,260, or 96.3 per cent, were advertised. In other words, though the number and amount of contracts awarded was substantially the same in the two periods in question, nearly three times the number and more than twice the amount of such contracts were advertised in 1908 and 1909 than in the two preceding years.

*The amounts involved do not furnish as safe a guide as the number of contracts awarded in determining whether the administration is using the city's contracts to reward political supporters, as such favorites are not, as a rule, equipped adequately with plant or means to undertake large works, and, consequently, receive only the smaller contracts. Wherever political considerations influence the award of contracts they are generally given out in large numbers for relatively small amounts, so as to secure the support of the largest possible number of contractors.

The contracts of the Supply Department have been made with more regard to economy than in preceding years. Thus, flagstones were purchased at 33 cts. a square foot in 1908, and 34 cts. in 1909, as against 67 cts. in 1907. Greater care has been taken also in respect to coal purchases, and the city's interests have been better protected as to prices, weights and quality than in former years. The abandonment of the city's stone crushing operations and the purchase in the open market of the stone needed have been the means of saving large sums of money. The average cost of stone at the city crushers, exclusive of the cost of carting, but including interest and depreciation charges, was $1.60 a ton from 1897 to 1905 inclusive, $2.85 in 1906, and $3.24 in 1907. Allowing 40 cts. a ton for carting to the job, the prices in 1906 and 1907 were $3.25 and $3.64 respectively, whereas the average prices of stone delivered on the job in 1908 and 1909 were $1.39 and $1.16½ respectively. If the cost per ton in 1908 and 1909 had been the same as in 1907, the city would have expended for crushed stone in the last two years $250,251.52 more than it actually paid.

It will be remembered that the reports of the first finance commission showed a large proportion of the city work done by day labor at extravagant costs, and recommended a very general change from day labor work to contract work. These recommendations were in considerable measure adopted with results which we let the finance commission again present in its own words as follows:

The most notable improvement has been made in the Street Department. The contract system has been greatly extended and the department force considerably reduced. The efficiency of the force has also shown a marked increase; and the loss on day labor, as compared with contract work, though large, is not so great as it has been. Thus, the cost of resurfacing macadam roads by day labor, which was $1.07 a square yard in 1905-06, $1.19 in 1906-07, and 95 cts. in 1907-08, was reduced to 63.9 cts. in 1908-09. In 1907-08 it cost $373,036.50 to resurface 392,670 sq. yds., while in 1908-09 it cost only $259,713.88 for 406,438 sq. yds., or in the latter year $113,322.62 less for 13,768 sq. yds. more. If the prices of 1907-08 had obtained in 1908-09, it would have cost the city about $126,000 more than it actually paid. The total cost of maintenance over the entire area of macadam roads, including street cleaning by the Paving Division, was 11 cts. per sq. yd. in 1905-06 and 1906-07, 8 cts. in 1907-08, and 5.3 cts. in 1908-09.

The contracts for laying and repairing asphalt pavements have been made in 1908-09 and in 1909-10 at prices far less than those which obtained in former years. Thus, prior to 1908-09, the uniform price for laying or repairing asphalt, or bitulithic pavements, was $2.50 a sq. yd. for surface and binder. The contracts were awarded without competition, the city officials maintaining that competition could not be secured as the asphalt business was controlled by a trust, and the bitulithic pavements by a company which had a patent process. In the last two years, however, bids have been solicited by public advertisement, competition has been secured, and the cost has been greatly reduced. The price for laying the pavement ranged from $1.84 to $2 a sq. yd. in 1908-09, and $1.50 to $2.20 in 1909-10. In these two years 22,574 sq. yds. were laid at a cost of $38,407.75, the average cost being $1.70 a sq. yd., or 80 cts. less than the former price; and the city has saved in the last two years on this item alone the sum of $18,059.20. In the ten years from 1898-99 to 1907-08, inclusive, 327,286 yards were laid at a uniform price or $2.50 a square yard, or an excess of 80 cts. a square yard over the average prices of 1908-09 and 1909-10. If genuine competition had been secured in the ten years prior to 1908-09, as undoubtedly it could have been, prices as low as the average of the last two years could have been obtained and a loss of $261,828.80 on this item would have been prevented.

The repairing of asphalt pavements was likewise said to be in the control of the trust and the contracts were also awarded without competition at the uniform price of $2.50 a square yard. But in the last two years public advertisement secured bids at lower prices and the work was let in 1908-09 at $1.73 and in 1909-10 at $1.62 a square yard with resulting large savings to the city.

The abandonment of the city's stone crushing operations has effected a large saving, as previously stated.

The work of cleaning catch-basins, which in 1907-08 and in preceding years was done partly by day labor and partly by contract, was done by contract to a larger extent in 1908-09, and entirely by contract in 1909-10, with excellent results. In 1906-07 the cost of cleaning 7,922 basins, including the cost of examination and location, was $62,653.82, or $7.90 each; in 1907-08 8,630 cost $60,993.05, or $7.06 each; but in 1908-09 9,253 cost only $46,052.57, or $4.97 each, and in 1909-10 6,488 cost only $29,879.79, or $4.60 each. The saving in the last two years, as compared with the prices in 1907-08, was $35,199.10.

The cost of teaming has likewise been greatly reduced, partly because of the adoption of the system of hiring teams by contract after public advertisement for bids, and partly because of the discontinuance of the wasteful practice of furnishing and carting materials to city contractors. The cost, exclusive of snow removal, was $391,982 in 1907-08, $278,829.02 in 1908-09, and $116,355.77 in 1909-10. Much of the loss on the teaming account in 1907-08, and in preceding years, was due to the practice of hiring teams without competition, at excessive prices, from individuals who had political influence with the administration.

Many other improvements in the administration of the Street Department are worthy of mention, but the foregoing will serve as illustrations of the efficiency and economy which have been obtained under the present superintendent, who, though hampered at times by outside interference and always by the inefficiency of the old men in the service, has succeeded in accomplishing notable reforms.

Second only in importance to the commission's evidence of improvements made is its report on failures in administration. We quote again as follows:

The foregoing summary shows that many improvements in administration have been made, but side by side with notable achievements there have been serious failures.

The expenditure for the mayor's office, instead of being an example for the heads of departments, have indicated a disregard for economy.

The large appropriations of the year 1909-10, and the resulting high tax rate were caused partly by the meritorious practice of paying for "street improvements" and other current expenses out of taxes instead of loans, but mainly by the retention of unnecessary employes and the maintenance of an extravagant scale of salaries. A much larger saving than any which has been effected could have been made if the superfluous employes had been removed, and the excessive salaries had been reduced to a proper figure. Some employes in the lower grades, principally laborers, have been discharged, but practically no salaries have been reduced, while some have been unjustifiably increased. Many who were discharged have been reinstated, and some reductions in salary have been followed by restorations. The reduction in the number of city and county employes in the last two years is not a substantial one, as is shown by the following table:

Number of Persons Employed on April 30, of Each of the Following Years.

Year.	City.	County.	Total.
1905-06	12,558	536	13,094
1906-07	12,949	550	13,499
1907-08	13,174	579	13,753
1908-09	13,108	571	13,679
1909-10	12,645	577	13,222

From this it appears that in 1908-09 there were only 74 employes less than in 1907-08. In 1909-10 there were 531 less than in 1907-08 and 457 less than in 1908-09.

There has been a saving in the pay rolls of some of the departments in the last two years, as compared with those of 1907-08, but the total saving cannot be definitely ascertained until the close of the fiscal year. Whatever savings may have been made can be accounted for as follows:

1. By the discharge of some of the superfluous employes in the lower grades, such as laborers, mechanics, inspectors, etc., due in part to a creditable, though insufficient, extension of the contract system.

2. By the discharge or reduction in salary of a few in the higher grades.

The results are far below the reasonable expectations of those interested in reducing the city's expenditures. No good reason can be given for the failure to adopt the former Finance Commission's recommendations as to reductions in salaries in the Assessing, Collecting Treasury, City Clerk, Clerk of Common Council, Clerk of Committees, City Messenger,

Fig. 2—View of Chimney Being Jacketed With Concrete.

Soldiers' Relief, Weights and Measures and other departments.

Unnecessary appointments have also been made, as for example those of the two additional assessors, which, in effect, were nothing more nor less than deliberate gifts of $8,000 a year of the city's money. Moreover, the mayor's office has frequently interfered with the conduct of the departments in the making of appointments to subordinate offices, and in at least one case, that of the Penal Institutions Department, with demonstrated pernicious results.

We shall pass by the evidence afforded by this report of the manifest economy of contract work over day labor in constructing and maintaining city works. The contention of this journal from the first and persistently since is now being proved on so many hands that it needs but little argument. There is, however, another matter which we have urged that is worthy of further comment. This is the value of a review commission such as the finance commission of Boston in making known definitely to the people those responsible for failure of administration. Take for example the charges of failure in administration quoted above from the finance commission's report. Such charges repeated from year to year are bound to have effect on and ultimately to bring reform from even the most callous public sentiment. There should be a finance commission in every large city and that commission should be composed of a fair proportion of engineers

Concrete and Reinforced Concrete Section

Note: This section is devoted to methods and cost of constructing concrete and reinforced concrete structures. It will cover the selection, testing and proportioning of concrete materials; laboratory tests of concrete; concrete mixing, transportation and placing; fabrication and placing of reinforcement, and form construction and erection. It will also contain articles on new and interesting developments in the design of reinforced concrete.

Methods of Putting a Reinforced Concrete Jacket on a Cracked Chimney.

The work described consisted in molding a jacket 5-ins. thick of reinforced concrete around a cracked and leaky chimney at the plant of the Winchester Repeating Arms Co., at New Haven, Conn.

The original chimney was of reinforced concrete, but it had developed large vertical cracks which allowed the escape of smoke and at times the inflow of air—both of these actions being harmful to the efficiency of the draft. This chimney rested on a brick foundation which was part of the power house building. Above this foundation it was about 80 ft. high, with outside diameters of 8 ft. at the bottom, and 6 ft. at the top; it was 4 ft. in diameter, inside, and was unlined. The old concrete, forming a wall about 4 ins. thick in the cylindrical part of the chimney, had proved seriously defective, aside from developing cracks. It had been laid as a stiff, dry mortar, without stone, and by the time the contractors took hold of the job, the mortar had become so soft and "punky" that it crumbled easily under a blow, and came away from the reinforcing metal with dangerous readiness.

The new concrete jacket put about the old chimney was 5 ins. thick over the whole surface of the old structure. The vertical reinforcement consisted of four sets of square twisted steel bars with 32 in each set, equally spaced, and with the ends of the successive sets lapped. The lowest set of bars, ⅝ in. thick and 20 ft. long, were upset at their lower ends to ¾ in. diameter, and were screwed into an anchor ring 4 ins. wide by ½ in. thick sunk in the brick work at the base of the chimney. The other three sets of vertical bars were ½ in. square and 24 ft., 22 ft. and 20 ft. long, respectively. Outside this system of lapped vertical bars were placed horizontal hoops of 3.8-in. square twisted steel, spaced 6 ins. apart. The concrete of the shell was mixed 1:2:4, with the stone small.

Before the first section of the concrete jacket was applied the old chimney was carefully wrapped with asbestos felt. This served a double purpose, acting first as an expansion joint between the old and new structures, and serving also to protect the green jacket against too rapid drying by the heat of the inner shell, and against the drawing of moisture from the green concrete into the old chimney.

The aspect of the work, which is of especial practical value, was the ingenious construction and operation of the form used by the contractors on the cylindrical portion of the chimney. The form proper consisted of a cylinder of 16 gage iron, 5 ft. high, with an inside diameter of 5 ft. 8 ins. This was made in three equal sections divided vertically. The horizontal framing consisted of three 2x2x¼-in. angles rolled to a true circular arc. Each section of the form proper therefore constituted a cylindrical surface of 120° braced horizontally by the curved angle bars, one at the top, one at the bottom, and one midway between. Extending horizontally from the top of each of these sections was built a platform braced diagonally to the bottom of the form section with 2x2x¼-in. angles, and resting on horizontal angle bars running to the upper corners of each section of the form. These three sections of form and staging combined were fastened together by bolts running through angle bars on the vertical edges of each section of the form and through the pairs of adjacent angle iron supports under the platform. The form and the working platform were suspended by heavy ropes from three 12-in. single blocks, which were themselves hung from a heavy ring set on top of the overhang of the chimney. The cylindrical portion of the jacket, in which the form was involved, was made in the following manner. The asbestos having been applied over a height of about 5 ft. from the top of the cylindrical form, the form was then raised, and concrete was filled into the space between the form and the chimney, and closely tamped about the reinforcing steel. The next forenoon the asbestos and steel were extended farther up the

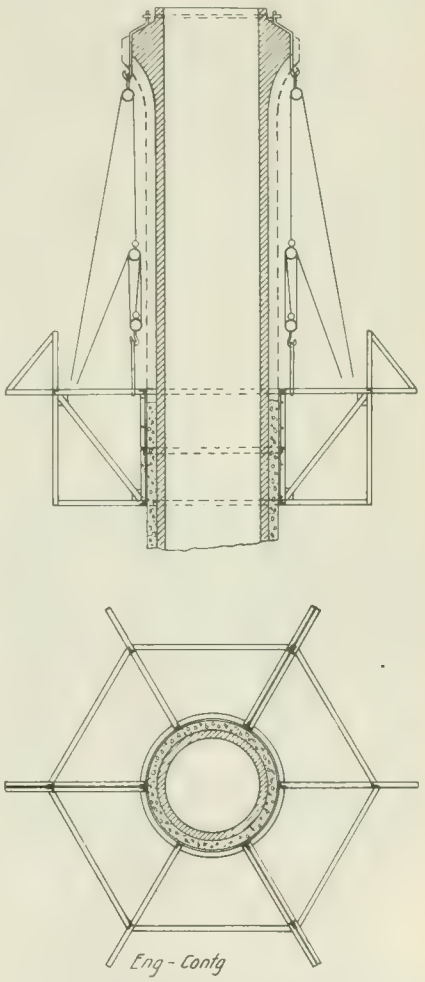


Fig. 1—Sketch Showing Method of Slinging Forms for Jacketing a Chimney With Concrete.

chimney, and the form was hoisted a distance of 4 ft. 10 ins., leaving a lap of 2 ins. on the concrete placed the day before. The concrete of the second day's work was placed in the afternoon, and was allowed to set until the next morning, when the form was again raised 4 ft. 10 ins., and a new ring of concrete was placed that afternoon. The form and platform were prepared for hoisting by loosening the bolts in the facing angle bars which formed the three joints. This allowed the form to swing a little free of the new concrete and permitting of easy movement.

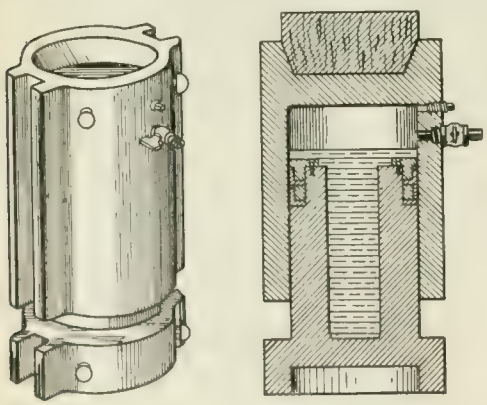
An interesting feature of the preparatory work was the method by which the steeplejack reached the top of the chimney. One of

the largest cracks in the old structure ran from the top to bottom, and this furnished a good place for driving in stout hooks. At the start, the steeple-jack climbed up a ladder resting on the roof of the power house, and reaching up on the chimney drove a stout hook into the big crack. From this hook he then hung a small block carrying a rope. This combination made it possible to hoist a second ladder, which was allowed to lap on the first ladder, to which it was lashed. Climbing to the top of the second ladder, the steeple-jack drove a second hook into the crack in the chimney, reaching up as far as possible. Putting a block and line on this second hook, he was able, after getting down to the power house roof, to raise another ladder, which was lashed to the second ladder. From the top of this third ladder he drove a third hook into the crack, and so extended his track another space upward, and so on. The ladders had hooks at the ends, which held them away from the chimney. They were held firmly in one direction by lashings to the hooks, and the combination was stayed by ropes carried round the chimney every 15 ft. The ladders were taken down by reversing the process of erection. The contractors for this work were the Aberthaw Construction Co., of Boston, Mass.

A Pneumatic Cushion Cap for Driving Reinforced Concrete Piles.

In driving reinforced concrete piles by hammers some form of cushion cap is essential to prevent shattering of the pile head. Various forms of such cap have been devised and used from plain wooden pillow blocks to elaborately packed and cushioned caps of steel and iron. The accompanying cut shows a pneumatic cushion cap which has been tried out successfully in actual pile driving.

Referring to the drawing, it will be seen that this cap consists of an upper cylinder casting and a lower piston casting. The cylinder casting is hollowed out or dished on top to receive a block of wood, which receives the blow of the hammer, and also has on opposite sides flanges which engage the guides



Pneumatic Cushion Cap for Driving Concrete Piles.

of the pile driver. This casting also has bolt-like lugs for attaching hoisting rope and its shell near the top is pierced with two holes, the upper one closed by a screw plug and intended for admitting oil to the cylinder, and the lower one closed by a valve nipple and intended for the admission of compressed air to the cylinder above the oil.

The piston casting has a plunger portion which fits snugly into the cylinder casting and has packing rings around its top. The bottom part or base is cored out to engage the top of the pile being driven. It also has side flanges which engage the guides of the pile driver.

In operation the cap is assembled as shown and filled partly with oil through the upper opening in the cylinder shell. Then air is admitted through the lower valve and the valve is closed. In regard to the operation the inventor says:

We have a hand air pump on the pile driver, and two minutes before starting the hammer we attach the air hose of the pump to a stop cock of the air cushion, and a few strokes with the pump will charge the air chamber with sufficient air for a continuous hard day's driving. It is self-lubricating. The plunger is cored out, for two good reasons: First, to lengthen the casting, and second, it acts as a receptacle to hold the oil, which is very essential in keeping the two surfaces well lubricated under the constant hammering. On our various jobs we used, or rather the air in the chamber would compress, from ⅝ in. to ¾ in., according to the hardness of the ground. We used an Automatic No. 2 Vulcan Steam Hammer, weighing 85,000 lbs., striking a 5-ton blow, and about 70 strokes per minute.

The following further information is given by Mr. Lee Highley, assistant engineer, Missouri Pacific Ry., St. Louis, Mo.:

I witnessed the test driving done at Main and Dorcas streets, this city, for the Manufacturers' Ry. on June 15, by the McCully Construction Co. In this test a corrugated reinforced concrete pile and an ordinary cypress pile were driven with a steam hammer using the DeWitt Patented Compressed Air Cushion Block. The piles were about 30 ft. long and both were followed below the ground surface. The corrugated concrete pile in question was one of a number made by the McCully Construction Co. for this particular work and had been three days in the form and seven days in the air. The piles were driven in made ground, containing much rubbish and drift, near the Mississippi River, and the driving was particularly difficult. The concrete pile was put down in an hour, penetrating less than 0.01 ft. at each blow of the hammer, which was 5-ton. The pile withstood the blows in good manner and showed but very slight abrasion at the top corners when the hood was removed.

The cypress pile, somewhat smaller than the concrete one, was driven under the same conditions in 11 minutes. It penetrated 0.05 ft. per blow, showing much less frictional resistance than the other pile. So successfully did the air cushion work that this pile was scarcely bruised by the hood.

This demonstration along with the work done for the Manufacturers' Ry. affords good evidence that the reinforced concrete pile and compressed air cushion are a practical success.

The cushion cap described is the invention of F. L. Aymond and C. C. De Witt of St. Louis, Mo. The above description has been prepared from information furnished by the inventors and others and obtained from the patent specifications.

Reinforced Concrete Bridges for Track Elevation, in Evanston, Ill., of the Chicago, Milwaukee & St. Paul Railway.*

The Bridge and Building Department of the Chicago, Milwaukee & St. Paul Ry. Co., under the direction of Mr. C. F. Loweth, Engineer and Superintendent, is completing some interesting construction work in connection with grade separation in Evanston, Ill. The work presented a number of difficult problems and a description of the solutions proposed and of those adopted, together with a discussion of the reasons for the choice made, will probably be of interest.

The City of Evanston extends about four miles along the shore of Lake Michigan just north of the city limits of Chicago. It has a population of nearly 30,000, and is almost exclusively a residence town; its inhabitants go to Chicago for their shopping, amusements, and daily vocations. The Chicago & Evanston Division of the Chicago, Milwaukee & St. Paul Ry. runs from the Union Depot, Chicago, northward through the North Shore suburbs of the city, through Evanston and into the town of Wilmette, just north of Evanston, a total distance of about 14 miles. This line handles a considerable freight traffic from the north branch of the Chicago River and some from Evanston, and formerly took care of a certain amount of suburban passenger traffic along the North Shore. The Chicago terminal of the C. M. & St. P. Ry. is, however, not very convenient to the main business, shopping, and theater center which lies within the "Union Loop" made by the elevated railroads of the city.

The Northwestern Elevated R. R. originally extended from the Union Loop to Wilson Ave., a distance of 6½ miles, and its terminal was at Wilson Ave. Station on the line of the Chicago & Evanston Division of the C. M. & St. P. Ry. The Northwestern Elevated had long desired an extension to Evanston and the growing suburbs north, and in August, 1907, it obtained a lease from the C. M. & St. P. Ry., which allowed it to run its trains on the latter company's right of way from Wilson Ave. to Central St., a distance of 7.2 miles. This part of the St. Paul line was modified for electric traffic and, on May 16, 1908, trains were run from the Union Loop to the north end of Evanston; a distance of about 13.7 miles. The St. Paul tracks north of Central St. are used by the Chicago & Milwaukee Electric R. R. which parallels the Northwestern Elevated down to Church St.

The right of way of the Chicago & Northwestern Ry. adjoins that of the Chicago, Milwaukee & St. Paul Ry. from a point near the southern boundary of Evanston to Davis St., which is one block south of the limit of the track elevation. The very heavy traffic on the Chicago & Northwestern Ry. Co.'s line and the frequency of the electric trains on the St. Paul Co.'s tracks made it difficult to prevent accidents at the numerous street crossings. The unusual condition brought about by the proximity of the railways led the city and the two railway companies to agree upon grade separation. An ordinance was passed in March, 1907, by the general terms of which the Chicago, Milwaukee & St. Paul Ry. Co. was required to elevate its tracks for that part of the line extending from the southern boundary of the city to Church St., which is at the north end of the business district. According to the ordinance, the top of rail was to be above specified elevations at each subway; the embankment to be as wide as desired by the company, but retained within the right of way by suitable walls.

The bridges which carry the elevated tracks over the streets are, from an engineering standpoint, the most important features of track elevation work for the reason that they control the elevation of base of rail and consequently the profile of the line, that they furnish the largest separate items of cost in such work, and that they are practically the only features of the work which are constantly before the eyes of the public and which affect the public most directly. These three matters were considered when the question of the type of structure for the Evanston subways was taken up, and it was endeavored to design bridges which would have (1) floors as thin as practicable, to make the elevation of the tracks a minimum; (2) initial costs as small as possible consistent with durability and economy in maintenance, and (3) a good appearance and qualities which would render them noiseless and as nearly waterproof as possible.

The ordinance relating to subway bridges mentioned metal bridges and masonry bridges, the idea being to eliminate wooden or temporary construction and non-continuous floors. A study was therefore made of several types proposed, either of which would comply with the spirit of the ordinance.

Under the ordinance fourteen subways were required and they came under two general classes:

Class *A*—Seven subways whose greatest span is 26 ft., or less. All but one of these subways have the roadway divided into two spans by a pier in the middle of the street.

Class *B*—Seven subways whose greatest spans vary from about 30 ft. to about 36 ft. None of these subways have piers in the middle of the roadway.

In making the preliminary estimates, these two classes were considered separately, because structures that were satisfactory for

*Abstracts, with comments and discussion, from a paper by Mr. E. O. Griefenhagen, Office Engineer, Bridge and Building Department, C., M. & St. P. Ry., read before the Western Society of Engineers, Feb. 9, 1910.

one class were not necessarily best for the other class on account of the difference in length of span. As representing the Class *A* subways, Grove St. was chosen, which was to have two sidewalks 10 ft. wide and a 46-ft. roadway, with piers allowed at the curb lines and at the middle of of the street, making a four-span crossing. As representing class *B* subways, Greenwood St. was chosen, which was to have sidewalks 10 ft. wide and a 36-ft. roadway, with piers allowed at the curb lines only, making a three span bridge.

There were five schemes drawn up and estimated for the Grove St. subway, as follows:

Scheme *A-1*—Reinforced concrete slabs, 13 ft. wide, supported by reinforced concrete piers, each pier having four columns. (See Fig. 1).

Scheme *A-2*—I-beams d ck spans (eight 20-in. I-beams per track for roadway spans) with a reinforced concrete ballast deck supported by structural steel bents or piers of two columns per bent.

Scheme *A-3*—I-beam deck spans (four 24-in. I-beams per track for roadway spans) with solid reinforced concrete ballast deck and ornamental reinforced concrete parapets or facia girders; supported by structural steel bents or piers of two columns per bent.

Sceheme *A-4*—Through plate girder spans with solid floor composed of 15-in. I-beams spaced about 18 ins. c. to c. and covered with a solid reinforced concrete ballast deck; girders supported by structural steel bents or piers of three columns per bent.

Scheme *A-5*—Through plate girder spans with I-beam floor, similar in design to scheme *A-3*, except that the curb piers are omitted and the girders span from the abutments to the middle pier.

There were six designs drawn up and estimated for the Greenwood St. Subway as follows:

Scheme *B-1*—Reinforced concrete through girder bridge composed of heavy reinforced concrete girders, with a solid continuous concrete ballast floor spanning between them, supported by reinforced concrete piers; each pier having three columns.

Scheme *B-2*—Through plate girder spans with I-beams floor composed of 12-in. I-beams spaced 15 ins. c. to c. with a continuous reinforced concrete ballast deck; girders supported by structural steel bents or piers of three columns per bent.

Scheme *B-3*—Through plate girder spans with regular steel cross floor beam and stringer floor system, with a continuous reinforced concrete ballast deck; girders supported by structural steel bents or piers of three columns per bent.

Scheme *B-4*—Bethlehem girder beam deck spans (six 26-in. beams per track for roadway spans) with a reinforced concrete ballast deck; supported by structural steel bents or piers of two columns per bent.

Scheme *B-5*—Similar to scheme *B-4* except for the additions of ornamental concrete parapets or facia girders.

Scheme *B-6*—Span made up of two 30-in. Bethlehem girder beams per rail; rails set down between pairs of beams and supported by a concrete floor; spans supported by structural steel bents or piers of two columns per bent. This scheme has since been used by the C. B. & Q. Ry. Co. on track elevation work.

All the above schemes were estimated for a double track bridge exclusive of track, abutments, falsework, depression of street, paving, and all other items which were common, of every type considered, and which, therefore, would not affect their relative costs. Natural foundations were assumed in all cases. It was found that pile foundations would add about 10 per cent to the estimates. The following table shows the relative costs and depths from base of rail to low bridge for each structure estimated—(the cost of Scheme *A-1* being the lowest, is called 100).

Scheme.	Depth of floor.	Cost.
A-1	4 ft. 0 ins.	100
A-2	3 ft. 8 ins.	112
A-3	4 ft. 0 ins.	108
A-4	3 ft. 5½ ins.	146
A-5	3 ft. 5½ ins.	149
B-1	2 ft. 10½ ins.	104
B-2	2 ft. 10¾ ins.	150
B-3	3 ft. 9½ ins.	134
B-4	4 ft. 2 ins.	134
B-5	4 ft. 2 ins.	136
B-6	2 ft. 0 ins.	132

The depths of the floors for the schemes are second only to the first cost of the bridge in their bearing on the total cost of the track elevation work and they were fully considered in the choice of the final types.

Scheme *A-3* was considered a less satisfactory design than scheme *A-2*, because of its greater depth and because the permanence of the false concrete facia girders under the action of deflection and vibration was questioned. Schemes *A-4*, *A-5*, and *B-3* were discarded because their heavy first cost was not compensated for by a shallow floor and because the girders projecting above the track level were considered undesirable. Scheme *B-5* was replaced by scheme *B-4* in the final estimates because there was little difference in the two designs. Scheme *B-6* was ruled out because of its non-continuous floor and because of the unsatisfactory roadbed which it provided.

This left five schemes for final consideration; two schemes for the Class *A* subways and three schemes for the Class *B* subways. Relative costs and depths of floor for the schemes are given below:

Scheme.	Depth of floor.	Cost.
A-1	4 ft. 0 ins.	100
A-2	3 ft. 8 ins.	112
B-1	2 ft. 10 ins.	104
B-2	2 ft. 10¾ ins.	150
B-4	4 ft. 2 ins.	134

Since the depth of the floor controlled the gradient of the track and the amount of fill required, it was necessary to figure this effect in dollars and cents before the cheapest combination of schemes for the two classes of crossings could be ascertained. Accordingly, calculations were made to determine the amount of fill and the yardage in retaining walls as well as the effect on the gradients, for several combinations. The combination of all-concrete bridges, Schemes *A-1* and *B-1*, required from 4,500 to 13,000 cu. yds. of fill and from 320 to 540 cu. yds. of concrete less than any other combination. These facts, together with the figures given in the table of costs, showed conclusively that reinforced concrete bridges for all subways had the least first cost from all points of view. The advantages for the concrete bridges, exclusive of first cost, as compared with the structural steel bridges were tabulated as follows:

Advantages Claimed for Concrete Bridges.

(1) Greater economy.
(2) Greater rigidity and freedom from vibration; noiseless.
(3) Durability, practically permanent.
(4) Require almost no maintenance.
(5) Of good appearance, as befits bridges in a residence town.
(6) Built entirely of the same materials;

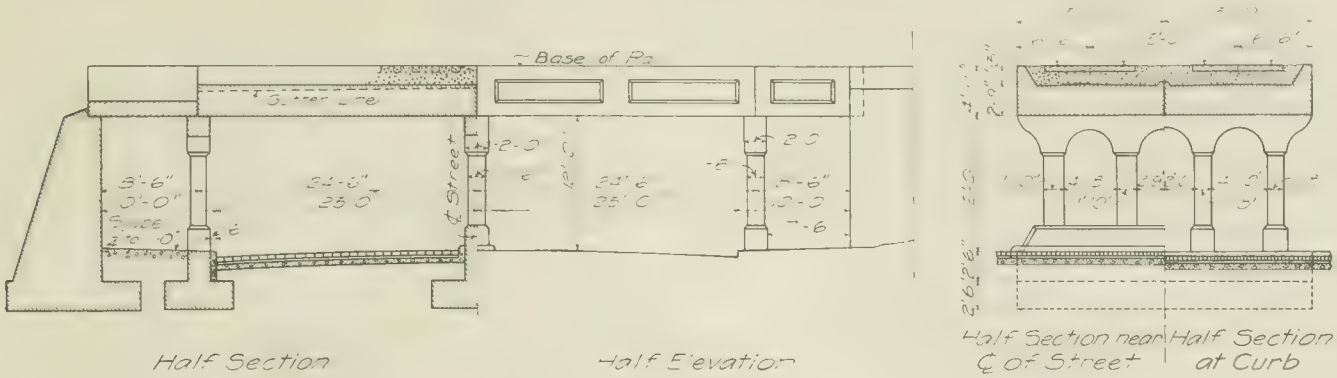


Fig. 1—Proposed Scheme A.

Fig. 2—View of Lake Street Subway Bridge.

footings, abutments and piers can be put in by the same forces, with the same plant.

(7) All work can be done by the company.

Advantages Claimed for Steel Bridges.

(1) The strength of the structures can be definitely determined by a field examination in case the plans are destroyed.

(2) Ordinary errors of workmanship will not affect the stability of the structure.

(3) Alterations not impossible.

(4) Bridges will always have some salvage value.

(5) Ordinance need not be amended, as some cases. On the basis of this information, natural footings were used at 1¾ to 2 tons per sq. ft. for the bridges at Greenleaf St. and all streets south, and pile foundations were used at all points north of this crossing. A bearing on piles of from 12 to 16 tons was allowed. The question of carrying columns down to bed rock or into firm clay on concrete cylinders was considered, and found to be unwarranted by the conditions.

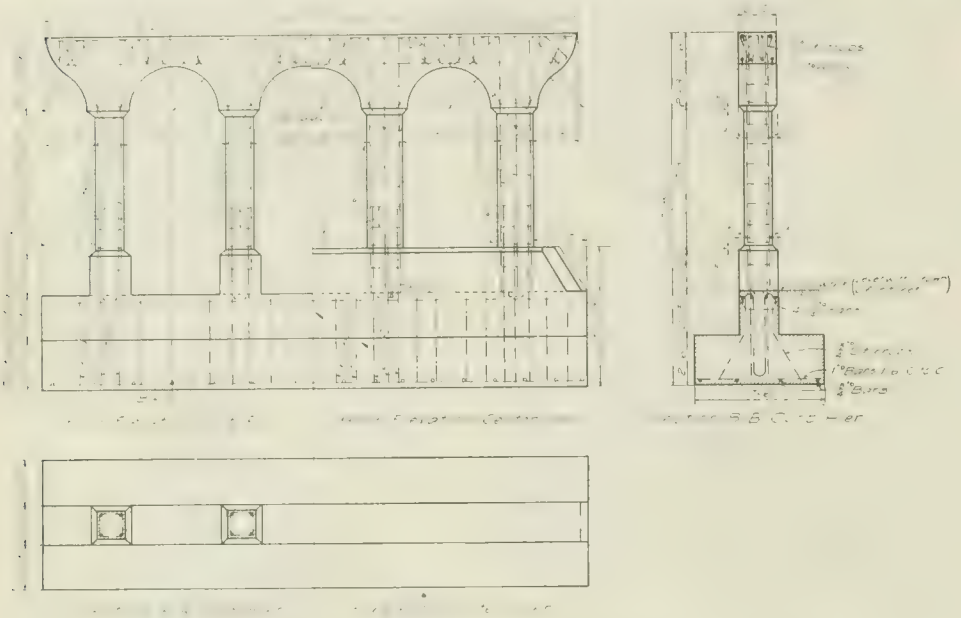


Fig. 3—Details of Piers Chicago Avenue Subway Bridge.

would probably be the case if concrete superstructure were adopted.

(6) A disadvantage of the proposed concrete through girders which steel bridges do not have is that the former require the spreading of the tracks to clear the middle girder.

It was decided to use concrete bridges. A sentiment had developed in the city in favor of wider subways and this, of course, permitted shorter spans, as piers would now be permitted in the middle of the streets. The railroad company agreed to the change for the investigation had shown the great economy of short spans, and the ordinance was amended, permitting the use of reinforced concrete bridges and containing the following revised schedule of subways:

Name of subway.	Total width between abutments.	Width of sidewalk.	Width of roadway	No. of roadway spans.	Head-room.	Skew.
	ft.	ft.	feet.		ft.ins.	
Chicago Ave.	60	10	20 & 20	2	13 0	18°34′
Mulford St.	40	10	20 & 20	1	12 0	17°40′
Rinn St.	60	10	20 & 20	2	12 0	8°29′
Madison St.	60	10	20 & 20	2	13 0	10°0′
Washington St.	60	10	20 & 20	2	12 0	10°20′
Main St.	66	13	20 & 20	2	12 0	21°13′
Greenleaf St.	60	10	20 & 20	2	12 0	10°36′
Dempster St.	66	13	20 & 20	2	12 0	10°36′
Greenwood St.	66	13	20 & 20	2	12 0	11°53′
Lake St.	66	13	20 & 20	2	12 0	15°19′
Grove St.	66	13	20 & 20	2	13 0	20°38′
Davis St.	80	14	26 & 26	2	12 0	8°28′
Church St.	68	14	20 & 20	2	12 6	0°02′

The standard loading for permanent work on the C. M. & St. P. Ry., east of the Missouri River, is Cooper's E-50. A study was made of a typical subway bridge for three probable loadings and comparative costs estimated with the following results:

Cooper's E-50	100
Cooper's E-40	96
100-ton electric locomotive	96

As a result of this study, all work was designed for Cooper's E-50 loading, the saving being too small on the lighter loadings and future changes in rolling stock could not be foretold.

To fix foundation loadings, pits and wash borings were made at each crossing, the wash borings being made to a depth of 50 ft. in

The Chicago Ave. subway is typical and a description of the bridge at this street will apply to the bridges throughout the track ele-

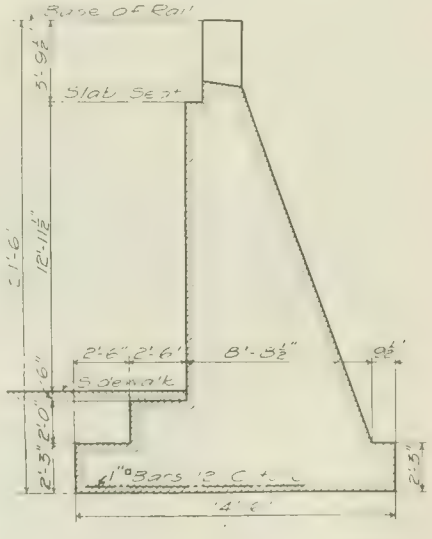


Fig. 4—Section of Abutment Chicago Avenue Subway Bridge.

vation. This subway is on an 18° 34′ skew and has two 10-ft. sidewalks and a 40-ft. roadway. Curb piers are allowed within the sidewalk space. A similar pier divides the road-

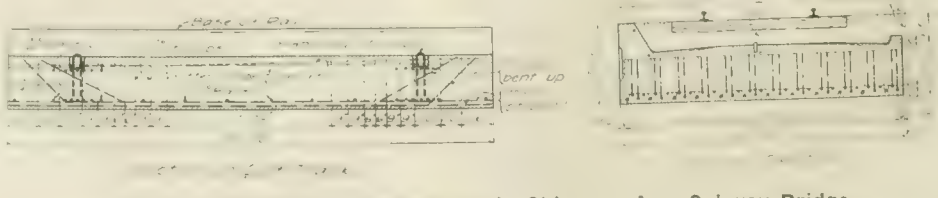


Fig. 5—Details of Roadway Slab Chicago Ave. Subway Bridge.

way into two channels. The face of the abutments and wing walls is on the street line. A clear head room of 13 ft. above the crown of the street is provided according to the ordinance. The elevation of the sidewalks at the curb line is the same as that of the crown of the street and the sidewalks are sloped upward toward the abutment at the rate of one quarter of an inch to the foot.

The requisite massiveness of the bridge, due to the heavy loading and the nature of the material employed, limited the architectural treatment to the simplest lines. The slabs which carry the tracks over the various openings between the abutments and piers are provided with a parapet of uniform depth and width over the entire crossing. The bare surface of this parapet is relieved by simple rectangular recessed panels. The abutments are of heavy construction and give the effect of solidity to the end supports. The composition of the piers was worked out to provide the necessary size of sections and at the same time create an impression of lightness and gracefulness which would relieve any tendency toward a tunnel-like appearance in the subways. The widening of the piers below and above the columns, and the introduction of the curved brackets have an advantage from a structural as well as from an aesthetic standpoint.

The general appearance of the completed subway bridges may be seen from Fig. 2, which is a view at Lake St.

There are three piers for each subway, except at Mulford St., which has only one span over the roadway. The side or curb piers are placed with the outer face 6 in. behind the curb line, and the middle piers are placed on the center line of the roadway.

The appearance of the piers as constructed may be seen from Fig. 2, which is a view of the Lake St. subway bridge. The details of the Chicago Ave. piers are shown on Fig. 3. In general, each pier consists of four columns supporting a cross girder and carried by a footing girder which distributes the load to a footing slab.

The top girder, capping the columns, is given an arched form and figured as a continuous beam. The arches provide curved brackets which stiffen the columns laterally and which give depth to the beam at the points of greatest shear. There are two 1-in. bars in the top of the girder running the full length of the pier, and an additional pair of 1-in. bars over each column, bent down to assist in taking care of web stresses. There are four 1-in. bars in the bottom of the beam run ning the full length of the pier. Six to eight ½-in. square stirrups bent in the shape of a *W* are placed in the beams between columns, and three such stirrups in each side cantilever. The curved brackets are reinforced by pairs of 1-in. diagonal bars. The top girders are made 6 ins. wider than the columns; this makes their width 24 ins. in all cases except the middle pier at Davis St., where they are 30 ins. wide. The depth of the beam at the crown of the arch varies from 18 ins. to 24 ins. The ends of the cantilevers are cut off perpendicular to the center line of the pier and the concrete slabs are allowed to project beyond the extreme corner, which gives a better appearance and a more satisfactory detail than would be obtained if the ends were made parallel and flush with the slab parapets, because the arrangement adopted eliminates the sharp corner and warped surface.

The column shafts from the springing line of the top arches to the top of the base or pedestal vary in height from 6 ft. to 7 ft. 3 ins. The top of the so-called base or ped-

Engineering-Contracting Monthly Review Index of Civil Engineering Literature.

A classified index and review of the civil engineering papers, articles, reports, pamphlets and books published during the month just passed is given in the succeeding pages. The literature indexed and reviewed—with the exception of books—relates solely to civil engineering. In the section devoted to Book Reviews all books in all branches of engineering are listed as received and such of them as seem worthy are reviewed as fully as due regard for conciseness will permit. In choosing books for review rigid selection is exercised. Next to careful choice of books for review timeliness of review is sought. All books are reviewed within a month of their receipt. The same statement is true of the articles and papers that are indexed. Also, as in choosing books for review, the choice of articles and papers for indexing is based on merit. Numerical strength in "titles indexed" is not sought; excellence of selection is sought.

The purposes of the Monthly Review Index are: First, to inform civil engineers and contractors of the articles and papers of merit that are published each month, in such a way as will give a clear idea of their character and scope; second, to supply the user with the date and place of publication, the length of each article and the cost at which it can be secured. The name, adopted abbreviations, place of publication and price per number of each periodical examined for civil engineering articles are given in the list immediately following. The other information is given in the index proper for each article separately.

Books reviewed will be sent post paid on receipt of price by the Book Department of ENGINEERING CONTRACTING; periodicals, etc., containing articles indexed should be ordered direct from the publishers.

LIST OF PERIODICALS INDEXED.

American Architect (Am. Arch.), New York, N. Y.; w; 7x10 in.; 15 cts.
American Builders' Review (Am. Bldrs. Rev.), San Francisco, Cal.; m; 7x10 in.; 50 cts.
American Carpenter and Builder (Am. Car. & Bldr.), Chicago, Ill.; New York, N. Y.; m; 7x10 in., 20 cts.
American Engineer and R. R. Journal (Am. Engr. & R. R. Jl.), York, N. Y.; m; 7x10 in.; 20 cts.
American Gas Light Journal (Am. G. L. Jl.), New York; N. Y.; w; 10x13 in.; 10 cts.
American Institute of Electrical Engineers Proceedings (Am. I. of E. E. Proc.), New York, N. Y.; m; 4x7 in.; 50 cts.
American Machinist (Am. Mchst.), New York; w; 7x10 in.; 15 cts.
American Society of Civil Engineers Proceedings (Am. Soc. C. E. Proc.), New York, N. Y.; m; 4x7 in.; 75 cts.
American Society of Mechanical Engineers Journal (Am. Soc. M. E. Jl.), New York, N. Y.; m; 4x7 in.; $1.
Annales des Ponts et Chaussees (An. P. & C.), Paris, France; m.
Applied Science, Toronto, Ont.; m; 6x9 in.; 20 cts.
Architects and Builders Journal (Arch. & Bldrs. Jl.), Baltimore, Md.; m; 9x12 in.; 20 cts.
Architects and Builders Magazine (Arch. & Bldrs. Mag.), New York, N. Y.; m; 5x8 in.; 20 cts.
Architect and Engineer of California (Arch. & Engr.), San Francisco, Cal.; m; 5x7 in.; 15 cts.
International Railway Congress Bulletin (Int. Ry. Cong. Bul.), Brussels; m; 50 cts.
California Journal of Technology (Cal. Jl. of Tech.), Berkeley, Cal.; m; 4x7 in.; 25 cts.
Canadian Architect (Can. Arch.), Toronto, Ont.; m; 7x19 in.; 20 cts.
Canadian Cement and Concrete Review (Can. Cem. & Conc. Rev.), Toronto, Ont.
Canadian Engineer (Can. Engr.), Toronto, Ont.; w; 7x11 in.; 20 cts.
Canadian Machinery and Manufacturing News (Can. Mach. & Mfg. News), Toronto, Ont.; m; 7x10 in.; 15 cts.
Canadian Mining Journal (Can. Min. Jl.), Toronto, Ont.; bi-w; 7x10 in., 20 cts.
Canadian Municipal Journal (Can. Mun. Jl.), Montreal, Que.; m; 6¾x10 in.; 10 cts.
Canadian Society of Civil Engineers Proceedings (Can. Soc. C. E. Proc.), Montreal; m; 4x7 in.; 50 cts.
Carpentry and Building (Carp. & Bldg.), New York, N. Y.; m; 11x8 in.; 10 cts.
Cassier's Magazine (Cas. Mag.), New York; m; 5x8 in.; 25 cts.
Cement, New York, N. Y.; bi-m; 5x8 in.; 25 cts.
Cement Age (Cem. Age), New York, N. Y.; m; 4¾x8 in.; 15 cts.
Cement and Engineering News (Cem. & Eng. News), Chicago, Ill.; 7x10 in ; 25 cts.
Cement Era (Cem. Era), Chicago, Ill.; m; 7x10 in.; 10 cts.
Cement-Record (Cem. Rec.), m; 4¾x8 ins.; 15 cts.
Cement World (Cem. Wld.), Chicago, Ill.; m; 9x11 in.; 10 cts.
Chemical Engineer (Chem. Engr.), Chicago, Ill.; m; 4x7 in.; 15 cts.
Clay Worker (Cl. Wkr.), Indianapolis, Ind.; m; 7x10 in.; 20 cts.
Compressed Air (Comp. Air), New York, N. Y., m; 5x7 in.; 10 cts.
Concrete, Detroit, Mich.; m; 6x9 in.; 15 cts.
Concrete Age (Conc. Age), Atlanta, Ga.; m; 9x11 in.; 10 cts.
Concrete and Constructional Engineering (Conc. & Cons. Eng.), London, England; m; 5x7 in.; 25 cts.
Concrete Engineering (Conc. Eng.), Cleveland, O.; m; 7x10 in.; 10 cts.
Contract News, Chicago, Ill.; bi-w; 7x10 in.; 10 cts.
Contractor (Contr.), Chicago, Ill.; bi-w; 7x10 in.; 20 cts.
Cornell Civil Engineer (Cor. Civ. Engr.), Ithaca, N. Y.; m; 4x7 in.; 25 cts.
Domestic Engineering (Dom. Engr.), Chicago, Ill.; w; 6x9 in.; 10 cts.
Electrical Age (Elec. Age), New York, N. Y.; m; 7x10 in.; 10 cts.
Electrical Review (Elec. Rev.), New York, N. Y.; 8x10 in.; 10 cts.
Electric Railway Journal (Elec. Ry. Jl.), New York, N. Y.; w; 7x10 in.; 10 cts.
Electrical World (Elec. Wld.), New York, N. Y.; w; 7x10 in.; 10 cts.
Electric Traction Weekly (Elec. Trac. Wkly.), Chicago, Ill.; w; 7x10 in.; 10 cts.
Engineer (Engr. Lon.), London, England; w; 4x11 in.
Engineer (Engr.), Chicago, Ill.; bi-w; 7x10 in.; 20 cts.
Engineering (Eng.), London, England; w; 8x11 in.
Engineering-Contracting (Eng.-Contg.), Chicago, w; 7x10 in.; 10 cts.
Engineering Digest (Eng. Dig.), New York; m; 5x8 in.; 20 cts.
Engineering and Mining Journal (Eng. & Min. Jl.), New York; w; 7x10 in.; 15 cts
Engineering Magazine (Eng. Mag.), New York; m; 5x7 in.; 25 cts.
Engineering News (Eng. News), New York; w; 8x11 in.; 15 cts.
Engineering Record (Eng. Rec.), New York; w; 8x11 in.; 10 cts.
Engineers' Club of Philadelphia Proceedings (Engr.'s Club, Phila. Proc.), Philadelphia; qr; 4x7 in.; 25 cts.
Fire and Water Engineering (F. & W. Eng.), New York, N. Y.; 8x11 in.; 10 cts.
Le Genie Civil Paris, France; w.
Good Roads Magazine (Gd. Rds. Mag.), New York, N. Y.; m; 7x10 in.; 10 cts.
Industrial Magazine (Ind. Mag.), Cleveland, O.; m; 4x7 in.; 10 cts.
Industrial World (Ind. Wld.), Pittsburg, Pa.; w; 7x10 in.; 10 cts.
Insurance Engineering (Ins. Eng.), New York; m; 4x6 in.; 25 cts.
Iron Age, New York, N. Y.; w; 7x11 in.; 15 cts.
Iron Trade Review (Iron T. Rev.), Cleveland, O.; w; 7x10 in.; 15 cts.
Irrigation Age (Irr. Age), Chicago, Ill.; m; 7x9 in.; 10 cts.
Journal Association of Engineering Societies (Jl. Assoc. Engr. Soc.), Boston, Mass.; m; 4x7 in.; 30 cts.
Journal Franklin Institute (Jl. Frank. Inst.), Philadelphia, Pa.; m; 4x7 in.; 50 cts.
Journal New England Waterworks Association (Jl. N. E. W. W. Assoc.), Boston, Mass.; q; 4x7 in.
Journal Western Society of Engineers (Jl. W. Soc. Engrs.), Chicago, Ill.; bi-m; 4x7 in.; 50 cts.
Journal of Electricity, Power and Gas (Jl. Elec., P. & G.), San Francisco, Cal.; w; 7x10 in.; 10 cts.
Journal of Worcester Polytechnic Institute (Jl. W. P. I.), m; 4x7 in.; 20 cts.
Machinery, New York, N. Y.; m; 7x11 in.; 20 cts.
Marine Review (Marine Rev.), Cleveland, O.; w; 7x10 in.; 15 cts.
Mines and Minerals (Mi. & Mis.), Scranton, Pa.; w; 7x9 in.; 20 cts.
Mining and Scientific Press (Min. & Sci. P.), San Francisco, Cal.; w; 7x11 in.; 15 cts.
Mining Reporter (Min. Rep.), Denver, Colo.; w; 7x10 in.; 15 cts.
Mining World (Min. Wld.), Chicago, Ill.; w; 7x10 in.; 10 cts.
Modern Machinery (Mod. Mchy.), Chicago, Ill.; m; 7x10 in.; 10 cts.
Municipal Journal and Engineer (Mun. Jl. & Eng.), New York, N. Y.; w; 7x10 in.; 10 cts.
Municipal Engineering Magazine (Mun. Eng. Mag.), Indianapolis, Ind.; m; 4x7 in.; 25 cts.
Ores and Metals (O. & M.), Denver, Colo.; bi-w; 6x10 in.; 10 cts.
Pacific Building Engineer (Pac. Bldg. Engr.), Seattle, Wash.; w; 9x11 in.; 15 cts.
Popular Mechanics (Pop. Mech.), Chicago, Ill.; m; 5x7 in.; 10 cts.
The Polytechnic (Poly.), Troy, N. Y.; m; 5x8 in.; 15 cts.
Power and Engineer (Pwr. & Engr.), New York; m; 7x10 in.; 20 cts.
Railway Age Gazette (R. R. Age Gaz.), New York; w; 8x11 in.; 15 cts.
Railway Master Mechanic (Ry. M. M.), Chicago; m; 7x10 in.; 10 cts.
Railway and Engineering Review (Ry. & Eng. Rev.), Chicago, Ill.; w; 9x11 in.; 10 cts.
Railway and Locomotive Engineering (Ry. & Loco. Eng.), New York, N. Y.; m; 7x10 in.; 20 cts.
Railway and Marine World (Ry. & M. Wld.), Toronto, Ont.; m; 7x10 in.; 15 cts.
Railway Engineering and Maintenance of Way (Ry. Eng. & M. W.), Chicago, Ill.; m; 7x10 in.; 10 cts.
Roadmaster and Foreman (Rd. & For.), Chicago; 7x10 in.; 10 cts.
Rock Products (Rk. Prod.), Chicago, Ill.; bi-w; 9x11 in.; 10 cts.
Rose Technic, Terre Haute, Ind.; m; 4x7 in.; 15 cts.
School of Mines Quarterly (Sch. Min. Quart.), New York, N. Y.; qr; 4x7 in.; 50 cts.
Schweizerische Bauzeitung, Zurich; w.
Scientific American (Sci. Am.), New York; w; 9x14 in.; 10 cts.
Scientfic American Supplement (Sci. Am. Sup.), New York, N. Y.; w; 9x14 in.; 10 cts.
Sibley Journal of Engineering (Sib. Jl. Eng.), Ithaca, N. Y.; m; 4x7 in.; 20 cts.
Stevens Institute Indicator (Stev. Inst. Ind.), Hoboken, N. J.; m; 4x7 in.; 20 cts.
Street Railway Bulletin (St. Ry. Bul.), Boston; m; 6x10 in.; 10 cts.
Surveyor (Surveyor), London, England; w; 6x11 in.; 10 cts.
Technology Quarterly (Tech Qr.), Boston; qr; 4x6 in.; 35 cts.
U. S. Department of Agriculture Bulletin (Dept. Agr. Bul.), Washington, D. C.; 4x7 in.
U. S. Geological Survey Bulletin (Geo. Surv. Bul.), Washington, D. C.; 4x7 in.
Waterproofing and Fireproofing (W. P. & F. P.), Detroit, Mich.; m; 7x10 in.; 10 cts.
Zeitschrift d. Oest. Ing. u. Arch. Ver. Vienna; w
Zeitschrift d. Ver Deutscher Ing.; Berlin; w.

ROADS AND STREETS.

The Use of Tar for Road-Making and Repairs.—By Wm. Wade. Surveyor, Jan. 21, 1910. 1½ pp.

This is a paper read at a recent meeting of the Institution of Municipal Engineers, England, giving personal experiences. He concludes that the cost of tar grouting is no more than that of repairing a road by the old water-bound method. He divides tar treatment into: Tar painting or waterproofing the surface; Tar-macadam, or mixing tar with the stone previous to its being laid in the road; and, Tar-grouting, or grouting the stone with tar and pitch when the road is being coated.

Notes on Street Paving.—By Thos. B. McMath. El. Tr. Wkly., Jan. 29, 1910. 1½ pp.

This is an article read by the chief engineer of the Indianapolis Traction & Terminal Company at the January convention of the Central Electric Railway Association. From the point of view of the engineer, whose work is of a somewhat special nature in street paving, this paper is instructive.

Gutter Culverts.—Mun. Jl. & Eng., Jan. 5, 1910. 3 pp.

Detail drawings and half-tone views are presented, illustrating present practice in Chattanooga, Tenn. Comparisons are made between pipes and box culverts of masonry.

Concrete Paving at Memphis. — By J. H Weatherford. Mun. Jl. & Eng., Jan. 5, 1910. 2½ pp.

A very good description of concrete pavements in a city where this pavement is in successful use.

Street Crossings and Driveways.—Mun. Jl. & Eng., Jan. 12, 1910. 2 pp.

An article illustrating private driveways across sidewalks, alley crossings, etc.

Washington Street Lighting.—El. Wld., Jan. 6, 1910. 2 pp.

This is a digest of a report by W. C. Allen, Electrical Engineer for the city of Washington, D. C. Tests were made on typical street lighting installations to enable a comparison to be made of relative efficiencies. A table gives comparison of lighting and another table gives costs of lighting.

Concrete Pavement Construction at Boise, Ida.—Eng.-Contg., Jan. 19, 1910. ½ p.

Describes methods of construction and gives general costs.

Data on Street Work at New Bedford, Mass.—Eng.-Contg., Jan. 19, 1910. ½ p.

Gives various cost data on street work covering, curbing, oiling macadam and pavement construction of several kinds.

Economics of Street Pavements.—Eng.-Contg., Jan. 12, 1910, 1 2-3 pp.

Presents estimates and discussion comparing the economics of various forms of pavement, including granite block, sheet asphalt and macadam. Summarizes conclusions as to pavements most economic for various classes of streets. A valuable paper.

Notes on Road and Street Work.—Eng.-Contg., Jan. 5, 1910, 1½ pp.

Gives results of observations on the effect of automobile traffic on roads of various surfaces; also illustrates and describes a card for recording street maintenance work.

The Possibilities of Portland Cement as a Road Material.—Eng.-Contg., Jan. 5, 1910, 1 p.

Describes a method of concrete road construction which it is believed will do away with cracking and spalling and should not cost more than 10 to 15 cts. per square yard more than ordinary macadam. Also discusses possibilities of securing a more elastic concrete by admixture with mineral oils.

SEWERS.

Modern Methods of Sewage Disposal.—By T. Aird Murray. App. Sci., January, 1910. 10 pp.

A paper read before the Engineering Society, University of Toronto. A very good review of the subject.

Disposal of Manufactural Wastes and Sewage at Gloversville. Part I.—Eng. Rec., Jan. 22, 1910. 2⅝ pp. Part II.—Jan 29, 1910. 3 pp.

Describes experiments made to dispose of sewage and factory wastes in a city of about 20,000 inhabitants, containing 26 tanneries in addition to other factories.

Sewage Disposal Works, Grand Canyon, Arizona. Eng. Rec., Jan. 29, 1910. 1¼ pp.

Describes a plant designed by the Cameron Septic Tank Co. in operation for four years past in disposing of the sewage of two large tourist hotels.

The Principles Involved in the Purification of Sewage.—Eng. Dig., Jan., 1910. 2 pp.

Abstract of an article read by Dr. L. W. Hignett before the Institution of Municipal Engineers (England). A concise analysis of sewage is given.

Tank Treatment of Sewage.—Mun. Jl. & Eng., Jan. 5, 1910. 2 pp.

A digest of a paper read in England by Mr. A. P. I. Cotterell giving a general review of the treatment of sewage in tanks.

Oriental Sanitary Engineering.—By C. T. Evennette. Dom. Eng., Jan. 1, 1910. 5 pp.

An interesting paper dealing with the peculiar conditions existing in India and complicating the work of the sanitarian, whether engineer or medical man.

Sewage Disposal for Institutions and Small Communities. — By Theodore Horton. Dom. Eng., Jan. 1, 1910. 3½ pp.

The author is chief engineer of the New York State Board of Health and this article is a reprint of a paper read before a recent conference of sanitary officers of New York. The article, while not of value to the designing engineer, will be useful for an engineer trying to interest a community in sewage disposal.

Ocean Grove Sewage Disposal Plant. — By Clyde Potts. Eng. Rec., Jan. 8, 1910. 1½ pp.

The total cost of this work was $20,400. The summer sewage flow is a maximum of 1,200,000 gallons per day and the winter consumption only 300,000 gallons. Describes construction of septic tanks to care for this great variation.

Sewage Disposal Plant at the Danville (Pa.) State Hospital.—Eng. Rec., Jan. 15, 1910. 1½ pp.

Gives a good description of a plant for the disposal of about 350,000 gallons of sewage in 24 hours. The works comprise primary sedimentation tanks, a sludge bed, sprinkling filter, and secondary sedimentation tanks.

The Disinfection of Water and Sewage Filter Effluents.—Eng. Rec., Jan. 15, 1910. 1½ pp.

Gives abstract of paper read by Prof. Earle B. Phelps at the last meeting of the Sanitary Section of the Boston Society of Civil Engineers and discussion on same.

Standards for Sewage Effluents.—Eng.-Contg., Jan. 5, 1910. 1 1-3 pp.

Describes the difference between a good and a bad effluent, describes a sample test for quality of effluent, and discusses various questions relating to both. A valuable paper.

WATERWORKS AND HYDRAULICS

The Deep Well System of Water Supply for South Bend, Ind.—By Alonzo T. Hammond. Eng. News, Jan. 27, 1910. 1 p. Eng. Rec., Jan. 29, 1910. ¾ p.

Abstract of a paper read at the 1910 annual meeting of the Indiana Engineering Society.

The Design of Pressure Tunnels of the Catskill Aqueduct. Part I.—Eng. Rec., Jan. 29, 1910. 2½ pp.

These tunnels are a part of the aqueduct system for the supply of water to New York City. They have no counterpart in tunnels now in operation and are located at a depth of about 200 feet below the surface. They are to be lined with concrete and the article describes the design and reasons for it; being an abstract of a paper read by Mr. Thomas H. Wiggin, senior designing engineer, before the Society of Municipal Engineers of New York City.

Depth of Water Pipe.—Mun. Jl. & Eng., Jan. 5, 1910. 3 pp.

Gives data from 87 cities collected by the N. E. W. W. Assoc. on depths at which water pipe should be laid to prevent freezing.

Damages by Electrolysis.—Mun. Jl. & Eng., Jan. 5, 1910. 1 p.

A digest of data furnished by the Consular Service of the United States on methods used in ten leading European cities to guard against danger of electrolysis in underground water mains and metallic conduits.

Iron Lime Coagulation at St. Louis.—Mun. Jl & Eng., Jan. 5, 1910. 4¾ pp.

This is a general descriptive article of the purification plant at St. Louis. The water is cleared in large basins without filtration by the addition of lime and iron. Some costs are given.

The Great Chaudiere Dam, Ottawa, Ont.—By Douglas L. McLean. Can. Eng., Jan. 21, 1910. 7 pp.

This dam raises the level of the water in Nepean Bay, Ottawa River, from 8 to 10 feet, thereby giving Ottawa power plants, including the water works, that much more effective working head. The dam is constructed of reinforced concrete piers with 22-ft. openings for stop logs, there being 15 ft. of water on the sills. There are 51 piers and 50 sluice openings in the arc of a circle having a radius of 567 ft. and a length of 1,300 ft. The work cost $225,000.

The Multiple Arch Dam.—Jl. El. P. & G., Jan. 1, 1910. ¾ p.

Two letters referring to the multiple arch dam built near Hume, Calif., under the patents of John S. Eastwood, and described in an earlier issue of the Journal with later comments by C. E. Grunsky. One of these letters gives the economic angle for radii of arches. The second letter is from Mr. E. Wegmann, showing that this form of dam is not new and was used in India in 1800 and in New South Wales in 1898. Also refers to Trans. Am. Soc. C. E., Dec., 1897, and Dec., 1902, where this type of dam was discussed mathematically.

A Multiple Arch Dam.—Eng. Rec., Jan. 15, 1910. ¾ p.

This is a description of the Hume, Cal., dam patented by John S. Eastwood and described by him in the Journal of Electricity, Power & Gas, from which the notes for this article were taken.

Cut and Cover Construction on the Catskill Aqueduct.—Eng. Rec., Jan. 8, 1910. 3½ pp.

This aqueduct is of concrete with elliptical sides and dished bottom, the extreme width being 17 ft. 6 ins. and the height 17 ft. The article describes the handling of forms and mixing and placing of concrete as well as the excavation and filling.

Hydroelectric Development of the Minidoka Project.—Eng. Rec., Jan. 8, 1910. 3¾ pp.

A general description of a 6,000-k.w. power plant to pump water on the Minidoka Project in Idaho for irrigation.

The Water Purification Works at Carson City, Colo.—Eng. Rec., Jan. 15, 1910. 2 pp.

Describes a plant consisting of a settling basin, two slow sand filters and two clear water reservoirs, each reservoir having a capacity of 2,000,000 gallons.

RIVERS, HARBORS AND CANALS.

The Royal Commission's Report on Waterways.—Eng. Rec., Jan. 22, 1910. 2⅓ pp.

A commission was appointed in 1906 in Great Britain to study artificial waterways. A report was published in December, 1909, on canals in Great Britain and in Continental Europe. The committee was divided on the proper policy to pursue to restore canals to their former place. The article is merely a short digest of a long document.

Substructure of Pier 4, Boston Terminal, Boston & Albany R. R.—Eng. Rec., Jan. 29, 1910. 3½ pp.

This pier is 776 feet long and 240 feet wide, with a solid earth core about 400 feet long, with pile construction on both sides. About 6,000 piles from 30 to 80 feet long were required. Part of the construction is reinforced concrete. Detail drawings are given for the principal portions of the work.

The Reservoir Possibilities of the Sources of the Mississippi and Tributaries of the Upper Mississippi River with Reference to the Improvement of Navigation.—By Charles W. Durham. Eng. News, Jan. 20, 1910. 4¾ pp.

The author is an Assistant U. S. Engineer, and this article is written to show the greatest practicable extent to which flow regulation may be obtained by constructing reservoirs to impound surplus water in time of flood, and its effect upon navigation. A good review by a man who has had access to, and examined, all data on the subject collected by government engineers.

A Large Wood and Steel Floating Dry Dock.—Eng. Rec., Jan. 8, 1910. 2¼ pp.

Description of a floating dock, 364 ft. 9 ins. long and 100 ft. wide over all with a lifting

capacity of 6,500 tons recently built for service at Brooklyn, N. Y.

RAILWAYS.

Relining a Railroad Tunnel With Cast-Iron Segments.—Eng. Rec., Jan. 1, 1910. 1⅓ pp.

Abstract of a paper by Mr. William Clewer before the Institution of Civil Engineers of England describing the substitution of cast iron segmental lining for brick in a horseshoe shaped Welsh railway tunnel. Views are given showing methods and results.

Evanston Track Elevation, Chicago, Milwaukee & St. Paul Ry.—By E. O. Griefenhagen. Eng. Rec., Jan. 22, 1910. 2½ pp.

This article describes the general route and discusses the several types suggested for bridges over streets, showing why reinforced concrete was decided upon.

Rerunning Curves.—By Geo. L. Jensen. Eng. Rec., Jan. 22, 1910.

The writer points out the differences between the location and the rerunning of curves and gives practical methods for the latter problem.

Track on German Railways.—Eng. Rec., Jan. 29, 1910. 2⅓ pp.

Abstract of Bulletin 115 of the American Railway Engineering and Maintenance of Way Association.

The Tractive Power of Simple and Compound Locomotives.—By Sidney C. Carpenter. Ry. Age-Gaz., Jan. 28, 1910. 1 p.

In this article five diagrams are given by means of which the tractive power of locomotives may be closely approximated without calculation. Several examples are given.

The Design of the Evanston Subway Bridges, Chicago, Milwaukee & St. Paul Ry.—By E. O. Griefhagen. Eng. Rec., Jan. 29, 1910. 2⅓ pp.

This article describes the design of reinforced concrete girder bridges to carry a railroad over city streets; gives load assumptions; sketch details and half-tone illustration of a completed structure.

The Unit System of Organization.—By Major Charles Hine. Ry. Age-Gaz., Jan. 21, 1910. 3½ pp.

A great deal has been heard lately in regard to the present unit system of organization on the Union Pacific System. This paper, read before the Western Railway Club, Chicago, Jan. 18, by the man who introduced the system, gives a full account of it. The discussion is printed in the Jan. 28th issue. 1¼ pp.

Maintenance Regulation Cards.—By R. W. Burnett. Ry. & Marine Wld., Jan., 1910. 4 pp.

The author is General Master Car Builder, C. P. R., and describes his card system for keeping complete track of his work scattered all over the railway system.

Locomotive Terminals.—Am. Eng. & R. R. Jl., Jan., 1910. 12½ pp.

The first installment of a series of articles discussing the arrangement, design, construction and operation of locomotive terminal facilities to obtain the greatest efficiency.

Some Questions of Passenger Station Design.—W. W. Finley. Ry. & Eng. Rev., Jan. 8, 1910. 1½ pp.

An address by the president of the Southern Railway at the annual banquet of the American Institute of Architects. Brings out the fact that capital invested in passenger stations in excess of the amount necessary to provide adequate and proper facilities for doing passenger business is unproductive.

A Railway Ditching Machine for Small Cuts and Fills.—Eng. News, Jan. 20, 1910. 3 pp.

Describes the Bowman ditcher used on the Southern Pacific Railway to do the work that is too small to require a steam shovel and on which manual labor would be too expensive. The machine is mounted on a flat car and plows and scrapes either or both sides of a right-of-way.

A Method of Determining Relative Economy, with Rules and Tables for Practical Computation.—Eng.-Contg., Jan. 19, 1910, 2¾ pp.

A presentation of formulas and tables for figuring relative values. A useful article to railway engineers.

Appraised Value of the Steam Railways of Wisconsin.—Eng.-Contg., Jan. 19, 1910, 2-3 p.

Gives tables of valuation for new and in depreciated condition of Wisconsin railways and itemized values per mile.

Original Cost and Cost of Reproduction of the Northern Pacific Railway (1,645 Miles) in the State of Washington.—Eng.-Contg., Jan. 12, 1910, 6 pp.

Gives the detailed costs obtained by the engineers of the Washington State Railway Commission in the work of valuing the railways of that state. A unique set of figures.

BRIDGES, BUILDINGS AND FOUNDATIONS.

The Construction of the Substructure of the McKinley Bridge Across the Mississippi River at St. Louis, Mo.—By F. E. Washburn. Eng. News, Jan. 6, 1910. 7⅓ pp.

This is a very good article for bridge designers and contractors, as it is highly practical and gives details of caissons, etc., and describes difficulties encountered in sinking the caisson.

Tests on Steel I-Beams.—Eng. News, Jan. 6, 1910. 1 p.

Two letters are given, one by Prof. Marburg and one by Edward Godfrey, discussing recent tests on I-beams and effect of tests on the webs of the beams.

A Composite Sand and Rock Foundation for a Tall Building.—Eng. News, Jan. 6, 1910. 1½ pp.

Describes methods used for the foundation of the New York City Municipal Building, 25 stories high and capped with a tower rising 560 feet above street level. About two-thirds of the building is over solid rock and the remainder over deep sand.

Approximate Cost of Mill Buildings.—By Chas. T. Main. Eng. News, Jan. 27, 1910. 1½ pp. Eng Rec., Jan. 29, 1910. 1½ pp.

Abstract of a paper presented before the New England Cotton Manufacturers' Association, April, 1904, revised to conform to prices prevailing about January, 1910. Contains six diagrams and three tables in the text.

A Large Steel Frame Rolling Mill Building.—Eng. Rec., Jan. 29, 1910. 3⅓ pp., ill.

This building encloses a rectangle of about 240 ft. by 491 ft. The principal reason for describing the structure arises because of the special details of the columns, girders and trusses caused by heavy concentrated loads on crane runways, and also runway connections.

A New Moment Table.—By C. R. Young. Can. Eng., Jan. 7, 1910. 2 pp. App. Sci., Jan., 1910. 3 pp. and inset.

A moment table for railway bridges is given wherein moments are given about successive points 1 ft. apart. The loadings are for the Dominion Government Specifications, 1908, but by applying the ratio for other classes the table can be used generally. Directions for use accompany the table.

Dry Rot in Wooden Posts.—Ins. Eng., Dec., 1909. 9 pp.

A recent fire in a factory building in New York city showed the timbers to have been badly attacked by dry rot, causing a collapse of the building just as the fire was under control. The report of Prof. Woolsen forms a part of this article.

Modern Steel Caissons.—By A. J. Springer. Ir. Tr. Rev., Jan. 6, 1910. 11 pp.

This is a remarkably complete description of the development and application of steel caissons in subaqueous work for various purposes.

A Girder Bridge With Structural Steel Reinforcement.—Conc. Eng., January, 1910. 5 pp.

A bridge in Cowley County, Kas., is described, consisting of three 50-ft. spans and one 32-ft. span. The floor is 26 ft. above low water. The reinforcement was so designed that it is in the shape of a very light truss, merely heavy enough to carry the forms and concrete, as frequent and high rises in the river made centering difficult and expensive. A full description is given of forms and construction.

Rapid Deterioration of Steel Work From the Corrosive Action of Locomotive Gas, McCallie Avenue Bridge, Chattanooga, Tenn.—Eng. News, Jan. 20, 1910. ⅔ p.

Extracts from a report by the City Engineer on a steel bridge built in 1905 and now deteriorated at least 75 per cent because of gases from locomotives. The paint on the floor system and lower chords seems to have been removed by the heat, coupled with the abrasive action of cinders forced against it. Recom-

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mends protection of such members with concrete.

Replacing a German Railroad Bridge.—Eng Rec., Jan. 8, 1910. 1 p.

Describes methods whereby a four-track railroad bridge was removed by traveling cranes and a new bridge put in its place. A remarkably interesting piece of work.

Calculation of Stresses in Suspension Bridges.—Eng. Rec., Jan. 8, 1910. ⅔ p.

This consists of two appendices to the report of Ralph Modjeski on the Manhattan bridge; one on Stresses in Towers and Cables; the other on Stresses in the Lower Floor Beams and Lateral Systems.

The Lethbridge Railroad Viaduct.—Eng. Rec., Jan. 8, 1910. 1¾ pp.

This article is an abstract of a paper by C. M. Monsarratt before the Canadian Society of Civil Engineers. Describes erection work on a viaduct 5,327 feet long and 314 feet high from the bed of the river to the base of rail.

Computing Stresses in Highway Bridges With Inclined Chords.—By W. H. Hoffman. Eng. Rec., Jan. 8, 1910. ½ p.

A letter to the editor giving a clear method of computation for bridge trusses.

The Grand Stand at the Minnesota State Fair Grounds.—Eng. Rec., Jan. 15, 1910. 3⅔ pp.

This is a combined exposition building and grand stand built of reinforced concrete in 80 days. The description is good and well illustrated. The formula for obtaining riser heights for seats is given.

Launching the Reventazon Bridge, Costa Rica.—Eng. Rec., Jan. 15, 1910. 1⅔ pp.

This bridge has a single track 400-ft. span with pin-connected trusses 53 ft. deep, 20 ft. apart on centers with 28.57 ft. panels. On account of torrential floods in the river, which would interfere with false work, a temporary pier was placed in the middle of the river, the bridge erected on shore and launched horizontally to position over this pier to afford an auxiliary bearing at midstream. The work is described in this article.

A Suggested Form of Building Contract Designed to Secure Justice and Equity to Both Owner and Contractor.—Eng.-Contg., Jan. 12, 1910, pp.

Discusses building contracts and presents a form of contract designed to secure equity to both owner and contractor.

A New Method of Sinking Cylinder Foundation in Underpinning the Cambridge Building, New York City.—Eng.-Contg., Jan. 12, 1910, 2 1-3 pp.

Describes an interesting job of underpinning a building foundation which was endangered by a tunnel excavation. A new method of sinking steel cylinder piers is described.

CONCRETE AND REINFORCED CONCRETE.

Efficiency of Compounds for Waterproofing Concrete.—Eng. Rec., Jan. 15, 1910. ⅔ p.

Abstract of a bulletin recently issued by the University of Wisconsin at Madison describing experiments on waterproofing compounds.

Long-Span Reinforced Concrete Girder Bridges.—By F. W. Scheidenhelm. Eng. News, Jan. 27, 1910. 5¾ pp.

Describes the design and construction of reinforced concrete girder bridges having 75 ft. spans for interurban traffic. Gives costs and details of forms.

The Construction of the Rocky River Bridge.—Eng. Rec., Jan. 1, 1910. 4 pp.

Describes the contractor's part in the building of a reinforced concrete arch bridge. The total length is 708 ft., embracing an arch of 280 ft. over the river, three 44-ft. arches at one end and two of the same size at the other end. Steel centering was used.

A Unique Type of Reinforced Concrete Construction. — By Theodore L. Condron. Eng. News, Jan. 27, 1910. 3 pp. Eng. Rec., Jan. 22, [illegible] pp.

Abstract of a paper read before the Western Society of Civil Engineers and printed in the December number of the "Societies" journal. This paper describes a flat panel floor construc- [illegible] analyzed pre-

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Possible Uses of Mineral Oils Mixed With Concrete.—By Albert Moyer. Eng. Rec., Jan. 1, 1910. 1⅓ pp.

Gives the results of tests and suggests the possibilities of concrete containing oil.

A New Type of U-Abutment.—Eng. Rec., Jan 22, 1910. ½ p.

Describes, with detail drawings, a new type of U-abutment having a reinforced concrete deck so that the inside fill is on a slope and it is not necessary to design the walls to retain earth pressure.

Notes on Concrete.—Eng. Rec., Jan. 29, 1910. 1 p.

Abstract of an informal discussion on concrete and cement at a meeting of the Boston Society of Civil Engineers. This discussion was printed in full in the Journal of the Association of Engineering Societies, November, 1909, occupying 28 pages.

A Unique Type of Reinforced Concrete Construction.—By Theodore L. Condron. Jl. W. Soc. Eng., Dec., 1909. 40 pp.

This is a paper read before the Western Society of Engineers, Dec. 15, 1909, together with the discussion. An excellent review of types and methods with description of a method for girderless floors evolved by Messrs. Condron and Sinks which can be mathematically analyzed.

The Use of Chain for Concrete Reinforcement.—By Theodore H. Skinner. Conc. Eng., January, 1910. 5 pp.

Mr. Skinner is engineer for the Oneida Community and has originated a method for using chains as reinforcement for concrete. This paper gives results of tests and presents Mr. Skinner's conclusions. He assumes that the slabs really became trussed beams in which the concrete forms a strut. This is of course practically the assumption made by manufacturers of expanded metal and wire fabric in continuous slab construction.

Plans of Concrete Bridge on Southern Ry.—Ry. Eng. Rev., Jan. 8, 1910. 2 pp.

In this, the first of a series of articles on construction work on the Southern Ry., illustrated a reinforced concrete bridge on a light curve. There are four 5 centered arches, each 70-ft. span. Reproductions are given of all essential details, together with details of the lightened abutments.

The Failure of a Concrete Dam at Dansville, N. Y.—Eng. News, Jan. 13, 1910. 1⅓ pp.

The dam was 123 ft. long by 9 ft. 6 ins. high, with flash board to increase the height to 11 ft. 6 ins., and design was made on a basis of a flood level giving a depth of 12 ft. 6 ins. The cause for failure was given as being inferior workmanship, but there is room for a reasonable belief that the face slab was too nearly vertical and the resultant pressure created quite a bending moment on the flat bottom slab which was not reinforced as a thin deep beam.

Tapering Concrete Chimneys. — Eng. News, Jan. 13, 1910. 2 pp.

Nearly all concrete chimneys heretofore built have been cylindrical in form and reductions in diameter have been made by offsets. The objections structurally and aesthetically to such chimneys led to the design of forms whereby tapering chimneys may be erected in concrete. This article describes, with line drawings and half-tones, tapering concrete chimneys lately built at Chillicothe, O., and at Muncie, Ind.

Concrete Shell Casings for Protecting Wooden Piles Against the Teredo.—Eng. News, Jan. 13, 1910. 1½ pp.

This article consists of abstracts from a paper before the American Society of Civil Engineers by T. Howard Barnes, Sept., 1909, entitled, "The Reinforced Concrete Wharf of the United Fruit Company at Bocas La Toro, Panama."

The Mulberry Street Reinforced Concrete Viaduct, Harrisburg, Pa.—Eng. News, Jan. 13, 1910. 5 pp.

A well illustrated description of one of the longest reinforced concrete viaducts in the world. It is 1,841 ft. long, 78 ft. above the ground at its highest point, and carries on 19 arches a 28-ft. roadway and two 8-ft. sidewalks. Many details are given.

Continuity in Reinforced Concrete Beams.—Eng. News, Jan. 13, 1910. 3 pp.

Letters to the editor discussing an article in Eng. News of Sept. 30, 1909, and comments on same. These letters are written by Prof. R. E. Spaulding, Mr. Sanford E. Thompson and Mr. R. E. W. Hagarty.

The Economy of Plain and Reinforced Concrete Columns.—By Charles W. Hall. Eng. Rec., Jan. 8, 1910. 1⅔ pp.

This writer presents diagrams to illustrate comparative costs of concrete columns, plain and reinforced, showing the reinforced concrete to be the cheaper, contrary to usual ideas.

Pressure of Concrete on Forms.—Eng. Rec., Jan. 15, 1910. 1 p.

Abstract of an article by Maj. Francis R. Shunk in Professional Memoirs of the Engineer Corps, U. S. A., describing experiments made by him to determine the pressure of concrete on forms.

Comparative Cost of Constructing Two Identical Reinforced Concrete Buildings—One of Separately Molded Members and One of Members Molded in Place.—Eng.-Contg., Jan. 19, 1910, 1 p.

Describes construction of two identical reinforced concrete car barns, one of concrete molded in place and one of separately molded concrete members, and gives itemized comparative costs.

Economical Selection and Proportion of Aggregates for Portland Cement Concrete.—Eng.-Contg., Jan. 19, 1910. 3½ pp.

Describing a practical method of proportioning concrete to secure the most economical use of materials. Selection of large aggregates, mortar for concrete, selection of Portland cement and correct proportioning are some of the subjects discussed.

Reducing Contraction and Absorption of Concrete by Mixing It with Mineral Oil.—Eng.-Contg., Jan. 12, 1910, 1¼ pp.

Describes tests made on cement briquettes mixed with oil to determine the effect. Clinking and cracking seemed to be wholly eliminated by the oil addition. The paper discusses these results and considers the possibilities of reducing the contraction and absorption of concrete by the admixture of oil.

Reinforced Concrete Girder Bridge, Bexar County, Texas.—Eng.-Contg., Jan. 26, 1910, 1 p.

Illustrates structural details and describes construction of a bridge of 14 50-ft. reinforced concrete girder spans. Some unusually thin reinforced concrete abutment walls are shown.

Some Data and Records of Experience Regarding the Disintegration of Concrete by Alkali.—Eng.-Contg., Jan. 5, 1910. 2⅓ pp.

This is a summary and critical discussion of the various more important studies that have been made on the effect of alkali water on concrete. As a review and summary the article is valuable.

Method and Cost of Constructing Concrete Boundary Monuments.—Eng.-Contg., Jan. 5, 1910, 1-3 p.

Illustrates form of monument and describes construction and gives costs averaged from 103 monuments.

Tests to Determine the Efficiency of Various Commercial Waterproofing Compounds for Concrete.—Eng.-Contg., Jan. 5, 1910, 3¼ pp.

Describes procedure of tests and apparatus and gives results obtained with some 12 to 14 materials. Strength tests as well as tests for water tightness were made on all samples.

EARTH AND ROCK EXCAVATION.

Setting Out Inclined Shaft Timbers.—By D. J. Browne. Min. Sci., Jan. 27, 1910. 3 pp.

This is an article dealing with the setting of timbers in an inclined air shaft and describing the methods of survey.

Cableways for Deep Fills.—By William Hewitt. Eng. Dig., Jan., 1910. 5½ pp.

This is an interesting description with a number of illustrations of cableways placed across hollows to be filled and suspended from them cradle bridges on which cars are run. These outfits are used to make fills without falsework.

A Device for Washing Sand and Gravel.—By Sam G. Porter. Eng. Rec., Jan. 29, 1910. ½ p.

Gives description with detail drawing of plant which will wash 10 cu. yds. per hour. Can be made on the job.

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Firing Shots by Electricity.—By Sydney F. Walker. Eng. & Min. Jl., Jan. 22, 1910. 2 pp.

A discussion of the causes leading to misfires and suggestions with respect to the selection of high and low tension fuses.

Woodford Haulage System in Earth Moving Operations.—Ry. & Eng. Rev., Jan. 22, 1910. 1 p.

Describes an electric haulage system in a quarry in which the output is handled in motor dump cars which traverse a circular track adjacent to the quarry face. The cost of handling rock by this method is said to be 3.4 cents per cu. yd., as against 5.5 cents with locomotives.

Circular vs. Rectangular Shaft Sinking.—By Henry M. Payne. Eng. & Min. Jl., Jan. 22, 1910. 1⅔ pp.

The writer claims the cost of lining circular shafts is less and that besides being safer the circular form is more permanent.

Modern Shaft Sinking.—By F. Donaldson. Min. & Min., Jan., 1910. 3 pp.

In the November, 1909, issue of Mines and Minerals was commenced a series of articles on "Modern Shaft Sinking," of which this is the second installment, to be continued. This one describes the Knid-Chandron boring process and cementation of water bearing strata.

Locomotives vs. Stationary Hoisting Engines for Raising Material in Open Cut Mines.—By J. F. Jackson. Eng. News, Jan. 13, 1910. 1 p.

Contains many suggestive data for contractors engaged on heavy open cuts.

A New Explosives Ordinance for the City of Chicago.—Eng. News, Jan. 13, 1910. 2 pp.

Gives in full an ordinance passed Dec. 20, 1909, to regulate the storage, conveying and use of explosives within the limits of the city of Chicago, Ill.

Excavating Submerged Rock With a Drill Boat.—Eng. Rec., Jan. 8, 1910. 1⅔ pp.

A practical article on the methods adopted for the removal of about 25,000 cu. yds. of rock having its original surface from 5 ft. to 20 ft. below mean low tide, to secure a depth of 29 ft. below mean low tide.

Inclined Diamond Drill Borings Under the Hudson River.—Eng. Rec., Jan. 15, 1910. 2 pp.

The holes must go to a vertical depth of 1,400 ft. to locate the position of a ledge of rock in which the aqueduct tunnel for New York City is to be built. This article describes the work of boring the holes and the methods used to obtain the angle of the bore at different depths below the surface.

Gravel Washing Plants.—Eng. Rec., Jan. 15, 1910. 2 pp.

A general description of a plant for screening and washing 750 cu. yds. of gravel per 10-hour day.

Data on the Storage and Handling of Explosives.—Eng.-Contg., Jan. 5, 1910, 5½ pp.

This is a useful summary of data and instruction on the storage and handling of explosives in blasting and mining. Details of thaw houses and magazines are shown and also diagrams showing manner of loading holes, fixing primers and fuses, locating holes, etc.

Cost of Boring Five Test Wells for a Double Track Railway Bridge in California.—Eng.-Contg., Jan. 5, 1910, 1 p.

Describes methods of work and shows special chart for recording progress and character of test borings. Itemized costs are given, including all expenses.

Method of Making a Blast Displacing 180,000 Tons of Rock, with Some Costs.—Eng.-Contg., Jan. 19, 1910, 1 p.

Shows diagram of tunnel, describes method of charging, tamping and firing and gives results and costs, with some comments on the handling of large blasts.

A Special Hand Auger for Test Borings and Method of Using It in Prospecting for Coal.—Eng.-Contg., Jan. 19, 1910, 1 p.

Describes and illustrates simple and economical hand auger for making test borings and methods of using it, with some costs.

Cost of Stripping a Gravel Pit.—Eng.-Contg., Jan. 19, 1910, ½ p.

Gives methods and costs of stripping a gravel pit, using elevating graders and wheeled scrapers.

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Wall, Patillas Irrigation Project, Porto Rico.—Eng.-Contg., Jan. 19, 1910, 1½ pp.

Describes and illustrates earth fill dam of interesting construction and gives methods of depositing materials. A good general article.

SURVEYING AND DRAFTING.

Colliery Surveys.—By David Harrington. Min. & Min., Jan., 1910. 2¾ pp.

Continued from the December, 1909, issue. To be continued. A very practical article on the subject.

Surveying Helps.—Min. Sci., Jan. 20, 1910. 2 pp.

One article gives 20 illustrations of signals used in surveying by instrumentmen and their helpers and another article describes and illustrates apparatus used in Europe for surveying a bore hole.

MISCELLANEOUS.

Iron and Steel Prices for Fifteen Years.—Iron Tr. Rev., Jan. 6, 1910.

The information is given in a chart issued as an annual supplement to the Iron Trade Review. This same issue contains several valuable reviews on the iron and steel industry with prices in different years.

A New Process in Iron Metallurgy—Slow Rusting Iron Produced in the Open Hearth Furnace.—Eng. News, Jan. 6, 1910. 3 pp.

American ingot iron is the trade name of a material used for road culverts and widely advertised as rust proof. It is an almost pure iron made in the open hearth furnace, and this article describes the process very clearly.

Relative Cost of Municipal Work Done by Day Labor and Contract in Boston, Mass.—By Harrison P. Eddy. Eng. News, Jan. 27, 1910. 3 pp.

A paper read in December, 1909, before Section 1 of the American Association for the Advancement of Science.

Economical Wood Preservation.—By Robert Hays. Ry. Age-Gaz., Jan. 28, 1910. 2 pp.

Considerable valuable information is given on the subject of wood preservation by creosote and crude petroleum. The author objects to specifications calling for absorption in pounds of oil per cubic feet and gives reasons why the absorption should be governed by the square feet of surface of the wood treated.

Wire Ropes in Colliery Practice.—By R. H Rowland. Eng. & Min. Jour., Jan. 20, 1910. 3 pp.

Illustrates the various arrangements of pulleys and discusses the benefits of lubricating both winding and hauling ropes. Lubrication properly applied preserves the interior hemp core and lessens the friction of the internal wires as the loaded rope passes over the pulleys. It is believed also that non-lubrication induces fatigue in the steel.

Cold Bending of Large Iron Conduit. — By George H. Westermann. El. Wld., Jan. 20, 1910. 1½ pp.

Describes home-made apparatus for bending wrought iron pipe conduit with diameters up to 3½ ins. without the aid of heat.

The Referencing of Engineering Literature.—By A. L. Menzin. Eng. Rec., Jan. 29, 1910. 1¼ pp.

The author compares present lengthy methods of indexing in use by technical men and advocates the use of legal methods as being concise. Examples are given. Briefly the method is to give first the volume number, followed by an abbreviation of the name of the publication and then the page number. An article ordinarily indexed, for example, as being in "The Journ. West. Soc. Engs.—Oct. 1907," would be indexed under the lawyers' method as in "12 J. W. S. E. 661." Other examples are given with reference to indexing professional papers, magazine articles, text books, catalogs, bulletins, drawings.

Municipal Waste, Its Collection and Disposal.—By Wm. Calder. Surveyor, Jan. 7, 1910, 3 pp. Jan. 14, 1½ pp.

This is an article by the City Engineer of Prahran, Victoria, read before the Australian Health Society. It is an able review of the subject with special reference to conditions in Australia.

On Computing.—By Russell Tracy Crawford. Cal. Jl. Tech., Jan., 1910. 7 pp.

An article of considerable value to students giving short cuts and methods seldom found in print.

Installation Cost of a Modern Steam Turbine Plant.—El. Wld., Jan. 20, 1910. 1 p.

The name of the plant is not given, but costs are given in detail. The plant is a 2,500-k.w. central station in a building to have an ultimate equipment of 10,000 k.w. Total cost per kilowatt, initial equipment, $91.98.

Advanced and Simplified Plumbing.—By Wm. Paul Gerhard. Dom. Eng., Jan. 8, 1910. 1½ pp.

This is a reprint of a paper read before the Massachusetts Society of Sanitary Officers. In it the well known author gives the essentials of modern plumbing, thus making the article of value to men who have to write or enforce plumbing ordinances.

The Carquinez Span.—Jl. El. P. & G., Jan. 22, 1910. 5¼ pp.

This article appeared in the May and October, 1901, numbers of the Journal of Electricity, Power and Gas and is here reprinted by request. It is an excellent description of the details in the work of spanning Carquinez Straits, California, with heavy high tension cables operating at 60,000 volts. The clear span is 4,427 ft., and a minimum clearance of 200 feet had to be provided above the water so full rigged ships could go under.

Valuation of Public Service Corporations.—By W. H. Williams. El. Ry. Jl., Jan. 8, 1910. 2 pp.

This is an abstract of a paper presented at a joint session of the American Economic Association and American Political Science Association, New York, Dec. 30, 1909. It deals entirely with railway lines and the effect of valuations on rate-making. The full address has been published in pamphlet form and may be obtained from the author, who is third vice-president of the Delaware & Hudson Co., New York.

The Design and Operation of Refuse Destructors.—Eng. Rec., Jan. 8, 1910. 1 p.

A very good general article digested from a paper read by Wm. F. Loveday before the Institution of Municipal Engineers and Surveyors, Great Britain.

Logarithmic Diagrams Based on Isoplethe Points.—By H. A. Gehring. Eng. Rec., Jan. 15, 1910. 2½ pp.

The title describes the character of the paper. Diagrams are drawn upon the principle of the slide rule to simplify calculations. In many ways these diagrams are preferable to those drawn on common cross section paper, but are not always superior to diagrams drawn on logarithmic ruled paper.

Methods of Filing Books, Pamphlets, Trade Catalogs and Periodicals for Small Private Libraries or Information Departments.—Eng.-Contg., Jan. 19, 1910, 1 p.

Describes a system of filing information of various sorts in small private libraries.

Processes for the Preservative Treatment of Timber and Approximate Costs of Treatment.—Eng.-Contg., Jan. 19, 1910. 1 p.

Describes several methods of treatment, gives time required for each stage of process and compares costs of the several processes.

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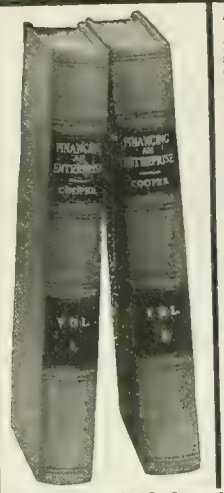

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The Study of Engineering-Contracting in Engineering Colleges.—Eng.-Contg., Jan. 12, 1910, ¾ p.

An argument contending the possibilities of college courses in engineering contracting and a discussion of methods.

Refuse Disposal, and the New Refuse Incineration Plant for Milwaukee.—Eng.-Contg., Jan. 12, 1910, 2¾ pp.

A general description with illustrations of the new refuse incineration plant for the city of Milwaukee. A good general descriptive article.

Formulas for the Capacity of Tile Drains.—Eng.-Contg., Jan. 12, 1910, ½ p.

Analyzes various formulas for computing capacity of drainage tile and presents an argument for the use of the Kutler and Chezy formulas.

Suggestions on the Design and Selection of Traction Engines.—Eng.-Contg., Jan. 12, 1910, 1⅔ pp.

Gives the requirements of an ideal traction engine, discusses relative merits of steam and internal combustion engine power, gives formulas for determining horse-power for both and gives several useful tables of horsepowers.

Comparative Methods and Costs of Underground Conduit Construction.—Eng.-Contg., Jan. 5, 1910, 3 pp.

Describes various methods of construction, compares their advantages and gives comparative detailed costs of two types of conduits.

PUBLICATIONS RECEIVED.

Report on The Result of Certain Efficiency Tests of Centrifugal Pumps.—By Arthur L. Adams. The American Well Works, Aurora, Ill. Paper 6x9 ins. 12 pp. illustrated. Trade publication. Free.

Water Resources of the Blue Grass Region, Kentucky.—By George Charlton Matson; with a Chapter on the Quality of the Waters. By Chase Palmer. U. S. Geological Survey. Water Supply Bulletin 233. Washington, D. C. Paper 6x9 ins. 224 pp. illustrated.

Tests of Run-of-Mine and Briquetted Coal.—U. S. Geological Survey, Washington, D. C. Two bulletins:

Bulletin 403, Tests on the Torpedo Boat Biddle. By Walter T. Ray and Henry Kreisinger, with collaboration of Lieut. Com. Kenneth McAlpine, U. S. N. and Ensign J. W. Hayward, U. S. N. Paper 6x9 ins. 49 pp. illustrated.

Bulletin 412, Tests in a Locomotive Boiler. By Walter T. Ray and Henry Kreisinger. Paper 6x9 ins. 32 pp. illustrated.

Commercial Deductions from Comparisons of Gasoline and Alcohol Tests on Internal Combustion Engines.—By Robert M. Strong. U. S. Geological Survey, Bulletin No. 392. Government Printing Office, Washington, D. C. Paper 6x9 ins. 38 pp.

Incidental Problems in Gas-Producer Tests.—By R. H. Fernald, C. D. Smith, J. K. Clement and H. A. Grine. U. S. Geological Survey, Bulletin No. 393. Government Printing Office, Washington, D. C. Paper 6x9 ins. 29 pp. illustrated.

The Utilization of Fuel in Locomotive Practice.—By W. F. M. Goss. U. S. Geological Survey, Bulletin No. 402. Government Printing Office, Washington, D. C. Paper 6x9 ins. 28 pp. illustrated.

Report of Michigan Board of State Tax Commissioners and State Board of Assessors, 1907-8.—Secretary of State, Lansing, Mich. Cloth. 6x9 ins. 391 pp.

A Primer on Explosives for Coal Mines.—By Charles E. Munroe and Clarence Hall. U. S. Geological Survey, Washington, D. C. Bulletin 42[illegible]

This well written bulletin contains a great deal of information valuable to all users of explosives for blasting purposes.

Veneers, 1908.—Forest Products Bulletin 5. Bureau of the Census, Washington, D. C. Paper 6x9 ins. 13 pp.

Report Upon the Maintenance and Repair of the Washington Aqueduct, District of Columbia, and Washington Aqueduct Filtration Plant.—By J. J. Morrow, Major, Corps of Engineers, U. S. A. Benig Appendix D. D. D. Annual Report of Chief of Engineers 1909. Washington, D. C. Paper 6x9 ins. 28 pp. illustrated.

This report contains matter of value and interest to men in charge of filter plants for city

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Concrete Garages.—The Atlas Portland Cement Co., 30 Broad St., New York. Paper 6½x9 ins. 36 pp. illustrated. Trade publication.

This book is one of a series of valuable books on the use of cement issued by the Atlas Portland Cement Co. For garages and similar buildings it is seldom the case that an architect is employed, the owner employing a contractor to erect a shed for the machine. The hints and illustrations in this book are therefore of great value to men who want fireproof buildings in which to house their automobiles.

The Development of the Downflow Boiler.—By J. C. Parker. Parker Boiler Co., Philadelphia, Pa. Paper 6x9 ins. 26 pp. illustrated. Trade publication.

This is an authorized reprint from the January 1909 Proceedings of the Engineers Club of Philadelphia and describes in an interesting way the development of a boiler that is attracting much attention in power engineering circles.

BOOK REVIEWS.

Simplified Mechanical Perspective.—By Frank Forrest Frederick, Peoria, Ill. The Manual Arts Press. Cloth, 7x10 ins. 544 pp., illustrated. 75 cts.

This is a thoroughly good little book. The subject is presented in a plain, practical manner, and considerable attention is paid to the perspective of interiors of rooms, thus making it an excellent reference manual for engineers and architects.

A Treatise on Masonry Construction.—By Ira Osborn Baker, C. E., D. Eng. Professor of Civil Engineering, University of Illinois. Tenth edition, rewritten and enlarged. New York, John Wiley & Sons; London, Chapman & Hall, Ltd. Cloth, 6x9 ins. 745 pp., 244 illustrations. $5.

This is the best work on masonry in the English language, and no engineer or contractor can afford not to own it. The first edition appeared in 1889 and was immediately popular. In 1899 it was revised and this present edition has been rewritten to bring the subject fully to date. The size of the volume has been increased by adding to the number of pages. There are three new chapters on Reinforced Concrete, Concrete Building Blocks and Elastic Arch. The best oractice of leading engineers has been illustrated. Materials used in masonry construction are first fully described, followed by a discussion of foundations on land and under water, after which the design and construction of masonry structures are fully dealt with. A remarkably full index of 13 pages makes of the book an ideal work for reference. Copious references are made to original sources of information. The publishers have aided fully in making the book pleasing to the eye. The paper, type, illustrations and binding are excellent.

The Theory of Structures.—By R. J. Woods, M. Inst. C. E. London, Edwin Arnold; New York, Longmans, Green & Co. Cloth, 5½x8¾ ins., 276 pp., 157 illustrations in the text. $3.

The first thing that attracts the attention of the reader of this book is the large number of numerical examples to test the knowledge of the student. This gives it considerable value as a reference book. The first chapter takes up the subjects of compound stresses and principal stresses; the second chapter earth pressure, and the third chapter stresses due to eccentric loads. A number of worked numerical examples are given to illustrate eccentric stresses in steel details. The greater portion of these three chapters relates to earth pressure and the stability of masonry walls, buttresses and dams.

The author is very clear in his methods, but takes it for granted that his readers are able to integrate and differentiate, so that the book is intended, as he states in the preface, "for advanced students and draughtsmen engaged in structural design." It is not ideally arranged as a full text book because of a lack of balance in the contents. As a desk help for a designer and as a reference text in schools it is good.

Chapter IV, 15 pages, deals with working stresses and cross-sectional areas, and stresses in girders with parallel chords by method of coefficients. Chapter V, 10 pages, deals with the general method for girders with parallel chords. Chapter VI, 8 pages, is on parabolic girders, and Chapter VII, 16 pages, on curved girders not parabolic. Chapter VIII, 17 pages, takes up the subjects of wind pressure, portal bracing, high steel trestles. Chapter IX, 19 pages, continuous girders. Chapter X, 10 pages, cantilever girders, suspension and stiffening girders. Chapter XI, 17 pages, design of riveted joints. Chapter XII, 15 pages, plate girders, in which a design for a single track plate girder of 60 ft. span is worked out. Chapter XIII, 12 pages, columns and struts. Chapter XIV, 25 pages, arched ribs and braced arches. Chapter XV, 30 pages, reinforced concrete. This chapter is based on the well known American work of Turneaure & Maurer.

American users of the book must remember the British ton is 2,240 pounds, for the author gives stresses in terms of "tons per sq. in.," customary in British engineering practice, instead of using "lbs. per sq. in.," as is customary in America.

How to Use Concrete.—Compiled by Walter C. Boynton and R. Marshall. Detroit, Mich., Concrete Publishing Co. Cloth, 6x9 ins., 233 pp., illustrated. $1.

The compilers of this book are the editor and associate editor, respectively, of the monthly journal "Concrete." It is practically a scrapbook of articles and fillers of more or less value clipped largely from semi-popular trade publications. It is not intended for and is of slight value to engineers. It has a 12-page index.

Diagrams for Designing Reinforced Concrete Structures, Including Diagrams for Reactions and Strengths of Steel Beams.—By G. F. Dodge, M. West. Soc. Eng. Chicago and New York. The Myron C. Clark Publishing Co., London, E. & F. N. Spon, Ltd. Cloth. 12x15 ins. 109 pp. 4 tables; 65 illustrations in the text; 36 full-page diagrams, $4.

Because of the number of variables entering into reinforced concrete design no satisfactory books of tables, similar to the steel hand books have appeared to assist men who design in this composite material. It is a question whether such books will appear until authorities come closer together on the many present points of difference. Diagrams, however, are in common use and many are very ingenious. Each designer, has prepared his personal diagrams with reference to a particular building ordinance or his own idea. The only diagrams so far published have been partial only.

In this book Mr. Dodge shows the possibilities that lie in diagrammatic computation. Every diagram is complete and the pencil in tracing a problem never leaves the paper. He recommends a strip of tracing cloth with a light line ruled on it instead of a pencil. An example of the simplicity of the use of one of his diagrams is as follows: Diagram No. 1 is for slabs. At the top in the upper left hand corner the vertical lines indicate percentages of steel. Starting at an assumed per cent of steel drop vertically to intersecting diagonal lines giving, respectively, the steel and concrete stresses, then to the right to an intersection with the loading conditions (W1 8-10-12-16-20-24 as required), then down to the span. From this point to the right for safe live load, then up or down vertically to the steel percentage. From this point a line to the edge of the diagram gives the steel area and in the upper right hand corner an auxiliary diagram starts from the area drops vertically to any size rod or bar wanted and to the right is found the spacing c. to c. between the rods or bars. In connection with the live load lines a pretty solution is given. When the live load line is reached drop vertically to the bottom of the diagram to the slab thickness. This slab thickness is the thickness above steel, but allows for 0.8 in. covering of concrete for the steel. It will be seen therefore that no preliminary assumptions are made for total load. The lines are curves for total load but the author has done all the figuring and made the proper deductions. Instead of assuming a total load and obtaining the depth to center of steel the designer uses only the live load and gets his total slab thickness together with reinforcing area, sizes and spacing of steel.

From the foregoing the reader may see how simple a matter the calculation of a slab becomes. The range of steel and concrete stresses is as great as any designer will be called upon to deal with and the same is true of spans, live loads and percentages of steel. Five slab diagrams are given for values of the ratio between

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By A. V. BLEININGER,
Ceramic Chemist with the Clay Products Section of the U. S. Geological Survey.

An extensive paper on the work of the Section, giving results of tests on clay products used in construction work.

"Contracts for Structural Steel Work"

An extensive discussion by Attorneys, Architects, Engineers and Contract Managers, covering "Liabilities;" "Penalties," "Damages," "Arbitration," "Relations of Parties in a Contract," and "Payments." Forms of Contracts of unusual merit are given.

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moduli of elasticity = 12, 15, 18, 20 and 30, the last for cinder concrete. Every diagram being on one sheet the designer can start from any assumption as to load, fiber stresses, steel area or slab thickness and trace lines to obtain the other data. The value of the diagrams for the purpose of reviewing designs and checking calculations may be thus seen.

The diagrams mentioned use the straight line theory of variation of stress. To make the book complete every straight line diagram has a parabolic stress diagram duplicate. The diagrams cover the design of rectangular beams, both straight line and parabolic; T-beams, straight line theory; beams with compressive reinforcement. Diagrams are given for longitudinally reinforced columns and for hooped columns for ultimate loads as well as for working loads.

The best treatment the reviewer has read on the subject of shear and diagonal tension is given here with diagrams to proportion web reinforcement. Deflection is also considered and a diagram given so the probable deflection under any load may be ascertained. The question of deflection has not been deemed of enough importance to be mentioned in concrete text books until the past year. The subject of impact is also discussed and a diagram given to ascertain the allowance to be made for it. Two diagrams give more data on steel beams than many hand books contain in numerous tables; and to supplement these diagrams four tables are presented giving moments of resistance for standard steel beams and Bethlehem sections. The concrete designer must so often use steel beams in connection with his other work that these tables and diagrams possess peculiar value. The author presents 33 cases of bending moments, reactions and shears for different loadings, together with the maximum deflections in most cases. From an inspection of the figures the designer may select the loading condition to be considered in using the proper diagram. Two familiar diagrams, one for reactions, the other for bending moments are given, computed in accordance with the "Theorem of Three Moments" for continuous beams.

Diagrams are also given for bending moments and are duplicated where convenience dictates so the user of the book is not required to turn pages but may, in nearly every case, find all required information on facing pages. Each diagram is accompanied by a page of instructions for use containing a worked example.

The author has had an extremely good experience in reinforced concrete design and the data presented were developed by him to obtain the greatest possible saving in the detail work of designing with exact formulas. It is based on the published results of the tests of Professor Talbot and the standard work of Turneaure & Maurer. The nomenclature is the same as that of these eminent authorities so the user is not confused by the introduction of new letters and does not have to give new meanings to letters in common use in formulas. While the diagrams and the descriptions of their use are so plain that men with a very slight knowledge can use them, the author has placed in the book a discussion on reinforced concrete of great value and scientific enough to satisfy the most captious engineer. The collection of formulas is complete so results from the diagrams may be checked by designers who prefer arithmetical work. Men who prefer tables may readily compute extended tables from the data here presented. Instead of using ordinary cross section paper in which all curves converge, logarithmic ruled paper is used in which the curves are straight parallel lines in nearly every case. A real need has been supplied and the office man is at last given a book he has wanted.

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Managing Editor, Engineering-Contracting
and
Charles S. Hill, C. E.,
Associate Editor, Engineering-Contracting.

THIS book handles the subject of concrete construction entirely from the view-point of the ***builder*** of concrete structures. The testing of cement, the physical properties of cements and concrete, and the design of concrete structures are not considered. The aim of the authors has been to eliminate all matter not germane to the constructing end of their subject. By doing this it has been possible to crowd a vast amount of detailed information on methods and cost of concrete construction into a volume of moderate size. The book is a treatise on the ***methods and cost*** of building in ***concrete.***

WHILE concrete design is not considered, no designer of concrete can be a really good designer without having a profound knowledge of costs and of practical methods of construction. This book will be of interest therefore to every engineer and architect who is engaged in designing concrete structures. It should be of particular assistance, however, to the contractor or engineer engaged in the actual work of making and placing concrete.

THE methods given are practical methods and they are so given that the practical man can use them. The costs given are actual costs, itemized, analyzed and reduced to units. Costs of material, costs of transporting, costs of mixing, costs of placing, costs of tamping, costs of finishing, costs of forms, costs of bending and placing reinforcement, costs of waterproofing, costs of superintendence, costs of plant, interest charges, depreciation charges are all given, and to make these costs useful, the conditions and the methods of doing the work are stated in each case.

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Containing Items of Interest to Railroad, Public Works and Other Contractors.

The Doings of the Week.

Several large railroad construction contracts have been let recently, among them the following: Grading, tunneling and masonry work for the Durango-Llano Grande line of the National Railways of Mexico. This line is to be 100 kilometers long and the contracts were secured by John Phillips and the Cia Bancariade Fomento, both of the city of Mexico. Contracts for 83.3 miles of double track work on the Coast Lines of the Atchison, Topeka & Santa Fe Ry. have also been let, the successful contractors being the C. H. Sharp Contracting Co., Kansas City, Mo.: Mishou & Millard, Pueblo, Colo.; L. J. Smith Contracting Co., Kansas City, Mo.; and the Sharp-Hauser Contracting Co., Los Angeles. ——One of the largest drainage contracts for several weeks is now being advertised by the auditor of Marshall County, at Warren, Minn. The work calls for the construction of ditches requiring the excavation of 5,539,578 cu. yds. of material. Bids are to be opened March 1. ——Two large dam contracts were let during the past week. One of these called for the construction of a dam and power house on the Cedar River at Cedar Falls, Wis., the contract being secured by the Ambursen Hydraulic Construction Co. of Boston, Mass. The other contract was for the construction of the power development on the Etowah River near Creighton, Ga., this work being secured by Frank B. Gilbreth, Inc., New York.——George W. Jackson, Inc., New York and Chicago, has secured the contract for constructing the Yonkers siphon for the Board of Water Supply of New York city, the contract price being $1,479,425. This deep pressure tunnel is designed for a pressure of 300 lbs. and an interesting method of grouting will be employed to make it water tight. A description of this method will be found elsewhere in this issue. ——Preliminary matters for a 300,000 acre irrigation system between Canon City, Colo., and Pueblo, Colo., are shaping up so that bids for its construction will be asked within the next two months. The system will iinclude the construction of about 150 miles of main canals, 300 or 400 miles of laterals, 10 reservoir dams, etc. The Arnold Co., Chicago, Ill., is the engineer.——The Norfolk & Western Ry. has asked bids for constructing a 4,700 ft. tunnel at the head of Beech Fork in Virginia, and also the low grade connecting lines, about 8.9 miles long, at Petersburg, Va.——Shanty house talk was evidently responsible for the report that the Atlantic Coast Line R. R. was to build a branch line from Springhope to Raleigh, N. C., for officials of the road write that they have no information of any such extension.——The Soo is planning to build two cut offs on its subsidiary line, the Wisconsin Central, and it looks as though these contracts would be let this month or early in March.

Back to the Farm and Return.

We have a friend who was a sincere believer in the "back to the farm" movement so vigorously advocated at this present time by those who wish to sell their farms. We say was, for he is no longer a sincere believer; he tried it. This man had a very nice contracting business and was making much money; somehow he got the idea that the farmer's life was the "life for him." That he has changed his view is shown by a recent letter, extracts from which are given below: "——— ———. As you know, a couple of years ago I got tired of the dirt moving business and decided to buy a farm. So I sold my graders and scrapers and bought a nice little 150-acre place. I moved on to my farm in the winter, so as to begin getting my crops in the ground as early in the spring as possible. I didn't know much about farming, but I had a hired man who did, or fooled me into thinking he did. Just as soon as the snow went off and the ground was right we put in the crop and it came up fine. Then came a hard frost, the hardest ever known in that vicinity, and killed off all my green stuff. So we started all over again. This time the corn had hardly come out of the ground before a wet spell came. It rained for two weeks and the second planting was spoiled. In addition, the river came up and washed off about 10 acres of my land, swept away a hay shed, and drowned two cows. We finally put in the third crop, and this time it took. At the end of the year when I settled up my account I found that I hadn't made a cent. The next year I had about the same luck, and I found that my profits were practically the same as they were the first year. That was enough for me and I'm going back to the good old contracting business, where a man only has to work 12 hours a day, seven days a week. There's money in my farm; I put in $6,000 myself, and it is still put. But now that I have succeeded in making one blade of grass grow where two grew before, I'm going to beat it while my wind is good."

Placing the Blame.

The city of Paris is beginning to recover from the recent disastrous flood in the Seine and some of the Parisians are now engaged in a bitter attack on the French engineering profession, which they hold responsible for the invasion of the city by the floods. One member of the French Academy discussing the question of which was most to blame, the members of parliament or the engineers declares that the latter were, and goes on to say that the presumptuous and arrogant confidence of the engineers in their dry formulae prevented them seeing the plain fact, which the veriest ignoramus would take cognizance of, is that the windows open on the Seine only a few feet above its ordinary level all along the railway subway that skirts its left bank invite disaster. He further predicts that when the city has resumed its normal condition, the engineers will sketch plans of restoration whose chief feature will be that they will merely afford another stupendous opportunity for political jobbers and corrupt contractors to make colossal fortunes. Another eminent Parisian asserts that the city is the victim of the "pseudo science" of engineering, and says: "The dry rot of formal technology has done the harm. These engineers in their fatuous conceit commanded nature, as did King Canute, to pause at a certain point, and nature refused to pause, simply because their modern constructions which were to have restrained it proved much feebler and much less the creations of common sense and honest workmanship than those of the modest engineers who worked under Valois kings and Bourbons."

News from New York City.

Associated press dispatches of the past week contained two news items which interested us very much. One of these referred to an old timer whom we had thought had been lost in the shuffle of time. It will be seen, however, from the following news note that he is still doing business at his old stand: "Patrick Diskin, a carpenter, is in the Lebanon hospital because he deliberately sawed off the end of a log on which he was seated six stories above the ground. The man apparently is not injured seriously. Diskin had been ordered to saw off the end of the log, which projected from a window over the street. He went up, got out on the end of the beam and carefully sawed it in two between himself and the window. The beam was bruised at one corner and Patrick was unconscious. Asked today why he had done such a thing, Diskin replied: 'Sure, them was my orders.'" The other item refers to the duties of a water register. It seems that the mayor of New York city asked several of the officials of the city to make personal reports on their duties. The following report was said to have been made by a $3.000 a year water register; it is given verbatim: "Generenll Busnes off Water Rejeter: Seen that all clorks rive on tim. Seen that they doo doty evey day. Seen all permit too tak out meter. Seen that send out billes. Seen that constuchers pay billes. Every day too setle all disputes. Seen all billes complaints look after. Seen Joe Mole and Malor every day.'

Confirmed Reports by Engineers and Contractors

RAILROADS, POWER DEVELOPMENTS, LEVEES, DRAINAGE AND IRRIGATION WORKS.

Railroads—Steam and Electric.

ARKANSAS.

The Memphis, Paris & Gulf R. R. has preliminary lines run from Ashdown, Ark., to Terrell, Tex., 154 miles, and the locating engineer, G. H. Cravens, and two men are now at Nashville laying the proposed locating line on the map. The company intends to run preliminary lines from Murfreesboro, Ark., via Arkadelphia, Pine Bluff, Marianna and into Memphis. The line from Memphis to Dallas is 112 miles shorter than any other line. H. C. McCluer, Nashville, Ark., is chief engineer, Memphis, Paris & Gulf R. R.

CALIFORNIA.

Contracts for double track work on the Coast Lines of the Atchison, Topeka & Santa Fe Ry. have been let by H. C. Phillips, chief engineer of the A., T. & S. F. Coast Lines, Los Angeles, Cal., as follows: For double tracking Rio Puerco to Suwanee, a distance of 13.1 miles, El Rita to Laguna, 6.4 miles. McCartys to Horace, 6 miles, to the C. H. Sharp Contracting Co., Kansas City, Mo.; all of this work is in New Mexico, on the Albuquerque division. Winslow to Dennison, a distance of 12.6 miles, let to Mishou & Millard of Pueblo, Colo.; this work is on the Albuquerque division in Arizona. Flagstaff to Williams, let to L. J. Smith Contracting Co. of Kansas City, Mo., a distance of 34 miles, on the Albuquerque division in Arizona. Daggett to Barstow, on the Arizona division in California, a distance of 9.4 miles, and Barstow to Cottonwood, on the Los Angeles division in California, a distance of 11.8 miles, to the Sharp-Hauser Contracting Co. of Los Angeles. This up to the present time covers all second track work awarded on the Coast Lines.

IOWA.

The Iowa & Illinois Ry. Co. has asked the city council of Davenport for a franchise for a track along the river front. The company has not completed its plans for the track as yet. P. P. Crafts, Clinton, Ia., is general manager.

The Railroad Promotion & Construction Co. of Des Moines is projecting the construction of an 80 mile interurban line from Des Moines through Dallas, Columbia, Russell and Centerville. Surveys have not been made and the project as yet is in the promotion stage. H. H. Polk, Des Moines, is president and B. Schreiner, Des Moines, is chief engineer.

KANSAS.

The Hutchinson Interurban Ry. Co., W. A. Scothorn, general manager, Hutchinson, Kas., is planning an extension of about one-half mile to the fair grounds. Surveys have not been made as yet.

NORTH DAKOTA.

The Wahpeton-Breckenridge Street Ry. Co. now has under construction a one mile street railway line on the Main streets of Wahpeton and Breckenridge. F. L. Strum, Wahpeton, N. D., is chief engineer and Mathias Braun, Wahpeton, is president.

OKLAHOMA.

The Oklahoma Union Traction Co. is projecting a 30 mile line from Tulsa to Sapulpa and Tulsa to Broken Arrow. Surveys have been partially made, the construction capital has been secured in part and a portion of the line is now under construction. G. B. Small, Tulsa, Okla., is chief engineer and A. A. Small, Tulsa, is president.

OREGON.

We are advised that the Oregon Electric Street Ry. Co. has not as yet reached any definite decision as to its extensions proposed for this year. Press reports state that the company has had surveys completed for extensions aggregating 65 miles. Guy W. Talbot, Portland, Ore., is vice president and general manager.

The Mount Hood R. R. Co. is projecting the construction of a 75 mile line to connect with the Oregon Railroad & Navigation Co.'s line. Surveys have not been made as yet. W. H. Eccles, Dee, Ore., is president and Jas. W. West, Dee, Ore., is chief engineer.

TEXAS.

M. J. Healy, railroad promoter, Mineola, Tex., writes us that he has a $500,000 or $600,000 job for the construction of the Texas, New Mexico & Pacific Ry. from McKinney to Bridgeport, Tex. He writes that it is a good opening for a contractor or construction company that can take an interest of $50,000 in stock. Estimates, profiles, etc., can be seen at McKinney.

The Brownwood North & South Ry. Co., of Brownwood, Tex., has effected its organization, and on Feb. 2 elected the following officers: Brook Smith, President; Will H. Mayes, Vice President; D. F. Johnson, Secretary, and Ward McConnell, Treasurer. John Meade, Chief Engineer, will have matters in shape within a few days, and it is believed that contracts can be let between Feb. 20 and March 1. Contracts and bids will likely be made through Secretary D. F. Johnson, Brownwood, and passed on by the Board of Directors. The first construction work will be on a 20-mile line to Mav.

VIRGINIA

The Chesapeake & Ohio Ry. has a corps of engineers in the field making surveys between Charlottesville and Orange. No decision, however, has been reached as to what work, if any, will be undertaken. H. Pierce, Richmond, Va., is engineer of construction, Chesapeake & Ohio Ry.

The Norfolk & Western Ry., James R. Schick, engineer, branch lines, Roanoke, Va., has issued invitations for bids for the construction of a 4,700 ft. tunnel at the head of Beech Fork of Dry Fork on a 15.5 mile connection between the Dry Fork branch of the Norfolk and Western and the Indian Creek waters of Clinch River, about six miles north of Cedar Bluff. The tunnel is located in Tazewell County, Virginia. The balance of work is not to be let at present. Invitations are also out for the construction of the Petersburg low grade connecting lines, about 8.9 miles, lying south of the city of Petersburg, Va., between Poe and Addison.

WASHINGTON

As previously stated in these columns, the Lorimer & Gallagher Co., 217 La Salle St., Chicago, Ill., has the contract for filling in the bridges on the line of the Chicago, Milwaukee & Puget Sound Ry. east of the Columbia River in Washington. The contract includes 1,000,000 cu. yds. of earth excavation. The Lorimer & Gallagher Co. has 75,000 cu. yds. of team work, which it will sublet at once.

WISCONSIN.

The Minneapolis, St. Paul & Sault Ste. Marie Ry. has surveys in progress for two cutoffs on the Wisconsin Central, one of 17 miles, New Richmond to Withrow, and one of 19 miles, Spencer to Owen. Construction contracts will be let the latter part of February or the first of March. Thomas Greene, Minneapolis, Minn., is chief engineer.

CANADA.

The Edmonton Radial Ry., Chas. E. Taylor, superintendent, Edmonton, Alberta, will let construction contracts in April or May for five miles of line. Surveys have not been made as yet.

MEXICO.

Bids were opened Jan. 11 by James M. Reid, chief engineer, National Railways of Mexico, for the grading, tunnel and masonry work on the 100 kilometer line from Durango to Llano Grande, Durango, the contracts being let as follows: John Phillips, Fundicion de las Delicias, 3a. Calle de las Delicias, Mexico, D. F.; Cia. Bancaria de Fomento, Obras y Bienes Raices, S. A. Ave. del 5 de Mayo, Mexico, D. F.

Power Developments, Levees, Drainage and Irrigation Works.

COLORADO.

Contracts are to be let within the next two months for the construction of an irrigation system between Canon City, Colo., and Pueblo, Colo., which will irrigate 300,000 acres of land lying on both sides of the Arkansas River. In general these contracts will cover about 150 miles of main canals and between 300 and 400 miles of laterals and smaller canals, the total yardage amounting to approximately 700,000 yds. of rock and 3,000,000 yds. of earth, 10 reservoir dams amounting to about 5,000,000 yds. of earth and 100,000 yds. of masonry; also several masonry diversion dams, ranging in height from 20 to 50 ft., and several miles of concrete siphon. W. H. Rosecrans of the Arnold Co., 181 La Salle St., Chicago, Ill., is chief engineer, and H. G. Raschbacher, Canon City, Colo., is resident engineer.

GEORGIA.

The contract for the construction of the power development on the Etowah River, near Creighton, Ga., for the Blue Ridge Power Co., has been secured by Frank B. Gilbreth, Inc., 60 Broadway, New York. This work will include the construction of a Ransom hollow dam 42 ft. high and 600 ft. long, and a reinforced concrete power house sufficient for 4,000 h. p. installed.

ILLINOIS.

As noted in a previous issue, bids will be received until 10 a. m., Feb. 23, by Major Thos. H. Rees, U. S. Engineers, 508 Federal Bldg., Chicago, for dredging and rock excavation in the Chicago River. The work to be done consists in the excavation of rock and non-dredgable hard pan from a point in the north branch of the Chicago River about 520 ft. below Fullerton Ave. bridge and up to that bridge, in Chicago. The total estimated quantity of material to be removed to complete the work is 5,000 cu. yds., place measurement. The materials to be removed consist generally of impure limestone rock, covered in scattered sections with irregular strata of hard pan varying in thickness between 1 in. and 1 ft. and somewhat more in a few places. The southerly 250 ft. contains only a comparatively thin layer of hard pan above grade (averaging not more than about ½ ft. in thickness) and this is to be classed with soft material if it is found that it can be removed by means of an ordinary dredge; otherwise, that is to say, if blasting must be done, it will be classed as rock. The cuts will average about as follows: From the bridge southwardly about 300 ft., 3 ft.; thence sloping gradually to zero. The rock and hard pan will be excavated to 21 ft. below Chicago city datum.

IOWA.

O. P. Herrick, Observatory Bldg., Des Moines, Ia., has been awarded the contract for constructing a levee in Drainage District No. 9, in Allen Township, Polk County. Bids for the work were opened Feb. 1 and it includes the moving and placing of about 89,505 cu. yds. of earth. The contract price was 20.7 cts. per cubic yard.

LOUISIANA.

Plans are under way for the drainage of 50,000 acres of land in the vicinity of Bayou La Fourche, by means of canals, levees, lateral ditches and pumping plans. Engineering details of the work have not been completed, but the following information as to what is to be done is available: The work for the most part will consist of the construction of drainage ditches, the total yardage of which will approximate 1,000,000 cu. yds. Seventy-five per cent of this will be in large canals of 40-ft. bottom and less, the remaining 25 per cent being in small lateral ditches. This material should be moved in ten months after signing of contract. In addition thereto there will be two central stations developing electricity for the operation of direct connected, electrically driven pumps, of which there will be in the neighborhood of 15, each of a capacity of 36,000 gallons per minute. The Arnold Co., C. E. Freeman, assistant chief engineer, hydraulic department, 181 La Salle St., Chicago, Ill., is the engineer for the work.

MINNESOTA.

Bids are asked by J. L. Johnson, county auditor, Oliva, Minn., until 10 a. m., March 1, for constructing County Ditch No. 45. The open ditch work includes the following:

	Width of Bottom. Ft.	Average Depth. Ft.	Cubic Yards.	Estimated Cost.
A. Main	8	6.7	85,370	$ 5,976.00
B. Main	10	6.2	103,535	7,247.00
C. Lateral	6	5.5	21,602	1,512.17
Total			210,507	$14,735.17

Can be dug with one dredge without rebuilding.

	Width of Bottom. Ft.	Average Depth. Ft.	Cubic Yards.	Estimated Cost.
A. Lateral	4	6.	29,289	$ 2,343.00
B. Lateral	6	6.3	32,659	3,265.00
C. Lateral	6	5.5	3,300	350.00
Total			65,448	$ 5,958.00

Can be dug with a walking machine or small dredge without rebuilding.

	Width of Bottom. Ft.	Cubic Yards.	Estimated Cost.
A. Lateral	cleaning	...	$ 90.00
B. Lateral	2	868	131.00
C. Lateral	4	1,476	147.62
Total		2,344	$368.62

Can be done with teams and scrapers.

The tile work includes the following materials for construction of about 14.3 miles of tile drains:

Tile to be of hard burned clay and sizes ranging from 5 ins. to 24 ins. in diameter, estimated of furnishing all materials on the ground	$9,726.35
Estimated cost of construction work	6,626.35
Total estimated cost of tile work complete	$16,389.10
Also one 14-in., one 10-in. and one 18-in. iron R. R. culvert, in place, estimated to cost	$ 378.64
And lowering present 3-ft. culvert	144.00
Total	$ 522.64
Grand total for the drainage system of	$37,973.53

Bids will be opened at the office of A. G. Lundgren, auditor of Marshall County, at Warren, Minn., at 10 a. m., March 1, for the construction of Judicial Ditch No. 11 of Marshall and Beltrami counties. The work includes the excavation of 5,539,578 cu. yds. of main ditch and branches, the estimated cost being $529,963; also the leveling of 550 miles of road work along the ditch. W. R. Hoag, 1320 Seventh St., southeast, Minneapolis, Minn., is the engineer. The official advertisement will be found elsewhere in this issue.

NEW YORK.

George W. Jackson, Inc., 46 Wall St., New York, and Chicago, Ill., has been awarded Contract 54, for constructing the Yonkers siphon, etc., for the Board of Water Supply of New York city. Bids for this work were opened Jan. 25. The contract price was $1,479,425 and the work includes the construction of a portion of the Yonkers siphon, a deep pressure tunnel 16 ft. 7 ins. inside diameter, and about 2 miles long, reached through three shafts from 100 to 150 ft. in depth, and a connection chamber with appurtenant works The work is located in the city of Yonkers, about 1½ miles northwest of the Mt. Vernon station on the Harlem division of the New York Central & Hudson River R. R.

OHIO.

W. H. Garretson, 705 Delta Ave., Cincinnati, O., has 20,000 cu. yds. of grading to sublet. The material is good and a good price will be paid.

TEXAS.

The Grand Falls Drainage District has postponed the date for opening bids for constructing a drainage system from Jan. 22 to 2 p. m., Feb. 23. Bids will be received by H. V. Carr, secretary of the district, at Grand Falls, Tex. Bonds in the sum of $33,000 have been issued for the work. A. H. Dunlap is the engineer.

WEST VIRGINIA.

The White Rock Sand Co., of Corinth, W. Va., which has been for three years past producing 100 tons of crushed and washed white rock sand of a superior quality, is now in the market for improved machinery, and will at once build a modern plant for mining, crushing and loading not less than 500 tons per day. The company is located on the main line of the B. & O. R. R., between Grafton, W. Va., and Cumberland, Md. The rock is hard, and the new plant will be of the heaviest and most modern machinery, which has not yet been decided on. Contracts for new machinery will be given within a month or two, for probably $50,000. H. L. Moore is General Manager and E. F. Hartley is President.

The Chicago, Milwaukee & St. Paul Ry. has men at work on the proposed new S. Dak. line from Wakapala to Bell Fourche. The contract for the grade to Horse Butte in Meade County has been let.

Rails and ties for the Northern Parks branch lines both north and south out of Mandan, N. Dak., have been ordered for delivery in the city March 1, and as soon thereafter as the weather will permit, work will be started.

The Coastwise Dredging Co., of Norfolk, Va., has been awarded the contract by the U. S. Government for blowing up the sunken barge John McNally, which lies at the bottom near Buch Bluff Light, Va. The contract price was $2,300.

The Norfolk & Western Ry., C. S. Churchill, chief engineer, Roanoke, Va., is reported to have awarded a contract for a 20-mile cut-off from Canebreak, W. Va., to Tip Top, Va.

The Arizona & Eastern R. R. Co. has filed its articles of incorporation in Phoenix, Ariz. The company is capitalized for $40,000,000, divided into 400,000 shares. The new company is to take over all the Arizona properties of the Southern Pacific and to add further mileage. The incorporators are Robert S. Lovett, president of the Southern Pacific; Epes Randolph, Eugene S. Ives, Charles E. Walker and Gibson Taylor of Tucson; Benjamin Titus, D. H. Kedzie, M. M. Crocker and O. S. Lordsburg. The properties to be taken over are the Arizona Eastern R. R. Co., Maricopa & Phoenix R. R. Co., Arizona & Eastern R. R. Co. and the Gila Valley, Globe & Northern Co.

The Atchison, Topeka & Santa Fe Ry. is reported to be planning to construct an extension from Oakdale, La., the present terminus of the Gulf, Colorado & Santa Fe, to New Orleans, La. Frank Merritt, Galveston, Tex., is chief engineer, G. C. & S. F. Ry.

The Baltimore & Ohio R. R. is reported to be considering double tracking what is known as Flushing Hill on the C., L. & W. division this spring. The hill is between Flushing and Holloway, 27 miles west of Bridgeport, W. Va., and is a heavy grade, with two large trestles, and while only a little over three miles would be double tracked, the company would have to make many fills. It is understood that it intends to fill in the two trestles which are of steel, and one is 65 ft. high and over 400 ft. long.

The Belle Fourche Valley R. R. Co., a branch of the Chicago & Northwestern Ry., has filed a petition with the secretary of state of South Dakota providing for the construction of a 63-mile extension through Stoneville to a point about 6 miles north of White Owl, S. Dak. The line will probably be extended to Phillip later. It will be a feeder to the Pierre main line and will be connected with the Dallas line giving the Northwestern a straight line from Omaha, Sioux City and southern points with the northwestern section of South Dakota and southwestern Montana.

Advices from Chester, S. C., state that a company has been formed for the purpose of constructing an electric railway from that city to Great Falls, the seat of one of the Southern Power Co.'s big hydro-electric developments on Catawba River, which is to be the site of the Republic Cotton Mill.

The Minneapolis & St. Louis R. R., W. D. Taylor Chief Engineer, Chicago, Ill., is reported to have a gang of surveyors working out of Onaka, S. Dak., in the expectation of building a new line north and south through the town during the coming summer.

W. T. Carey & Bro., New Orleans, La., have been awarded the contract for constructing the new Dumser wharf for the Board of Port Commissioners of New Orleans. The contract price was $25,409, and the work is to be completed in 130 days.

Advices from Water Valley, Miss., state that it is believed there that the proposed Water Valley & Southeastern R. R. will be completed from Water Valley to Pittsboro, Calhoun county, during the present year. The distance is about 30 miles.

The original bill chartering the Baltimore & Washington Transit Co. to do business in Washington, D. C., is to be amended to allow the establishment of a cross-town line. The cars will be run by gasoline as a motive power. If the amendment goes through, the line will be made operative from Kennedy St. northwest, down 13th St. to Ohio Ave.

The Virginia & Carolina Southern R. R., C. N. Blue, General Manager, Aberdeen, N. C., is said to be planning to extend its line from St. Paul's to Elizabethtown, in Bladen County, N. C.

A bill has been introduced in the State Legislature in South Carolina authorizing an election to be held in each township in Orangeburg County upon the question of issuing township bonds to aid in building an electric road in Orangeburg and extending to North, Springfield, Bowman, Elloree, Branchville and other places. William C. Wolfe, Orangeburg, S. C., is interested.

Items Concerning Contractors and Their Work

RAILROADS, POWER DEVELOPMENTS, LEVEES, DRAINAGE AND IRRIGATION WORKS.

Arkansas Notes.

FROM CORRESPONDENTS AND OTHER SOURCES.

H. W. Eurcher, C. E., has started preliminary surveys from Cotton Plant, Ark., to Cache river for the construction of a railroad for the purpose mainly of transporting logs from White and Cache river bottoms to Cotton Plant mills for manufacturing into lumber.

The stockholders of the Fort Smith Light & Traction Co., of Fort Smith, have decided to increase the company's capital stock from $1,600,000 to $6,500,000. It was also decided to increase the bonded indebtedness to $650,000. The company plans to make extensive improvements, particularly that of entering Van Buren.

Right of way is being cleared for the Van Buren Interurban Ry. and two grading gangs are now at work. T. A. Bayley, Fort Smith, Ark., is interested.

California Notes.

FROM CORRESPONDENTS AND OTHER SOURCES.

The Atchison, Topeka & Santa Fe Ry., H. C. Phillips, Chief Engineer, Los Angeles, Cal., has contracted with Evans & Chapelle, Los Angeles, for approximately 350,000 tons of crushed granite to be used in ballasting parts of its valley line between Los Angeles and San Francisco. The granite will be quarried and crushed at points on the Merced river and will be transported over the Yosemite Valley Railway to Merced, where it will be delivered to the Santa Fe. Extensive crushing plants will be installed. Delivery will be begun as soon as spring opens, and will be at the rate of not less than 20 cars daily.

George West of San Bernardino has received a rush contract from the Sharp-Hauser Construction Co., on the Santa Fe double track work between Cottonwood and Daggett, and has already started work at Cottonwood. He expects to put about 150 head of stock and a large number of men on the job.

Willitts & Burr of San Francisco, who had the railroad construction cut-off work under Erickson & Petterson, west of Auburn, have finished their work and have moved their outfit to Eureka, for work for the California Northwestern between there and Willitts.

The Southern Pacific is to build another track between Indio and Coachella in the near future. The main spur at Coachella is also to be extended as far as the ice plant and the necessary grading work will be commenced soon.

Capt. A. E. Anderson of the California Transportation Committee has asked the Board of Trustees of Sacramento for permission to build an 80-ft. extension to the present city wharf. The work is to be done under the direction of and the plans are to be approved by the City Engineer of Sacramento.

Resolution is to come before the City Council of Long Beach for permanent improvements to the city wharf. The Board of Public Works will bring in estimates on various methods of improvement, including cement piling, cured in the sun and then jetted into position; rock breakwater and piling, rock filling under the wharf, and cast iron cylinders not less than 18 in. in diameter filled with concrete.

Application is to be made to the supervisors of San Francisco for a franchise for an extension of the Masonic Ave. line along K St. to Ninth or Tenth Ave., and south to O St., to be built by private capital with the assistance of the United Railroads. W. W. Allen, President of the Sunset Merchants' Association, San Francisco, is interested.

A committee of business men of Eureka, of which E. E. Skinner is chairman, are investigating a proposition for construction of an electric railroad between Eureka and Redding or Red Bluff, at an estimated cost of $7,000,000. It will probably be March before the committee is ready to make its final report and recommendations.

The Sacramento Valley Irrigation Co., according to advices from Willows, is calling for bids, to be opened about Feb. 15, for excavating laterals and the main canal requiring the removing of 1,500,000 cu. yds. of earth.

The Southern Pacific Ry. has set aside $600,000 for betterments in the Shasta division between Red Bluff and Ashland, Ore. This money is to be expended during the present fiscal year and will go for improvements in the way of building depots, lengthening side tracks and improving grounds.

The East Shore & Suburban Ry. Co. has applied to the city trustees of Albany for a new franchise for an extension of the company's line from Point Richmond, which is its southern terminus at the northern boundary of Albany known as the County Line south along San Pablo, then west and south to connect with the northern end of the Southern Pacific Co.'s loop extending out from Berkeley.

The Russian River Light & Power Co. has been incorporated with a capital stock of $300,000 and headquarters at San Francisco. The incorporators are as follows: J. E. Bennett of San Mateo; H. C. Eastman of Los Gatos; N. M. Twomey of San Francisco; E. R. Hough of Kentfield; L. R. Dickey of Alameda.

Colorado Notes.

FROM CORRESPONDENTS AND OTHER SOURCES.

The Palmer Estate has filed with the County Clerk at Colorado Springs a plat showing a proposed reservoir and system of ditches for irrigating a large tract of land east of Colorado Springs. The reservoir will cost about $500,000, but will not be built for some time, it is said. E. C. Van Diest, Colorado Springs, is the engineer.

The Otero Canal Co. of La Junta has arranged to sell $150,000 of bonds and has made arrangements to let contracts for the removal of wood frames at headgates, to be replaced by concrete; concrete siphons will be put in and the canal will be enlarged to carry 500 cu. feet per second. Of the amount to be realized by the sale of the bonds, $50,000 will be used for improvements to the reservoirs of the Otero system.

Kilpatrick Bros. & Collins, Beatrice, Neb., have begun work on their contract for the extension of the Union Pacific extension of the Denver-LaSalle line from Bent Junction to Fort Collins. The extension will be 40 miles long, and will involve much heavy work.

The San Luis Southern Ry. has tracklaying well under way for its line from Blanca.

The Cedar Grove Reservoir and Cedar Grove Canal, according to a report filed with the County Clerk at Pueblo, will cost $134,000, and will bring 22,000 acres of land under irrigation. E. F. Rizer, Pueblo, is the engineer.

The construction of a reservoir in Morgan county, to have a capacity of nearly 1,000,000 cu. feet, is proposed. It will be known as the San Arroyo irrigation project, and will water 10,000 acres. The bonds recently sold for $225,000, and $50,000 is ready to use. W. S. Abbott, Greeley, is engineer is charge of the construction work.

The directors of the Platte Valley Municipal Irrigation District, Henry F. Roeschlaub, Secretary, Fort Lupton, opened bids Feb. 7, for the sale of $600,000 of bonds of this district.

The Denver, Laramie & Northwestern R. R. is making efforts to materially improve its road bed between Milliken and Denver, Colo., and W. E. Green, Vice President of the road has a steam shovel at work taking out gravel for ballast.

Carmon Layton, the promoter of the Paradox R. R. project has been negotiating with a big construction company in Pueblo, Colo., and it is expected that the company will be given the contract for the construction of the proposed railroad and work will be started about April 1. Location surveys will be continued as soon as spring opens up and the project rushed to completion. The company has opened headquarters at the office of R. G. Trotter & Co., Montrose, Colo.

Business men of Lamar, Colo., have succeeded in raising a $55,000 cash bonus for the Denver & Gulf R. R. to be paid upon the completion of the road which is now constructed within 25 miles of that city. The company of which Frederick A. Umsted is President, is constructing a line from Texhoma, Tex., to a connection with the Union Pacific at Limon, Colo., and under the present arrangements Lamar will be a division point on the line. According to a statement reported to have been made by the president, the company has financed a line from Texhoma east to Canadian City, Tex., a distance of 74 miles, which will eventually extend south to Dallas.

David Heaton of Salida has obtained a lease on the Calumet branch of the Denver & Rio Grande R. R. and will begin work as soon as the weather will permit in rebuilding and extending the line to handle the large granite deposits northwest of Salida. It is announced that $100,000 will be spent in the work and that a large force will be put on the line early this spring.

Illinois Notes.

FROM CORRESPONDENTS AND OTHER SOURCES.

The Rockford & Interurban Ry. Co., T. M. Ellis, Vice President and General Manager, Rockford, Ill., has set aside about $250,000 which will be spent in Rockford the coming season in adding to and improving the present system. A considerable part of the above sum will be spent in replacing the present rails with 70 lb. steel.

The Chicago & Elmhurst Ry. Co. has been chartered with a capital stock of $5,000, and proposes to build a road from the east line of Oak Park to Addison, Dupage county. The directors and incorporators are: H. D. Williford, Jr., Henry L. Fearing, F. D. Kilmer, Alfred J. Parker, Frederick W. Pringle, William A. Rawson, all of Chicago.

The Chicago, Burlington & Quincy R. R. is to increase its switching facilities at Galesburg

A petition requesting the board of Forest Park, Ill., to pass an ordinance permitting the extension of the Chicago and Oak Park elevated road through the village has been before the village trustees.

An ordinance has been before the City Council of Springfield to grant a right to the Springfield Consolidated Street Ry. Co. to lay a single track in Lawrence Ave. from Amos Ave. to the western limits of the city.

Indiana Notes.

FROM CORRESPONDENTS AND OTHER SOURCES.

Petitions are being circulated in Warwick County asking the County Commissioners to dredge Pigeon Creek. As proposed the dredging will begin at the county line between Gibson and Warrick counties and end at a point near the Vanderburg county line. The estimated cost of the project is close to $100,000. Louis Meyer, Boonville, is County Surveyor.

The Cleveland, Cincinnati, Chicago & St. Louis Ry. started engineers at work Jan. 26 between Muncie and Indianapolis, platting for a double track.

The Burns Construction Co., Isabella Bldg., Chicago, Ill., is stated to have been awarded the contract for building the Evansville, Mt. Carmel & Olney traction line. As proposed the line will be sixty-four miles long, extending from Evansville through Darmstadt, Cynthiana, Owensville, Mt. Carmel, Friendsville,

Lancaster and Berryville to Olney. E. Q. Lockyear, Evansville, Ind., is secretary of the traction company.

The city officials of Fort Wayne are stated to be taking steps preparatory to having track elevation work begun in that city. Frank M. Randall is City Engineer.

H. H. Knife, Robinson, Ill., is promoting a project in the construction of an ore carrying railroad from Terre Haute to Mississippi river.

The Hammond, Whiting & East Chicago Street Ry. Co. has plans to extend its system from its southernmost point at the Standard Steel Car plant, Hammond, north into East Chicago, over Forsythe Ave., and from there via 141st St. to Indiana Harbor.

The Chicago & Indiana Air Line Ry. Co. has filed a notice of change of name to the Chicago Lake Shore & South Bend Ry Co., also an amendment to its articles of incorporation to fix the directorate at from 5 to 13 members.

Iowa Notes.

FROM CORRESPONDENTS AND OTHER SOURCES.

The Chicago & Northwestern Ry. is said to be planning a number of improvements at Belle Plaine this year. These include the erection of an 80-stall roundhouse, the construction of additional sidetrack facilities in that city, and the laying of a third track to Tama, 16 miles westward.

A preliminary survey of the Des Moines River between Ottumwa and Eldon, with a view to ascertaining the practicability of building a dam whereby water power will be furnished, will be made shortly by Engineer Dobson, of the Iowa Construction Commission. The commission was created last year.

The construction of a subway under the C., B. & Q. Ry. tracks at either North Clinton or North Main st., at Albia, is proposed. This work would cost about $45,000.

The Omaha & Council Bluffs Street Railway & Bridge Co., operating a street railway at Council Bluffs, has made a proposition to the City Council of that city whereby it proposes to construct this year a line on First Ave. from Pearl St. to Main St., and thence on Main St. to Broadway; a line on North Eighth St. from Broadway to Avenue H.

Advices from Charles City state that C. W. Hart, of that city, president of the Hart-Parr Co., has offered to give from the Hart-Parr Co. $100,000 toward a street car and interurban line for Charles City if the people there will give the same amount. This will be enough to start the line. It is intended to have the interurban line extend about 40 miles, connecting with at least six or seven railroads. This line will carry freight, and a new bridge is planned across the Cedar River for this traffic.

The county supervisors at Sioux City have been petitioned to appoint an engineer to make survey for a new ditch, which is to be known as the Little Sioux ditch. Its proposed course will be from Miller township, running through Oto and Little Sioux townships.

About 115 men are now engaged in the preliminary construction work for the large power development on the Des Moines river at Keokuk. Hugh L. Cooper, 50 Wall St., New York, is the promoter of the project.

Kansas Notes.

FROM CORRESPONDENTS AND OTHER SOURCES.

An election is to be held in Finney County on Feb. 28 to vote on issuing $30,000 of bonds for the Garden City, Gulf & Northern R. R. If the bonds are voted the provision will be that the Garden City, Gulf & Northern Railroad must have completed a stretch of track between Garden City and Liberal by Dec. 31, 1910.

The Chicago, Rock Island & Pacific Ry., J. B. Berry, Chief Engineer, Chicago, Ill., is buying a strip of right of way along its line from Topeka to Herington, 82 miles, so that it can put in a double track this season.

The first contract for excavating at the turns of Soldier creek at Topeka has been let by the North Side drainage board to Hamil & Yencer, of Topeka, who have begun work The contract was let for making the cut at what is known as the Robinson bend near the Sam Harper farm. The price set by the contract was 16 cts. per cu. yd. and it is estimated that there are 10,000 cu. yds. of earth to be moved at this place. This is the first work in connection with the attempt on the part of the North Side drainage board to straighten the bed of Soldier creek. There are two other cuts being planned by the board.

The construction of an electric railway from Baxter to the Mission mines and possibly to Hattonville is proposed. As projected the line would be about 13 miles long. Attorney E. B. Morgan, Baxter, is interested.

Michigan Notes.

FROM CORRESPONDENTS AND OTHER SOURCES.

The Lake Superior & Ishpeming Ry. Co., R. C. Young, Chief Engineer, Marquette, is preparing to extend its line to the Cleveland-Cliffs Iron Company's North Lake property, at Marquette. As proposed the line will branch out from the main track at a point a trifle north of the Lake Superior dump, at the western end of Division St., and will cross both the Northwestern and South Shore tracks, also West Division St., by a steel trestle.

The Boyne City, Gaylord & Alpena R. R., W. H. White, President and General Manager, Boyne, has placed contracts for the ties to be used in the extension of the road from Gaylord east to Hillman, where a connection will be made with the Detroit & Mackinac.

The Kalamazoo, Gull Lake & Northern Electric R. R. Co., with offices at Battle Creek, is reported to have received offers to finance the projected line. Col. W. V. Jacobs is interested.

The Grand Trunk Ry. is said to be planning to extend its coal mine spur through the coal fields north of Corunna and to New Lothrop. The necessary right of way has been secured up to within about 3 miles of New Lothrop. The proposed line is directly north from Kerby, for a distance of about 8 or 9 miles, and then takes an easterly course. H. G. Kelley, Montreal, Que., is Ass't Engineer.

The Oak Park Power Co., of Flint, Mich., has increased its capital stock from $60,000 to $200,000.

Minnesota Notes.

FROM CORRESPONDENTS AND OTHER SOURCES.

A mass meeting was held Feb. 5 in Pleasant Hill township and plans were outlined to have the Chicago Great Western Ry. build a branch from St. Charles to Fremont and thence east to LaCrosse. If this plan fails then steps will be taken to organize an electric railroad company. William Burke, Witoka, Minn., is interested.

The City Council of Virginia, Minn., has granted a franchise for the proposed street railway connecting Virginia, Eveleth and Gilbert. It is expected that the promoters of the interurban line, represented by E. G. Chapman of Chicago and W. M. Prindle of Duluth, will begin construction work on the proposed line early in the spring.

Barnett & Record, contractors, Minneapolis, will put 150 men at work about Feb. 15 on rebuilding Ore Dock No. 2 at Two Harbors.

A. B. Randall, Artonville, Minn., auditor of Big Stone County, will sell on March 1, bonds amounting to $20,000 for the construction of ditches.

The horse dealers at the Midway Horse Market at Minneapolis report excellent business for 1909. Nearly 1,000 more horses were sold than during any previous year since the market was established by Barrett & Zimmerman some 20 years ago. This heavy movement was caused by the big demand for horses and mules for railroad work early in the summer and the large orders placed by the big lumbering interests all during September, October, November and December. There had been very little railroading or logging during 1907 and 1908 on account of the money stringency, with the result that both railroad and logging contractors had allowed their supply of horses and mules to become depleted, with the result that they had to buy heavily in order to carry on unusually heavy operations. Horses have been high and indications are that values will hold steady the coming year about on a level with 1909 prices. The heaviest shipments were made to the lumbering interests in northern California, Washington, western Montana, Minnesota and Wisconsin, to railroad contractors in Dakota, Montana and Canada and to contractors who are working on big irrigation projects in Idaho, Wyoming and other western states; the big icing and transfer companies in the eastern cities were liberal buyers. The big Wednesday auction sales will begin shortly, which will bring heavy consignments of all classes of horses on the market, and the offerings will include from 500 to 600 head of horses and mules constantly during February, March and April.

Missouri Notes.

FROM CORRESPONDENTS AND OTHER SOURCES.

The Mexico, Santa Fe & Perry Traction Co. is reported to have had work started on the erection of its power plant at Mexico, Mo. Right of way for the line has been secured and it is said that construction work on the north and south divisions will be started soon, and that the line will eventually be built between Mexico and Hannibal via Perry, Senter and New London. Judge M. Crum, Mexico, Mo., is President. The J. J. Burns Construction Co., Isabella Bldg., Chicago, Ill., has the contract.

The Kansas City Terminal Ry. Co. has given notice to the City Council of Kansas City, that it proposes to build the new Union Station and terminals on the larger of two plans provided in the ordinance. This means that the company will spend in Kansas City in the next 5 years approximately $30,000,000 instead of $15,000,000. John V. Hanna is Chief Engineer of the Terminal Ry. Co.

According to a statement, reported to have been made by H. U. Mudge, president of the Chicago, Rock Island & Pacific R. R., the company is seriously considering the improvement of the Kansas City terminals and double tracking the line between Kansas City and Cameron Junction. The company is also contemplating double tracking the line between Topeka, Kan., and Herington.

St. Louis Items.

BY A. B. KOENIG.

E. A. Smith died suddenly in Las Vegas, N. M., last Tuesday. His body was brought to Kansas City for burial. Smith had only been married recently to Miss Emma Borden of Malvern, Ark.

Reese & Nagel secured the contract for paving the river front at Hannibal, Mo.

Mike Conroy returned from Buffalo, N. Y., and has resumed work on the Burlington extension near Marion, Ill.

Wm. Nuttall, representing M. C. Connors of Chicago, spent a couple of days in town. Nuttall informs us that they have the reservoir that they are building for the Burlington R. R. at Centralia, Ill., about half finished. Barcus & Jennings are doing this work for Mr. Connors.

Harrington Bros. are still on the double track work of the Burlington R. R. near Hanover, Ill.

Gus. Landberg has his steam shovel plant on the Burlington R. R. at Galena Junction, Ill.

Alex. McGavock & Son are at Savanna, Ill., on the Burlington R. R. with their steam shovel and car plant.

Chas. Van Wormer is grading side tracks for the Burlington R. R. at Virden, Ill.

The Board of Public Improvements has approved the drafts of ordinances for the construction of sidewalks on these streets: Michigan Ave., between Meramec St. and Gasconade St.; Rebecca St., from Grand Ave. west 554 ft.; 21st St., between Chouteau Ave. and Pain St.; Allen Ave., between Longfellow Blvd. and Compton Ave. (north side); Bartmer Ave., between Hodiamont Ave. and city limits; Bertha Ave., between Hamilton Ave. and

Hodiamont Ave.; Blackstone Ave., between Page Blvd. and Easton Ave.; Ella Ave., Hodiamont Ave. and city limits; Etzel Ave., between Hamilton Ave. and Hodiamont Ave.; Hodiamont Ave., between Wells Ave. and Elston Ave. (east side); Laurel St. between Wells Ave. and Easton Ave.; Nebraska Ave. between Meramec St. and Dakota St. (west side); Shawmut Pl., between Julian Ave. and Wells Ave.; Wells Ave., between Hodiamont Ave. and city limits; Alabama Ave., Loughborough Ave. and Iron St.; Alabama Ave., between River des Peres and Ivory St.; Belt Ave., between De Giverville Ave. and Waterman Ave.; Gasconade St., between Oregon Ave. and Pennsylvania Ave.; Grand Ave., between Neosho St. and Montana St.; Humphrey St., between Oak Hill Ave. and Morgan Ford Rd.; Ivory Ave., between Alabama Ave. and Primm St.; Itaska St., between Broadway and Compton St.; Itaska St., between Compton and Virginia Aves.; Idaho Ave., between Loughborough Ave. and Kansas St.; Koelm Ave., between Pennsylvania Ave. and Virginia Ave.; Keokuk St., between Minnesota Ave. and Grand Ave.; Loughborough Ave., between Alabama Ave. and Colorado Ave.; Michigan Ave., between Dover St. and Bates St.; Michigan Ave., between Neosho St. and South Dakota St.; Michigan Ave., between Fillmore St. and Wilmington Rd. (west side); Minnesota Ave., between Itaska St. and Neosho St. (east side); Minnesota Ave., between Neosho St. and Dakota St. (west side); Neosho St., between Michigan Ave. and Virginia Ave.; President St., between Lemp Ave. and Wisconsin Ave. (north side); Virginia Ave., between Main St. and Bates St.; Wilmington Rd., between Michigan Ave. and Colorado Ave.; Indiana Ave., from Chippewa St. south as far as open; Geyer Ave., between Longfellow and Compton Aves. (north side).

Stockholders of the St. Louis, Iron Mountain & Southern Ry. on Feb. 2 voted to increase the capital stock to $190,000,000. The increase is $60,000,000. The absorption of 23 auxiliary lines and an increase of $25,000,000 in the bonded indebtedness, out of which the lines will be improved, were voted on favorably. The auxiliary lines which were acquired are Arkansas & Louisiana, Arkansas Midland, Arkansas Southwestern, Brinkley, Helena & Indian Bay, Coal Belt, Eldorado & Bastrop, Farmerville & Southern, Garland Western, Gurdon & Fort Smith, Gurdon & Fort Smith Northern, Herrin Ry., Herrin & Johnston City, Kansas & Arkansas Valley, Little Rock & Hot Springs Western, Little Rock & Monroe, Little Rock Junction Ry., Mississippi River, Hamburg & Western, Natchez & Western, New Orleans & Northwestern, Pine Bluff & Western, Springfield Southwestern, St. Louis, Watkins & Gulf, and Wabash Southern.

Nebraska Notes.

FROM CORRESPONDENTS AND OTHER SOURCES.

The Nebraska Transportation Co., incorporated under the South Dakota laws, has petitioned the City Council of Fremont, Neb., for right of way over several streets for an interurban electric line that the company proposes to build from Omaha to Fremont. The company asks a 50-year franchise and a 3-year limit in which to complete the line.

The Union Pacific R. R., E. D. Schermerhorn, Omaha, Neb., Supervisor of Bridges and Buildings, is to expend $100,000 for a new coaling station at Kearney, and much of the material is already on the ground. Other improvements at Kearney are contemplated.

A movement is on foot in Hastings, Neb., to raise a fund amounting to $10,000 for the construction of the Nebraska, Kansas and Southern R. R. extension to that city.

New York Notes.

FROM CORRESPONDENTS AND OTHER SOURCES.

The Commissioners appointed to decide as to whether the proposed Lexington Ave. subway route in New York City should be modified to make it a double-deck subway, with the express and local trains on different levels, between Houston St. and 103d St. and 119th St. and the Hudson River, have reported in favor of the double-deck plan. According to the testimony of Henry B. Seaman, chief engineer of the public service commission, the proposed double-decked route could be constructed by tunneling, whereas it would sometimes be required to make an open cut for a four-track subway. He said that the double-deck scheme would require less property to be purchased for stations.

The Pennsylvania R. R., J. T. Richards, Chief Engineer Maintenance of Way, Philadelphia, Pa., is said to be planning to double track its line this spring between Hinsdale and Franklinville, thus completing the double track to Olean. If laid as recently surveyed the road bed will be changed through Ischua and will cross the Farwell and Cline farms to avoid a double crossing of Ischua Creek.

A bill has been introduced in the State Legislature to appropriate $100,000 for improving the Black River Canal from Boonville to Lyons Falls. The canal will be improved in three sections, from Rome to Boonville, Boonville to Lyons Falls and Lyons Falls to Carthage. The first mentioned section was improved last year and next year it is expected that an appropriation will be made for the improvement of the Lyons Falls-Carthage section. It is also probable that the state engineer will be asked to prepare an estimate of the cost of the construction of a canal from Carthage to Dexter. The work will be done by contract under the direction of the State Superintendent of Public Works, Albany.

Alex. Sturgeon, of Kingston, has been awarded a contract to build a 200-foot dock and considerable cribbing at Stockport for Joseph McLean of Kingston. He will also build about 300 feet of docking for the Tomkins Cove Stone Co.

The State Public Service Commission, second district, has authorized the Rockland Railroad Co. to execute a mortgage upon all its property for $3,000,000, securing an issue of 5 per cent 50-year gold bonds of $3,000,000, and allowing the issuance at present of $2,350,000 of common stock; $415,700 of the stock is to pay for all services and expenses in organizing and promoting the enterprise and providing for all engineering and legal expenses until the road is put into operation. The proceeds of the balance of the stock and the bonds authorized are to be used for construction and equipment. The rest of the bonds and authorized stock shall not be issued except upon further order of the commission.

The public service commission has asked the Legislature for an appropriation of $600,000 to be spent for the elimination of grade crossings within the city limits of New York. In the act passed by the Legislature for the doing away of these crossings, most of which are in Brooklyn and Queens, it is provided that when such changes are made in the grade crossings, 50 per cent of the cost shall be borne by the company, 25 per cent by the city and the remaining 25 per cent by the state.

A bill is before the State Legislature providing for the acquisition of a site and for the construction and equipment of a power house, coal pockets and conduits, to furnish heat, light and power for the state capitol and the new state education building. The bill authorizes an expenditure of $500,000.

The State Public Service Commission began a rehearing on Feb. 2, at Albany, on the application of the Buffalo, Rochester & Eastern R. R. Co. for permission to build a double track railroad from Buffalo to Troy.

The construction of an electric railway between Athens and Towanda is proposed and franchises have already been secured in Towanda. Citizens of that place have also subscribed $250,000 for the line. Mial Lilley, Towanda, is interested.

Ohio Notes.

FROM CORRESPONDENTS AND OTHER SOURCES.

The directors of the Norfolk & Western Ry. on Jan. 27 authorized the construction of 13 miles of additional double track in West Virginia and about 48 miles in Ohio. Authority also was given for the construction of a low grade belt line around the city of Petersburg, Va., for contracts for new equipment involving an outlay of $3,700,000. Further information regarding some of this work is given under Confirmed Reports in this issue. J. R. Schick, Roanoke, Va., is Engineer of Branch Lines, Norfolk & Western.

John H. Francisco has commenced work on the grading for the new double tracking for the N. & W. R. R. between Hanging Rock and Wheelersburg.

The Pennsylvania R. R. is planning to construct several subways in Alliance this year. R. Trimble, Pittsburg, Pa., is Chief Engineer Maintenance of Ways.

The Cleveland Short Line Ry. of Cleveland, has completed the first section of its belt line at Cleveland from the southerly city limits —Marcelline Ave. west to the junction of the Lake Shore Ry., Rockport. This section has been completed at a cost of $6,000,000. The part from Marcelline Ave. to Collinwood is now under construction and cannot be completed for 2 or 3 years. The sum of $10,000,000 has been appropriated for this section. Ben T. Hopkins and W. R. Hopkins, Cleveland, O., are interested.

The Ohio Electric Ry. Co. is said to have made plans to extend the Lima-Defiance division from its present terminus near the plant of the Pressed Steel Co., at Defiance, about 2 miles from the city over Greenler St. and East Second St. to the Second St. Auglaize river bridge, 3 blocks from the court house and business section. In making the extension it will be necessary to cross the Baltimore & Ohio R. R.

The Cleveland Electric Illuminating Co., of Cleveland, is to begin work in the spring at the foot of East 71st St., upon the large power house and the tunnel and bulkhead in the lake, to supply water for the condensing engines.

Bids are reported to have been opened Feb. 1 at the office of C. F. Losh, assistant engineer, Norfolk & Western Ry., at Portsmouth, O., for improvements to the Columbus District of the N. & W., which will involve the expenditure of $1,500,000. The improvements include double tracking between Davis station, 10 miles north of Portsmouth, to Piketon, change of line from Chillicothe to Delano, extensions of culverts, etc., along the entire district. Among the contractors who bid on the work are said to be the following: M. C. Boxley, of the Mason-Hanger Co., of Salem, Va.; Ryan and Walsh Construction Cos.; J. H. Vaughn, of Roanoke; J. R. Sarpell, Thomas A. King, of Louisville; P. J. Millett and E. R. Keller, of Roanoke.

Oklahoma Notes.

FROM CORRESPONDENTS AND OTHER SOURCES.

Surveys are reported to have been completed for the proposed Webbers Falls-Warner R. R., and an excellent route found. The distance between the two places is 14 miles and the line will require the construction of but one bridge. Chas. Hagerty, Muskogee, Okla., is engineer.

A bonus of $50,000 has been promised by Waurika to the Henrietta & Southwestern Ry. Co., which proposes to build a road from Henrietta, Tex., to Waurika by way of Byars, Tex. Work is expected to start in 60 days.

The Caddo Development Co. has submitted a proposition to the Commercial Club of El Reno, for the building of an extension line to Chickasha and Anadarko.

It is reported in the vicinity of Muskogee, Okla., that the Missouri, Oklahoma & Gulf, will, upon its completion of the line to Sherman, Tex., take steps toward extending the line from Rex, where a connection is made with the Iron Mountain, to Kansas City, Mo. J. J. Harrison, Calvin, Okla., is Chief Engineer of the company.

The annual meeting of the stockholders of the Oklahoma & Golden City R. R. was recently held in Pawhuska, Okla. The company was chartered 2 years ago with a capital stock of $12,000,000 to construct a line through Jefferson City, Golden City and Carthage, Mo.; and Pawhuska, Bartlesville and Miami, Okla. It is reported that Canadian capitalists have financed the road. The officers of the

company are as follows: E. M. Dempsy, Pawhuska, president; J. A. Wimberly, Pawhuska, and L. C. Lohman, Jefferson City, vice presidents; W. H. Reed, Golden City, Mo., secretary; W. B. Burns, Golden City, treasurer; W. S. Hawkins, Pawhuska, chief engineer; E. E. Grinstead, general attorney, and J. A. Grisel, Golden City, general manager.

A company has been organized at Woodward, and proposes the construction of an interurban line from that city to Fort Supply.

Ground was broken at Guthrie, Jan. 29 on the grade of the Mountain, Valley & Plains R. R., to be constructed from Guthrie to Cimarron, N. M. Ten teams under the direction of Chief Engineer J. E. Conlin were placed at work on the grade, and other men and teams were on the way from western Oklahoma. The Robberts Construction Co. of Philadelphia, which has the contract for the construction work on the new road, is said to have experienced great difficulty in getting men or teams here on account of the large amount of public improvement work which is now going on. The construction company will make its headquarters at Guthrie and make this the supply point for the various crews. The first section of the line to be completed will be between Guthrie and Kingfisher.

Oregon Notes.

FROM CORRESPONDENTS AND OTHER SOURCES.

The Commercial Club, of Mist, has appointed committees to ascertain the cost of surveying a route for an electric railroad to Clatskanie. If the estimated cost of construction is not placed too high, the citizens of the valley, assisted by those of Clatskanie, will endeavor to build the road.

John R. Allen has applied to the City Council of Ashland for a franchise for the entrance of his projected Rogue River Valley electric road into Ashland.

The holdings of the Three Sisters Irrigation Co. have been taken over by the Columbia Southern Irrigation Co., a survey has been made and plans perfected for the construction of a reservior system. By building a dam 70 ft. high in a narrow gorge flood waters can be impounded sufficient to water at least 25,000 acres of land. To build the dam and remake the canals and laterals will cost about $400,000, it is estimated. Surveys of the project have been made by Frank C. Kelsey of Portland, Ore.

The Baker City Interurban Ry. Co. which proposes the construction of a street railway in Baker City, has placed an order for 7,000 railway ties and proposes to have 2½ miles of line in operation by July 1. The line is to be a link in an interurban belt line 45 miles in length operating in Baker Valley. The surveys for the city and interurban portion have been completed and all engineering features have been worked out and with the completion of the city line all the money for which has been put up and is now available, the interurban line which will form a comprehensive belt around Baker Valley will be undertaken and financed by a series of construction bonds. The security for the first 10 miles will consist of the completed 2½ miles in Baker City, together with franchise and other rights. Sections of 10 miles each will be built as rapidly as the work can be done thereafter. Anthony Mohr, Baker City, Ore., is Treasurer.

Pennsylvania Notes.

FROM CORRESPONDENTS AND OTHER SOURCES.

Westwater & Casey, Columbus, O., have completed their contract for the filtration plant for Pittsburg 154 days ahead of scheduled time, thereby earning a bonus of $100 per day.

The bondholders have approved the plan for the reorganization of the Trenton & New Brunswick R. R. and the New Jersey Short Line R. R., as prepared by the bondholders' committee, of which A. M. Taylor, of Philadelphia, is chairman. The bulk of the money that will be needed to complete the high-speed line through Trenton, N. J., to Elizabethport via New Brunswick will be raised by issuing bonds against the property acquired by the new company.

A bill is before the State Legislature of Maryland to incorporate the Baltimore and Pennsylvania Ry. Co., with James H. Wilson, Jacob H. Sherman, Jacob A. Frederick, Newton S. Watts, Jacob Pierce Burns, Frank L. Hancock, Daniel F. Reisenwehr and William T. Dietrich named as the incorporators. The capital stock is placed at $600,000, with the privilege of increasing it to any amount that may be deemed necessary. According to the bill the road is to run from Reisterstown "around or through Hampstead and Manchester and Carroll counties, to the Pennsylvania state line." Permission is given to the incorporators to acquire the Hampstead & Manchester R. R. franchise.

The Chambersburg, Greencastle & Waynesboro Street Railway Co., of Chambersburg, is considering extending its line from Pen Mar to Blue Ridge Summit next fall and also from Chambersburg to Shippensburg.

Final surveys have been made, the capital has been secured and construction contracts will be let early in the spring for the projected 31 mile line of the Clarion & East Brady Electric Ry. from the county seat of Clarion county through Reidsburg and Philipston to East Brady, Armstrong county. At Reidsburg connection is made with the Franklin & Clearfield branch of the New York Central lines and at East Brady the Allegheny Valley railroad is reached. George E. Arnold, Clarion, Pa., is president.

Improvement work on the Philadelphia & Reading Ry. is reported as being as follows: The grading for the double track on the East Penn between Blandon and Lyons is progressing rapidly, and it is expected that it will be finished within the next 30 days. Fehr & O'Rourke of Reading have the contract. Smith & Campion, Mahanoy City, received the contract to build the third track on the Harrisburg division between Myerstown and Prescott. It is expected that it will be ready for service early in the spring. The contract for the fourth track of the Reading company between Phœnixville and Perkiomen Junction was awarded to Charles F. King & Co. of Pottsville. The work will be started at an early date.

A merger has been effected whereby all the electric railways between Berwick and Pottsville as well as 20 electric light and four gas plants come under the control of one company. The electric railways absorbed are the Danville & Bloomsburg, Columbia & Montour, Northumberland Light, Heat and Railways, Shamokin & Edgewood, Shamokin & Mt. Carmel and the Skuylkill Railways Co. By the construction of 65 miles of electric railway the company will own 142 miles of road, the only remaining links necessary to connect Scranton and Wilkes-Barre with Philadelphia, via Pottsville. Twenty miles of railway will be constructed to connect the Columbia & Montour system with the Wyoming Valley lines, and the construction of 10 miles of road between Danville and Sunbury will complete the link as far as Sunbury, and other short links and extensions will be made. Meikleham & Dinsmore, 25 Broad St., New York city, are interested.

The East Pittsburg Board of Trade is asking the McKeesport & Highland Grove Street Ry. Co. to build a new short line from East Pittsburg to McKeesport.

The Wheeling & Lake Erie R. R., H. T. Douglas, chief engineer, Cleveland, O., is stated to have given orders for the immediate construction of some 93 miles of track east from the system's present terminus, New Haven, Pa., to Belington, W. Va.

According to reports from the vicinity of Harrisburg, Pa., the Potomac & Susquehanna R. R. Co. will soon ask for a charter to construct a new railroad that will start at a point near Williamsport, connecting with the New York Central lines and run south to Frederick, Md. Negotiations are now pending for the purchase of the trolley line under construction from Carlisle to Newville, the Chambersburg, Greencastle & Waynesboro St. Ry. With these lines and the construction of gaps between Newville and Chambersburg, Pen Mar and Thurmont and Thurmont and Gettysburg and the line north of Carlisle to the destination a through line will be had. The company is represented by a large Philadelphia contractor.

Texas Notes.

FROM CORRESPONDENTS AND OTHER SOURCES.

The City of Denison has closed arrangements with the Missouri, Oklahoma & Gulf Ry., William Kenefick, President, Kansas City, Mo., for an entrance to that city. The Missouri, Oklahoma & Gulf Ry. is now built from Wagoner, Okla., to Durant. The contract for a bridge across Red River requires that it be completed by June 1. The contract involves distributing yards near Denison, and it is probable that all passenger trains will run into the new Union Station in Denison, when the latter is completed, though arrangements to that effect have not been completed. Mr. Kenefick has expressed the intention of building the road from Wagoner to Kansas City as soon as it is completed into Denison.

In a report from Dalhart, William R. Evans, Vice President of the Denver, Colorado & Gulf R. R., is quoted as stating that the road would be completed into Denver by the end of the year. The road is now being built out of Texhoma, Tex., northwest, and it is stated that steel laying is to begin in a few days southeast from Texhoma. The original survey of the road heads for Port Arthur, but there is now talk of diverting the route to Aransas Pass via San Antonio. The Denver, Colorado & Gulf is being largely financed by Kansas City and St. Louis capital, it is said.

Final surveys were started at De Leon on Jan. 22 to locate the Texas Central line from that place to Rising Star and Cross Plains, via Duster and Sipe Springs. C. Hamilton, Waco, Tex., is general manager.

A proposition has been submitted to the City Council of Austin, Tex., by Colonel A. B. Potter, W. M. Sturgis and T. W. Holland, of Scranton, Pa., for rebuilding the Austin dam. According to this proposition a dam is to be erected at a cost of $1,800,000, to be paid for by the city in 30 years, during which time its builders will furnish power to the city.

The Panhandle Construction Co., of Dalhart, has been incorporated with a capital stock of $10,000, the incorporators being Fred L. Bryant, W. D. Garwood and S. H. Madden.

The Chamber of Commerce of Quanah has raised the necessary $30,000 of stock subscriptions to guarantee the immediate construction of the Quanah & Gulf. Ry. from Quanah to a point in the Young County coal fields, the first link of the line between Quanah and Medicine Mound, Tex., on the Orient Ry. According to a statement of L. S. Walker, President of the railway, surveys will begin of the entire line via the Young County coal fields to Cleburne, Temple or Waco, and construction work will commence on the Quanah end of the line within the next few weeks, the road as far as Medicine Mound vicinity to be put in operation not later than Sept. 1 this year.

Permission of the U. S. Government is being sought by a syndicate which proposes to dig a channel from the town of Aransas Pass across Harbor Island to Aransas Pass. A. J. Bell, San Antonio, is interested.

The Bettison Fishing Pier Co., W. J. Chapman, Manager, Galveston, has had plans prepared for rebuilding its pier on the jetty seven miles from Galveston, which was destroyed by wind and waves last July. About $10,000 will be invested in the new pier and in a new boat. Reinforced concrete construction is proposed.

Residents of South Flores St., San Antonio, are asking that the San Antonio Traction Co. extend its line on that street.

A company is being organized at Brownsville by B. G. Stegman, for the purpose of building a street car line from that city to Matamoros.

The old charter for the Chicago, Weatherford & Brazos Valley Ry. has been renewed and a meeting is to be held Feb. 21 at Weatherford to discuss plans for building an interurban line from that city to a connection with the Rock Island at Paradise or Bridgeport. The line would be 35.62 miles long, running across the headwaters of the Trinity River. In

this distance no serious engineering problems have been encountered. The grades are slight and the curves few. The construction of only one truss bridge would be necessary, and it is thought that this might be avoided by the use of a part of the Rock Island tracks. This bridge would be over the Trinity, two miles south of Bridgeport, and would require a span of 125 ft. C. C. Littleton is secretary.

The Atchison, Topeka & Santa Fe Ry. has commenced the work of widening and raising its track between Temple and Coleman and relaying it with the heaviest steel rails in anticipation of the time when this piece of track will be the main line from California to the gulf. Between Temple and Lampasas Junction and from Zephyr to Brownwood the track will be rock ballasted. The sum of $380,000 is being expended in making the improvements named.

Bids were opened Jan. 28 at the office of Frank Merritt, chief engineer, Gulf, Colorado & Santa Fe Ry., Galveston, for the construction of about 100 miles of line from Lometa on the Gulf, Colorado & Santa Fe Ry., through the towns of San Saba and Brady and into the vicinity of Eden. There were in all seven or eight bids. Surveys for this new line of the Santa Fe have been completed, and it is likely the work of constructing the line will start soon and be prosecuted without delay. Connecting at Lometa with the San Angelo branch of the Santa Fe, the route of the new line will extend westward to San Saba, crossing the Colorado River at a point near Chadwick's mill, near the mouth of Elliott Creek. From San Saba the line will extend to Richland Springs and thence westward, passing through what was formerly the town of Rochelle. The line will also pass through the big Sellman ranch near Brady. From Brady it is proposed to build in a somewhat northwesterly direction to the vicinity of Eden. At the present time Eden will likely be the terminus of the line, but later it is possible the Santa Fe will build to Eldorado or, on the other hand, may extend the line to San Angelo to connect with the San Angelo branch. It was at one time contemplated to build in a southwesterly direction from Brady, but it was later decided to extend the road in the direction of Eden.

George Bryne of Houston has an outfit at work on the Flag Springs property, a mile east of Tyler, constructing a 17 acre reservoir for the International & Great Northern Ry.

The Commercial Club of Mineral Wells is raising a $20,000 bonus to be paid for the 18-mile extension of the Gulf, Texas & Western R. R. from Jacksboro to Oran. Knox Brothers of Jacksboro are thought to be behind the proposed line, which is now in course of construction from Olney to that place.

George Hill, Tyler, has completed his contract for putting in two large oil tanks at Victoria for the Gulf Refining Co.

The Brownwood North & South R. R. of Brownwood, recently incorporated, has awarded grading contracts for the first 20 miles of its line north from Brownwood to May.

Citizens of Commanche, Tex., are in favor of raising a bonus of $50,000 and granting right of way and terminals for the Abilene Central, which was recently incorporated with a capital stock of $150,000 and headquarters at Abilene, Tex., from Abilene to Waco, Tex. Morgan Jones, Abilene, Tex., is an incorporator of the company.

According to reports in circulation at Fort Worth, Tex., H. U. Mudge, president of the Chicago, Rock Island & Pacific R. R., has announced that he will accept the proposition of Stamford and extend a line to that city. Nothing definite has been decided on.

Advices from Rising Star state that E. F. Bucy and Lee Burkhead have begun work on their contract for constructing 15 miles of the Abilene Central R. R.

Utah Notes.

FROM CORRESPONDENTS AND OTHER SOURCES.

Eastern capitalists have made overtures to Simon Bamberger, Salt Lake City, looking to the construction of a new interurban line from Brigham City to Ogden, tapping a new territory, and connecting with the Bamberger lines at Ogden. The Bamberger line will form another part of the system, linking Ogden and Salt Lake, and passing through a most productive territory. From Salt Lake a line will be built southward to Payson and other Utah county points, which include Provo, American Fork and Lehi. In Salt Lake City the line will be extended from Postoffice place and Main St. to the city limits, where the interurban system will continue onward to the south.

Jesse Knight of Salt Lake City has applied to the city council of Provo for a street railway franchise to be used in connection with an interurban line which he proposes building to connect Brigham City and Payson. The first section of the line to be built will extend from Payson to Murray. The county commissioners of Utah and Salt Lake counties will be asked to grant certain rights along the public highways to make this connection, and later the line will be extended from Murray to the southern limits of Salt Lake, where the line will be met with an extension of the Bamberger line, which runs from Salt Lake to Ogden. The northern end of the interurban system, projecting into Box Elder county, will be built from Ogden, while the line to the south is being constructed. Several power plants, in addition to the ones already owned by Mr. Knight, will be required.

Virginia Notes.

FROM CORRESPONDENTS AND OTHER SOURCES.

The Chesapeake & Ohio R. R. has engineers in the field making a survey for a new double track line between Gordonsville and Charlottesville, by which it is said the distance between the two cities will be shortened two miles. The line surveyed is a quarter of a mile nearer the mountains than the present Cobham Station.

Washington Notes.

FROM CORRESPONDENTS AND OTHER SOURCES.

The Grays Harbor & Puget Sound Ry. (Union Pacific) has an application before the City Council of Aberdeen for permission to build a spur track on Hume St., in that city, from Division St. to 1st St.

Robert E. Strahorn, President North Coast R. R., is reported to have issued orders for contractors to immediately start work on the deep cut and fill at Union Gap, six miles below North Yakima, where the North Coast and Northern Pacific Co. occupy a narrow pass through the hills. This work is taken as an indication that Strahorn's road will soon be in North Yakima, Union Gap being the only heavy grading near the city. F. L. Pitman, Spokane, Wash., is Chief Engineer, North Coast R. R.

The Chicago, Milwaukee & St. Paul Ry. has filed notice with the secretary of state at Olympia that at a meeting in Chicago the directors ordered the construction of a branch from Warden, on the present main line, in Grant County, northerly and easterly to Griffith, Adams County, 45 miles.

C. E. Lind has been making such progress with his contract for constructing the water front cut-off line at Bellingham that it is believed that the road will be completed and ready to turn over to the Bellingham Terminals & Railway Co. on March 1. The contractor had only the work of grading and trestle building to do, as the company will itself lay the rails. The grade has been established up the Squalicum Creek bottom and comparatively little work remains to be done before the junction with the old line immediately north of the city will have been affected.

The Olympia Canal Co. has been incorporated with a capital stock of $20,000,000, and headquarters at Tacoma, and proposes to build a canal from Olympia to Elma in Chehalis County, on the Chehalis River, and dredge out that stream to the harbor. The incorporators are A. P. Gillies, Tacoma; H. C. Scheel, Tenino, and H. C. Davis, Tacoma. The F. M. Andrews Co., New York City, is back of the project.

The Columbia Contract Co. will resume active work at the Fisher Landing quarries, nine miles above Vancouver, on March 1, when 500 men will be put to work getting out rock for the government jetty at the mouth of the Columbia River. The company has 15 large barges for carrying the rock to Fort Stevens, where the rock is hoisted aboard cars belonging to the government and taken out over the jetty track to a point where the sea has a depth of over 30 feet. The chunks of rock weigh from 18 tons each down to 50 pounds.

Winter operations on the Oroville-Pateros branch of the Great Northern have been confined to sections of the line where construction work is sufficiently heavy to make excavation and grading economical, the lighter work being of such a character that it can be finished quickly after the spring break up and be ready as early as the sections of rock excavation and heavy dirt cuts. Several crews are at work between Oroville and Riverside, generally engaged in rock cuts. A large camp has been established five miles above Okanogan by Peterson Brothers. Swanson Brothers, who have a contract below that place, are making good progress and have opened up two rock cuts. Louis Larson is at work on an eight-mile stretch extending from Malott to Ophir. Between Pateros and Ophir Captain A. L. Riley has several crews at work and has established a new camp near the Zeller ranch, where a third steam shovel will soon be put in operation. Riley's equipment consists of three large steam shovels, a number of "dinky" engines, and several score of dump cars. His first camp is at the Adams ranch, below Brewster; his second about two miles above Brewster, and the third is being established near the Zeller ranch. All the sections of the line that can be worked economically at this time are covered. Other outfits are at Oroville awaiting the first signs of spring, and when the frost has left the ground there will be no delay, it is announced, in establishing camps every few miles on the entire branch.

Advices from Everett state that the Sultan Railway & Power Co., a corporation promoted and financed by Judge George D. Emery in 1907, and which has expended upwards of $60,000 in work upon the site of its power plant, at the head of the Sultan Canyon, will this season construct an electric line from the Great Northern power plant site in order to transport its machinery. It is further said that Boston and other Eastern capitalists who are interested in the Forty-five and other mining properties of the upper portions of the district are arranging for an extension of the line up the valley. The distance from the railroad to the power plant is about 16 miles, and from the latter point to one equally accessible to the Forty-five, North Coast, Little Chief and Blackman mines is about eight miles.

Announcement has been made that the Northern Pacific Ry. will begin work on the extension of its peninsula line northward from its present terminus at Moclips to Port Angeles, during the coming spring months.

Grading for the yards of the Grays Harbor & Puget Sound (Union Pacific) Ry. at Cosmopolis, across the river from Aberdeen, will commence shortly.

The extension of the North Yakima & Valley R. R., 12 miles up the Moxee Valley, which is now under construction, will be completed by May 1, 1910. The work was delayed owing to condemnation proceedings to secure the right of way. George Donald, North Yakima, Wash., is president of the railroad.

The Wenatchee Valley Railway & Power Co. of Wenatchee has asked that city for a franchise to operate a street railway on certain streets in the city. Plans of the proposed railway have been under consideration for some time.

The Northern Pacific Ry. has filed papers at Olympia for three subsidiary lines, the Port Angeles & Olympia Ry. Co., the Port Angeles Peninsular Ry. Co. and the Olympic Peninsular Ry. Co., indicating that the N. P. is to take an active part in the development of the Olympic peninsula. The officials of the three railways are all identified with the Northern Pacific Ry. The Port Angeles & Olympia Ry. was surveyed two years ago and follows a water grade from Olympia to Port Angeles, skirting Hood canal, from Olympia to Quilcene; thence to Port Williams, Dun-

genness and Port Angeles. The Port Angeles & Peninsular Ry. has also been surveyed from Port Angeles through the valley of the Soleduck river to the vicinity of the Pacific coast, thence south to join the present Northern Pacific terminal at Moclips.

Wisconsin Notes.

FROM CORRESPONDENTS AND OTHER SOURCES.

The Ambursen Hydraulic Construction Co., 176 Federal St., Boston, Mass., is stated to have been awarded a $300,000 contract by the Chippewa Valley Railway, Light & Heat Power Co., of Eau Claire, to build a dam and power house at Cedar Falls, Dunn County, on the Cedar River, to develop 8,000 H. P. The plant will be finished by Sept. 1. The equipment will cost $200,000 additional. Enough machinery to generate 2,000 H. P. will be operated this year.

The Chicago & Wisconsin Valley Ry. Co. has applied to the City Councils of Stevens Point and Portage for franchises for its projected interurban line. According to a statement of Allan T. Russell, chief engineer of the company, the finances of the company have been arranged for and building will go ahead rapidly as soon as the spring opens the roads, and it is expected the line will be in operation between Stevens Point and Portage early next fall.

Officials of the Milwaukee & Fox River alley are to take steps immediately toward securing right of way for the proposed line from Milwaukee to Cedarburg, Plymouth, Elkhart Lake, Kiel, Chilton and Stockbridge on Lake Winnebago, a total distance of 135 miles. The estimated cost of the project is $3,000,000 and eastern capitalists are backing it. The Western Engineering & Construction Co., J. A. Mesiroff, president, is in charge of the work.

The Rockford Interurban Co. has applied to the city council of Janesville for a franchise to run cars over the route now operated by the Janesville Street Railway Co. on South Main St., then on to West Milwaukee St. to the terminal of the present line.

Canadian Notes.

FROM CORRESPONDENTS AND OTHER SOURCES.

Announcement has been made to Parliament by George H. Graham, Minister of Railways, Ottawa, Ont., that the Canadian Government will begin the construction of the railway to Hudson Bay next spring. The road will be built as a government work, but probably will be operated by one of the existing private corporations or by several jointly. It is calculated that the route will be available four months in the year and that a great portion of the Western Canadian wheat crop can be hauled out each year at a saving of 5 cents a bushel in freight. The line is expected to be opened for business in three years.

The St. John Valley Ry. Co., of Fredericton, N. B., has completed arrangements for having surveys made for its projected line.

The Monarch Co. has applied to the provincial parliament at Toronto, Ont., for incorporation for a proposed new radial railway. It is proposed to start at the corner of Bathurst and Dupont Sts., Toronto, and, running in almost a straight line through the counties of York and Simcoe, provide a street railway for Barrie and Orillia and an express service between Barrie and Toronto, scheduled to make the run of 65 miles in one and a half hours.

The Canadian Pacific Ry., according to an announcement of G. J. Bury, General Manager, will spend $30,000,000 in Western Canada this year in extensions into new settlements, bridges, shops and double tracking the main line.

John Gunn & Sons, Winnipeg, Man., will shortly commence work on their contract for constructing the substructure of the Canadian Pacific bridge at Edmonton. The contract amounts to about $500,000.

Announcement has been made by Wm. Mackenzie, Toronto, Ont., president of the Canadian Northern Ry., that construction of the Vancouver-Edmonton section of his railway would commence on March 15 at New Westminster, B. C. He also stated that the line would be open for traffic from Vancouver to Montreal in April, 1914. M. H. MacLeod, Winnipeg, Man., is general manager.

The Canadian Northern Ry. is said to be planning extensive improvement work for this spring on its Winnipeg-Prince Albert line. Heavier steel will be laid and much ballasting done. It is said that at least $250,000 will be spent on the Winnipeg-Brandon portion of the line.

Mexico Notes.

FROM CORRESPONDENTS AND OTHER SOURCES.

The Tabasco Plantation Co., owning the Oaxaquenna sugar plantation in the State of Vera Cruz, is having surveys made for a standard gage railroad to give the Oaxaquena plantation connection with the Tehuantepec Railway near Santa Lucrecia Station, a distance of 18 kilometers. Construction will be commenced after the close of the rainy season in the fall and the line will be in operation next year. The company has 28 kilometers of narrow gage railroad on the plantation, and will increase this to 42 kilometers during the next year. The home office of the Tabasco Plantation Co. is in Minneapolis, Minn. The president is George McArthur of Aberdeen, S. Dak.

An official of the Dardanelle, Ola & Southern R. R., is reported to have announced that a proposition has been submitted to him by New York capitalists interested in the undeveloped coal section of Arkansas, to construct a railroad from a connection with the Dardanelle, Ola & Southern to Fort Smith or to a connection with the Arkansas Central R. R. F. S. Yantis, Dardanelle, Ark., is Superintendent of the company.

Officials of the New Mexico Central Ry. Co., are considering the construction of a 100-mile extension of the line southeast of Torrance to Roswell, N. Mex. W. S. Hopewell, Albuquerque, President of the company, is reported to have said that the financial affairs now pending in the courts will not delay the construction of the new line.

According to reports the Great Northern Ry. Co.'s surveyors are running lines for the proposed line from Fargo, N. Dak., to Minot or Williston. The survey passes two miles north of Amenia, N. Dak. H. F. Hamilton, Minot, N. Dak., is Resident Engineer of the company.

Citizens of Fort Ransom, N. Dak., are taking vigorous steps toward securing the construction of the proposed Chicago, Milwaukee & St. Paul line from Harlem, S. Dak., to Valley City, N. Dak., through that town. A bonus and free right of way has been offered the company, it is said.

According to reports from Watertown, S. Dak., the Minneapolis & St. Louis R. R. Co., has set aside $165,000 for the purpose of constructing a new pasenger depot and yards in that city, which is to be the chief division point of the road west of Minneapolis, Minn. J. H. Reinholdt, Minneapolis, Minn., is Asst. Chief Engineer of the Company.

Progressive Union of Hammond, La., is making vigorous efforts to obtain the construction of a motor railway from Hammond to Genesee to connect with the Illinois Central R. R. Towns along the proposed route have offered assistance to the promoters.

Contractor M. J. Heney, Cordova, Alaska, is continuing construction work during the winter months on the Copper River & Northwestern Ry. and now has about 1,000 men at work. It is expected that at least 4,000 men will be at work by the early part of March. The first 100 miles of track was completed to Tiekal on Dec. 23, and it is expected that the road will be completed to the Bonanza copper mine—its present objective point—in the early fall of this year. From there extensions will be made as warranted by the development of the country. Up to the middle of January there had been very little really severe weather, and with the exception of a week or two during December the trains have been running with regularity. For a while it was impossible to go beyond Miles glacier, owing to a sudden thaw and heavy rains, but these did no damage, and a subsequent freeze-up put everything in excellent shape. The big rotary snow plows have been called out but twice so far.

Citizens of Lewiston, Ida., are organizing the Lewiston Terminal Co., for the purpose of constructing an interurban and street railway around and in Lewiston.

Plans are now under way for the construction of the proposed electric line from Manning, N. Dak., to Mandan.

Application has been filed with the City Council of Newbern, N. C., for a franchise for a motor car line which is projected to run from Newbern to Trenton, N. C., in Jones County, a distance of 18 miles. W. S. X. Taylor and A. D. Stevens are interested in the proposition.

The Northern Pacific has decided upon a route for the construction of its portion of the new coast cutoff from Marmarth, N. Dak., through the Bad Lands. The line will cross the Missouri river near Marmarth, necessitating the construction of a bridge over one mile in length and 210 ft. above the water level. The 10 miles of track through the Bad Lands will cost $6,000,000 and will require three years work.

Construction work on the Gilmore & Pittsburg R. R., now being built in Idaho, is being rushed. Thomas Dixon, Sunfield, Idaho, has the sub-contract of 35 miles of grading out of Salmon. It is expected that the entire roadbed will be in shape so that the rails can be laid into Salmon sometime during March at the latest.

The Idaho Northern R. R., W. P. Smith, Chief Engineer, Enaville, Idaho, has petitioned the County Commissioners at Emmet, Idaho, for the privilege of extending its line along one of the main roads east of Emmett, which passes by section 4. This is one of the surveys the Idaho Northern made during the past summer.

The Georgia, Southwestern & Gulf Ry., recently organized to build a line from Cordele, Ga., to St. Andrews Bay, Fla., is said to have negotiated a loan of $4,000,000 in France for building and equipping the line. Of this sum $500,000 is said to be available for immediate construction work. The company proposes to take over the Albany & Northern R. R., which extends from Cordele, Ga., to Albany, Ga., and to build a line of road from Albany to the Gulf. It is also proposed to build a line from here to Hawkinsville. This will give a direct line to Charleston, S. C. J. S. Crews, Albany, Ga., is General Manager, Albany & Northern R. R.

The stockholders of the Boise & Interurban Ry. Co., H. E. Dalton, Manager, Boise, Ida., have approved plans for an early extension of the interurban line and there is a strong probability of the line being extended either to Payette, Emmett or Kuna during the summer.

The Osceola Construction Co. has been organized, according to reports, to construct the projected electric railway of the Omaha, Western & Lincoln R. R., from Omaha, Neb., to Hastings, Neb. Frank E. Schaff, Lincoln, Neb., is President of both companies.

The stockholders of the Aberdeen Street Ry. Co. of Aberdeen, S. Dak., have decided to proceed at once to comply with the company's charter requiring the construction and operation of four miles of street railway in the city in 1910. Charles N. Herreld, Aberdeen, is manager.

BIDS ASKED.

Bids are asked on following work, the notes being arranged alphabetically by states:

Bridges.

Denver, Colo.—Until noon, Feb. 26, by Charles W. Comstock, State Engineer, Denver, Colo., for the construction of five concrete piers and two concrete abutments for the State Bridge to be erected over the Grand River at Grand Junction, Mesa County, Colo. Official advertisement will be found elsewhere in this issue.

Montezuma, Ia.—Until Feb. 23, by Board of County Supervisors, for the construction of cement bridges and culverts in this county for the year 1910. J. W. Rose is County Auditor.

Savannah, Ga.—Until noon, March 14, by County Commissioners for furnishing necessary material and labor for the construction of a steel highway bridge including foundations for the same over Herb River on LaRoche Ave. G. Reuben Butler, Clerk of County Commissioners.

Decatur, Ill.—Until Feb. 14, by Board of County Commissioners for the construction of two steel bridges across the west fork of Flint Creek in the southern part of this county.

Wilmette, Ill.—Until noon, Feb. 16, by Sanitary District of Chicago, Ill., for the fabrication and erection of metal work for Sheridan Road Bridge and Wilmette Pumping Station, for the North Shore Channel of the Sanitary District of Chicago in this village. Robert R. McCormick is President of the Board of Trustees.

Niagara Falls, N. Y.—Until 7:30 p. m., Feb. 15 (readvertisement of bids asked Feb. 1), by Board of Public Works, for the construction of old Fourth St. Bridge over Gill Creek at East Falls St.

Snohomish, Wash.—Until 10 a. m., Feb. 28, by Board of County Commissioners, for the construction of a steel swing span over the Snohomish River at this town. The work consists of a 280-ft. span, 20-ft. roadway, two 6-ft. sidewalks on concrete center pier and concrete abutments.

Saskatoon, Sask.—Until 5 p. m., Feb. 14, by J. H. Trusdale, City Clerk, for foundations for the foot bridge at 20th St.

Saskatoon, Sask.—Until 5 p. m., Feb. 21, by J. H. Trusdale, City Clerk, for the construction of a steel overhead foot bridge at 20th St. William Hopkins is Mayor.

Buildings.

Bids are asked on following work, the notes being arranged alphabetically by states:

Kankakee, Ill.—Until 10 a. m., Mar. 8, by Board of Administration, State Capitol Bldg., Springfield, Ill., for the construction of a building at the Kankakee State Hospital. Frank D. Whipp is Fiscal Supervisor.

Rome, Ga.—Until 3 p. m., March 18, by James Knox Taylor, Supervising Architect, Treasury Department, Washington, D. C., for the extension, remodeling, etc., including plumbing, gas piping, heating apparatus, electric conduits and wiring of the United States Post Office at Rome, Ga.

Crookston, Minn.—Until noon, Feb. 28, by State Board of Control, St. Paul, Minn., for the construction and completion of a Ladies' Dormitory Building and an Auditorium and Gymnasium Building at the Northwestern Experiment Farm, Crookston, Minn.

Glencoe, Minn.—Until 1:30 p. m., Feb. 25, by F. D. Stocking, County Auditor, for remodeling the old court house building.

Fremont, Neb.—Until 3 p. m., March 22, for James Knox Taylor, Supervising Architect. Treasury Department, Washington, D. C., for the extension, remodeling, etc., including plumbing, gas piping, heating apparatus, electric wiring and conduits, of the U. S. Post Office at Fremont, Neb.

Butte, Mont.—Until 2 p. m., March 30, by Board of County Commissioners, for the erection of a new county court house at Butte, Mont. M. Kerr Beadle is County Clerk.

Jackson, Tenn.—Until 3 p. m., March 11, by James Knox Taylor, Supervising Architect, Treasury Department, Washington, D. C., for the extension, remodeling, etc., including plumbing, gas piping, heating apparatus, electric conduits and wiring and standard clock system of the U. S. Post Office and Court House at Jackson, Tenn.

Fort Douglas, Utah.—Until 10 a. m., March 1, by Kenneth P. Williams, Constructing Quartermaster, for the construction of one double bar rack, with plumbing, heating, electric wiring and fixtures complete at Fort Douglas, Utah.

Fort Monroe, Va.—Until 10 a. m., March 3, by Capt. E. R. Tilton, Constructing Quartermaster, for wire door and window screens for eight new buildings at Fort Monroe, Va.

Richmond, Va.—Until 3 p. m., March 17, by James Knox Taylor, Supervising Architect Treasury Department, Washington, D. C., for the construction of the United States Post Office, Court House and Custom House at Richmond, Va.

Seattle, Wash.—Until 11 a. m., Feb. 16, by Capt. E. C. Long, Constructing Quartermaster, 482 Arcade Annex, Seattle, Wash., for the construction of a wagon shed for 18 vehicles and the conversion of a stable into a commissary sales and storehouse, a wagon shed into a quartermaster and commissary storehouse and a coal shed into an ordnance machine shop at Fort Worden.

Green Bay, Wis.—Until noon, Mar. 15, by County Commissioners, for furnishing and decorating the new court house at Green Bay, Wis. Elmer S. Hall is County Clerk.

Fort D. A. Russell, Wyo.—Until 9:30 a. m., March 2, by Constructing Quartermaster, Cheyenne, Wyo., for the construction of the following buildings at Fort D. A. Russell: For constructing, plumbing, heating, electric wiring and electric fixtures, for two Administration Buildings, Plans No. 122-F; one Guard House, Plans No. 206; one set of quarters for four officers, Plans No. 237-B; for construction, plumbing, electric wiring and electric fixtures for one Stable, Quartermaster's Department, Plans No. 139-L; for construction and plumbing for one Vehicle Shed, Plans No. 209; for construction only of one Storehouse for Powder, Plans No. 263; one Storehouse for Ammunition, Plans No. 262, and one Ice House, Plans No. 196-A.

Fort Mackenzie, Wyo.—Until 2 p. m., March 7, by Constructing Quartermaster, for the construction, plumbing and electric wiring of a brick stable for 50 horses plan 139-L.

Roads and Streets.

Bids are asked on following work, the notes being arranged alphabetically by states:

Burlington, Ia.—Until 4 p. m., Feb. 21, by J. F. Winter, City Engineer, for improving Arch St., including grading and curbing and paving with mineral rubber asphaltic concrete. A certified check for $500 must be filed with each bid.

Wichita, Kan.—Until 9 a. m., Feb. 21, by William Sence, City Clerk, for paving West Douglas Ave., from Exposition Ave., to Sheridan Ave., Washington Ave., from Second St. to Kellogg St., and Roosevelt Ave., from South Park Ave. to Central Ave. The approximate quantities are 75,000 sq. yds. brick block pavement on 6-in. Portland cement concrete base and 18,000 cu. yds. of earth excavation. Bert C. Wells is City Engineer. Official advertisement will be found elsewhere in this issue.

Towson, Md.—Until Feb. 17, by Highway Commission, E. Stanton Bosley, Secretary, for grading and macadamizing road between Mount Washington and Brooklandville, known as the Falls Road, Sec. 2, 3.20 miles in length.

Westminster, Md.—Until noon, Feb. 14, by Board of County Commissioners, for improving the public highway between New Windsor and Uniontown Road. The work will include the grading and macadamizing of about 1 mile of road. O. E. Dodrer is Clerk.

Fort Hamilton, N. Y.—Until 11 a. m., March 3, by Constructing Quartermaster, for walks, drains and grading in vicinity of new buildings at this post.

Dallas, Tex.—Until Feb. 11, by J. B. Winslett, City Secretary, for the improvement of Austin St., between Commerce St. and Jackson St., by paving. Bids will be received on the following materials: Vitrified brick, vitrified brick paving block, concrete curb and concrete gutter, combination curb and gutter.

Appleton, Wis.—Until 3 p. m., Feb. 19, by Board of Public Works, for paving the following streets: Prospect and Second St., from Pearl St. to Locust St.; Walnut St., from Prospect St. to Dillon St.; Lawrence St., from the Lawrence St. viaduct to Walnut St.; Appleton St., from the Chicago & Northwestern Ry. tracks north to Second Ave.; Durkee St., from Lawrence St. north to the Chicago & Northwestern Ry. track; Union St., from Alton to North St.; Union St., from North St. to the Chicago & Northwestern tracks. Permanent pavement is to be used on concrete foundation. Official advertisement will be found elsewhere in this issue.

Burlington, Wis.—Until 2 p. m., March 15, by P. J. Hurtgen, City Engineer, for brick paving. The work includes 10,321 sq. yds. of brick paving on 6-in. concrete base; 2,500 lin. ft. of cement curb; 2,660 cu. yds. of excavation.

Green Bay, Wis.—Until 2 p. m., Feb. 17, by City Clerk, for the paving of certain streets with brick, asphalt, tar, macadam, creosoted wood block, Blome's granitoid block, sandstone block, or concrete. W. W. Reed is City Engineer.

Lake, Wis.—Until 2 p. m., Feb. 19, by M. J. McNamara, Town Clerk, for grading the south half of Oklahoma Ave., from Clement Ave., to the Chicago & Northwestern Ry.

Oshkosh, Wis.—Until 2 p. m., Feb. 17, by Board of Public Works for furnishing all necessary labor and material for grading, curbing and repaving with brick, creosoted wood blocks, cement, Blome Co. patented granitoid concrete pavement, rock asphalt, sheet asphalt or tar macadam on concrete foundation Oregon St., from 15th to 17th St.; Otter St., from State to Broad St.; State St., from Washington St. to Ceape St.; Market St., from High to Marion St. J. E. Mallery is Chairman of the board.

Sheboygan, Wis.—Until 4 p. m., Feb. 11, by Board of Public Works, for grading, curbing, paving or macadamizing portions of Michigan Ave., Huron Ave., Superior Ave., North 12th St., and Center Ave. John Kummer is Chairman of the Board.

Sewers.

Bids are asked on following work, the notes being arranged alphabetically by states:

Oakland, Cal.—Until 11 a. m., Feb. 9, by Board of Public Works, for furnishing necessary labor and material for the construction of drainage structures on Broadway between 20th St. and Piedmont Ave.

Boone, Ia.—Until 7:30 p. m., Feb. 16, by Otto Hile, City Clerk, for the construction of the Fifth Ward Sewer. The work includes approximately 9⅓ miles of vitrified pipe sewer from 8 to 15 in. K. C. Kastberg is City Engineer.

East St. Louis, Ill.—Until Feb. 16, by Board of Local Improvements, for the construction of vitrified pipe sewers in several streets.

Holton, Kan.—Until noon, by Mayor and City Council, at the office of City Clerk, for reletting the work for the construction of a sewerage system and disposal works for this city. S. H. Newell is City Clerk. Official advertisement will be found elsewhere in this issue.

Carterville, Mo.—Until 5 p. m., Feb. 17, by H. E. Moody, City Clerk, for the construction of 9,050 ft. of district sewers. F. A. Funk is City Engineer.

Vandalia, Mo.—Until Feb. 24, by City, for the furnishing necessary labor and material for the construction of a water works and sewer system. Fuller-Coult Co., Chemical Bldg., St. Louis, Mo., is the Engineer.

Medina, N. Y.—Until 8 p. m., Feb. 15, by Board of Sewer Commissioners, for furnishing of all materials and labor for the construction of an addition to the sewer system of the village. Daniel D. Holdredge is President, Board.

Cincinnati, O.—Until noon, Feb. 11, by Director of Public Works, for the construction of a surface water sewer in Harrison Ave. J. J. Wenner is Clerk of the Board.

Cleveland, Tenn.—Until April 1, by City, for the construction of a sewer system and disposal plant. Solomon Norcross Co., Atlanta, Ga., is Engineer. The work is estimtaed to cost $35,000.

El Paso, Tex.—Until March 3 (extension of date from Feb. 3), by Percy McGhee, City Clerk, for furnishing necessary labor and material for the construction of refuse incinerator, steel stack and sewage pumping station equipment with appurtenances. Hering & Fuller, 170 Broadway, New York, N. Y., are the Engineers.

Vancouver Barracks, Wash.—Until 11 a. m., Feb. 25, by Constructing Quartermaster, for the construction of a storm sewer, catch basins, manholes, outfall, etc.

Burlington, Wis.—Until 2 p. m., March 15, by P. J. Hurtgen, City Engineer, for sanitary sewers and storm sewers. The first includes 1,861 lin. ft. of 10-in. vitrified pipe sewer; 1,073 lin. ft. of 8-in. vitrified pipe sewer; 560 lin. ft. of 6-in. vitrified pipe sewer; 8 manholes; 2 lampholes. The latter includes 716 lin. ft. of 12-in. vitrified pipe sewer; 360 lin. ft. of 10-in. pipe sewer; 300 lin. ft. of 12-in. vitrified pipe sewer; 5 manholes; 12 street inlets.

Water Supply.

Bids are asked on following work, the notes being arranged alphabetically by states:

Burlington, Ia.—Until 2 p. m., Feb. 17 (date postponed from Feb. 2), by County Board of Supervisors, for furnishing and erecting a complete pumping station, including buildings and machinery. Harman Engineering Co., Peoria, Ill., are the Engineers. Official advertisement appeared in the Jan. 19 issue.

Chicago Heights, Ill.—Until 8 p. m., Feb. 18, by W. E. Lennertz, City Clerk, for new pumping equipment, including 4 deep well pumps, 2 service pumps, transformers, switchboards, one drilled well, etc.

Fort Wayne, Detroit, Mich.—Until 11 a. m., Feb. 17, by Capt. D. W. Kilburn, Constructing Quartermaster, for the construction of an extension to water mains, etc.

Fort Bayard, N. Mex.—Until 11 a. m., Feb. 21, by Capt. S. P. Vestal, Constructing Quartermaster, for complete construction of extension of post water main from end of main near hay barn to the dairy barn with the installation of a fire plug.

Nottingham, O.—Until noon, Feb. 18, by J. C. Steinickle, Village Clerk, for the construction of water mains on several of the streets. J. B. Davis & Sons, 207 Arcade, Cleveland, O., are the Engineers.

Ardmore, Okla.—Until noon, Feb. 21 (readvertisement of bids called Feb. 1) by G. H. Bruce, City Clerk, for the construction of sedimentation basins and filtration plant and for the extension of the present water main at the city lake.

Burlington, Wis.—Until 2 p. m., March 15, by P. J. Hurtgen, City Engineer, for the extension of the water works system. The work includes 1,334 lin. ft. of 4-in. water pipe; 4 4-in. gates and valve boxes; one 6-in. gate and valve box; one hydrant; two hydrants reset.

Miscellaneous.

Bids are asked on following work, the notes being arranged alphabetically by states:

Hammond, Ind.—Until Feb. 15, by Board of Public Works, for the construction of an electric light and power plant.

estal is 1 ft. 11½ ins. above the top of the curb or crown of the street. In the curb piers this pedestal has its horizontal dimensions 6 ins. greater than the column shaft. In the case of the center piers, the pedestals are replaced by a continuous base or wheel guard running the full length of the pier and built with a starling at each end.

The columns are reinforced with about 1.5 per cent of steel consisting of 1-in. vertical bars. This reinforcement is held in place by ties of ½-in. bars spaced 12 ins. c. to c. vertically. The main column bars extend from the construction joint at the level of the crown of the roadway to the top of the top girder. Each one of these column bars is wired to a footing bar which extends from the bottom of the footings to a height of 4 ft. 6 ins. above the construction joint, thus furnishing continuous reinforcement from the bottom to the top of the piers to provide for any bending moment which is likely to occur. The concrete columns are 18 ins. wide in a direction perpendicular to the center line of the roadway, except in the case of the center pier at Davis St., where they are 24 ins. wide. The dimensions of the curb columns are either 18x20 ins. or 18x22 ins. except at Davis St., where they are 18x24 ins. The center pier columns are all 18x22 ins., except at Davis St., where they are 24 ins. square. The maximum stress on the column section is about 450 lbs. per sq. in. including impact. The stress ratio between concrete and steel is 12, thus the maximum stress on the steel in compression is about 5,400 lbs. per sq. in., including impact.

Fig. 6—View of Washington Street Subway Bridge, Showing Piers and Falsework.

A footing beam 27 in. deep distributes the load of the columns to the footing slab. The top of this beam is reinforced by ¾-in. bars extending the full length of the pier, and a number of ¾-in. stirrups tie it to the footing slab. The footing slab is 30 ins. deep and varies in width according to the bearing area required to keep within the allowable unit pressure on the foundations. The slab is reinforced by transverse 1-in. bars. Four to five ¾-in. bars are placed longitudinally in the bottom of the footing to provide for possible inequalities in pressure brought about by variations in the foundation conditions, and to take any negative moment which might occur directly underneath the columns or in the side cantilevers.

The concrete for the piers, with the exception of the column shafts, is a 1:2½:5 mixture. The concrete for the column is better than a 1:2:4 concrete. Square corrugated bars were used.

The abutments are massive plain concrete construction of gravity section above the footing and have sufficient width of footing to keep the toe pressure within the allowable limit. Reinforced concrete abutments were not considered because it was expected that this work would be done during freezing weather. The abutments were figured for earth pressure (according to Rankine's theory) for a live load surcharge of 10,000 lbs. per lin. ft. of track spread over a width of 13 ft. and for the reaction of the slab spanning the sidewalk.

Fig. 4 is a cross section of the north abutment at the Chicago Ave. subway. This abutment is 21 ft. 6 ins. high from base of rail to bottom of footing, and has a base of 14 ft. 6 ins., making a ratio of base to the height of .67. The footing has a toe projection of 5 ft. reinforced by 1-in. bars. The step is added to keep the unit shear low and make shear reinforcement unnecessary. The north abutment at Church street is on piles. The rows of piles are spaced in such a manner that the load on the extreme front row will never exceed the allowable bearing value for the maximum lateral forces, and that the load on the rear row will not exceed the bearing for the minimum lateral forces. For average conditions the bearing on all piles is practically the same.

As shown by Fig. 4, a seat is provided near the top of the abutments for a width necessary to accommodate the sidewalk slabs. On either side of this seat the abutments are carried up level with the tops of the slab parapets and base of rail. The abutments which adjoin those of the Chicago & Northwestern R. R. subways have a slight batter on the front face and a coping under the bridge seats in order that the structures for the two railroads might be similar where they come into close proximity. The abutments for the other subways are made with vertical faces and without coping. The wing walls are carried out along the street line sufficiently far to prevent the slopes from encroaching on the sidewalks. The tops of the wing walls are sloped down 1½ to 1 to a height of 7 ft. above the ground and are then carried level to the end in order to match up with the 7-ft. fences. All abutments are designed with a view to providing for a future third track. The footings are built to the full width on the side upon which the future track will come and the wings are stepped down in such a way as to make the addition of future neatwork practicable.

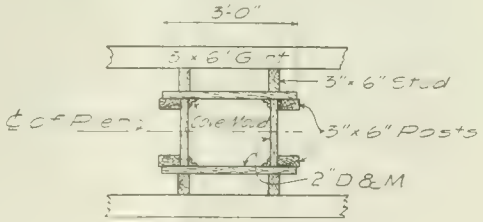

Fig. 7—Section of Column Form.

Design of Slabs.—In all the subway bridges, except Davis St., each track is carried over each span by a single reinforced concrete slab about 13 ft. wide (12 ft. 11¾ ins.). The roadway opening at Davis St. are spanned by two slabs per track. As all of the subway bridges are on a skew varying from 2° to 21° 13', the slabs take the shape of parallelograms with their sides parallel to the direction of the track and their ends parallel to the center line of the street. The outside parapets of the track slabs are carried up to the level of the base of rail and are 9 ins. wide at the top. The faces of the slabs are panelled as shown in Fig. 2. The inside parapets are made low and merely serve as curbs for the gutters as shown in the detail, Fig. 5.

The slabs are designed for a live load equivalent to Cooper's E-50 loading plus impact, and for the dead load of track, ballast and concrete. It was assumed that the entire load would distribute over the full width of 13 ft. The presence of 15 to 28 ins. of ballast and the transverse reinforcement as well as the large ratio of the thickness of the slabs to their width, makes this a safe assumption. The longitudinal tension reinforcement consists of a double row of 1-in. bars laid in a direction parallel to the track and spaced as shown in the cross section, Fig. 5. The shear reinforcement consists of ½-in. "U" stirrups, assisted by the bent up ends of a number of the longitudinal bars, as shown in the detail. The transverse reinforcement consists of ½-in. bars spaced as shown. Inverted U-shaped handling stirrups are embedded at each end of the slab in a line parallel to the track and passing through the center of gravity of the slab. A rectangular depression around the tops of these stirrups gives room for the lifting device. The ends of the stirrups are bent horizontally for a distance of 1 ft. Seven ¾-in. bars placed transversely in both the top and bottom of the slabs at each stirrup take care of cross bending stresses which occur during the handling of the slabs.

The roadway slabs 13 ft. wide vary in thickness from 2 ft. 5 ins. to 3 ft. 5 ins., making the thickness of the bridge floor from bottom of the slab to base of rail from 3 ft. 8 ins. to 4 ft. 10 ins. The sidewalk slabs vary in thickness between 1 ft. 6 ins. and 1 ft. 7 ins. The roadway slabs are given a crown of 2-ins. under the center line of track, which provides for a gutter at each side with a minimum depth of 2 ins. These gutters are sloped from the center line of the bridge toward the abutments. The sidewalk slabs are sloped 3 ins. between the curb piers and the abutments. This arrangement provides for draining the entire bridge floor in each direction from the center line of the street over the back of the abutments. The joints between the sidewalk and roadway slabs are to be sealed and waterproofed in such a manner that the water will pass over them. The section, Fig. 2, shows the arrangement of slabs and direction of drainage.

The roadway slabs at Davis St. have an over-all length of 27 ft. 6 ins., and it was found that a single slab 13 ft. wide would be too heavy to handle; consequently two slabs were used, each 6 ft. 6 ins. wide. A difficulty was encountered in the design of these slabs due to the fact that the resultant of the live load does not pass through the longitudinal center line of the half slab. On

Fig. 8—Details of Form Work for Slabs.

account of this fact the intensity of the reaction near the inner edge was increased, making it necessary to provide for a greater moment at this edge than at the outer edge. This variation of moment was taken care of, partly by varying the cross section, partly by varying the per cent of reinforcement, and partly by adding compressive reinforcement.

Construction of Piers and Abutments.—The building of the piers and abutments was difficult on account of the adverse local conditions, such as the narrow right of way (in some cases only 40 ft. wide), the frequency of the electric trains on the double track line, and the presence of the overhead trolley wires. The trains were operated at 10-minute intervals for the greater part of the day and night, the only respite being gained between the hours of 2 a. m. and 5 a. m., when the interval was increased to 1 hour.

Fig. 9—View of Slab Yard at Harvard Ave.

All excavation, driving of foundation piles, and placing of concrete footings were done, insofar as possible, before the construction of the falsework bridges and before the raising of the grade. The track was carried across the pits on wooden stringers. The foundation piles were of oak or tamarack 24 to 30 ft. in length. The standard track driver was employed and it was necessary to operate the trains single track while the driver was in a position to work. The trolley wires were thrown aside as much as possible and the interfering span wires removed. Two drivers were used, and day and night shifts were kept busy. The night crew drove the piles farthest from the center line of track because in driving such piles the swing of the driver interfered with both tracks, consequently the time of night was chosen in which the interval between trains was the greatest.

Pile trestles were put in over all crossings to carry traffic during the erection of the forms and the placing of the concrete for abutments and piers, Fig. 6.

It was found impracticable to use sectional forms for the piers to the extent planned, and only the forms for the column shafts and the centers for the arches were designed to be interchangeable. The sheeting for the column bases and the top girders was built in place. All sheeting was placed with joints horizontal and was composed of 2x8-in. lumber. Fig. 7 shows the details of the formwork for one column. The sections parallel to the side of the pier were made 3 ft. wide and braced by 3x6-in. vertical studs, and by horizontal girts running the full length of the pier. The sections for the column sides perpendicular to the face of the pier were made of the exact width of the column and fitted in between the side sections. The sheeting for these sections was nailed to 3x6-in. posts, which were offset at the bottom from shorter posts supported on the footing girder. The top posts were bevelled at the top for the 3-in. offset to the top girder, and also afforded support for the arch centers. The arch centers were made up of solid semicircles of 2-in. lumber and 1x2-in. lagging was used. The lagging was made just long enough to fit between the forms for the faces of the pier. The reverse curves at the ends of the piers were cut from 2x12-in. boards and were nailed to the inside of the side forms to support 1x2-in. lagging. Cleats were nailed across the tops of the pier forms to support the reinforcing bars in the top beam and to keep the forms from spreading. All steel was wired into place before the pier was poured. A loose board was left at the bottom of each column to make it possible to inspect and clean out the column form before placing concrete. To remove the forms it was only necessary to take off the side girts and the centering for the reverse curve cantilevers, after which the sections could be peeled from the face of the pier.

Forms for the abutments were of the Bridge & Building Department's standard type for such work, consisting of 2x8-in. form lumber supported by 3x6-in. posts spaced about 24-in. centers, which in turn were braced by double 3x6-in. girts. The forms were tied across by form-bolts and No. 10 wire.

Two alternative methods for providing the concreting plant were considered, (1) a mixer set up on the ground to handle material dumped at the site, and (2) a concreting train. The first method proposed would make construction less dependent on train service than the second and would obstruct the track only during the unloading of material. The disadvantages of this scheme, however, were numerous; the equipment could not be used continuously, the concrete would have to be raised with a derrick or wheeled into position, and at many points the right of way was hardly wide enough to provide sufficient space for the accommodation of the plant and material. The method of concreting direct from trains was adopted. To permit the use of this scheme, both facing and trailing point-switches were put in at convenient intervals along the line. With this arrangement either track could be used over the various crossings and all trains were operated single track through the block while the mixer was in use. A pilot and switchmen were used to handle trains through the block on account of the fact that there was no dispatching system. There were three concreting trains operated and two No. 1 and one No. 2½ Smith mixers were used. The mixers were mounted on flat cars in such a position that the discharge just cleared the end of the car. The number of cars of material varied—the average was three cars stone, two cars sand and one car cement following the mixer in the order named. An old locomotive boiler was mounted and hauled in the rear of the train during winter months to furnish steam for heating concreting materials.

Both chutes and wheelbarrows were used in depositing the concrete. The use of chutes was found to be the least satisfactory for piers because it required that the train be spotted at each pier in turn, while the use of wheelbarrows made it possible to concrete all of them at the same time, thus permitting the use of a larger crew and doing away with considerable switching and delay.

Construction of Slabs.—The slabs were molded in the Howard Ave. yard, Fig. 9, at the south end of the track elevation, about an average distance of one mile from their place of erection. The ground on the site was first leveled and second-hand 12x12-in. or 8x16-in. sills were laid and driven to a uniform bearing with a 65-lb. sheet pile pounder. A floor of 2x8-in. D. & M. planking was laid on the sills and the whole carefully leveled with an instrument. The slabs were cast to bring the direction of the span parallel to the joints in the floor. The forms for the face of the slab parapet were made up of 3x6-in. posts 5 ft. high and spaced 24-in. centers, sheeted with 2x8-in. D. & M. planking, which extended within 12 ins. of the top of the posts. The forms for the ends and backs were made of 3x6-in. x 4 ft. posts spaced 24-in. centers and sheeted with 1-in. S1S&2E boards. The side forms were braced to 6x8-in. timbers spiked to the projecting end of the sills. The sides were made long enough for the longest slab, but were used for the shorter slabs as well, and each side and end was built as a complete section and moved from place to place on a push car. It was found possible to use each section about 12 times, after which the sheeting was renewed. The old lumber was used for backs of walls and abutments for sheet piling. Pairs of posts in the side forms were directly opposite, and a 2x8-in. or 3x6-in. plank was spiked to their sides above the sheeting. These timbers stiffened the entire form, afforded support for the reinforcing bars, carried the forms for the back of the parapet, and sustained runways for the wheelbarrows. Fig. 8 shows these details. Blanks made up of 1x8-in. S1S&2E lumber and 1x4-in. cleats were nailed to the inside of the parapet form to produce the recessed panels in the face of the finished slab.

Fig. 10—Elevation of Slab Erecting Train.

The inforcing bars and stirrups for the track slabs were cut to the proper length and bent to the required shapes at the yard. They were hauled to the forms on a push car and wired into place. The lower longitudinal bars were first laid on wooden blocks at the required distance from the top of the floor, cross bars were next placed and wired to the longitudinal bars to act as spacers, and finally U-shaped stirrups were hooked under the

longitudinal bars at the bottom and supported by wire from the top cross pieces of the form. After all bars had been hung from the form in this manner, the small blocks were removed and the concrete was poured.

The concrete was machine mixed, a No. 1 Smith mixer being used on the job. The mixer discharged into a hopper with a gate at the lower end, and each workman loaded his own barrow by lifting this gate. The mixer was spotted each day in the most convenient location relative to the slabs to be concreted in that day's work. When the form had been filled to within about 4 inches of

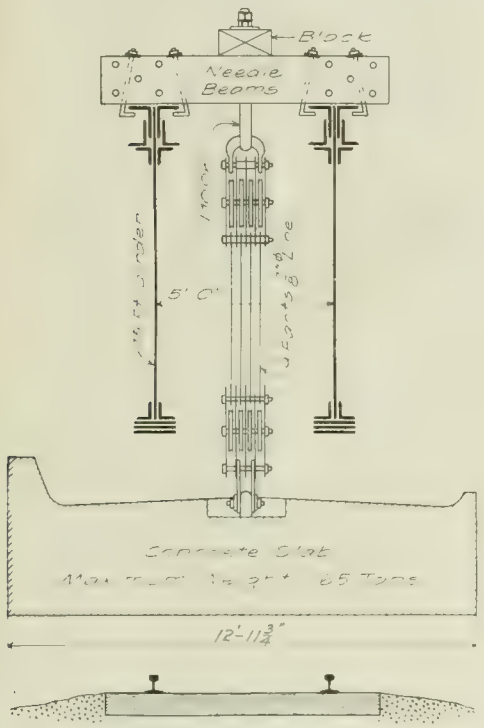

Fig. 11—Cross-Section of Erecting Girders.

the top, the supporting wires were cut and pushed down into the concrete in order that the slab might be finished to the required surface.

Erection of Slabs.—The problems involved in the erection of the slabs were the transportation from the seasoning yard to the respective bridge sites, and the placing of them in their final position; all to be done in a way to cause the least possible interference with passenger traffic. The first idea was to transport the slabs on flat cars and place them with a derrick car or wrecking crane. The company had a number of 100-ton wrecking cranes and a number of 30-to 50-ton derrick cars available, and it was found that the sidewalk slabs could be handled readily in this way. The roadway slabs, however, averaged about 65 tons each, and needed special consideration. The use of a 100-ton wrecking crane was considered first. The slabs were to be handled by means of a triangular toggle frame attached to the handling rods which were imbedded in the concrete. The frame consists of a channel strut and two pairs of eye bars which extend from the ends of the strut to a pin over the middle of the slab. This device is used by the B. & B. Department in the erection of concrete trestle slabs. The use of the device requires a reach on the part of the crane equal to at least one-half of the length of the slab, and this reach could not be obtained in this case without a considerable outhaul and alteration in the body of the car. The next scheme involved the use of two derrick cars; one at each end of the slab. The cars were to be spotted at each side of the span and the slab was to be brought up on the second track and lifted from the flat car into place. This plan would interfere with traffic on both tracks to an undesirable extent and also would require an excessive side pick with the accompanying necessity for blocking outriggers and guying towers. A scheme for bringing the slab to the bridge site between derrick cars and on the same track was suggested as an alternative and found to be better in some respects, but far from satisfactory. At this juncture an erection device was suggested by Mr. C. F. Loweth which eliminated all the uncertainties accompanying derrick car erection and it was used without any material modifications.

The general layout of the erecting device as used is shown in Fig. 10 and consists of a 75-ft. plate girder span, taken from stock and temporarily available, mounted on two steel flat cars of 100-ton capacity. The cars are spaced to permit the slab to hang between them when attached to the girders, and are provided with a special timber deck of 8x16-in. timbers securely cross braced and bolted to the car body. Transverse to this decking are two 12x12-in. bolsters carrying a bearing plate upon which the bearing plate and timber bolster of the girders is placed. A king pin was passed through both plates and bolsters and the plates were kept well greased to permit turning motion. The train pull was transmitted from the girders to the cars in each case by means of a special lower lateral system which provided a pin plate to receive the king pin. Fig. 11 is a cross section of the girders and shows the methods of supporting the slabs. Two pairs of 8x16-in. needle beams, spaced 8 ins. apart, and carrying a wooden block with hook, spanned the girders. Each end of the concrete slab was suspended from a set of these beams (see Fig. 10) by tackle made up of two 4-sheave blocks and 9 parts ⅞-in. diameter wire line. The company had two derrick cars, completely equipped with engine, rigging and tackle, which could be spared from other work. These cars were coupled to the train, one at each end, and the lines supporting the two ends of the slab were controlled by the respective derrick car engineers. The procedure in placing the slab with this device was as follows: The slab was jacked up and placed on girder carriages mounted on rails. After the erecting train had been properly placed, the girder carriage track was extended across the main track, and the slabs were rolled underneath the girders, connected, lifted and carried to the bridge site. The train was spotted in a position which would bring the slab directly above its final bearings, the track was removed, the falsework was torn out, and the bridge seats were prepared with a stiff cement mortar. When all was in readiness the slab was carefully lowered into place. By making the mortar of the right consistency and thickness, and by raising and lowering the slab a few times, it was found possible to bring the thickness of the bed to the required dimension and to line up the adjacent slabs in a very satisfactory manner.

Retaining Walls.—The right of way of the C. M. & St. P. Ry. through Evanston varies in width from about 40 ft. to about 115 ft. The two tracks were elevated to an average height of about 17 ft. above the natural ground surface, and, as mentioned before, provision was made throughout the work for the probable future addition of a third track. With these conditions existing, it would have been necessary to build a retaining wall along at least one side of the right of way for practically the full length of the track elevation, if it had not been for the fact that the right of way of the Chicago & Northwestern Railway adjoined that of the C. M. & St. P. Ry. for a large part of the distance. The two railway companies entered into an agreement in advance of the work, by the terms of which the space between the shoulders of their respective embankments was to be filled to the level of the tracks, and the cost of about 8,000 ft. of full height retaining wall saved to each of the companies.

There is in all about 4,500 ft. of retaining wall in the track elevation work, the walls varying in height, above the ground surface, from a mere curb of 3 or 4 ft. to the full height of the embankment. With a few exceptions, the walls were of the ordinary plain concrete gravity section similar to the abutments. This type was considered an advisable one on account of conditions beyond the control of the designer. Rankine's theory of earth pressure was used in designing for the lateral forces. The effect of the live load surcharge was calculated on an assumption of vertical spread through the embankment. A maximum toe pressure of 1¾ tons per sq. ft. was adhered to. As a general rule the walls were constructed in alternate sections; the sections are approximately 25 ft. in length and the construction joints are marked with a V-groove. The appearance of the walls is improved wherever possible by the addition of a coping and rectangular recessed panels. In cases where it is desired to provide for a future increase in height which might be made necessary by the shifting or addition of tracks, the design of the footings was modified and a heavy step is added to the back of the neatwork in order that any future extension will require a minimum of excavation and give the greatest stability to the final wall.

There were a number of inclined teamways required by the Chicago & Northwestern Ry. adjoining the right of way of the C. M. & St. P. Ry. and at these points it was necessary to build retaining walls. These teamways are on a 5 per cent grade, making a total length of about 265 ft. of wall necessary in each case. The height of the teamway varied from the street grade to the full height of the track elevation work. As the C. M. & St. P. Ry. found it necessary to place its embankment before the fill for the teamway was made, a wall founded on the natural ground and capable of sustaining the embankment without front support was required. With the teamway in place the difference of the elevation of the earth on the two sides, and therefore the overturning moment, for that part of the retaining wall at the upper end would be small, and the lower part of the wall would be buried and useless. On account of this fact the design adopted as the most economical one under the circumstances shows a full height solid gravity retaining wall to a point 90 ft. from the summit of the teamway. The wall beyond this point consists of a curb coming 3 ft. below the final surface of the teamway and supported on buttresses. The curb wall was reinforced as a beam to carry its weight between piers and was made of a section sufficient to give it stability in itself. The buttresses or piers and their footings

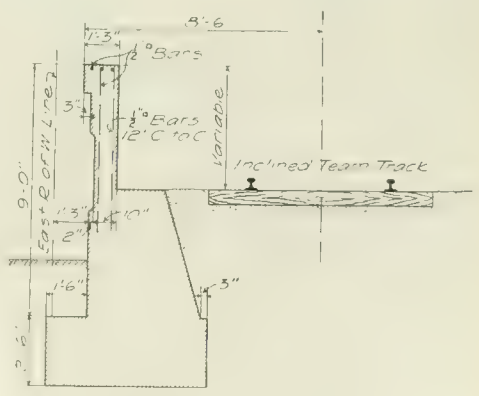

Fig. 12—Section of Wall Along Chicago Avenue.

were proportioned to sustain the entire structure when under the action of the back fill before the teamway was in place without exceeding the allowable pressure on the foundations.

The ordinance required a concrete wall or fence 7 ft. high for a distance of about 1,550 ft. along Chicago Ave. where the C. M. & St. P. Ry. was permitted to extend its right of way to the curb line. This wall is of variable section depending on the grade and the position of the nearest track. From Madison St. south there are two team tracks parallel to Chicago Ave., rising on a grade of

0.5 per cent. Fig. 12 is a cross section of the wall at this location showing the method of providing for the 7 ft. height required by ordinance. The opening and paneling shown serve to break the monotony of the long stretch of concrete surface in a rather satisfactory manner. The coping is continuous and the panels are 9 ft. in length by 3 ft. in height, the spacing between panels being 3 ft. 6 ins.

The form work for retaining walls was of the department's standard type as described in connection with the construction of abutments. There were several cases, however, where the location of the tracks made it impossible to support the forms by the usual outside braces, and in these cases the rather unusual expedient was adopted of tying the side forms to bolts embedded near the opposite edge of the concrete footings.

The concrete for retaining walls at some distance from the track was placed by means of a stiff legged derrick mounted on a flat car of the concreting train and carrying a concrete bucket designed by the department for this special purpose. Fig. 13 is a detail of the bucket. It has a conical shape and is made up of sheet steel plates. A sliding discharge gate at the small end is controlled by a handle and a system of levers. The position of the levers and the gate while concrete is being discharged is shown dotted in the figure. This bucket proved especially convenient in discharging into narrow openings, and was very easily controlled.

Mr. Griefenhagen in his paper dwells somewhat at length on the design and construction of the stations. The problems were somewhat special and few readers of ENGINEERING-CONTRACTING will be interested in them. The paper will be published in full in the Journal of the Western Society of Engineers.

The grading and paving of the subways and station approaches were done by contract, with brick on a 6-in. concrete base, expansion joints being provided at 40 ft. intervals.

The actual track raising was begun in the spring of 1909 and was carried on by the engineering department. To facilitate the handling of material a temporary yard was built at Howard Ave., and the engines on the work usually tied up in this yard at night, thus eliminating delay on account of the late arrival of motive power. Side dump cars were used throughout the work and all material was unloaded by hand. About 300,000 cu. yds. of material were used for the entire work. It consisted of sand and gravel hauled from the Fox Lake region.

The scheme of raising tracks was according to the usual methods. One track at a time was thrown out of service, cars were emptied, the material leveled and the tracks were raised about 6 ins. to 8 ins. ready for the next load of fill. When the difference in elevation of the two tracks became about 2 or 3 ft., the traffic was shifted and the low track raised.

Owing to the narrow right of way the problem of raising the tracks at some places was quite complicated, especially where space had to be left for walls which could not be completed before the elevation was begun. At such points a system of bulwarks was employed. The work over Main St. is typical. Retaining walls were required on both sides of the right of way north of Main St. and on the west side south of Main St. The tracks were first raised about 4 ft. over the crossing and temporary bridges put in to keep the street open for traffic. North of the crossing the west track was raised as high as possible without interfering with the operation of the east track. Then the east track was thrown out of service in its turn and elevated, and a falsework bridge was put in across the street. Solid piles were driven on both sides of the track north of the bridge for a distance required to prevent the slopes of the embankment from blocking the west track and northeast wall location. These side piles were from 22 to 30 ft. long and had from 10 to 18 ft. penetration. They were driven about 7 ft center to center and old ties were thrown in behind them to retain the fill. It was found that after a time they began to spread and consequently were tied together by a number of strands of No. 10 wire running through the embankment just below the track.

The backs of abutments and retaining walls were not waterproofed. The fill was drained with 6-in. tile laid along the back of the walls, one drain served for retaining walls, but two lines were laid behind abutments, one near the bottom and one near the top. Tile pipe laid between the tracks drained the subgrade. A combination manhole and catch-basin with about 3 ft. interior diameter was placed behind each abutment. All drains were carried into the nearest catch-basin, and the catch-basin in turn discharged into the city sewers through a 9-in. pipe. The subways are drained by suitable inlets which were in all cases located at some distance from the street intersections in order that the depth of gutter and the step at the sidewalk crossings might be as small as possible. The gutter grates were of the "Duplex" type. There was a catch-basin located at each inlet and one manhole in each subway.

The design and construction of the subway bridges, retaining walls, concrete work connected with the stations, station buildings and platforms, as well as the street paving and drainage for the entire track elevation work, were executed by the Bridge and Building Department of the Chicago, Milwaukee & St. Paul Ry. under the direction of Mr. Loweth, engineer and superintendent. The filling and track work were done by the engineering department of the company. With the exception of a few minor contracts, all of the construction work was done by the Bridge and Building Department's forces. The construction and design, respectively, were, in a general way, in charge of L. D. Hadwen and J. H. Prior and were directly in charge of R. J. Middleton and of E. O. Greifenhagen.

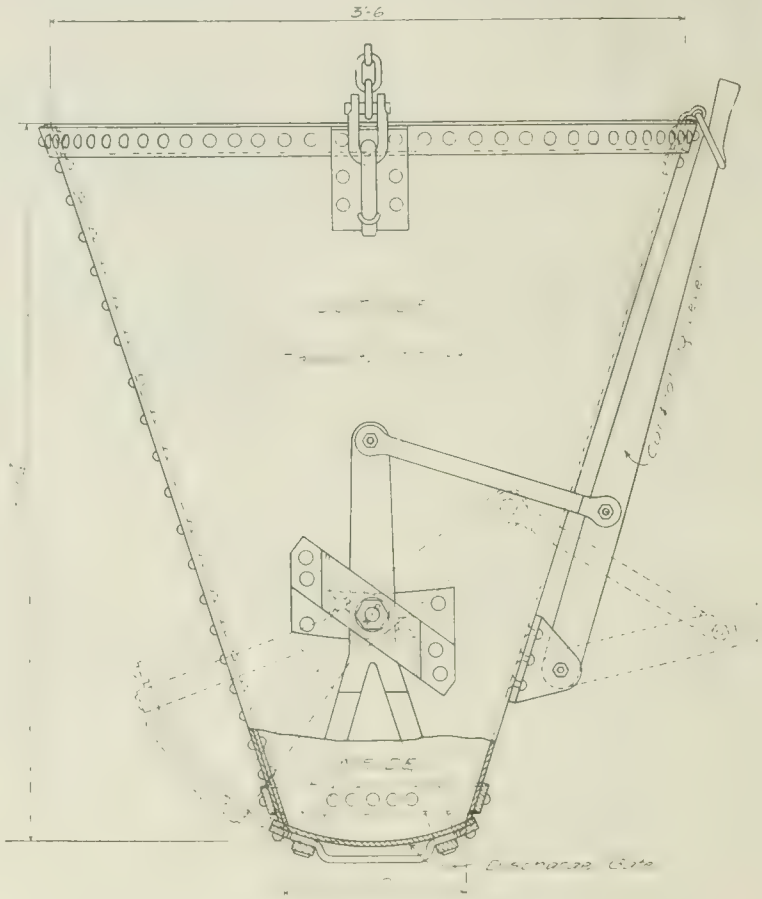

Fig. 13—Side Elevation of Concrete Bucket.

Annual Meeting of the Ohio Engineering Society.

The annual meeting of the Ohio Engineering Society was held at the Great Southern Hotel, Columbus, O., Feb. 8, 9 and 10, 1910. President C. J. Peters of Tiffin, presided throughout the sessions. The attendance was large and enthusiastic, and about 30 applications for membership were favorably acted upon, making the total membership of the society about 250. The report of the secretary-treasurer showed a prosperous condition.

Considerable time was spent in the consideration of the proposed bill now pending in the state legislature, providing for the appointment of a State Board of Registration and Examination for civil and mining engineers and surveyors. It is believed that this bill, for which the engineers of the state have been working for several years, has an excellent chance of favorable consideration by the legislature.

The sessions opened on Tuesday, February 8th, with an address of welcome by Hon. George S. Marshall, mayor of Columbus, who referred in complimentary terms to the work of engineers employed by that city in designing and construction of the water and sewage purification plants and the garbage reduction plant now under construction, and extended the usual felicitations.

President Peters, in his annual address, offered numerous suggestions for the betterment of professional conditions in the state, and urged the policy of more aggressive self-assertion.

Mr. T. C. Connar, mining engineer of Zanesville, read an original and somewhat unusual paper on the origin of weights and measures, tracing the connection between the modern units and ancient Egyptian and Hebrew standards, in a very ingenious manner.

Professor John R. Chamberlin, of the Ohio State University, described at length the Cerro de Pasco Railway in South America. The road is about 80 miles in length, having a maximum curvature of 16 degrees and approximately 2 per cent average grade.

An interesting paper entitled "Some Principles Governing the Design of Small Sewage Purification Plants," was read by Paul Hansen, acting chief engineer, Ohio State Board of Health.

Mr. George P. Shute, of the firm of Bradbury & Shute, civil and sanitary engineers of Columbus, contributed a description of a small waterworks system installed under his supervision at Medina, Ohio. The source of water is a gravel bed underlying the Rocky River, at a distance of 2½ miles from the village, the water being collected by an

open joint tile and lifted to a standpipe 290 ft. above the pumps; the pumping outfit being of the producer gas type. A special feature to which attention was called was the economical operation, the present operating cost being about 3½ cts. per 1,000 gals., or less than one-third the average cost of supplying of water to municipalities of comparable size of the state. The quality of the water is excellent, being soft and free from any contamination of consequence.

Mr. George J. Bock, Jr., contracting engineer of Coshocton, discussed the relation of the engineer to the contractor from the standpoint of the latter. Mr. Bock traced much of the friction betwen engineers and contractors to improper specifications or incompetency on the part of the engineer. A lively discussion followed the expression of his views during which many instances were given tending to show that the fault was not always with the engineer.

Mr. James C. Wonders, State Highway Commissioner, spoke on the subject, "Proper Types of Roads."

A report upon the use of Road Preservatives and Dust Suppression Materials in Hamilton County, Ohio, was read by Colonel J. M. Harper of the Committee on Highways. Tarvia has been used as a preservative on 13½ miles of macadam roadway and asphalt oil as a dust eliminator on 45½ miles. The use of these materials is reported to be satisfactory. The specifications provide for the application of from 2 to 2½ gallons of Tarvia per square yard, which was paid for at a uniform price of 25 cts. per square yard, including application. Roads treated 18 months ago, subjected to heavy traffic, are reported to be in as good condition as when built. The application of oil cost on an average of 2.9 cts. per sq. yd. Methods of application were described in detail and specifications quoted.

A paper on Road Construction in Hamilton County, Ohio, by Clinton Cowen, County Surveyor, was also read. An interesting point brought out in this paper was the greater cost of maintaining macadam roads in this latitude than is the case either farther north or south, owing to the alternate freezing and thawing so frequent during the winter season.

Mr. Frank R. Landers of Cleveland, County Surveyor of Cuyahoga County, described the extensive road improvement of that county, giving a historical sketch of the development from the old plank road through the evolution period to the present system of paving with brick. The development of the road laws of the state was mentioned.

Mr. D. W. Seitz, Assistant State Highway Commissioner, described the experimental road recently constructed by the State Highway Department, near Columbus.

Mr. Frank M. Kennedy of Washington, C. H., read a paper descriptive of a flat slab reinforced concrete construction for road crossings over small waterways.

An exhaustive description of the Rocky River bridge at Cleveland, Ohio, was given by Mr. A. M. Folgate. The principal features of this bridge are the design of the main arch with a span of 280 feet, the method of raising the compressive strength of the concrete by the introduction of embedded stone slabs, and the arrangements for the centering used during the erection of the main arches.

The use of automatic siphons and air lock apparatus was described and explained in detail by Mr. E. G. Bradbury, M. Am. Soc. C. E. The various types of siphons were illustrated by charts. Remedies for defective operation were suggested.

The convention closed with a most enjoyable banquet, at which Col. J. M. Harper of Cincinnati, acted as toastmaster.

The following officers were elected for the ensuing year: E. G. Bradbury, Columbus, O., president; John Laylin, Newark, O., vice president; C. J. Knisely, New Philadelphia, O., secretary-treasurer; J. M. Harper, Cincinnati, O., F. J. Collarius, Dayton, O., A. F. Cole, Marietta, O.; and B. E. Trask, Granville, O., trustees.

Earth and Rock Section

Note: This section is devoted to methods and costs of excavating earth and rock and building embankments. It will cover the grading of roads and railroads, diking and canal work, dredging, building reservoirs and earth dams, sewer and water pipe trenching, quarrying, etc.

Methods and Cost of Hydraulic Filling at Cairo, Ill.

BY JEAN M. ALLEN.*

A notable job of hydraulic filling is now in progress at Cairo, Ill. This city has a large acreage of "low areas" resulting from the building of levees and the establishment of the city grade from 6 ft. to 9 ft. above the original ground, and this low ground has been a handicap to the physical development of the city. In the early days a large amount of the low ground was filled in by hauling in material by teams. The fact, however, that there was in the Mississippi River just back of the city and within a mile of the lowest areas a large sand bar suggested the practicability of hydraulic filling and in 1906 a local company, with a capital stock of $30,000, was organized to take up this work and contracts amounting to approximately 500,000 cu. yds. were taken. Of this amount about 270,000 cu. yds. were for the filling of the terminals of the Cairo & Thebes R. R. and about 230,000 cu. yds. for filling the low streets of the city. This company was originally the Cairo Contracting & Dredging Co., but was later reorganized as the Cairo Sand & Gravel Co., which company is now carrying on the work.

There seemed very few data available on a plant of this kind. Some of the builders of standard dredging pumps declared that the proposed heads were excessive and declined to submit bids on the equipment. A somewhat similar plant found working in Kansas City, was carefully studied and much valuable information gained therefrom.

The following was the plant eventually decided upon and installed: A floating dredge was installed in the Mississippi River adjacent to the sand bar. It was connected to the bank by a pile trestle extending into the river a distance of 100 ft. and by a rigid pontoon line 160 ft. long connecting the boat with the trestle. (Fig. 1.) Articulations at the connection of the trestle with the pontoons and of the pontoons with the bow of the boad enable the suction pipe, located at the stern of the boat, to pump sand from any point in the interior of a semicircle whose radius is 380 ft.

On the boat was installed a 12-in. centrifugal dredging pump of a standard make with a 32-in. runner. This pump was belted to a 20x24-in. slide valve engine. Three "Mississippi River" boilers, each 44 in. in diameter and 22 ft. long, supply steam at a pressure of 140 lbs. To save time necessary to construct a hull for the dredge a river tow boat 141 ft. long, 26 ft. beam and 4½ ft. deep was secured and the dredging machinery placed upon it. The boat's original boilers, feed pumps and capstans were utilized in the dredging equipment. The suction pipe passes over the stern of the boat and is raised and lowered by a small hoisting engine. In high water periods this suction pipe is about 50 ft. long. (Fig. 3.)

A shore pumping plant or "booster" plant was located just inside the levee at a distance of about 1,800 ft. from the boat. The pump and engine are duplicates of those on the boat. Steam is furnished by two standard tubular boilers 76 ins. in diameter and 16 ft. long. The discharge pipe from the boat plant connects directly to the suction of the shore plant

Fig. 1—Map of Portion of Cairo, Ill., Showing Areas Filled by Hydraulic Filling Plant.

*Superintendent Cairo Sand & Gravel Co., Cairo, Ill.

pump. Both boat and shore plant use the Mississippi River water for boiler feed and both plants run non-condensing.

The length of the pipe line from the shore plant to the discharge was about 1,300 ft. when the filling commenced and has been increased to 4,400 ft. with the progress of the work. All pipe used except the suction and pontoon pipe is 12-in. spiral riveted pipe, asphalted. Nearly all the pipe is No. 12 gage, but on the end of the discharge line where the pipe requires frequent handling and lightness is a prime consideration, some No. 14 and 16 gage is used. (Fig. 4.)

Fig. 2—Pontoon Line Supporting Pipe Carr ying Dredged Material.

A private telephone line connects the boat, shore plant and end of discharge pipe, and by it the suction operator is kept constantly informed as to the percentage of solids carried in the water and is thus enabled to regulate the supply. It may be mentioned here that the surplus water finds its way to the river by means of the city sewers.

The original estimates of the cost were somewhat exceeded and $42,000 was expended on the plant before it was ready for operation.

The plant was started late in the season of 1907. A number of difficulties developed after the plant had been in operation a short time. The most serious was the rapid wearing of the shells of the dredging pumps. These were of cast iron and not very thick and it was found that every 15,000 cu. yds. pumped required a new set of shells at both the boat and the shore plant. This extreme wear was due in part to the quality of the material handled. The Mississippi River sand is very coarse and sharp. The high speed at which the pump had to be driven caused the shells to cut out faster than most sand pumps. It was found that, at low water periods and when pumping to the most distant areas a peripheral speed of the runner of about 5,500 ft. per minute had to be maintained to produce the required velocity in the pipe. Considerable trouble was experienced with the pump shafts as they wore very fast in the stuffing boxes and finally broke. As the pumps were of the side suction type great trouble was experienced in caring for the end thrust of the runner.

A great deal of time and money was spent in the endeavor to produce a pump more suitable for the work. Pumps with larger diameter runners, and with renewable liners in the shells were tried and at length a pump was evolved that gives very good satisfaction. The present pumps, which were designed and built specially for this work, are of the double suction type to obviate the end thrust. The runners are built up of steel casting and ¾-in. boiler plate and are 52 ins. in diameter. The shaft is 6 ins. in diameter.

The shells are concentric with the shaft and are heavy steel castings. The inside dimensions are 6 ft. in diameter and 10 ins. wide. The metal in the shells is 1½ ins. thick on the sides and 2 ins. thick on the circumference. These pumps have given excellent service. A pair of them has pumped 80,000 cu. yds. of sand and it is estimated that a pair of the steel shells will deliver 200,000 cu. yds. before wearing through.

The 22-in. belts connecting the engines and pumps gave a great deal of trouble. Canvas, rubber and leather belts were tried, but none would stand the severe service. At last a wire rope drive was installed in both plants. This drive consists of the ordinary grooved pulleys and ten parts of ¾-in. wire rope. Each strand of the wire is served with marlin which produces a very flexible rope. This transmission has given excellent service and has caused no trouble since its installation. (Fig. 5.)

The periods of unusually high and low water experienced the last two years have proven a great handicap to the work. At the extreme low water, which has lasted for two or three months in the fall of the year, the sand bar is entirely dry and the boat is aground and cannot be moved to secure a supply of sand. Again at high water which is sometimes 45 ft. above low water, the land outside the levee and the trestle work to which the pontoons connect is from 6 to 10 ft. under the water. The running ice which fills the river during January and February makes it dangerous to work during those months. These conditions render it necessary to suspend operations for at least six months out of the twelve. The plant has been averaging about 30,000 cu. yds. per month when running, and, up to date, about 340,000 cu. yds. have been moved.

A set of observations of the working conditions were taken December 4, 1909. The elevations and locations of suction and discharge pipes were about as shown in the accompanying map, Fig. 1.

Fig. 3—Suction End of Boat Pumping Plant.

Fig. 4—Method of Supporting 4,400 Ft. Pipe Line on Shore.

BOAT.

Engine	132 R. P. M.
Pump	352 R. P. M.
Indicated horse power	321
Pump suction	15 ins. vacuum
Pump discharge	60 lbs. pressure
Steam pressure, boiler	138 lbs.
Coal consumption	About 1 ton lump per hour

SHORE PLANT.

Engine	140 R. P. M.
Pump	384 R. P. M.
Indicated horse power	365
Pump suction	4 lbs. pressure
Pump discharge	82 lbs. pressure
Steam pressure, boiler	130 lbs.
Coal consumption—About 0.7 lbs. screenings per hour.	

The velocity of the water was not determined accurately, but was about 10′ per second. The percentage of solids carried is also difficult to determine for the reason that a

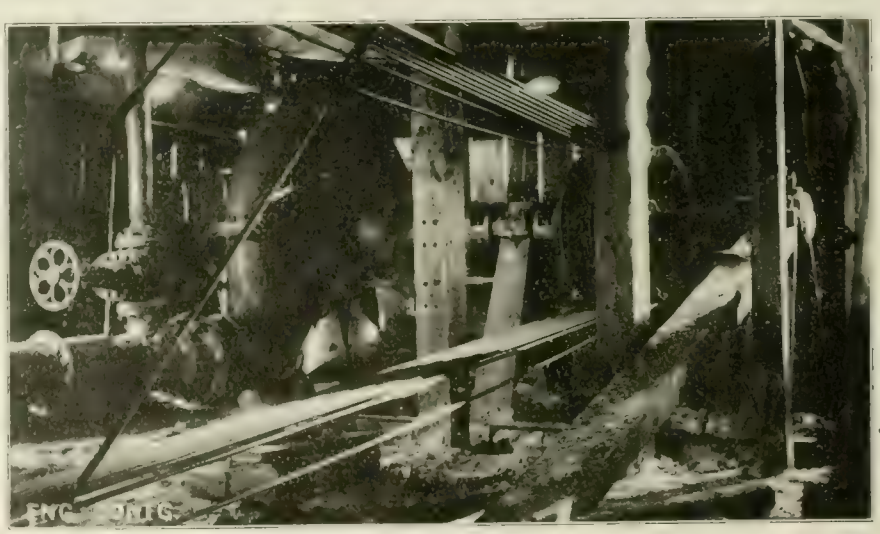

Fig. 5—Interior of "Booster" Plant on Land, Showing Pump and Wire Rope Drive.

few hundred feet away from the pumps the sand settles to the bottom of the pipe, and while from 10 per cent to 20 per cent of the cross sectional area of the pipe may be filled with sand, this sand travels at a much slower velocity than the water. The average amount of solids delivered per hour is about 65 or 70 cu. yds.

About 16 men are required on the day shift and about 14 on the night shift. The weekly pay roll amounts to about $500. An extract from the report of October, 1909, is an average performance and may be of interest:

Total yardage pumped		33,577.9
Total hours run		515
Yards per hour		65
Expenses—		Per cu. yd.
Fuel	$1,630.36	$0.0482
Labor	2,011.45	0.0599
Repairs	277.17	0.0082
Oil	75.39	0.0022
Office and sundry	269.88	0.008
Total	$4,264.25	$0.1265

This statement makes no allowance for interest, depreciation nor insurance.

The contract price on the above work is from 24 cts. to 30 cts. for the railroad work and from 28 cts. to 44 cts. for the city work—the latter payable in bonds.

A feature of the work which may be of interest to some is the method used in building the levees to confine the material within the desired areas. At first the levees were thrown up of earth by means of slip scrapers, but later they were built of sand directly from the pipes by what are termed "shutter" or "slide pipes." A number of lengths of the regular discharge pipe are provided with openings on the lower side about 3x4 ins., the 4-in. dimension being crosswise of the pipe. These openings are spaced about 3 ft. apart in the pipe and are closed by suitable sliding plates of No. 8 sheet steel which work in grooved castings which bolt over the openings in the pipe. (Fig. 6.) When one or more of these slides are opened the sand issuing from them is of the consistency of mortar and builds up very steeply. It is possible with a little care in operation to build up the sand to a 1:1 slope on the outside of the fill. If the slope is too steep the slides may be opened wider and some water allowed to escape which flattens down the slope to any extent desired. (Fig. 7.) The end of the discharge pipe is continued some distance away so that the water therefrom will not interfere with the levee building.

In making the levees in this manner advantage is taken of the fact that the heavy sand in long pipe lines is not carried in suspension by the water, but moves along the bottom of the pipe, three or four inches deep, and at a much slower velocity than the water. The action is very much like waves, there being alternately high and low places, the higher material being continually removed and carried forward to a depression. This peculiar wave-like action of sand transported in water is dealt with in many U. S. Government Engineer reports and in Johnson's Surveying.

During the present winter the boat plant was badly damaged by floating ice and plans are now under way to place the machinery on a specially built barge and it is also intended to put surface condensers in both plants. It is expected that this will result in decreased coal consumption and also in increased capacity, as in the past it has been necessary to wash boilers about every five days, causing a loss of from 12 to 16 hours at each washing.

Fig. 6—Method of Building Levees to Retain Sand Fill.

Sanitary Considerations in the Establishment of Contractors' Camps.

The housing of large bodies of men as in the construction camps of contractors is at-attracting more and more the attention of sanitarians. In the state of New York regular investigations are made into the state of the camps with a view to minimizing the danger to surrounding communities. It is a well known fact that a disease resembling small pox has swept over sections of country in which heavy construction work has been going on for some months and the cases of infection have been traced to contractors' camps. Typhoid fever, and in earlier days typhus, have been traced to workmen's camps. Some English papers have lately referred to the attention now being paid to "navvies" camps in Great Britain and the more strict supervision of such camps is being urged there.

Apart from the danger to health of the community in the immediate vicinity and to the pollution of water supplies of communities located on streams that might be contaminated by the refuse of camps, is the question of comfort for the men themselves. The standard of living everywhere is being raised now and unless there are some comforts provided for the men they prefer to loaf in towns and cities where the moving picture machine vies with the saloon as an attraction and the flaming arc is more attractive than the dirty, smelling oil lamp of the bunk house. Formerly men complained of the food because it is in the nature of men to complain when herded in bodies, and now they even complain if the camp is not clean and sanitary. They have read so much about microbes and germs that they exaggerate the dangers to themselves of unsanitary surroundings and a bad camp is now worse than a poor camp in the minds of some.

In the first place the camp should not be selected alone for convenience, but it should be selected with a view to good drainage. The site should be somewhat elevated above the surrounding country, so it cannot be inundated by near-by streams or by rains. The writer has a number of times been obliged to turn out in the night and hold a tent in a driving rain while the other fellows dug trenches around it to keep the rain from wetting everything inside. In after years when he was in charge himself things of that sort never happened. In even a temporary one-night camp the site for the tent was carefully selected and everything made snug before nightfall. But we are not considering temporary camps of one-night stands. The fault is common with contractors camps, whether tents or shacks are used, of selecting some place convenient to the work and a little off the line of the work, and erecting the domiciles for the men, regardless of whether the ground is well drained or capable of drainage.

The camp site should not be under large trees, but rather should be in a sunny spot. There should be no low lying ground near by nor should there be swamps. Of course these points cannot always be guarded against, but they should be taken into consideration, and the best that can be done under the circumstances in selecting the camp site should be done. When near streams it is an excellent idea to camp above high water line and away from mud flats. Plenty of air and sunshine are wanted. The presence of stagnant water means that mosquitoes will breed and possibly some varieties will appear that may carry infection from man to man. When flies appear in great numbers it is a foregone conclusion that the sanitary conditions are bad. Some men believe it is not a bad idea to have plenty of flies around, as they are scavengers. Flies are certainly scavengers, but they are really a warning sent out that health conditions are bad and growing worse.

Tents should not have earth floors, nor should shacks have earth floors. There should be a space underneath for a free circulation of air. If it is not possible to have floors in the tents or buildings, then by all means build cots for sleeping purposes, so that no man will be obliged to sleep next the ground. When temporary camps are used

Fig. 7—Slope of Levees Built by the Bottom Sand Gates in Pipe Line.

every man should have under his blankets a thick layer of straw or boughs of trees. During the daytime the walls of the tents should be raised to permit a free circulation of air and buildings should be provided with means to secure a free circulation of air close to the floor.

Catarrhal complaints arise when men are compelled to sleep night after night in unaired blankets. It has been found that mattresses make men more comfortable than blankets only, and some sort of mattress should be supplied every man. Blankets may be piled on top of a man until his bones ache with the weight, but if there is not a comfortable thickness of bedding underneath he will be cold and the cold will likely develop into catarrh. When, however, mattresses are used there should be a careful and frequent examination made of them. If the mattresses are simply bags filled with straw they should be emptied and washed at least once a month or vermin will appear.

All buildings should have plenty of windows and there should be openings in the walls near the roof, so that air and sunshine may be obtained. During the day the windows and ventilating openings should be kept open for ventilation. If there are no watchmen and thieves are feared the openings should all be protected with heavy netting. The fear of thieves should not prevent the securing of a change of air after the men leave. It is one of the hardest things in the world to make the average laborer sleep with open windows, for this class of men is generally afraid of night air. Therefore during the day when the men are out, the buildings should be well aired.

A camp usually consists of a number of bunk houses in which there is a stove, generally in the center of the room, a table or two, some benches along the sides of the lower bunks, and around the room tiers of bunks. Men who prefer to go to bed early will get into their bunks, where they often lie and read and smoke by the light of a candle or poor oil lamp. The men who sit around on the benches and talk are also smoking. The men who are reading are smoking. The men playing cards at the tables are smoking. All windows and doors are closely shut and the air is so thick that it is hard to see and the eyes water when first one enters the room. Very often the odor is stifling, especially when the stove is red hot and the men are vying with each other as to who can spit the straightest at the hottest spots.

The writer believes this system is bad. There should be a common room apart from the sleeping apartment and communication between the two should be by a porch. In other words the two rooms should be separated a few feet and the men in passing from one to the other should be compelled to pass through the outer air. It will do them good and can do no harm. Of course, the passage way may have a roof, but it should have no sides. The common room should have tables and plenty of chairs and benches, so that all the men may be accommodated there. The men may smoke and read and play cards if they desire. In some cases it is really advisable to have something like the old style army canteen in connection with the camp. The men can secure light drinks of beer, coffee or tea; tobacco and all the profits of the canteen to go towards a premium account. This premium may be divided among the men in proportion to the number of hours time they have put in during the month, in addition to their regular pay. Of course, strict regulations would have to be enforced to prevent the men getting enough liquor to get drunk, but this is a matter of detail, to be arranged for each camp or contractor. The men who are employed by contractors who house their employes in camps are of a wandering nature and some premium device might work to hold them.

The sleeping rooms should be kept clear of smoke. A rule should be strictly enforced that the sleeping rooms are for sleeping purposes only and no smoking or talking above a whisper should be permitted. They should be aired daily and swept daily. At least once each month the mattresses should be changed and the bunks at that time given a thorough cleaning and the insides of the bunks should be whitewashed occasionally. Stoves should not be permitted in the sleeping rooms except in very cold weather. Lines should be provided in the aisles between the bunks so that each morning when the men arise they will hang their bedding on the lines to air during the day, and thus the bedding cannot collect dampness from perspiration, to give the sleeper catarrh and rheumatism. The writer has had several camps where such regulations were in force and has found the men more than willing to do their share when they found it was the rule.

There are some men who delight in being filthy and who are proud of the number of days they can go without a bath. They take a particular delight in telling stories at meal times that will turn the stomach of a squeamish man and the tales they tell about the condition of the clothing in contact with their skin are not pleasant. Such men are seldom good workers and are not favorites with the majority of their fellow workers. They should be discharged as soon as possible. Some attention to comfort of the men will result in a camp getting a good name and from such camps there is no cry of a scarcity of labor. The average farmer boy does not like to herd with the common run of laborers to be found in construction camps, but in decently ordered camps it is no trouble to draw upon the surrounding farms for a large proportion of the labor.

The question of water supply is a most important one in establishing a camp. A spring is no whit better than its surroundings and the springs in the vicinity of a construction camp should be carefully investigated. They are only overflows of ground water, and ground water is easily contaminated. In a lava or in a limestone formation, where great cavities are found in the country rock it is almost impossible to find good springs if the surrounding country is well settled or in the vicinity of sheep camps or cattle ranges. In a sandstone country, in shale, or granite the springs may be safer, but springs are as a rule pretty poor sources of water supply.

The little mountain stream may be pleasing to the eye but a trip should be made for several miles up the stream above the camp before deciding upon it as a source of water supply. The river and the lake have the same objections that the stream may have, and wells are of course only springs. As a matter of preliminary treatment of water it is a good plan to dig a hole about 15 or 20 ft square and about 4 ft. deep in the ground near the water. In the middle set a barrel with a great many holes bored in the side. On the outside of the barrel place pieces of broken burnt clay, charcoal and stones that will pass through a 1 in. mesh, this material to be about 6 in. thick around the barrel. One way to hold it is to place 6 in. outside the barrel a wire netting with ½-in. mesh and fill the space with the clay, stone and charcoal. Then fill the rest of the excavation with coarse sand. Make a connection with the water so that it will fill this bed of sand and seeping through it get into the barrel, from which all the water used in the camp shall be taken. Several of these sand filters may be put in, and while they clog after awhile, still, for the short time a camp is used, they are a pretty fair substitute for a good spring. In the kitchen there should be a Forbes water sterilizer, or all the water should be boiled and the men instructed to drink only the sterilized or boiled water. The barrel of course should be screened, and so should every open receptacle containing water. If the country is subject to frequent rainfalls it will certainly pay to make some provision for saving the rain water.

In the greater number of camps the men do their own washing, Sunday being wash day. To prevent contamination of the water supply and to encourage the men to wash their clothes some conveniences should be supplied. There should be a place provided where the work can be done conveniently, and, if on a running stream, the place should be below the source of water supply. It is, of course, very desirable that there be plenty of running water and if the water supply for the camp can be procured at a point considerably higher than the camp site so a flowing stream can come to the camp, it will be easy to arrange so that a small stream can be diverted through a spot arranged conveniently for laundry work. A plant of this kind once arranged consisted of a long bench above which ran a small flume, having holes bored in the bottom at regular intervals, closed with wooden plugs. On the bench the men set metal wash tubs, furnished by the contractor, and these tubs were filled by pulling out the plugs in the flume. A waste flume ran underneath the bench so it was an easy matter to change the water and dispose of the waste without causing much sloppiness in the camp. Poles with metal clothes lines were erected close by and the men all took pleasure in the comforts never before enjoyed in such camps.

Waste is a matter not hard to take care of. It consists of combustible matter, such as paper, etc., of which the men in camp individually contribute a great part. There should be boxes placed at certain buildings and the men urged to throw waste paper and old clothes into these boxes. In addition there should be a man employed during the day to look after waste and garbage.

Combustible waste is readily disposed of by merely taking it to a convenient place and burning it. This should be done frequently. There is also incombustible waste such as tin cans and bottles. Most of this will come from the kitchen, but a little will come from the bunkhouse. It is not dangerous, but is unsightly and should be thrown into some convenient ravine or into a hole and buried. Of course when thrown into a ravine it should be cast into one that drains into the stream below camp. The incombustible matter is collected and taken out of sight merely as a part of the scheme to make the men adopt a decently high standard of living.

A third kind of waste matter, furnished almost entirely by the commissary department, is putrescible, or what is generally termed garbage. The best way to dispose of garbage is to plow a piece of ground and allow it to stand. Each day the garbage should be taken to it and laid in one of the furrows when men with shovels will throw dirt from the next furrow to cover it. The covering should be thin but complete. Nitrifying organisms will attend to its disposal and the covering of earth will prevent the breeding of too many flies. If the camp is a pretty good sized one it might pay to construct a furnace in which to burn all garbage and combustible waste. Usually, however, there is so much moisture in garbage it pays better to bury it and the combustible waste may be burned in the open without a furnace.

The waste matter most dangerous to the community is human excreta, and when this question is reached we have to pause. Privies in construction camps are a frightful nuisance. If none are provided the whole camp becomes so filthy as to render it dangerous to walk around it after dark and it soon becomes unsightly and odorous in the daytime. The men dislike to do anything to make matters any better and yet the proper disposal of the human excreta is the gravest problem to be faced in camp sanitation. Privies are fly breeders, and after a very short period of use the men abandon them and consult simply their own convenience each day regardless and heedless of results. Yet it is from the vast amount of this particular form of waste matter that we have most to fear. Only this can convey the germs of typhoid fever. Talks to the men do little good and there are no means of controlling them as in military camps.

In this disposal of faecal matter then it is practically necessary to have men to look after it. Dry earth closets are the things to use. If men would be willing to attend to such matters it is best to have holes dug

3 ft. deep with posthole diggers, with the soil placed around the edge of the hole. Immediately after use enough earth is scraped or kicked in to cover the faecal matter. When the hole is filled another can be dug immediately along side. Since it is hard and generally almost impossible to get men to attend properly to this the contractor should erect buildings like the ordinary privy but without any pit underneath. The back should be open and under the seats should be placed boxes or pails. Inside should be large boxes full of ashes, sand, etc., with scoops. Each man can put a scoop full of ashes into the box under the seat and he should be asked to do so, but to insure it being done there should be a man or two in camp whose duty shall be to visit the sinks regularly and see that all faecal matter is covered with the ashes, sand or dust. If black loam can be secured it is far better than any other material. The contents of the pails may be deposited on the plot of plowed ground used for the disposal of garbage or may be placed in any other convenient place and covered with a few inches of earth. Properly taken care of a dry earth closet is perfectly odorless. Some idea of the amount of this waste may be gained when it is estimated that from 2½ to 3 oz. of excrement per day must be figured on for each person. For a camp of 300 men this means between 50 and 60 lbs. per day, for the disposal of which about double that amount of dry earth or ashes will be required. If proper closets are erected and looked after by a good attendant they will be used by the men and the full amount of excrement may be expected to require disposal. Galvanized metal coal scuttles make the best receptacles and one should be provided for every ten men in camp. This number will be found amply large.

If the camp is located on a stream the kitchen and dining room should be at the upper end of the camp and the sinks should be at the lower end, but not near the water. In fact the water disposal of waste is the one thing to guard against. It breeds carelessness in the occupants of the camp, increases the number of flies and mosquitoes and other pests on wings, and is a source of danger to communities lower down.

The vicinity of the camp should be protected also. For a distance of about 1,000 ft. in all directions care should be taken to drain all pools of standing water or they should be oiled. In pools not readily drained and in which the oil might be a permanent detriment it is a good idea to plant catfish spawn, for this fish will soon dispose of all wrigglers and larvae to be found in water. The malaria carrying mosquito is to be especially guarded against.

The stables should be located some distance from the camp and be kept as clean as possible. The manure should be carried out daily and piled where it will be least offensive and where the leachings will not poison the water. The drinking place for horses should not be near an eddy nor should it be a place where the horses will stand in mud. In fact, it pays to go to some expense to provide drinking troughs. If the water can be brought to camp by gravity this is an easy matter to arrange, but the expense of pumping is not large and providing water in this way is preferable to permitting the horses to drink directly from the stream in which they are standing.

While it is realized that all the remarks here made about camps for workmen simply touch upon well understood points, only a cursory visit to the majority of camps is required to see that few of the precautions here recounted are regarded. The camp site is generally selected without any preliminary study or thought, and as soon as selected the erection of tents or shacks is begun. The question of water supply is not as a rule considered until the stream near by begins to show evidence of pollution. It is economy to do all that can be done in a sanitary way for a camp. The health of the men under sanitary conditions will be good and even the poorest kind of a man likes a clean camp and a place where some thought is given to his comfort, without too many irksome rules.

Roads and Streets Section

Note: This section is devoted to methods and costs of road and street construction. It will cover road building in all its details, the construction of pavements, sidewalks and gutters, the testing and use of paving materials and the machinery and tools used in road building and paving.

Directions for Working Steam Road Rollers and Steam Traction Engines.

The following instructions and directions for the working and maintenance of steam road rollers and steam traction engines have been taken from a booklet issued by Aveling & Porter, Lt., Rochester, England, while the directions were principally intended for engineers operating the road rollers and traction engines manufactured by the above mentioned firm, yet in a general sense the directions can be applied to other makes of rollers and traction engines.

PREPARATIONS FOR COMMENCING WORK.

The Boiler.—Pour clear soft water (or the best that can be obtained) into the boiler by means of the funnel until at least 1 in. of the water appears in the gauge glass, the lower cock of which should be opened two or three times for a moment to ascertain that it is in proper working order; should the water refuse to rise freely up the glass, take out the two front screws, pass a piece of wire through each passage to the boiler, replace the screws, shut the bottom cock (the other two being kept open), and the true level of the water inside the boiler then will be shown.

The Tubes.—Pass the brush or cleanser through the tubes from the smoke-box every morning and once during the day—say at noon—remove all soot from fire and smoke-box.

The Fire Bars.—Clean the fire bars, and see that the proper number are in their places; remove all dirt from the ash pan twice a day, or oftener if necessary, spread over the fire bars some straw or shavings and firewood, cover thinly with coals, apply a light and add coals in small quantities as the fire burns up, then afterwards keep the fire thin and regular over the whole of the grate surface.

Bearings.—Turn the flywheel of the engine gently round to see whether any of the bearings are screwed or keyed up too tight, or if (after a frosty night) there is any ice in the cylinder or pump; if there be any ice, thaw it with hot water or hot irons; and if the bearings are too tight, stand at the side of the flywheel, take hold of two opposite arms and move the wheel round about 1 in. backwards and forwards a few times; this will show whether any bearings are either too tight or too slack, especially the eccentric straps.

When the steam is up to the working pressure, set the engine to half stroke, open the cylinder cocks wide, and the starting valve or regulator about one-third; the engine will then be set in motion. Close the cylinder cocks when water ceases to be blown out, and open the regulator to the extent required to work the engine.

The Pump.—The feed pump should be tried immediately the engine is in motion to ascertain whether it is in working order before the water has time to get low in the boiler; first open the suction cock, then the snifting cock, this will ensure the pump working if the valves are free from dirt, the packing good, the joints air-tight, and the pump cool. Should the pump have become heated cold water must be poured upon it.

Should the pump not work properly and steam or hot water only issue from the snifting cock, the conclusion will be that the delivery valve is choked; the fire should then be immediately withdrawn and steam blown off. The cover of the feed valve box must then be removed, and the valve taken out and cleaned; but should no water issue from the snifting cock, then see if the suction valve—namely, that next to the pump barrel—is choked. This may be done while steam is up, and if on inspection this valve be found free in action, clean and satisfactory, then remake the joints of the cover and suction valve with a little twine or lamp cotton, as the defect must have arisen from the pump drawing air either at the packing round the pump plunger (which must be removed and new packing put in), or else from the plug of the suction cock being too slack.

If the pump still refuses to work, as shown by the water disappearing in the gauge glass, withdraw the fire, blow off the steam, again carefully examine the pump and valve, refill the boiler to the proper height by means of the funnel and make a second trial, and if not successful an engine fitter should be at once sent for.

When the pump is properly at work with the cock full open the supply of water to the boiler will be more than is required; the cock should therefore be closed to such a point that, when the pump is constantly at work, the proper quantity of water will be passed into the boiler. This arrangement will keep the pump in good working order, and (provided the work does not vary) will prevent the irregularity of steam pressure which would arise from starting and stopping the pump at intervals. The aim should be, as far as possible, to regulate the supply to the demand (just sufficient to keep the water at one level in the glass), so that an even temperature may be maintained in the plates of the boiler, the tubes and the fire-box. It is impossible to work an engine economically unless a *constant moderate* supply of water is kept in the boiler.

The small screw in the valve box leading from pump to boiler should be occasionally scoured out with a piece of wire.

THE INJECTOR.

1st.—Open the valves or cocks connecting the injector with the boiler.

2d.—Open the water supply, by means of the hand lever, to the extent required for the steam pressure in the boiler.

3d.—Open the steam spindle slightly, until the water issues freely from the overflow pipe, then open up the steam spindle or cock to the full extent. If water continues to issue from the overflow pipe, regulate the water supply by the lever.

The injector should always be used for supplying water to the boiler in preference to the pump, as by its use the steam which gives the velocity requisite to enable the water to enter the boiler returns with the water into the boiler in a condensed state.

BEFORE STARTING ENGINE.

Before starting the engine open the cylinder cocks and let the crank shaft make a few revolutions, to ascertain that every part of the engine is working properly. The driver should also see that he has the requisite supply of fuel and that the tender is full of clean water, that the oil cups are filled up, and that the worsted syphons in the oil cups really supply oil to the bearings.

The oil holes and teeth of the compensating gear must be examined and all dirt picked out; the teenth of the pinions and spur wheels must be greased or oiled; the axle bearings of driving wheels and front must also be attended to and oiled; take hold of the flywheel and pull the crank to half stroke; connect the driving gear with the crank shaft pinion, and take the greatest care to have it properly secured, as many accidents have occurred from the neglect of this precaution, especially at night; push over the reversing lever to the forward part of the quadrant, and carefully turn on the steam by pushing forward the regulator handle a short distance.

Should the engine not start in consequence of the crank being on the center, shut off the

steam by pulling the regulator handle back again, and also pull the reversing lever to the back part of the quadrant without turning on the steam; the crank will then most probably leave the center—if it does so, reverse the lever and turn on the steam gently at the same time. The engine will then start; but should the crank not leave the center, take hold of the flywheel and turn the crank up or down as may be required. The regulator should be *opened gently*, especially with a full boiler, to avoid priming. As the engine feels the load the regulator may be opened, and as the engine increases in speed the reversing lever should be pulled back a notch or two at a time, in order to work the steam expansively and with the greatest economy.

MANAGEMENT ON THE ROAD.

If any difficulty is found in hauling a train of loaded wagons up an incline, one-half the train should be taken up first, and the remainder afterwards, and the two parts connected again at the top of the incline. Should the engine sink into a soft place in the road, disconnect the train, let the engine get out of the hole itself, and then draw the train through by means of a long chain. If the engine becomes so far embedded in the ground as to rest upon the tender, raise it by means of the screw-jack, and place blocking under the wheels before starting—faggots, small branches of trees or straw will be found very suitable for this purpose.

In ascending steep inclines the engine should be steered straight up the hill, and, to prevent priming, the water level in the boiler must neither be too high nor too low, lest the lead rivet should melt out when the engine again arrives at level ground. The feed pump must be shut off while ascending a short incline, but must be started again just before reaching the top of the hill. Before going down hill the driver should see that he has a good supply of water in the boiler, or otherwise the furnace crown will he laid bare, and the lead rivet will be melted; the furnace door should be opened and the dampers closed, and if the engine goes too fast the regulator must be partially or wholly closed; also, if necessary, the engine must be reversed, but this should be avoided if possible by using the break on the tender and wagons.

In steering let care be taken not to turn the steering wheels more than is absolutely necessary to make a required curve, as both additional work and an unnecessary strain are put upon the engine by so doing, and when turning a corner the driver should make as great a sweep as the road will permit.

If the driving wheels should slip in passing over soft ground, put the spikes into the wheels; and if these prove insufficient, fix the paddles; these paddles must, however, be removed on arriving at hard ground, upon which they are never to be used.

Advantage should be taken of each stoppage upon the road to examine the driving gear and wheels, to see that they have not sustained any injury; to try the brasses, and to see whether they are loose or have been heating; to tighten up glands if necessary; to examine cotters and eccentrics and see that they have not worked loose.

A fresh supply of water should be taken along the road whenever it can be obtained, and the tender filled up before leaving the spot.

Take care that ashes and soot are not allowed to accumulate in the smoke box, or the door will become red hot and be drawn so that air will enter. The smoke box door must shut tight to enable plenty of steam to be made.

A portion of the water in the boiler should be blown out at least twice every working day, but before doing so raise the water in the boiler about 2 or 3 inches above the working level; then open the blow-out tap and allow the water to run down to the working level, by this means a considerable quantity of deposit will be carried out with the water which would otherwise adhere to the firebox.

The firebox is fitted with a lead or safety rivet, and if the water is allowed to become so low as not to cover the top of the firebox, this rivet will be melted and let out the steam and water, which will extinguish the fire; but as the replacing of the rivet causes stoppage and annoyance, this should never be allowed to occur. This lead rivet can be replaced by unscrewing it from the inside of the firebox.

PRIMING.

Priming is an indication of either dirty water, low steam, or slovenly driving, and sometimes of all three causes existing together.

After a large quantity of water has been evaporated from a boiler, certain deposits must accumulate, as nothing but pure water can be generated into steam. If a glass window could be conveniently and safely fixed so that the state of the water could be seen it would, where cleaning out had been neglected, be found to have the appearance of thick gruel.

Priming is often caused by drawing off considerable quantities of steam when the pressure is low. The engine driver should therefore see that the steam is steadily maintained at a little below the maximum working pressure, even when there is very little of it being used.

Should priming occur, open the cylinder cocks, and partly close the regulator, so as to reduce the speed of the engine. Priming is at all times to be avoided as much as possible, for the foul water damages the slide valve, piston and cylinder surfaces. In nearly all cases the remedy is to clean out the boiler.

FIRING.

Proper attention is to be paid to the firing of the boiler, and care must always be taken to keep the bars covered with fuel. The coal should be put on in small quantities at frequent intervals. Where smokeless fuel cannot be obtained, the fire should not be fed when passing, or just before passing, through towns or villages, or by houses on the road side. If hard coals are used there will be little or no trouble from the accumulation of clinkers upon the bars or of soot in the tubes; but if soft coals are used, then at least once during the day (say at noon) the clinkers must be removed and the tubes swept. This can be readily done by cleaning one side of the bars at a time and removing the fire in each case to the opposite side. In firing, the coals should be placed in the corners of the firebox and next the plates, and the fire should be kept lowest in the middle, as the fuel will always have a tendency to work to the center of the grate by reason of the shaking of the engine. If too much coal is put on at once the fire will be choked, clinkers will be formed, stays, tubes, and even the fire box-plates (especially the corners of the frames) will start leaking, because of the unequal contraction, the plates being of different thicknesses, the smoke-box door will get hot, become twisted, and will not shut closely, steam is not made, and clouds of black smoke issue from the funnel, all in consequence of it being impossible for the air to pass through the grate bars in sufficient quantities to produce proper combustion. Nothing shows the ability of an engine driver more than firing. Some men will burn twice as much coal as others, and yet their engine will be constantly short of steam or blowing off "like mad," wasting fuel, water, and steam and ruining their master's property.

The Damper.—The damper door and the ashpan should fit well, as it is impossible to fire economically unless attention is paid to the admission of air, which must be adjusted according to the load.

OILING.

It is the duty of the engine driver to be as economical with the oil as possible without running the risk of heated bearings. All oil cups should be carefully inspected, and the worsted in the syphon pipes should be renewed whenever they are found to be choked or "gummed up;" the threads of worsted should be arranged so as to supply to big ends of connecting rods about four drops of oil per minute. When the engine is standing the trimming should be pulled out of the syphon pipe and placed on one side in the cup or axle box until the engine is again required to work; before replacing them a few drops of oil may be poured down the pipe to ensure lubrication while the trimming is getting to work. The oil cups should never be filled so full as to waste the oil over the side. The appearance of the engine will show if proper care and attention has been paid to this important point. Heated bearings, worn out brasses, and the engine covered with oil thrown from the overfilled oil cups tell their own tale. The teeth of the pinions and spur wheels should be kept carefully oiled or greased.

ADJUSTMENT OF BEARINGS.

Connecting Rods.—The brasses in the "big end" of the connecting rod require to be fitted "brass and brass" to work well, but with sufficient slackness on the crank bearing to allow of their being easily moved sideways by hand. Before a brass is tightened up it is advisable to mark the cotter on the underside, that it may show how much it descends at each blow. The "little end" brasses require the same treatment and attention. Care must be taken that the length of the connecting rod is not varied by the adjustment; the marks upon the slide bar will show this. If it has been necessary to file the brasses to bring them closer together, and the connecting rod has been shortened, a piece of metal may be placed between the strap and the brasses. Crank shaft and connecting rod brasses will wear longer and knock less if the edges of the brasses or packing pieces are filed away for adjustment (by keying or screwing up as the case may be) *a little at a time and often.* With proper attention they seldom run hot. The necessity for adjusting a bearing will be made known by a disagreeable knocking or thumping of the engine when passing its centers, and which, if allowed to continue, is very injurious to the working parts of the engine.

Eccentrics.—Particular attention should be bestowed upon the bolts, nuts, cotters and pins; the straps are adjusted by means of two set screws which are tapped into one-half of the eccentric strap, consequently the nuts on the outside are only locking nuts to secure the screws at the proper point; the strap should therefore be adjusted by turning equally the screws which join the two halves of the strap together, and when sufficiently tight they should be held by a spanner, and the locking nuts screwed up tight to prevent the screws from working loose.

After adjustment, the crank shaft should be turned round by hand to ascertain if the eccentric straps have been screwed up too tightly.

Piston Rod, Etc.—The cross head cotter and split pins, the gland nuts, the valve spindle nut, and gland require careful inspection every time steam is got up; nearly all accidents are caused by engine drivers not carefully examining all bolts, nuts, set screws, and split pins about the working parts of the engine and seeing that they are in their proper places before starting work.

Packing Glands.—The stuffing boxes and all the parts of the engines, where hemp packing is used, must be so packed and screwed down as to entirely prevent an escape of steam. When screwing down, if the gland fails to accomplish this, the old packing should be removed and fresh put in. This operation is best performed as follows: Cut the spun yarn into lengths of two feet, soak it well in oil or tallow, draw back the gland, then pass the yarn round the rod one turn at a time, then force it down to the bottom of the stuffing box with a piece of wood or iron, and repeat this process until the stuffing box is nearly full; the gland must then be put back in its place, and the two nuts screwed down with care; should the gland be *easily* screwed close up, it will show that more packing is required.

Piston Cylinder and Slide Valve.—No engine can work efficiently unless the piston fits the cylinder accurately; the sound of the exhaust steam should be clearly heard and the "beat" should be at regular intervals; any defect in either the slide or the cylinder will be noticed by an attentive driver, who detects at once if "blowing through" is taking place by the exhaust becoming continuous and weak

instead of sharp and clearly defined; this may be caused by slack or broken piston rings, by the slide valve faces becoming worn and allowing the steam to pass into the exhaust without having previously entered the cylinder, or by the cylinder wearing oval. In either case an engine fitter should be at once employed and the defect remedied, or the increased and wasteful consumption of coal will cause damage to tubes and firebox.

AFTER THE WORK IS FINISHED.

The fire is to be carefully withdrawn and all ashes and clinkers entirely removed from the firebox and raked clear of the boiler. The fire must not, under any pretence, be quenched by throwing water in the firebox.

During frosty weather open all cocks, including the blow-out tap (if the boiler is empty), so that the water may escape instead of freezing; the risk of bursting cocks will then be avoided. Take off the cover of the suction valve and see that the pump is free from ice; if the frost is very severe bind up the pump and glass water gauge with straw or hay bands, so that the water may not be liable to freeze while the engine is at work.

The engine should be well rubbed over with cotton waste, and all dirt, grit, and superfluous oil that may have accumulated during the day's work removed, and everything made clean and tidy; the brasses adjusted, if necessary, glands tightened up, cotters and eccentrics examined to see that they are not loose, and the driving gear and wheels examined to see that they have not sustained any injury; and everything left ready (as far as practicable) for future work.

If the engine is likely to be out of work for two months or longer, the piston rod should be withdrawn and the interior of the cylinder greased. The packing should also be removed from the valve glands, and all bright work should be coated with a mixture of tallow and white lead to prevent rusting.

The engine driver should also ascertain that no parts are rusting from water or steam leakages, and he should give the same attention to the parts out of sight as to those that are visible. The corners of the coal bunkers and foot plate should be thoroughly cleaned, and accumulations of small coal removed to prevent rusting.

WASHING OUT BOILER.

There are four mud holes at the bottom of the firebox of the boiler, the covers of which should, under ordinary circumstances, be taken off after every 100 hours' work, but if the water be very dirty after every 50 hours' work. All dirt and sediment is to be removed from the firebox by means of the rake furnished for that purpose. The boiler should then be thoroughly washed out by means of a hose (if available), or pails of clean water be thrown in at the manhole until the whole of the accumulated mud and sediment is removed from the boiler. If this be neglected the tubes will commence to leak and the firebox (more especially the tube-plate) will crack in those parts where the sediment is allowed to accumulate, after which constant leaking from some part or other will be the result.

The driver should get inside the firebox and thoroughly examine with a light everything in it; when bulging of the plates round the stay heads is discovered, it is generally a sign of dirt at the back of the plates and should be at once removed.

Leaky tubes and cracked tubes or side plates are a sure indication that the boiler is in a foul state; and upon the first appearance of such symptoms the tubes should be drawn and cleaned, the boiler properly cleaned out and examined by a boiler maker, or a person accustomed to such work. The mud-hole joints are a common source of leakage and corrosion and should be kept perfectly steam and water tight. With ordinary care and good water the boilers will last many years; but if these instructions are not properly carried out, and the water be impregnated with lime or dirt, a few months' working will suffice to do considerable damage to the plates in immediate contact with the fire.

Strict attention to the proper cleaning of the boiler is therefore of the greatest importance, for if neglected extensive damage to it will be the result.

The tender should also be thoroughly cleaned out and the pump pipes cleaned and examined.

Any defect must be at once remedied, even if it be necessary to suspend the boiler from work for a time. No pressure of work shall be considered equivalent to the risk of accident.

PRECAUTIONS FOR SECURING SAFETY OF BOILERS.

It is the duty of the engine driver to ascertain, by personal observation and minute inspection, that the boiler is steam tight. Positive safety is the first consideration, and with a view of securing this condition the boiler should, in addition to the ordinary cleaning, be annually inspected by a properly qualified person, the man-hole and mud-hole covers should be removed, and the tubes and boiler be scaled as far as practicable, and afterwards thoroughly washed out. If the tubes are very dirty they should be drawn and cleaned (under any circumstances, even if none but clean water has been used, this operation should be performed once in two years). The several fittings, cocks, valve, safety valves, bearings, gearing, and other appendages should then be examined, the boiler filled with water, and when any doubt exists as to the strength of any part of the boiler it should be tested by hydraulic pressure to at least double that at which the safety valves open when under steam.

The interior of the boiler should also be examined with a candle or a small spirit lamp on the end of a piece of copper wire. Special attention should be taken to ensure the removal of all dirt from the stays around and on the top of the fire box.

Great attention should be paid to the prompt renewal of any broken firebox stays. It is to be noticed that it is not always possible to detect a broken stay by the ordinary process of sounding with a hammer, as a stay may sometimes be broken nearly through and still sound all right when tapped. A far better plan is to drill a small hole, say about 1/10 in. diameter, up the center of any stay of which the soundness is suspected, when, if a fracture exists, it will be, of course, indicated by leakage. As the fracture of stays almost invariably takes place close to the plates to which they are screwed, a hole drilled in for about an inch deep from each end is sufficient.

All repairs, testing and cleaning should be conducted, not only in a proper manner, but also promptly, but at the least expense that is compatible with efficiency.

Slight repairs should be performed by the driver in charge of these engines, but a properly qualified mechanic should be employed if any considerable repair or alteration is required.

The dangerous practice of attempting to repair cracks in fire boxes by the insertion of copper plugs should never be permitted. The cracked piece of plate should be cut out and a patch put on and secured by screwed studs (or rivets if possible); the stays should come through the patch, which should be of good size, as small patches never stand well.

Work of the Municipal Asphalt Plant of San Francisco in 1909.

The accompanying table shows the output and unit costs on the operation of the municipal asphalt plant of San Francisco for the seven month period beginning March 1, 1909, and ending Sept. 30. It will be observed that the output of the plant for the month of March is much less than the results obtained for the other periods named. The principal cause of this is due to the installation of an extra asphalt heating tank, which has more than double the original capacity of the plant. The cuts in the table include the expense of improvements and repairs at the plant during the seven months period.

The cost of material delivered at the yard of the asphalt plant for the fiscal year 1909-10 was as follows:

Broken rock for binder per ton	$ 1.45
Antioch sand, per ton	1.30
Monterey & Bay Development Co.'s sand, per ton	1.00
Limestone dust, $8.50 per ton, less sacks returned, $2.60	5.90
Cement, $2.38 per bbl., less 10c for sacks returned	2.38
Asphalt from refinery, per ton	15.00

The binder consists of two-thirds broken rock to one-third sand (two parts Antioch to one part Bay Development Co.'s sand), 50 lbs. of lime-stone dust to 8 cu. ft. of mixture, rock and sand, and asphalt enough to cement the particles together.

The following is an analysis showing the constituent parts of the asphaltic binder:

	Per cent.
Asphalt	6.00
Sand	37.18
Dust	6.50
Rock	50.31

The mesh composition of sand and filled is as follows:

	Per cent.
Pass 200 screen	6.50 dust
Pass 80 to 200 screen	13.28 sand
Pass 50 to 80 screen	13.98 sand
Pass 30 to 50 screen	5.31 sand
Pass 20 to 30 screen	3.85 sand
Pass 10 to 20 screen	.76 sand
Pass 0 to 10 screen	50.31 sand

This mixture is giving excellent results under heavy traffic with 1½ in. wearing surface laid over it. The wearing surface is held as closely as possible to the New York formula for mixing asphaltic wearing surface.

The following is an average analysis of wearing surface delivered from the plant:

Sand	8 cu. ft.
Limestone dust	150 lbs.
Asphalt	130 lbs.

This gives the following:

	Per cent.
Bitumen	10.57
Passing 200 mesh screen (dust)	14.80
Sand passing 80 screen rejected by 200.	28.04
Sand passing 50 screen rejected by 80.	30.80
Sand passing 30 screen rejected by 50.	8.20
Sand passing 20 screen rejected by 30.	6.86
Sand passing 10 screen rejected by 20.	.70
Sand passing 0 screen rejected by 10.	.00

COST OF OPERATING MUNICIPAL ASPHALT PLANT, SAN FRANCISCO, CAL.

1909.	Cubic feet binder.	Cubic feet wearing surface.	Cost of material in binder. Per cu. ft.	Cost of material in wearing surface. Per cu. ft.	Cost of labor at plant. Per cu. ft. binder and surface.	Expense at plant. Per cu. ft. binder and material.	Total cost material, repairs and labor at plant Per sq. yd. pavement	Total cost labor, teams, etc., on street Per sq. yd. pavement.	Total cost of laying pavement. Per sq. yd.	Square yards pavement laid.
March	11,702	9,054	$0.150	$0.319	$0.0402	....	$0.908	$0.441	$1.399	6,604
April	20,234	20,620	.151	.289	.0402	$0.008	.690	.342	1.032	15,941
May	17,912	26,712	.150	.272	.0435	.013	.568	.278	.855	21,985
June	23,528	25,428	.150	.269	.0427	.021	.631	.257	.898	21,436
July	28,088	26,096	.137	.281	.042	.014	.669	.311	.980	21,320
August	25,288	26,848	.137	.260	.044	.027	.620	.313	.933	22,824
September	24,486	24,992	.137	.259	.040	.027	.591	.304	.895	22,267
Total	151,238	159,750	$0.143*	$0.274*	$0.438*	$0.017*	$0.639*	$0.309*	$0.948*	132,377*

*Average.

The lime stone dust gives about 85 per cent of its weight, passing the 200 screen.

Where the pavement is laid for very heavy traffic, cement is used instead of limestone dust for a filler. This character of pavement with a cement filler has been in use on Market St. for several months where the traffic is the most severe in its wear on the pavement and no appreciable deterioration is noticeable.

Market St. from Second St. to East St. has been paved with this class of pavement for nearly four years and has received the wearing effects of the heaviest traffic in the world (considering that a dead axe is used here) and except where the pavement has been patched over trenches, it appears to be as good as when laid.

The asphalt used is the residuum of the asphaltic oils obtained from the oil fields of California. It is prepared specially for city use, having a penetration of 70 to 90 by the District of Columbia standard. Annual contracts are made with the Union Oil Co. and the Monarch Oil Co. of this state. The plant is in charge of J. R. Price, assistant city engineer, to whom we are indebted for the above information.

English Methods of Using Tar as a Binder in Macadam Road Construction.

The use of tar in macadam road construction has been common in England for a number of years. In fact tar macadam has been in use in many residential towns for the past 20 or 30 years. Broadly speaking the three following methods of applying the tar have been employed: Tar-painting or waterproofing the surfaces; tar-macadam or mixing tar with the stone previous to its being laid on the road; and tar grouting or grouting the stone with tar and pitch when the road is being coated. In a paper read before the Northern District Meeting of the Institution of Municipal Engineers, Mr. William Wade, assistant surveyor to the Northumberland County Council, gave the following information, drawn from his own experience, regarding the use of tar by the above three methods:

Tar Painting.—Tar painting may be used on either an ordinary road, made in the usual manner, or upon a new stretch of metal. In the case of tar painting, a stretch of road which has carried traffic for some time, it is essential that all dust should be removed from the road before the liquid is applied. After the removal, the road is then ready for the application of the tar, which is heated in tanks of various sizes. These tanks are fitted with distributors or jets, and tar at the proper temperature is applied by pressure so as to secure a certain amount of penetration as well as equal distribution. The tarred surface has then granite, spar or other suitable screenings sprinkled over it. The cost of tar painting works as follows: One gallon of tar will cover an area of from 10 to 20 sq. yds., at a cost of from 1d to 1½d per square yard.

Tar Macadam.—I have now to deal with the second method—*viz.*, that of thoroughly mixing the stone with tar and pitch previous to its being laid on the highway. This is perhaps better known to you as tar-macadam. As it is absolutely essential that all stone should be perfectly dry and free from moisture, you will readily see that a shed or some covered-in structure will materially help in getting the work done in a speedy and efficient manner. The stone used is of three sizes—2½ in., 1½ in. and ½ in.—and should be free from dust and moisture. The tarring may be done by hand or by machinery. The latter method is much cheaper, and I find that machine-tarred stone is superior to that mixed by hand. After the stone is tarred it is stacked in separate heaps. The best results are obtained when the tarred material is allowed to be undisturbed from one to three weeks before it is applied to the road. I omitted to mention that the proportion of pitch must be greater for the bottom coat than for the two succeeding ones.

The 2½-in. stone is first put on the road foundation. Above this the 1½-in. is placed, and the ½-in. is used as a finishing coat, over which is sprinkled ⅜-in. dry granite screenings free from dust. Each layer of stone is well rolled before the one above is put on. It is very necessary that more than ordinary care should be taken in the consolidation of the separate layers. When completed, the combined thickness of the three coats gives an average depth of 4 in., the depth of material, of course, being greater in the center than on the sides of the road. A 15-ton roller is preferable, especially if the traffic be heavy, for if a light steam roller be used, when traffic heavier than the roller passes over the road, the result will, in all probability, be disastrous for the road. One ton of tarred stone will cover an area of 6 sq. yds., and the average quantity of tar required for 1 ton of stone is 8 gal. and 20 lb. of pitch.

The 8 miles of tar-macadam laid by the Northumberland County Council cost on the average 2s 2d per square yard, inclusive of mixing plant, etc. The roads treated were structurally weak—a penned bottom of 6-in. whinstone was laid down on the existing road to give a good foundation, on which the tarred stone was placed. Good drainage and strength of structure are important factors in the laying down of a successful tar-macadam roadway. The cost of reconstructing a road by means of penning it with 6 in. of whinstone varies from 10d to 1s 6d per square yard, according to the distance the stone has to be brought.

Tar Grouting.—And now I come to deal with the third method, that of tar grouting the stone with tar and pitch when the road is being coated.

Before beginning tar grouting it is necessary to take into consideration the weight of loads and the nature of the traffic the road is likely to be called upon to carry. This will altogether determine the size of the broken stone, its quality and the thickness of the coat to be laid on the surface. On roads that carry heavy traffic 3-in. hand-broken whinstone should be used, while on those where there is no motor wagon or locomotive traffic. I would recommend 2½-in.

After the stone is laid on, it is slightly rolled. The pitch and tar are together heated in tanks to boiling point and a quantity of creosote oil is added. Stirring is necessary to enable the ingredients to be thoroughly well assimilated.

The boiling matrix is poured in the interstices by means of a specially made can and distributor. Each individual stone is thus thoroughly well grouted and embedded in or surrounded by the mixture. While still hot, ⅜-in. slag or whin chippings are applied and properly consolidated with a 15-ton roller until an integral crust is formed.

I have given a very brief outline of the preparation and use of material for the three different methods of treating a road with tar as a binder. I now propose to deal with, in as concise a manner as possible, the various advantages and disadvantages connected with these respective modes of road making and repairs. At the outset, let me say that I consider wet rolling will shortly be a thing of the past on our main highways where motor traffic has to be dealt with.

Tar painting may with great advantage be used on suburban roads where the traffic is light or where the dust nuisance is greatly felt and watering has to be resorted to. The tar acts as a protection, and protects the life of the road surface *so long as it is dry.* It has this great drawback, being only *externally* applied, it breaks up in wet weather, and the combined action of the wheels and horses' feet soon put the roads into an uneven and dirty condition. This, of course, applies to roads where the traffic is heavy. To sum up, tar painting is not to be compared with either tar-macadam or tar grouting as far as lasting properties are concerned. The tar in this case is not so much a binder as a protection to the road surface.

Tar-macadam possesses the following advantages:—

(1) The small stone of which the crust is composed being well tarred before being laid on the road gives a compact and smooth surface.

(2) The tar-macadam road is perfectly sanitary and almost dustless, so that cleansing is reduced to a minimum.

(3) It is easily repaired and the cost of maintenance is 30 per cent less than that of ordinary macadam.

For motorists it is an ideal road.

Tar-macadam, as no doubt you are aware, is not without its drawbacks. The chief of these, so far as road authorities are concerned, is the heavy initial cost. From the point of view of those using the road, the slippery nature of the surface, especially during hoar frosts, is an objectionable feature. However, this remedies itself in course of time by the tar gradually leaving the road dry by evaporation. Locomotive traffic tends to cause the top layer, which is only 1½ in. in thickness, to become separated from the layer below. This, of course, means the break up of the road so far as the crust is concerned. This is the reason why tar-macadam is not adapted for heavy loads.

Tar grouting differs from tar-macadam in these respects:—

(1) By broken stone being applied in one coat.

(2) The stone is of a uniform size.

(3) Owing to a larger quantity of pitch being mixed with the tar, the mixture quickly solidifies and adhesion is instantly secured, in much the same way as is done in the wood or granite paving.

The Northumberland County Council has this year (1909) tar grouted 15,436 tons of broken stone on a stretch of upwards of 14 miles of main road in various parts of the county. This work, I find, can be carried out very satisfactorily by doing one half of the road at a time. I may say I did not receive a single complaint while the work was in progress. Furthermore, there was an entire absence of loose stones—generally an annoying feature on ordinary newly-rolled patches. In September last I supervised the work of making the road approaches over a new bridge. Clay was used in order to bring the roadway to the required level. You are all aware of the difficulty of making a satisfactory highway over newly-filled clay. Yet, after these approaches had been penned with rubble whin, and then coated with 2½-in. hand-broken whinstone, I found that by tar grouting I was enabled to get a firm and permanent road at once. The cost of tar grouting is no more than that of repairing a road by the old water-bound method.

A tar-grouted highway is, as yet, the nearest approach we have to an idea road. It is certainly for mixed traffic superior to the other methods I have mentioned. Yet, at the same time, I must not omit to say that the surface is not quite so suitable for motors as that of tar-macadam.

Road Maintenance With the Road Drag.—Hale township in Carroll county, Missouri, has an excellent system for the maintenance of its roads by means of the road drag. By this system an overseer is placed over every eight miles of road and is held responsible for dragging the roads under his care. The overseers are under the Township Board's direction, thus making a central authority by means of which a united action is obtained over the entire township. After a rain, each overseer uses the telephone to get the citizens out with ten drags, and all the roads of the township are dragged at practically the same time. The major part of the work is done in April, May and June. Volunteer work is gratefully accepted but not depended upon Those doing the regular work are paid for it by a previous agreement. In this way the roads over the whole township are maintained in excellent condition at a cost of from $10 to $15 per mile per year, including $15 paid each overseer.

Engineers of the Great Northern Paper Co have prepared plans for a new concrete dam to replace the wooden dam on Millinocket stream, at Bangor, Me. It will be built largely of concrete and will cost about $30,000, in addition to the cost of land at each end.

Water-works and Sewer Section

Note: This section is devoted to methods and costs of constructing sewers and water-works. It will cover the construction work for all details of water supply and sewerage, including sewage purification and water filtration.

Depth of Water Pipe.

Water pipes have been in use so many generations that in every community custom has established depths at which all pipes should be laid. A great many men have brought up the question of lessening the depth in many places, for a lessened depth not only results in lowering first cost but affects service connections and repair work. To assist in a study of this matter the New England Water Works Association appointed a committee in 1908 with Mr. Frank A. Barbour of Boston as chairman, and the report of this committee has been lately published in Vol. 23, p. 425 of the Journal of the New England Water Works Association.

A carefully prepared circular containing a number of questions bearing on the subject, was sent to three hundred and twenty officials in charge of water works plants and ninety replies were received. Each city replying was given a number, which number is shown on the accompanying map, Fig. 1, in relation to the temperature curve. A chart, Fig. 2, was prepared in which the horizontal lines represent depths to center of pipes and the vertical lines, the mean temperature of coldest month in an average year. On this diagram the different places, from which replies were received, have been plotted. The diagonal straight line expresses the relation of depth to mean temperature of coldest month as indicated by an average of the replies received. Extremes are illustrated by Mauch Chunk, Pa., (34) and Cleveland, Ohio, (44) the former satisfactorily operating pipes at a depth to axis of 3 ft., 6 ins., and the latter believing 6 ft. 6 ins. to be necessary. The committee remarks that obviously local conditions other than temperature, and including depth of snow covering, must furnish, in great part, the explanation. The diagram emphasizes the variation in depth in cities and towns with the same mean temperature of coldest month.

The report of the committee concisely stated is largely negative in character,—that is to say, it appears that freezing has not occurred at the depths generally adopted for laying water pipe. Whether these depths are excessive, however, cannot be predicated from the information at hand, because where freezing has occurred there has always been an obvious explanation, usually little or no velocity, and an analysis of these explanations and of the local conditions pertaining does not finally justify any general deduction as to necessary depths.

With practical unanimity all replies state that the present depths are sufficient, and a considerable number suggest that lesser depths might safely be used. Whenever freezing has occurred it has been largely at night or where there was practically no current, and it is believed that where there is a velocity, say, in excess of one-quarter of a foot per second, and particularly in the case of ground water supplies, depths somewhat less than those now used would generally be safe. In main feeders, and in those portions of the distribution system where there will be an assured circulation, the question of minimum depths should be given careful consideration. It is not in the mains but in the services that most of the trouble from freezing occurs, and in the services such trouble usually results from skimping by plumbers or contractors, resulting in the actual laying of the services at depths considerably less than the mains. There is a strong feeling apparent that services should be laid by the municipalities.

Twenty-eight of the places replying report the tapping of service connections on the top of the main, 39 on the side, 12 on the quarter, and 7 in various ways. Freezing of services generally starts at the house and backs out into the main, and it is believed that if services were tapped on the side of the main and then dropped to the depth required to meet local conditions, the lessening of the depth at which the main is laid to that justified by the velocity of the water in the main would not result in increased freezing of services.

In determining the depth of pipe, the character of the soil and of the surface of the ground are factors of some importance. In but very few places, however, from which replies were received is the nature of the soil taken into account in deciding as to the necessary depth at which the pipes should be laid. In 10 per cent of the replies it appears that some attention is paid to the character of the street surface, although apparently there is no prevailing rule. Some consider that a pavement is equal to one foot of cover; others that pipe should be laid deeper in a paved street. An average of the replies received indicates that freezing extends one foot deeper in streets than in fields; also that in streets frost will reach 1 foot 5 inches deeper in gravel than in clay, with sand half way between. In fields it would appear that frost will extend one foot farther in gravel than in clay, with sand again intermediate in effect. It is

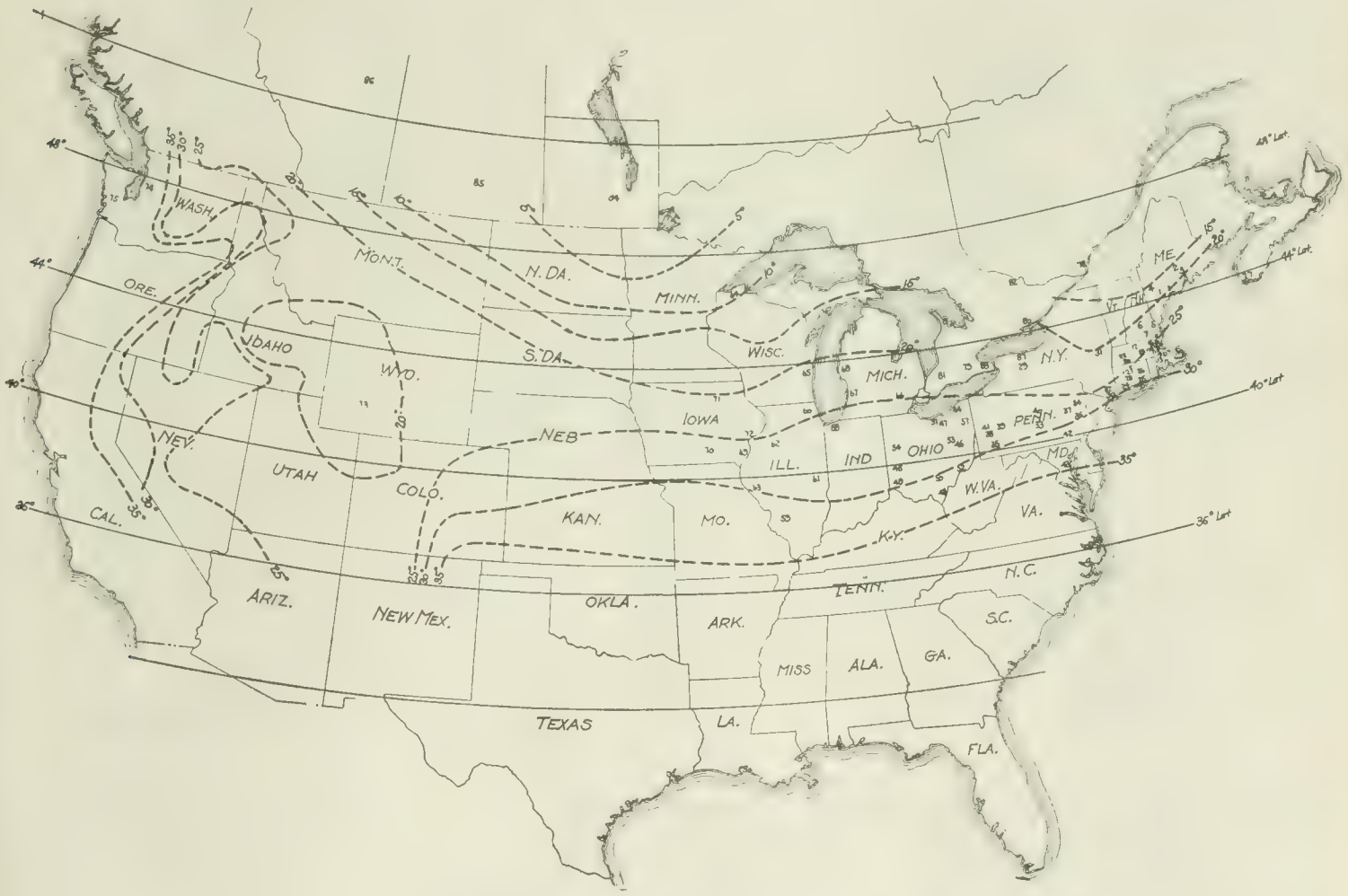

Fig. 1—Map of United States Showing Relation of Depth of Pipes to Temperature.

obvious that the character of the soil is a factor of such relative importance as to demand consideration in determining the economical depth.

Fifty-three places report actual experience in the freezing of pipes. All of these cases were in distribution systems and none in the leading mains Fifty per cent were on dead ends and all were in pipes where there was little or no velocity. All but three of the cases of freezing were in pipes smaller than 10 inches in diameter, only seven in pipes as large as 8 inches in diameter; in all cases the ground was frozen below the axis of the pipe, and the ground water level was also below the pipe. In 80 per cent of the cases the ground was bare of snow at the time of freezing. All stoppages were total. Thirty-five places report the character of the earth in which the pipes were laid; of these 40 per cent were in clay, 48.6 per cent in gravel, 5.7 per cent in sand, and 5.7 per cent in rock.

While all cases of freezing reported are stated to have resulted in total stoppage of the pipes, there are records of ice formation in concentric rings in pipes as large as 24 inches in diameter, the occurrences not being evidenced by stoppage of the large main, but only by loss of head through increased friction, or, in some cases, by stoppage of gates or smaller pipe connections by the ice loosening and breaking up in a thaw and forming an ice jam at some point of obstruction. Such formation of ice in a layer adjoining the metal of the pipe has occurred in instances of extreme low temperature in the eastern Canadian Provinces in conduits where there was a considerable velocity. Obviously, as the ring of ice forms, the velocity of the water increases and a total stoppage does not result. In other cases of freezing, particularly in smaller pipes, the ice formation is not solid nor does it start from the outside, but is rather in the form of "slush" uniformly distributed throughout the cross-section of the pipe. This has been noted in a 4-inch pipe, in which there was considerable velocity, laid at a depth of 6 feet in a salt marsh in New Brunswick.

There is a belief or tradition in the minds of many plumbers and water-works superintendents that most stoppages by ice formation occur in a thaw which follows a period of severe cold weather, and the reason generally advanced for this alleged phenomenon is that the evaporation from the surface during the early stages of the thaw produces additional refrigeration or reduction of temperature at the depth of the water main sufficient to cause freezing. No indication of the existence of such conditions has appeared in the reports received of frozen pipes, and this reference is here made to induce the production of evidence, if any exists, in support of this theory.

In the discussion following the report the information was brought out that there are no more cases of freezing in those places where the depth of the pipe is less than in those where the depth is greater than that shown by the average line. It must, therefore, be concluded either that this variation in the depths at which pipes are laid in different localities with the same mean temperature of coldest month are to be explained by peculiar local conditions, or that in some places the depth shown is unnecessarily great. Personally, Mr. Barbour believes that it is safe to lay pipes where there is an assured circulation at all times, at depths less than are frequently adopted in present practice. Mr. Leonard Metcalf believed it desirable to follow up all reports of frozen pipes and commenting on the fact that the freezing of pipes seems to depend more on the velocity through the pipe than anything lese, stated that it is on this very fact that we have the fewest data, as it is difficult information to get. Mr. Coggeshall stated that he had noticed several times when thaws came after a long period of cold weather during which some services had frozen, that other service pipes in the immediate vicinity stopped. Mr. Charles W. Sherman suggested that pipes of the largest sizes might to a greater extent than is now the practice be advantageously laid at a lesser depth than the smaller pipes; in view of the fact that the committee had no reports of pipes larger than 10 inches in diameter which have frozen and very few pipes larger than 6 inches.

Considerable interesting information was given in many of the reports from cities and towns but it was noticeable throughout that in the work of the committee and the discussion following the committee report, no consideration was given to causes other than danger of freezing, as affecting depths at which pipes are laid. At the present time the danger of freezing is a minor point, for the traffic on streets must largely settle this important question. Interurban electric cars of great weight travel over streets in small towns and in the larger cities the street cars are yearly growing in size and weight. Heavy auto trucks are supplanting horse drawn delivery wagons and road rollers of great weight are used on all modern street construction. Machine excavators are used generally for sewer work and these heavy machines play havoc with the joints of water pipe laid in shallow trenches. A minimum depth of about five feet should be required to the top of the water pipes to protect them from heavy traffic and freezing should be taken into consideration in localities where experience has proven that five feet is too shallow. Metering alone is not going to check the present costly water waste in American cities. Good construction must come before meters, which, after all, chiefly affect water supply after it leaves the mains and goes into the house service pipes.

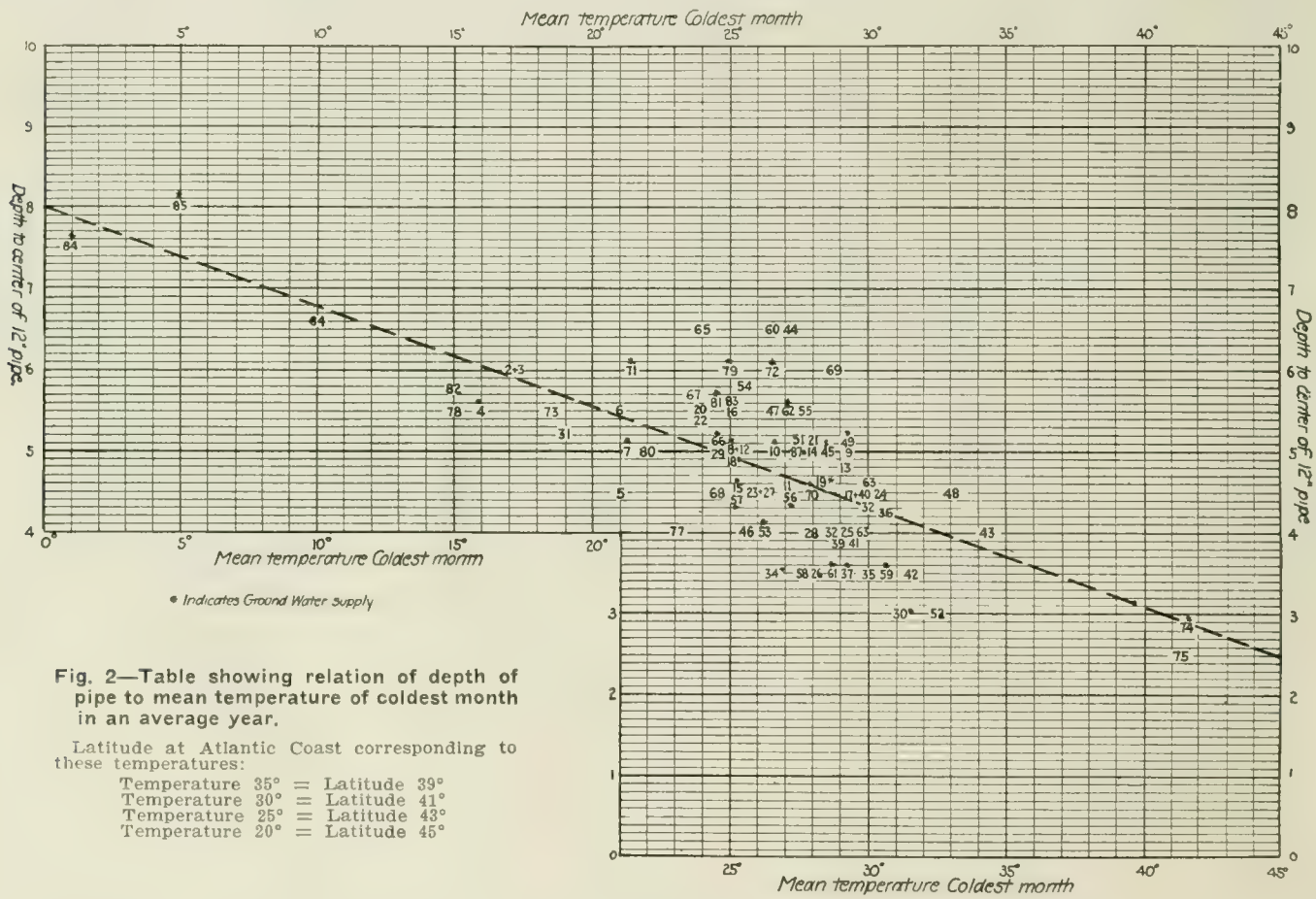
Mean temperature Coldest month
Depth to center of 12" pipe
Mean temperature Coldest month
* Indicates Ground Water Supply
Depth to center of 12" pipe
Mean temperature Coldest month

Fig. 2—Table showing relation of depth of pipe to mean temperature of coldest month in an average year.

Latitude at Atlantic Coast corresponding to these temperatures:

Temperature 35° = Latitude 39°
Temperature 30° = Latitude 41°
Temperature 25° = Latitude 43°
Temperature 20° = Latitude 45°

Reclaiming Dredged Lands.—In California thousands of acres of once fertile lands have been lost to agriculture because of hydraulic and dredge mining which covered the land with boulders and debris. Near Oroville the Feather River Dredging Co., with a capital stock of $2,500,000 has been organized to reclaim these lands by means of dredges and rock crushers. The Natomas Consolidated Co. has also established four rock crushing plants for the same purpose. The crushed rock is used for concrete, railroad ballast, macadam and other purposes. The land from which the boulders are removed is put under cultivation as fast as it is cleared and orchards are now seen where a few months ago were piles of stone and sand. Much of the material will be used for levee work, thus reclaiming many acres of swamp and overflowed trite lands.

Unclassified and General Articles

Note: This section is devoted to methods and cost articles on construction work not properly coming under any of the preceding classifications.

Some Types of Sea Walls and Their Structural Characteristics and Cost.*

The low cost of water born freight has been a deciding factor in the location of many industrial undertakings and with the location came the important problem of maintaining and securing the sea-wall or bulkhead against settlement and other movements tending to deform or destroy the structure. Many types

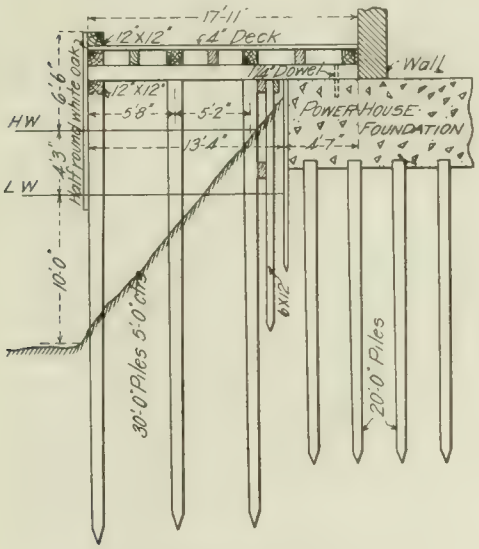

Fig. 1—Pile Bulkhead With Timber Platform, First Street Slip.

of sea-wall or bulkheads have been used in this work, and the present paper is an endeavor to indicate a number of constructions which have been used with success, together with a brief statement of the difficulties encountered,

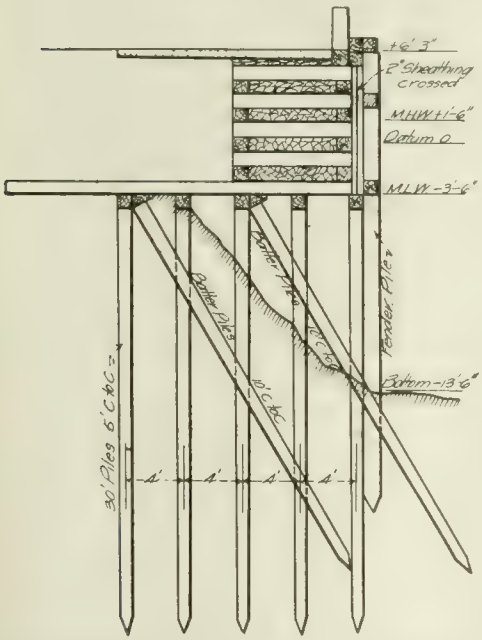

Fig. 2—Crib Bulkhead on Piles, Gowanus Canal Type.

and an approximate statement of the costs involved.

*A paper by Geo. A. Orrock read at the annual convention of the Connecticut Society of Engineers for 1910.

Two general types of construction have been followed according to the conditions found in the subsoil. On rocky or ledge bottom, the stone retaining wall was probably first used and is a common type today. Where the subsoil is sand, silt or clay the pile or pile and relieving platform construction have generaly been used. The crib bulkhead may be used on any bottom.

Crib Bulkheads—The earliest examples of this type consist of a few rough logs laid along the water's edge, the filling behind being earth and sand. Later the crib was built of rough logs, notched at the junctions to form a kind of rectangular framing, weighted with stone to sink it to the bottom, the filling being rock, earth and sand as before. As the crib sank into the subsoil additional logs were placed, building it up to the proper height. Many of these bulkheads are in use today and are strong and substantial. The modern crib is made of squared timber, halved

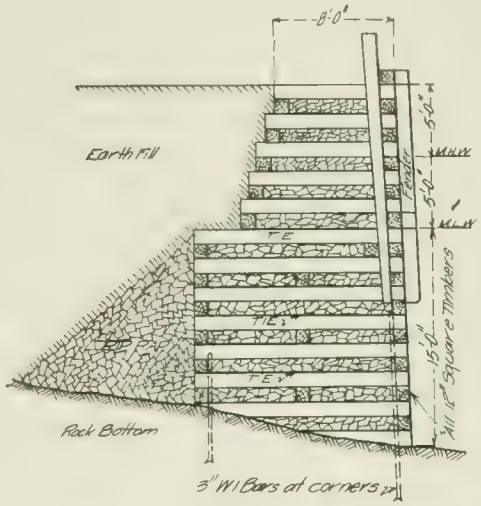

Fig. 3—Crib Bulkhead on Rock Bottom.

together at the corners and splices, the successive corners held together with drift bolts. Mooring piles and string pieces are provided and a deck of 6-in. plank is usually added.

Where timber is cheap and a good hard clay or gravel bottom may be found at a reasonable depth, the crib bulkhead is perhaps the best method of cheap construction, and in good locations its life is from 50 to 75 years.

Crib bulkheads are also used on rocky bottom swept clean by swift currents. See Fig. 4. The cribs are built on shore with the lower courses fitted to the contour of the bottom, floated to the location, held in place by hawsers while being sunk, and then anchored by drilling holes in the ledge at the internal corners of the crib for the insertion of heavy iron bars. A bulkhead of this type in good water should have a life of 50 years or longer.

Pile Bulkhead—Where good bottom is not obtainable at reasonable depths, recourse must be had to piling, and the most ordinary form of pile wharf or bulkhead may be adopted. This consists of four or more rows of piles capped with square timber, placed at about 5 to 8 ft. apart and floored over with planking of suitable thickness. The caps extend 8 or 10 ft. over the earth bank and the projecting ends are supported on a mudsill which also caps the short sheet piling used to prevent the washing away of the earth fill. See Fig. 1. A better construction caps each line of piles with 6x12 in. timbers gained into the pile head. A still better construction gains into the pile head two longitudinal caps breaking joints, the square timber cross sills being above the longitudinal caps and drift bolted to the pile heads. The deck planking should run longitudinally. Mooring piles and string pieces are provided and in the best examples two additional stringers are run on the front row of piles and vertical plank is placed to cut off access beneath the bulkhead. The bracing of pile bulkheads may be accom-

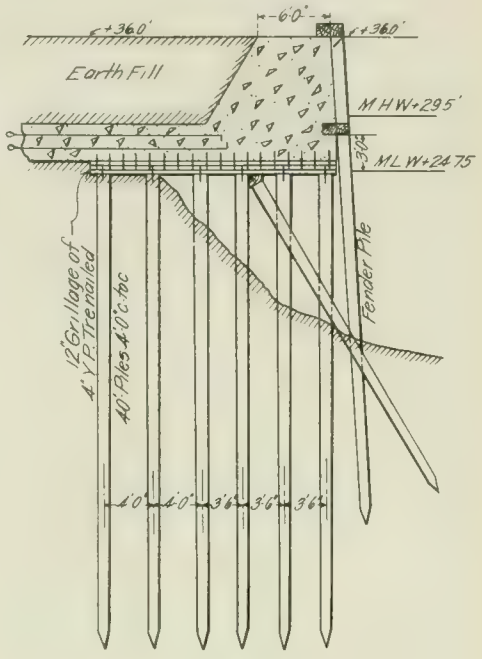

Fig. 4—Kent Avenue Bulkhead, Wallabout Basin Type.

plished either by brace piles (by far the commonest way), driven at an angle, the tops sawed off and bearing against a longitudinal stringer; or by cross bracing between low water and the bulkhead deck. The latter method is much better in ordinary situations as every pile is partially braced, while with the brace pile a slight settlement usually spoils

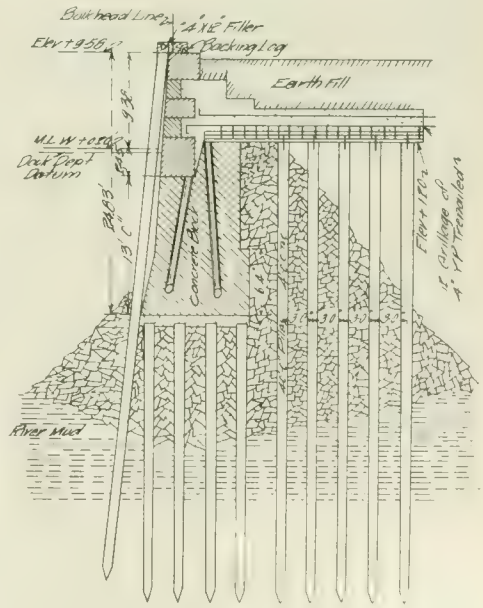

Fig. 5—Standard Bulkhead, Department of Docks, New York City.

the bearing of the brace pile and prevents its action.

Masonry Bulkheads—For important works, with good bottom available, and especially with a high range of tide levels (10 ft. and above) the ordinary stone retaining wall is quite satisfactory and has been much used. This wall is usually built in sections between sheet piling and when properly built is permanent. Seawalls of this type are known to

have been in existence as early as 800 B. C. and have been in use ever since. The masonry wall is possible only when good bottom is available.

Where the tide range is small and the bottom is bad the masonry wall may be built on a plank platform supported on piles. See Fig. 5. The piles are cut off about 1 ft. below low water and capped by two layers of 4 in. planks laid in opposite directions and held in place by trenails. On this platform as a foundation the wall is built in rubble masonry or concrete and carried to the proper height. The plank platform should be carried 10 or 15 ft. back of the wall to act as a relieving platform preventing the thrust of the earth from coming on the piles. Brace piles are also used, a double row, two piles to every cross row. A better method is to tie the masonry wall to a bunch of piles driven in the solid earth about 60 ft. back of the bulkhead by means of iron rods embedded in concrete. This method has been used a number of times and in no case has any outward movement been observed. This type of bulkhead has been criticised as to permanence, but most of the critics agree that it will last 50 years at least.

Where a more permanent and better type of bulkhead is desired, the sea wall (Fig. 6) adopted by the Dock Department of the city of New York may be used. The wall itself is made up of concrete blocks 80 tons in weight. Rows of piles about 2 ft. 6 in. c. to c. are driven and cut off 15 ft. below low water. These piles are covered with a mattress of concrete in canvas bags and the blocks, which are made up on shore, are set up on the mattress. Back of the blocks rows of piles about 5 ft. c. to c. are driven and cut off at low water. These piles are capped with two layers of 6 in. planking laid crossways and held with treenails and drift bolts. This capping extends over a part of the top of the concrete face block. The wall above low water mark is built of granite ashlar backed with concrete and the filling is carried by the relieving platform. Two sets of brace piles are driven in every 55 ft. bay. The bottom is usually prepared by dredging to 18 ft. below low water, and after the piles are driven, sufficient rip rap is dumped between them to consolidate the mud and steady the piles near their upper extremity.

This type of bulkhead is now adopted as the standard bulkhead for Manhattan Island. Where the bulkhead is loaded very heavily and the supporting piles are quite long, the tying in of the bulkhead to heavy construction further inshore has been very successful, no measureable horizontal movement having been observed in a period of 5 years, while in somewhat similar construction depending on brace piles the movement in the same time has been as great as 3 or 4 in.

Where timber is used in bulkhead construction an investigation should be made as to the presence of the "teredo navalis" and "limnoria lignorum." The ravages of these marine borers appear to be confined to the portion of the pile between mean tide and about 2 ft. below the lowest water level, but never below the mud. Creosoted timber is not affected till the dead oil is washed out by the action of the water, but untreated piles are rapidly affected. Near New Glasgow, N. S., a yellow pine pile 14 ins. in diameter was observed to be eaten entirely off by the "teredo" in the course of one season. Similar occurrences are reported from various ports in the West Indies and gulf of Mexico. At Norfolk the life of an untreated pile is only two or three years. In the neighborhood of New York the teredo does not flourish, due to the sewage contamination, but the limnoria is common and destructive. Untreated timber lasts from 5 to 15 years, and much longer when protected by mud. Where creosoted timber cannot be obtained or is too costly the portion of the pile from the mud level to above high water is often protected by a wrapping of tar paper held in place by wooden battens, and this method is effective as long as the battens last. The best and safest method is to creosote the piles, using about 12 lbs. of dead oil of coal tar per cubic foot. Concrete or tile pipes slipped over the piles have also been used as a protection.

Friction Bearing Piles.—In New England waters reasonable good bottom for piles is usually to be found within a reasonable depth and piles longer than 45 ft. are seldom needed. Silt deposits are sometimes found, however, where piles over 100 ft. long are needed, and in one case in my own practice we drove a pile 128 ft. with a settlement of 6 ins. at the last blow. In such a case friction bearing piles are a necessity and four 3x3-in. strips are nailed longitudinally along the pile to give additional surface, and where a very long pile is needed, to act at the same time as splice plates. It is usual to allow from 100 to 300 lbs. per sq. ft. of pile surface in the silt for the supporting power of these piles. In the installation mentioned above (see Fig. 3) 90-ft. piles were used without strips and about 250 sq. ft. of friction surface was available on each pile. The loadings averaged 16 tons per mile and no serious settlement has occurred. The ground back of the bulkhead has been loaded in excess of 1 ton per sq. ft. at various times in the six years since the bulkhead has been in place and a considerable movement outwards has occurred, amounting in some places to over 3 ft. Timber cribs 20 ft. wide on the bottom, 10 ft. wide on top and 25 ft. deep along the side lines of the property have been pressed outwards in some places to the extent of 7 ft. That the movement comes from the center of the property and much below the surface is shown by the position taken by the face of the bulkhead and cribs, which invariably slant inwards at the top. From certain borings made on the property it would appear that solid bottom is at least 2550 ft. below the water level.

Where pile bulkheads are built on sand bottom boulders are frequently encountered at such depths that piling is impossible. Where the boulder is small, 6 to 10 ft. in diameter, I have had a number of heavier piles driven surrounding the boulder, pulling the pile heads into place with chains until the rip rap and grillage could be placed. Larger boulders were broken up with dynamite until a 4-ft. pile spacing could be obtained.

Costs.—Under New York conditions the standard bulkhead in Fig. 6 should cost about $600 per running foot. The bulkhead shown in Fig. 5 and known as the Wallabout Basin type should cost about $225. Pile and crib work depend largely on the timber cost. The First Street wall, Fig. 1, cost about $30 per running foot. The Gowanus Canal wall, Fig. 2, cost about $50 per running foot. In all these examples the piles average 30 to 40 ft. long.

Crude Petroleum As a Timber Preservative.*

With one or two exceptions it has not been possible as yet to formulate any definite results on the treatment of wood, in which crude petroleum (or combinations of it with other things) have been used. It is, therefore, only within my power to give a short resume of the status of the crude petroleum treatments.

It has been only recently that treatment of timbers with crude oil has been undertaken commercially. Two railways have adopted it. The National Lines of Mexico, at Aguascalientes, and the Atchison, Topeka & Santa Fe Ry., at Albuquerque, N. Mex. The former is using the Mexican crude oil, and the latter gets its supply from Bakersfield, Cal.

As yet it is purely an assumption, as to the probable results of this kind of treatment, because it is radically different from all past deductions as to the preservation of timber. Heretofore it has been considered essential to have in the preservative medium an element that was either germicidal or antiseptic in its nature. This new treatment is depending upon an entirely new conception of preservation, namely, the elimination of air or oxygen and moisture. This has for its basis the well-known fact that in order that fungi may thrive, there must be present three essential conditions: moisture, air or oxygen, and the proper temperature.

Therefore, this crude oil treatment gets its impetus from the fact that it probably will be (1) a weatherproofing agent, as the tie is thoroughly impregnated with the oil, and (2) that the fungi will not be able to thrive, from the presence of any moisture which may have been left in the timber previous to treatment, due to the absence of oxygen or air.

The various crude oils which are in use either commercially or experimentally have been examined as to their germicidal or antiseptic properties, and from all known tests covering such work none of them contain any such properties.

The first oil to be used in the United States commercially was the Bakersfield oil. Timbers treated with this oil have been in the experimental track of the Gulf, Colorado & Santa Fe Ry., near Pelican, Tex., for over three years, and some ties taken out recently for examination were entirely free from all indications of decay. This is promising, though not convincing, that the treatment has its merits; that it will preserve the tie for its mechanical life. Recently the Santa Fe Ry. has investigated other oils, more especially a Mexican oil from Ebano. Another oil from Oklahoma has been tried.

Pine has been the principal wood used in the experiments. The gums required a considerable longer time and a higher pressure. Using Ebano oil on gum ties, one experiment gave an absorption of 55 lbs. per tie, yet the ties were somewhat checked from being subjected to such a high pressure (175 lbs.) and a high temperature (200° F.).

There is, apparently, no difficulty in thoroughly impregnating all the sap wood of the different species of pine. In the case of the loblolly, it is thoroughly saturated. All the sap of the shortleaf and some of the heart receive treatment, while with the long-leaf, the penetration is confined entirely to the sap wood.

With cresoted ties, it is not unusual to find that after they have been air-seasoned a year after the treatment they weigh less than they did when treated. Such is not the case with the crude oil treatment. Seasoning tests with the three oils gave the following tie results, after seasoning ten months: 27 ties treated with Bakersfield oil lost an average of 2.6 lbs. each; 30 ties treated with Oklahoma oil lost an average of 14.3 lbs. each; 30 ties treated with Ebano oil lost an average of 14.4 lbs. each.

The crude oils are viscid at ordinary temperatures, but do not affect pipe lines during treatments. The oil is used at a temperature varying from 175° to 200° F.

Checking seems to be reduced to a minimum with this treatment, except in a few cases where it was necessary to use great pressure and high temperatures. On standing any small checks that are former become filled with the oil, which forms a plug against the entrance of any moisture. On seasoning the ties after treatment, the oil has a tendency to form a coating on the outside. This forms a very insoluble covering to the whole tie, very much like the theoretical leather formation which was supposed to form in the Wellhouse process.

The Ebano oil does not mix with thinner crude oils, as it becomes coagulated, forming a sticky mass. At the outset of this treatment, two objections were suggested: (1) The ties would be inflammable, and (2) the spikes would be liable to work loose. Both the objections never existed in actual practice, and no such conditions exist among ties treated with these crude oils.

The success of this treatment depends upon the fact that all the sap wood must be thoroughly impregnated and with all the oil that it is possible to force into them.

The National Ry. of Mexico has not much doubt that the Mexican pine ties will last their mechanical life, which they figure will be about five or six years when treated. They figure the cost to be less than 20 cts. (Mexican currency) per tie, and will answer their special requirements, if they get five or six years' life.

*Abstract of a paper by C. M. Taylor read at the annual meeting of the Wood Preservers' Association, at Chicago, Jan. 19, 1910.

LETTERS TO THE EDITOR.

Observations on the Panama Canal Work.

We are requested by Mr. C. L. Bartlett of Cedar Rapids, Ia., to state that the communication under the above title and above his name, which was published in this column in our issue of Jan. 26, 1910, does not embody the ideas intended to be conveyed in his original manuscript and he therefore disavows the letter as published. This letter was an effort of the editors to arrive at and to express clearly the meaning of our correspondent as truly as it could be determined from his manuscript. The task was undertaken at the instance of our correspondent, who in his letter submitting the manuscript wrote: "Make any changes you may wish to to make it more readable." The editors regret that they were incapable of the task.—Editors.

How to Increase the Efficiency of the Civil Service.

We have received two communications discussing questions raised in our editorial of Feby. 2, 1910, bearing the above title. These letters are signed with pseudonym only. If the writers will send us their real names, not necessarily for publication but as guarantee of good faith, we shall be glad to give space to their very interesting letters. We cannot publish anonymous communications.—Editors.

Comparative Methods and Costs of Underground Conduit Construction.

Sirs: Referring to the article under the above title in your issue of Jan. 5, 1910, we must take exception to the unfavorable comparison which Mr. Mayer has made between fiber and tile conduit. We should very much like to know whether the fiber conduit he mentions in Table I, Comparative Costs, was laid in the same trench or under the same soil, labor and other conditions as the tile which is mentioned in the same table, and if so, where? In view of the fact that a direct statement has been made that it costs 18 cts. per duct ft. to lay single fiber as against 15 cts. to lay single tile, with the same concrete envelope (which statement we beg to take exception to) we think we are entitled to know the particulars of this installation and the original memorandum of cost data on same.

Very truly yours,
AMERICAN CONDUIT CO.,
Per A. G. McClure.

New York, N. Y., Jan. 22, 1910.

Ripley Combination Wood and Concrete Piles—A Correction.

Sirs: In your article, page 122, of the issue Feb. 9, 1910, referring to the Ripley Combination Pile, you state that the manufacture of this pile is controlled by the "Robbins-Ripley Co., Engineers and Contractors, New York City." The Monks-Ripley Pile Co. owns the pile in the United States and West Indies. The Robbins-Ripley Co. owns it in Canada and Mexico. I may possibly have written you concerning the work on the Robbins-Ripley Company's paper, but feel sure that all my letters have been signed "Monks-Ripley Pile Co." I would appreciate it if you would correct this error in your next issue.

Yours truly,
JOHN W. RIPLEY,
Sec. The Monks-Ripley Pile Co.

82 Beaver St., New York, Feb. 10, 1910.

Depreciation of Contractors' Plant.

Sirs: Will you kindly inform me if there are in your files any articles on records of actual depreciation of contractors' plant.

Yours very truly,
JOHN H. LANCE.

Wilkes-Barre, Pa., Feb. 8, 1910.

(In February, 1906, issue of ENGINEERING-CONTRACTING data on this subject were given from records of Messrs. McArthur Bros. Co., as follows: Locomotives, cars, track excavators, power machinery, furniture 1.1 per cent per month; scrapers, wagons, carts, buggies, horses, mules, harness, cook house, bedding, tents, etc., 2.0 per cent per month; boats, scows, docks, marine equipment, 4 per cent per month; picks, shovels, blacksmith's small tools, 5 per cent per month; real estate, buildings, fence, yards, walks, 0.5 per cent per month. These items were given again in ENGINEERING-CONTRACTING, issue of July 15, 1908, p. 49. In the 1906 publication the statement was made that this monthly depreciation allowance does not include the actual current repairs to the plant. While the percentages are called "arbitrary," they are doubtless based upon the long experience of this firm of contractors. The 4 per cent monthly depreciation appears too high for boats and the 2 per cent seems too low for drag scrapers. We believe our readers should be able to give some data on this important subject.—Editors.)

Bonding Concrete to Wood.

Sirs: I am trying to find something to make concrete adhere or bond firmly to wood. I have tried many compounds and chemicals, but find that in most cases they have a tendency to weaken the concrete. It may be that in your experience you have come across something that would accomplish this end. If so, I wish you would kindly communicate with me or publish the same in the columns of your valuable publication.

Yours sincerely,
JOS. M. CLEARY,
Landscape Architect.

San Francisco, Cal., Feb. 1, 1910.

(The swelling of wood when wet and the shrinking while drying, prevent a bond with concrete. When wooden frames have to be set in concrete and it is essential that a close fit be obtained the wood should be well soaked, preferably in oil, to prevent any alteration in shape or size. Then it should receive two or more coats of paint to retain the liquid with which the pores are filled. It will not bond with the concrete but it is customary to drive nails in it with two or three inch spaces between and projecting a couple of inches. The concrete when poured will embed these nails and the heads furnish a grip in addition to the bond of the concrete to the metal.—Editors.)

Earth Pressure on Buried Structures in Trenches.

Sirs: I have just been reading a paper by your Mr. McCullough before the Illinois Society of Engineers and Surveyors on "Culvert and Sewer Design," in January, 1909. On page 113 he gives a formula which is intended to express the result of Mr. Barbour's experiments on the pressure on buried structures, and which appears to show that the ratio of pressure to weight becomes a constant at a depth of about 10 ft. and is equal to about 37 per cent. I am not quite sure that I fully understand Mr. McCullough's meaning, and would like to ask if he intends to say that Mr. Barbour's experiments show that the vertical pressure on the cover of a culvert buried more than 10 ft. is only 37 per cent of the vertical height of the filling directly over it? For instance, suppose a filling 20 ft. deep of sand weighing 100 lbs. per cu. ft. over a box culvert of 4-ft. span. The weight directly over each square foot of the cover is evidently 2,000 lbs. Does the formula mean that the vertical pressure on each square foot is only 740 lbs.? This is certainly very important if correct. Suppose the trench were sheeted vertically and the sheeting left in, how would that modify the formula, if at all?

Yours truly,
E. W. MUENSCHER,
County Engineer, Manistee County, Michigan.

Manistee, Mich., Feb. 7, 1910.

(The paper clearly states that the experiments made by Mr. Barbour showed the transmitted pressure to buried structures, *in trenches*, to be practically 37 per cent of the weight of the filled material, as well as of vehicles passing over the trench, for all depths exceeding 10 ft. The following is an extract from the paper referred to:

Mr. Barbour states as a result of the experiments, in which many different materials were used, that the pressure of earth in a trench is a function of the cohesion of the material, rather than of friction on the sides of the trench, or of the width of the trench.

Mr. Barbour's paper is printed in full in Vol. XIX (1897) "Journal of the Association of Engineering Societies," p. 193. A paper by Professor Ketchum on the cohesion of earth as affecting the tendency of trenches to cave was published in Vol. XL, Transactions of the American Society of Civil Engineers and this was republished in the August 26, 1908, issue of ENGINEERING-CONTRACTING. The experiments of Mr. Barbour on trenches with banks sloped ¼ to 1 indicated that after a depth of 4 ft. the pressure transmitted to the buried structure was 52 per cent of the weight and remained constant for all depths exceeding 4 ft. This fact was taken as lending color to the theory that in *embankments* all the weight directly over a buried structure should be counted. The experiments indicated that the condition of the sides of the trench was a negligible factor.—Editors.)

The Cost of Filtering Water.

Sirs: Can you advise the writer where he can learn what it costs to filter water per million gallons? Also the total cost per million gallons for furnishing filtered water to cities of about 15,000 inhabitants.

Yours truly,
THOS. O. POPE.

Massillon, O., Feb. 7, 1910.

(The cost for furnishing water is not far from $100 per million gallons and the cost of filtering is less than $10 per million gallons, including capital charges. Counting 100 gals. per capita per day the city of 15,000 inhabitants will require 1,500,000 gals. in 24 hours.

In ENGINEERING-CONTRACTING, June 2, 1909, information was given for five slow sand plants from which the following data are taken. Ashland, Wis., daily capacity 1,000,000 gals., the cost for filtering was $2.26 and capital charges were $5.05, making the total cost for filtering $7.31 per million gallons. The cost of the plant was $40,178.

The Berwyn, Pa., plant with a capacity of 1,500,000 gallons per day cost $18,535.59. The cost of operation is not given. The Uyack, N. Y., plant with a daily capacity of 630,000 gals. cost $29,094; cost of operation not given. The Superior, Wis., plant with a daily capacity of 5,000,000 gals., cost $89,485. The cost per million dollars for cleaning sand was $1.48 per million gallons. The cost of a plant treating 70,000,000 gals. per day (slow sand filter) was $3,356,300. The cost of operation is about $2 and with capital charges added is a total of about $9 per million gallons. Mr. J. A. Vogleson gave the following costs for cleaning filter sand per million gallons. Washington, D. C., (1906), $0.60; Albany, N. Y., (1899-1901) $1.66; Belmont, (Philadelphia) Pa., (1905) $1.25; Upper Roxboro (Philadelphia) Pa., (1905) $0.63.

In ENGINEERING-CONTRACTING for July 7, 1909, the following data are given, with references to sources of information: Albany, N. Y., slow sand plant cost for 12,500,000 gals. per day, 1899, $1.67 per million gallons, exclusive of capital charges, the sand cleaning alone being $1.19 per million gallons. During 1899 the cost at Lawrence, Mass., was given at $8.19 per million gallons. During 1900 the cost at Mt. Vernon, N. Y., including interest on plant, $5.51 per million gallons. Cost of scraping sand at Poughkeepsie, N. Y., during 1900, $1.30, and cost of snow and ice removal, $0.48 per million gallons. The estimated operating cost (1899)) for a plant for Cincinnati, Ohio, was $9.96 per million gallons. This plant is now in operation.

In ENGINEERING-CONTRACTING, Nov. 24, 1909, there was an account of the Philadelphia, Pa., filters from which the following operating costs, exclusive of capital charges, are taken. Lower Roxborough, daily average 9,701,700 gals., $5.21 per million gallons; Upper Roxborough, daily average, 13,106,700 gals., $4.46 per million gallons; Belmont, daily average 36,211,400 gals., $3.30 per million gal-

lons; Torresdale, daily average 63,000,000 gals., $2.80 per million gallons.

In ENGINEERING-CONTRACTING Dec. 22, 1910, in an article on the Washington, D. C., filter plant it was stated that it cost $3.66 per million gallons, the daily average being over 61,000,000 gallons.

Slow sand filters, sometimes called the English method of filtration, are filters of large area through which the water trickles slowly with little or no head. Suspended matters slowly collect on the surface and organic matters collect so that bacteria develop and the purification of the water is partly biological. From time to time the surface clogs and must be cleaned, this cleaning being the principal operating expense. Mechanical filters are essentially sand washing machines. They cover much less area than slow sand filters and are generally all under roof. Water stands over the beds with depth sufficient to give a head that forces water through the sand many times faster than through slow sand filters, therefore this method is now generally termed rapid sand filtration. The action is entirely one of straining and to do the work of the mat that slowly forms on the slow sand beds, it is necessary to use coagulants. These coagulants are added to the water in a preliminary settling basin to collect the suspended matter and bacteria, the sand beds completing the work of clearing the water. While rapid sand filters properly operated are efficient in removing bacteria, there is no biological action. The sand beds are washed by reversing the flow of water, thus forcing filtered water back through the sand and carrying off mud, etc., caught on the top. About 5 per cent of the filtered water is used for washing.

The operating costs of rapid sand filters are higher than with slow sand filters, due to the cost of the coagulants and wash water. The capital charges are less because of the smaller amount of land covered and the smaller amount of sand used in the beds. The difference is in favor of the rapid sand filters. As the city grows and land increases in value, extensions to the rapid sand filtration plant are more cheaply made as compared with the slow sand filtration plant. In the slow sand filter bacteria and organic matter are removed and oxidized in a more efficient manner than in rapid sand filters. Recent work however done in sterilizing water in rapid sand filters puts them ahead of slow sand filters as efficient removers of harmful bacteria.—Editors.)

Technical Society Meetings.

The list following names those technical societies in which engineers and contractors are most interested, whose meetings are to be held within three months of the date of this issue. There are given for each society listed the date and place of meeting and the name and address of the secretary, to whom all communications and inquiries should be addressed.

American Institute of Mining Engineers.
March 1-5. Annual meeting at Pittsburg, Pa. Secy., R. W. Raymond, 29 West 39th St., New York City.

American Railway Engineering and Maintenance of Way Association.
March 15-17, 1910. Annual convention at Chicago, Ill. Secy., E. H. Fritch, 962 Monadnock Block, Chicago, Ill.

American Society of Engineering Contractors.
Feb. 24-26, 1910. Annual convention at Chicago, Ill. Secy., Daniel J. Hauer, Park Row Building, New York, N. Y.

American Water Works Association.—April 26-30, 1910. Annual convention at New Orleans, La. Headquarters, Gruenwald Hotel. Secy., J. M. Diven, Charleston, S. C.

Engineering Society of Wisconsin.
Feb. 23-25. Annual meeting at Milwaukee, Wis. Secy., W. G. Kirchoffer, 31 Vroman Bldg., Madison, Wis.

Illinois Association of Municipal Contractors.
Feb. 24-26. Annual meeting at Chicago, Ill. Secy., Orie T. Dunlap, Edwardsville, Ill.

Iowa Association of Cement Users.
March 9-11, 1910. Annual meeting in Cedar Rapids, Ia. Secy., Ira A. Williams, Iowa State College, Ames, Iowa.

National Association of Cement Users.
Feb. 21-25, 1910. Annual meeting at Chicago, Ill. Secy., Geo. C. Wright. Address all communications to Edw. E. Krause, Asst. to the President, Harrison Bldg., Philadelphia, Pa.

Northwestern Cement Products Association.
Feb. 18-21, 1910. Annual meeting at Chicago, Ill. Chairman of Executive Committee, O. U. Miracle, Minneapolis, Minn.

Personals.

Mr. Frank T. Fowler, member of the Board of Local Improvements of Chicago, Ill., has been appointed temporarily as Superintendent of Streets of that city.

Mr. E. G. Johnson has been appointed assistant engineer of the Vincennes division of the Vandalia line and of the Indianapolis terminals of the Pennsylvania line.

Orville A. Henrie, a contractor of Berwick, Pa., died Feb. 10 in the hospital at Washington, D. C., from injuries sustained in the burning of a hotel in that city.

Mr. J. W. Stone has been appointed Acting Division Engineer of the Philadelphia Division of the Pennsylvania R. R., with office at Harrisburg, Pa., succeeding Mr. G. H. Brown, who has been granted leave of absence.

Mr. Elwood Grissinger, of Buffalo, N. Y., has resigned his position as Superintendent and Electrical Engineer of the Genesee Light & Power Co., of Batavia, N. Y. He will continue as Consulting Engineer for the company.

Mr. T. J. Wyche, heretofore Division Engineer of the Western Pacific Ry., with headquarters at Elko, Nev., has been appointed Chief Engineer with headquarters at San Francisco, Cal., succeeding Mr. Virgil G. Bogue, retired.

Mr. M. H. Wickhorst, of Aurora, Ill., Engineer of Tests of the Chicago, Burlington & Quincy R. R., has been made Chief Steel Chemist, in charge of rail tests, by the American Railway Engineering and Maintenance of Way Association.

Frank Hanigan, a well-known contractor and builder, of Denver, Colo., died suddenly last week at London, England. Mr. Hanigan retired from active business life a short time ago, and at the time of his death was on a vacation trip. He came to Denver in 1876.

Mr. I. M. De Varona, heretofore Chief Engineer of the Department of Water Supply, Gas and Electricity of Manhattan Borough, New York City, has been made Chief Engineer of the reorganized department for the entire city, with jurisdiction in all the boroughs.

Mr. Elwin C. Foster, recently President of the New Orleans Railway & Light Co. and formerly Vice-President and General Manager of the subsidiary companies of the Massachusetts Electric Companies, has become associated with Sanderson & Porter, with offices at 52 William St., New York City.

A. S. Bieber, J. C. Griffin and J. B. Joyce, Civil Engineers in the employ of the Ray Consolidated Copper Co., and R. P. Coleman, W. H. Freeland and W. C. Franz, Mining Engineers of Salt Lake City, Utah, were killed Feb. 6 in the wreck of a motor car on a private railway running from Kelvin, Ariz., to the mines of the Ray Copper Co. The car was wrecked by a blast

Dean F. E. Turneaure of the College of Mechanics and Engineering of the University of Wisconsin gave two addresses before the instructional staff of the College of Engineering of the University of Illinois on February 10 and 11. His subject on the first day was "The Stress in Bridges under the Load of Moving Trains," and on the second day, "Some Features of the Manhattan Suspension Bridge."

Mr. Howard G. Hetzler, who was recently elected President of the Chicago & Western Indiana and the Belt Rys., at Chicago, Ill., began his railroad service as Assistant Civil Engineer for the Chicago, Burlington & Quincy R. R. This was in 1886. From 1891 to 1892 he was Engineer of Maintenance of Way for the Louisville, New Albany & Chicago Ry., and from 1892 to 1898 he was Roadmaster of the Chicago, Burlington & Quincy at Chicago. In 1898 he became Superintendent of Freight Terminals for the Burlington, and later was elected President of the Metropolitan West Side Elevated Ry., of Chicago, a position he has held for the past five years.

Mr. A. W. Grosvenor, until recently Assistant Engineer in connection with the Grand Central Station improvements of the New York Central lines at New York City, has opened an office at 311 Bank Block, Fort Waynes, Ind., where he will engage in a civil engineering practice. Mr. Grosvenor was graduated from the Massachusetts Institute of Technology, at Boston, in 1899, and has since been employed consecutively as Assistant Engineer of Maintenance of Way on the Pennsylvania Lines West of Pittsburg; Assistant Superintendent of Caissons with S. Pearson & Son, Inc., on East River tunnel construction at New York City, and Night Superintendent with the United Engineering & Contracting Co., of New York City.

The Turner Construction Co., 11 Broadway, New York City, has recently reorganized its branch office at Buffalo, N. Y., and has given up its old quarters at the Builders' Exchange Building to occupy its new larger offices at 312 Prudential Building. This organization has put the Buffalo branch office on an independent basis, so that the branch will be able to handle jobs independent of the main office in New York City. Mr. James L. Bruff will continue as Manager of the Buffalo territory; Mr. H. E. Plumer, who has been associated with the Company at its main office during the past four years, will be the Engineer; Mr. Wm. E. Lyle, now acting as Superintendent for the Company on the buildings being erected for the Pierce-Arrow Motor Car Co., will be General Superintendent.

Catalogs Worth Having.

Engineers and contractors should have on file the latest catalogs of machines, tools and supplies that they use. In sending for catalogs reviewed or advertised in this paper, you will confer a favor on us if you will write directly to the advertisers and state that you saw the catalog mentioned in ENGINEERING-CONTRACTING. If you are in the market for tools, machinery or supplies, tell us and we will notify promptly the leading manufacturers.

Trident Water Meters.—Paper, 8x10 ins. 62 pp. Neptune Meter Co., New York, N. Y.

This catalogue contains full information about water meters made by this company. All details are illustrated and tables of capacity given.

The Lehigh Valley.—Paper. 5x7½ ins. 48 pp. Blanc Stainless Cement Co., Allentown, Pa.

A beautiful little brochure containing a historical sketch of the Lehigh Valley and illustrated with half-tones of noted buildings.

Rock Drills.—Paper. 3½x6 ins. 30 pp. McKiernan Drill Co., 115 Broadway, New York City.

This is the 1910 catalogue of McKiernan Rock Drills.

The Svenson Mixer.—Paper. 5½x8 ins. Svenson-Schuman Company, Bessemer Building, Pittsburg, Pa.

Describes a continuous delivery, automatic proportioning concrete mixer, that mixes first dry and then wet.

Concrete Machinery.—Paper. 6x9 ins. 40 pp. The McKelvey Machinery Co., Cleveland, O.

Describes McKelvey continuous and batch mixers and illustrates many combinations and installations of the mixers in actual use. Cars and buckets are also shown.

Symons Crushers.—Paper, 6x9 ins., 38 pp. The T. L. Smith Co., Old Colony Bldg., Chicago, Ill.

This catalog shows evidence of preparation by a man who understands how to give information to practical men. Stone crushing plants are illustrated and tables given to show sizes and capacities and horse power required, together with a new table showing percentages of crushed stone which will pass through screens of different sizes.

Pile Driving Machinery.—Paper, 6x9 ins., 32 pp. Union Iron Works, Hoboken, N. J.

A valuable book for contractors illustrating the use of Arnott's Patent Steam Pile Hammers in driving piles, especially sheet piling.

Keays Cable Grip.—Paper, 5x7 ins., 8 pp. Keays Cable Grip Co., 95 Liberty St., New York, N. Y.

Describes a reliable and efficient device for handling industrial cars on the cable haulage system.

Elevator Controllers.—Paper, 5x8 ins., 128 pp. The Cutler-Hamner Mfg. Co., Milwaukee, Wis.

This book describes the newly re-designed line of electric elevator controllers recently placed on the market by this company. It should be of value to structural engineers, mill designers and architects. Full information is given as to sizes, installation and operation.

The Contractor's Pump.—A. A. Parker, Waterford, N. Y.

This circular describes a new style of motor driven diaphragm pump for contractors' use. Mr. Parker is a contractor and the pump was evolved by him to meet his own needs in pumping out excavations. The valves will pass anything large enough to get through a 3-inch suction.

The Freezing of Concrete.—The Carbondale Calcium Co., Carbondale, Pa.

This company sends in several valuable bulletins dealing with the prevention of freezing in concrete by the addition of calcium carbide. Tables are given showing how to proportion water in mixing concrete and how much calcium chloride to use with certain amounts of water.

Chanute Medal Award.—Professor Arthur N. Talbot has been awarded the 1909 Civil Engineering Chanute Medal of the Western Society of Engineers for his paper entitled "Tests of Cast-Iron and Reinforced Concrete Pipes." Three medals on the foundation established by Dr. Octave Chanute are given annually by the Western Society of Engineers for the best paper read the preceding year in the lines, respectively, of Civil Engineering, Mechanical Engineering and Electrical Engineering.

Contract News Section

of

ENGINEERING-CONTRACTING

A Consolidation of Engineering-Contracting—Contract News—Engineering World—The Dirt Mover.

Containing Items of Interest to Railroad, Public Works and Other Contractors.

The Doings of the Week.

The principal feature on the week in railroad construction work was the awarding of contracts by the Norfolk & Western Ry. for a considerable amount of double track and branch line work in Ohio and West Virginia; the contractors who got in on this work were as follows: D. W. Flickwir, Roanoke, Va.; J. R. Sarpell & Son, Louisville, Ky.; Luck Construction Co., Roanoke, Va.; Carpenter & Boxley, Roanoke, Va.; Moorman Bros., Lynchburg, Va.; Ryan Co., Lexington, N. C.; E. G. Nave Bros. Co., Portsmouth, O., and Sturm & Adams, Columbus, O.—The Callahan Construction Co., Knoxville, Tenn., secured the contract from the Louisville & Nashville R. R., for constructing the Harlan extension on the Wasioto & Black Mountain R. R. in Kentucky. The extension will be about 25 miles long with a yardage of 600,000, mostly rock.—The Cincinnati, Hamilton & Dayton R. R. has awarded the contract for its new dock and freight terminal at Toledo, O., to the Great Lakes Dredge & Dock Co., of Toledo.—Another large contract, which we are unable to confirm at this writing, is said to have been let to F. S. Darling, Toronto, Ont. This contract calls for the construction of the Alberta & Great Waterways Ry. which is to be 350 miles long and will extend from Edmonton, Alberta, to Fort McMurray.—A couple of large stripping contracts in the iron range in Minnesota were awarded during the past week. Winston, Dear & Co. secured one of these calling for the stripping of the Buffalo & Susquehanna iron mine, the work requiring about 6,000,000 cu. yds. of excavation. The other contract was secured by the Roberts-Kingston Co., of Duluth; it calls for stripping the Union mine of the Republic Iron & Steel Co., near Virginia mine. There is about 1,250,000 cu. yds. in this contract.—Matters are shaping up so that it now looks as though the Duluth, Winnipeg & Pacific Ry. (Canadian Northern line) would shortly let the contract for constructing its 75 mile line from Virginia, Minn., to Duluth. H. T. Hazen, 619 Lyceum Bldg., Duluth, Minn., is Chief Engineer.—The city of Chicago is going to take active steps soon for the construction of its long projected subway system. The city has $4,500,000 available to start the work, and recently appointed Bion J. Arnold, Chicago, as Engineer to have charge of the subway construction.—The Big Four (C. C. C. & St. L. Ry.) has announced a considerable amount of new construction work to be done this year, the work including two pieces of second track, a 7½-mile cut-off and a new line for Mt. Carmel, Ill., to Evansville, Ind.

Trunk Line Highways.

One of the most interesting developments of the Good Roads movement has been the agitation for the construction of additional trunk line roads—continuous stretches of improved highway connecting important cities. In the eastern states before the advent of the steam railroad all the important cities were connected by continuous lines of highway, which were, in most cases, about the only really passable roads in the neighborhoods through which they passed. Many of these highways were built by private capital and toll was charged for the teams pasing over them. Perhaps the best example of these old time lines of continuous highway was the National Road which was constructed by the Government under a special act of Congress. As originally planned this road was to extend from the tidewater of the Atlantic ocean to the Ohio River. It was, however, built from Cumberland, Md., to a point in Ohio, several hundred miles from the Ohio River, and there allowed to stop. The road was several hundred miles long, and was 80 ft. wide, 30 ft. of which was macadamized. With the coming of the railroads and the consequent passing of the stage coach many sections of these old highways were neglected and fell into disrepair. The advent of the automobile has brought about a demand for a revival of the old trunk line highways and many eastern states have harkened to the demand. New Jersey has a number of such highways crossing the state, and New Hampshire is now constructing a highway to extend from the lower border of the state up the Connecticut River valley to the White Mountains. At the Massachusetts state line connections will be made with trunk lines from that state. In New York the State Highway Commission has been engaged in locating 38 of these state through routes, and contracts for $2,500,000 worth of work on these will be let shortly.

Water Power Conservation.

The state of New York, which is now spending a large sum in constructing its barge canal and on state highway work, will offer a further field for the contractor if the State Legislature takes favorable action on the recommendations of the Water Supply Commission. The Commission has just recommended an amendment to the constitution permitting an issue of $20,000,000 of state bonds for the building of storage reservoirs with a view of generating electric power and controlling the water flow of the streams of the state. The commission estimates that 1,500,000 H. P. of water energy is running to waste in the state annually and that this energy, if properly controlled, would have a yearly rental value of $15,000,000. The bill which accompany the commission's proposed plan of operation provided for a general and systematic development of the water resources of the state. Under its provisions the initiative for building storage reservoirs may be taken by individuals, associations or corporations subject to the recommendations of the commission and the approval of the governor. All contracts for the acquiring of lands and the construction of reservoirs by the commission must have the governor's approval. It is recommended that the first water storage dam be constructed at Conklinville on the Sacandage River 50 miles north of Albany. This would convert 30 miles of the present river valley into an artificial lake as large as Lake George, the cost being estimated at $4,650,000. The annual fixed charges and maintenance are estimated at $337,700, while the gross earnings of the plant from the sale of electric power would be $427,500, leaving an annual net revenue to the state of $189,000. The Genessee River dam and reservoir at Portage would cost $4,518,000. The commission recommends the construction of other reservoirs by the state for the purpose of regulating the flow of the rivers for power purposes and flood control whenever the owners of the interests which will be benefited by such control shall ask by petition the state water supply commission to build such reservoirs and furnish a sufficient guarantee that such reservoirs when completed will provide a net revenue to the state.

Busting the Trust.

The city of Los Angeles lately advertised for bids to supply the city with approximately 110,000 bbls. of Portland cement. A number of bids were received and the price was $1.85 per bbl. The reading of the prices was monotonously proceeded with and interest in the subject was suddenly awakened by a bid in which no price was fixed; the bidder merely stating that he was prepared to furnish cement at 10 cts. per bbl. lower than any legitimate bidder. Logically this meant $1.75 per bbl., but to the business men of the Council it gave an opportunity to "bust the trust" and do some trading. The trust was busted and the man was so rigidly held to his offer to underbid that he sold the city of Los Angeles all the cement required for $1.35 per bbl. The saving was about $60,000 and may be more by the time all the cement is purchased.

The Southern Pacific is said to be planning to enlarge its yards at Bowie, Cal., by the addition of several miles of siding.

Confirmed Reports by Engineers and Contractors

RAILROADS, POWER DEVELOPMENTS, LEVEES, DRAINAGE AND IRRIGATION WORKS.

Railroads—Steam and Electric.

INDIANA.

The Cleveland, Cincinnati, Chicago & St. Louis Ry. is to undertake the following new construction work this year: A second track from Indianapolis to Anderson on the Indianapolis Division, a second track from Shelby to Greenwich on the Cleveland Division, a 7½-mile cut-off from Middletown to Miamisburg on the Cincinnati Division, and a new line from Mt. Carmel, Ill., to Evansville, Ind.

KENTUCKY.

The Louisville & Nashville R. R. Co., has awarded the Callahan Construction Co., Empire Bldg., Knoxville, Tenn., the contract for what is known as the Harlan Extension of the Wasioto & Black Mountain R. R., commencing from near Pineville, Ky., and extending through Bell and Harlan counties to Harlan, Ky., a distance of 25 miles. The yardage will approximate 600,000 yds., mostly rock, with some good scraper work, and about 10,000 yds. of cut stone and concrete masonry. The material is very fine, being sandstone, shale, earth, etc. Mr. E. R. Keller, general superintendent of the Callahan Construction Co., will be in charge of the work and is now located at Pineville, Ky. The work includes one tunnel about 520 ft. long with small approaches. All good work for contractors with this sort of equipment.

MISSOURI.

Mulvill Brothers, P. O. Box 81, Alton, Ill., have been awarded a contract by the Chicago & Alton R. R. for putting in tracks to the new quarry the railroad intends to operate between Selsa and Independence, Mo., 14 miles from Kansas City. The company has purchased 80 acres which is half a 50 foot ledge. This makes a very desirable quarry location, the rock being of good quality with no stripping on it. About 16,000 ft. of track is to be laid. Mulvill Bros. will sublet the team work, amounting to 7,000 yds. embankment, 4 ft. fill; free transportation for men and outfits.

OHIO.

The Cincinnati, Hamilton & Dayton R. R. has awarded contracts for its dock, ore handling plant and freight terminal at Toledo, O. The Wellman-Seaver-Morgan Co., Cleveland, O., was awarded the contract for the ore handling plant and the Great Lakes Dredge & Dock Co., Toledo, O., was awarded the contract for the dock and dredging. The latter contract includes 300,000 cu. yds. of earth excavation, 22,000 cu. yds. of concrete masonry, 300,000 lin. ft. of piling and dredging 300,000 cu. yds.

The Norfolk & Western R. R. has awarded contracts as follows for second track work and branch line work in Ohio and West Virginia: D. W. Flickwir, Roanoke, Va., 3.2 miles of branch lines work on Indian Creek above Cedar Bluff, including 4,700 ft. tunnel. J. H. Sarpell & Son, Louisville, Ky., three miles of double track, including tunnels, east of Huger, W. Va. The Luck Construction Co., Roanoke, Va., three miles of double track west of Wyoming, W. Va. Carpenter & Boxley, Roanoke, Va., three and a half miles double track west of Wharncliffe, W. Va. Moorman Bros. Co., Lynchburg, Va., three and a half miles double track east of Devon, W. Va. Ryan Co., Lexington, N. C., eleven miles double track in Ohio west of Davis. E. G. Nave Bros. Co., Portsmouth, O., seven miles double track east of Piketon, Ohio. Sturm & Adams, Columbus, O., six miles double track between Renick and Delano, O. A. H. Valz, Staunton, Va., .8 miles Dry Fork Branch Extension.

PENNSYLVANIA.

The Easton & Washington Traction Co. is making arrangements to secure the necessary capital for the construction of its 43-mile line through Hackettstown, Lake Hopatcong, High Bridge, Clinton, Oxford and Belmer. M. P. McLeath, Easton, Pa., has the contract. R. M. Petby, Washington, N. J., is president and W. O. Hay, Easton, Pa., is general manager.

TEXAS.

The Texas Central R. R. has run one preliminary line for its branch from DeLeon to Rising Star and location work is now under way, over 16 miles of the line having been located on Feb. 4. On the proposed Rotan extension one preliminary line of about 100 miles has been run and the chief engineer is now running preliminary on another line several miles south of the first preliminary. The ties and rails have been purchased for the DeLeon branch, but no contracts for earth work or bridge work have been let nor will be until the location is completed and estimates made. Chas. Hamilton, Waco, Tex., is vice president and general manager.

WASHINGTON.

O. F. Leonard, Railroad, Canal and Drainage Contractor, North Yakima, Wash., will sublet 50,000 yds. of wheelbarrow and car work, limit of haul is 2,400 ft., cuts 18 ft. wide, 1 ct. overhaul after 600 ft.

WEST VIRGINIA.

The Buckhannon & Northern R. R. Co. will probably let construction contracts this spring for its projected 32-mile line from the Pennsylvania-West Virginia State Line along the Monongahela River to Riversville, W. Va. Surveys were made in 1907 and are being revised this year. J. T. Blair, Parkersburg, W. Va., is president; S. D. Brady, Parkersburg, is chief engineer, and B. M. Laughead, Morgantown, W. Va., is locating engineer.

Power Developments, Levees, Drainage and Irragation Works.

CALIFORNIA.

The South San Joaquin Irrigation District has been organized under the Wright Law and proposes the irrigation of about 70,000 acres of land. A bond issue of $1,875,000 has been voted and as soon as these bonds are sold the work will be commenced. The district is located in the southern part of San Joaquin County. In connection with the irrigation system, plans have been made for a drainage system to control the underground water level. Edwin Duryea, 1314 Humboldt Bank Bldg., San Francisco, Cal., is Chief Engineer of the district.

The Stockton Chamber of Commerce, J. M. Eddy, Secretary, Stockton, Cal., has launched a project for the construction of a reservoir in the foothills to control the freshets of the Calaveras River. The undertaking is still in its infancy, although an organization is contemplated to promote such a construction in behalf of the public welfare, and it is probable that an incorporation will be formed to secure the rights and promote the financing of it with a view of turning it over either to the county, the city of Stockton, or to a district to be formed for the purpose. At the present time, no steps have been taken farther than filing on the water, investigating the capacity of the dam, consulting with engineers regarding its feasibility, and taking steps to secure the dam site and the acreage covered by the reservoir.

IDAHO.

The Portland Wood Pipe Co., Portland, Ore., has been awarded the contract for furnishing the material and construction of 25,500 ft. of 42-in. continuous stave pipe for the irrigation system at Port Falls, Idaho, mentioned in these columns in our Jan. 12 issue. The line will require approximately 640,000 ft. of lumber milled into staves, approximately 365,000 lb. of mild steel bands of ½-in. and ⅝-in. diameter, and about 40,000 lb. of malleable cast iron shoes. Construction work will begin about the middle of March.

LOUISIANA.

Damerin & White, Hennen Bldg., New Orleans, La., have been awarded the contract for constructing David's Ferry South Levee No. 2 for the Red River and Bayou des Glaises Levee and Drainage District. The work includes the placing of about 350,000 cu. yds. of material and the contract price is 25 cts. per cubic yard. Bids were opened Feb. 1.

NEW YORK.

David Peoples, Betz Bldg., Philadelphia, Pa., has been awarded the contract for constructing seven steel pipe siphons, and adjoining portions of the Catskill Aqueduct for the Board of Water Supply of New York City. Bids for the work were opened Jan. 18, and the contract price was $1,189,500. The contract includes 30,000 cu. yds. removal of rock, 90,000 cu. yds. earth excavation, 20,000 cu. yds. rock excavation, 140,000 cu. yds. refill and embankment, 43,400 cu. yds. concrete, etc.

OREGON.

The Oregon Valley Land Co., with general offices at 101 Massachusetts Bldg., Kansas City, Mo., and field office at Lakeview, Ore., is building an irrigation system in the vicinity of Lakeview at an estimated cost of $750,000, of which it has spent to date about $280,000. Last July, the company let a contract to the Hall Construction Co., of Los Angeles, Cal., for construction of one of its main canals, requiring the excavation of about 600,000 cu. yds. of material, of which 50 per cent was loose rock and 15 per cent was solid rock. This contract has now been completed and another contract has been let to the same party for one other main canal, amounting to about 500,000 cu. yds., which they will complete by next July. The Orchard Valley Land Co. will let to contract not later than next April 1st the following: A loose rock dam, 62 ft. high and 600 ft. long on top, and containing the following approximate quantities:

Loose rock fill, 40,000 cu. yds.
Hand-laid dry wall, 15,000 cu. yds.
Wasteway (Exc.), 15,000 cu. yds.
Masonry, 2,000 cu. yds.
Lumber in facing, 150,000 ft. B. M.

The company has already built an outlet tunnel and stripped the foundation to bed rock. The sluice-gates were made by the Coffin Valve Co., Boston, and are on the ground ready for erection. An additional contract will be let for about 3½ miles of flume, about half of which is on bench and remainder on trestle, with bents up to 30 feet high, although the average height is about 18 ft. This will require about 2,500,000 ft. B. M. of lumber and one or more cars of ⅝ bolts. About ⅔ of the lumber to be used is within a mile of a saw-mill operated by the company. The company will also have somewhere in the neighborhood of 500 miles of laterals of different dimensions to let next summer.

The Orchard Valley concern has under consideration at the present the following: One earth dam, 80 ft. high and 1,000 ft. on top, approximating 200,000 cu. yds., 20 miles of canals beside laterals, all within 15 miles of Lakeview. One earth and loose rock dam about 60 ft. high and approximating 100,000 cu. yds., and 50 miles of canals, beside laterals, all within 30 miles of Lakeview. Only preliminary work has been done on these so far and plans are not yet completed. G. W. Rice, Lakeview, Ore., is Chief Engineer in charge of the work.

Items Concerning Contractors and Their Work

RAILROADS, POWER DEVELOPMENTS, LEVEES, DRAINAGE AND IRRIGATION WORKS.

Alabama Notes.

FROM CORRESPONDENTS AND OTHER SOURCES.

The city council of Bessemer has granted a franchise to the Birmingham Light & Power Co. to construct tracks and operate lines on Second Ave., 18th St., First Ave., 20th St. and Fourth Ave.

The Atlanta & St. Andrews Bay R. R. recently completed from Dotham, Ala., to St. Andrews Bay, now proposes to extend the line to Opelika, Ala., a distance of 90 miles, crossing the Seaboard from Montgomery to Cordele, the Central of Georgia from Montgomery to Eufaula. B. W. Teele, Dothan, Ala., is general manager and chief engineer.

Advices from Mobile state that the Mississippi Central, the New Orleans & Great Northern and the New Orleans, Mobile & Chicago, formerly the Mobile, Jackson & Kansas City Ry., are to be merged, the object being the establishment of a new trunk line between Chicago and the gulf coast with New Orleans as the southern terminal. The plan provides for the New Orleans, Mobile & Chicago R. R., W. F. Owen, general manager, Mobile, Ala., to extend its tracks from Middletown, Tenn., to Cairo, Ill., 180 miles. This will be the northern link of the new route. Later on it will extend into Chicago. Meanwhile traffic arrangements will take the line into the lake city. The southern link necessary to complete the trunk system will be built between Columbia, Miss., and Hattiesburg. This is only 27 miles.

The Louisville & Nashville R. R. has completed plans and specifications for its new shops to be erected at Boyles, a few miles north of Birmingham. About $650,000 will be spent on the shops and an additional sum for side tracks. Contracts are to be let at once. The work is in charge of T. Q. Harrison, division engineer, Birmingham.

Citizens of Anniston, Ala., are taking active steps to secure the construction of the branch line of the Seaboard Air Line Ry. to that city from Jacksonville. Surveys for the line have already been made. W. L. Seddon, Portsmouth, Va., is chief engineer of the company.

The Hodges-Downey Construction Co. of Birmingham, has been organized with a capital stock of $100,000 fully paid, and will engage in a general construction business for railways, canals, public and private highways. Officers are: James Downey, president and general manager; H. C. Hodges, vice president; J. C. Hodges, secretary and treasurer.

Arkansas Notes.

FROM CORRESPONDENTS AND OTHER SOURCES.

Ground has been broken at a point three miles south of Rogers, Ark., for an extension of the Arkansas, Oklahoma & Western R. R. to Bald Knob, a distance of 172 miles east. M. Hays, Rogers, Ark., is chief engineer.

Citizens of Cotton Plant, Ark., are taking steps toward securing the construction of a railroad from that place to the Caché River.

The Fort Smith & Interurban Ry. Co., has been chartered with a capital stock of $100,000, and headquarters in the Cotton Exchange Bldg., Fort Smith, Ark. The projected route is from a point in the northern part of Fort Smith in a northeasterly direction to a point beyond the city limits where a spur will be built toward the proposed free bridge. The main line will turn southeasterly and running near the Arkansas River will enter Mazzard Prairie about half way between McNally hill and Little Mazzard Creek, and will extend across the prairie, dividing the section lying between the Fort Smith suburban and the Arkansas Central lines, crossing Fort Towson, or Texas road, and coming into Wheeler Ave. near the southern limits of the city, where another Y will be made and the line extended to Bonanza, Jenny Lind and Greenwood. George Sengel is President and Jerome Sengel is Secretary.

California Notes.

FROM CORRESPONDENTS AND OTHER SOURCES.

The Harbor Improvement Co., T. J. Hampton, president, Santa Monica, proposes the construction of breakwaters and wharves and has obtained options on water front land. The plans of the company call for the construction of a sea wall, completely protecting three long wharves, which will be able to accommodate the largest ships afloat.

The Redlands & Yucaipa Land Co. of Redlands is considering abandoning its plan to build an electric line connecting the valley with Redlands, and may turn over the right-of-way, surveys and work already completed to E. H. Huntington, who is said to contemplate the extension of the Redlands Central line on Citrus Ave. through Sand Canyon to the valley. Engineers of the company are said to have completed a survey and prepared a report for the directors and an early decision is expected. The line would be about ten miles in length and of this one mile has been constructed and material is at hand for more.

One of the heaviest pieces of railroad construction work now under way in California is the Rocklin-Colfax cut-off on the Southern Pacific Ry. Work on this cut-off was started last March and will probably be two years before it is completed. Erickson & Peterson, 841 Monadnock Bldg., San Francisco, the contractors for the work, have had 3,000 men at work on the Rocklin cut-off, extending from Rocklin to Clipper Gap, along the line of the old Central Pacific, in reconstructing a part of the old roadbed and double tracking others a distance of 20 miles. In the distance named the contractors are cutting eight tunnels, having an aggregate length of almost 10,000 ft., one of the heaviest and longest of these being through Clipper Gap mountain. The contractors have on the ground, distributed along the line of work, 14 steam shovels, 30 locomotives, 600 head of stock, 14 construction camps and all the equipment necessary to a railroad contract of this nature.

The Del Norte Southern Ry., financed by Hobbs, Wall & Co., of San Francisco, and operating in Del Norte county, will be extended southward about eight miles this summer. This line will eventually connect with the Southern Pacific chain of roads in Humboldt County.

The Central California Traction Co. has secured water front land at X St. in Sacramento and will soon start work there on its water front terminal. The line is now under construction between Sacramento and Stockton.

The formation of a new river protection district comprising the territory lying between Olive and the Newbert protection districts is proposed and a committee made up of J. A. Knapp of Anaheim and C. S. Holt and W. W. Mills of Garden Grove have asked the board of supervisors to indorse the scheme.

The Southern Pacific has surveys under way in Colusa county on the new cut-off which is intended to shorten running time between San Francisco and Portland. The cut-off will be constructed between Colusa and Rumsey and will give the Southern Pacific a shorter route by way of Elmira, Rumsey and Colusa Junction.

The commissioners of the Northwest Long Beach Stormwater District of Long Beach have recommended to the county supervisors that the district be extended to include 2,000 more acres. It is urged that the proposed dredging of the channel through the district as far north as the Los Cerritos trestle would benefit this other property. The district now includes 4,000 acres.

Agents supposed to be representing the Mojave River Power Co. are now working in the Mojave River district securing options on lands and water rights. The Mojave River Power Co. is composed of wealthy San Francisco and Oakland men, who have taken over the Westwater power and water interests, including the Victorville reservoir site. It is said that within 90 days this syndicate will commence the construction of the reservoir at Victor Narrows, and that the power will be used at Los Angeles.

It is reported here in Sacramento that as soon as the Northern Electric R. R. secures the permission of Sacramento and Yolo counties and the government to erect a bridge across the Sacramento River from Sacramento the extension of the line to Woodland will be undertaken.

The Butte & Tehoma Power Co. has had preliminary work started on its proposed power plant on Mill Creek, 14 miles south of Lyonsville.

The Sevier Light, Power & Milling Co. of Salina, has acquired the property of the Salina Mill & Power Co. and will spend $50,000 for improvements. A power plant will be erected on Rattlesnake site in Salmon canyon. This will furnish light for the Gunnison and Sevier valleys, and also power to the present roller mill and also to a gypsum mill of 400 tons capacity, which it is proposed to erect. The new company is capitalized at $100,000.

The San Diego, El Cajon & Escondido Ry. Co., recently organized to construct 60 miles of railway into the interior of San Diego county, has applied to the Board of Harbor Commissioners for a franchise to construct a wharf and pier at the foot of E St. in San Diego, Cal.

Engineers of the Atchison, Topeka & Santa Fe Coast Lines are making preliminary surveys for the proposed branch line from Mentone in the Yucaipa Valley, above Redlands, Cal. H. C. Phillips, Los Angeles, Cal., is chief engineer of the company.

The Central Mission and Hayes Valley Improvement Club are to take action in the interest of the franchise for the cross-town street car line on Gough St., Mission, Cal.

Citizens of Lockeford, Cal., have turned down the proposition of the Central California Traction Co. to construct a branch line from either Norton Station or Lodi and assert that right-of-way and other inducements will be offered only to a company who will construct a direct line from Lockeford to Stockton, Cal.

Peter Hoare, Hayward, has been awarded the contract for constructing the loop line of the Southern Pacific Co. in Oakland. The company has commenced the demolition of 16 houses on its right of way through Melrose to Elmhurst.

The Northern Electric Ry. Co., which operates a line between Sacramento, Marysville, Oroville and Chico, has secured rights of way across Los Molinos colony, twelve miles below Red Bluff. The right of way was granted free on condition that the railroad be extended from Chico to Los Molinos before the end of 1910, and on to Red Bluff before the close of 1911. Other necessary rights of way have nearly all been secured. The deeds just filed cover twelve miles of the distance between Chico and Red Bluff. The company will also soon build from Yuba City through Meridian and Colusa to Hamilton City.

The matter of constructing an electric street railway from Corte Madera through Ross Valley towns and San Rafael to McNears Point is under consideration. John Foge, San Rafael, is interested.

The Golden Gate Valley Improvement Association of San Francisco, has petitioned the Supervisors to offer either the United Rail-

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roads or the Presidio and Ferries Railroad a franchise for a car line on Chestnut or Greenwich Sts.

Colorado Notes.

FROM CORRESPONDENTS AND OTHER SOURCES.

The Incline Ry. Co. of Colorado Springs has secured all the right of way for its projected incline railway up the slope of Mt. Manitou.

The Arizona & Colorado R. R., a Southern Pacific line, is planning to have work started shortly on its projected branch toward Globe, Ariz., via Lordsburg, N. Mex. Incorporation papers have been prepared in Santa Fe, N. Mex., for the Arizona-Colorado Railroad Co., with capitalization of $4,000,000, to build a branch line of the Southern Pacific from Lordsburg through western New Mexico, to Durango. L. H. Lord, Tuscon, Ariz., is assistant chief engineer, Arizona & Colorado R. R.

The Greeley Construction Co., Greeley, has been awarded the contract for building the McGraw reservoir for the Greeley-Pondee District. The work amounts to about $100,000.

The Plateau Valley R. R., recently incorporated by Patsey McCaffrey, L. T. Stewart, T. H. Brown, Morgan Hall and John Carlisle of De Beque, Colo., and the Plateau Valley, is reported to have secured the necessary capital for the construction of its proposed steam railroad to the Plateau Valley. Surveys for this road were made in 1906.

It is believed here in Denver that construction work will be started early this spring on the Arizona & Colorado Ry. It is said that a construction company is to be incorporated shortly under the laws of New Mexico witn a capital stock of $4,000,000 to have charge of the construction of the road. The new line, which is a Southern Pacific project, will start at a point near Clifton, Ariz., cross over into New Mexico and go almost directly north. It will cross the Navajo Indian reservation for almost its entire width and follow the Rio Chaco up to Fruitland, a point a few miles west of Farmington, N. Mex. It will then turn east to Farmington. An extension will then be continued north up the La Plata River to Hesperus, Col., or some point in that vicinity. If trackage agreements are not made with the Denver & Rio Grande the road will build up the Las Animas direct into Durango. The new line will cost approximately $4,000,000, and will be built under the direction of Epes Randolph, President, Tucson, Ariz. Wm. Hood, San Francisco, Cal., is Chief Engineer.

The Toll Gate Reservoir & Irrigation Co. of Denver, has been incorporated with a capital stock of $100,000, the incorporators being A. D. Annis, A. J. Simonson, and Arthur Ponsford.

The city council of Fort Morgan has passed the ordinance vacating the streets and alleys crossed by the new Union Pacific right of way through the heart of the city and also granting it 30 ft. along Railroad Ave.

The Denver, Laramie & Northwestern R. R. Co. has filed its charter in Wyoming and will, it is reported, take over the holdings of the Denver, Laramie & Northwestern Ry. It is said the company is planning extensive developments in Wyoming with 200 miles of construction work promised for this summer. E. A. Buck, 511 E. & C. Bldg., Denver, Colo., is chief engineer.

Work has been resumed on the Nederland dam of the Central Colorado Power Co., near Boulder. About 50 men were sent to the camp on Feb. 1 to put the concrete mixing plant in shape to resume construction of the dam, which will be 186 ft. high, of solid concrete and has been completed to a height of about 100 ft. The company expects to commence storing flood waters in the reservoir next spring, and will push the dam, expecting to have the plant ready to deliver energy by July 1.

Advices from Salida state that the O. K. Mining & Developing Co. has commenced work on its 3,000-ft. tunnel through the Big Four mountain, in the Cleora district. The tunnel will be called the Big Four.

The stockholders of the DeWesse-Dye Ditch & Reservoir Co. at a meeting at Canon City accepted a proposition allowing the Colorado Southern Irrigation Co. to construct a dam in Grape Creek canon in Custer county, for the conservation of the flood waters. The dam which the latter company proposes to build will be nearly 200 ft. high, and will cost $500,000.

Work has already been commenced upon the Little Dry Creek reservoir between Platteville and Fort Lupton by Charles C. Woodward, Prairie City, Ia. The estimated cost of the improvement is $25,000. Mr. Woodward is also interested in the J. S. ditch and reservoir in that vicinity, which is estimated to cost $14,000.

The Big Dry Creek Ditch & Reservoir Co. of Brighton, Colo., has secured a renewal of its charter. Daniel Brown is president of the company.

It is reported that all surveys have been completed and other preliminary matters arranged for the immediate construction of a new railroad from Delta through the Surface Creek valley to Cedaredge, Colo. The line which will eventually extend south to Montrose and into the Paradox Valley is promoted by a number of capitalists of northern Colorado. The Delta County Business Men's Association, Delta, Colo., is interested in the project.

Idaho Notes.

FROM CORRESPONDENTS AND OTHER SOURCES.

B. G. Jayne, New York City, has filed maps in the U. S. land office at Boise, Idaho, for a large dam and reservoir on Snake river in the vicinity of Hall's fruit ranch, 20 miles south of Mountainhome. It is proposed to develop power and to irrigate about 200,000 acres of land lying between Snake river on the south, the Oregan Short Line road on the north, Medbury segregation on the east, to Sunnyside segregation on the west.

Illinois Notes.

FROM CORRESPONDENTS AND OTHER SOURCES.

It now looks as though active steps would be taken soon to have work started on a subway system for Chicago. Bion J. Arnold, Chicago, chairman of the board of supervising engineers, has been appointed engineer in charge of the subway work, and it is said that he will begin at once to organize a force and prepare plans for the work. The city has a fund of about $4,500,000 received from the traction companies as compensation, which is available for subway construction. The traction companies are also required to advance $5,000,000 for subway construction under the terms of their franchises.

The Decatur Southern Traction Co. of Decatur, has been incorporated and proposes to construct a line from Decatur to Pana. The capital stock is $25,000, and the incorporators are George H. Winsor, James Aldrich, Smith and Joseph Nordenchild of New York; J. J. Pierpont of Pana; B. J. Wilson of Denver, Colo.; Harry M. Snape of Springfield, Ill., and H. C. Simons of Virden, Ill. This is the same company which took out incorporation papers a few weeks ago. Arrangements for building the road are now practically complete, and it is planned to begin work within 60 or 90 days.

A franchise has been granted to the Springfield & Jacksonville Electric Ry. Co. to construct a line through Morgan county. This completes the necessary rights that the company needs and work will commence at once to further the road, of which two miles has already been built out of Springfield. It is proposed to complete the road by July 1, and work is now under way at both ends.

Surveys are now under way in Christian county for an interurban line which is projected from Springfield to Cairo through the western part of the county. The proposed line is an extension from the Springfield, Rochester & Pawnee interurban road which is already constructed from Springfield to Rochester and is in operation. The route, according to the chief promoter, John E. Melick, will be from Rochester southeast and from Morrisonville to Hillsboro, Greenville, Pinkneyville, Carlyle, Nashville, Murphysboro, Jonesboro and on to Cairo.

The Illinois Light & Power Co. has spent about $85,000 on preliminary work on its proposed power development on the Kankakee River, 14 miles below Kankakee. The dam is to furnish power and light for Kankakee, Wilmington, Joliet and other cities in this section, and in addition the company is to build and operate an electric traction line between Kankakee, Wilmington and Joliet. Franchises are now being asked in Kankakee by Arthur N. Powers, one of the promoters.

The Tri-Cities & Northeastern Ry. is negotiating with the Village Board of Watertown for a right of way through that place. J. W. Simonson, Port Byron, Ill., is president.

The Peoria Terminal Ry. Co., E. A. Burrell, general manager, Peoria, will begin work this spring on laying a considerable amount of new track for its terminal system.

The Rock Island Southern Ry., J. W. Walsh, president, is to apply to the city council of Rock Island for permission to lay a single track along the river front from Fourth Ave. and First St. to the 20th St. depot, which is to be terminal of the steam and electric trains of the new road.

Promoters of the proposed Sterling & Northern R. R. Co., are preparing to incorporate the company with a capital stock of $300,000, and headquarters at Sterling, Ill. The line as projected by the organization will connect Sterling, Savanna and probably Freeport, Ill. William Usborne, Sterling, Ill., T. A. Gault and G. M. Weed are interested.

The directors of the Illinois Traction System are considering the improvement and extension of the present system during 1910. H. E. Chubbuck, Peoria, Ill., is General Manager of the company.

Right of way has all been secured for the proposed line of the Bloomington, Pontiac & Joliet Ry. Company's line from Joliet to Chicago, and steps are being taken to obtain right of way south of Pontiac. H. A. Fisher, Joliet, Ill., is interested in the company.

The River Front Committee of the East St. Louis City Council are to at once decide upon the best site for a public wharf and how much of the river front will be necessary. William O'Malley is Chairman of the Committee.

Indiana Notes.

FROM CORRESPONDENTS AND OTHER SOURCES.

The Northern Indiana Ry. Co. has taken over the property of the Southern Michigan Ry. and will hereafter operate that road. The construction of a line from St. Joseph to a connection with the Michigan electric line may be considered. Samuel Murdock, Lafayette, Ind., is secretary.

The Evansville & Terre Haute Ry. Co., is to soon construct coal docks 1,000 ft. in length on its property along the river below Pigeon Creek.

W. E. Moser, Logansport, Ind., who was connected with the Logansport, Frankfort & Indianapolis Ry., sometime ago, has organized a new company and will start on preliminaries at once for the construction of a line from Logansport to Franfort.

Iowa Notes.

FROM CORRESPONDENTS AND OTHER SOURCES.

The Davenport-Muscatine Ry. Co. has filed its articles of incorporation with the county clerk at Davenport. The company has a capital stock of $100,000 and will have its headquarters at Muscatine. It was organized for the building and maintenance of an interurban railroad between Davenport and Muscatine, the same to be constructed in the event a concession extending the franchises at present held by the Davenport railway and lighting companies is granted by the city. J. F. Porter is president and H. E. Weeks is secretary.

At a recent meeting at Creston of the stockholders of the proposed Des Moines, Winterset & Creston R. R. reports were made showing that stock to the amount of $62,450 had been disposed of. About $75,000 more of stock is to be sold and arrangements for this end are being made. Work is to be started when this final block of stock is sold. R. Brown, Creston, is president.

The Commercial Association of Columbus Junction is to have surveys made to decide on the possibility of constructing a power dam across the Cedar River above Columbus Junction.

The Dubuque Boat & Boiler Works, of Dubuque, is building a dredge boat for the C. B. & Q. Ry. It will be used between St. Paul and Savanna, and will be 120 ft. x 30 ft. x 5 ft. with an 18-in. pump.

The Atlantic North & Southern R. R. has secured $411,000 of the $512,000 required to build its 38-mile extension from Atlanta to Villisca. Rottenborg, Ross and Judd, Atlantic, Ia., are the owners of the road.

J. V. Wellsford, of Dubuque, will shortly make a proposition to the Dubuque Industrial Corporation for the construction of an interurban line from Dubuque to Clinton by way of Maquoketa. The syndicate which Mr. Wellsford represents, is said to be willing to construct and equip the road ready for use if Dubuque will secure the necessary franchise, the right of way and will construct the terminals.

The construction of an interurban line through Harrison County is proposed. The route under consideration is between Council Bluffs via Beebeetown, Logan, Magnolia, Little Sioux and Sioux City, connecting with an eastern line at Logan. M. H. Miller, Des Moines, is reported to be interested.

It is announced at San Angelo that construction work on the Colorado & Concho was to commence about Feb. 15. It is reported that the contracts were mostly let to people living in Colorado City, and who will begin the construction on that end of the line. It is believed that the grade will be completed within eight months.

Surveys are to be resumed in the spring for the projected line of the South Dakota Interurban Ry. Co., west from Sioux City to Bijou Hills, S. Dak. It will require one month's work to complete the surveys. W. E. Miller, Bijou Hills, S. Dak., is President.

The Chicago, Burlington & Quincy R. R., G. A. Laubenfels, District Engineer, Burlington, Ia., has ordered out twenty construction gangs on the Creston Division. One of the first pieces of work to be begun will be the double tracking between Red Oak and Balfour, which is the only stretch of the line between Chicago and Pacific Junction that is not already double tracked. New bridges also are being contemplated.

C. A. McGee, Parkston, S. Dak., and Pittsburg, Pa., has presented a proposition to Centerville for the construction of an electric line through that city with terminals at Sioux Falls and Sioux City, Ia., passing through Elk Point, Beeville and Worthing. Work he says, will be started about March 1. The estimated cost of the project is $600,000, the line costing about $15,000 per mile.

Preliminary arrangements are being made for the extensive improvement of the Chicago, Rock Island & Pacific yards at Muscatine, Ia. Ties and other material have already arrived for the purpose.

Kansas Notes.

FROM CORRESPONDENTS AND OTHER SOURCES.

It is believed here in Kansas City that the Chicago, Rock Island & Pacific Ry. will soon change its attitude regarding the Kaw River improvements and that the Kaw Valley Drainage Board will be enabled to go ahead with its extensive plans for drainage work. William H. Daniels, Kansas City, Kan., is chairman of the Kaw Valley Drainage Board.

D. H. Siggins, Coffeyville, Kan., is considering a proposition from the Commercial Club of Chanute, for extending the electric interurban which he is operating in Montgomery county to Chanute.

An irrigation project is proposed for southwest Kansas and John W. Baughman, Liberal, Kan., has filed notices appropriating water from the Cimarron River in southeast Grant county. It is proposed to irrigate about 40,000 acres of land. A dam is to be constructed at the intersection of the north and south forks of the Cimarron in southeast Grand county. W. E. Adams, Lewiston, Idaho, was the engineer.

The Illinois Traction System, H. E. Chubbuck, General Manager, Peoria, Ill., which owns the street railway and light plant at Wichita, is planning to construct a new $700,000 power plant in that city, capable of developing 4,000 HP. The Illinois Traction system interests are also said to be considering several interurban propositions in the vicinity of Wichita.

The Wichita, Kinsley, Scott City & Denver Air Line R. R. Co. is taking steps to construct the line from Wichita to Kinsley. The cost of the proposed line will be $15,000 per mile, $2,000 of which the promoters expect to raise by township aid bonds. W. F. Brown, Iuka, Kan., is interested in the project.

The improvements to be made this year by the Missouri Pacific R. R., on its Kansas lines, will cost about $4,000,000. The following is a detailed statement of the expenditures:

Ballast	$ 500,000
Rail (new)	450,000
Flood protection	100,000
Bridge filling	60,000
Bridge strengthening	240,000
Grade reduction	80,000
Sidings, passing, miscellaneous	50,000
Hoisington yard and shops	435,000
Kansas City, Kas., Kaw bridge and tracks	266,000
Kansas City, Kas., rearrangement	40,000
Other terminal yards	100,000
Edgewater connecting railway	20,000
K. C., Kas., passenger station	36,000
Miscellaneous new stations	70,000
Living houses	30,000
Miscellaneous structures (new water tanks, stock pens, scales, etc.)	140,000
1,015,000 new ties (material only)	485,500
New equipment	745,000
Repairs to bridge and structures	124,165
Total	$3,944,665

Michigan Notes.

FROM CORRESPONDENTS AND OTHER SOURCES.

The Lansing & Northeastern Ry. Co. has been granted a franchise to enter the city of Owosso. The company intends to secure the present Owosso & Corunna electric railway and later extend this to Durand and possibly to enter Flint. To the north a branch will be run to Saginaw and this will give the new road a line parallel with the M. C. branch all the way from the main line to Saginaw. The road will be constructed by the recently incorporated Lansing & Northeastern Construction Co., the principal stockholders of which are T. E. Atwood, Caro, George G. Moore and Kirke Lathrop, Detroit.

An ordinance has been before the city council of Saginaw granting a franchise to the Saginaw Valley Traction Co. to lay tracks in Franklin St., Genesee to Janes, and in Germania Ave., Washington to Franklin.

The Commonwealth Power Co., J. B. Foote, General Superintendent, is planning the erection of a large auxiliary steam power plant at Kalamazoo.

Arthur C. O'Connor and Matthew Flinn, who have large property interests in Hamtramch, a suburb of Detroit, have petitioned the village council for permission to lay about five miles of street car track and also have asked franchises for gas, heating and electric light.

The roadbed of the proposed Coldwater, Marshall & Macinac R. R. Co., which went into the hands of Elbert E. Simmons, Trustee, in 1902, has recently been transferred to the Michigan Trust Co., Grand Rapids, Mich. The deed includes the company's lands from the southern line of Calhoun County through Marshall, Tekonsha, Olivet, Vermontville, Sunfield, Portland, Lyons, Carson City Summer and Elm Hall.

The town of Brighton will vote at an election to be held in March on granting a franchise to the proposed Detroit, Grand Rapids & Lansing Electric Ry.

The Village Council and Township Board of Watervliet have granted a franchise for an electric railroad through that place to Wm. C. Plumb, representative of the Uncle Sam Oil Co., of Kansas City, Mo. He proposes building an electric interurban from Kalamazoo to Benton Harbor.

The Boyne City, Gaylord & Alpena R. R. has secured right of way for its projected extension to Hillman, where a connection will be made with the Detroit & Mackinac.

Minnesota Notes.

FROM CORRESPONDENTS AND OTHER SOURCES.

The Chicago, Milwaukee & St. Paul Ry. has presented a plan to the City Council of Minneapolis for the elimination of the present grade crossings of its H. & D. Division tracks in the city. The plan proposes the depression of the tracks, the cut starting at the company's yards in south Minneapolis, with the first bridge at Cedar Ave., and continuing for three miles and 2,800 ft. to the present bridge across Hennepin Ave. The work involves a great deal of excavation to a level of 20 feet below the present street grade; the building of 37 concrete bridges, and the double tracking of the new roadbed the entire distance. If the proposition is accepted by the city, the company will start work as soon this spring as possible, and complete the job in two years at a cost estimated at from $1,250,000 to $1,300,000. M. D. Rhame, Minneapolis, is Division Engineer.

Work on the southern part of the Thief River Falls line and the Cuyuna Iron Range line of the Soo is pretty well finished and early next month the headquarters of the engineering crews in charge of the work, will be moved from Aitkin to Bemidji. This will put the engineers in closer touch with the work on the northern section of the Thief River Falls line, which will be the principal scene of operations hereafter. Early this month, steel was laid a few miles north of Lawler Junction in the direction of McGregor; tracklaying, however, has been abandoned until the weather becomes warmer. The grading has been completed to the point where the road crosses the Mississippi river. In the spring the grading will be pushed all along the line between the present extremities of the completed work and this will be completed

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before tracklaying is started. When the crews start laying steel again it is the intention to keep right on until the line is completed.

The Chicago, Milwaukee & St. Paul R. R. is to construct new yards at Bass Lake, 1½ miles west of Lake Isles Boulevard in Minneapolis. As noted elsewhere in this column, the railroad has submitted plans for the depression of tracks for its H. & D. Divisions, and if these plans are approved, the work of making the fill at Bass Lake for the new yards will be carried on simultaneously with the track depression work. The depression work will require about 600,000 cu. yds. of excation and this will be used in the fill. M. D. Rhame, Minneapolis, is Division Engineer.

Duluth and the Ranges.

BY PETER E. MEAGHER.

Winston, Dear & Co., stripping contractors, were awarded a large contract this week to strip the Buffalo & Susquehanna Iron Mine. There are 6,000,000 cu. yds. of material to be excavated in this contract, and it will take about five years to complete the same. They are going to put a large standard gauge outfit on this work, and will start the same immediately.

Johnson, Rodgers & Curtiss is the name of a new contracting company that was formed here recently. The first contract they have taken is for some railroad work on the Soo line, under Foley, Welch & Stewart. They have already started on this work.

C. A. Lewellen, general manager of the Minneapolis branch of the J. I. Case Threshing Machine Co., spent a couple of days here recently. He reported business in his line very good.

C. J. A. Morris of the contracting firm of Shepard & Morris, St. Paul, Minn., was a caller on the writer recently. They have about 60 miles of railroad work on the Great Northern in North Dakota and will start on the same about March first. They have some good team work to let, and any contractors interested by writing them will get any information that they desire.

W. F. King, concrete contractor, was a caller recently. He has several jobs under way at the present time, and is employing about 300 men.

Jerry Mahoney, railroad contractor, came in from his work at Mandan, N. Dak., and paid us a visit this week. He expects to be all cleaned up in a short while, and will then be in the market for work for a 30-team outfit.

Howard Greer, Jr., contractor, from Chicago, was a caller in Duluth a few days ago. I understand he was up here looking over some work.

Martin Cain, railroad contractor, was a caller at this office recently. He is engaged on a logging contract at the present time, but will be in the market for some work just as soon as the season opens.

The Roberts-Kingston Co., contractors of Duluth, were awarded, a few days ago, a contract by the Republic Iron & Steel Co. to strip their Union mine near Virginia, Minn. There is about 1,250,000 cu. yds. in this contract, and they will start on the same about April 1st and rush it to completion as fast as possible.

Andrew Perrin of the contracting firm of Carl Hall & Co., left last week with his family for a trip to Mexico. He expects to be gone for about six weeks.

Dale & Bumgardner, steam shovel contractors on the Soo Line, who shut down their work a short while ago on account of frost, have again started up their operations, and will continue to work until their present contract is completed.

The writer is very glad to report that Greer Thompson, formerly general superintendent for the Drake & Stratton Co., stripping contractors on the Iron Range, near Duluth, has been promoted to the position of general manager for the same company. Mr. Thompson is a very popular man in this vicinity, and has a host of friends. We wish to congratulate Mr. Thompson on securing his new position. J. P. Baines, who was assistant superintendent under Mr. Thompson, has been promoted to Mr. Thompson's old position of general superintendent. Mr. Baines is a very capable man, and is well liked by all who come in contact with him, and this office wishes him success in his new position, which we know he will fill capably.

F. G. Winston, Gardner Stevens and H. C. Hanson of the Winston-Dear Co. were visitors in Duluth last week looking over new work that is contemplated being let in the very near future.

The Canadian Northern Railway Co. have at last ended the controversy that they have been having with the city council of Duluth regarding right-of-way for their railroad into this city. This week the council gave them full authority to come in here over the right-of-way that they had staked out. We understand that this was the only technicality that was holding back the letting of their contract for the extension of their road from Virginia, Minn., to Duluth, a distance of 87 miles. So the probabilities are that this work will be let in the very near future.

F. J. Mann, steam shovel contractor, was a caller in Duluth recently. He has taken a new contract from Foley, Welch & Stewart on the Soo Line, and will put one shovel to work immediately.

J. E. Erickson of the railroad firm of Murphy Brothers & Erickson, contractors on the Soo Line, was a caller at this office. They have about 200 men working at the present time, and just as soon as the weather loosens up a little they will put a larger force of men to work.

The demand for laborers in Duluth at the present time is quite heavy. There seems to be quite a bit of work going on in all different lines, and already we are commencing to feel a slight scarcity of laborers to fill the positions offered. The lumber, woods and saw-mills are employing a great many men, and there is quite a bit of stripping and railroad contracting going on at present, but the real heavy work will not start in until about April 1st, and as it looks now we will then have quite a scarcity of men.

Missouri Notes.

FROM CORRESPONDENTS AND OTHER SOURCES.

The land owners in the Phelps City Dike and Drainage District will soon issue bonds for raising money to straighten the Nishnabotna River. James F. Gore, Rockport, Mo., is attorney for the district.

The Laclede, Dallas & Western R. R. Co. has been incorporated and proposes to construct a railroad from Phillipsburg, Laclede county, to a point eight miles west of Buffalo, Dallas county. The road is to be 30 miles long. The stockholders are all residents of Kansas City and are as follows: Sam T. McDermott, B. B. Joffee, C. M. Blackman, W. F. Farren and C. W. German.

F. C. Yentsch of Mount Vernon, Mo., is taking steps to organize a company to build an interurban railroad from Springfield to Carthage. The projected route will be from Springfield to Haseltine, Nichols, Halltown, Paris Springs, Mount Vernon, Hoberg, Stotts City and Carthage. The line will be about 60 miles in length. The Springfield Traction Co., of Springfield, is also projecting a line from Springfield to Carthage. Surveys for such a line have been made and according to these the route will be through Billings, Republic, Marionville, Aurora, Verona, Monett, Pierce City, Sarcoxie and in Carthage.

The St. Louis, Iron Mountain & Southern has under way extensive improvements on the main line from Poplar Bluff, Mo., to Little Rock, Ark., the 100-lb. steel which is being used costing alone about $1,300,000. The company is also planning the construction of new shops at Argenta, and an expenditure of about $100,000 for small depots along the line. E. F. Mitchell, St. Louis, Mo., is Engineer of Construction.

Nevada Notes.

FROM CORRESPONDENTS AND OTHER SOURCES.

The Eureka & Palisade R. R., G. D. Abbott, superintendent, Palisade, Nev., is to build a new branch line to the new mining camp of Buckhorn. The branch will leave the main road at a station called Blackburn and will be 17 miles long. It is stated that steel has already been ordered to complete the job, work upon which will be started within the next two months.

New York Notes.

FROM CORRESPONDENTS AND OTHER SOURCES.

The Catskill Traction Co., of Catskill, N. Y., has been incorporated with a capital stock of $200,000, the incorporators being F. N. Dubois, J. H. Story and R. F. Story, Catskill, and J. C. Conway, Brooklyn.

The Water Supply Commission in its report to the Legislature recommends an amendment to the Constitution, permitting an issue of $20,000,000 of State bonds for the building of storage reservoirs with a view of generating electric power and controlling the water flow of the streams of the State. The Commission recommends a second Constitutional amendment permitting the flooding of State lands for storage reservoirs. About 50,000 acres of State lands of which but 11,000 acres would be timber land, is needed for this purpose.

C. D. Hodge & Co., Watertown, N. Y., have begun work on their contract for developing 1,400 HP. on the Oswegatchie River, 1½ miles from Gouverneur, for the Oswegatchie Light & Power Co., of Gouverneur. The power house will be 50 feet in length and 30 ft. wide. The plans call for the construction of a concrete and steel frame 70 ft. in length and 40 ft. wide. The contract further calls for its completion by July 1, and includes the excavation of 8,000 cu. yds. of dirt.

According to reports circulating in Speonk, L. I., the Long Island R. R. Co., has secured 10 acres of land for the purpose of constructing an intermediate terminal station at that place. The work will include the construction of a pumping station, round house and sufficient sidings for 100 cars. J. R. Savage, Jamaica, N. Y., is Chief Engineer of the company.

A number of the business men on Madison St., Oneida, N. Y., have held a meeting to take steps toward securing the Oneida Railway Co. to continue its tracks down that street as was contemplated when the franchise was granted. R. B. Ruby is interested.

The Hudson Cos., 30 Church St., New York city, have arranged to sell $5,500,000 of notes,

the proceeds of which will complete the Hudson system of tunnels as originally planned to 33d St. and 6th Ave., New York.

A committee, of which Raymond Smith, Oyster Bay (L. I.), N. Y., is Chairman, has been appointed to take steps to receive the construction of a trolley road to connect Hicksville and Oyster Bay, and which shall then be carried along through Central Park to Farmingdale and there connect with the cross-island trolley at Amityville.

Bids were opened at Albany on Feb. 10 by the State Armory Commission for grading the site and constructing a new rifle range in Blauvelt, Rockland County, to take the place of the Creedmoor range for the National Guard organizations of New York city and vicinity. Martin Murray of Troy, was the low bidder, at $111,121.

Ohio Notes.

FROM CORRESPONDENTS AND OTHER SOURCES.

County commissioners at Ravenna have been asked for an extension of time for the franchise granted Thomas Childs, Akron, O., for an electric railroad between Akron and Youngstown. It is said that work on the line will be commenced this summer. The project will cost about $1,000,000.

Surveyors have been at work at Findlay on the proposed electric line that will run from Toledo to Columbus, connecting at Marion with a road already built. The route is from Upper Sandusky to Carey, Fostoria and to Toledo. Frank M. Ohl of Toledo is interested.

The Schoepf syndicate controlling a number of electric railways in Indiana is said to be having maps made by its engineers at Indianapolis, Ind., for building a traction line from Zanesville to Cambridge, and from that place to Wheeling with an ultimate destination at Pittsburg, Pa.

The Ohio Electric Ry. Co. has applied to the city council of Zanesville for a franchise to permit it to extend its line over Linden Ave. from Lee St. to Commission St.

The Skinner Shipbuilding & Drydock Co., of Baltimore, Md., has launched the first of the six lighters it is building for the Breakwater Co. of Cleveland, O. The vessel is 115 ft. long, 34 feet beam and 8½ ft. deep, and is to be fitted with derrick and steam machinery for the lifting of heavy stone to be used in the building of the harbor of safety at Cape May, N. J.

According to a statement, reported to have been made by Dr. L. E. Niles, Springfield, O., the capital has been secured for the construction of the Kentucky North & South R. R. Co.'s 200-mile line in coal territory of Kentucky. Bonds amounting to $12,400,000 have been sold, it is said, and construction work will be started early in the Spring. Edgar Parsons, Springfield, O., is Engineer of the company.

The Minster & Laramie Ry. Co. has been incorporated with a capital stock of $100,000, for the purpose of constructing a trolley line from Loramie to Minster to connect with the Minster branch of the Western Ohio Electric Ry. The incorporators are: F. D. Carpenter, of Lima, Ohio, General Manager of the Western Ohio; John H. Koenig, of St. Marys, President of the Ft. Wayne and Springfield Railway Company; E. L. Herr, and E. C. Riddle and C. C. Collins, of Cleveland. Work will commence on the new road at once.

Contracts aggregating nearly $1,000,000 have been let by the Norfolk & Western Ry., for work on the division between Columbus and Portsmouth, the successful contractors being as follows: Strum & Adams, Columbus, six miles of track between Renick and Delano, O.; the E. G. Nave Brothers' Co., Portsmouth, O.; seven miles double track east of Piketown, O.; the Ryan Co., Lexington, N. C., 11 miles double track in Ohio, west of Davis Station.

Oklahoma Notes.

FROM CORRESPONDENTS AND OTHER SOURCES.

D. P. Siggins of Coffeyville, Kan., and R. S. Litchfield and H. F. Sinclair of Independence, Kan., and others have applied to the city commission of Tulsa for a franchise for an interurban railway system which will connect Bartlesville, Coffeyville, Muskogee, Tulsa, Sapulpa and Okmulgee.

The Chickasha Street Railway Co. of Chickasha has been chartered with $150,000 capital and proposes to build an electric line in Chickasha and into parts of Grady county. The length of the proposed line is six miles, and the estimated cost $100,000. The directors are Charles F. Woodward and W. Raymond Emerson, of Wakefield, Mass.; Lawrence Martin, E. D. Welborn and W. P. Weston, of Chickasha.

The Wichita Falls & Northwestern Ry., Frank Kell, general manager, Wichita Falls, has ordered the steel for the extension from Altus to Hollis, Okla., and that as soon as it arrives active construction work will begin. The Wichita Falls & Northwestern recently purchased the grade and the right of way of the Altus, Roswell & Pacific between Altus and Wellington, Texas. The road is to be constructed at once between Altus and Hollis, but it is not yet certain that it will be built to Wellington.

The Kansas, Lawton & Gulf R. R. Co. has filed an amended charter. The original charter of the road calls for a line from Randlette, in Comanche county, to the northwest line of the state, to Harper county. The amended charter gives a branch line from Randlette northeast to the north line of Osage county. J. M. Bellamy of Lawton is President.

The Wichita Falls & Northwestern Ry. Co., has submitted a proposition to construct a line to Lawton by way of Devol, to the Lawton Chamber of Commerce. Frank Kell, Wichita Falls, Tex., is President of the railroad company.

Work is progressing rapidly on the proposed line of the Clinton, Oklahoma & Western. Twelve miles of track have been laid from Clinton, Okla., to a point within 7 miles of Butler.

The Chamber of Commerce of Magnum, of which T. P. Clay is President, has closed a contract with the American Central Ry. for the construction of the road through Magnum, from or near Miami, Tex., to the Santa Fe, via Vernon, Tex., to San Antonio.

Oregon Notes.

FROM CORRESPONDENTS AND OTHER SOURCES.

Surveys for the Coos Bay-Boise R. R. are being continued and early this month Engineer F. W. Stevens, who is in charge of one of the survey parties moved his headquarters to Marshfield, after having run the survey from a point midway between that place and Roseburg. The location has been made to Myrtle Point from the summit of the mountain, and the preliminary surveys have been made from Myrtle Point to Marshfield, or a point near here. Thirteen men are at work under Engineer Stevens, and Engineer F. W. Haines has the same number working for him on the Roseburg end of the line. The company has asked at both Coos Bay and Roseburg for a bonus of $150,000 to be paid after a locomotive is run over the finished road from Marshfield to Roseburg.

Land owners in the vicinity of Vale are planning to form a co-operative organization for the purpose of installing an irrigation system. It is proposed to build a large storage reservoir on the Middle Fork of the Malheur River at Warm Springs, near the Harney county line.

The Oregon Railroad & Navigation Co. has secured a strip of land between its right of way and the river, north and east of the depot, at The Dalles, which will be used for double track purposes at its yards in that city.

The Oregon Eastern Ry., a Harriman line, has filed amended surveys at the U. S. Land office at Lakeview. The new survey eliminates a large number of curves in the 12 miles covered by it.

The Northwestern Corporation, A. Welsh, General Manager, Portland, Ore., now operating in Walla Walla and surrounding territory, will enter the Grande valley, touching at all the towns, and penetrate Wallowa county.

Pennsylvania Notes.

FROM CORRESPONDENTS AND OTHER SOURCES.

The Wilkesbarre Ry. Co. has been chartered and proposes to operate a line ten miles long between Wilkesbarre and Pittston. The capital stock is $100,000, and the incorporators are Thomas J. Connelly, Ashley, president; Joseph L. Dunn, E. J. Loughran, Henry de Mun and J. Francis Folz, Wilkesbarre, and Joseph H. Smith and John R. Williams, Edwardsville.

Final surveys have been started by F. E. Barrett, C. E., Pittsburg, Pa., on the projected trolley line of the recently organized Pittsburg, Butler, Slippery Rock & Grove City Ry. Co. The line will be about 20 miles long and will connect Butler and Slippery Rock. The officers of the company are W. C. Thompson, president, Butler, and J. A. Smith, secretary, Butler. Connection will be made with the Pittsburg & Butler and the Pittsburg, Harmony, Butler & New Castle lines at Butler, and with the proposed Slippery Rock & Grove City trolley line, contracts for the construction of which will be let in March. The road will likely go by way of Prospect and West Liberty. With this link constructed Grove City will be connected with Pittsburg by trolley. Plans are also under way for a line from Grove City to Greenville and on to Meadville, where connection will be made with the Meadville-Conneaut Lake lines, making a continuous trolley system between Pittsburg and Buffalo.

The construction of an electric railway from New Castle to New Wilmington and thence north to Mercer and possibly to Greenville and Sharon is proposed. At a recent meeting of the promoters at the office of State Senator Campbell, Sharon, steps were taken to finance the road.

The Schuylkill Valley Traction Co. of Norristown is considering extending its Chestnut Hill line from City Line along the Wissahickon road to the Wheel Pump Hotel on the Bethlehem turnpike, and thus secure a terminus at Chestnut Hill Park.

It looks as though something would be doing soon regarding the double tracking of the Somerset and Columbia branch of the Baltimore & Ohio R. R., in Somerset County, as contractors have been over the line preparatory to submitting bids on the work. A. M. Kinsman, Baltimore, Md., is Chief Engineer.

The Pennsylvania Water & Power Co. has acquired possession of all property of the McCalls Ferry Power Co., and has recorded a mortgage for $12,500,000, the Knickerbocker Trust Co., of New York, being the trustees of the mortgage bonds. With the proceeds received from the sale of bonds, work on the dam will be pushed to speedy completion.

The New Park & Fawn Grove R. R., of Fawn Grove, proposes to extend its line from the latter place to Delta.

Delaware, Lackawanna & Western R. R. has decided to construct a line from its present terminus at Northumberland, Pa., to Winfield on the western side of the Susquehanna River, where it will connect with the Reading Ry., giving the D. L. & W. a direct route to Philadelphia, Pa. The work will include the construction of a steel bridge across the river. G. J. Ray, Hoboken, N. J., is Chief Engineer of the company.

The Western Maryland Ry. is to have a bill introduced in the Maryland Legislature to amend its charter so as to empower the company to sell its unissued treasury stock, amounting to about $26,000,000. It is proposed to use these funds to enable the road to build and equip its proposed extension from Cumberland, Md., to New Haven, Pa., without increasing its indebtedness. It is planned to begin work of construction upon the new branch early in the spring, and it is estimated that the line will be opened for traffic by the middle of 1912. H. R. Pratt, Baltimore, Md., is Chief Engineer.

Texas Notes.

FROM CORRESPONDENTS AND OTHER SOURCES.

At a meeting recently held at Caldwell by parties interested in the Brazos levee an agreement was reached which will settle the injunction which had been issued and allow the work to be begun without unnecessary delay. It was agreed that the levee be extended, the parties whose land was included in the extension agreeing as to the amount they were to pay for the extension.

Citizens of the southern section of Houston are discussing ways and means to have the Houston Electric Co. build an extension to its system to include that portion of the city.

Citizens of Temple have subscribed over $100,000 for the Temple Northwestern Ry. and as soon as the remainder of the bonus is secured W. J. McDaniel, Dallas, will put 75 teams on the grading work.

The Missouri, Kansas & Texas Ry. of Texas will construct a spur switch from the main line of the railway near Fisher, northeast of Dallas, to the site of the new White Rock pumping station at the west end of the dam in White Rock reservoir. The switch will be four or five miles long.

Announcement has been made that the contract for constructing the San Antonio, Rio Grande & Tampico R. R. Co.'s line has been signed and work will begin within the next four weeks. Work will be started in the first 100 mile section, from San Antonio to Tampico, Mexico. Eastern capitalists have financed the road and it will be built under the direction of G. W. Noch, railroad construction engineer, of New York city, who has been staying at the St. Anthony Hotel in San Antonio, Tex. The San Antonio, Rio Grande & Tampico was recently chartered, the incorporators being: J. F. Edwards, St. Louis; A. B. Hedden, Plainfield, N. J.; G. Stuart Simons, New York; H. M. Aubrey and A. L. Mattlock, San Antonio.

The Commercial Club of Seminole is taking steps to secure a railroad to connect with the Rock Island lines at or near Dalhart, in Dallam county.

The War Department has returned the plans for the 13-ft.channel at Corpus Christi, Tex., to the Board of Engineers, and it is expected that the work will be recommended with an appropriation of $225,000.

According to an announcement, reported to have been made by Lee Frisby, Austin, Tex., construction work will be started about September on the proposed line from Beeville, Tex., to the border by way of Oakville and Cotulla.

Articles of incorporation of the Coleman, Brady & Southern R. R. have been signed. The proposed road will run from Coleman to Brady and Llano and will connect with the International & Great Northern at some point in Comal County, Tex.

It is expected that at the February meeting of the stockholders of the St. Louis, Brownsville & Mexico R. R., formal control of that road will be assumed by the St. Louis & San Francisco Ry., and that the offices of the former company will be moved to Houston and merged with the Colorado Southern, New Orleans & Pacific, other companies controlled by the Frisco.

The Denver & Gulf R. R. Co., of Texas, has filed articles of incorporation at Austin, Tex., with a capital stock of $100,000, and headquarters at Texhoma, Tex. The company proposes the construction of a line from Texhoma to the Texas-Oklahoma boundary line. The incorporators are W. A. Evans, H. C. Umstead, James Hicks and F. A. Umsted, Texahoma, Okla.

Board of Trade of Cotulla, Tex., has taken up the proposition regarding the bonus necessary to secure the construction of a railroad from Beeville to Eagle Pass. Work will probably begin at once, it is reported.

Practically all right of way has been secured for the Fort Worth-Cleburne Interurban line, and it is understood that the road will be built this spring.

The Uvalde & Crystal City R. R. now has 41 miles of line in operation and has had surveys made from Crystal City to Carrizo Springs. J. E. Franklin, St. Louis, Mo., is interested.

The final route for the St. Louis & San Francisco extension from Brady to Menardville has been adopted. Most of the grading on the first 17½ miles of line out of Brady has already been completed and contracts are to be let at once for the remainder of the line into Menardville.

Grading into Seymour for the line of the Gulf, Texas & Western R. R. has been completed and the tracklaying gang is only a few miles from the city.

Utah Notes.

FROM CORRESPONDENTS AND OTHER SOURCES.

Boyer Bros., railroad contractors of Springville who have been working on the Cedar Creek railroad, which is being built for the Castle Valley Coal Co., have completed their contract and have brought their outfit home.

The Ogden Rapid Transit Co., Joseph Bailey, superintendent, Ogden, is planning to begin the construction of a street railway line down 24th St. from Washington Ave. to Wall Ave., connecting with the 25th and Wall Ave. lines. The work will begin as soon as the spring opens.

The Daly-Judge Mining Co., George W. Lambourne, Manager, Salt Lake City, is still working on the details for the proposed Daly-Judge-Snake Creek tunnel. Bids for the work are said to have been received.

Virginia Notes.

FROM CORRESPONDENTS AND OTHER SOURCES.

The Norfolk Terminal Railway Co. of Norfolk, Va., has been incorporated with a capital stock of $50,000 to $150,000 and proposes to build a railroad on Main St. in Norfolk. The officers of the company are: L. E. Johnson, president, Roanoke; Raymond Du Puy, vice-president, Norfolk; Francis W. Russell, secretary, Norfolk; Caldwell Hardy, treasurer, Norfolk.

Surveys for the extension of the Richmond & Chesapeake Bay Ry., an electric line, have been completed to a point midway between Ashland and Fredericksburg. Wm. Northrop, Richmond, Va., is general manager.

The Virginian Ry., according to reports, is to let contracts shortly for the construction of a branch line between Survey and Sweenyburg, a distance of ten miles.

Maps for a route through Dickens County have been filed with the Circuit Court at Roanoke by the Elkhorn Southern Ry. The route most likely to be selected seems to be down Crane Nest River, passing within two miles of Clintwood, the capital of the county, and through the famous "Breaks," to Elkhorn City, Ky. Other surveys have also been made along McClure and Found rivers, as well as Russell's fork of Big Sandy River.

The Norfolk Terminal Ry. Co., of Norfolk, has applied for a charter and proposes to build and maintain a $1,000,000 terminal in Norfolk. The project has been financed and work will be pushed as rapidly as possible as soon as detail plans are prepared. The Norfolk & Western, the Virginian and the Norfolk & Southern Rys. are back of the project.

The U. S. Senate has granted another extension of six months to the Washington, Spa Springs & Gretta Ry. Co., of Maryland, in which to enter the District of Columbia. The company was authorized to extend its tracks into the District by an act approved by Congress Feb. 18, 1907, which provided that the line should be completed with cars running within two years from its passage. Last year this was extended to March 3, 1910.

Washington Notes.

FROM CORRESPONDENTS AND OTHER SOURCES.

The city of Charleston will shortly vote on issuing $3,000 of bonds for constructing a new city dock.

Ranchers and business men met in Mount Vernon recently and organized the Skagit River Improvement Association, the object being to rebuild the present dike and secure aid from the government for dredging the Skagit River. Alfred Polson is president of the association.

The Valley Railway & Power Co. is seeking a franchise in Kent for its projected railway which is to connect that city and Renton. Right of way has been arranged for. The officers of the Valley Railway & Power Co. are: H. B. Madison of Kent, president; Robert Bridges of O'Brien, vice president; Isaac P. Calhoun of Kent, secretary; Thomas Chapman of O'Brien, treasurer; Lee Monohan of Renton, auditor, and A. T. West, general manager.

Track laying on the Union Pacific, interrupted in December by floods, has been resumed and if no further delay results the tracks will be laid to South Aberdeen by March 15. There will be seven stations located between Aberdeen, Grays Harbor and Rochester. All of the material is now on the ground.

The Skagit County Power Co. is planning to begin actual construction work this spring on its power plant on the upper Skagit River, 30 miles from Rockport. The proposed power plant will cost in the neighborhood of $6,000,000. It will have a capacity of 100,000 h. p. A flume 20,000 ft. long and averaging about 20 ft. in width is being built in order to obtain "head." The river at present is a succession of small cascades and will be harnessed and forced through a long tunnel, most of which is to be cut through solid rock. E. H. Freeman, Anacortes, Wash., is field manager. In connection with the work the Great Northern Ry., A. Stewart, assistant chief engineer, Seattle, Wash., is to build a 30-mile branch to the site of the power plant, to be used in carrying in supplies for the work. Surveys for the branch have been made and work is to be started shortly.

The Oregon & Washington R. R. Co. has awarded a contract to Dibble & Hawthorne, National Bank of Commerce Bldg., Tacoma, Wash., for the construction of three miles of track in that city, from the Northern Pacific drawbridge to the Prescott yards.

The Chicago, Milwaukee & Puget Sound R. R., has recently awarded construction contracts for the extension of the Tacoma & Eastern R. R., a subsidiary line, 20 miles south of Glenavon, Wash.

The Puget Sound Electric Ry. Co. is planning to make improvements to its interurban line between Tacoma and Seattle this year that will involve the expenditure of about $400,000. The immediate improvements as outlined by R. T. Laffin, District Manager for Stone & Webster, Boston, Mass., are as follows: Station at Puyallup, $8,000; station at Black River, $5,377; station at Renton, $1,000; tool house at Bay street yards, Seattle, $500; new pits, $600; second track at Black River, $7,500; parlor car, $9,500; motor car, $17,000; car barn at Bay street, Seattle, $12,000; second track at Argo, $34,640, and Riverton siding, $4,000.

The Chicago, Milwaukee & Puget Sound Ry. is rushing work on the construction of its line to Everett from Moncton. H. C. Henry, the contractor who constructed the Milwaukee road from Mowbridge, Mont., to the Puget Sound country, is working a large grading crew this side of Moncton. As soon as condemnation suits pending against McDougall St. property owners, at Everett, for right of way are concluded, the company proposes to begin its preparations for the laying of steel in Everett, and still later, when the weather becomes more settled, Contractor Henry will begin construction on the road each way, north and south, from Tolt, in the Cherry valley.

Wisconsin Notes.

FROM CORRESPONDENTS AND OTHER SOURCES.

The Manitowoc Dry Dock Co., Manitowoc, has been awarded a contract for constructing a $50,000 sand sucker dredge for the Great Lakes Land Co. of Chicago, Ill.

The Merrill Electric R. R. of Merrill, Wis., has been granted permission to extend its

lines from the west side to the 6th ward in Merrill.

The city council of Winona has reconsidered its action and will now grant the La-Crosse & Winona Traction Co., of LaCrosse, a franchise to enter the city.

Citizens of Waukesha, Wis., are to take active steps immediately toward raising a $5,000 bonus to secure the construction of the Milwaukee-Western Branch line from Sussex to that city.

Canadian Notes.

FROM CORRESPONDENTS AND OTHER SOURCES.

The Canadian Pacific Ry., F. Lee, division engineer, Winnipeg, Man., will commence work soon on double tracking its line to Portage La Prairie.

Work is to be started in June on the construction of a light railway line from Stewart at the head of the Portland canal, British Columbia, inland 15 miles to tap a number of mining properties owned by a syndicate in which D. D. Mann, Toronto, Ont., is interested.

Among the improvements planned by the Canadian Pacific Ry. for the present year for western Canada are the completion of the new line from Weyburn to Lethbridge, and the construction of a line east from the latter point. Work will also probably be done this year on the line from Outlook to Castor, where there remains a gap of 225 miles, which will connect Moose Jaw directly with Edmonton.

Lawford Grant, Montreal, Que., has a proposition before the city council of Regina, Sask., for establishing a street railway there.

The Railway Committee of the House of Commons has authorized the Canadian Ry., M. H. MacLeod, general manager, Winnipeg, Man., to construct the following new lines in the west: From a point at or near Dundee, thence in a generally northerly and easterly direction to a point on the Winnipeg River in or near township 18, range 10 east of the principal meridian. From a point on the company's line at or near Portage la Prairie, thence in a generally southerly and easterly direction to a point on the Ridgeville section of its line of railway in or near township 5, range 7, west of the second meridian. From a point at or near Moose Jaw, thence in a generally southern and easterly direction, keeping west of Moose Creek, and the Souris River, to a point in or near township 2, thence easterly to a point at or near Beinfait, with a branch from a point at or near Roche Percee in township 1, range 6, west of the second meridian. From a point on the Qu'Appelle, Long Lake and Saskatchewan railway between Division and Disley, thence in a generally westerly and northwesterly direction to a point on the Saskatoon-Calgary line in or near township 30, range 14, west of the third meridian. From a point on its main line at or near Lashburn in township 48, range 25 west of the third meridian, thence in a generally westerly and northwesterly direction to a point on its authorized line between Edmonton and Camrose in or near township 50, range 22, west of the fourth meridian. From a point on its Saskatoon-Calgary line in or near township 28, range 6 west of the fourth meridian, thence in a generally northwesterly and westerly direction to a point at or near Rocky Mountain house on the North Saskatchewan River. From a point on its Saskatoon-Calgary line at or near the crossing of the Red Deer River in or near township 28, range 19 west of the fourth meridian, thence in a generally northwesterly and westerly direction, passing through or near Innisfail and Rocky Mountain house, to the headwaters of the Brazeau and McLeod rivers, and thence to a point on its authorized line at or near the Yellow Head Pass. From a point on its constructed line near Winnipegosis, thence in a generally southerly and easterly direction to a point on its constructed line near the south end of Lake Manitoba. From a point on its authorized line between Prince Albert and Battleford, in or near township 49, range 31, west of the third meridian, thence in a generally northwesterly and northern direction to a point at or near the Great Slave lake. From a point on its authorized line east of Lake Manitoba, then westerly via the Narrows, to a point on its constructed line between Grand View and Roblin.

F. S. Darling, Toronto, Ont., is stated to have been awarded the contract for constructing the Alberta & Great Waterways Ry. The line will be 350 miles long and will extend from Edmonton, Alberta, to Fort McMurray. W. R. Clark, Kansas City, Mo., is president.

P. P. Elliott, timber contractor, has a contract to take out 250,000 ties for the Canadian Northern Ry. Co., and has several camps at Banning, Ont., near Fort Frances, filling the orders. The Northern Construction Co. has a contract to take out 400,000 ties for the same company and have a number of camps in north and west of Banning.

The British Columbia Electric Ry. Co. of Victoria, B. C., has acquired a frontage upon Douglas St., which will be utilized for the company's suburban terminals, with the inception of their lines tapping the Saanich peninsula, work upon which, it is expected, will be commenced in the near future.

Work is to be started at once on re-arranging the various properties covered by the recent merger of electric and gas plants in Quebec, Que., so they can be operated as a unit. About $1,000,000 will be expended. The work will be in charge of R. S. Kelsch, Montreal, Que.

Articles of incorporation have been filed with the Canadian Parliament by the Monarch Ry. Co., with a capital stock of $1,000,000 and bonds amounting to $2,500,000. The organization proposes the construction and operation of a new radial railway from Toronto to Orillia, by way of Aurora, Holland Landing, Bradford, Deerhurst, Churchill, Stroud and Allandale and also branches to Lake Simcoe and Markham. The incorporators are W. H. Price, Charles M. Garbey, James F. Coughlin, N. R. Lindsay and Steffan F. Adalia.

Town Council of Niagara-on-the-Lake is taking steps to secure the extension of the International Ry. Company's line from Queenston to that place. James Aikens, Niagara-on-the-Lake, Ont., is interested.

Mexico Notes.

FROM CORRESPONDENTS AND OTHER SOURCES.

Construction work is to be started this spring on the Jalisco Ry. which is to run from La Vega on the Central R. R. to Chamela on the coast. Paul de Velaine, Mexico City, represents the syndicate which is backing the road.

The German banking house of Bleichroeder of Berlin is considering building new railroads in Mexico. The company has sent Baron Hans von Bleichroeder to the United States to take active direction of the enterprise. For about six months he will have an office in the banking house of Kissell, Kinnicut & Co., in Wall St., in New York City, to work out the details.

A company has been organized to build a railroad from Tezziutlan, state of Pueblo, through the state of Vera Cruz, to the port of Nautla. The $2,500,000 gold capital has all been subscribed. A branch line will also be operated between Papantla and Misantla.

The government of the state of Coahuila, Mexico, has granted a concession to the Kansas City, Mexico & Orient Ry., to extend its proposed branch south from San Angelo, Tex., to Allerde, Mexico, where it will connect with the National Railways of Mexico. The company will commence work immediately on this branch which is 200 miles in length. Application will be made to the governments of the United States and Mexico for the construction of an International railway bridge across the Rio Grande. C. H. Webster, Sweetwater, Tex., is Chief Engineer.

Acosta brothers have applied to the Department of Fomento, City of Mexico, for permission to utilize the waters of the Palchan River for the purpose of supplying motive force. The power is to be used in the hacienda "La Mina," situated in the canton of Misantla, in the state of Veracruz. It is desired to use the water at the rate of 5,000 liters per second, at a point situated 1 kilometer south of the intersection of the road to the hacienda with that to the village of Vecuala.

The Waldo Street Ry. Co. proposes to begin work in the spring on an extension from Camden, Me., through to Belfast, Me., and several of the Waldo County towns. Wm. T. Cobb, Rockland, Me., is interested.

The Missouri Pacific Ry., M. L. Byers, Chief Engineer Maintenance of Way, St. Louis, Mo., is planning the expenditure of several million dollars for improvements to its lines in Nebraska. Surveys are already underway for work on the Kansas City-Omaha line, and nearly $500,000 will be spent for new yards at Falls City.

Hobart D. Shaw, C. E., of Gulfport, Miss., has gone to Richardson, Miss., where he will have charge of the engineering work for the projected Baton Rouge & Gulfport Ry. This company, which is backed by the Louisville Lumber Co., projects a line from Richardson to Bogalusa, La.

The Georgia Railway & Electric Co., of Atlanta, Ga., has an application before the City Council of that city for permission to make additions to certain of its street railway lines in order to better the schedules thereon.

At present there are about 900 men employed between Key West, Fla., and Knights Key on the extension of the Florida East Coast Ry. This force will be gradually increased and the work pushed rapidly to completion. There will be more openings in the fills between the keys which will materially strengthen the work, inasmuch as it will allow a passage for the great volume of water which sweeps in from the ocean.

A bill is before the U. S. Senate to allow the Standard Oil Co. to construct a pipe line for oil or gas across the public lands of Arkansas. The passage of this measure will make it possible to complete the pipe lines from the Oklahoma oil fields to the Gulf of Mexico.

The Maine State Board of Railroad Commissioners has been petitioned by the Boston & Maine R. R. to approve the location of a proposed branch or spur track in the city of Portland, Me. The city has already granted its consent.

The stockholders of the Winston-Salem Southbound Ry. Co., at a meeting in Winston, N. C., on Feb. 3, authorized the directors to issue bonds to the amount of $5,000,000 to be used in construction and equipment of this road, now being built from that city to Wadesboro, N. C.

The Knoxville, Sevierville & Eastern R. R. recently completed by W. J. Oliver of Knoxville, Tenn., is reported to have made preliminary surveys for a 25 mile extension east of Sevierville, Tenn.

It is stated that J. H. Barrett, of Pittsburg, Pa., has made a proposition to the promoters of the Highland street car line at Albuquerque, N. Mex., for the construction of the line.

Bids have been received by W. L. Darling, St. Paul, Minn., chief engineer of the Northern Pacific Ry., for the construction of eight miles of double track between Missoula, Mont., and De Smet station. The work requires a considerable amount of excavation. Winston Bros., Minneapolis, Minn., were among the contractors who bid on the work.

The Southern Power Co. proposes to erect its fourth power plant on the Catawba River and now has preliminary surveys underway for the development of water power on the Catawba River at the Lookout Shoals, N. C., at a point touching Catawba, Iredell,

and Alexander counties. For a long distance the river spreads out over a bed of rock, the water being very shallow in most places. The company will erect a dam, build a power house, etc., to develop the 8,000 HP. said to be available. The current will be turned into Hickory, N. C., and Statesville, the latter place being the chief distributing point.

Steps are being taken by citizens of the towns along the proposed right of way to secure the construction of a railroad from Columbia, S. C., to Greenwood by way of Lexington and Saluda. Farmers along the line have expressed their willingness to grant free right of way for the project.

A movement is under way to build an interurban railway from Lincoln to Auburn, via Cheney, Bennet, Dunbar, Talmage and Brock. T. P. Kennard, president of the organization that built the road to College View, Neb., is interested.

According to reports from Linton, N. D., surveys are being made by engineers of the Northern Pacific Ry., for a line from Edgeley, in LaMoure County, to some point in Morton or Hettinger counties, probably Mott, N. D. It is believed the line will run through portions of LaMoure, Logan, McIntosh, Emmons, Morton and Hettinger counties.

The Louisville & Nashville R. R., J. H. Peyton, Louisville, Ky., assistant to the president, is considering having an embankment made between Scarton, Miss. and West Pascagoula, Miss., on the south side of the track to protect it from tropical storms.

The Western Maryland Ry. Co., a new corporation, incorporated under the laws of the state of Maryland with a capital stock of $60,000,000 to take over the Western Maryland R. R., has been admitted to do business in West Virginia.

The Carolina-Tennessee Power Co., 114 Broadway, New York city, is planning to start work early in the spring on a $5,000,000 power plant, the main object of which is to furnish power for the two big copper plants at Ducktown, Tenn. Two dams will be built on the Hiwasse River, one at Appalachia and the second 20 miles above Appalachia. They will generate 60,000 HP.

It has been announced that Boise, Idaho, will be the base of all operations connected with the construction of the line of the recently incorporated Boise-Butte R. R. Co. Work will be started in the near future, it is expected, and the cost of the project will be upward from $20,000,000. E. H. McAuley, member of the city council of Boise, Idaho, is an incorporator of the company.

Advices from Clagstone, Idaho, state that Engineer Eidelblush has completed surveys for the ditch which is to drain Hoodoo Lake and reclaim the land now partly covered with water. There is 4,500 acres to be reclaimed for meadow land, the bonds having been sold to eastern capitalists. Work will start in the spring.

Good progress is being made on the Santa Fe cutoff from Parker to Bengal and it is reported that trains will be operating over it by May 1. The new route will shorten the distance from Phœnix to Los Angeles, Cal., at least 200 miles.

An ordinance is now before the City Council of New Orleans, La., to grant a franchise for a street railway in Algiers, a suburb of New Orleans. The project is said to contemplate the construction of a new electric line to be built out of Algiers along the southern coast. Ex-Governor H. C. Warmoth and Theodore S. Wilkinson are reported to be interested.

The city of Natchez, Miss., has voted a bond issue of $50,000 to be given the Mississippi River Western R. R. as a bonus to build into Natchez. The $50,000 is not to be paid to the road until they have completed the same from Meridian to Natchez and running trains into the city over its own tracks.

Wells Bros. & Bacon, contractors for the Bliss-Rupert cutoff, Idaho, are preparing to rush their work. They have the yards at Bliss full of ties, rails and other necessary material. During the past month a force of about 80 men have been employed blasting the rock along the right of way and men and teams are to start work on the first 10 miles.

A. J. Bright, Nashville, Tenn., who recently completed surveys for the proposed railroad from Westmoreland, Tenn., to Red Boiling Springs, has filed plans and specifications for the proposed work with the promoters of the road at LaFayette.

Citizens of Iberville Parish, Louisiana, have been granted permission by the Governor and the Atchafalaya Levee Board to dam the Alabama Bayou in the Atchafalaya District.

The Rutland Railway, Light & Power Co. of Rutland, Vt., has completed surveys and is securing right of way for its projected electric railway extension from Fair Haven, Vt., to Poultney, Vt. Construction work on the line is to be started in March.

The Minneapolis & St. Louis R. R. has two lines surveyed for the entrance of Pierre, S. Dak. This work was mentioned in our last issue. W. D. Taylor, Chicago, Ill., is Chief Engineer of the company.

The Cincinnati, Newport & Licking Valley R. R. has been incorporated with a capital stock of $20,000, and permission to increase it to $5,000,000. The principal office of the company is at Cynthiana, Ky. The road will be 65 miles in length and extend from Cynthiana in Harrison County to Newport, in Campbell County. The incorporators are as follows: R. W. Day, Scranton, Pa.; F. L. Fuller, New York; Wade H. Hall, Cynthiana; Harrison Peterson, Cynthiana; T. J. Foster, Scranton, Pa.; W. L. Connell, Scranton, Pa.; D. G. McVean, Covington; R. H. Ross, Cynthiana.

It is rumored in Ambrose, N. Dak., that the Minneapolis, St. Paul & Sault Ste. Marie R. R. is considering the construction of a 60-mile branch from that city to Plentywood, Mont. Thomas Green, Minneapolis, Minn., is Chief Engineer of the company.

The Midland Construction Co. of Jamestown, N. D., is reported to have asked bids for 4,000 tons of steel rails to be used in the construction of its proposed railway from Jamestown to Edgeley. The proposed route of the railroad will carry it through Edgeley, Jamestown, Cooperstown and Aneta, and crossing the Great Northern line near Shawnee, west of Larimore. The road will finally pass through western Walsh and Pembina counties.

The East Tennessee & Western North Carolina R. R. Co., has plans under way, it is said, for the construction of a two-mile branch line to the farm of J. H. Smalling, near the Watauga River. E. P. Howe, Johnson City, Tenn., is President of the company.

The Wasioto & Black Mountain Ry., which has 13 miles of line under construction from Wasioto, Ky., to Toms Creek, has opened bids for an extension of the line from the latter place to the town of Harlan, a distance of 24 miles. The Callison Construction Co., Middlesboro, Ky., is making rapid progress on the first 13 miles of the line, and it is expected that this portion of the work will be completed within a month. T. J. Asher is president.

Citizens of Gulfport, Miss., have about succeeded in raising a bonus of $40,000 to secure the construction of a belt line by the Gulfport & Mississippi Court Traction Co. of Gulfport. The line would necessitate the construction of about seven miles of track and overhead work.

BIDS ASKED.

Bridges.

Bids are asked on following work, the notes being arranged alphabetically by states:

Westbrook, Conn.—Until noon, Feb. 21, by P. C. Burdick, First Selectman, Westbrook, Conn., for the construction of the combination steel and concrete bridge over the Menunketesuck River.

Duluth, Minn.—Until 10 a. m., Feb. 18, by Board of Public Works, for the construction and erection of a mass concrete or reinforced concrete bridge complete with abutments and approaches and including pavement and sidewalk, over Tischer's Creek on East Superior St. J. W. Preston is President and R. Murchison is Clerk of the Board of Public Works.

Grand Forks, N. Dak.—Until Feb. 16, by Board of County Commissioners, for the construction of several county bridges, to be constructed of iron and wood.

Madison, Neb.—Until noon, Feb. 19, by S. R. McFarland, County Clerk, for furnishing all necessary labor and material for the erection of the following bridges: 70-ft. span steel bridge with 16-ft. roadway across Battle Creek, near Battle Creek Hill; 40-ft. pile and stringer bridge with 16-ft. roadway; all other bridges ordered by Board of County Commissioners between 50 and 60 ft. in length.

Cleveland, O.—Until 11 a. m., March 2, by Board of Commissioners, John F. Goldenbogen, Clerk, for the construction of a concrete arch bridge on Irish Road, Middleburg Township.

Reading, Pa.—Until 10 a. m., March 3, by A. L. Rhoads, County Controller, for the construction of a reinforced concrete arch bridge in Wyomissing Borough, Berks County, Pa.

Chattanooga, Tenn.—Until March 1, by Robert Hooke, City Engineer, for the reconstruction of the McCallie Ave. viaduct. The cost of the work is estimated at $16,000.

Galveston, Tex.—Until noon, Feb. 17, by John M. Murch, County Auditor, for the construction of a bridge over Chigger Creek, on the Alvin-Friendswood Road. A certified check for $100 must be filed with each bid.

Kalama, Wash.—Until April 5, by Board of County Commissioners, for the construction of a 300-ft. steel highway bridge at Castlerock, Wash. The structure will have one span with wood flooring on a 16-ft. roadway. The substructure will be of concrete, having two piers 70 ft. high, 55 ft. being above the water. G. S. Roberts, Kalama, Wash., is Engineer.

Snohomish, Wash.—Until 10 a. m., Feb. 28, by John F. Birney, County Engineer, Everett, Wash., for the construction of a steel swing span over the Snohomish River at the town of Snohomish. Official advertisement will be found elsewhere in this issue.

Milwaukee, Wis.—Until 10:30 a. m., Feb. 17, by Board of Public Works, for repairing the protection pier of Pleasant Street bridge, crossing the Milwaukee River.

Winnipeg, Man.—Until March 7, by Board of Control, for the construction of an overhead bridge at Brown and Brant Sts.

Winnipeg, Man.—Until March 7, by Board of Control, M. Peterson, Secretary, for the construction of the Brant steel bridge at an estimated cost of $299,646.

Buildings.

Bids are asked on following work, the notes being arranged alphabetically by states:

Birmingham, Ala.—Until March 1, by D. H. Marbury, Chairman of Building Committee, Birmingham, Ala., for the erection of a church building for the Southside Baptist congregation, Birmingham, Ala.

Denver, Colo.—Until noon, March 7, by William K. Burchinell, Secretary State Board of Capitol Managers, for certain portions of the structural steel and cast iron work entering into the construction of "The Colorado State Museum Building."

Bristol, Conn.—Until 3 p. m., March 8, by James Knox Taylor, Supervising Architect, Treasury Department, Washington, D. C., for the construction of the retaining wall at the U. S. Post Office, Bristol, Conn.

Washington, D. C.—Until noon, Feb. 23, by District Commissioners, for constructing an eight-room school building on lots 20-24 square 388, at corner of 10th and E Sts., southwest.

Washington, D. C.—Until noon, Feb. 17, by District Commissioners, for the construction of the John Eaton school building No. 160, at the northeast corner of Lowell and 34th Sts., lots 2 to 11 exclusive, block 4, subdivision of Cleveland Heights.

Fort Dodge, Ia.—Until 2 p. m., Feb. 22, by C O. Case, Fort Dodge, Ia., for the construction of a Y. M. C. A. building at Fort Dodge, Ia.

Aurora, Ill.—Until 2 p. m., March 1, by Building Committee, Mrs. James Hanna, Chairman, at the office of Worst & Shepardson, Coulter Block, Aurora, Ill., for the erection and completion of a building for the Young Woman's Christian Association.

Chicago, Ill.—Until noon, March 2, by South Park Commissioners, at 57th St. and Cottage Grove Ave., for furnishing material and labor

for the construction of park buildings and swimming pool in Park No. 4, situated at 45th St. and Princeton Ave., Chicago, Ill.

Lincoln, Ill.—Until 3 p. m., Feb. 21, by James Knox Taylor, Supervising Architect, Treasury Department, Washington, D. C., for the construction complete, including plumbing, gas piping, heating apparatus, electric conduits and wiring, of the United States post office at Lincoln, Ill.

Quincy, Ill.—Until 3 p. m., March 28, by James Knox Taylor, Supervising Architect, Treasury Department, Washington, D. C., for the construction, including plumbing, gas piping, heating apparatus, electric conduits and wiring and standard clock system, of an extension, remodeling, etc.

Urbana, Ill.—Until 11 a. m., March 3, by Board of Trustees, University of Illinois, W. L. Abbott, Pres., at the Western Society of Civil Engineers, 1735 Monadnock Block, Chicago, Ill., for the construction of a fireproof school building at the University of Illinois, Urbana, Ill.

Connersville, Ind.—Until 3 p. m., March 23, by James Knox Taylor, Supervising Architect, Treasury Department, Washington, D. C., for the construction, including plumbing, gas piping, heating apparatus, electric conduits and wiring of the United States Post Office at Connersville, Ind.

Lexington, Ky.—Until 3 p. m., March 25, by James Knox Taylor, Supervising Architect, Treasury Department, Washington, D. C., for the extension, remodeling, etc., including plumbing, gas piping, heating apparatus, electric conduits and wiring of the United States Post Office at Lexington, Ky.

Cambridge, Mass.—Until 5 p. m., Feb. 17, by Dr. A. P. Norris, Mass. Ave. and Pleasant St., Cambridge, Mass., for the construction of a 16-family apartment brick house at the corner of Pleasant and Greene Sts., Cambridge.

Fort Robinson, Neb.—Until 11 a. m., March 5, by Malvern Hill Barnum, Constructing Quartermaster, for the construction, heating, plumbing and electric wiring and fixtures for one noncommissioner officers' quarters; also for an addition to the water main to connect same with the post system.

Fargo, N. Dak.—Until 2 p. m., Feb. 25, by W. A. Yoder, Secy., North Dakota Agricultural College, Fargo, N. Dak., for the completion of the Women's Building for the North Dakota Agricultural College.

Inkster, N. Dak.—Until noon, Feb. 23, by Secretary Grand Forks Builders' Exchange, for the construction of a brick store building for the Inkster Mercantile Co., Inkster, N. Dak.

Colfax, Wis.—Until March 7, by Henry B. Anderson, School Clerk, for the construction of a brick and stone school house at Colfax, Wis.

Fort Bayard, N. Mex.—Until 11 a. m., March 15, by Capt. S. P. Vestal, Constructing Quartermaster, for the complete construction, plumbing, heating, electric lighting fixtures for one double and one single ward building, three double and one single officers' quarters.

Toronto, Ont.—Until noon, March 1, by J. O. Reaume, Minister of Public Works, Toronto, Ont., for masonry, bricklaying, stone, carving, fireproofing, etc.; structural steel; steam heating; plumbing and gasfitting; iron armored conduit and electric wiring; vault doors, roofing; copper and sheet metal; carpenter work, ornamental iron and grille work; elevators; lathing and plastering; painting and glazing; marble and tile; metallic fireproof doors; base and trim; hardware; castings.

Roads and Streets.

Bids are asked on following work, the notes being arranged alphabetically by states:

Montgomery, Ala.—Until noon, March 7, by Robert Tait, City Treasurer, for the improving of Jeff Davis Ave., from Holt to Oak Sts., by grading, curbing and all necessary storm water sewers, gutters, etc., in conection therewith.

Washington, D. C.—Until noon, March 1, by Capt. H. L. Pettus, Constructing Quartermaster, for the construction of macadam roads, concrete walks, etc., at the Walter Reed General Hospital, Washington, D. C.

Franklin Park, Ill.—Until 8 p. m., Feb. 23, by Board of Local Improvements at Village Hall for the construction of about 11,000 ft. of cinder sidewalk. K. W. Pelsma is Secretary of the Board.

Ottawa, Kan.—Until 5 p. m., March 2, by F. A. Marcell, City Clerk, for grading, curbing, guttering and macadamizing with a bituminous binder the following streets in the city of Ottawa; Fourth St., from Cedar to Cherry St.; 5th St., from Cherry to Ash St.; Ash St., from 4th to 5th St.; Elm St., from 1st to 7th St.; Cedar St., from 4th to 10th St.; Logan St., from Main to Cherry St. The work includes 55,000 sq. yds. of macadam and 20,000 lin. ft. of concrete curb and gutter.

Chisholm, Minn.—Until noon, Feb. 19, by C. A. Munro, Village Recorder, for furnishing all necessary material and labor for the construction of about 60,000 sq. ft. of Portland cement sidewalk with 5,800 ft. of combination curb and gutter and crosswalks on Lake and adjoining streets.

Corning, N. Y.—Until 11 a. m., March 17, by Board of Public Works, for the construction of about 1½ miles of brick pavement with cement curbs and 1½ miles of bituminous macadam pavement with cement curbs. The work includes 12,000 sq. yds. of brick and 8,520 sq. yds. of macadam. W. C. Sleight is Clerk of the Board of Public Works.

Cincinnati, O.—Until noon, Feb. 25, by Board of County Commissioners, for the resurfacing of Cincinnati Ave., from east to west corporation lines of North Bend in Miami Township. Stanley Struble is President of the Board.

Wadsworth, O.—Until noon, Feb. 28, by Village Council for furnishing the necessary labor and materials for the improvement of South Main St., from the Erie R. R. Co. tracks to the south line of J. W. Billman lot 930 and Pardee St., from the west line of Mrs. Kate Hook's property in this village. L. F. Allen is Clerk.

Oklahoma City, Okla.—Until 5 p. m., March 7, by W. C. Burke, City Engineer, for 262,215 sq. yds. of sheet asphalt pavement, total length of which is about 15.78 miles and estimated cost is $860,000. The work includes: 262,215 sq. yds. pavement at an estimated cost of $539,228; 227,700 cu. yds. of earth excavation at $79,695; 2,500 cu. yds. of rock excavation at an estimated cost of $1,750; 11,200 cu. yds. of embankment at an estimated cost of $2,240; 172,530 lin. ft. of curb and gutter at an estimated cost of $132,345; 10,900 ft. header at an estimated cost of $1,635; 45,895 ft. of 10, 12, 15, 18, 21 and 24-in. vitrified pipe at an estimated cost of $59,449; 376 catch basins at an estimated cost of $7,520; 90 manholes at an estimated cost of $3,600; 45 sq. yds. of cut paving at an estimated cost of $157.

Gallitzin, Pa.—Until March 5, by Harry F. Conrad, Borough Secretary, for paving with brick, 9,000 sq. yds. of street. D. W. Dillman, 47-49 Altoona Trust Bldg., Altoona, Pa., is Engineer.

Sewickley, Pa.—Until 5 p. m., Feb. 24, by M. M. Maker, Borough Engineer, for macadamizing Walnut St., from Thorn St. to Frederick Ave. The work includes 730 cu. yds. excavation, 140 lin. ft. of new curb, 910 lin. ft. of redressed curb reset, 550 sq. yds. brick gutters, 1,635 sq. yds. of macadam; 7½ in. slag base; 2½ in. broken stone; 1½ Kentucky rock asphalt.

Sewers.

Bids are asked on following work, the notes being arranged alphabetically by states:

Vincennes, Ind.—Until 1:30 p. m., March 2, by Board of Public Works, for the complete plans, specifications and estimates for the installation of a sanitary and storm water system for this city.

Mt. Sterling, Ky.—Until 1 p. m., March 1, by City Clerk, for furnishing all necessary materials and labor for constructing 9½ miles of sewers from 6 to 24-in. in diameter, with all manholes, lampholes, flushtanks, etc., also reinforced concrete septic tanks. W. A. Samuels is Mayor.

Louisville, Ky.—Until noon, March 4, by Sewerage Commissioners, P. L. Atherton, Chairman, for the construction of Section "A" Castlewood Sewer Contract No. 61, including 5,951 ft. of concrete sewer, 39 to 66-in. diameter; 930 ft. 20-in. vitrified pipe, including 4,521 ft. of earth excavation and 1,500 cu. yds. of rock; 1,440 cu. yds. of concrete; 2,760 sq. yds. vitrified brick. J. B. F. Breed is Chief Engineer.

Alliance, Neb.—Until noon, Mar. 2, by F. W. Irish, City Clerk, for constructing 8-in. vitrified pipe sewers in five districts, the total estimated cost being $8,700. Official advertisement will be found elsewhere in this issue.

Florence, S. C.—Until 8 p. m., March 3, by Board of Sewerage Commissioners, for furnishing all material and labor for the construction of a system of sanitary sewers at Florence, S. C.

Roanoke, Va.—Until noon, Feb. 23, by W. L. Craft, City Clerk, for the construction of a sewer in alley between Orange and Melrose Aves., N. W. from 13th to 15th Sts. F. L. Giboney is City Engineer.

Water Supply.

Bids are asked on following work, the notes being arranged alphabetically by states:

Coffeyville, Kan.—Until 5 p. m., Feb. 21, by City Clerk, Rosa Bell, for the development and installation of a ground water supply, the necessary preliminary tests for which have already been made.

Fort Riley, Kan.—Until 10 a. m., March 8, by Capt. W. M. Whitman, Constructing Quartermaster, for the construction of boiler house and pump pit and furnishing and installing boiler pumping engine and water main at this post.

Wallington, N. J.—Until 8 p. m., Feb. 28, by Mayor and Council, for the construction of a reinforced concrete water reservoir and extension of artesian wells. A. L. Pettersen, Passaic, N. J., is Engineer.

Fort Sill, Okla.—Until 10 a. m., March 7, by Capt. David L. Stone, U. S. A., Constructing Quartermaster, for water distributing system; sewerage system; drainage system at Fort Sill, Okla.

Portland, Ore.—Until 4 p. m., March 8, by City Water Board, for the construction of the second pipe line to Bull Run. The work includes the construction of 24 miles of pipe and is estimated to cost $1,629,000. Official advertisement will be found elsewhere in this issue.

Miscellaneous.

Bids are asked on following work, the notes being arranged alphabetically by states:

Fort Morgan, Ala.—Cisterns—Until 1:30 p. m., March 7, by Capt. H. B. Chamberlin, for the construction of three reinforced concrete cisterns, one 30,000 gals. and two 8,500 gals capacity, at Fort Morgan, Ala.

Washington, D. C.—Hoists—Until Feb. 21, by Capt. F. C. Boggs, General Purchasing Officer, Isthmian Canal Commission, Washington, D. C., for furnishing double friction drum hoists, electrically operated.

Boston, Mass.—Trolley System—Until noon, March 2, by Board of Trustees, Infirmary Department, 28 Court Square, Boston, Mass., for the construction of a trolley system for the transportation of coal from the coal sheds to the power house of the almshouse on Long Island.

New York, N. Y.—Iron Standard—Until Feb. 21, by Maj. Gray Zalinski, Army Bldg., New York, N. Y., for furnishing under Schedule No. 34, labor and material for erecting one iron standard for Lincoln address cabinet in the Woodlawn national cemetery, at Elmira, N. Y.

Excavation, Earth and Rock.

Bids are asked on following work, the notes being arranged alphabetically by states:

Savannah, Ga.—Dredging—Until noon, March 9, by Col. Daniel C. Kingman, U. S. Engineers, Savannah, Ga., for dredging in Club and Plantation Creeks, Ga.

Harvel, Ill.—Drainage Work.—Until 10 a. m., March 1, by Commissioners of Union Drainage District No. 2, of the towns of Harvel and King, for cleaning out and reconstructing open ditches as follows: 18,200 lin. ft., base 6 ft., from 1 to 3½ ft. deeper than the present ditch, and 9,600 lin. ft., base 5 ft. from 3 to 4 ft. deeper than the present ditch, all side slopes 45 degrees, and all within an open ditch at present from 5 to 8 ft. deep, one single drain 22,700 ft. long and a branch drain 8,780 ft. long, in all estimated closely to contain about 49,886.

Monticello, Ill.—Drain.—Until 10 a. m., Feb. 26, by Lake Fork Special Drainage District Commissioners for the construction of 25,955 ft. of tile drains.

Woodstock, Ill.—Drainage System.—Until 10 a. m., March 4, by Commissioners of Rush Creek Drainage District, James E. Cunningham, Chairman, for constructing a system of drainage to include 88,000 cu. yds. open ditch work and 24,000 ft. of tile drains. Official advertisement will be found elsewhere in this issue.

Warrensburg, Mo.—Ditch Work.—Until noon, March 10, by Board of Supervisors of Blackwater Drainage District No. 1, of Johnson County, Mo., for clearing right of way and excavating main ditch, straightening Blackwater Creek and containing approximately 1,000,000 cu. yds. of earth and laterals and small ditches containing about 220,000 cu. yds. of earth. Robert J. Grover, Warrensburg, Mo., is Deputy Secretary and T. O. Stanley is Engineer.

Materials, Machines, Supplies, Etc.

Bids are asked on following work, the notes being arranged alphabetically by states:

Phoenix, Ariz.—Pumping Engine.—Until 4 p. m., March 14, by Superintendent of the Water Works Department, for one 5,000,000-gal. pumping engine.

Washington, D. C.—Paving Brick—Until 2 p. m., Feb. 18, by Capt. F. C. Boggs, General Purchasing Officer, Isthmian Canal Commission, Washington, D. C., for furnishing 30,000 paving brick 2½x4x8 in.

Washington, D. C.—Electrical Material—Until 10:30 a. m., Feb. 25, by Capt. F. C. Boggs, General Purchasing officer, Isthmian Canal Commission, Washington, D. C., for furnishing Electrical Material, including fixtures, fittings, cable, wire, line material, lineman's tools, hardware, mica, soldering material, insulating material, paint, varnish, japan, conduit, molding, rubber gloves, tape, etc.

Washington, D. C.—Hoisting Engine, Capstan, Etc.—Until 10:30, March 7, by Capt. F. C. Boggs, General Purchasing Officer, Isthmian Canal Commission, Washington, D. C., for furnishing: hoisting engine, capstans and engine, plumbs, boring machine, steel castings, dipper bails, gear cutters, milling tools, slitting saws, stocks and dies, twist drills, bits, chisels, open links, tacks, chain blocks, gauges, oil cups, steam whistles, unions, bellows, rubber belting, wick packing, gauge glasses, rakes, steel tapes, water closets, filing cabinets, beds, mattresses, chair bottoms, mats, awnings, cooks' aprons, napkins, towels, cheesecloth, yarn, kitchen utensils, dishes, glassware, cutlery, coal tar, soft soap, lumber, etc.

Washington, D. C.—Wireless Sending Sets.—Until Feb. 21, by Captain. C. DeF. Chandler, Capt, Signal Corps, U. S. Army, for furnishing four wireless telegraph sending sets, in accordance with Specification No. 525, Drawing No. 799.

Washington, D. C.—Steel Castings—Until 2 p. m., Feb. 18, by Capt. F. C. Boggs, General Purchasing Officer, Isthmian Canal Commission, Washington, D. C., for furnishing four sets (two

pieces to each set) of jaw plates for use on portable crusher.

Washington, D. C.—Valves—Until 2 p. m., Feb. 17, by Capt. F. C. Boggs, General Purchasing Officer, Isthmian Canal Commission, Washington, D. C., for 4 2-in. valves, cast iron body, brass lined, with blank flanges to reduce steam pressure from 170 to 80 lbs.

Washington, D. C.—Poles—Until 2 p. m., Feb. 23, Capt. F. C. Boggs, General Purchasing Officer, Isthmian Canal Commission, Washington, D. C., for furnishing 150 creosoted wood poles, 40 ft. long and 8 in. in diameter at the top.

Fort Sheridan, Ill.—Sanitary Fittings—Until Feb. 16, by Capt. M. E. Saville, Depot Quartermaster, Fort Sheridan, Ill., for furnishing a miscellaneous quantity of sanitary fittings.

Jackson Barracks, La.—Repairing Launch—Until 10 a. m., March 12, by Lieut. A. L. Loustalot, Constructing Quartermaster, for repairing the launch Mansfield.

Portland, Me.—Mooring Stones—Until noon, March 16, by Light House Inspector, Portland, Me., for furnishing mooring stones for use in the first lighthouse district for the fiscal year ending June 30, 1911.

Baltimore, Md.—Lumber, Rubber Hose, Etc.—Until Feb. 23, by Board of Awards, for furnishing and delivering to the Street Cleaning Department lumber, rubber hose, hose supplies, wagon and harness, supplies, carts, cart bodies, sweeping machines, oils, paints, leather, hardware tools, iron, steel, etc.

Saginaw, Mich.—Castings, Sewer Pipe—Until Feb. 18, by City Clerk, for furnishing sewer castings, Portland cement, sewer pipe and drain tile.

Williston, N. Dak.—Material—Until 10 a. m., March 8, by Board of County Commissioners, for the following material furnished f. o. b. cars at Williston: Twelve I beams 12x30, twelve I beams 10x25, twenty-four I beams 8x20, three I beams 6x18, four channels 12x30, four channels 10x25, eight channels 8x20, seventy-six channels, 3x2x¼x4, four L's 2x2x3-16x32, four L's 2x2x3-6x27, eight L's 2x2x3-16x22.

Gallitzin, Pa.—Paving Block—Until Feb. 28, by Harry F. Conrad, Borough Secretary, for furnishing 450,000 paving block. D. W. Dillman, 47-49 Altoona Trust Bldg., Altoona, Pa., is Engineer.

Frankfort Arsenal, Philadelphia, Pa.—Chain Drives and Bearings—Until 10 a. m., Feb. 17, by Commanding Officer, for furnishing four chain drives and six grooved ball thrust bearings.

Wheeling, W. Va.—Steel Forgings, Etc.—Until 11 a. m., Feb. 28, by Capt. F. W. Altstaetter, U. S. Engineers, Wheeling, W. Va., for furnishing and delivering structural steel, forgings, bolts, etc., for dams Nos. 8 and 11, Ohio River.

Seattle, Wash.—Spare Tail Shaft.—Until 11 a. m., March 11, by Quartermaster, U. S. A., 322 Arcade Annex, Seattle, Wash., for manufacturing and delivering f. o. b. cars, Pier 5, Seattle, one spare tail shaft.

Calgary, Alta.—C. I. Pipe, Specials, Etc.—Until noon, Feb. 25, by H. E. Gillis, City Clerk, for furnishing city cast iron pipe, valves, hydrants, specials, etc.

Winnipeg, Man.—Asphalt.—Until Feb. 25, by Board of Control, for supplying from 2,500 to 3,500 tons of asphalt for street paving in this city. Col. H. N. Ruttan is City Engineer.

CONTRACT LET.

The following contracts have been let recently:

BRIDGES.

Astoria, Ill.—Bridge—Springfield Bridge Co., at $1,480, for the erection of a bridge on a line between Isabel and Kerton Townships, having a 70-ft. span, with a 14-ft. roadway.

Sioux City, Ia.—Bridge—Lewis & Leeder, at $2,948, for the building of the new Sixth St. bridge over Perry creek.

Sioux City, Ia.—Culvert—P. C. Hansen, for the construction of a culvert at 24th and Jones Sts.

Shubuta, Miss.—Bridge—Austin Bros., for the construction of an iron bridge across the Chickasahay River, one mile east of Shubuta.

Cleveland, O.—Bridge—Van Dorn Iron Works, Cleveland, O., at $61.25 per ton or $38,282, for the steel for the superstructure of the bridge to be erected at the W. 25th St. crossing of the Nickel Plate Railroad.

North Bend, Ore.—Bridge—Victor Anderson, of this city, at $7,785, for the construction of a drawbridge on South slough. The bridge is to be completed by June 1.

Pendleton, Ore.—Bridges—Atlas Bridge Co., Portland, Ore., at $8,000, for the erection of four new steel bridges. The bridges are to be located, one at McCoy, across the Walla Walla river; one at Milton, across the Walla Walla river, Butter creek, near its mouth, and one across Dry creek, at Blue Mountain station.

Pittsburg, Pa.—Bridge.—Friday Contracting Co., at $64,326, for building the Meadow St. bridge across Negley Run Hollow.

Yankton, S. Dak.—Bridges—Hennipen Bridge Co., Minneapolis, Minn., for the construction of all the bridges to be erected in Yankton County during 1910. Bids were opened Feb. 3.

Roby, Tex.—Bridges—B. F. Leonard, Bowie Tex., for the construction of all the bridges on the last four miles of the Estacado & Gulf Railway Co.'s road into this city.

Castle Dale, Utah—Bridges—James J. Burke & Co., Salt Lake City, Utah, at $29,597, for the construction of five bridges in Emery County. The bridges will be of steel, with concrete abutments.

Shoshone, Wyo.—Bridge—Des Moines Bridge & Iron Works, Des Moines, Ia., for building a 130-ft. steel bridge in this city for highway traffic.

Winnipeg, Man.—Bridge—Thos. Kelley & Sons, for the construction of the piers of the joint railway bridge across the Assiniboine river, to be built by the Canadian Northern & Grand Trunk Pacific Railways. The bridge is to be 454 ft. in length and will cost about $50,000. The bridge will be of the deck plate girder type. There will be one section of 44 ft. at the north end which will be a through span, then two of the deck plate sections, each 80 ft. in length. The central span will be 90 ft. in length (Strauss trunnion lift pattern). At the south end there will be two more deck plate spans of 80 ft. each. Seven concrete piers are to be constructed.

Winnipeg, Man.—Viaduct—Hill & Sons, for the construction of the pedestals of the steel viaduct which the Canadian Pacific Railway will construct across the South Saskatchewan river at Outlook, Sask. The bridge will be 3,000 ft. in length and 126 ft. from top of the pedestals to the base of the rail. There are 110 piers to be built to carry the steel. The shore piers will be carried on nests of concrete piles, 430 in number, while 100,000 lin. ft. of wooden piles, each 50 ft. in length, will be driven to carry the river piers. The bridge is to have a traffic deck, to be suspended half way up the towers, which gives a roadway 29 ft. in width, with 16 ft. of head room.

ROADS AND STREETS.

Birmingham, Ala.—Paving.—Southern Bitulithic Co., of this city, for the construction of 75,000 sq. yds. of bitulithic pavement.

Indianapolis, Ind.—Grading—Lucky Bros., at $.25 per ft., for grading roadway of the first alley east of Illinois, from 27th to 28th St.

Davenport, Ia.—Paving—McCarthy Improvement Co., for the paving of Sixth, between Ripley and Harrison, at the following prices: Excavation, $63; asphalt paving $1.79½; brick paving, $1.79½; curbing, $.59.

Arkansas City, Kan.—Paving—Rushmore & Gowdy, Cherryvale, Kan., for the construction of 15,000 sq. yds. of brick paving in this city. Work is to begin at once.

Hutchinson, Kan.—Paving—Rushmore & Gowdy, Cherryvale, Kan., for the construction of an additional 3,000 sq. yds. of pavement in this city. Work will begin at once.

New Orleans, La.—Paving—Standard Paving Co., at $1,500, for hauling sq. granite blocks at $.12 per stone for the completion of the paving of Magnolia St., from the New Basin canal to Erato St.

Goldsboro, N. C.—Paving.—Atlantic Bitulithic Co., of this city, for the construction of 50,000 sq. yds. of bitulithic pavement.

Goldsboro, N. C.—Paving—Atlantic Bitulithic Co., Norfolk, at $100,000, for paving the business and residence streets with bitulithic. The work includes the construction of 50,000 sq. yds. of pavement.

Newark, N. J.—Paving.—Standard Bitulithic Co., for repairing 50,000 sq. yds. of asphalt in this city.

Cincinnati, O.—Paving—Shanklin & Cash, Columbia Hotel, Cincinnati, O., at $7,871, for the improvement of Bramble Ave., from Central Ave. to Plainville Pike, in Columbia Township.

Ada, Okla.—Paving. — Shelby Downard Co., Ardmore, at $1.80 per sq. yd., for paving Main, Broadway and Townsend Sts., using a 5-in. concrete base and 2-in. rock asphalt. The total cost of the work will be about $90,000.

Portland, Ore.—Paving.—Warren Construction Co., for the construction of 3,950 sq. yds. of bitulithic pavement on First St.

Dallas, Tex.—Paving.—Texas Bitulithic Co., of this city, for the construction of 23,085 sq. yds. of bitulithic pavement on Cedar Springs St.

Spokane, Wash.—Paving Plant—Jennuys Co., Indianapolis, Ind., at $16,600, for the construction of a complete asphalt plant of 1,000 yds. capacity. Bids were opened Feb. 1.

Glenova, W. Va.—Grading—William Patterson, West Bridgeport, O., for making improvements in this city. The work will consist of the grading for the principal street through the town, and also the sidewalks.

SEWERS AND WATER SUPPLY.

Montgomery, Ala.—Sewer—J. N. Mitchell, for the construction of the sanitary sewer from Highland Park to the outlet.

Tombstone, Ariz.—Water Tanks—Des Moines Bridge & Iron Works, Clinton, Ia., at $3,495, for the construction of the water tanks at the territorial prison.

Bloomington, Ill.—Sewers—Frank Sullivan, of this city, at $1,635, for the construction of a sewer on Broadway, from Hovey to Burleigh St., and at $353, for the construction of a sewer on the same street, from Hovey Ave., to Florence Ave.

Bloomington, Ill. — Waterworks — Following contracts have been awarded by the City Council for the entire construction work at the water plant: Gray & Bowman, building roof and floors, at $13,500; Allis-Chalmers, pumping engine, at $21,600; Heine boilers, set complete, at $9,052; Greene Engineering Co., stokers, at $2,519; Fairbanks-Morse, track scale, at $1,352; Gray & Bowman, tunnel, hydraulic lift, industrial track bunkers, elevated track, grading, etc., at $10,474; Heine Chimney Co., chimney, at $3,751; Frank Sullivan, outside piping, at $6,359; Frank Sullivan, plumbing, at $1,684; Gray & Bowman, wrecking old boilers, at $60. Total, $70,351.

Chicago, Ill.—Conduit—John W. Farley & Co., at $78,000, for the construction of a 12x16 ft. concrete conduit, for draining the west arm of the south branch of the Chicago river. The conduit will connect the west arm of the river with the Western Ave. sewer.

Abilene, Kan.—Sewer—Lyon & Snider, Salina, Kan., for the construction of the sewer in district No. 6 on North Olive and Kuney Sts.

Caney, Kan.—Sewer—Johnson & Hyatt, for the construction of a sewer in this city.

Omaha, Neb.—Sewer—National Construction Co., for the completion of the Mud creek sewer.

Portales, N. M.—Sewer System—S. J. Mathews, Kansas City, Mo., for the construction of a new sewer system, electric light and water works.

Syracuse, N. Y.—Sewer—John W. Davin, at $10,303, for the construction of a 20-in. sewer in Roby, Elsner, Dwight and other strets in the Fourth ward.

Syracuse, N. Y.—Sewers—Michael J. Gleason, for the construction of small sewers of vitrified pipe in Greenway Ave., Willis Ave., Avery Ave., and North Franklin St.

Erie, Pa.—Sewer—Dennis O'Brien, for the reconstruction of the sewer extending 550 ft. west in Fourth St., from the Millcreek intercepting main sewer, at $1.20 a ft. for laying 15-in. pipe, $.35 for 6-in. pipe, $1.40 for Y or T branches, and $40 for manholes.

Salt Lake City, Utah.—Sewer Extension—Bids were opened Feb. 4 by the Board of Public Works, for constructing Sewer Extension No. 220, the contract being let to the James Kennedy Construction Co., at the following bid: Excavating and backfilling, 50,632.96 cu. yds., per ..... $ 1.45

Vit. pipe, incl. 4" y's per lin. ft.—

6" 276.0 lin. ft.	0.25
8" 32,234.7 lin. ft.	0.48
10" 22,545.0 lin. ft.	0.651
12" 9,564.0 lin. ft.	0.80
15" 2,481.0 lin. ft.	1.20
Manholes, each, 160	70.00
Flush tanks, each, 61	145.00
Total	$134,267

Salt Lake City, Utah—Sewer—James Kennedy Construction Co., of this city, at $33,730, for the construction of sewer extension No. 249. Bids were opened Feb. 4.

Albuquerque, N. Mex.—Sewer System—Ripley, Hassleman & Missue, Pueblo, Colo., at $60,000, as a sub-contract from Glass & Fischer, for the construction of that portion of the sewer system beginning at the corner of Fourth St. and Stover Ave. and running to Seventh St.

EXCAVATION, MISCELLANEOUS, MATERIALS.

Joliet, Ill.—Light & Power—Sanitary District, Chicago, Ill., at $.01 per kilowatt hour, for furnishing electric light and power to the Illinois state penitentiary at this city.

New Orleans, Ia.—Oil House—General Contracting Co., New Orleans, La., at $1,498, for the construction of an oil house in this city.

West Boylston, Mass.—Electric Light Plant—Delta Electric Co., Barton place, Worcester, Mass., at $13,479, for the construction of the electric light plant at this city. The contract includes the construction of pole lines, substation and what other electrical construction needed for the lighting plant. The plant is to be completed by July 1.

St. Louis, Mo.—Pumping Machinery—R. D. Wood & Co., Philadelphia, Pa., for the installation of the pumping machinery in the new sewage pumping station to be located at the foot of Park View Ave.

Kearney, N. J.—Cells—Stewart Jail Works Co., Cincinnati, O., at $1,965, for the construction of five steel cells in the basement of the Town Hall in this city. The work includes all steel work for five men's cells, two women's cells and 1 padded cell, to be constructed of mild Bessemer steel. Bids were opened Feb. 1.

Paterson, N. J.—House—Frank B. Gilbreth, Inc., 60 Broadway, New York, N. Y., for the construction of the four-story and basement apartment house, to be erected at the corner of Clark and Ward Sts., for Isaac Wrubel, Middletown, Conn. The building will contain three houses of 40 apartments and will be constructed of concrete foundations, brick and stone walls of ornamental design, tar and gravel roofing, to be complete in all respects, with modern plumbing, electric wiring, steam heating, fire escapes, etc. William D. Johnson, Inc., Hartford, Conn., is the architect.

Paterson, N. J.—House—Frank B. Gilbreth, Inc., 60 Broadway, New York, N. Y., for the construction of the new apartment house to be erected on the south side of DeGrasse St., east of Hamilton St., in this city, by Isaac Wrubel,

Middletown, Conn. The house is to be equipped with modern improvements. William D. Johnson, Inc., Hartford, Conn., is the architect.

Brooklyn, N. Y.—Warehouse—Turner Construction Co., 11 Broadway, New York, N. Y., for the general construction of a 10-story and basement reinforced concrete warehouse to be built for the Pioneer Warehouse at 37-39 Flatbush Ave., Brooklyn. The building will be 40x 75 ft. in plan, and will have a brick veneer on the front. Louis L. Firuski is the owner and J. G. Glover is the architect. Work will be started May 1.

New York, N. Y.—Library—Cobb Construction Co., 47-49 Liberty St., New York, N. Y., at $543,750, for equipping and furnishing the New York Public Library.

Wilson, N. Y.—Light and Power Plant—Conant-Bryant Co., Buffalo, N. Y., for the construction of a modern electric lighting and power plant to be built in the town of Wilson. The contract calls for street lighting by the use of incandescent lamps on the residence streets and for 2,000 candlepower arc lights in the business section.

Dayton, O.—Lead—Dayton Supply Co., at $4.89 per 100 lbs., for furnishing 15 tons of fine pig lead for caulking pipes in the summer time for the water works department.

Pittsburg, Pa.—Lights—Sunlight Illuminating Co., for the incandescent lighting on the city streets.

Pittsburg, Pa.—Structural Material—American Bridge Co., for furnishing about 2,000 tons of structural material for the ore docks that the Cincinnati, Hamilton & Dayton Railroad Co. will build in Toledo, O.

Dallas, Tex.—Clearing Timber—McCord & Hieatt, at $4 per acre, for the clearing of the timber acreage in White Rock reservoir site north of the Garland road. The wood is the basis.

Pasco, Wash.—Pumping Plant—Kilbourn & Clarke, Seattle, Wash., for the installation of a pumping plant for the Columbia River Orchards Co., at Columbia orchards, near Wahluke, on the Columbia river. The plant will have a total capacity of 40,000 gals. per min. and is to furnish water for a 15,000-acre fruit land tract.

Hamilton, Ont.—Supplies—Following contracts have been awarded for furnishing the annual supplies for the waterworks, sewers and Board of Works Departments: Cement, Canadian Portland Cement Co., at $1.50 per barrel; lime, E. J. Guest, at $0.16 per bushel; timber, M. Brennen & Sons, at $27.75 per 1,000 ft.; sewer brick, Ollman Bros., at $8 per 1,000; castings, Gartshore-Morison Co., at $2.05 perd 100 lbs.; iron pipe, Gartshore-Morison Co., at $34 per ton; gate valves, Kerr Engine Co., Walkerville, at $9 for 6-in. valves, $36 for 12-in. valves; pig lead, Adam Hope, at $3.53 per 100 lbs.; lead pipe, Canada Metal Co., at $4.35 per 100 lbs.; hydrants, Canada Foundry Co., at $43.12 each; sewer pipe, Toronto & Hamilton Sewer Pipe Co.; paving brick, The Paving Brick Co., Massillon, O., at $26.50 per 1,000; gravel, E. New, except the district east of Sherman Ave.; wooden blocks, United States Preserving Co., at $1.95 per sq. yd.; brass, London Brass Co., at $3,000.

PROJECTED WORK.

Bridges.

Items Arranged Alphabetically by States.

Van Buren, Ark.—Waddell & Harrington, Engineers, of Kansas City, Mo., are to prepare plans for the construction of the proposed free bridge over the Arkansas River, between Fort Smith and Van Buren.

San Diego, Cal.—County Supervisor John Griffin has decided upon the erection of a $6,000 bridge over the Santa Margarita Creek, at the Ysidora crossing.

San Francisco, Cal.—Committee of the College Hill Improvement Club has been appointed to present plans to the County Supervisors for the construction of a bridge from Richland Ave. to Miguel St., connecting the Fairmount district and College Hill.

Washington, D. C.—Ralph Cameron, Arizona Delegate in the House of Representatives, has secured an appropriation from Congress of $50,000 for the construction of a bridge over the Little Colorado River at Tamsero, 60 miles north of Flagstaff, Ariz.

Washington, D. C.—Bill has been introduced into Congress by Representative Dalzell, authorizing the construction of a bridge over the Monongahela River, between the boroughs of Wilson and Glassport, Pa.

Cedar Rapids, Ia.—City Council is considering the construction of a bridge over the river at Third Ave.

Glasgow, Ky.—Barren and Allen Counties are making preparations for the construction of a new bridge across the Barren River at the ford near Port Oliver. Work will probably be started in the spring.

St. Joseph, Mich.—City is considering the matter of borrowing $20,000 to aid in the construction of the new bridge or viaduct along Wayne Road over the Michigan Central R. R. tracks and the bayou. The structure as planned is to cost $42,000.

Bowling Green, Mo.—County is considering the construction of a new bridge at Bradley's Ford. C. H. Harris is County Engineer.

Jefferson City, Mo.—Engineers are making surveys for the construction of a bridge over the Missouri River for the new interurban now under construction from Jefferson City to Columbia and Fulton. The Jefferson City approach will be just south of Bolivar St.

New London, Mo.—County Commissioners have decided to construct a new bridge over Spencer Creek at a point northwest of Elk Springs.

Fremont, Neb.—Board of Supervisors have approved the plans on file at Omaha for the new bridges under contemplation for Dodge County during 1910.

Mays Landing, N. J.—Board of Trade is taking steps to secure the construction of an overhead bridge at Estelville Road crossing.

Paterson, N. J.—The Philadelphia & Reading Ry. is to construct a new bridge at this place to eliminate a grade crossing.

Trenton, N. J.—Information has been received at this place to the effect that the New Jersey & Pennsylvania Traction Co. is arranging for the construction of two additional steel spans across Stoney Brook on the Princeton line to double the length of the bridge.

Trenton, N. J.—The Washington's Crossing Park Commission has appointed an executive committee to take up the matter of constructing a park on each side of the Delaware River at the point where Washington and the Continental Army crossed and to build a bridge connecting the parks.

Artesia, N. Mex.—Committee of the Commercial Club and the County Engineer have selected a site for the construction of the proposed bridge over the Pecos River three miles from the city.

Buffalo, N. Y.—Plans are under way for the construction of a bridge over the Buffalo River at Abbott Road. The structure will be lift type. Plans have already been completed for a new structure to replace the old bridge at Michigan St. It will cost $90,000 and is to have two spans.

New York, N. Y.—Public Commission have selected 179th St. as the New York terminal for the new bridge across the Hudson River, to connect with New Jersey.

Syracuse, N. Y.—Council is soon to order the construction of two bridges over Onondagua Creek, one at Dickerson St., to cost $11,000, and the other at Brighton Ave., to cost $7,500.

Medford, Ore.—City is planning the construction of another bridge over the Bear Creek in order that the east side sewers may connect with the trunk sewer on the west side running to the septic tank north of the city.

Sellwood (P. O. Portland), Ore.—Residents of this suburb are agitating the construction of a new bridge across the Williamette River to connect with South Portland.

Reading, Pa.—County is making an expenditure of $50,000 for the construction of bridges during 1910; $37,500 will be used for the reconstruction of Weigner's and Virginsville bridges and for borough bridges at Blue Marsh, Kempton, Wyomissing and Ruth's. The balance of the amount will go for repairs.

Houston, Tex.—Plans for the proposed Buffalo Bayou Bridge at San Jacinto St., have been presented to the City Council by F. L. Dormant, Engineer. The cost of the structure will probably come as high as $125,000 instead of $80,000, as first supposed.

Ogden, Utah.—Plans and specifications for the proposed bridge mentioned in our Feb. 2 issue, have been approved. The plans call for a 100-ft. span 18 ft. in width, to be constructed by the Utah Light & Railway Co., under direction of Engineer E. H. Dundas, Salt Lake City, Utah.

Waitsburg, Wash.—A foot bridge is to be constructed over the Touchet River at this place to serve until the Boston Ave. bridge, which was recently destroyed by flood, can be rebuilt.

Roads and Streets.

Items Arranged Alphabetically by States.

Redding, Cal.—Board of Supervisors have been petitioned to rebuild and repair the west side road from this city through Keswick, Copley and Corn, to Kennett; also asking that a new road be viewed and built from Kennett to Gregory, on the west side of the river, a distance of 18 miles.

San Diego, Cal.—City Council has recommended the granting of the petition for the paving of F St., from the water front to 25th St., a distance of nearly two miles.

Stockton, Cal.—Highway Commission has approved plans for the improvement of almost 100 miles of county roads under the bond act, which provides about $2,000,000. The roads to be improved are as follows. Cherokee lane to Eight Mile House, distance 8 miles; Waterloo road to Waterloo, distance 7 miles; Linden road to Linden, distance 12 miles; Copperopolis road to turn at Bollinger's, distance 8 miles; Farmington road to Robinson's lane, distance 12 miles; Mariposa road to east line of section 3, distance 12 miles; French Camp road to the intersection of Hogan road, distance 10 miles; West Side road to county line, distance 25 miles.

Ventura, Cal.—A survey is being made of the proposed Avenue Good Roads Division. When surveys are completed the Supervisors will submit a bond issue to the voters of the district.

Denver, Colo.—A nine-mile wagon road will be built from a point midway between Wagon Wheel Gap and Creede to the Wheeler national monument, at a cost of $15,000.

Aurora, Ill.—Board of Public Works has ordered the paving of Garfield Ave., State St., and East and West Park Places.

Bloomington, Ill.—Township Clerk Reeves of Bloomington Township has received a petition signed by 128 voters requesting that the question of building a hard road on the East Clay St. road east of the city be submitted to the voters at the primary election next month.

Champaign, Ill.—Board of Local Improvements is getting the preliminaries ready for the matter of paving Healey St., between Neil St. and Prospect Ave.

Elgin, Ill.—Board of Local Improvements has adopted a resolution for the proposed South State St. pavement. The improvement extends from Washburne St. to the north asylum gates. The material is to be brick with a sand filler and the estimate is about $20,000.

Freeport, Ill.—Board of Local Improvements has decided to pave Adams St. with brick.

Moline, Ill.—Board of Public Improvements has approved the paving of 18th St., from First to Third Ave., with brick, at an estimated cost of $5,133, and the paving of 19th St., from First to Third Ave., with brick, at an estimated cost of $5,119.

Moline, Ill.—City Engineer will prepare new estimates on the cost of paving 16th St., from 11th to 19th Ave., with brick.

Oaklawn, Ill.—City Council will consider the proposed paving of Cannon Ave., from Vermilion to Smith Sts., on Feb. 22.

Fort Wayne, Ind.—City Engineer has been instructed to prepare plans for the construction of sidewalks on the north side of Bell Ave., from Fox Ave. to the first alley west.

Goshen, Ind.—Resolutions of necessity for the paving of the intersections on cross streets between Main and Sixth Sts., on Washington, Jefferson, Madison, Monroe, Douglas, South Main from Douglas to Sixth, Clinton from Fifth to Sixth, South Third from Lincoln Ave. to Washington, have been introduced in the city council.

Richmond, Ind.—Wayne County Commissioners have been petitioned to authorize the construction of a macadam street with cement retainers on the National road, west of West Fifth St., to the road which is the boundary line of Wayne and Center Townships.

Atlantic Ia.—City Council has received plans from the Iowa Engineering Co. of Clinton for combination asphalt and brick paving and concrete gutter.

Colfax, Ia.—Steps have been taken to improve the mile stretch of high graded road leading into the city from the north. The Commercial Club is back of the movement.

Dighton, Kan.—The Industrial Club of this city is back of the construction of the proposed road from Salina via Great Bend, and then west through Barton, Rush, Ness, Lane, Scott, Wichita and Greeley Counties in the state of Kansas.

Hutchinson, Kan.—A petition is being circulated for the construction of a permanent road between Buhler and this city.

Wichita, Kan.—City Council has declared it necessary to pave Riverside Ave., from Buffum Ave. to Beal Ave., with macadam.

Haverhill, Mass.—Municipal Council intends to reconstruct and macadamize a number of the main thoroughfares of the city this year.

Grand Rapids, Mich.—City Engineer Anderson has estimated the cost of street improvements, including resurfacing, grading, graveling and paving, to be done this summer, at $720,000.

St. Charles, Mich.—St. Charles Township, Saginaw County, proposes to spend $10,000 on road improvements. An election will be held April 10 to vote on the proposition.

Sault St. Marie, Mich.—H. L. Parsible, Clerk of Chippewa County, will sell bonds in the amount of $100,000 for the construction of roads.

Waseca, Minn.—City will pave three residence streets or 14 blocks, with brick, this year.

Jackson, Miss.—City has voted the issuance of $253,000 worth of municipal improvement bonds.

Carthage, Mo.—A proposition is being agitated to extend a good wagon road alongside the White River Railway for a distance of 10 miles or more east of town.

Kansas City, Mo.—Commissioners of Jackson County are planning on spending $100,000 for the improvement of roads and an equal amount to build new ones this year.

Kansas City, Mo.—Plans are being made by the Warden of the Kansas Penitentiary at Lansing and in the Wyandotte and Leavenworth County Court Houses for the construction of the rock road from this city to Leavenworth.

St. Joseph, Mo.—Farmers, autoists and County Court will co-operate in a movement to construct a road around Croy hill at an estimated cost of $4,500.

Hastings, Neb.—City Council has passed an ordinance calling a special election on March 8 to give authority for the issuance of $50,000 of intersection paving bonds.

Lakewood, N. J.—City will build a parkway that will not cross a public road and which will be about 8 miles in length. A large grand stand is to be erected. It is planned to have the work completed by October. It is estimated to cost more than $500,000.

Binghamton, N. Y.—An ordinance has been introduced in the city council declaring the intention of the common council to construct a brick pavement on Conklin Ave., from the termination of the present Conklin Ave., pavement to De Russey St.

Matteawan, N. Y.—Village Clerk B. I. D. Rosa will sell, Feb. 23, bonds in the amount of $30,000 for paving purposes.

Williston, N. Dak.—City will hold an election Feb. 21 to vote on the issuance of $50,000 worth of public bonds.

Cincinnati, O.—An ordinance has been introduced in the City Council asking the City Engineer to submit to Council plans for widening Ludlow Ave., between Clifton Ave. and Brookline, from 60 to 80 ft.

Dayton, O.—City Council has been petitioned for the grading and graveling of Reasor Ave., from Main to Stillwater.

Defiance, O.—Petition is being circulated along East Second St. asking for the paving of that thoroughfare from the Auglaize river bridge to the East Side school building.

Mansfield, O.—Following work was brought before the City Council: To recommend the widening of Ohio St., from Vennum Ave. to Poplar St.; petition asking that Waring Ave. be improved from Franklin to Adams St., by paving with brick or block to a width of 20 ft.; petition to open and widen Arthur Ave., from First St. to Glessner Ave.; to prepare plans and estimates of the cost of improving Sturges Ave., from Park Ave. to West First St., with brick, asphalt or sheet asphalt; to prepare plans and estimates of the cost of improving the alleys west and north of the high school building by paving with brick or block; to have prepared plans and estimates of the cost of improving Foster St., from Park Ave. to Fourth St., by paving the roadway with brick or block and laying a new sidewalk; to prepare plans and estimates of the cost of improving North Franklin Ave., from Fourth to Sixth St., by paving with brick or block; to prepare plans and estimates of the cost of improving West Fourth St., from Main to Sycamore St., by paving with block asphalt, brick or sheet asphalt; to prepare plans and estimates of the cost of improving Benton St., by the construction of a new sidewalk of cement or stone on the west side.

Mansfield, O.—City Council has been petitioned for the paving of Waring Ave., with brick to a width of 20 ft.; also for the widening and improving of Arthur Ave.

Altus, Okla.—City has voted the issuance of $200,000 worth of municipal improvement bonds.

Chandler, Okla.—Creek Township has voted $5,975 bonds for road building and will construct four cross country roads from border to border. Three north and south roads leading to Bristow and one east and one west road leading to the border of Kellyville are planned.

Portland, Ore.—City Council has provided for the widening of Alberta St. to a width of 60 ft. The street will probably be paved from Union Ave. to East 33d St.

Springfield, Ore.—J. H. Rhoads, Recorder of the Common Council, will sell bonds, Feb. 28, in the amount of $10,000, for improvements.

Chester, Pa.—City will hold an election Feb. 15 in the borough of Prospect Park to vote on the issuance of $65,700 bonds for the purpose of grading and macadamizing a number of streets in the borough.

New Castle, Pa.—City Council has passed the following ordinances: To grade and pave East Main St., in the Third ward, between Pine St. and Crawford Ave.; to grade and pave County Line St., in the Third ward, between Walnut St. and Ray St.

Philadelphia, Pa.—Following ordinances are before the City Council for the grading of streets: Twenty-second ward, Wissahickon Ave., from Johnson St. to Hortter St.; 38th ward, 25th St., from Lehigh Ave. to Cambria St.; 40th ward, 68th St., from Baltimore & Ohio Railroad to Cobb's Creek Parkway; Chester Ave., from 65th St. to Church lane; 57th St., from Kingsessing Ave. to Greenway Ave.; 43d ward, Camac St., from Butler to Pike St.; Old York road, from Erie Ave. to Wingohocking St.; Hunting Park Ave., from Fifth St. to 6th St.; 46th ward, 59th St., from Spruce to Walnut St.; Alden St., from Chestnut to Sansom St.; Locust St., from 59th to 60th St.; Irving St., from 59th to 60th St.

Youngstown, Pa.—Property owners on Hayes Ave. will soon present a petition to the City Council asking that that thoroughfare be paved this spring.

Dallas, Tex.—City will soon let contracts for the paving of East Side Ave.

El Campo, Tex.—Preliminary steps have been taken for the purpose of organizing a good roads and drainage association by citizens of this city.

Fort Worth, Tex.—Street Commissioners have announced that they will pave during 1910 about 25 additional streets. The streets named in the list are: East Weatherford, East Belknap, Samuels Ave., West 2d, West 7th, from Throckmorton to the City Park bridge; Summit Ave., Penn St., Hill St., Hurley Ave., Alston Ave., College Ave., Lipscomb St., Jennings Ave., Missouri Ave., Bessie St., 8th Ave., East Front St., Terrell Ave., North Main St.

Waxahachie, Tex.—City Engineer has established the grades of the public roads of this city, which are to be graveled.

Seattle, Wash.—King County will spend $575,000 for the construction and improvement of country roads this year.

Milwaukee, Wis.—A petition is before the City Council asking for a parked driveway out Cedar St., and the Watertown plank road to the state fair grounds.

Sewers.

Items Arranged Alphabetically by States.

Wilmington, Del.—City Council has been asked to appropriate $200,000, so that plans can be made at an early date for the proposed street and sewer improvements.

Pocatello, Ida.—City is contemplating the construction of a more complete sewerage system.

Chicago, Ill.—Board of Local Improvements has passed an ordinance providing for the construction of a tile sewer in West 108th St., from Wentworth Ave. to point 530 ft. west of Princeton Ave.

Danville, Ill.—Board of Local Improvements has announced that work on the Oaklawn sanitary sewer system will be started early in the spring.

Lockport, Ill.—Board of Local Improvements has passed resolutions for the construction of a trunk sewer system in the city.

Moline, Ill.—Board of Public Improvements has approved the laying of sewers in the southwest district of Fifth ward sewer district at an estimated cost of $14,945, and the laying of sewers on 18½ St., from 13th to 14th Ave., at an estimated cost of $2,507.

Moline, Ill.—Bluff Improvement Association has asked the city to construct a sewer in the southeast district of the city along 27th St.

Momence, Ill.—Plans have been made for the construction of sewers at an estimated cost of $46,000. The work will include concrete and vitrified pipe sewers, bulkhead, combined flush tanks, manholes and catchbasins. G. F. Harney, Momence, is the Engineer in charge.

Rockford, Ill.—Plans are being prepared by the City Engineer for the construction of another trunk sewer system. The sewer will be located in the Northeast Sewer District and will have over a mile and a half of large pipe. It will empty into the river at the foot of St. Clair St.

Fort Wayne, Ind.—Board of Public Works has instructed the City Civil Engineer to prepare plans for a sewerage system for North Wayne Heights. The Engineer was also instructed to prepare plans for sewers in Forest Park.

Tolleston, Ind.—Town Board is preparing to go ahead with the construction of a system of sewers. The cost of the system is estimated at $200,000.

La Porte, Ind.—City Council has decided to submit the question for a public sewer to the voters of this town at the city election to be held March 28.

Hays, Kan.—City has engaged the W. K. Palmer Co., engineers, 718 Dwight Bldg., Kansas City, Mo., to make survey and to prepare plans for the construction of a sanitary sewer system for this city.

Wichita, Kan.—Petitions will probably be circulated soon for the construction of a sewer system from the north end of town to the river. It is estimated that the system would cost about $250,000.

Calumet, Mich.—City Council has passed an ordinance for a tile sewer in Stewart Ave., from 113th St., to alley north of 115th St.

Detroit, Mich.—City is considering the construction of two trunk sewers to relieve the north, northeast and northwest sections of the city at an expenditure of more than $1,000,000.

Flint, Mich.—Bids for the construction of sewers on Avon and Court Sts. and Fifth Ave. have been rejected and the Street Commissioner has been instructed to construct the sewers.

Flint, Mich.—City Council has declared it necessary to construct sewers on Warren, Dayton and Baker Sts., and Hamilton Ave., from Saginaw to Bonbright St., and a storm sewer on Hamilton Ave. over the same territory.

Grand Rapids, Mich.—City Engineer Anderson has estimated the cost of constructing sewers in the city during the coming summer at $30,000. Following is a list of sewers for which approximate estimates were submitted: Horton Ave., Seventh St., Shoemaker alley, Ninth St., Pine St., Laurel Ave., North College Ave., Arthur Ave., Watrous Ave., Griggs Ave., Quimby St. and California St.

Austin, Minn.—City Council has voted to construct a new storm sewer on St. Paul St., between Water and Bridge Sts.

Springfield, Mo.—A bill has been introduced in the City Council establishing sewer district No. 3 of section 6 of the main sewer.

Beatrice, Neb.—City is contemplating the construction of a sewer system.

St. Paul, Neb.—Mayor H. J. Paul is working on a plan by which a sewerage system can be installed in this city.

Wymore, Neb.—The W. K. Palmer Co., engineers, 718 Dwight Bldg., Kansas City, Mo., has been engaged to make surveys and to prepare plans for a sanitary sewer system.

Nogal, N. M.—Engineer W. P. Bullock of Kansas City, Mo., has agreed to furnish plans for the proposed sewer system for this city.

Binghampton, N. Y.—City Council has adopted an ordinance providing for the construction of a sewer in Moeller St., from Court St. for a distance of 1,280 ft., at an estimated cost of $3,100.

Hudson, N. Y.—A sewage disposal plant is to be built by the state for the Training School for Girls. Plans and specifications have been prepared.

Newburgh, N. Y.—A petition was presented to the City Council for the construction of a trunk sewer through Robinson Ave., Broadway and Lake St., from First St., to connect with the West Newburgh trunk sewer near the Muchattoes Lake ice houses.

Rochester, N. Y.—Plans and an ordinance for a new outlet sewer to take the place of the present Lake Ave. outlet are being prepared in the City Engineer's office. The new sewer will run through Dewey Ave. to Ridgeway Ave., along that thoroughfare to and across Lake Ave., and then to the river along an easement now held by the city.

Mansfield, O.—City Council has been petitioned for the construction of an 8-in. sanitary sewer on the west side of South Franklin Ave. The council has adopted a resolution ordering the director of service to prepare plans and estimates of the cost of improving Hammand Ave., from Chestnut St. to Mansfield Ave., by placing an 8-in. sanitary sewer on both sides of the street.

New Philadelphia, O.—State Health Board has ordered this city to complete its sewer system by Jan. 1, 1911. About one-half of the system is already completed.

Wilmington, O.—City Council has decided to submit to the electors of this city the proposition of constructing a sewage system. The estimated cost of the proposed system is $95,000.

Youngstown, O.—City Council has been petitioned to sewer Delaware Ave.

Portland, Ore.—Plans are being drawn for a sewer system to drain the Woodstock and Mount Scott district that will embrace about 10 sq. miles of territory. Plans are to be drawn for a sewer system to drain the Rose City Park, Center Addition and Rossmere district.

Allentown, Pa.—County Engineer Robert S. Rathburn is preparing plans and specifications for the power house and sewage disposal plant at the County Home.

Chester, Pa.—Plans have been presented to the sewer committee of the City Council for a new sewer system, including a disposal plant that will cost about $1,500,000.

Philadelphia, Pa.—Bureau of Surveys has authorized the construction of about 60 branch sewers, which will cost in the neighborhood of $100,000.

Florence, S. C.—City has sold $70,000 worth of bonds for the installation of a sewerage system. Plans have been accepted and the work will begin some time in March.

Franklin, Tenn.—City Recorder H. B. Fowlkes will sell bonds in the amount of $35,000, Feb. 14, for sewer and water construction.

Morristown, Tenn.—Plans are in preparation for the construction of new sewers at an estimated cost of $40,000. Contracts will be let as soon as plans have been made. The work will include a septic tank and about 7 miles of laterals. H. F. Nayer, Morristown, has charge of the work.

Morristown, Tenn.—City Treasurer W. C. Bushong will sell bonds, Feb. 18, in the amount of $40,000 for sewering.

Wenatchee, Wash.—City Council has passed a resolution declaring it necessary to construct sewers throughout the city at an expense of $250,000. The work will require the laying of about 16½ miles of sewers. Bids will be called for about April 1.

Winnipeg, Man.—Board of Public Works has been petitioned for the construction of a sewer on Portage Ave., between Main and Carlton Sts.

Water Supply.

Items Arranged Alphabetically by States.

Dorris, Cal.—Trustees of this place are negotiating with the United Iron Works of Oakland, Cal., for a system of water works estimated to cost between $7,000 and $10,000. Several donations have already been received.

Maricopa, Cal.—James Wagy, Los Angeles, Cal., is to install a $50,000 water works system in this city. The system will be operated entirely by gravity and includes the construction of a 17-mile pipe line.

Pasadena, Cal.—The proposition to have municipal ownership of water works, recently vo-

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CHAS. S. HILL
ERNEST McCULLOUGH
C. T. MURRAY
F. A. SMITH } EDITORS

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CONTENTS.

EDITORIAL: Page.

The Study of Engineering-Contracting in Engineering Colleges 165
The Use of Reinforced Concrete in the Subways Recently Constructed on the Track Elevation Work of the Illinois Central Railway Co. in the City of Chicago, Ill. 166
Reinforced Concrete Bridge Construction Track Elevation Work, C., B. & Q. R. R. Co., Chicago 168
What Consideration Should Be Given to Continuity in Reinforced Concrete Beams and Slabs 173
Some Notes on Specifications for Earth Work in Railway Construction.....175
Uniform Methods of Record and Cost Keeping on Railway Construction.....176
Proposed Standard Specifications for Portland Cement Curb and Gutter.....177
Notes on Road and Street Work.....178
Summary of Tests Made at New York City of Machines for Cleaning Streets by the Use of Water.....179
Method of Constructing Macadam with Asphaltic Oil Binders at Pasadena, Cal..179
The Efficiency of Day Labor Maintenance of Chicago Sewers with Particular Reference to Cleaning of Catch Basins and Sewers 180
Methods of Cost Analysis as Applied to Construction Work 181
Diagram for Estimating the Approximate Cost of Mill Buildings.....184
Dry Rot in Timber Structures.....186
Annual Meeting of the Connecticut Society of Civil Engineers.....187

The Study of Engineering-Contracting in Engineering Colleges.

Four years ago this journal urged editorially that engineering schools should establish courses in engineering-contracting in addition to their familiar courses in civil engineering, mechanical engineering, electrical engineering, etc. We have to thank Professor M. E. Cooley of the University of Michigan as the only engineering educator enough interested at the time to give attention to our plea. The idea has grown more familiar in the intervening years. A number of engineering educators have been thinking over and tentatively planning possible courses in engineering-contracting. A more general recognition of the possibilities of such a course of training exists among both engineering educators and engineering contractors. We are reminded of this at the present time by the perusal of the recently published discussions of some dozen teachers of engineering and well known men in the contracting business on a paper read by Mr. W. R. Harris at the December meeting of the American Society of Engineering Contractors. Mr. Harris' paper was printed in full in our issue of Jan. 12, 1910, so that any of our readers who are interested can turn to it. We shall mention here some few points in the discussion.

There was little question on the part of any of the men who took part in the discussion that engineering schools will be drawn upon for recruits to the business of engineering contracting; neither was it disputed that the value of these recruits depended upon the amount of their special knowledge of the business. The facts could hardly be otherwise, of course. But there was much difference of thought whether this special knowledge should, or could, be taught in school or left to be gained altogether in actual work after graduation, and, if taught in school, in what manner the teaching should be done. There can be no surprise at this difference of belief. It exists today, in part at least, in regard to the old established courses of civil, mechanical, electrical and mining engineering, in which, if anywhere differing notions should have in long years been jostled down to settled opinion.

Numerically the stronger notion among those who discussed the subject seemed to be that doubtful results would follow schooling in engineering-contracting. It is a notion that requires some analysis, it seems to us, before it is accepted. If it is contended that a school course will not make a trained engineering contractor, no one is likely to gainsay the fact. Neither do the older courses, long a part of the engineering college training, turn out trained civil, mining, mechanical or electrical engineers. Indeed, not too many capable engineering contractors have been developed by training both in and out of school. We do not imagine that this is the real thought of those who doubt the efficacy of schooling in engineering contracting. They think rather that the training in school cannot have the vital force of training in actual work. As one speaker said: "It is only playing at contracting. Failure would not strike home as it would if real dollars were lost." This is wholly true. It is just as true in the real designing of a bridge or a piece of machinery as compared with the school designing of the same structure or machine.

If we believe that specializing in bridge work or in machine design in school makes a graduate better fitted to be useful in a bridge works or in a machine works, then we must believe a special school training in engineering contracting will make a graduate better fitted to be useful to an engineering contracting firm. There is only one way of escaping this conclusion and that is contending that engineering contracting cannot be taught in school. Can such a contention be upheld? We think not. A student can be taught in the law of contracts and specifications; he can be drilled in taking off quantities and making estimates; he can be trained in recording and analyzing costs; he can be instructed in the general laws of business and of management engineering; he can even be schooled to some extent in the "human element" so interestingly discussed in the paper by Mr. DeWitt V. Moore, which is printed elsewhere in this issue. The above items by no means exhausts the schedule of things possible of being taught, and the boy who has had them taught him is better fitted to be useful as an employe of an engineering contractor than one who has not. If he knows little else, he at least knows that a knowledge of the subjects named is a part of the business and is so far ahead when he gets to learning from actual work.

There is another feeling noticeable throughout some of the printed discussions: That nothing is equal to practical experience and that practical experience cannot be taught. It it true that nothing wholly equals actual experience; it is only partly true that experience cannot be taught. General experience can be taught. It is general experience that a man works best when his pay increases in proportion to his output. This fact and other facts based on general experience is knowledge just as useful if gained while a college freshman as if gained after a year or two on the job. They can all be taught in school.

Another objection to college training in engineering contracting which is urged several times in the discussion is that the present engineering courses are too much crowded with work to permit the addition of more work. Perhaps. We have a notion that the average engineering curriculum could be cut down to give place to engineering contracting studies with considerable practical advantage to the student. Be this as it may, what has it to do with the matter? It is not proposed to add some score of engineering contracting studies to the present courses in civil or mechanical or electrical engineering, but to establish a *separate* course in engineering contracting. Or if anyone holds that the engineering contractor cannot possibly do without all the studies laid down for the engineering courses proper, add a two years' post-graduate course in engineering contracting. Some boys will stand for it.

The facts are, as they appear to us, that engineering-contracting can be taught in college just as well as can civil, electrical or mechanical engineering; that the results will be just as good in engineering contracting as in those older courses; that the teaching should be done in a course as separate and independent of the other courses as they are of each other; that post-graduate teaching in engineering contracting, like post-graduate teaching in any other line of study, should be left to the exceptional student who can afford the time and money for it.

In beginning these remarks we mentioned that the idea of special schooling in engineering-contracting in our technical schools was gaining ground. It is, but it will have to gain much more ground before we may expect to see engineering-contracting courses established in our technical schools. The great majority of engineering educators do not see that engineering-contracting is a distinct branch of engineering work, worthy because of required training and knowledge to be classed with other branches and the few who do see it cannot overrule the majority. We note that Prof. Haring in his discussion of Mr. Harris' paper expresses a different opinion, but we shall let our opinion stand as stated for the present. Again, engineering educators have not felt the call for school trained men in engineering-contracting. This, coupled with the fact that few engineering schools have money to spare to inaugurate and maintain the new course, furnishes another obstacle.

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Concrete and Reinforced Concrete Section

Note: This section is devoted to methods and cost of constructing concrete and reinforced concrete structures. It will cover the selection, testing and proportioning of concrete materials; laboratory tests of concrete; concrete mixing, transportation and placing; fabrication and placing of reinforcement, and form construction and erection. It will also contain articles on new and interesting developments in the design of reinforced concrete.

The Use of Reinforced Concrete in the Subways Recently Constructed on the Track Elevation Work of the Illinois Central Railroad Co. in the City of Chicago, Ill.

When arrangements were made by the Illinois Central R. R., in the fall of 1906, to start the track elevation work in the city of Chicago, extending south from 67th to 87th streets, investigations were made and a considerable number of designs worked up for subway bridges. In this territory there are six main tracks and from two to three side or passing tracks, making a width of the bridges, including the space left for suburban trains, about 130 ft.

Fig. 1—General View of Completed Subway Bridge 130 Feet Wide.

The original ordinance of 1902 was amended so that supports could be provided in the middle of the streets, thus shortening the spans. This made it possible to build a bridge in which the floor could be waterproofed and do away with girders projecting above the track levels. The use of center supports made it possible to study a number of alternative plans.

After going into the matter carefully the most desirable form was decided upon as being a reinforced concrete slab supported on plain concrete abutments and intermediate reinforced concrete arched girders. For the abutments the mixture was 1:3:6, the larger aggregate being crushed limestone. For the slabs the mixture was 1:2:5. A general view of one of the completed structures is given in Fig. 1, and a detail of the slabs is shown in Fig. 2.

The slabs were made of a width of 6 ft. and 3 in., as this was about as heavy a slab as could be handled with the derricks available, and would also give a certain number of slabs of the same width if the subways were constructed for the full width of the right of way. The large slab weighs 33 tons, being 25 ft. long, 6 ft. 3 ins. wide and 34 ins. deep. The small slab weighs nearly 8.5 tons, being 9 ft. 11 ins. long, 6 ft. 3 ins. wide and 18 ins. deep.

The slabs were all designed to carry the standard live load, which is two 187.75-ton engines, followed by a load of 6,000 lbs. per lin. ft. of track, together with the weight of the ballast, track and the slab. The slabs being 6 ft. 3 ins. wide and as it may be necessary at some future time to shift the locations of the tracks, it was considered advisable to distribute the load under the tie for a width not exceeding 9 ft. In designing the slab the steel stress was computed at 12,700 lbs. per sq. in. and the concrete stress at 700 lbs. per sq. in., not including impact. By adding impact as computed by the Illinois Central R. R. bridge department, the steel stress becomes 15,800 lbs. per sq. in. and the concrete stress 800 lbs. per sq. in. Owing to the fact that there will be a minimum of 10 ins. of ballast under the tie, the stresses caused by impact would be materially reduced from what is ordinarily figured on steel bridges without ballast. The impact therefore on these slabs is 50 per cent of the impact for steel bridges. (Mr. Thompson did not state the ratio of deformation between the steel and concrete, but the discussion brought out the fact that it was 12.—Editors.)

The streets all cross the right of way at an angle of about 81°, thus necessitating either some form of skew, or building the bridges at right angle with the street and making the skew with some other form of construction. Finally, it was decided to build the bridges square with the streets and make the skew for the outside tracks with I-beams encased in concrete. The style of supports is shown by Fig. 3. The columns are spaced 12 ft. 6 ins. apart, are 36 ins. square in the center of the street and 30x36 ins. at the curb lines. The transverse arches or cross beams are the same width as their respective columns and have a depth of 36 ins. at the center.

The cross beams are reinforced as simple and continuous beams. The vertical reinforcement of columns consists of 6 upright ¾-in. square bars, with horizontal hooping of ½-in. round rods spaced 6 ins. apart. While the stress in the concrete is only 460 lbs. per sq. in., the cross beam width was required to provide sufficient end bearing for the slabs, and it was thought that any saving made in concrete by reducing the size of the column would be offset by increased form work.

The end slabs were cast in place, together with the coping and false arches, with a pocket provided in the abutments and a seat on the end of the piers, from which to spring the false arches. A study of Figs. 1 and 3, shows the construction clearly. These small seats, or offsets, at the end of the arched piers, also form a bearing for future extension of the arched piers.

Uneven settlement of the footings would produce an uneven bearing for the slabs and might cause their failure so the footing question was studied very thoroughly, with the result that concrete cylinder piers were decided upon. The depth to which it was necessary to go in order to get a good foundation varied from 30 to 35 ft. below the grade of the street, or from 28 to 30 ft. below the lake level. At that depth a dense hard pan was encountered, and the bottoms of the cylinder piers (caissons, they are frequently termed), were dug out in the shape of a bell, so that the bearing on the soil did not exceed 5 tons per sq. ft. The cross supports were constructed as nearly as possible in a continuous operation, without the use of expansion joints, so as to have the whole mass a monolithic body of concrete; the average length of one of these intermediate supports was 130 ft.

The slabs were constructed at a point about six miles from the location of the subways, with company forces. Fig. 4 shows some of the finished slabs in the yard, the side forms being removed. The slabs were numbered in the order of their construction. After 70 large slabs were completed a change was made in their design. The reinforcing bars were bent up at a more obtuse angle and farther from the support. A number of stirrups were put in at each end, extending from the under side of the longitudinal reinforcement, to within an inch of the top of the beam, to better take care of internal stresses in the concrete. This change in design is shown by Fig. 2. In University of Illinois, Experiment Station Bulletin No. 28 (see ENGINEERING-CONTRACTING, July 29, 1908), is given a full description of

Fig. 3—Supports for Subway Bridges Showing Arrangements for Extensions.

*Extracts from a paper read by Mr. F. L. Thompson, Assistant Engineer of Bridges, Illinois Central R. R. Co., before the Bridge and Structural Section, Western Society of Engineers, Feb. 9, 1910.

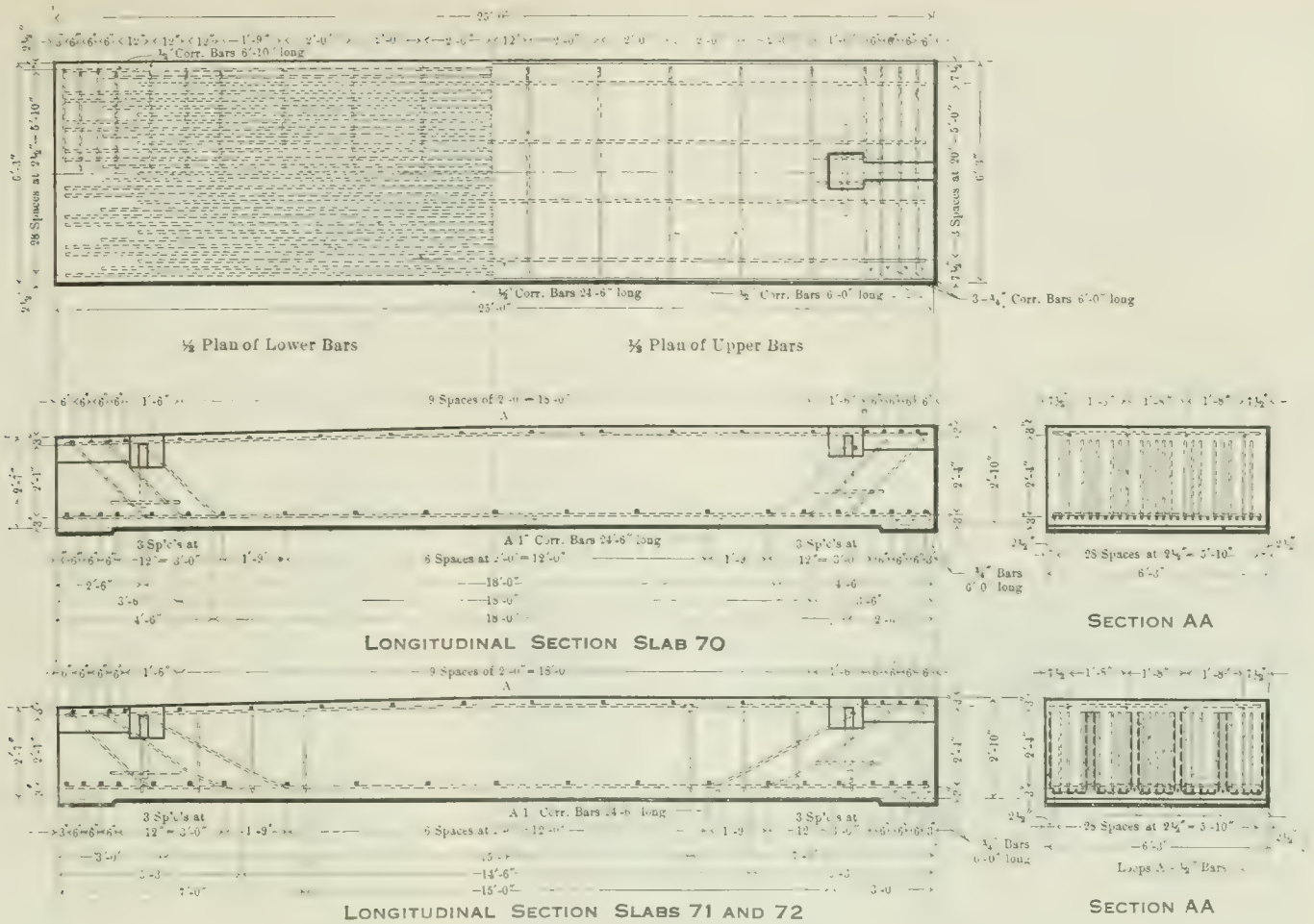
½ Plan of Lower Bars
½ Plan of Upper Bars
LONGITUDINAL SECTION SLAB 70
SECTION AA
LONGITUDINAL SECTION SLABS 71 AND 72
SECTION AA

Fig. 2—Details of Slab Construction for Subway Bridge Floors.

tests on two slabs made as shown by Fig. 2, Slab 70. After the test the design was changed.

In placing the large slabs, two derricks were used, as a derrick large enough to handle them was not available at the time. The subways not being at right angles to the railroad tracks it was necessaary at all times, during the placing of the slabs to have two tracks blocked to traffic. This did not cause any delay as the traffic could be shifted from one to another of the eight tracks. No trouble whatever was encountered in placing these heavy slabs.

After the slabs were placed the tracks were laid back, being blocked up temporarily until the waterproofing could be applied and the ballast put on. After the slabs were all placed the entire structure was waterproofed. Preceding the waterproofing all joints running with the tracks were filled with cement mortar. The end joints of all slabs were packed with oakum. On the concrete slabs, after being cleaned and dried, there was applied with brushes a coating of asphalt. This coating was made very thin so that the asphalt would penetrate all the recesses and voids and also form an anchorage for the waterproofing coat itself.

After this priming coat dried, there was applied with mops a heavy coating of an asphalt compound, which had been heated to a temperature of 400° F., and while this material was still hot, a layer of 8-oz. open mesh burlap was carefully laid down. The surface of this burlap was again heavily mopped with asphalt and two more layers of burlap applied in the same manner, making a three-ply burlap mat, all thoroughly saturated, cemented and bound together with the asphalt compound.

After the completion of this mat, the entire surface of the floor was covered with a mastic 1¼ ins. thick. Both the burlap mat and the mastic were carried up the sides of the coping, so that water could not get under the waterproofing material. The top of the mastic was then mopped with a coat of thin asphalt so that any cracks caused by the cooling of the mastic would be filled. This waterproofing has now been on about six months and has given entire satisfaction.

Proposed Standard Specifications for Plain Concrete Drain Tile.*

MATERIALS.

Cement shall meet the requirements of the Standard Specifications for Portland Cement of the American Society for Testing Materials, and adopted by this association (Standard No. 1).

Fine Aggregate shall consist of sand, crushed stone, or gravel screenings, graded from fine to coarse, passing when dry a screen having ¼-in. diameter holes, shall be preferably of silicious materials, clean, coarse, free from vegetable loam or other deleterious matter, and not more than 6 per cent shall pass a sieve having 100 meshes per linear inch.

Mortars composed of 1 part Portland cement and 3 parts fine aggregate by weight when made into briquets shall show a tensile strength of at least 70 per cent of the strength of 1:3 mortar of the same consistency made with the same cement and standard Ottawa sand.

Coarse Aggregate shall consist of inert material, graded in size, such as crushed stone or gravel, which is retained on a screen having ¼-in. diameter holes, shall not exceed in the largest dimension one-half the wall thickness of the tile and shall be clean, hard, durable, and free from all deleterious materials. Aggregates containing soft, flat or elongated particles shall be excluded.

*Committee report presented at the Feb. 21-24, 1910, convention of the National Association of Cement Users.

Fig. 4—View of Slab Yard.

Water shall be clean, free from oil, acid, strong alkalies, or vegetable matter.

PROPORTIONS.

A bag of Portland cement weighing 94 lbs. shall be considered as 1 cu. ft. All concrete shall be prepared and mixed in quantities requiring one or more full bags of cement, and the use of any device for mechanically proportioning the materials is prohibited.

Machine Made Tile, 8 ins. and less in diameter. Tile in sizes up to 8 ins. in diameter shall be made of a mixture of 1 part of cement to not more than 4 parts of fine aggregate (1:4).

10 to 16 ins. diameter. Tile from 10 to 16 ins. in diameter shall be made either from a mixture of 1 part of cement to not more than 4 parts of fine aggregate (1:4), or of a mixture of 1 part of cement to not more than 2 parts of fine aggregate and 4 parts of coarse aggregate (1:2:4).

18 to 30 ins. diameter. Tile from 18 to 30 ins. in diameter shall be made from a mixture of 1 part of cement to not more than 2 parts of fine aggregate and 4 parts of coarse aggregate (1:2:4).

Hand Made Tile, 8 ins. and less in diameter. Tile in sizes up to 8 ins. in diameter shall be made of a mixture of 1 part of cement to not more than 4 parts of fine aggregate (1:4).

10 to 16 ins. diameter. Tile from 10 to 16 ins. diameter shall be made either from a mixture of 1 part of cement and not more than 4 parts of fine aggregate (1:4), or of a mixture of 1 part of cement to not more than 2½ parts of fine aggregate and 4 parts of coarse aggregate (1:2½:4).

18 to 30 ins. diameter. Tile from 18 to 30 ins. in diameter shall be made of a mixture of 1 part of cement to not more than 2½ parts of fine aggregate and 5 parts of coarse aggregate (1:2½:5).

MIXING.

The ingredients of concrete shall be thoroughly mixed dry, sufficient water added to obtain the desired consistency, and the mixing shall continue until the cement is uniformly distributed and the mass is uniform in color and homogeneous.

a. Measuring Proportions. Methods of measurement of the proportions of the various ingredients, including the water, shall be used which will secure separate uniform measurements at all times.

b. Machine Mixing. When the conditions will permit, a machine mixer of a type which insures the proper mixing of the materials throughout the mass shall be used.

c. Hand Mixing. When it is necessary to mix by hand, the mixing shall be on a water-tight platform and the materials shall be turned until they are homogeneous in appearance and color.

d. Consistency. Machine Made Tile. For machine made tile the concrete shall be as wet as can be used and allow the immediate removal of the jackets. The concrete must be used within 20 mins. after the time it is mixed.

Hand Made Tile. For hand made tile the consistency of the concrete shall be such that it will be forced into every part of the mold by jarring or tapping. The concrete must be used within 40 mins. after the time it is mixed. The use of concrete requiring tamping is prohibited.

Fig. 5—Placing Slabs for Test; Illustrating Method of Handling.

e. Retempering. Retempering mortar or concrete—i. e., remixing with water after it has partially set—shall not be permitted.

FORMING.

Under no circumstances shall tile be made in a temperature lower than 40° F. Tile shall be formed so as to prevent laminations or planes of weakness.

Machine Made Tile. The tile shall be made in such a manner as to insure a dense and uniformly packed product with smooth ends and inner surfaces and show water marks on the outer surface (web-like markings indicating free moisture).

Hand Made Tile. Concrete for hand made tile shall be forced into the metal forms by jarring or tapping in such a manner as will obtain a smooth, dense surface and shall remain undisturbed in the form for at least 12 hours.

CURING.

Natural Curing. For the purpose of securing proper curing, the tile shall be protected from the sun and strong currents of air, shall be sprinkled at such regular intervals as necessary to prevent drying, and such other precautions taken as to enable the final set to take place under the most favorable conditions. At least 20 days shall be allowed for curing.

Steam Curing. The tile shall be removed from the molds as soon as the conditions will permit and shall be placed in an atmosphere of steam saturated with moisture for a period of at least 48 hours. The tile shall then be removed and stored for at least 14 days before use, being sprinkled three times a day during the first 7 days. Care to be taken to maintain the temperature at not less than 60° F.

DIMENSIONS

Diameter. The diameter or size of a tile shall refer to the inside diameter and be uniform in all directions. Tile with a diameter of more than 30 ins. shall be reinforced.

Thickness. The thickness of the tile wall shall be uniform throughout and shall not be less than one-tenth of the diameter, with a minimum thickness of ½ in.

Length. The length of a tile shall be uniform at all points and not less than the diameter, with a minimum of 12 ins. and a maximum of 30 ins.

FINISHED TILE.

Finished tile shall be free from cracks and other defects which will appreciably diminish their strengths, and shall give a clear metallic ring when struck with another tile or with a hammer.

Reinforced Concrete Bridge Construction, Track Elevation Work, C. B. & Q. R, R. Co. Chicago.*

The standard type of bridge used for the subways of the Chicago, Burlington & Quincy R. R. track elevation work at Chicago is a ballasted floor bridge, composed of two 24-ft. 3-in. street spans and two 8-ft. 9-in. sidewalk spans, resting upon solid concrete abutments at the street lines and three lines of columns and cross girders, two at curb line and one on the center line of street. The decks proper are reinforced concrete deck girder slabs and the columns and cross girders are also composed of reinforced concrete and rest upon concrete foundation cylinders, extending down to bed rock. The conditions to be met in the design of these bridges were as follows:

(1) Under the city ordinances the subways were to be 66 ft. wide, composed of a 46-ft. roadway and two 10-ft. sidewalks, allowing the use of three sets of columns and cross girders, one in the center line of the roadway and the other two on the curb lines. The spans were finally determined as stated. (2) The headroom or clearance was to be 12 ft. and 12 ft. 6 ins. above the established grades of the subways. (3) The bridges being at the eastern end of the Western avenue yard, it was very desirable that they be so designed that tracks and cross-overs could be placed at any point upon the structure. This requirement could only be satisfied with a ballasted floor type of bridge. (4) As thin a floor as possible within the limits of good practice was required to minimize the depth of fill, approach grades and height of walls. (5) A floor was required that was easily made water tight. (6) A floor was required that was as nearly sound proof as possible. (7) Comparative cost and permanence had to be considered.

After looking over the field for some time it was decided that one of the three following constructions would fill about all of the conditions: (1) A trough girder bridge composed of a number of troughs, made of plates and angles, concreted to form a solid deck. (2) An I-beam span, with concrete deck. (3) A reinforced concrete deck girder slab.

The different types were planned out and estimates made with the following result, the estimates being per square foot of superstructure:

	Pct.
Reinforced deck girder spans	100
I-beam span	171
Trough girders	208

This showed conclusively that a great saving could be made by the use of the reinforced concrete construction.

Abutments.—The soil underlying this location is composed mostly of soft blue clay and quicksand, and, taken as a whole, is not a very desirable material on which to place a foundation, but it was decided that with the bearing of the footing in addition to the piles it was amply safe to carry the abutment loads.

The footings for the several streets were put in during 1905 in advance of the other work and were built up to a point about 3 ft. above top of the footing proper. The abutments are of the solid type, as it was found that a buttressed abutment of this height would cost as much per lineal foot, if not more. As the forms were built and concreted after the temporary bridge was up, the work was done in a cramped space.

The forms were continuous, composed of

*From a paper by Mr. G. E. Tebbetts, read before the Bridge and Structural Section Western Society of Engineers, Chicago, Ill., Feb. 9, 1910.

studding and sheeting, the former being 3x6 ins. and the latter of 2-in. tongued and grooved planking. The sides were held together by ¾-in. rods, spaced about 4 ft. c. to c., both vertically and horizontally. This scheme worked

having an incline frame on it. The lower part of this incline is separate and can be removed and swung alongside the car when the outfit is moved. The cement car, which is placed immediately in rear of mixer, is an ordinary

This bucket was a V shaped affair, with a sliding door in one side, operated by a rack and pinion. Facing of the work was obtained by spading. This has worked satisfactorily, giving a smooth, uniform surface. The mix-

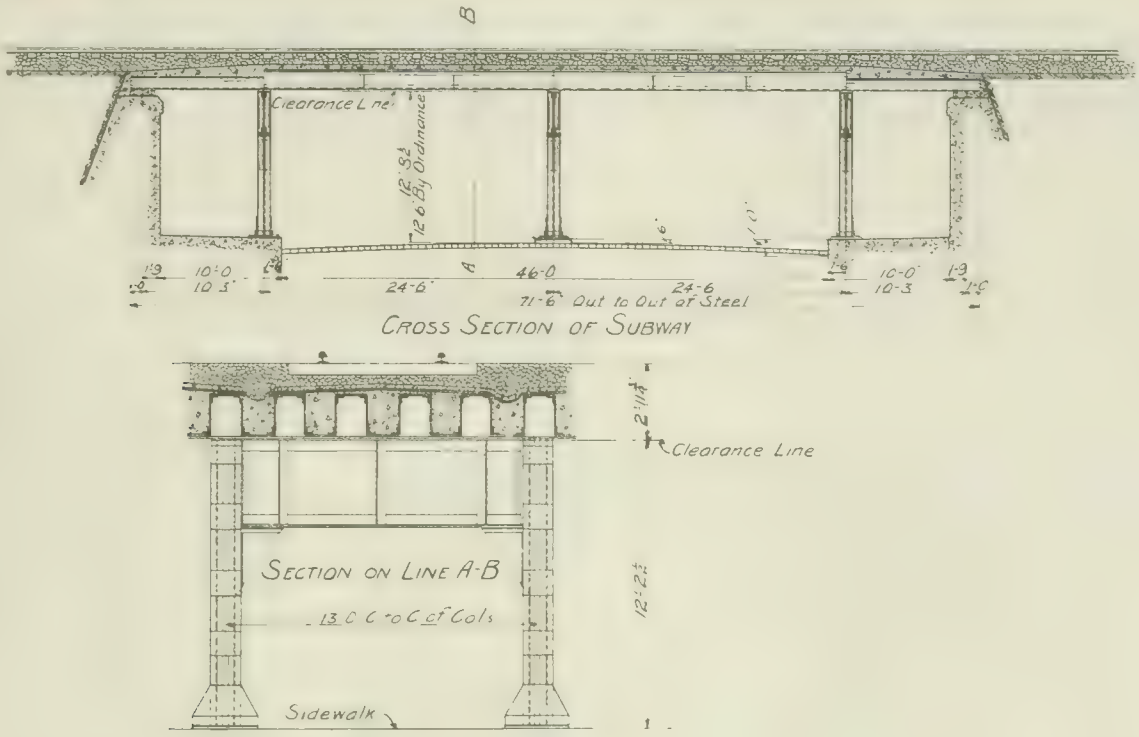

Fig. 1—Cross Section of Trough Girder Type.

far better than wire, as that was continually stretching and breaking. With wire ties it was not wise to fill the forms to a depth of over 4 ft., while with the ¾-in. tie rods the forms could be completely filled without danger of collapsing. The rods were incased in 1½-in. pipe of such lengths that the ends were about 3 ins. from the face of the forms, waste being packed around the rods. This worked very nicely, although there was considerable trouble in pulling the rods. A lever and chain were used to remove the rods from wall.

In concreting, the abutments were divided

gondola, having at the forward end an overhanging platform, supporting the two material hoppers. These have a capacity of 1½ cu. yds. or one batch. The gravel is wheeled in barrows from the gravel cars, a temporary runway being placed upon the cars for the purpose. The material is dropped from the hopper into the small material car and pulled up the incline by the hoisting engine. Here the load is dropped through the hopper bottom of the car to the mixer, the water being supplied from the barrel placed on top. This plant has proved to be very satisfactory as well as cheap.

ture was composed of 1¼ bbls. of cement to 1 cu. yd. of pit run gravel; this amount of cement was increased where the gravel was very fine. The gravel as a general thing was very fair quality, containing very little clay or other foreign matter and varied in size from 3-in. ring down to fine sand, the sand being in about the right proportion nicely to fill the voids.

The sections were, as a general thing, completed in one day, but where this could not be done, the surface was thoroughly cleaned the following morning, being scrubbed with wire brushes to remove all *laitance*, clay or other

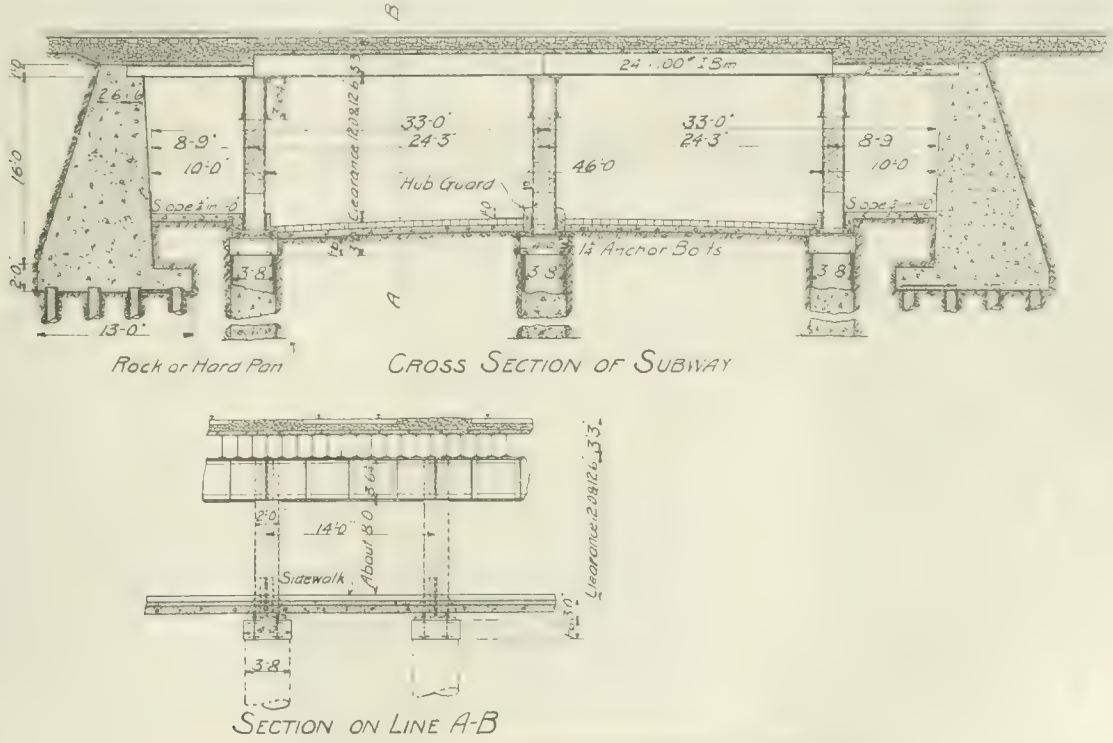

Fig. 2—Cross Section of I Beam Span With Concrete Deck.

into a number of sections, each containing about a day's work. The mixing outfit consists of a cylinder drum, with rods passing through it, driven by a chain drive from the hoisting engine. This is all mounted upon a flat car,

The mixer was set directly over the section where possible and the material delivered by a chute, but in cases where the section was too far away to use chutes a locomotive derrick car having a 1½ cu. yd. bucket was used.

foreign substances, and then well rinsed off before placing the fresh concrete.

Column Footings.—The loads upon the columns are as follows: Center column 204 tons and sidewalk column 138 tons. The question

as to kind of foundation lay between the use of an ordinary pile and concrete footing and cylinders; these after investigation were estimated to be about a stand-off as regards cost. Cylinders were adopted as they would rest upon a known substance, while the bearing power of a pile footing would be rather indefinite.

These cylinders are built in 3-ft. 8-in. wells, lagged with 2-in. lumber of about 5-ft. 6-in. lengths, and held from collapse by two 2x¾-in. steel rings. These rings are made in two pieces, and after being driven into place are bolted together. The depth of the cylinders varied from 15 ft. at Ashland Ave. to 65 ft. at Center Ave. There were in all about 600 wells dug, averaging about 40 ft. deep and costing approximately $250 each.

Columns and Cross Girders.—The columns and cross girders erected during 1906 were of steel, but after the success attending the construction of slabs during that year it was decided that reinforced concrete columns and cross girders would not only be more permanent but would also be more economical; this was borne out, as the following estimate will show (the estimate being for a 14-ft. bent):

Steel column and cross girder, 10,200 lbs. at 3.5 cts.	$357
Concrete column and cross girder, 7.12 cu. yds. and bars at $25	178

The concrete construction costs about 50 per cent of the steel work.

The lengths of span of the cross girders are 12 and 14 ft., these lengths being due to the fact that the shorter spans are more economical and that their lengths worked out to fit the width of right of way.

The columns are 24 ins. square, reinforced by a structural steel basket of four 3½x3½x½-in. angles tied together with batten plates about 2 ft. apart c. to c. This basket was about 18 ins. square and was wrapped with triangular mesh of No. 12 gage wire, the mesh being 4 ins., thus forming a wrapped column. The unit load upon the columns was 807 lbs. per square inch for the side columns, considering only that area inside the steel basket. Over the total area of column this reduces to 454 lbs. and 307 lbs. respectively.

The work was done as follows: The concrete in the cylinder having been purposely left below grade, the frames or baskets were placed over the center of the well column and carefully centered and plumbed, then enough concrete placed around the lower part to insure there being held firmly in place; after this had set for two or three days the column forms were set up and concreted up to the juncture with the cross girders, which is at the spring-

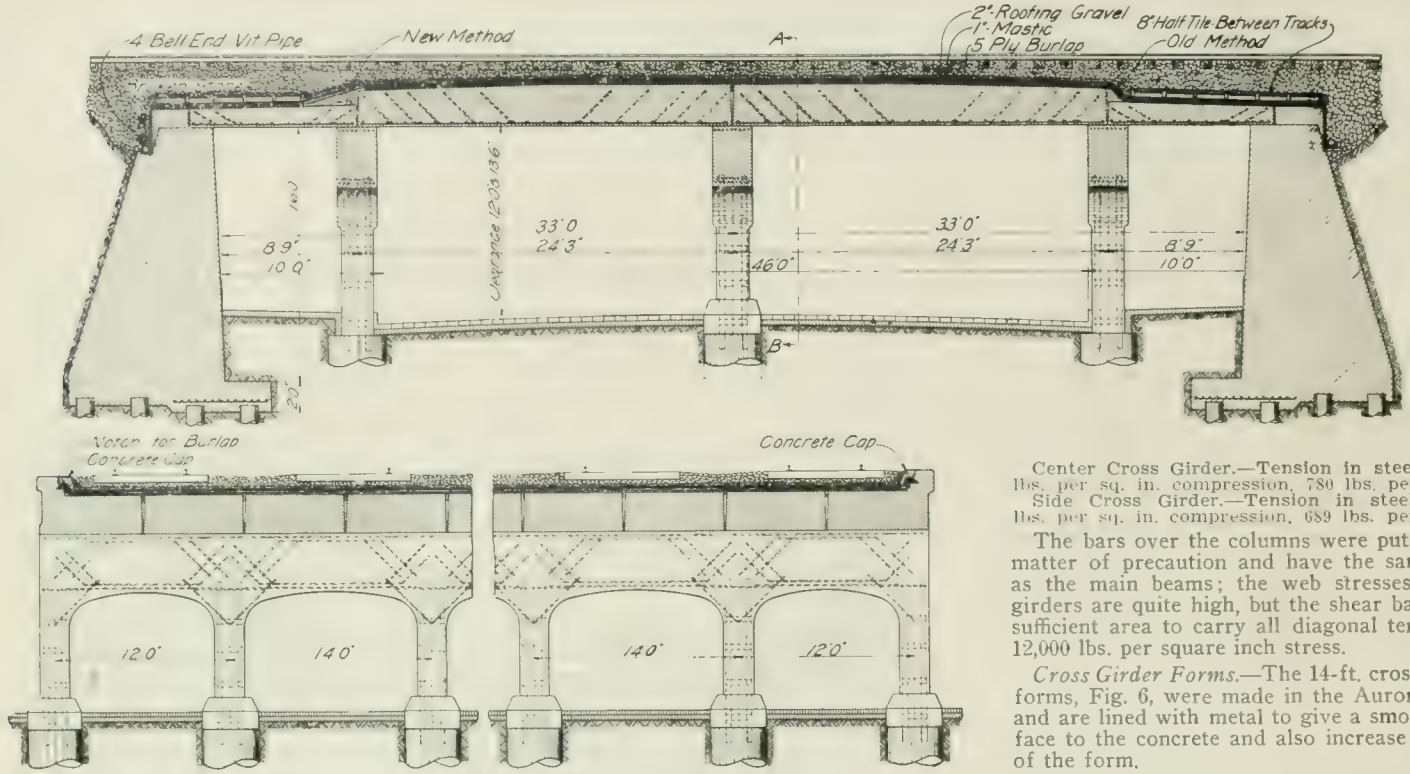

Fig. 3—Cross Section of Reinforced Concrete Deck Girder Slab.

ing line of the lower curve. The column forms were made in four pieces, metal lined, and held together by girts having a forked end to receive the bolt, this making a very stiff form. The mixture used was a 1:2:4 concrete of screened gravel, torpedo sand and cement, and was mixed and placed by hand.

The cross girders were designed as simple beams of 14 and 12 ft. span and are 2 ft. 6 ins. wide and 4 ft. deep at the center, the curve being put in for appearance only. They were designed as simple beams for the reason that they would be built as such, spans being bulk-headed at the center line of columns. The girders were designed by the use of the Johnson formula, and checked back by those of Prof. Talbot, the unit stresses being as follows:

Center Cross Girder.—Tension in steel, 14,850 lbs. per sq. in. compression, 780 lbs. per sq. in.
Side Cross Girder.—Tension in steel, 15,500 lbs. per sq. in. compression, 689 lbs. per sq. in.

The bars over the columns were put in as a matter of precaution and have the same area as the main beams; the web stresses in the girders are quite high, but the shear bars have sufficient area to carry all diagonal tension at 12,000 lbs. per square inch stress.

Cross Girder Forms.—The 14-ft. cross girder forms, Fig. 6, were made in the Aurora shops and are lined with metal to give a smooth surface to the concrete and also increase the life of the form.

Concrete Decks.—The decks, Figs. 7 and 8, were originally designed in 1905, the live load being the standard, live load, equivalent to about E60 Cooper's loading plus 50 per cent. For impact this was assumed to be distributed over 10 ft. of width. In checking back it was found that the stress in the steel was 12,750 lbs. and compression in concrete 668 lbs. per square inch for street slabs; it was 12,700 lbs. and 659 lbs. for sidewalk slabs. The slabs were cast in a specially designed yard, located at the west end of the Hawthorne yard, about four miles from the work.

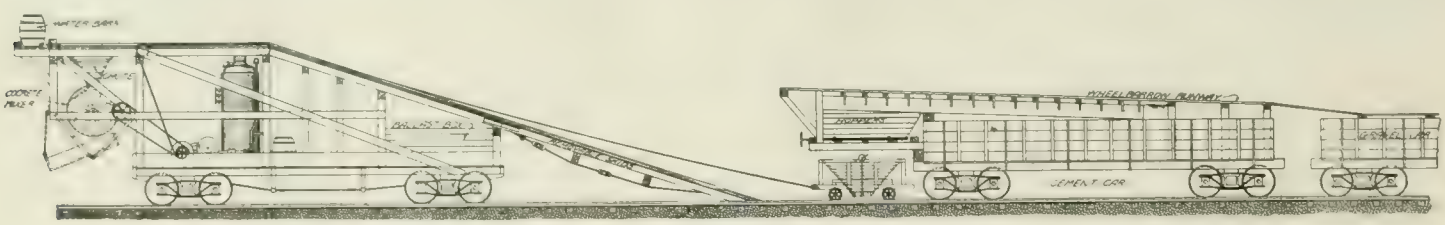

Fig. 4—Concrete Mixing Train.

The layout consisted of two main or working tracks, having forms on either side, 200 in number, these terminating in a single track used as a storage track, from which the slabs were placed in the storage piles. Later on in the year a third track south of the yard was put in as an additional storage track. The

Fig. 5—Type of Subway Built During 1906 Showing Tunnel Effect Where Bridge is Wide.

water supply came from a tank located about 1,000 ft. east of the yard and a 4-in. pipe was put in to supply the required amount.

Slab Forms.—A cinder foundation about 2

ft. deep was laid and upon this the mud sills were placed, being carefully tamped and leveled. The main sills rested upon the mud sills and were leveled up by the use of wedges.

uniformity was observed a mechanical analysis was made of the gravel and the required material added to give a dense concrete.

Test specimens in the form of cylinders, 6

street slabs and 20 days for the sidewalk slabs. In the storage yard the slabs were piled three high, the lower slab being placed on timbers set outside the quarter points and the ground

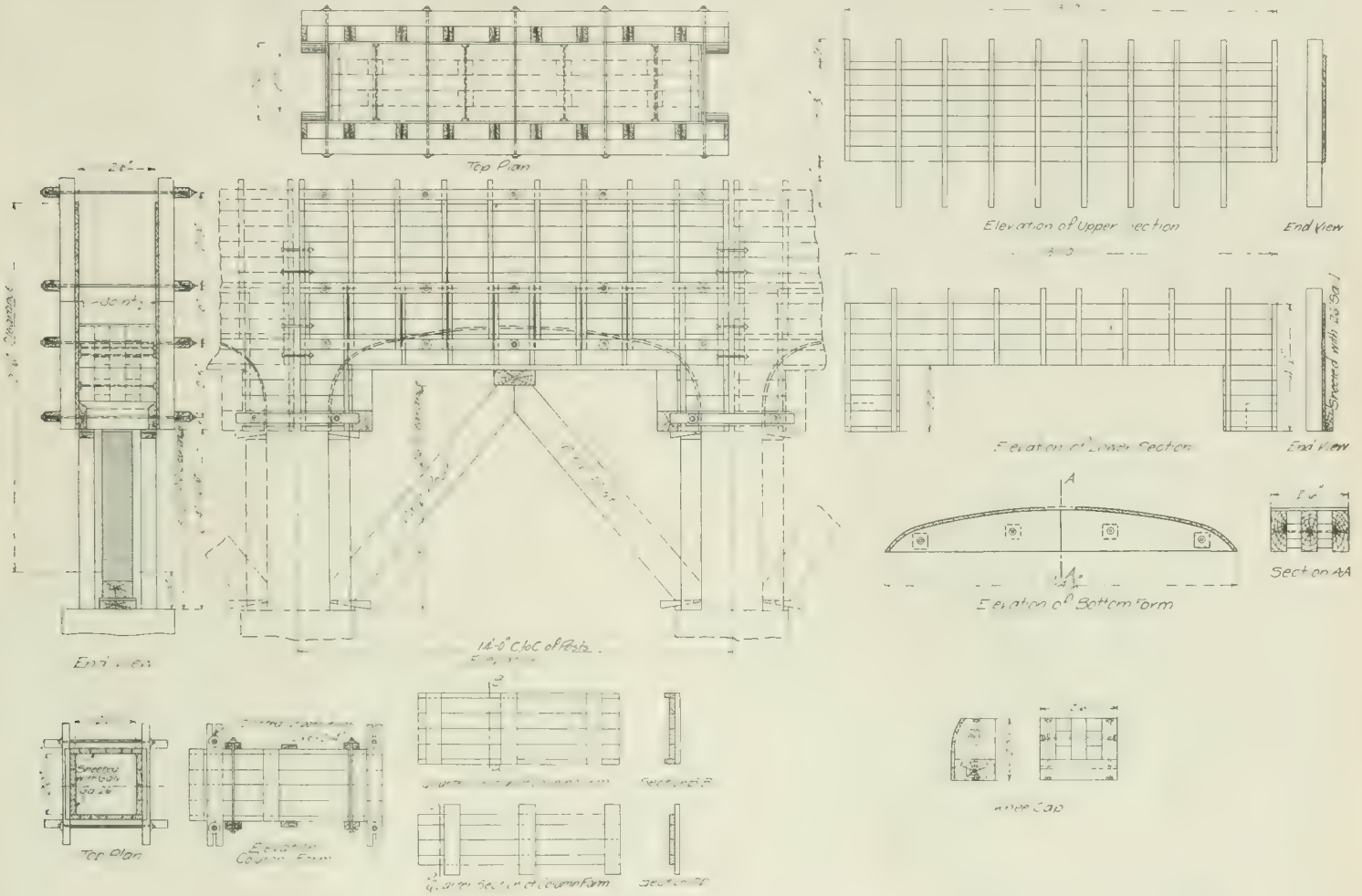

Fig. 6—Forms For Cross Girders, Showing Support and Arrangement for Using Forms on Different Spans.

(Fig. 9.) The floor consists of 2-in. tongue and groove lumber and was spiked firmly to all the sills so as to prevent warping. On the floor a template of 1-in. boards was laid and the sides and ends erected, these being units.

The bars were taken into the forms before the last end piece was placed and arranged later on as needed. In the placing of the bars small V shaped iron saddles were used. These were placed near the ends; the center and quarter points were carried on ½-in. bars placed transversely, to which the main bars were wired after being carefully spaced. The wiring had to be carefully done so as to hold the bars from spreading in concreting. The main stirrups were suspended in place and boxed in before concreting. These stirrups were made of 1⅝-in. round iron for the street slabs and 1⅛-in. for the sidewalk slabs, and were used to engage the toggle on the derrick for erection.

The forms were given a coat of coal tar paint, consisting of coal tar, kerosene and cement, which gave very good results and preserved the forms from checking and warping.

The mixing plant was placed opposite the slab form to be concreted and the concrete deposited direct by chute, the chute being long enough to reach well back past the middle of the form with trap doors intermediate, so that material could be placed uniformly. This mixing plant was the same as that used for abutments.

The first two or three batches were smaller and contained more sand than those later, this being done to simplify the working of the concrete around the reinforcement, which was not easy, the bars being only 2½ ins. c. to c. for 1-in. bars. After the lower 15 to 18 ins. were in place, the work was simple, care being taken to get a well spaded, smooth surface.

The mixture used was of a 1:4 concrete of pit run gravel, which was clean and of fairly uniform mixture. Whenever any change in

ins. in diameter and 9 ins. long, were taken every day and stored under identical conditions with the slabs. Results from 65 of these test pieces show an average crushing strength of 1,839 lbs. per square inch (60-day tests).

The side forms were removed from the slabs at the end of four days and the concrete kept

dug out under the center to prevent center binding. Two cases of center binding did occur with a result of breaking the lower slab over the back, there being no longitudinal reinforcement in the back of the slab.

The slabs built one year were for use the following year, so that they were well seasoned

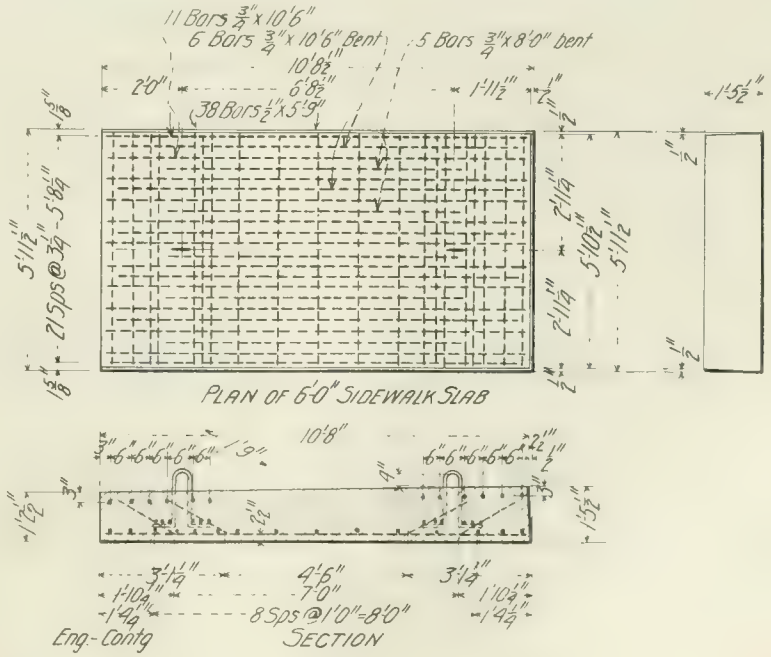

Fig. 7—Sidewalk Deck Slab.

damp by daily use of hose until three weeks old. The age at which the slabs were moved to the storage piles varied with the condition of the work, the earliest being 30 days for the

before being put under traffic. The slab is handled by the use of a toggle frame, consisting of four eye-bars with channel strut at the lower pins; this engages the slabs by the stirrup.

A pin connection is used, as it is far more reliable than a hook. The machine used the first year was a 75-ton wrecking crane, equipped with a 45-ft. straight boom. (Fig. 10.) The machine gave fairly good results, but the loads were too heavy, so a new derrick of 100 tons capacity has been bought for the coming year's work.

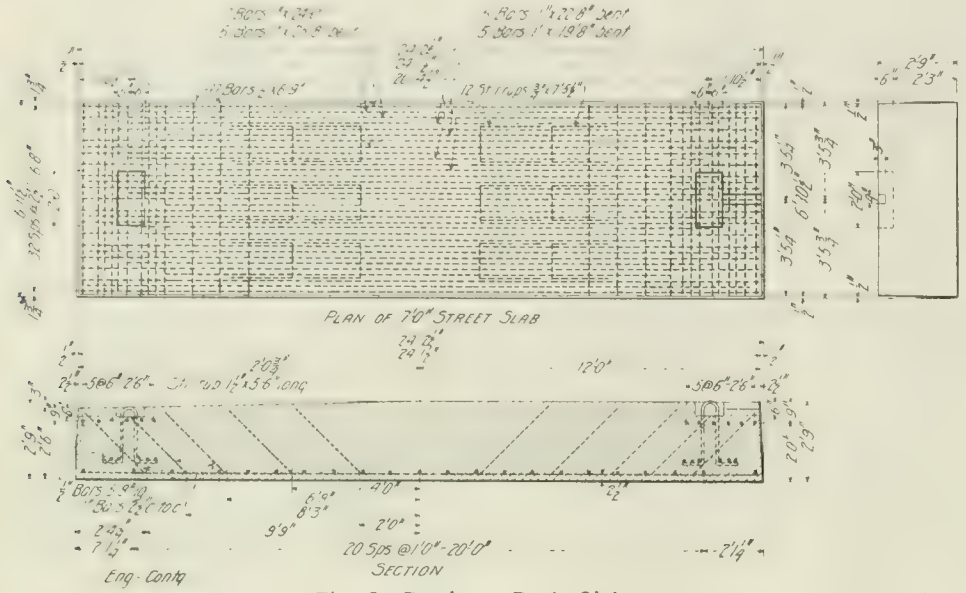

Fig. 8—Roadway Deck Slab.

In placing the slabs, they are loaded on cars at Hawthorne and shipped down to the work. The temporary bridge is pulled up by the derrick and the slabs are set directly ahead of the machine. This work is naturally slow on account of the loads to be handled and the care with which the machine must be blocked up before handling these loads.

At two of the street openings it was impracticable to secure, with the standard types of deck girder floors, the required clearance at the center of the roadway and a special reinforced concrete deck was accordingly designed to reduce the distance between the base of rail and clearance line sufficiently to obtain the headroom desired, without changing the grade of the tracks or affecting the established grades on street approaches to the subway. At the same time this design permits the floor system to be constructed in separate sections, which are delivered to the work as desired and erected without interrupting traffic on more than one track.

The floor is cast in sections which span the sidewalks and roadways the same as the floor slabs of the standard subway. The tracks are spaced 12½ and 13½ ft. apart on centers. Each of these sections consists of two built up girders spaced 3 ft. 8 ins. apart on centers, with a reinforced concrete trough cast between them. A section is thus made which can be handled from the storage piles to place on the bridge in a manner similar to that followed in setting the slabs.

The end of the trough sections are seated on rails embedded in the concrete of the abutments and of the cross girders. Each pair of troughs carry the rail of one track and are on a set of three rails bolted together and machined to give an even bearing surface. The lower flanges of the built up girders rest directly on these sets of rails, the joints of the abutments being embedded in concrete, while at the columns rust joints are made.

It may be noted that each rail is on short pieces of sawed ties placed on broken stone ballast in the trough girder. The rails are set on the inside of the center line of the row of short ties carrying each of them, in order to secure sufficient bearing on the ballast to provide for the outward thrust of the wheels. This arrangement also permits the use of track jacks for surfacing. The rails are placed on tie plates and attached to the ties by means of screw spikes. The pieces of ties fit so that it is impracticable to remove one at a time, but it is expected that renewals can be made when the rails are relaid.

After the sections of a trough have been set, they are bolted together. The top flanges of the beams in adjacent troughs also are tied together with straps and angles and are joined by reinforced concrete slabs of different depths, depending on the span and other conditions. A smooth floor broken only at each trough is thus secured. Between the tracks, the ends of the slabs are supported by 3½-in. angles riveted horizontally to the web of the built up steel beams, and the reinforcement is placed fully to utilize these supports.

The slabs are reinforced near the upper surface by strips of galvanized iron wire fencing to bond the surface of the slab together and prevent cracking. The ends of these strips are bent under the inside of the upper flanges of the girders in the space left at this point when the concrete trough is cast. A good anchorage is thus obtained to hold the slab to the top of the side of the trough.

The first bridge of this type was built at Forty-fourth Ave. in 1907 and proved so satisfactory in service that when similar conditions as to limited headroom were encountered at Union St. the same general design was followed. In fact the only change made in the second structure was to increase the width of the trough in order that longer ties could be used and the rails placed off center to provide for the side thrust. The possibility of having only one track out of service at a time, so interruption to traffic is avoided, was demonstrated with this construction at both crossings, since the trough girder sections carrying each track can be placed without reference to the balance of the tracks on the bridge.

Another special bridge was required in connection with this elevation where two tracks branch from the main line at Sangamon St. and extend to a manufacturing district 1.75 miles to the south. These tracks cross the street, which parallels the right of way closely, and had to be carried over it on a subway structure providing the same openings as those on the main elevation. At the crossing the tracks also are on a grade of 1 per cent and a curve of 12°, which made it impracticable to construct one of the standard subway bridge structures. A special trough girder reinforced concrete deck floor was accordingly designed to meet the conditions.

The three girders are built to act as beams between the points of support, and the floor slab permits the load of the track to be transferred to them, provisions being made for shearing stresses at the points of support of the latter. The abutments and the three transverse rows of concrete columns and girders carrying the floor were built in advance. The girders and floor were then built in sections extending between supports. No longitudinal joints were provided, but transverse joints were placed at the three piers and two abutments. The surface of the concrete in both track spaces was covered with a heavy coat of waterproofing, which was carried up to the top line of the ballast. A 4-in. tile was placed along both sides of each track to intercept and deliver to the sewers all water that passes through to the upper surface of the floor slab.

An entirely different type of bridge from those employed on the balance of the work has been erected to carry the tracks of this railroad over the right of way of the Pittsburg, Cincinnati, Chicago & St. Louis Ry. This right of way is to be elevated to eliminate grade crossings with streets which intersect it, and the tracks of the Chicago, Burlington & Quincy R. R. will be placed at a still higher level to avoid the existing grade crossings with these railroads. The bridge erected at this point consists of two through steel plate girder spans, one of 63 ft. 5 ins. and the other 77 ft. 8 ins., which carry five tracks. The general features of these spans follow the standard design of this company for structures of this type, which have suspended floors consisting of transverse I-beams embedded in concrete.

The abutting ends of the two spans are carried by latticed steel columns seated on 4'0 circular concrete pier footings, carried down to rock at a depth of 60 ft. The bases of these columns are placed 3 ft. below the present level of the tracks crossed, but the latter will be raised so as to leave a clearance of 18 ft. over them. The ends of the two spans also are carried by steel columns on concrete footings,

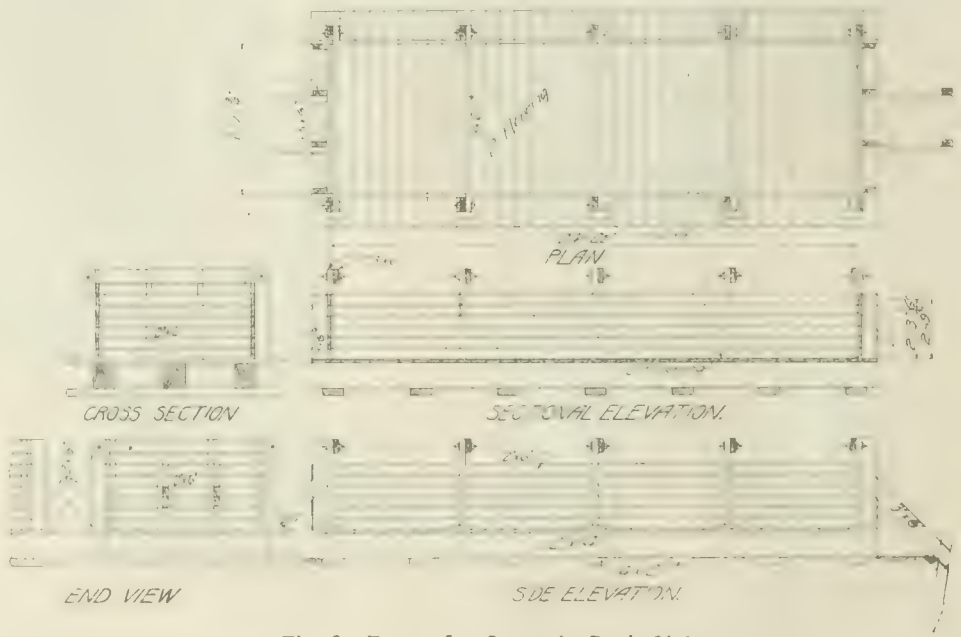

Fig. 9—Forms for Concrete Deck Slabs.

each of these columns being braced by diagonal strut seated on a reinforced concrete slab on piles under the fill, back of the opening provided. A reinforced concrete abutment was built on the line of the columns at both ends of the structure to hold the fill in place, wing walls being carried out on both sides to the toe of the slope. The columns are embedded in this wall, and the diagonal struts are in buttresses between the latter and the slab footing. The columns are designed, however, to carry the structure entirely independent of the abutment. The transverse row of columns near the middle of the crossing also embedded in a vertical concrete wall, 2 ft. 6 ins. thick, which has been placed simply as a means of protecting these columns from derailment.

The work is being done by company force under the direction of Mr. T. E. Calvert, chief engineer, and Mr. W. L. Breckinridge, engineer, maintenance of way, lines east of the Missouri river, and is under the immediate supervision of Mr. F. L. Stone, engineer of track elevation. The structures were designed under the direction of Mr. C. H. Cartlidge, bridge engineer.

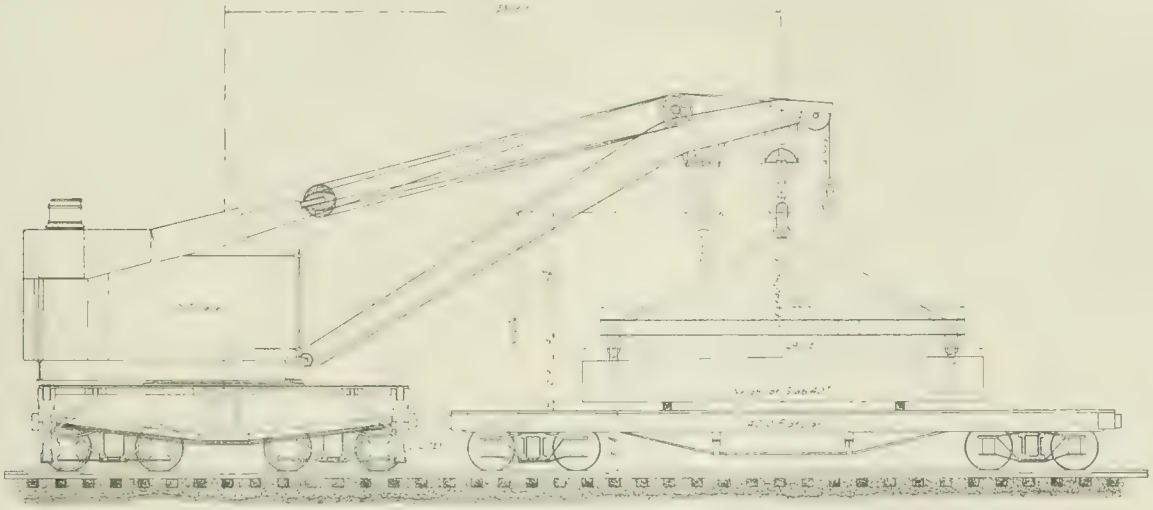

Fig. 10—Method of Handling Deck Slabs With Toggleframe.

What Consideration Should Be Given to Continuity in Reinforced Concrete Beams and Slabs.

BY M. E. THOMAS.*

A surprising variation exists in the present practice in calculating bending moments in reinforced concrete beams and slabs, speaking particularly of beams and slabs intended to act in a continuous manner. For instance for continuous beams the Cleveland, Washington, Boston and Kansas City building ordinances require the moment at the center to be calculated by $\frac{WL}{10}$, St. Louis, Chicago and New York require $\frac{WL}{8}$, while certain text books and engineers advocate using $\frac{WL}{12}$. For negative bending moment over the supports the practice varies, in some cases requiring steel as determined from a moment equal to $\frac{WL}{12}$ and in some 50 per cent of the amount used in center of beam, and in others the amount to be used over support is not definitely stated. The bending moments in slabs is in general more liberal, but just as varied. Of course in some cases where conservative moments are required, the allowable stresses in concrete and steel are more liberal, but it is not the intention here to discuss the relative merits of the different practices.

The two questions, What is the reason for all this variation? and What are the theoretical moments that would guide a designer? naturally occur to any one making a study of the moments allowed in practice, and it is the intention here to answer these two questions.

The difference of opinion as to whether continuous beams should be relied upon and to what extent may explain some of this variation, but this difference of opinion will not explain some of the inconsistencies existing. For instance, the St. Louis ordinance (April, 1907) requires all beams calculated as simple beams, with a moment at center $= \frac{WL}{8}$ and the full amount of negative moment at support or $= \frac{WL}{12}$, while Kansas City (ordinance 1908) allows moment at center calculated by $\frac{WL}{10}$ and only asks for 50 per cent of resulting amount of steel over support. As it happens, St. Louis allows $f_c = 800$, $f_s = 14{,}000$ for mild steel, 20,000 for high elastic limit steel, while Kansas City allows $f_c = 750$, $f_s = 16{,}000$, so that unit stresses allowed are practically the same.

The lack of a common idea of the principles of continuity explains the variations mentioned, also some of the apparent inconsistencies. So that in answering the second question the first is probably answered.

The accompanying diagram, Fig. 1, based on the theorem of three moments as presented in Merriman's Mechanics of Materials, has been developed and extended to give the true moment at the center and the supports of uniformly loaded continuous beams of equal spans. The rules accompanying table and the formulas from which they are derived are an important part of the table. The heavy hori-

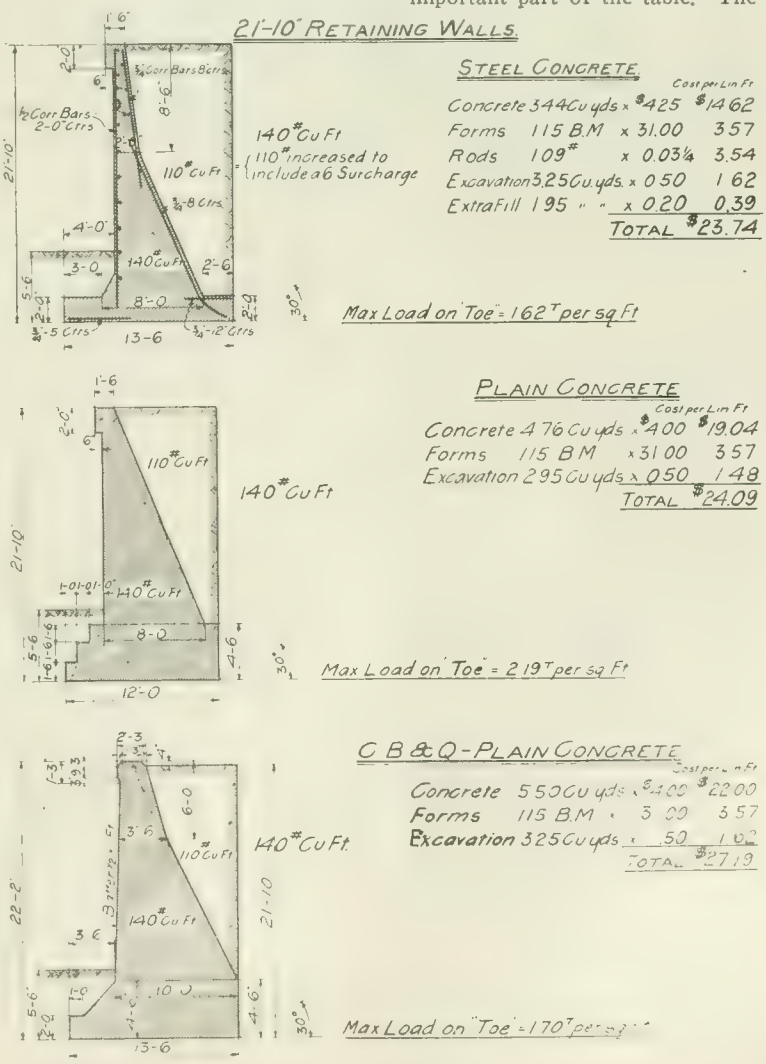
21'-10" Retaining Walls.
Steel Concrete.
Cost per Lin Ft
Concrete 3.44 Cu yds x $4.25 $14.62
Forms 115 B.M x 31.00 3.57
Rods 109# x 0.03¼ 3.54
Excavation 3.25 Cu yds. x 0.50 1.62
Extra Fill 1.95 " " x 0.20 0.39
Total $23.74
140# Cu Ft
110# increased to include a 6 Surcharge
Max Load on Toe = 1.62 T per sq Ft
Plain Concrete
Cost per Lin Ft
Concrete 4.76 Cu yds x $4.00 $19.04
Forms 115 B.M x 31.00 3.57
Excavation 2.95 Cu yds x 0.50 1.48
Total $24.09
140# Cu Ft
Max Load on Toe = 2.19 T per sq Ft
C B & Q - Plain Concrete
Cost per Lin Ft
Concrete 5.50 Cu yds x $4.00 $22.00
Forms 115 B.M x 3.00 3.57
Excavation 3.25 Cu yds x .50 1.62
Total $27.19
140# Cu Ft
Max Load on Toe = 1.70 T per sq Ft

Fig. 11—Comparison of Three Designs of Concrete Retaining Walls.

*Schenectady, N. Y.

zontal lines in the table represent beams and the cross lines the various supports. Above this line are given the bending moment factors at center and at the supports of any span in a number of spans. Below this line is given the

l = distance between supports.

Stating this formula as a rule—

The average of moment factors at the supports (disregarding negative sign) plus moment factor at center equals — 1/8.

of continuity is to consider the ends of the beam cantilevering out to the point of inflection and the span of beam between the points of inflection as a simple beam. This idea affords an independent way of proving the

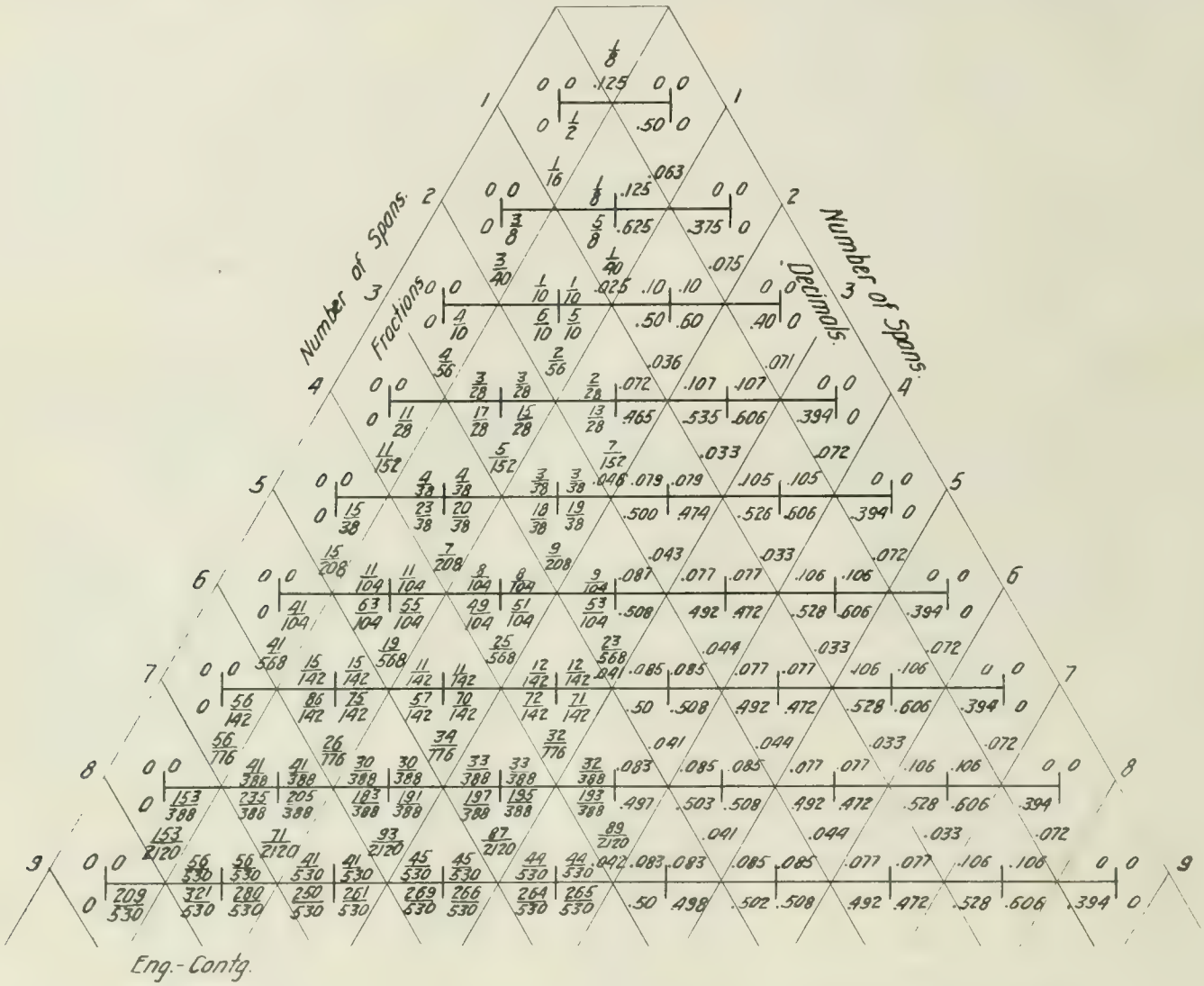

Fig. 1—Diagram for Theorem of Three Moments for Computing Reinforced Concrete Slabs.

Formulas—Theorem of three moments. Spans equal and loads equal and uniform. Starting at any support:

(1) $M_1 + 4M_2 + M_3 = -wl^2$, $M_2 + 4M_3 + M_4 = -wl^2$, etc.

(2) $V_1 = \frac{M_2 - M_1}{1} + \frac{wl}{2}$

(3) $M = M_1 - V_1x - \frac{1}{2}wx^2$, Mc = mom. at center $x = \frac{l}{2}$

(4) $Mc = M_1 + V_1\frac{l}{2} - \frac{1}{2}w\frac{l^2}{4}$, combine 2 and 1 (make $V_1 = V_1$).

(5) $-\frac{M_1+M_2}{2}$; $Mc = \frac{1}{8}wl^2$.

Substituting in (3) values of M_1 and V_1 and placing $M = 0$ x = distance out of point of inflection in terms of l.

For $M = \frac{wl^2}{12}$

$V_1 = \frac{wl}{2}$

$x = .211 = 1\text{-}5\ l.$

NOTES.

Above.—Moment factors for wl^2.
Below.—Vertical shear factors for wl.

(1st) From formula (5) average of sum of factors at supports in any span (disregarding sign) plus factor at center = ⅛ = .125.

(2d) Sum of vertical shear factors in a span = 1 and sum of factors at a support multiplied by wl equals the reaction.

(3d) The maximum distance out of point of inflection = 1-5 l in the case of a beam perfectly continuous or with fixed ends.

vertical shear factors at a support, the sum of which multiplied by WL is the reaction at that support. The left half is in common fractions derived from the formulas and the right half, which is symmetrical, gives the same fractions reduced to decimals, which better show the properties of the table. For instance starting at a beam of three spans and over and looking on the right hand side of the table we see that all end spans have practically the same corresponding factors. Similarly comparing spans next to the end we see they are the same. Also averaging the factors at the supports and adding average to factor in center we have 0.125 = ⅛ for any span. This naturally follows from formula (5) developed by combining (2) and (4) or $\frac{M_1 + M_2}{2} + Mc = \frac{Wl}{8}$

In which

M_1 = bending moment at any support.
M_2 = bending moment at next support.
Mc = bending moment at center support.
W = uniform load.

If the factors at the supports are considered equal, then disregarding negative sign.

The sum of moment factor at a support plus the moment factor in center equals — 1/8.

This rule applies to a simple beam where 0 (end factor) + 1/8 (center factor) = 1/8, and to a perfectly continuous or fixed end beam, where 1/12 (end factor) + 1/24 (center factor) = 1/8, and offers a ready means of determining the factors for any assumed degree of continuity.

Another way of looking at the principles

rule deduced from the Theorem of Three Moments.

Let Fig. 2 represent the conditions mentioned for a perfectly continuous beam.

From formula (3) the inflection point is out $0.21l$ = about the 1/5*th* point of span.

Then for Positive Movement at center consider simple beam 0.58.

$$M = \frac{wl^2}{8} = \frac{w\ (.58l)^2}{8} = \frac{0.042\ wl^2}{} = \frac{wl^2}{24}$$

Then for negative moment at the support

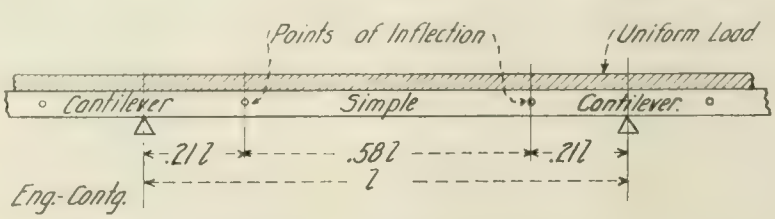

Fig. 2—Illustration of Continuous Beam Action.

consider the cantilever ends carrying their uniform load and the reaction of center span concentrated at inflection point.

$$M = \frac{w(.21l)^2}{2} + \frac{w(.58l)}{2} + 3.21l) = (.022 + .061)\,wl^2 = \frac{wl^2}{12}$$

Thus it is seen that as the inflection points are moved toward the support the degree of continuity of the beam lessens and at any point, if the moment factor of the center span is determined and added to the moment factor of the cantilever ends the sum of the two equals — 1/8.

In applying the rule in practice take the case of a T-beam which is built in a continuous manner in most structures. For full continuity the moment at the center equals $\frac{WL}{24}$ and the negative moment at the support equals $\frac{WL}{12}$. The moment at the center being one-half as much as at the support and having the advantage of a T-section for compression. Suppose we take the moment at center and support equal to $\frac{WL}{12}$, then if it is desired to utilize the T-section at center and stress the concrete up to 600 lbs. on the extreme fiber, the reverse bending moment at the end equal to $\frac{WL}{12}$ would ordinarily stress the concrete on the underside (where there is no T-section) over 1000 lbs.

In this case it is a waste of steel to reinforce the stem to develop a stress so much higher than allowable. In this case the theoretical moment at the support would be $\frac{WL}{24}$ and steel to take care of a moment of $\frac{WL}{16}$ or even $\frac{WL}{20}$ ought to be sufficient provided it is placed with proper regard to the point of inflection and proper stirrups are used.

The diagram shows the effect of continuous beams on columns. For instance, if full continuity is intended and the end beams run into columns or spandrels that will not take care of the negative moment. Then the end columns get about 3/8 of the live and dead load of a floor panel and the columns next to the end get 9/8 of a panel load or 12½ per cent more than is ordinarily allowed.

In bringing this discussion to a close it is to be noted that the theoretical moments and their use in designing is all that it was intended to discuss.

Central Water Way Board for Great Britain.—The appointment of a central waterway board for the United Kingdom was recommended in the final report of the commission appointed to make investigation into canal and inland navigation conditions of Great Britain. It was also urged by the commission that unification of waterways be immediately effected and their administration turned over to the board. The board is advised to investigate the existing conditions in regard to public interest, local assistance available, the prospects of traffic and railway competition. The first undertaking of importance will be the acquisition of British waterways now in the hands of railway companies.

Surveys have been made by W. R. Smythe, C. E., Santa Fe, N. Mex., for a reservoir project eight miles east of Stanley in southern Santa Fe county, which is to reclaim 15,000 acres. The dam will be built on a red sandstone foundation which outcrops and is never deeper than 10 ft. The dam is to be 1,000 ft. long at the top, 400 ft. at the base and it is to be 95 ft. high. Between 10,000 and 15,000 acre feet of flood waters are to be impounded.

Earth and Rock Section

Note: This section is devoted to methods and costs of excavating earth and rock and building embankments. It will cover the grading of roads and railroads, diking and canal work, dredging, building reservoirs and earth dams, sewer and water pipe trenching, quarrying, etc.

Some Notes on Specifications for Earthwork in Railway Construction.

The following notes on specifications for earthwork in railway construction touch upon questions of classification and overhaul in an interesting manner. They were prepared by Mr. James H. Bacon of the Grand Trunk Pacific Ry. and presented in a paper read before the American Society of Engineering Contractors on Jan. 10, 1910.

Specifications in General.—The two main objects of any specification are these: (1) To define the work to be done so that any competent contractor may submit an intelligent bid. (2) To establish a guide and a standard by which the contract may be interpreted with fairness to each party.

To attain the first of these desired results, if the proposed railway line is of any considerable length or is located through a country with varying physical characteristics, the company should (1) compile complete right of way maps, profiles, estimates of quantities showing as fully as possible the character of the work. (2) Divide the proposed line into sections and ask for separate bids and make separate contracts for each section. Each section should be homogeneous so that the actual cost of performing any given class of work shall be practically constant throughout the section. The item of the transportation of supplies is included. (3) Lay great stress on the necessity of each bidder making a personal inspection of the work.

To attain the second result three cardinal principles should be observed in preparing the specifications:

(1) The schedule of prices should include every item that can possibly be foreseen with a view of reducing "force account" work and "extra items" to a minimum and of preventing either party from claiming or denying without justification that any piece of work is covered by the specification.

(2) Every item in the schedule of prices should be adequately covered by a corresponding clause or section in the specifications.

(3) The specifications should be so worded as to reduce to a minimum the possibility of difference of opinion as to which clause of the specifications any given item in the schedule of prices refers.

With these principles in view, the expression "in the opinion of the engineer" or its equivalent should be excluded as far as possible. The price to be paid should be connected with the work done by language as concise and clear as possible. The contractor should have no excuse for insuring himself against loss by bidding higher prices than the actual work justifies.

Clearing and Grubbing.—The usual specifications for clearing seem to be sufficient, but exception may be taken to a common clause which provides that no grubbing will be allowed on the slopes of any cutting where depth of cutting exceeds a certain number of feet. The latter clause arose from the former practice of carrying a deep cut through to grade as the work progressed. This obviated the necessity of grubbing such cuts, as the stumps fell into the cut by gravity. With modern grading machines this practice has changed, and the contractor finds it necessary to grub out the stumps as the work progresses. The result is, if the limit above mentioned be 4 ft., that:

(1) The contractor is paid for grubbing where the cutting is 4 ft. or less, but is obliged to do exactly the same work at the same cost without pay where the cut is over 4 ft.

(2) The difference between 4 ft. and the next greater depth being infinitesimal, disputes arise as to payments.

(3) A change in grade or alignment may require a contractor at no measureable difference in cost to do unexpected grubbing without compensation or may give him compensation where the company did not expect to pay. All grubbing should be paid for.

Classification of Excavated Material.—Following up the general principles enunciated above and especially that which requires that "difference of opinion" shall be eliminated, it is clear to the writer that there should be only three classes of excavated material, not including excavation under water, or excavation or removal of any artificial work such as old masonry, etc. These three classes should be: (1) Solid rock. (2) Loose rock. (3) Common excavation.

Common Excavation.—In many specifications the dividing line between common excavation and loose rock is determined by the "plow test"; this test should be discarded entirely as unsatisfactory. There are thousands of acres, which may in the future be crossed by railways, where the material to be moved has not the faintest resemblance to rock and where no sane man would attempt to break ground with a plow. The plow test is impossible, and the logical result, if the specifications provide this test, is that such material must be classed as loose rock.

Many of the western roads have discarded this test and specify that "all material not classed as loose or solid rock shall be common excavation." The companies using this specification specify that loose rock shall be any rock that can be removed without blasting, although blasting may occasionally be resorted to, or any rock in detached masses varying in size between given limits, and that solid rock shall be rock in masses that cannot be removed without blasting. It will be noticed that these specifications require a definition of the word "rock."

The writer submits the following specifications for the classification of excavated material:

In these specifications the word "rock" shall be interpreted to mean any portion of the consolidated material forming the crust of the earth which has a greater volume than 1 cu. ft. Unconsolidated materials, such as sand, gravel, clay, hard pan, are not rock under these specifications.

Solid Rock.—All rock in masses that cannot be removed without drilling and blasting. All boulders or detached pieces of rock that measure 1 cu. yd. or more in volume.

Loose Rock.—All rock which is loose or soft enough to be removed without blasting, although blasting may, at the option of the contractor, be occasionally resorted to. Detached pieces of rock measuring in volume from 1 cu. ft. to 1 cu. yd.

Common Excavation.—All material not solid or loose rock.

The sizes specified for boulders and detached pieces are of course subject to be changed according to varying circumstances. No tests are recommended, as the writer believes that they would serve no useful purpose and tend to cause complications.

Excavation Under Water.—This classification should be applied to all channels and pits under water which cannot be drained by ditching. The price or prices paid should be per cubic yard and should cover all material and labor, including coffer dams, necesssary to do the excavation required. There should be at least two classes—i. e., with and without coffer dams. In many cases special specifications would be necessary.

Overhaul.—Overhaul should be paid for, a price fixed by the company, per cubic yard per hundred feet beyond the free haul, and the method by which overhaul is to be calculated should be described. The price should equal the cost of the work and is therefore a variable quantity. The limit of free haul is also variable. Both price and free haul limit should be accurately fixed for each section.

Sub-Contracts.—Sub-contracts should be recognized and proper provisions made for their protection. In the face of the universal practice of letting sub-contracts it is absurd to forbid them even with the usual proviso that they may be made with the written consent of the chief engineer.

Uniform Methods of Record and Cost Keeping on Railroad Construction.*

The method of keeping costs of railroad construction work by an engineering contracting firm is one of the most important features of the contracting business. I say "engineering contracting firm" because I believe that future successful contracting business is going to be carried on by contractors that are thoroughly trained engineers. The contractor that submits a bid for a contract after having made a few meager calculations and then finally throws such calculations in the waste basket and makes a bid almost purely from guess work is destined to be sidetracked by the engineering contractor, who has made estimates of his work from systematically prepared records of cost keeping of actual work performed.

It is customary among some contractors, after having made a rough calculation of the cost of a certain piece of work, to look over their bid and say, "Well, I know this piece or section of work will be let for such and such a figure," and finally ignore all their calculations and resort to guess work. They are not willing to submit their bid as figured, for the simple reason that they know at the start their data, if any at all, are not reliable, and such being the case a guess is better than risking their calculations on poor records of previous work. Not only is it necessary for the contractor to be able to bid successfully on contract work, but he should have such engineering training as will enable him correctly to calculate the contents of all kinds of excavation. He should be able to calculate the contents of all masonry structures, not roughly, but accurately, so that when the finals are returned he will know whether the engineer in charge of his work has submitted estimates that are correct.

The contractor should have records of all cross sections and should go over his work before the grading is begun and carefully examine the ground, to see if the engineer has cross sectioned his work properly; that is, taken sections where they are needed and a sufficient number of them. It often happens that the engineer in charge of a piece of construction work is so busy, especially at the beginning of the work, that he does not have time to give his attention to the cross sectioning, but has to leave it to others who in some instances are really incompetent to do the work. The engineer never has time to examine the cross sections on the ground to see if they have been properly taken, and without such an examination neither he nor the contractor is aware of the fact that certain sections that affect very materially the contents of the excavations have been improperly taken, partly through ignorance and partly through carelessness.

The successful contractor should have as complete a record of all notes pertaining to the work as does the engineer in charge of the work. Taking a piece of railroad construction work or any construction work, let us see what notes on cost keeping and engineering records the contractor should keep, from beginning to end of his contract. One part of the contractor's office should be used for keeping and filing of all engineering records and cost data.

Let us take first the method of keeping the engineering records, as they are just as essential as the cost keeping and should be kept together. The first thing the contractor should do in carrying out his contract is to form an acquaintance with the engineer in direct charge of his work. He should tell the engineer of his plans in regard to cost keeping, stating that it will be necessary for him (the contractor) to have a copy of all cross sections, level and alignment notes. It is not likely that the engineer can furnish all the cross section notes at once, but they can be gotten as fast as the engineer takes them in the field. Let me say as a side remark that no honest engineer should hesitate to give the contractor a copy of his notes, for he should be only too glad to have a competent contractor check all his work. It should not take the engineer long to judge whether the contractor really is competent to handle engineering records and is really in earnest about his cost keeping. The engineer and contractor should at all times be on the best of terms, for an exchange of notes is of the greatest value to both.

The cross section notes should be copied by the contractor from the engineer's record in a regular book made for the purpose. A good form is published by Keuffel & Esser and numbered in their catalogue 380. If the engineer is slow in giving the cross section notes it is well for the contractor to copy the notes in a transit book, K. & E. No. 360, as fast as he can get them, and later copy all the notes consecutively in cross section book, K. & E., No. 380. These notes should be plotted on cross section paper and carefully used each month to work up monthly estimates. A planimeter is a very handy instrument and should be used by all contractors.

Before any grading work is started and in fact as fast as the engineer sets the slope stakes, good heavy stakes about 3 ft. long should be driven 1 ft. deep at each slope stake and the station number and cutting marked on same. The importance of this is obvious.

The contractor should plot a profile on heavy profile paper—plate B, 4x30—full width, so as to enable him to keep a careful record of each month's work, using a color for each month. The quantities of each month's work, both grading and masonry, should be printed on the profile in same color to show actual figures. This progress profile should never leave the office. The contractor should also plot a profile in profile book (a good form is published by the Engineering News Publishing Co.).

This profile book should be an exact copy of the office profile, although on a much smaller scale, and should be carried in the pocket at all times for reference. These profiles should contain all alignment and level notes, property lines, road and channel changes, masonry structures, clearing, etc. The contractor should have a private note book, preferably a field book, and in it keep a daily record of the progress of the work, giving the actual condition of each piece of work. He should have an office copy of all notes, such as cross sections, road and channel changes, masonry structures, clearing, etc. He should have a tape, hand level and level rod, and it would be well for him to have a transit and level combined.

Having given a general outline of the method of keeping the engineering records, we will now look to the method of cost keeping. The contractor's time keeper should keep his daily time book in such shape as will enable him to transfer his notes to a special book, which also contains the monthly estimate, as taken by the contractor himself. The monthly estimate as given by the engineer in charge should not be used by the contractor in calculating his unit costs of the work, as very often they are too approximate and not reliable enough for a close approximate of the actual cost of the work.

The cost keeping record book should be so constructed as to enable the contractor to charge all labor against the quantities of estimate, with suitable columns for prorating fixed charges and expenses, of the entire contract against each particular piece of work.

After the contract is complete and the final estimate has been received and accepted by the contractor, he should prepare a final cost keeping record book, making all chargings of the different pieces of work against the final quantities as given in final estimate.

The object of the monthly cost records is to show the contractor the progress he is making and what this progress is costing him. His daily record book or diary gives him the conditions under which the different pieces of work were done and the two together are invaluable to him not only for his present but also for future work. The final cost keeping record book will principally be used in figuring on new contracts.

*A paper by E. M. Lanehead, Morgantown, W. Va., read at the Jan. 19 1910 meeting of the American Society of Engineering Contractors.

Annual Convention of the American Water Works Association.

The thirtieth Annual Convention of the American Water Works Association will be held in New Orleans, April 26th-30th, 1910. Headquarters will be at the Grunewald Hotel, where ample and convenient arrangements have been made for the Secretary's office, meeting rooms and exhibition rooms; all on one floor. The Southwestern Passenger Association has granted a rate of a fare and one-third, plus 25c, for the round trip. Application has been made to the other passenger associations for rates. The entertainment features will be in charge of the Water Works Manufacturers' Association, and will include a visit to the new water-works and sewage disposal plants of the city of New Orleans, which have just been completed at an expense of about $28,000,000.

The usual number of papers are being prepared for this occasion. There will also be an experience meeting, at which a number of short papers will be presented and discussed, and a general talk on water-works managements. The question box will also be taken up at this session, if time permits. The full program will soon be made out, and will be announced a little later. As outlined at present, it is about as follows:

Monday, April 25th; the Secretary's office will be open for registration during the day. Tuesday, April 26th; at 10 a m the association will be welcomed by his Honor, the Mayor of New Orleans, who is also President of the Sewage and Water Board. This will be followed by the President's address, and reports of committees. The afternoon session will be devoted to continued reports of committees and reading of papers. In the evening, instead of the usual formal reception, an informal evening is proposed. This will be opened by Mr. Geo. G. Earl, who will give an illustrated lecture on the New Orleans Sewage and Water Supply. After this lecture refreshments will be served, and the floor cleared for dancing. Wednesday, April 27th; morning session, reading and discussion of papers. In the afternoon, a trip to the New Orleans Pumping Station and Filter Plant. (Lunch will be served at the Pumping Station.) Thursday, April 28th; morning session, reading of papers. Afternoon, some form of entertainment, probably a trip on the river. In the evening a theater party. Friday, April 29th; morning, afternoon and evening will be devoted to reading and discussing papers.

Mr. George G. Earl is Chairman of the local committee, of which Col. L. H. Gardner and Mr. John T. Eastwood are the other members. The exhibits will be in charge of the Water Works Manufacturers' Association, Mr. R. E. Milligan, Sec'y, 15 Broad St., New York City.

Arrangements are already being made for excursion parties from New York, in charge of Mr. F. W. Shepperd, of Fire & Water Engineering, 136 W. 22nd St.; from Chicago, under the direction of Mr. F. J. Bradley, 313 Dearborn st. Mr. Alexander Milne, Supt. Water Works, St. Catharines, Ontario, Canada, is arranging for an excursion from that vicinity, probably starting from Buffalo.

Following the recommendations of Daniel Willard, the newly elected president of the Baltimore & Ohio R. R., the directors of the company are said to have made an appropriation of $8,000,000 for immediate improvements. A considerable portion of this sum will be spent for about 30 miles of third track to be built through the mountains in the West Virginia coal territory.

Roads and Streets Section

Note: This section is devoted to methods and costs of road and street construction. It will cover road building in all its details, the construction of pavements, sidewalks and gutters, the testing and use of paving materials and the machinery and tools used in road building and paving.

Proposed Standard Specifications for Portland Cement Curb and Gutter.*

Materials.—The cement shall meet the requirements of the standard specification for Portland cement of the American Society for Testing Materials and adopted by the association (Standard No. 1).

Fine aggregates shall consist of sand, crushed stone or gravel screenings, graded from fine to coarse, passing when dry a screen having ¼ in. diameter holes, shall be preferably of siliceous materials, clean, coarse, free from loam, vegetable or other deleterious matter, and not more than 3 per cent shall pass a sieve having 100 meshes per linear inch.

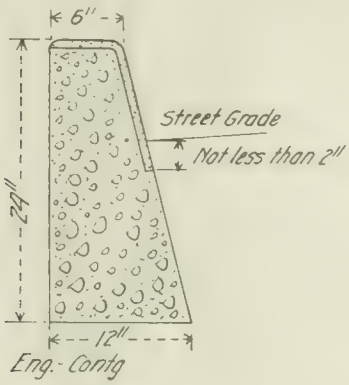

Fig. 1—Standard Concrete Curb.

Mortars composed of 1 part Portland cement and 3 parts fine aggregate by weight when made into briquettes shall show a tensile strength of at least 70 per cent of the strength of 1:3 mortar of the same consistency made with the same cement and standard Ottawa sand.

Coarse aggregates shall consist of inert materials graded in size, such as crushed stone or gravel, which are retained on a screen having ¼ in. diameter holes, shall be clean, hard, durable and free from all deleterious materials. Aggregates containing soft, flat or elongated particles shall be excluded. The maximum size of the coarse aggregates shall not exceed that which will pass in every direction a 1¼-in. ring.

Natural deposit of sand and gravel usually being out of balance, the engineer shall have the option of requiring that they be screened and remixed to agree with the proportions specified under Base, or require the determination of voids in the aggregate as it comes and have it used in the proportions specified under Base.

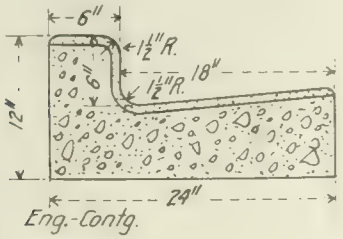

Fig. 2—Standard Concrete Curb and Gutter.

When a sub-base is required, only clean, hard cinders, slag, gravel, crushed stone or broken brick shall be used. The material shall not be smaller than ½ in. nor exceed 4 ins. in the largest dimension.

Water shall be clean, free from oil, acid, strong alkalies or vegetable matter.

The expansion joint filler shall be a suitable elastic water proof compound that will not become soft and run out in hot weather or hard and brittle and chip out in cold weather.

Sub-Grade.—When a sub-base is required the sub-grade shall be not less than 12 ins. below the finished surface of the gutter.

All soft or spongy places shall be removed and all depressions filled with suitable filling material, which shall be thoroughly compacted by flooding and tamping in layers not exceeding 6 ins. in thickness.

When a fill exceeding 1 ft. in thickness is required to bring the work to grade it shall be made in a manner satisfactory to the engineer.

When required, a suitable drainage system shall be installed and connected with sewers or other drains indicated by the engineer.

Sub-Base.—A sub-base shall be provided if required by the engineer, composed of cinders or other suitable material hereinbefore specified, which shall be rammed thoroughly to a surface at least 6 ins. below the finished surface of the gutter.

While compacting the sub-base the material shall be kept thoroughly wet and shall be in that condition when the concrete is deposited.

Forms.—Forms shall be free from warp and of sufficient strength to resist springing out of shape. All mortar and dirt shall be removed from forms that have been previously used. The forms shall be well staked or otherwise held to the established line and grade, and their upper surface shall conform with finished surfaces of the curb and gutter respectively. At least once in every 150 ft., ½-in. expansion joints shall be provided. All forms shall be thoroughly wetted before any material is deposited against them.

Dimensions.—The section of the curb shall conform with that shown in Fig. 1. The thickness at the base shall be not less than 12 ins. and the thickness at the top not less than 6 ins., with a batter on the street side of 1 to 4. The section of the combination curb and gutter shall conform with that shown in Fig. 2. The depth of the back of the curb shall be not less than 12 ins. and the depth of the face not less than 6 ins.

The breadth of the gutter shall not be less than 16 ins. nor more than 24 ins.

Construction.—The curb and gutter shall be divided into sections not less than 5 nor more than 8 ft. long, by some method which will insure the complete separation of the sections by a joint not less than ⅛ in. nor more than ¼ in. wide. At street corners the construction shall conform with that shown in Figs. 3 and 4.

Concrete.—The concrete for the curb and gutter shall be so proportioned that the cement shall overfill the voids in the fine aggregate by at least 5 per cent and the mortar shall overfill the voids in the coarse aggregate by at least 10 per cent. The proportions shall not exceed 1 part cement to 8 parts fine and coarse aggregates. When the voids are not determined, the concrete shall be composed of 1 part cement, 3 parts fine aggregate and 5 parts coarse aggregate. When natural mixed aggregates are used and the proportions of fine and coarse aggregate are not corrected, the concrete shall be proportioned so that the cement overfills the voids by at least 10 per cent. The proportions shall not exceed 1 part cement to 4 parts aggregate.

The method of measuring the materials for the concrete, including water, shall be one which will insure separate uniform proportioning at all times. A bag of cement (94 lbs.) shall be considered to have a volume of 1 cu. ft.

The ingredients of the concrete shall be thoroughly mixed dry, sufficient water added to obtain the desired consistency, and the mixing continued until the materials are uniformly distributed and the mass is uniform in color and homogeneous. When conditions will permit, a machine mixer of a type which insures the uniform proportioning of the materials throughout the mass shall be used. When it is necessary to mix by hand, the mixing shall be on a water-tight platform and the materials shall be turned until they are homogeneous in appearance and color. The materials shall be mixed wet enough to produce a concrete of a consistency that will flush readily under light tamping and which can be handled without causing a separation of the coarse aggregate from the mortar.

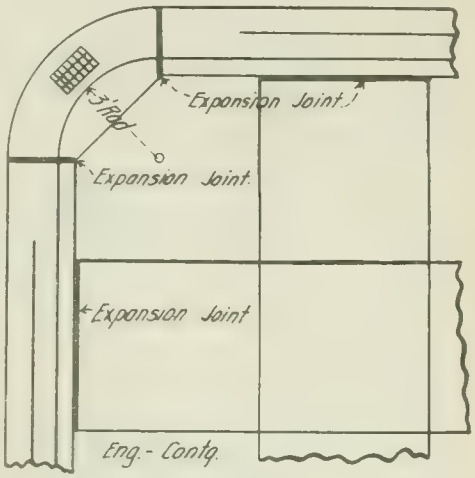

Fig. 3—Plan of Construction at Street Corners.

Retempering—that is, mixing with additional water, mortar or concrete that has partially hardened—will not be permitted.

A layer of concrete shall be deposited to the top of the gutter form and tamped, the width of the gutter, to a surface all points of which shall be at least the thickness of the wearing surface below the finished surface of the gutter. The cement placed for the curb shall be tamped and the remainder of the concrete placed and tamped to permit of the application of the required wearing surface to the face and top of the curb. After the addition of water the mixture shall be handled rapidly to the place of final deposit. Under no circumstances shall concrete be used that has partially hardened.

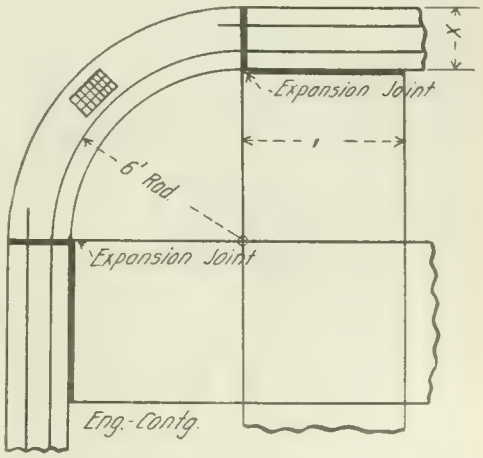

Fig. 4—Plan of Construction at Street Corners.

Concrete shall not be mixed or deposited when the temperature is below freezing unless special precautions are taken to avoid the use

*Committee report made to the National Association of Cement Users, annual convention, Chicago, Ill., February, 1910.

of materials containing frost and to protect the work against frost until thoroughly hardened.

Workmen shall not be permitted to walk on freshly laid concrete, and where sand or dust collects on the concrete it shall be carefully removed before the wearing surface is applied.

Wearing Surface.—The wearing surface shall be mixed of 1 part cement and not more than 2 parts fine aggregate, with sufficient water to produce a consistency which will not require tamping, but which can be easily spread into position. The mortar for the wearing surface shall be mixed in a mortar box. The wearing surface shall be placed immediately after mixing, and in no case shall more than 50 minutes elapse between the time the concrete is mixed and the time the wearing surface is placed.

The wearing surface on the gutter and on the top and face of the curb shall be at least ¾ in. thick. The surface and edges of the curb and gutter and joint between sections shall be finished in a workmanlike manner. All edges shall be rounded to a radius of about ½ in.

When required, the surface shall be troweled smooth. The application of neat cement to the surface in order to hasten the hardening is prohibited.

When coloring matter is required it shall be mixed dry with the cement until the mixture is of a uniform color. The quantity and quality of the coloring shall be such as not to impair the strength of the wearing surface. When completed, the curb and gutter shall be kept moist and protected from traffic for at least 1 week.

Notes on Road and Street Work.

Road Work in North Carolina in 1909.—During the year 1909 there were 403 miles of road surfaced in North Carolina, as follows:

	Miles.	Cost.
Macadam	131½	$502,490
Gravel	108½	56,700
Sand-clay	163	90,000
Total	403	$649,190

The average cost per mile of the macadam was $3,821, the highest cost per mile reported being $4,560 and the lowest $3,000 per mile. The average cost of the gravel roads was $513 per mile, the highest cost per mile reported being $1,200 and the lowest $500 per mile. The average cost of the sand-clay roads was $552, the highest cost per mile reported being $1,000 and the lowest $350 per mile. The greater number of sand-clay roads were constructed in eastern North Carolina, where there was but little grading to be done. The comparatively low average per mile for macadam roads of $3,821 is due to the fact that some of the roads reported as built and macadamized during 1909 were already partially graded. In some instances the location of a road was changed but very little, so that all that had to be done with the old road to prepare it for macadam surfacing was to widen the right of way and do a little grading by cutting down a few knolls and filling up one or two hollows. The low cost per mile of the gravel roads is also due to the fact that there was not a large amount of grading to be done before they were ready to be surfaced with gravel. Besides the above amount there was also spent in the state during 1909 $403,700 in the maintenance of roads. The greater part of this was spent in the repair of dirt roads. This makes a total of $1,052,890 that North Carolina spent on her roads during the year 1909. There were 19 out of the 98 counties composing the state that spent practically nothing in money on their roads, and what repairing was done was by the old labor tax, which requires every able bodied man between the ages of 18 and 45 to work 4 to 6 days per year in repairing the public roads. In lieu of this they could pay 75 cts. for each day they did not work. We are indebted to Joseph Hyde Pratt, state geologist, Chapel Hill, N. C., for the above information. In our issues of Feb. 2 and 9 we gave a summary of the road work done in 1909 in a number of other states.

Street Railway Construction on Paved Streets.—In 1908 the street railway track built in 1894 and 1895 in the city of Syracuse, N. Y., began to show signs of failure. The tracks laid at that time were in conformity with the best practice, consisting of 90-lb., 9-in. girder rail on timber ties spaced 2 ft. 8 ins. center to center on a 6-in. bed of broken stone ballast. As a result of the 13 or 14 years of service some points of weakness naturally developed. In some cases the wooden ties decayed, causing an uneven grade and widening of the gage. In other cases the rail itself failed because of lack of sufficient metal in the web. On the whole, the service rendered by this type of construction was satisfactory, but with the introduction of the heavier types of urban and interurban cars it became necessary to devise a stronger structure and to make some changes in the manner of street paving to conform to the greater depth of wheel flanges. As a result the Syracuse Rapid Transit Ry. Co. and the Syracuse, Lakeside & Northern Ry. Co. laid some experimental track on the plans shown in the accompanying cuts to renew the old structure. The former company constructed its experimental track with steel cross ties embedded in and upon Portland cement concrete, the 95-lb. tee rails being secured to the cross ties and underpinned with concrete throughout their lengths. The space between rails and tracks and 2 ft. outside was paved with vitrified bricks, a special brick being used next to the rail on the gage line to accommodate the flanges of the car wheels. The Lakeside road paved Noxon St. pursuant to a franchise provision, and in the railway portion of the street laid wooden cross ties on 6 ins. of concrete. The concrete was brought up to the top of the cross ties and brick pavement on a sand cushion laid to grade. A 90-lb. tee rail (American Society of Civil Engineers' standard) was spiked to the cross ties. The same type of special brick was used next to the gage line.

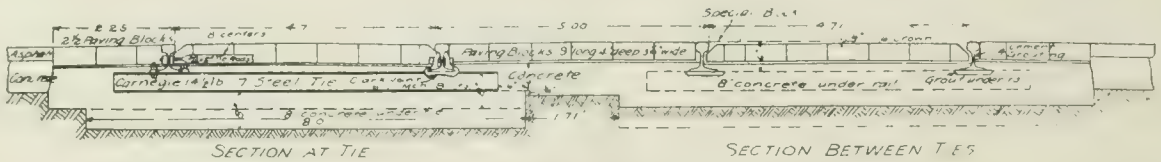

Fig. 1—Experimetal Track of the Syracuse Rapid Transit Ry., at Syracuse, N. Y.

loose and cracked wearing surfaces would be seen if workmen could be made to understand that a wearing surface will not adhere to, or form a bond with, a base covered with loam or dirt which they have "tracked" over it either through carelessness or in order to save a few steps. Clean cut joints between the slabs and expansion joints adjoining the curbs at streets and alley returns, and at frequent intervals in long stretches of walk, are absolutely necessary if broken curb stones and broken slabs in the walks are to be avoided. Expansion joints at street and alley returns can be eliminated by constructing the curbing with a "recess" into which the sidewalk slab may be laid.

Data on Street Work, Carlisle, Pa.—During 1909 two blocks, 4,400 sq. yds. of asphaltic macadam were laid on East Louther St., at Carlisle, the work being done by day labor. The old bed was so worn that 6 in. of new stone was required. After this stone had been thoroughly compacted by rolling, heated asphalt, 90 per cent pure, was forced to penetrate about 3 in. by a special sprinkling wagon; it was then covered with screenings and rolled. The cost of the 4,400 sq. yds. of asphaltic macadam was $1,069, or 25 cts. per square yard. This cost can be itemized as follows:

	Per sq. yd.
New stone	$0.07
Labor and rolling	.05
Asphalt and applying	.13
Total	$0.25

The asphaltic macadam on East Louther St., according to the annual report of C. A. Bingham, city engineer, from which these notes have been taken, has given a very satisfactory street and has proved mudless, dustless, noiseless and waterproof, with the additional advantage of being easily cleaned. Only one block was resurfaced with Tarvia during the past year. The cost of this work was 14 cts. per square yard, itemized as follows:

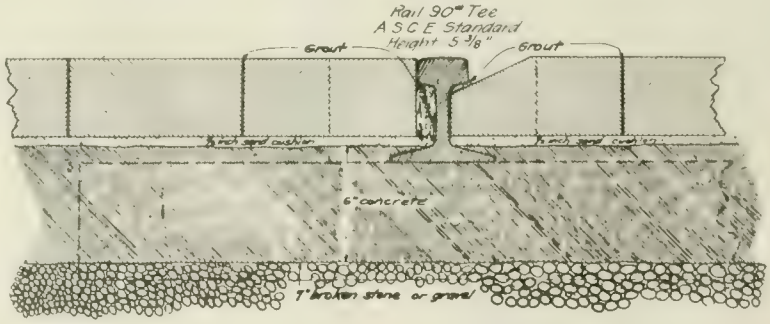

Fig. 2—Experimental Track of the Syracuse Lakeside & Northern Ry. at Syracuse, N. Y.

Hints on Constructing Cement Sidewalks

The following hints have been taken from a paper by Mr. N. E. Murray, superintendent bureau of sidewalks of Chicago, Ill., presented at the last annual convention of the Illinois Society of Engineers and Surveyors: Before constructing cement walks on a foundation that has been traveled over for several months, "pick up" the entire surface, flood and retamp it. The reason for this is obvious. On filling of this character the foot travel generally follows one well-defined line, usually in the center, which becomes solid and well packed and will not "settle" under additional weight; while the filling to either side of the center, on being given additional weight, usually settles sufficiently to cause a crack lengthwise through the walk, unless the entire surface is loosened and retamped to a uniform density before the concrete is put on. A successful contractor states that in cold weather he mixes the concrete as dry as it is possible to have it, and then puts in the base in two courses, tamping each course separately—in this way obtaining a more uniform density in the concretes, and as a result has never had to record a "failure" in his work. Better results will be obtained and fewer walks with

	Per sq. yd.
New stone	$0.09
Labor and rolling	.02
Tarvia	.03
	$0.14

About 6,000 sq. yds. of this Tarvia was laid in the previous year, and the report states that it has proven excellent for residential streets. Several pieces of plain macadam were laid during the year, the cost of 8-in. macadam being as follows:

	Per sq. yd.
Crushed stone	$0.26
Labor and rolling	.11
Carting, etc.	.04
Total	$0.41

The plain macadam streets at Carlisle need resurfacing at least every three years on account of soft limestone and the improper refilling of trenches by public service companies. This resurfacing, of which much was done last year, cost as follows:

New stone	$0.10
Labor and rolling	.06
Total	$0.16

During the year over 1,500 lin. ft. of 3. ft. brick gutters were laid along macadam streets, the unit cost being as follows: Labor, 13 cts. per lin. ft.; bricks, 20 cts. per lin. ft. In addition a concrete culvert 20 in. x 36 in. and about 200 ft. in length was laid at a cost of $1.66 per lin. ft.

Wages paid during the year in the above work were as follows:

	Per hour.
Foreman	17 cts.
Roller engineer	20 cts.
Laborers	11 cts.
Carting	25 cts.

Crushed stone cost about 89 cts. per cubic yard.

Summary of Tests Made at New York City of Machines for Cleaning Streets by the Use of Water.

The street cleaning department of New York city, as noted in our issue of Aug. 25, 1909, has been conducting tests of street flushing machines, with a view to securing data to guide the department in awarding contracts for flushing and cleaning the streets by machines or devices in which water is used. The contracts, which are to be let shortly, will call for the flushing of a large amount of street surface in the boroughs of Manhattan, Brooklyn and the Bronx. For this work the city has been divided into districts, there being six in Manhattan borough, eight in the borough of Brooklyn, and the bronx will be considered as one district. The six flushing districts in Manhattan borough are formed from the regular department of street cleaning districts approximately as follows: Flushing District No. 1 is formed from Department Street Cleaning Districts Nos. 1 and 2; Flushing District No. 2 from Street Cleaning Districts Nos. 3 and 4; Flushing District No. 3 from parts of D. S. C. Districts Nos. 5 and 6; Flushing District No. 4 from parts of D. S. C. Districts Nos. 5, 6 and 8; Flushing District No. 5 from D. S. C. Districts Nos. 7 and 10 and parts of No. 8; Flushing District No. 6 from parts of D. S. C. Districts Nos. 9 and 11. The proportion of the whole work to be done in each district is: District No. 1, 11 per cent; No. 2, 25 per cent; No. 3, 18 per cent; No. 4, 17 per cent; No. 5, 15 per cent; and No. 6, 14 per cent.

The tests, the results of which are given in the accompanying tabulation, were conducted in the 11 department of street cleaning districts noted above. In the tests in order to obtain comparative costs each machine was assumed as costing $1,000, horses were placed at $300, wages of drivers and sweepers were $800 per year and maintenance at $2.70 per day. A price of 13½ cts. per 1,000 gals. was placed on the water supplied by the city. Under the contract the flushing and sweeping up of the debris will be done as much as possible at night and it is planned to have the work begin at about 11 p. m. and continue until 7 a. m. The work will extend from April 1 to Oct. 31.

The five flushing machines mentioned in the tabulation are all operated by air pressure, with the exception of the Studebaker, which runs a rotary pump and engine. Each machine weighs loaded about 3,000 lbs.

The tests were conducted under the general supervision of Mr. A. F. Gunther, district superintendent, while Mr. E. D. Very, engineer of the department, was in charge of collecting and preparing the cost data. It is to the latter that we are indebted for the results given in the accompanying tabulation.

SUMMARY OF DATA FOR TESTS OF MACHINES FOR CLEANING STREETS BY THE USE OF WATER.

Make of Machine.	No. of Machines in Gang.	Days Tested	Percentage of Various Pavements. Asphalt.	Granite	Wood.	Sq. Yds. Cleaned Per Machine Per Day.	Gals. of Water Used Per 1,000 Sq. Yds
District No. 1—							
American	2	14	7	33	60	9,896	1,003
Connelly	2	47	9	53	38	12,611	903
District No. 2—							
American	4	14	...	..	..	.....	.....
American	5	21	67	24	9	15,624	558
Connelly	3	11	...	..	..	.....	.....
Connelly	4	8	67	20	13	16,846	481
Squegee	2	20	82	..	18	21,247	404
Sanitary	4	47	63	30	7	13,406	995
District No. 3—							
American	4	47	94	2	4	18,487	542
Ratigan	3	3	...	..	..	.....	.....
Ratigan	3	20	92	1	7	17,983	490
Connelly	2	2	...	..	..	.....	.....
Connelly	3	3	...	..	..	.....	.....
Connelly	4	9	89	1	10	26,476	152
District No. 4—							
American	4	14	90	10	..	13,751	810
Connelly	4	21	99	1	..	21,657	566
Sanitary	2	47	68	32	..	19,355	472
District No. 5—							
Ratigan	3	47	49	51	..	9,827	666
Connelly	2	14	62	38	..	38,980	328
Squegee	1	5	...	..	..	.....	.....
Squegee	2	12	100	..	..	47,491	153
Sanitary	4	28	95	5	..	32,792	314
District No. 6—							
Connelly	2	16	...	..	..	.....	.....
Connelly	4	7	77	23	..	26,689	463
Squegee	2	15	100	..	..	68,948	125
Sanitary	4	47	83	17	..	27,347	385
District No. 7—							
Ratigan	2	47	71	29	..	15,137	675
Connelly	2	36	89	11	..	*51,567	272
Squegee	2	16	100	..	..	75,161	91
Sanitary	2	13	...	..	..	.....	.....
Sanitary	4	15	88	12	..	28,234	371
District No. 8—							
American	2	47	89	11	..	18,679	499
Connelly	2	26	96	4	..	40,994	317
Studebaker	1	41	43	57	..	*34,657	528
District No. 9—							
Connelly	2	24	89	10	1	38,572	273
Squegee	3	18	99	..	1	46,142	151
Sanitary	2	13	96	2	2	25,522	324
District No. 10							
American	2	47	75	25	..	21,254	359
Connelly	2	25	75	25	..	25,862	387
District No. 11—							
American	2	47	97	3	..	22,193	454
Connelly	2	20	100	..	..	46,651	187
Connelly	2	27	98	2	..	*40,222	240

*Day work; all other work done at night.

Method of Constructing Macadam with Asphaltic Oil Binder at Pasadena, Cal.

Macadam constructed with heavy California asphaltic oil as a binder has of late years come into much use in southern California for city streets and country roads. The city of Pasadena especially has a considerable amount of this kind of pavement and has found it to be hard, dustless and mudless, and one which the hardest and heaviest automobile traffic cannot ravel. The method of constructing this pavement as employed at Pasadena was described by Mr. S. J. Van Ordum, city engineer of that city, before a conventnon of the League of California Municipalities, and the matter in this article has been taken from his paper.

Preparing Base.—The roadbed is first graded, watered and thoroughly rolled with a heavy roller. Stone of a size not larger than 2½ ins. in its largest dimension and not smaller than will pass a ¼-in. screen is then placed to such a depth that after being thoroughly sprinkled and rolled with a 12-ton roller the surface shall be 1¾ ins. below the surface of the finished pavement. The depth of this base depends upon the character of the soil, drainage, character and amount of traffic upon the street. The average depth of this base under ordinary conditions is about 4¼ ins., which with the top surfacing of 1¾ ins. makes a 6-in. macadam pavement.

As the rolling of the broken stone foundation progresses, rock screenings of a size not greater than will pass through a 1¼-in. screen are spread over the surface in sufficient quantities to bind the broken stone foundation and form a true surface.

The idea in placing a binder on the base rock is to partially bind the rock so that it will not be displaced in oiling or placing the subsequent layers of rock. It is not necessary nor is it advisable to thoroughly close and seal all the voids in the rock, for the first coat of oil which is applied to the base would then be unable to penetrate the base.

Upon this base prepared as above specified is then applied liquid asphaltum at the rate of ¾ gal. to each square yard of street surface.

Wearing Surface.—A layer of crushed rock consisting of stone which will pass through a 1¼-in. screen and be retained by a ¾-in. screen is evenly spread over the rock base to such depth that, after being thoroughly sprinkled and rolled with a 12-ton roller, it is 1¼ ins. in thickness.

Liquid asphaltum is then applied at the rate of ¾ gal. to each square yard of street surface, after which a coat of crushed rock of a size which will pass through a ¾-in. screen and be retained on a ¼-in. screen is evenly spread to a depth of ½ in. in thickness.

The surface is then thoroughly watered and rolled, followed by a coating of liquid asphaltum applied at the rate of ¼ gal. per square yard. After spreading a light coating of rock screenings ¼ in. and under in size, sufficient to absorb all surplus oil and produce a uniform surface, the pavement is watered and thoroughly rolled until it becomes hard and smooth, true to grade and cross section, and free from all hollows and irregularities.

Care should be taken to have the different courses of rock carefully screened and spread uniformly over the street. If crusher run of rock is used the unequal density of the pavement will result in too little oil in one place and too much oil in another spot. The street when completed should have a surplus of rock screenings on the surface, for the sun and continued traffic will bring out the oil which combined with the fine screenings gives the street the asphalt finish.

A trench cut in an oil macadam is repaired by first thoroughly tamping the base rock to within about 2 ins. of the surface, the edges of the pavement next to the trench should then be cut and the space filled with rock and oil which had previously been mixed by hand. A light coating of screenings is then spread over the surface and the whole thoroughly tamped with a hand tamper.

The oil which has been most successfully used has been the heavy crude or topped oils from the Sunset fields near Bakersfield and contains from 75 per cent to 87 per cent asphaltum. Great care should be taken in selecting the asphaltic oil, for the success of the pavement depends to a great extent upon the character of the oil used. Especially is this true if a topped or partially refined oil is used. Refineries are negligent in topping oils and often turn out a bad product which is very hard to detect from a first class road oil. It is also economy for them to top the oil in as short a time as possible, heating the oil to a high temperature, and in so doing cracking the asphalt content.

Iron and Steel Production in 1909.—The year 1909 witnessed a wonderful revival in the iron and steel industry of the United States, and the production of the former will nearly reach the record production of 1907. According to an estimate made by E. C. Harder of the U. S. Geological Survey the production of iron ore in 1909 was approximately 51,000,000 long tons, while the production of pig iron totaled about 25,500,000 long tons. The following table shows the production in long tons of iron ore and pig iron in 1907 and 1908 and the estimated production for 1909:

	1907	1908	1909
Pig iron	25,781,361	15,936,018	25,500,000
Iron ore—			
Lake Superior district	41,638,744	28,225,412	41,000,000
Alabama	4,039,453	3,734,438	} 10,000,000
New York	1,375,020	697,473	
Other states	4,667,402	3,326,013	
Total ore	51,720,619	35,983,336	51,000,000

Water-works and Sewer Section

Note: This section is devoted to methods and costs of constructing sewers and water-works. It will cover the construction work for all details of water supply and sewerage, including sewage purification and water filtration.

The Efficiency of Day Labor Maintenance of Chicago Sewers with Particular Reference to Cleaning of Catch Basins and Sewers.*

A classification of the work of the Chicago Bureau of Sewers is as follows: (1) Chemical work, (2) establishment of bench and street grades, (3) inspection of house drains and (4) maintenance of sewer system. This study applies particularly to the last division of the work, which is subdivided as follows:

(a) Catch basin repairs: A maintenance force consisting of a civil engineer and nine gangs, with a brick mason foreman, makes minor repairs to catch basins and sewers.

(b) Operation and repair of sewage pumping stations: Five pumping stations are maintained to raise sewage from one level to another for suitable disposal. Jurisdiction of engineer in Bureau of Engineering.

(c) Control of supply yards: Two yards containing various supplies, sewer pipe brick, cement tools, etc., are maintained.

(d) Cleaning of catch basins and sewers: Involves removal of material accumulated in catch basins, also removal of sediment and obstructions from sewers. There are five districts, each with a foreman, subforeman and force of teams and men varying from 30 to 50 individuals. The method of cleaning the catch basins varies. In some instances the material is removed by buckets and ropes and dumped directly itno large water tight trucks. In other instances it is taken out by means of long handled shovels called "spoons" and placed on the surface of the street, to be collected thereafter. The sewers are cleaned either by flushing with a hose or, if the obstruction is not removable that way, by dragging knotted ropes, wooden or iron scrapers of different dimensions from one manhole to another.

The principal part of the bureau's work consists in the maintenance of the sewer system. The expenditures are almost entirely on pay rolls, the large bulk of the employes being laborers. Approximately 50 per cent of the expenditure was for cleaning sewers and catch basins.

In seeking to determine the efficiency of the laboring forces attention was largely confined to the work of the force engaged in cleaning catch basins and sewers. Inspectors were appointed to observe the gangs with a view to reporting on the amount of time actually spent in productive labor, amount of material removed, movements of teams, aptitude of forces, etc. Observations were classified under the headings Time Working, Time Wasted, Time Waiting, and Time Away from Work.

After an amount of time had been devoted to this secret observation sufficient to form a basis for the determination of the normal activities of the force, the same men were sent out openly to make the same character of observations. Obviously the purpose of this procedure was to contrast the normal activities of the gangs with their possible activities. Such a comparison would show a loss of efficiency which might be due to incompetent direction and supervision by supervising officials of the bureau, including its district foreman. A study of the record of the material removed taken in conjunction with the pay roll expenditures could also be made to show the unit cost of such work as it actually exists and in addition the unit cost of productive labor or in other words the amount such work should cost. From a comparison of the latter figures with the former would then be developed the lack of efficiency of the force due to any and every existing condition of delinquency affecting the work.

[An itemized daily record of time worked, time wasted and time waiting, gang by gang, for approximately a month follows. Only the general summary of the inspectors is given, quoted as follows.—Editors]

Referring in a general way to the condition found in the Department of Sewers during my several weeks of both secret and open observation covering the work of cleaning catch basins, and the character of the service rendered by labor and teams engaged in this work the following is submitted:

During the secret observations we found the service of laborers to be of a very low grade of efficiency. Loafing, drinking and visiting saloons during working hours is a general custom. No effort is made to hide from the public this neglect of duty. Men stand out on the street or wherever they happen to be when a bucket of beer is drunk, evidently indifferent to any one in authority or fear of being seen and punished by some person responsible for the work of the department.

Lack of supervision and direction is apparent throughout the department, or that part of it that has to do with labor and teams cleaning catch basins. In only one instance during our four weeks of secret observations did any foreman or assistant foreman appear where a crew was at work. In this case he remained probably five minutes to hand some written instructions to the crew. During our open observations, either the foreman or the assistant foreman visited the crew several times each day. I am unable to discover any duties performed by the assistant foreman in the two districts mentioned in this report that could not be performed by a messenger boy.

The department depends entirely for its information concerning the condition of catch basins upon complaints sent in by citizens. There is no system of inspection or investigation of catch basins to occupy the time and attention of the assistant foreman. His work, as I observed it, consists in carrying a list of the complaints made out at headquarters and given him for delivery to the gangs that are working too far from headquarters to call for their instructions in person. The hours on duty are arranged by the different crews to suit their own convenience and wishes, beginning and concluding work whenever they see fit, without direction or interference from any one.

With reference to the value of services rendered the department by the teams employed in this work, I find great waste in the many useless and unnecessary trips made by teams hauling only partly loaded wagons between points of loading and various dumps. This last could be corrected were each wagon numbered and examined at the dump as to the size of load by a reliable man. This would provide an accurate record of the amount of dirt hauled by each team and serve as reliable data covering the work of each crew. Teams come and go without direction of any one, in some instances, the crew of laborers being idle for hours waiting for team to set wagon for loading.

An arrangement is in effect with all crews observed, which provides that in case two teams are used with three wagons, one of the teams makes only one load each day, the other makes two. Then on the following day the trips are arranged so that the team making two trips the day before only makes one. This in effect gives one team a full day's pay for half a day's work each day. With crews made up of two wagons and one team it is possible in almost all localities to make two trips to the dump and have an empty wagon on hand for loading after the second has left for the dump.

Referring to these conditions and particularly to the records of individual gangs, the report continues:

The foregoing extracts serve to show the character of the faults existing in the service. Attention is directed to the fact that the extraordinary condition of inefficiency is found not in one or two gangs but in every gang observed.

The extent of the normal delinquency of the force with respect to the waste of time alone is shown in Schedule I attached hereto. This is a summary of the data contained on the graphic charts covering secret observations. It shows the aggregate time in minutes of all the men watched secretly and the relation of the classified time to the total time under observation.

An examination of Schedule I shows that the amount of time wasted per gang ranges from 189 per cent to 89 per cent of the total time observed, the average being 46 per cent. There is a strong probability that if the time shown as "unaccounted for" could be classified this average would be increased to 50 per cent at last. This means that the laborers of the bureau are in the habit of wasting practically half of every day by loafing or leaving the work entirely. Schedule II, which follows Schedule I, gives exactly the same character of information. The conditions, however, are different here since the observations were made openly.

A comparison of the figures in corresponding columns of these two schedules clearly shows the effect of critical inspection on the normal activity of the force. The normal average percentage of working time is almost doubled and that of wasted time is reduced from 46 per cent to less than 14 per cent.

It might be expected that under the series of open observations the wasted time would be entirely eliminated. In a few instances this was practically the case, but in others it still amounted to about ⅛ of the 8-hour day. A part of this waste of time under open observation can be attributed to the inexcusably bad system in vogue, but the remainder is unquestionably due to the bold disregard of authority engendered by a close association with politica. influence.

Anticipating that this unwholesome but familiar condition might be encountered among the sewer gangs, provision was made for securing a basis of comparison which would be largely independent of this and other similar features affecting different work. This was accomplished by securing data from which a cost analysis of work could be made. The time of all men engaged in productive labor was segregated, reduced to dollars and cents and divided by the amount of material disposed of. The result appears as the result of productive labor or useful work per cubic yard of material removed. Where this unit cost of productive labor is compared with the actual or pay roll unit cost of labor, the difference represents the self demonstrated loss of efficiency due to any and every cause.

Obviously, if the work performed cannot be measured in units of quantity, the method fails. For this reason the cleaning of sewers is not readily susceptible of analysis, but the cleaning of catch basins, on the contrary, provides every essential condition.

Schedule III has, therefore, been prepared, utilizing this method of determining absolutely the efficiency of that part of the force so engaged.

The deductions to be drawn from this schedule are astounding. It is there shown by a succession of figures whose very uniformity attests the reliability of the observations, that the present average unit cost of cleaning catch basins is 255 per cent of what these very gangs demonstrated they could make the average cost, and 340 per cent of what several gangs showed should be the unit cost.

In other words, the gangs themselves proved that their normal work showed a loss of efficiency of nearly 61 per cent as compared with what several individual gangs actually did.

It is impossible to controvert the deductions thus drawn. The figures correspond exactly to

*Abstract of a report by B. F. Melton, Engineer, to the Chicago Commission on City Expenditures, commonly known as the Merriam Commission.

the characterizations made in the previous extracts from inspector's reports.

Item.	Schedule I. Secret Observation.	Schedule II. Open Observation.
Total time observed, hours	760	[illegible]
Time worked, per cent	[illegible]	76.4
Time wasted, per cent	46.0	13.8
Time waiting, per cent	2.3	4.3
Time, unaccounted for, per cent	11.7	5.5
Total	100	100

SCHEDULE III.

Item.	Secret Observations.	Open Observations.
Pay roll cost per cu. yd.	$5.11	$2.59
Produc. labor cost per cu. yd.	[illegible]	2.00

Dikes for Tide Lands.—The owners of northwestern tide lands have been perplexed with the problem of providing impervious dikes. In most cases, when a dike broke the destruction was started from a small hole burrowed through by a rodent. Charles N. Hudson, engineer for the Harbor Columbia Canal project, has submitted the following plan for a permanent dike. A narrow trench about 2 ft. deep is first dug along the center line of the proposed dike. In this trench a thin wall or tongue of iron or concrete is placed. Earth to the desired thickness and height is then piled on each side of the tongue to form the dike or levee. Where sheet iron is used to form the tongue it is necessary to use stokes or posts to hold the iron in position while placing the earth. As concrete does not rust it is a more suitable material for the tongue than iron. Concrete slabs 1 in. thick and any convenient width or length, say 2 ft. wide and 6 ft. long, can readily be molded. Slabs can be made during the winter season for spring dike work. In setting up the concrete tongue the slabs are set edge on edge, with broken joints held in place by means of wooden clamps while the earth is carefully put in place.

Workman's Compensation Law in Canada.—An act providing compensation to workmen accidentally injured was passed by the Quebec legislature and took effect Jan. 1, 1910. The act makes provision for all classes of workmen except agricultural laborers and seamen on board sailing vessels. The act was founded on a similar law in England and is very liberal. In case of permanent incapacity the workman is allowed an amount equal to 50 per cent of the yearly wage. In case of permanent and partial incapacity the compensation is half the sum by which the wages are reduced. For temporary incapacity, provided the inability to work has lasted seven days, a payment of half the daily wages beginning at the eighth day, is required. The law is in effect only where the capital of the income is less than $2,000. Accidents causing death are compensated by a sum equal to four times the average yearly wage of the deceased at the time of the accident. Except in case of intentional injury the compensation shall not be less than $1,000 or more than $2,000. Medical and funeral expenses are also furnished except to members of a friendly society.

Progress on the Gatun Locks.—The report of the Isthmian Canal Commission on the progress of work on the Gatun Locks shows a record amount for the month of January. During the week of Jan. 24 a total of 14,165 cu. yds. of concrete was placed. The average for the week was 2,361 cu. yds. per day. The largest day's work reported was on Jan. 25, when 2,764 cu. yds. were placed. Operation on all parts of the work are progressing favorably. At the time of the report the floor in the bay of the locks was nearing completion, all the excavation having been finished. In the second locks one of the steam shovels excavating for foundations was at grade, 18 ft. below sea level. In the east wall two of the monoliths were in the course of construction one having been finished and three forms for the center wall monolith were in the process of erection. Simultaneously work was being pushed on the sill of the emergency dam and on the sill in the east chamber.

Unclassified and General Articles

Note: This section is devoted to methods and cost articles on construction work not properly coming under any of the preceding classifications.

Methods of Cost Analysis as Applied to Construction Work.*

By the very meaning of the term, cost analysis is in no sense a new idea, being merely a modern designation for good judgment based upon experience, or the analysis within the brain of the individual as to the relative cost of different classes of work, such judgment and decision being reached through an intimate acquaintance with costs, the value of the best work along various lines of construction.

Since the days when things were first built, the individual workman has accumulated a mind full of relative costs of work based upon his own impressions and experiences. Those in whose brain the idea of cost analysis, or good judgment, received its highest development, are the ones who have advanced from the position of laborer to foreman, to superintendents, and finally to the position of employers.

Many a successful contractor has been a man who, without education, has by years of hard labor and experience accumulated a knowledge of costs which has enabled him to make propositions which as examples of conservative bidding, and as evidence of the real cost of the proposition, are above criticism, and which are really nearer the truth than the engineers' estimates, prepared on the basis of data collected from preceding lettings and theoretical costs. I desire to lay emphasis upon this particular point, for herein lies absolutely all the value of cost analysis. The mere cost of a proposition when reduced to dollars and cents is of little value, except when used with the good judgment attendant upon actual experience and a personal acquaintance with the nature of the work.

The cost analysis turn of mind is not something to be acquired, unless the individual has within himself an instinctive disposition to ascertain why the results are as recorded. The laborer who advances to the position of a business of his own, no matter how ignorant and uneducated, is a man who grasps this fundamental point, and he, perhaps unconsciously, gains a relative idea of the value of work in proportion to the circumstances surrounding same; or, in other words, this man really has the advantage of not being encumbered with reports which influence his judgment, but instead, forms his conclusions entirely with regard to the circumstances and conditions under which he must work. Too often the modern idea of cost recording to be used as a basis for future operations obscures these points, and costs are used which are in no sense indicative of the actual work.

Under the method mentioned, however, whereby the gradual self-advancement of the laborer to the position of employer is secured, and wherein the knowledge must be absolutely based upon experience, the advancement of the individual is necessarily slow, as far as relates to the successful man. The individual starting in with insufficient experience is entirely at a disadvantage, and unless he meets with very unusual or fortunate circumstances the result is failure. In the old days, the artisan in any special line had accumulated within his brain all the details necessary to successfully complete any work. In our day, blue prints are supplied to the contractor, and if he cannot read a plan, or estimate the quantities from a blue print, he is very seriously at a disadvantage.

Modern cost analysis demands, therefore, not only a record of actual results, but the ability to read and interpret a plan for the purposes of applying such practical information to the problem in hand.

*A paper by DeWitt V. Moore read at the January meeting of the American Society of Engineering Contractors.

COST RECORDING.

The subject of properly recording costs is a very difficult and complicated one when applied to construction work, and is not only complicated, but in some cases is exasperating and almost impossible of application. The subject of cost recording has been covered very fully by a number of writers, with regard to its application to manufacturing plants, where we have an industry within the limits of the four walls of a building, and where the men are always in sight and subject to observation and a close check upon their output. Labor working under these conditions is largely independent of the weather, is generally of a higher grade, and the facilities for a close check upon the actual time employed are greatly increased.

In the case of construction work, a large percentage of the payroll cost will be made up of common labor, in many cases foreigners to whom it is impossible even to explain what is desired. All labor is exposed to the inclemencies of the weather, and the output of the men is thereby directly affected. The circumstances surrounding the work, and the very nature of the work itself, make it difficult to sift out the bad labor from the good, except through the medium of the foreman, and the output is measured more from the gang unit than from the individual unit. The laborer, as a result, not being hired except in especial cases for any particular line of work, is shoved around from one class of work to another, so that at the best all that can be expected is an approximate estimate of the distribution of his time and the work accomplished; and he may also at any time be placed on work where there is absolutely no unit measurement of output. The character of the work handled, the class of labor, the numerous large gangs with frequent discharges and additions of new men, serve, therefore, to complicate the work of cost analysis; and if an attempt is made to reduce the subject to too fine a point, and too much stress is laid upon it, the attention of the superintendent, foreman, sub-foreman and timekeeper is soon distracted, and the result is an increased cost. While it is an excellent thing to have the cost recorded in such shape that it may be analyzed, still if such a line of thought is carried to the extreme, resulting in an actually increased payroll, through lack of proper supervision and attention, it will hardly make up for the loss of the money.

The foregoing remarks have a special reference to the subject of the cost of the labor, but to a very large extent the same conditions exist with reference to the cost of the material and other items entering into the cost of construction. In the case of material delivered to the manufacturing plant, it is possible to properly store and protect same. It is also possible to issue same from a storeroom, with a storekeeper and a perfect system of reports as to material used. On construction work, such a refinement is absolutely impossible. It is, of course, possible to check up material received, and to protect same to the best advantage; but, nevertheless, all material is directly cut in the open, subject to damage by weather, or loss by thieving. The labor employed has direct access to the material, as it is piled around, attendant to the work, and outside of supervision by the timekeeper or foreman, and there is no check upon the material used. A carpenter will invariably saw off a short piece of board from a long, new piece, rather than draw out the nails and clean up an old board which would have answered the purpose. When the size of the gang is considered, the irresponsibility of the character of the labor, and the difficulty of watching each man all the time, make it evident that the cost analysis of the material used must

be considered from a different viewpoint than in a manufacturing enterprise.

If cost analysis in construction work is unsatisfactory, as far as labor and material are concerned, how much more so is it the case in the consideration of expense items, such as fittings and repairs, small tools, boots, paulins and other items, which are of just as much importance to the work as the labor and material. These items, insignificant in character and few with reference to the unit, are in the aggregate of tremendous importance. Small tools may be purchased, thrown down and immediately covered by the excavation of material; bolts and small tools may be stolen by the workmen; large pieces of packing wasted or the remaining supply of bolts, nails, or other material be thrown to one side and lost. These are leaks which apparently should be overcome by the proper kind of supervision, yet if too much attention is paid to this line of the work, it is both possible and probable that the construction work itself will be neglected, resulting in a decreased output or increased cost.

Cost analysis is, therefore, in connection with construction work, a subject which requires a broad-minded policy, far different from the red tape system which is possible in manufacturing. A man who may have just exactly the right turn of clerical mind, who may be exact in his accounts and correct in his reports, in the position of payroll clerk, timekeeper or stock-room clerk, in connection with a manufacturing plant, may be an absolute failure when placed upon construction work in like capacity.

While it may sound as rather a broad statement, the writer is clearly of the opinion that the construction man in the field as superintendent, foreman, material clerk or timekeeper must consider all accounts as they arise in the guise of dollars and not cents. "Penny wise and pound foolish" can have no better exemplication than in work of this kind, and yet cents must be considered where the cents occur in such a way as to be accumulative.

METHODS OF COST ANALYSIS AS APPLIED TO LABOR COSTS.

Conceding that cost analysis is just as important to the contractor as to the manufacturer the attempt must be made to overcome the difficulties and obtain just as near the true cost as the conditions, the character and importance of the work, and the cost of securing the information will justify. But in so obtaining costs in construction work there is a further difference when we compare with the factory, viz.:

While such recorded costs are of benefit, still they are also a detriment. Where no recorded cost exists the mind of the estimator, or contractor, is entirely free from any influence which might tend to make him doubt his personal recollection or knowledge of the work during the progress of construction. Where such recorded costs do exist, it is but natural that they should be referred to in making new estimates, and the influence is to subordinate the personal recollection to the black-and-white figures actually before one.

Granting that this is true of the individual who is using his own cost records, how much more is it true of the one who is attempting to formulate a proposition where he is, at least to some extent, basing his decision upon the recorded costs of others. Every individual who has collected cost data, and has occasion to refer to them, as soon as the reference is made will unconsciously have a *mental picture of the work*, and the conditions surrounding it, and the circumstances under which the work was done; but if the cost records are encumbered with a complete description of this character, the reference will be so laborious that the cost records would be of no value. It is therefore essential that any published cost records be accompanied by a brief, pointed description of the kind of work, where and when done, the weather, the equipment used, the rate of wages paid, the character of labor, etc., and even then that they be used with discretion.

The subject of cost analysis is a step forward from the subject of cost recording, or cost collection, or cost distribution, and is an extremely difficult and complicated subject. Each and every job has its own peculiar characteristics, and in the beginning of the work it is necessary to analyze the work to be done, study to determine where even the same class of work will show a different result, and therefore attempt to get as close and complete a record as possible with due reference to the different characters. As the work proceeds many unforseen conditions will arise, which will make necessary new and special distributions.

These remarks might seem to justify the conclusion that the writer believes in a complicated and extensive set of distributions on any one job, which is far from the case. It is better to reduce the number of classifications to the very minimum, and not to attempt to divide the different items into too great a number of elements. It is far better to take a general class of work, and let all of the elements which go to make up that classification be recorded therein, and then give such a complete description of the circumstances and conditions surrounding the work as will enable the formation of a mental picture. However, should the same class of work as carried under the general head require this class of work to be done under different conditions, or methods, then such a separate distribution should be carried.

With special reference to the subject of sewer construction, let us consider the effect of the above remarks. Let us suppose that we have a sewer contract for construction which is in the nature of a main sewer with branches, and which will gradually reduce in size from the out-fall to the farthermost limit of the drainage area.

In the case of the "mental-analysis-only" sort of contractor, the work will be allowed to proceed under his personal direction and the cost of the work will be determined entirely from such personal observation from day to day in connection with his book expenditures, thereby forming mental conclusions which, while probably correct, are only of value to himself, and cannot be of service even to his own organization, except by word-of-mouth instruction.

In the case of a cost collection system, where the cost of the various classes of work is kept separately for the entire job, the cost of a cubic yard of excavation will be determined as the total cost of this class of work divided by the number of cubic yards handled; and the same will be true of concrete, brick, pipe-laying, etc.

When the subject is given the proper study, however, from the question of cost analysis, it will be seen that neither one of the preceding methods is the proper one. In the first place, depending upon the size of the sewer and depth will depend the relative proportion of the sheeting and shoring of the trench, in proportion to the cubic yards of earth handled. Again, the amount of sheeting and shoring will depend upon whether the sewer is to be built of brick, concrete or pipe, inasmuch as with pipe, the pipe-laying can follow the excavation much closer, thereby reducing the amount of timber work. Again, the size of the sewer has an influence upon the cost, inasmuch as it fixes the quantities per lineal foot of trench. This, however, is not as applicable to excavation and pipe-laying as it is to concrete work. Again, there is a vast difference between the handling of wet trenches and dry excavations, both of which may have occurred on the same job, and if cost analysis does not distinguish the difference, the resulting average price is not a true indication of the value of the work. Again, many sections of the work may be surrounded by special conditions, such as railroad crossings, interference with existing sewers, pipes, conduits, etc. Or the same job may include work in improved streets and unimproved. Unless the distinction is made here, the average cost will be misleading.

The writer has found, by a long personal experience that it is impossible to depend upon the average timekeeper or clerk to make these distinctions. Generally, however, it is the case that any job that is entered into has been studied, and some attention given these points in the preparation of the estimate. Therefore, as soon as the actual construction is started it is wise to divide the work into as many different sections as it is expected will be necessary, by making separate or special sections, thereafter running such sections as though each were a separate contract or unit. While it is true that the collection of cost information is rather indefinite and hard to obtain when a construction crew is passing from one section to the next, still we have the advantage of trying as closely as possible to obtain the cost of the individual section, and we have always the summary by merely the addition of all of the sections.

Where this separation of cost is not kept at all, there is no possible way to recover the information lost. Where the cost is kept, even although in an unsatisfactory manner, some information can be gleaned and the total and average are always available. As an example, on a straight run of a sewer of the same size, it may be necessary to cross an intersecting street where there are obstructions, such as street railroad tracks, sewer pipes, gas pipes, conduits, etc., and unless the intersecting street between street lines is considered as a section by itself and a persistent effort made to determine the cost of the labor in this section, the result will be an increased average cost over the entire length, which cost would be misleading in case the information was ever referred to with reference to a proposition of a like character where there was not an intersecting street. Emphasis is laid here upon the proper study of the lay-out of the work, and the consideration of sections, as made above, as being of the utmost importance with reference to the office work of the analysis of the cost.

If the information has been secured in the manner suggested, it is at once available, and tables or charts may be prepared, showing the cost of the same class of work of the various sections, under the different circumstances. These costs may not be absolute, nor is it expected that they will be used without mental reservations; but they do at least form the basis of intelligent thought and estimating. Inasmuch as it is extremely difficult to tabulate these results in a sufficiently clear manner to be able to determine at a glance the information required, the writer considers that graphical charts are to be desired. On such a chart can be grouped different classes of work under different conditions, and different jobs under comparatively the same conditions, and the result is that information can be secured that is of great assistance.

COST ANALYSIS AS APPLIED TO LABOR AND MATERIAL AND EXPENSE.

On the foregoing we have considered labor cost principally. Cost Anaylsis implies far more. Modern writers seem to be agreed upon the fact that cost is represented by labor, plus material, plus expense. This analysis is further elaborated by the division of labor into "Direct Labor" and "Indirect Labor," or "Productive Labor" and "Non-productive Labor." Material is divided into that entering directly into the job, plus material incidental to the construction, but necessary to the performance thereof. Expense is further divided into expense items directly connected with the cost of production and expense connected with the marketing or selling of the product.

There can be no argument as to the fact that these items are the primary elements in the case of any business. However, when it comes to the application to any one particular line of business, there arise a great many different ideas as to the right method. In construction work direct labor may be considered that labor which is necessary for the performance of any particular line of work, after all materials have been delivered within a reasonable limit of the site of the work. Indirect labor is a proper charge against the cost of materials, expense, supervision, etc., etc., as appears proper. For instance, a labor item appearing as the cost of the hauling of gravel, stone or cement, in a concrete job, should appear as a material item; that is, the cost of such labor should be added to the material, in order to determine the value of the material f. o. b. the site of the work. On the other hand, the labor items incident to the hauling of an outfit, or the moving of an outfit from

job to job, the hauling of repairs and fittings, etc., are properly a general charge against the work as a whole, and therefore should appear as expense items.

It is necessary that this division be made, or otherwise there would be no common ground on which comparison can be made between any particular line of work under different conditions and circumstances. On the other hand, labor which appears directly upon the job, or which is more or less of a floating character, should be distributed from day to day to different lines of work, for the reason that *if it is at all necessary to the job,* it is necessary to each item of work, and therefore it is proper to distribute it directly to the item thereby in a broader sense avoiding any item of indirect labor immediately upon the work. This applies to engineers, pump-men, timekeepers, sub-foremen and foremen.

In construction work, there necessarily must be a certain amount of material not directly intering into and making a part of the finished work, but which is necessary to its performance. It would be a very pleasant experience if a complete record could be made, so that the amount of such incidental material used for each class of work could be determined; but all of us who have had experience know that in construction work it is absolutely necessary to supply a more or less varied character of timber, steel and other material for use as emergencies arise, and it is almost impossible to keep any record other than to know how such material has been delivered and how much salvage exists at the end of the work. Therefore, in the absence of any better method, it seems best to consider all such material as being charged directly against and forming a part of the job, giving a credit for any salvage, and charging the cost against the class of work effected.

The item of expense is a very different proposition to handle, and includes not only material in the way of incidental supplies, but also various items of expense which cannot be considered either material or labor. For instance, the material furnished and labor expended for the commissary quarters for the men, whether fixed or movable, in the way of wagons, is a direct expense chargeable against the work as a whole, and not against any one item of the work. Again, as an illustration, the purchase of pipe, and the installation thereof for water supply, and the removal thereof, and the salvage on the pipe, is an expense item. As a further illustration, the bond and liability insurance on any job is a direct expense item, depending directly upon the size of the work.

Job expense items, therefore, are of two kinds. Those which are composed of material, labor or expense which are necessary to the performance of the work, and the amount of which is irrespective of the size of the job. Second, those expense items in the way of material, labor or expense which are necessary, or depend absolutely upon the mount of work to be performed. In addition, we have indirect expense items to be charged to each job, the amount, however, being determined by the average annual amount of business. Whether it is better to distinguish between direct labor and supervising labor, is a question for the individual preference. In the writer's judgment, it is very well established that a certain amount of direct labor requires a certain amount of supervision, and therefore the supervision rendered is held by him to be a part of the direct charge.

To apportion these expense items in the proper way is a matter of great importance. We may have jobs running all the way from twenty per cent labor to all labor, depending upon the character of the work and under what conditions the work is awarded.

It is at once apparent that on any one job all items of expense should not be bunched, but rather should they be divided into the various principal elements, in order that the one job may be compared with others and an intelligent idea formed of the comparative cost.

As an illustration of such division of expense, the writer suggests in ordinary construction work the following general divisions, viz.:

First—Bond, Insurance and Interest.
Second—Petty Tools.
Third—General Expense.
Fourth—Fittings and Repairs.
Fifth—Commissary and Commissary Supplies.
Sixth—Tools and Machinery.
Seventh—Fuel and Oil.
Eighth—Special, Incidental Costs.

If these various divisions are determined on all jobs and established, as a certain percentage on the cost of labor and materials, or either, we have a direct basis for comparison between jobs of like character, but with partly similar conditions.

Bond, insurance and interest need no comment.

To the item of Petty Tools should be charged such items in the way of small tools as are easily lost, worn out or stolen.

To the item of General Expense is to be charged such items as nails, wire, bolts and also items of expense which go to make up the repairs to Petty Tools.

To the item of Fittings and Repairs should be charged all work incident to the repairs and fitting up of tools and machinery.

To the item of Tools and Machinery can only be charged the tools and machinery employed on the job on some basis of a fair rental value, or the annual depreciation, it being expected that the Fittings and Repairs account, if properly kept and carried out, will keep the tools and machinery in good working condition.

The Commissary item mentioned should be carried as a separate account for such items as tents, paulins, boots, lanterns, etc., etc., these items being of more or less importance, depending upon the character of the work, and the item being more or less of a supplemental expense item. This account also taking care of boarding house, etc., when necessary.

The term Fuel and Oil is in itself significant, it being interpreted as the fuel and oil necessary for the production of power, and in this connection, if electric power is used the electric current bills are a proper charge.

Special items incident to any particular work should be considered as items of especial nature and not allowed to affect the ordinary divisions.

Now, if some general division, not too elaborate, is made of expense items, as mentioned, and the amount of same is determined by a percentage against the job as a whole, we have one method of proper apportionment of expense items.

A great many manufacturers, contractors and writers signify a preference for the method of dividing the cost into the various unit items of work performed. But no one can claim that this is entirely satisfactory or exact. The percentage method, to all practical purposes, accomplishes the same end, and is more simple of application. To the manufacturer who is producing articles of uniform value, or articles of a uniform kind, but varying in quality, and therefore of a different value, there may be a question as to the method. In construction work no two jobs are exactly similar, and may be greatly different. Therefore, they cannot be carried strictly as departments in a manufacturing plant, for this implies different classes of work under the same executive management. They may do better compared to a number of different plants, established in different localities, under their own management, reporting to a general executive head.

The writer's contention has always been that the percentage method is fair even under these circumstances, for the higher the grade of work performed, the greater the corresponding cost of labor, inspection, supervision, investment, etc., etc. Therefore it is perfectly fair to charge a greater proportion of the general expense item against the higher grade of work, as is the case where the percentage system is used.

A very important point, however, and one that must not be overlooked if the percentage system is used, is whether the percentage shall be determined upon the cost of material, upon the cost of labor or upon the summation of the two items. Many times a job is let where the owner furnishes all the material, the contractor only furnishing the necessary labor to install. Again, the proposition may be one where the cost of materials is very large in comparison with the cost of the necessaary labor.

No better illustration could be made of these conditions than the cost of the construction of railways. In the first case, if the owner is to furnish all materials, and the contractor is to furnish only the labor, his contract will only run from $500 to $1,000 per mile, or 100 per cent labor. Whereas, if the contractor is to furnish the material, the contract may run from $6,000 to $7,000 per mile, with the labor representing only 8 to 16 per cent.

If the percentage system, therefore, is used for determination of the expense portion of cost, three methods are suggested; but after such method of apportionment of expense, or burden, has been selected, the same method must be used for all time thereafter, or the results will be of no value for use in comparison of jobs or for use in making new estimates. The three methods are as follows:

(1) Apportionment as a percentage of the labor only. This method is good, for the reason that the labor is a fair indication of the amount and character of the work done, and unless the rate of pay, or the class of labor, is extraordinary, jobs may be directly compared on this basis. This method is recommended. However, since some labor must be directly charged to material, it will be necessary to deduct this labor before arriving at the actual amount of labor entering into the work.

(2) Apportionment by percentage of material. This is not a good method, for the reason that the material is not an indication of the work done, inasmuch as while the cost of the material may be standard at the point of production, its cost to the contractor is indicated by the addition of the cost of the transportation and delivery. Therefore, no comparison can be made between the job located close to the shipping point, and located directly on a side track, as against the same class of work at a considerable distance from the railroad, where all material must be hauled.

(3) Apportionment by percentage on the cost of material plus labor. While in a great many ways this method is unsatisfactory, still it will give a fair comparative average, and it has the advantage that the inconsistencies of labor and material are to a certain extent adjusted and averaged. It also has the advantage of being the most simple of application.

The various elements of expense cost must be kept separately on each job in order that any new contract arising may receive proper consideration by a proper combination of items of expense, which will form a part thereof. A sharp distinction should be made between jobs of different character, and not coming under the same classification.

Depreciation of machinery has been handled in a great many different ways by different writers. It has been apportioned by an annual depreciation and a fixed percentage. It appears to the writer, in the construction business, that the conditions are somewhat different from those in any permanent plant. In the permanent plant, a piece of machinery is installed and unless some improvement is made in the machinery, thereby requiring its removal, it will be used for a certain definite purpose until actually worn out. The contractor, on the other hand, is continually buying, selling and trading equipment. Equipment is purchased for special requirements of the contract and then disposed of. If new machinery is purchased, charge to the Tool and Machinery Account the second-hand value of same, charging the difference to the job. Inasmuch as the Fittings and Repairs Account, previously referred to, is a direct charge against each piece of the work, and, if in addition, the machinery is properly taken care of, it will always be in condition to realize the second-hand selling value.

In conclusion, the observer who forms a judgment of the cost of one class of work merely by observation, by stop watch or like means, may determine comparisons which are valuable in the supervision of work from day to day, but he does not form any true ideas of the actual cost of the work. The cost accountant, dealing with his records, containing as they do all items of miscellaneous, or indirect,

labor; also containing as they do non-productive time, caused by moving, charges, etc., arrives at costs which may be safely used as true costs, under the conditions. The effect upon the cost account of the conditions, circumstances, weather, quantities of work to be done, area covered by the work, the general lay-out of the construction plan, etc., must be considered in the final analysis.

The following charted summary presents in condensed form the writer's idea of cost analysis as applied to construction work:

- COST.
  - 1. Material
    - 1. Actually entering into the work divided by items of different character.
      - 1. Actual Quantities.
      - 2. F. O. B. Price.
      - 3. Waste.
    - 2. Accessory or Incidental.
      - 1. Quantity.
      - 2. Price.
      - 3. Salvage and Loss.
    - 3. Labor
      - 1. Delivery to Job.
  - 2. Labor
    - 1. Direct or Productive.
      - 1. Itemized by Sections of varying character.
      - 2. Itemized by kind of work done (Gen. Div.)
      - 3. Special divisions of pay work.
    - 2. Indirect of Nonproductive. To be proportioned over the various items of Productive Labor.
      - 1. On Job.
        - 1. Supervision.
        - 2. Repairs.
        - 3. Incidentals.
      - 2. Material Delivery (A material charge).
      - 3. General Supervision.
    - 3. Yards or Shop. Direct Labor.
  - 3. General Charges. To be proportioned over cost of material or labor, or their sum.
    - 1. Direct to Job.
      - 1. Bond and Insurance.
      - 2. Expense.
      - 3. Fittings and Repairs.
      - 4. Fuel and Oil.
      - 5. Specials.
      - 6. Commissary (Where Required).
    - 2. Indirect to Job.
      - 1. Petty Tools.
      - 2. Tools and Machinery.
      - 3. Yard and Shops, Payroll and expense of general character.
      - 4. General Office Payroll and expense

A System of Cost Keeping for Engineering Construction.*

The desirability of contractors throughout the country adopting a uniform system of keeping their accounts is very great. The main advantage is that gradually all engaged in contracting work will become familiar with what it actually costs them to do their work, and the very wide variation of bids which are now submitted at almost all lettings will eventually be done away with. It should prevent all but the most reckless from making proposals below cost. If these very desirable results are finally attained, the contractor's business will become a more stable one, and one in which banking houses especially would have more confidence than they have at present.

The uniform system adopted should be simple, inexpensive to keep, and should have wide flexibility to permit its application to contracts of all kinds. The author has for a great many years been using a system deduced from the book keeping methods of our railroad companies, which he has found to be satisfactory in all respects. There are six general headings into which all contract work must be divided. They are as follows:

First.—Materials of construction.
Second.—Labor.
Third.—Supplies.
Fourth.—Plant.
Fifth.—General Expense or Administration Charges.
Sixth.—Profit.

All general heads into which any contract is classified, such as excavation, concrete, masonry, etc., must be subdivided into such detail as may be desired, keeping constantly in mind the above headings.

For the purpose of explanation it is probably better to take an example of actual work. Let it be supposed that the construction of a reinforced concrete retaining wall is to be undertaken, the work to consist of excavation, concrete and steel reinforcement. The heading "excavation" would be divided as follows:

Labor—
1. Excavating in Trench.
2. Hoisting Excavated Material.
3. Trucking.
4. Backfilling.
5. Shoring and Sheeting.

Supplies—
6. Coal.
7. Oil.
8. Water.
9. Miscellaneous.

Plant—
10. Cost Delivered.
11. Maintenance.
12. Removal.

General Expense—
13. General Expense.

Profit—
Expenditures, during the execution of the work, would be distributed as Excavation Nos. 1, 2, 3, etc.

"Concrete" could be divided as follows:

Materials of Construction—
1. Cement Delivered.
2. Sand Delivered.
3. Stone or Gravel Delivered.
4. Facing Material Delivered.
5. Lumber for Forms Delivered.
6. Cement Bags.

Labor—
7. Mixing Concrete.
8. Transporting Concrete.
9. Depositing Concrete.
10. Making Forms.
11. Erecting Forms.
12. Facing.

Supplies—
13. Coal.
14. Oil.
15. Water.
16. Miscellaneous.

Plant—
17. Cost Delivered.
18. Maintenance.
19. Removal.

General Expense—
20. General Expense.

Profit—

"Steel Reinforcement" could be divided as follows:

Materials of Construction—
1. Bars Delivered.
2. Wire Delivered.

Labor—
3. Storing and Distributing Steel.
4. Bending Steel.
5. Placing Steel.

Supplies—
6. Miscellaneous.

Plant—
7. Cost Delivered.
8. Maintenance.
9. Removal.

General Expense—
10. General Expense.

Profit—

It should be noted that in each of the above subdivisions the general headings are always included.

The "general expense" or "administration account" should be subdivided, for example, as follows:

General Expense—
1. Engineering.
2. Bookkeeper, Stenographer.
3. Timekeeper, Storekeeper.
4. Telephone, Stationery, Sundries.
5. Rentals.
6. Legal Expense.
7. Surety Bond.
8. Liability Insurance.
9. Watchmen.
10. Interest and Discount.

In preparing a bid for work of this character the cost of each one of the above items should be carefully estimated with the best data available, and the charges for the general expense, plant and profit should then be apportioned to the various items of the work as above indicated in accordance with their relative value. In this way the unit price that should be submitted for the excavation, concrete and steel reinforcement can be determined. If such a method of computing would be adopted by all competitors, then there would be but little variation in their bids, and surely the low bidder could not be very much too low. The method which is used by so many contractors at the present time of jumping at the price that they should submit is one that cannot be too strongly condemned.

When the work is started, ledger accounts should be opened with each item as above enumerated.

The general expense account should be kept separately with subdivisions as above suggested, and then at intervals, by means of journal entries, should be transferred to the excavation, concrete and reinforcement accounts, using the same percentages of apportionment which were used in making the proposal. By simply adding up all the accounts of any one class and dividing them by the amount of work done, the cost of execution at any stage of the work can readily be determined.

The books required for such a system of accounts are of the simplest character, and can be purchased at any stationery store. They consist of cash book, ledger, journal and voucher book.

The voucher system should be used. As is well known, under this system all bills and pay rolls are inclosed in a blank, on the back of which is a place for distributing the amount to the proper accounts.

If it is desirable to keep a running account with the parties with whom much business is done, their vouchers can be credited to them, charged to the voucher account, and placed among the paid vouchers.

In the case of a contracting concern carrying on a number of contracts at the same time, ledger accounts should be started with the contracts themselves, each given a number and a subsidiary set of books kept for each contractor.

In order to aid in the distribution of the pay roll a system of cards may be used, upon which are placed the amount of labor expended under each head for each day. This work is usually done by the assistant engineer from the reports of the time keeper and the foremen of the various gangs. One set of cards is used for each week. These cards are very valuable for keeping track of labor costs, checking the pay roll, and should, if properly kept up, prevent all disputes or padding of pay rolls.

As can be readily seen, the above system as outlined can be used for any kind of contract work, the headings being arranged to suit the work on hand. These headings can be subdivided to any refinement desired by the contractor.

The system is very inexpensive, as it requires no elaborate forms and no more help than is usually required. As far as the author, aided by many years of experience, is able to judge, it meets all the requirements that a uniform system of accounts can need.

*A paper by Mr. Gustave Kaufman, read at the Jan. 10, 1910, meeting of the American Society of Engineering Contractors. A previous article illustrating the various record blanks used by Mr. Kaufman will be found in Engineering-Contracting for March 13, 1907.

Diagrams for Estimating the Approximate Cost of Mill Buildings.*

It is sometimes convenient to be able to tell off hand the approximate cost of proposed buildings or the cost, if new, of existing buildings without going through an estimate of all the quantities of materials and labor.

It is not an uncommon thing to hear the cost of mill buildings placed from 70 cts. to $1 per sq. ft. of floor space, regardless of the size or number of stories. There is, however, a wide range of cost per square foot of floor space, depending upon the width, length, height of stories, and number of stories.

Some time ago I placed a valuation upon a portion of the property of a corporation, including some 400 or 500 buildings. In order

*A paper by Charles T. Main, Consulting Engineer, Boston, Mass., presented before the New England Cotton Manufacturers' Association.

to have a standard of cost from which to start in each case, I prepared a series of diagrams showing the approximate costs of buildings varying in length and width and from one story to six stories in height. The height of stories also was varied for different

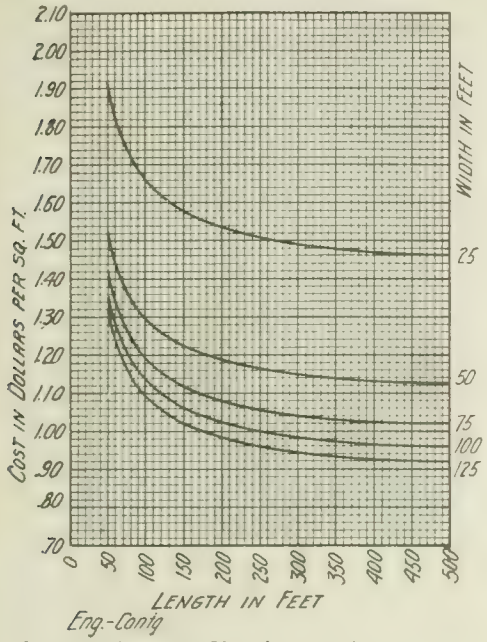

Fig. 1—Diagram Showing Estimated Cost Per Square Foot of Floor Area for One-Story Brick Buildings for Textile Manufacturing.

widths, being assumed 13 ft. high if 25 ft. wide, 14 ft. if 50 ft. wide, 15 ft. for 75 ft., 16 ft. for 100 ft. and over.

The costs used in making up the diagrams are based largely upon the actual cost of work done under average conditions of cost of materials and labor and with average soil for foundations.

The costs given include plumbing, but no heating, sprinklers, or lighting. These three latter items would add roughly 10 cents per square foot of floor area.

Use of Diagrams.—(1) The diagrams can be used to determine the probable approxi-

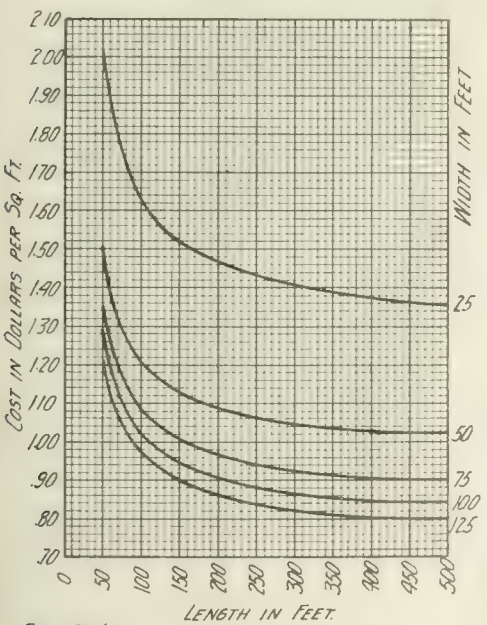

Fig. 2—Diagram Showing Estimated Cost Per Square Foot of Floor Area for Two-Story Brick Buildings for Textile Manufacturing.

mate cost of proposed brick buildings of the type known as "slow burning" to be used for manufacturing purposes with total floor load of about 75 lbs. per sq. ft., and these can be taken from the diagrams readily. For example, if it is desired to know the probable cost of a mill 400 ft. long by 100 ft. wide by 3 stories high, refer to the sheet showing the cost of three story buildings. On the curve for buildings 100 ft. wide, find the point where the vertical line of 400 ft. in length cuts the curve, then move horizontally along this line to the left hand vertical line, on which will be found the cost of 81 cts.

The cost given is for brick manufacturing buildings under average conditions and can be modified if necessary for the following conditions:

(*a*) If the soil is poor or the conditions of the site are such as to require more than the ordinary amount of foundations, the cost will be increased.

(*b*) If the end or a side of the building is formed by another building, the cost of one or the other will be reduced slightly.

(*c*) If the building is to be used for ordinary storage purposes with low stories and no top floors, the cost will be decreased about 10 per cent for large low buildings, to 25 per cent for small high ones, about 20 per cent usually being fair.

(*d*) If the buildings are to be used for manufacturing purposes and are to be substantially built of wood, the cost will be decreased about 6 per cent for large one story

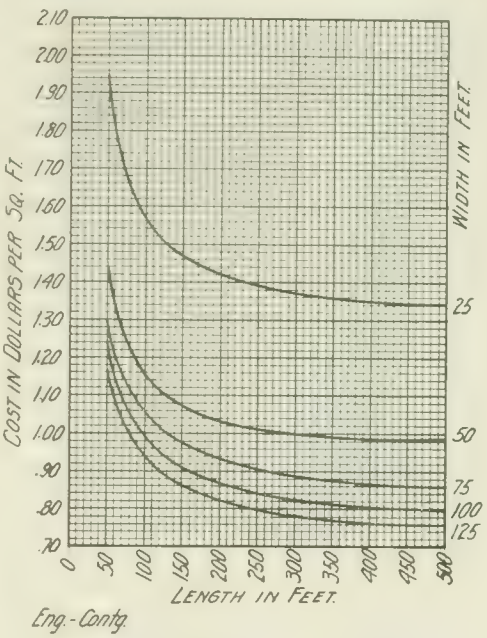

Fig. 3—Diagram Showing Estimated Cost Per Square Foot of Floor Area for Three-Story Brick Buildings for Textile Manufacturing.

buildings, to 33 per cent for high small buildings, and 15 per cent would usually be fair.

(*e*) If the buildings are to be used for storage with low stories and built substantially of wood, the cost will be decreased from 13 per cent for large one story buildings to 50 per cent for small high buildings, and 30 per cent would usually be fair.

(*f*) If the total floor loads are more than 75 pounds per square foot the cost is increased.

(*g*) For office buildings the cost must be increased to cover architectural features on the outside and interior finish.

The cost of very light wooden structures is much less than the above figures would give.

Table I shows the approximate ratio of the costs of different kinds of buildings to the cost of those shown by the curves.

(2) The diagrams can be used as a basis of valuation of different buildings.

A building, no matter how built nor how expensive it was to build, cannot be of any more value for the purpose to which it is put than a modern building properly designed for that particular purpose. The cost of such a modern building is then the limit of value of existing buildings.

Existing buildings are usually of less value than new modern buildings for the reason that there has been some depreciation due to age and that the buildings are not as well suited to the business as a modern building would be.

Starting with the diagrams as a base, the value can be approximately determined by making the proper deductions.

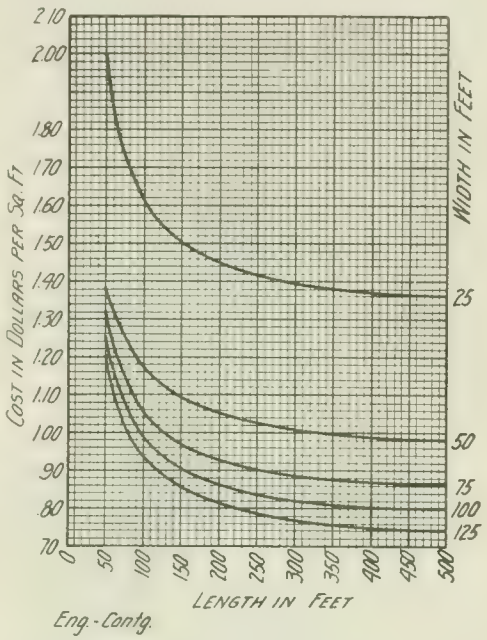

Fig. 4—Diagram Showing Estimated Cost Per Square Foot of Floor Area for Four-Story Brick Buildings for Textile Manufacturing.

(3) The diagrams can be used as a basis for insurance valuations after deducting about 5 per cent for large buildings to 15 per cent for small ones, for the cost of foundations, as it is not customary to include the foundations in the insurable value.

Basis of Estimates.—Table II shows the costs which form the basis of the estimates and these unit prices can be used to compute the cost of any building not covered by the diagrams.

The cost of brick walls is based on 22 bricks per cubic foot, costing $18 per thousand laid. Openings are estimated at 40 cts.

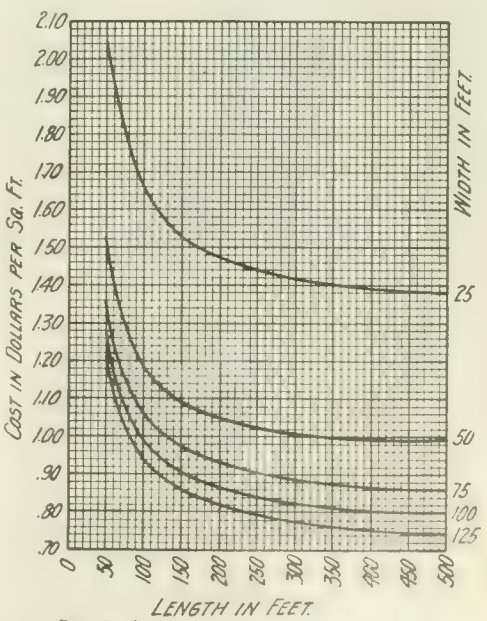

Fig. 5—Diagram Showing Estimated Cost Per Square Foot of Floor Area for Five-Story Brick Buildings for Textile Manufacturing.

per square foot, including windows, doors and sills.

Ordinary mill floors, including timbers, planking and top floor with southern pine tim-

TABLE I.—SHOWING RATIO OF COST OF BUILDINGS DESIGNATED, COMPARED WITH BRICK MILLS OF STANDARD CONSTRUCTION.

Superficial feet of Floor in one story.	Frame Mills.						Brick Store House.						Frame Store House.					
	1 Sto.	2 Sto.	3 Sto.	4 Sto.	5 Sto.	6 Sto.	1 Sto.	2 Sto.	3 Sto.	4 Sto.	5 Sto.	6 Sto.	1 Sto.	2 Sto.	3 Sto.	4 Sto.	5 Sto.	6 Sto.
1250	.86	.67					.80	.73					.70	.51				
2500	.86	.73					.85	.73					.75	.58				
5000	.89	.78	.75	.73	.70	.67	.83	.80	.78	.76	.76	.75	.74	.60	.56	.53	.51	.48
7500	.90	.79	.77	.74	.71	.69	.85	.81	.78	.77	.76	.76	.77	.63	.58	.55	.53	.51
10000	.99	.80	.78	.75	.73	.70	.87	.81	.79	.78	.77	.76	.78	.65	.60	.57	.55	.53
15000	.91	.82	.79	.77	.75	.72	.89	.83	.81	.79	.78	.78	.81	.67	.64	.61	.59	.56
20000	.92	.85	.81	.79	.77	.74	.90	.84	.82	.80	.80	.79	.82	.70	.67	.64	.61	.59
25000	.92	.85	.82	.80	.78	.76	.91	.85	.83	.82	.81	.80	.83	.72	.69	.66	.63	.61
30000	.93	.86	.84	.81	.80	.77	.91	.86	.84	.82	.81	.81	.84	.73	.70	.67	.65	.62
35000	.93	.87	.84	.82	.80	.78	.92	.86	.84	.83	.82	.81	.85	.74	.71	.68	.66	.63
40000	.93	.87	.85	.83	.81	.79	.92	.87	.85	.84	.83	.82	.86	.75	.72	.69	.67	.64
45000	.94	.87	.85	.83	.82	.79	.92	.87	.85	.84	.83	.82	.86	.76	.72	.70	.67	.65
50000	.94	.88	.86	.84	.82	.80	.92	.88	.86	.84	.83	.83	.87	.77	.73	.71	.69	.66

ber at $40 per M. ft. B. M. and spruce planking at $30 per M. ft. costs about 32 cts. per sq. ft., which has been used as a unit price.

Ordinary mill roofs covered with tar and gravel, with lumber at the above prices, cost about 25 cts. per sq. ft., and this has been used in the estimates.

Add for stairways, elevator wells, plumbing, partitions, and special work.

Deductions from Diagrams.—(1) An examination of the diagrams shows immediately the decrease in cost as the width is increased.

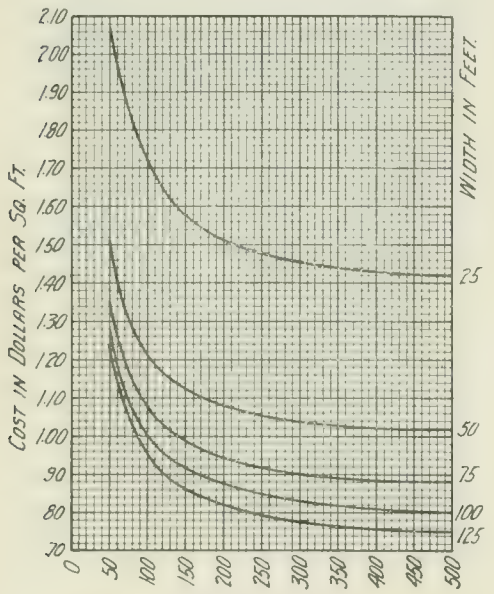

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Fig. 6—Diagram Showing Estimated Cost Per Square Foot of Floor Area for Six-Story Brick Buildings for Textile Manufacturing.

This is due to the fact that the cost of the walls and outside foundations, which is an important item of cost, relative to the total cost, is decreased as the width increases.

For example, supposing a three story building is desired with 30,000 sq. ft. on each floor.

If the building were 600x50 ft., its cost would be about 99 cts. a sq. ft.

If the building were 400x75 ft., its cost would be about 87 cts. a sq. ft.

If the building were 300x100 ft., its cost would be about 83 cts. a sq. ft.

If the building were 240x 125 ft.; its cost would be about 80 cts. a sq. ft.

(2) The diagrams show that the minimum cost per square foot is reached with a four story building. A three story building costs a trifle more than a four story. A one story building is the most expensive. This is due to a combination of several features:

(*a*) The cost of ordinary foundations does not increase in proportion to the number of stories, and therefore their cost is less per square foot as the number of stories is increased, at least up to the limit of the diagram.

(*b*) The roof is the same for a one story building as for one of any other number of stories, and therefore its cost relative to the total cost grows less as the number of stories increases.

(*c*) The cost of columns, including the supporting piers and castings, does not vary much per story as the stories are added.

(*d*) As the number of stories increases, the cost of the walls, owing to increased thickness, increases in a greater ratio than the number of stories, and this item is the one which in the four story building offsets the saving in foundations and roof.

(3) The saving by the use of frame construction for walls instead of brick is not as great as many persons think. The only saving is in somewhat lighter foundations and in the outside surfaces of the building. The floor, columns, and roof must be the same strength and construction in any case.

Reinforced Concrete Buildings.—From such estimates and proposals as I have been able to get and from work done it appears that the cost of reinforced concrete buildings designed to carry floor loads of 100 lbs. per sq. ft. or less would cost about 25 per cent more than the slow burning type of mill construction.

TABLE III.—DATA FOR ESTIMATING APPROXIMATELY THE COST OF MILL BUILDINGS. SIZE KNOWN, BUT NO DEFINITE PLANS MADE.

Height of Building.	Foundations. Including excavation. Cost per lin. ft. outside walls.	Foundations. Including excavation. Cost per lin. ft. inside walls.	Brick Walls. Including doors and windows. Cost per sq. ft. of surface. outside walls.	Brick Walls. Including doors and windows. Cost per sq. ft. of surface. inside walls.
One-story	$2.00	$1.75	$0.40	$0.40
Two stories	2.90	2.25	.44	.40
Three stories	3.80	2.80	.47	.40
Four stories	4.70	3.40	.50	.43
Five stories	5.60	3.90	.53	.45
Six stories	6.50	4.50	.57	.47

Floors 38 cts. per sq. ft. of gross floor space. This price will include column piers, column, castings and wrought iron.

Roof 30 cts. per sq. ft., including projection, say 18 ins., including columns, etc.

Allow two stairways and one elevator tower in building over two stories high up to 150 ft long. Allow two stairways and two elevator towers up to 300 ft. long. Allow three stairways and three elevator towers over 300 ft. long.

Brick walls enclosing stairs and elevators, estimated as inside walls.

Stairs $100 per flight, per story.

Allow two fixtures on each floor up to 5,000 sq. ft. of floor space, and add one fixture for each additional 5,000 sq. ft. or fraction thereof. Allow $75 per fixture.

Add about 10 per cent for incidentals.

TABLE II.—PRICES AND OTHER DATA USED FOR ESTIMATING THE COST OF BUILDINGS.

	FOUNDATIONS, including excavations. Cost per lin. ft. for outside walls.	FOUNDATIONS, including excavations. Cost per lin. ft. for inside walls.	BRICK WALLS. Cost per sq. ft. of surface. outside walls.	BRICK WALLS. Cost per sq. ft. of surface. inside walls.	Columns including piers and castings. Cost of one.
One-story building	$2.00	$1.75	$0.40	$0.40	$15 00
Two-story building	2.90	2.25	.44	.40	15.00
Three-story building	3.80	2.80	.47	.40	15.00
Four-story building	4.70	3.40	.50	.43	15.00
Five-story building	5.60	3.90	.53	.45	15.00
Six-story building	6.50	4.50	.57	.47	15.00

From ground to first floor 3 ft. Buildings 25 ft. wide, stories 13 ft. high. Buildings 50 ft. wide, stories 14 ft. high. Buildings 75 ft. wide, stories 15 ft. high. Buildings 100 ft. wide, stories 16 ft. high. Buildings 125 ft. wide, stories 16 ft. high.

Floors 32 cts. per square foot, of gross floor space, not including columns. If columns are included, 38 cts.

Roof 25 cts. per square foot, not including columns. If columns are included, 30 cts.

Roof to project 18 ins. all around buildings.

Stairways, including partitions, $100 each flight.

Allow two stairways and one elevator tower for buildings up to 150 ft. long.

Allow two stairways and two elevator towers for buildings up to 300 ft. long.

In building over two stories, allow three stairways and three elevator towers for buildings over 300 ft. long.

In buildings over two stories, plumbing $75 for each fixture, including piping and partitions.

Allow 2 fixtures on each floor up to 5,000 sq. ft. of floor space and add one fixture for each additional 5,000 sq. ft. of floor or fraction thereof.

From the above data the approximate cost of any size and shape of building can be estimated in a few minutes. After the cost of the items given is determined about 10 per cent should be added for incidentals.

Dry Rot in Timber Structures.

A building having thick floors supported on heavy wooden beams and posts is not necessarily a building of slow-burning or mill-construction type. Architects and engineers have in many cases departed considerably from the ideas of the late Edward Atkinson and few know that an authorized manual on the subject is in existence. The fifth edition is now ready for distribution and contains data on reinforced concrete, the price being only 25 cts.*

A recent fire in a New York City factory building has called attention sharply to the fact that some essential points are disregarded in construction termed "slow burning" or "mill construction," because heavy timbers are used. Professor Ira H. Woolson of Columbia University was told by the chief of the fire department that after the fire, in the building mentioned, was under control the floors began to fall in irregular sections and soon the whole floor system was in the basement. The building was only 18 years old, 6 stories high, 200 ft. deep, with a 75 ft. frontage on one street and a 50 ft. frontage on the other side of the block.

An examination showed so many unprotected floor openings and liberal use of light wainscoting, etc., that it was in no sense slow burning, but merely an imitation of that type. A portion of the first floor was carried on steel I-beams supported by cast iron columns. The rest of the building was framed with heavy timbers supposedly in compliance with mill-building requirements. On the three lower floors the posts were of white oak and the girders of long-leaf yellow pine. In the three upper floors the posts were of long-leaf yellow pine, as were also the girders. Workmanship was first class and in all details it was apparent that an attempt had been made to erect a good structure of the mill-building type.

A careful examination showed it to be a clear case of failure by dry rot. Nearly all the posts examined showed they had been burned through for 2 or 3 feet at the upper end. The remainder of the sound wood was charred for a depth of only ½ in. to 1 in., which would scarcely have affected the strength. The yellow pine posts were in better shape than the oak and evidence of rot in the girders was slight. It was evident that the final collapse was due to burning out of dry punk wood produced by dry rot in the posts.

In the opinion of Prof. Woolson the build-

*Insurance Engineering Experiment Station, 31 Milk Street, Boston, Mass.

ing was rapidly approaching a dangerous condition, even though no fire had occurred. The following is from the report of Prof. Woolson as published in Insurance Engineering:

The majority of the heavy oak posts on the three lower floors must have retained but a small proportion of the strength they were supposed to possess. The outside shell at the top was all the sound wood that remained. The time must inevitably have come when a concentration of load on some floor due to stacking of stock or the movement of a large machine would have caused serious settlement and perhaps a collapse. The writer has never known a case of this kind before. An inquiry among insurance authorities of the city has not produced record of a similar instance, although it is probable that failures of this kind have occurred. Evidence on the subject may be secured from some of the insurance companies whose business covers the manufacturing plants of New England, where heavy timber construction is much more common than in this vicinity. It is quite apparent that this subject is of vital interest to owners of this type of building, as well as to insurance companies who carry risks upon them.

Cause of Dry Rot.—Dry rot is a well known fungus disease of wood, which is sure to develop when green or wet timber is encased so that air may not circulate around it. Most building specifications require that the ends of wooden beams encased in walls shall have an air space around them to prevent dry rot. The rules of the factory mutual insurance companies of New England specify that wooden posts shall have 1½-in. hole bored through them and two ½-in. holes crosswise near the top and bottom to prevent checking. No mention is made of this provision being a preventive of dry rot, but it is quite certain that if the posts in this building had been thus bored they would not have rotted.

The timber was doubtless only partially seasoned and the placing of the 4-in. socket caps upon it effectually excluded the air from the ends, giving the moisture no chance to escape. As a result dry rot developed, and had been slowly progressing until practically the whole cross section of the posts had been reduced to a dry punk which could be broken by the fingers and would ignite from a match. The worst feature of this kind of decay lies in the fact that it proceeds from the interior, the outside seasoned shell of the timber giving no indication of the rottenness within. It is possible that the manufacture of paper in the building may have produced a moist atmosphere which aided the decay after it had once begun.

Another interesting point in connection with the matter is that this condition has been brought about in a period of 18 years. It was about 25 years ago that the late Edward Atkinson began to advocate the merits of slow-burning mill construction in which heavy timber framing of this character was employed.

Warning.—A large number of factories and warehouses have been erected since that time of similar construction. It is important to know how many of them are getting into a dangerous condition by this slow method of deterioration. If the posts of such buildings have been bored as described above, they are probably in as perfect condition today as when installed, but, unfortunately, all building specifications have not made boring of posts a requisite, and where buildings were erected, as this one was, not conforming to slow-burning construction, it is very likely this provision of post protection was seldom employed. The soundness of posts in such buildings today will depend upon their degree of dryness when installed, the snugness with which the caps fitted, as well as the atmospheric conditions of the building, whether dry or damp, and other things, such as painting, etc. It is well known that painting of timber before it is thoroughly seasoned is conducive to dry rot.

Fortunately the condition of such posts can easily be ascertained by boring a half-inch hole through them.

While yellow-pine will yield to dry rot under favorable surroundings, still it is not so susceptible to the disease as oak, and it is known that certain rot fungi will attack hardwoods and not attack resinous woods like pine. It may be that the yellow-pine timber in this building was less affected by the rot than the oak, because the particular fungus which caused the trouble would not thrive in pine, or it may have been much better seasoned than the oak. At least it is encouraging that the yellow-pine apparently resisted the disease best, for the day of oak construction is nearly gone, and the large proportion of such constructions in the past 20 years has probably been of pine.

In discussing the matter the editor has the following to say:

One requirement of the early specifications for slow-burning construction was that the heavy wooden posts should be bored lengthwise and crosswise near each end, to provide ventilation and thus avoid dry rot. Neither posts nor beams were to be painted under about three years, to allow ample time for seasoning of the wood. An alternate requirement for floor beams was to use two sticks of the necessary strength, bolted together, with an air space between. The test of time has proved the wisdom of those precautions, as well as the other original requirements for this type of construction. So-called failures have been due to violations of the principles of mill-construction.

Some years ago there was an organization that went by the name of The American Society of Irrigation Engineers. Two or three annual meetings were held and some thin proceedings printed. In one of the volumes was a discussion of the value of trestles in which posts and girders were made of several pieces having good air space between for the very purpose of avoiding dry rot. Not only did engineers engaged in irrigation work recognize the danger of dry rot in large timbers, but technical literature is full of references to it. The matter is not of recent knowledge, but dry rot and its danger has been known for centuries. It is therefore criminal for designers to neglect to provide means to prevent it. The danger of collapse being a real one, it behooves the occupants of all heavy timber framed buildings to make an inspection of the interior of each post and girder.

Annual Meeting of the Connecticut Society of Civil Engineers.

The annual meeting of the Connecticut Society of Civil Engineers was held at New Haven, Conn., Feb. 7 and 8. The report of the retiring president, F. J. Easterbrook, showed substantial numerical and financial gains for the past year. The total membership of the association numbered 297, against 286 at the same time last year. The meeting was opened by the president in business session on Feb. 7. Following a banquet in the evening a day was spent in the hearing of papers and discussions. The attendance was large and great interest was displayed in the final session.

In his speech before the business session President Easterbrook strongly advocated the establishment of an association library. A movement in this direction is anticipated. The appointment of committees includes one to frame a resolution to present to the Connecticut representatives in congress, providing for an appropriation for the purchase of a large testing machine.

A paper by Mr. Benjamin S. Hinckley, engineer for the New York, New Haven & Hartford R. R., on "Problems Handled by the Test Department of a Large Corporation," was read by the secretary in the absence of Mr. Hinckley. The duties of the test department of a corporation as an aid to the purchasing department were pointed out and illustrated. A number of interesting slides were used to show the results of various kinds of tests. An interesting talk on civic conditions abroad was given by Mr. Frederick L. Lord of Hartford, Conn. The beautifying of the municipality was largely dealt with, views of various styles of trolley waiting stations, lighting posts, trolley poles, etc.; all built with a view to making the city beautiful being shown.

Mr. Charles S. Shandler read a paper on "Dams Approved by Henry F. Potter," now deceased, describing the construction of dams built under the supervision of Mr. Potter. Some dams on the Statucket River, built by Mr. Potter between the years 1860 and 1870, are still in serviceable condition. A paper on sea walls by Mr. George A. Arrah was also read. This paper was printed in our issue of Feb. 16, 1910.

LETTERS TO THE EDITOR.

The Kutter-Sanborn Alphabetic Order Tables.

Sirs:—On page 65 of the Jan. 19, 1910, issue of your valuable magazine mention is made of the Kate E. Sanborn arrangement of C. A. Cutter's alphabetic order table. Can you explain briefly what this system is, or else furnish a reference whereby I may avail myself of this information? I am familiar with the Dewey decimal system, and am much interested in this classification which apparently is a supplement to same. Assuring you that any information you may be able to give me will be highly appreciated, I am,

Very sincerely yours,

W. W. JOURDIN.

El Paso, Tex., Feb. 3, 1910.

(To secure authoritative information our correspondent's inquiry was taken up with the librarian of the Chicago Public Library and we print below the reply received.—Editors.)

Sirs:—Replying to your inquiry of the 8th inst., we beg to say that the Cutter alphabetic order tables were designed to give author-numbers to books, made up of the first letter of the author's name and certain figures representing the other letters in his name. Books bearing these author-numbers, if arranged first alphabetically by the letters, and then in the numerical order of the numbers following the letters, will always stand in the alphabetical order of the author's names.

In Mr. Cutter's original tables the vowels and the letter "S" were followed by the next letter of the name instead of immediately by a figure (as Abbot, Ab2). Because many who used the tables disliked this feature he procured the assistance of Miss Kate E. Sanborn to prepare a table in which the vowels and "S" are treated as the consonants are in his own table, that is, the initial letter is followed by a figure. The tables are carried out to three figures.

The Cutter-Sanborn Alphabetic order tables may be purchased of the Library Bureau, 168 Wabash Ave., Chicago, Ill., for $2.50. A pamphlet is included, giving directions for their use. An Article on "How to Use the Cutter Book Numbers" may be found in the Library Journal, Vol. 12, pp. 251-252.

Other material about the subject is fragmentary and hardly worth listing.

Yours very truly,

C. B. RODEN,
Assistant Librarian,
The Chicago Public Library.

Chicago, Feb. 15, 1910.

Per Capita Cost of City Government at Des Moines, Ia.—The accompanying tabulation taken from the annual report of the city of Des Moines, Ia., for the fiscal year ending March 31, 1909, shows the per capita cost of government in that city during the fiscal year, the figures being based on a population of 100,000. In passing it may be noted that the figures are for the first year under which the city has been governed on the commission plan:

	Maintenance.	Improvement.	Total.
General government	$ .61	$ .01	$ .62
Protection of life and property	2.37	1	2.47
Health and sanitation	.30	.23	.53
Highways	1.18	1.08	2.26
Libraries	11	18	[illegible]
Recreation	18	1	.25
Miscellaneous	.13	...	.13
Cemeteries	16	[illegible]	.23
Public Debt—			
Interest	.33	...	.33
Principal	...	.06	.06
Outstanding debt obligations	1.76	...	1.76
	$7.14	$2.12	$9.56

Long Term Rainfall Observations.—Observations of temperature and rainfall for a period of 95 years are given in the last annual report of Mr. L. M. Hastings, city engineer of Cambridge, Mass. The observations were taken at New Bedford, Mass., by Mr. Rodman and son and are valuable as being carefully taken and complete. They are given in the report in the form of a diagram and an examination of this shows that "climate" as indicated by daily average temperature has changed but little in the period, if a number of years be considered. The diagram shows that the average annual temperature for the 95 years was 48.370° F., while the average annual precipitation for the period was 46.72 ins. The elder Mr. Rodman began the taking of these observations in 1813.

Cost of Maintaining Horses at Des Moines, Ia.—The Department of Streets and Public Improvements of the city of Des Moines, Ia., during the fiscal year ending March 31, 1909, had under its charge 23 horses, of which 20 were used in street cleaning work. The cost of maintaining the horses was as follows:

	Total.	Per horse.
Feed used, including amount on hand Apr. 1, 1908	$2,794.47	$121.50
Shoeing	620.10	26.96
Drugs, etc.	29.17	1.26
Veterinary service	9.00	.39
Care of horses	876.25	38.10
Total	$4,328.99	

The item care of horses includes the $854.75 as salary of the barn man.

The construction of an electric railway from Cordele, Ga., to Daphne, a pleasure resort eight miles east of the city on the Seaboard Air Line railway and Flint River, is proposed. Citizens of Cordele are interested in the project.

The Butte Street Ry. Co. of Butte, Mont., is planning to extend its Englewood line at Butte a distance of 1¼ miles.

Technical Society Meetings.

The list following names those technical societies in which engineers and contractors are most interested, whose meetings are to be held within three months of the date of this issue. There are given for each society listed the date and place of meeting and the name and address of the secretary, to whom all communications and inquiries should be addressed.

American Institute of Mining Engineers.
March 1-5. Annual meeting at Pittsburg, Pa. Secy., R. W. Raymond, 29 West 39th St., New York City.

American Railway Engineering and Maintenance of Way Association.
March 15-17, 1910. Annual convention at Chicago, Ill. Secy., E. H. Fritch, 962 Monadnock Block, Chicago, Ill.

American Society of Engineering Contractors.
Feb. 24-26, 1910. Annual convention at Chicago, Ill. Secy., Daniel J. Hauer, Park Row Building, New York, N. Y.

American Water Works Association.—April 26-30, 1910. Annual convention at New Orleans, La. Headquarters, Gruenwald Hotel. Secy., J. M. Diven, Charleston, S. C.

Illinois Association of Municipal Contractors.
Feb. 24-26. Annual meeting at Chicago, Ill. Secy., Orie T. Dunlap, Edwardsville, Ill.

Indiana Sanitary and Water Supply Association.
Feb. 25, 1910. Annual meeting at Indianapolis, Ind. Headquarters, Claypool Hotel. Secy., F. C. Jordan, Indianapolis, Ind.

Iowa Association of Cement Users.
March 9-11, 1910. Annual meeting in Cedar Rapids, Ia. Secy., Ira A. Williams, Iowa State College, Ames, Iowa.

National Association of Cement Users.
Feb. 21-25, 1910. Annual meeting at Chicago, Ill. Secy., Geo. C. Wright. Address all communications to Edw. E. Krause, Asst. to the President, Harrison Bldg., Philadelphia, Pa.

Notes from Technical Societies.

Illinois Water Supply Association.—The annual meeting of this association, of which Mr. Dabney H. Maury of Peoria, Ill., is president, will be held at Champaign, Ill., March 8 and 9, 1910. The following papers will be read and discussed: "Experience With Deep Well Pumps," F. C. Ainsbury, Champaign, Ill.; "Relation Between Typhoid Death Rate and Water Supplies of Illinois," Edward Bartow, Urbana, Ill.; "Water Supplies from Lake Michigan," W. C. Bouton, M. D., Waukegan, Ill.; "The Operation of Mechanical Filters," J. H. Brewster, Indianapolis, Ind.; "The Possibility of Pollution of Shallow Wells," C. B. Burdick, Chicago, Ill.; "Quality of the Waters of the Mississippi System," R. B. Dole, Washington, D. C.; "Legislation in Relation to Stream Pollution," H. M. Ely, Danville, Ill.; "A State Bureau of Municipal Information," J. W. Garner, Urbana, Ill.; "Use of Ozone in Treatment of Western Waters," W. F. Monfort, St. Louis, Mo.; "Action of Mississippi River Water on Metals," W. F. Monfort, St. Louis, Mo.; "Filtration of Water Supplies," J. L. Pearse, Chicago, Ill.; "Water Works Franchises," M. H. Robinson, Urbana, Ill.; "A City Water Supply from Shallow Wells," O. T. Smith, Freeport, Ill.; "Rate of Flow of Water Into Wells," A. N. Talbot, Urbana, Ill.; "Comparison of Hydrated Lime With Ordinary Lime in Water Treatment," C. E. Thomas, Chicago, Ill.; "Should Water Companies Furnish Private Services Free to Patrons Up to and Including the Meters?" E. P. Wheeler, Lake Forest, Ill.; "Significance of the Term Alakalinity in Water Analysis and the Determination of Alkalinity by Means of Indicators," E. W. Washburn, Urbana, Ill.; "Disinfection of Water," C. E. A. Winslow, Boston, Mass.

Iowa Cement Users' Association.—The following is the program of the convention to be held in Cedar Rapids, Ia., March 9-11, 1910. Headquarters will be at the Montrose Hotel: Wednesday afternoon, 1:30 p. m., Address of Welcome, Mayor M. J. Miles, Cedar Rapids. Response, J. C. Burch, Iowa Portland Cement Co., Des Moines. President's Address, Geo. H. Carlon, Oskaloosa. "Cement in Government Irrigation Work" (illustrated), C. J. Blanchard, U. S. Reclamation Service, Washington, D. C. "Permeability of Concrete," F. M. Okey, Iowa State College, Ames. Appointment of Committees. Thursday morning, 9 a. m.—"Effect of Cold on Cement," G. P. Dieckmann, Northwestern States Portland Cement Co., Mason City. "History of Cement and Its Uses," H. M. Herald, Assistant City Engineer, Burlington. "Cement Sidewalks and Floors," Jesse Hines, Greenfield. "Steam Curing of Cement Products," G. E. Tathwell, Cedar Rapids. Thursday evening, 8 p. m.—"Cement in Street Work," C. T. Wilson, City Engineer, Waterloo. "Surface Finishing of Cement Work," P. P. Comoli, Sioux City. "Modern Manufacture of Portland Cement" (illustrated), G. P. Dieckmann, Mason City. "Specifications for Cement Tile," A. Marston, Iowa State College, Ames. Reports of Committees. Friday morning, 9 a. m.—"Concrete Work in Freezing Weather," W. B. Wallace, Cedar Rapids. "Concrete Bridge Construction," T. H. MacDonald, Iowa Highway Commission, Ames. "Manufacture and Use of Cement Tile," P. H. Atwood, Armstrong. Illustrated address, R. I. Humphrey, National Association Cement Users, Philadelphia.

Personals.

Mr. J. C. Dunn, Contractor, formerly of Cleveland, O., has opened an office at Room 308, Ellsworth Bldg., Chicago, Ill.

Mr. William Meier, of Chicago, Ill., a civil engineer for the Chicago, Milwaukee & St. Paul R. R., was accidentally killed by drowning Feb. 14.

Mr. D. W. Hays, Engineer, Truckee-Carson project, has resigned from the Reclamation Service to enter private engineering practice at Reno, Nev.

Mr. James A. Green of Chicago has opened offices at 226-228 La Salle street, of that city, where he will engage in irrigation and hydraulic engineering and construction.

Mr. Everett M. Alvord has resigned the office of General Superintendent of the Missouri, Kansas & Texas R. R. to accept the position of General Manager of the Midland Valley R. R.

Mr. George F. Samuel, Assistant City Engineer, Chicago, Ill., will occupy the position vacated by City Engineer John Ericson, as acting engineer, during the latter's leave of absence.

Mr. Thomas H. Carters, a civil engineer of Portland, Ore., died Feb. 13. He was engineer in charge of construction of the Astoria & Columbia River R. R. and was formerly vice-president of the system.

Mr. William Arthur of Omaha, Neb., has been appointed valuator in the buildings division of the physical valuation department of the Nebraska Railway Commission. He will take charge of the office March 1.

Mr. H. M. Chapin, formerly with the New York Central Lines and the Cambria Steel Co., and Mr. T. J. Bryson, formerly with the American Bridge Co. and the Cambria Steel Co., have formed a partnership under the firm name of Chapin & Bryson and will engage in the practice of architectural and civil engineering. Their offices will be in the Nettleton Bldg., Ashtabula, O.

Mr. C. de Vere Fairchild, Terminal Engineer of the Grand Trunk Pacific Ry., has retired to his winter house on the Isle of Pines. Mr. Fairchild has engaged extensively in engineering throughout the last eleven years. During the last three years he has had charge of the extensive terminal improvements of the Grand Trunk Pacific at Ft. William, Ont. It is expected that after a vacation of some length he will again take up professional work.

Mr. F. J. Benning, formerly holding a position with the Pittsburg Railways Co., has been appointed to the office of Superintendent of Construction of the Cincinnati Traction Co. Mr. Benning will take charge of the extensive track construction and replacement work begun by the Cincinnati Traction Co. Mr. E. A. Berry, Engineer of Roadway, who has had entire charge of engineering and construction work, will be relieved of this part of the work, remaining in the capacity of Engineer of Roadway.

Lieut.-Col. Henry A. Allen, senior member of the engineering firm of Henry A. Allen & Co., of Chicago, Ill., has been appointed to the new position of Consulting Engineer for the Department of Public Works of that city. Col. Allen will be remembered as being one of the engineers appointed by President Taft to decide on the question of type of the Panama canal. He graduated from the United States Naval Academy in 1887 and for eleven years was managing engineer for the Allis-Chalmers Co.

Catalogs Worth Having.

Engineers and contractors should have on file the latest catalogs of machines, tools and supplies that they use. In sending for catalogs reviewed or advertised in this paper, you will confer a favor on us if you will write directly to the advertisers and state that you saw the catalog mentioned in ENGINEERING-CONTRACTING. If you are in the market for tools, machinery or supplies, tell us and we will notify promptly the leading manufacturers.

Power From Exhaust Steam.—Paper, 6x9 ins., 15 pp. American Regenerator Co., Monadnock Blk., Chicago, Ill.

This booklet describes the American Regenerator, a device for the conservation of the heat energy of exhaust steam. Cuts and tables accompanying the discussion relative to the application of the regenerator show how the saving is affected.

Tartex.—Paper, 6x9 ins. Barrett Manufacturing Co., Chicago, Ill.

This company is sending out a sample of "Tartex," which is a new reinforced waterproofing felt. A few remarks on the qualities of "Tartex" accompany the sample.

Draft and Driers.—American Blower Co., Detroit, Mich.

This firm sends in a number of pamphlets describing appliances made and sold by them for inducing draft in power plants and for ventilation, as well as for drying plants for laundries, lumber kilns, etc. A great deal of practical information is given and a number of valuable tables are presented. For men who preserve these pamphlets a loose leaf binder is provided.

Sewer Facts. — Paper, 4¾x7¾ ins., 60 pp. Western Clay Products Publicity Bureau, Kansas City, Mo.

This book is a well written attack on concrete sewers.

Power Transmission Machinery.—Cloth, 4½x7¼ ins, 270 pp. Jones & Laughlin Steel Co., Pittsburg, Pa.

This is a new complete hand book on power transmission. It contains a number of tables giving horsepower of belts and line shafts, with tables and other useful information on wheels, belt tighteners, etc. Tables are given of properties of sections with sizes. The book is profusely illustrated.

Brass Well Screens.—Paper, 3¼x6¼ ins., 8 pp. E. E. Johnson, St. Paul, Minn.

This pamphlet describes the Johnson brass well screen. It contains illustrations, price lists and scales showing the sizes to order for screening out different grades of sand in the well.

Underground Conduit Construction. — Paper, 3½x6½ ins., 32 pp. American Conduit Co., 501 Marquette Bldg., Chicago, Ill.

Contains a highly instructive article on the installation of electric light and telephone wire conduits in city streets. Many diagrams and views are used to show details of trenches, manholes, building connections, etc. Some handy diagrams and tables on the cost of concrete per cubic yard are included. The Bitumenized Fibre Conduit, a product of this company, is also described.

You-Ree-Ka.—Paper, 5¼x8 ins., 12 pp. Henry Kroder Co., Passaic, N. J.

Describes the You-Ree-Ka Ventilating apparatus. Diagrams and views are used to aid in describing installation and operation.

Conveyors.—Paper, 6x9 ins., 39 pp. Weller Mfg. Co., Chicago, Ill.

A supplement to Catalog No. 19 of this company, containing revised net price lists on spiral screw conveyors and all fittings, conveyor buckets, winches, pulleys, pulley chains, sprocket wheels, corn cleaners and corn shellers.

Derrick Fittings.—Paper, 6x9 ins., 23 pp. The National Equipment Co., Chicago, Ill.

This bulletin furnishes complete information about guy, tower, stiff leg and revolving derricks and convertible derrick fittings made and sold by this company. All derricks are described with the aid of diagrams. Order lists are furnished, and where practical are accompanied by list of prices. Cuts of all fittings are shown.

Contract News Section

of

ENGINEERING-CONTRACTING

A Consolidation of ENGINEERING-CONTRACTING—CONTRACT NEWS—ENGINEERING WORLD—THE DIRT MOVER.

Containing Items of Interest to Railroad, Public Works and Other Contractors.

The Doings of the Week.

The principal railway construction contract of the week was let by the Santa Fe and calls for the construction of 100 miles of new line in Texas from Lometa to Brady. The contract was secured by Levy & Owens, Galveston, Tex., the C. H. Sharp Contracting Co., of Kansas City, Mo., and Morey-Faulhaber Co., St. Louis, Mo. Among the smaller contracts which have come to our notice, are the following: W. R. Falker Construction Co., Rogers, Ark., 40 miles' extension of the Arkansas, Oklahoma & Western R. R., in Arkansas; Wade & Clower, St. Paul, N. C., an extension of the Virginia, Carolina & Southern R. R. in North Carolina; McNichol Paving & Construction Co., Philadelphia, 3rd and 4th track work at Valley Forge, Pa., for the Reading Ry.; Gust Freeden, Norway, Mich., 4.6 mile mine spur at Ishpeming, Mich., for the Lake Superior & Ishpeming Ry.—The U. S. House of Representatives has passed, without a murmur the River and Harbor Bill carrying an appropriation of something like $45,000,000.—A large municipal contract is now being advertised by the City of Portland, Ore., The contract calls for the construction of a second pipe line to Bull Run, estimated to cost about $1,629,000.—Prospects look bright for the commencement of work on the Western Maryland extension from Cumberland, Md., to New Haven, Pa. The company has asked legislative leave to issue about $15,000,000 of stock to build the extension, which will be 83 miles long.—The Missouri, Kansas & Texas R. R. is getting in line with the other roads and is planning to expend a considerable sum this season for betterments. In fact it is said that the company is planning to spend $5,000,000 in improving its line through Kansas, Texas and Oklahoma. In the latter state several stretches of double track will be laid. —The U. S. Senate is still discussing the Senate bill to appropriate $30,000,000 for the completion of the U. S. Reclamation Projects already begun; some of the senators oppose the bill for fear that part of the appropriation will be used to start new irrigation projects.—Here is some little dope on what the railroads do not intend to do at the present time: St. Louis, Iron Mountain & Southern Ry.: "Reports relative to extensive improvement work along the main line of the St. Louis, Iron Mountain & Southern Ry. from Poplar Bluff to Little Rock, Ark., are erroneous, as no such expenditure has been authorized." Rock Island Lines: "We have no immediate expectation of double tracking the line between Topeka and Herington." Michigan Central R. R.: "There is no truth in the statement that this company proposes building an additional track from Buffalo to Detroit at the present time." Gulf, Colorado & Santa Fe Ry.: "The report of the contemplated extension east of Oakdale, La., is premature."

Flinn's Partner.

State Senator William Flinn, of Pittsburg, Pa., is not less well known as a contractor than he is as a politician. In the latter capacity in one of Pittsburg's hot municipal campaigns he was largely the chief issue, one party holding him responsible for everything bad that had happened in the city for years, including the overflowing of the Monongahela River, and the other party claiming that he was responsible for everything good that had happened. Flinn at that time was a member of the firm of Booth & Flinn, and the fact was taken advantage of by his opponents, as is told in the following manner in a recent issue of the Saturday Evening Post: At a mass meeting of colored citizens an impassioned orator assailed Flinn and charged him with all sorts of high crimes and misdemeanors, and in his ecstasy of denunciation wound up with: "An', I ast you, who was it what shot down that great man, Abrum Linkum? I ast you dat. It was Flinn." "Hol' on, Mistuh Speakah," broke in a Flinn man. "It wasn't no man named Flinn what shot Mistuh Linkum." "Who was it, den?" shouted the orator. "Booth." "Well," yelled the speaker triumphantly, "what's de diffrunce? It was one of de firm."

An Old Time Road Builner.

Just 100 years ago there died in England a road builder whose work antedates even that of Macadam and Telford. He was not a pioneer of good road construction, in as much as he developed no new system of building highways as did Macadam and Telford, but nevertheless his work was a great advance over that of his predecessors. This man's name was John Metcalf. He was born in 1717 and before taking up road construction work he was successively a fiddler, soldier, horse-dealer and carrier. When about 25 years old he had the misfortune to lose his eyesight through illness. His first road work was in 1765 when he took a sub-contract for constructing three miles of new road between Boroughbridge and Harrogate in England. In this work, as in all his other work, he relied entirely on trusty foremen for carrying out his plans. His first piece of work was so successful that his services were in much demand. In the counties of Lancashire, Derbyshire, Cheshire and Yorkshire alone, he constructed over 180 miles of road, the work in some instances involving the erection of many bridges, the building of retaining walls and culverts at the crossing of difficult bogs.

Street Improvement by Proxy.

Engineering schools nowadays devote some little time to giving the student experience in the every day problems which will confront him in actual practice. The School of Engineering at the University of Wisconsin in particular does considerable in this line, and in this it is ably assisted by the Civil Engineering Society, which is composed of students taking the course in civil engineering at the university. Recently the society issued the following notice: "On Friday evening, in the engineering auditorium, bids for the improvement of University Ave. will be opened, the contract let, the street improved, and the contractor paid. All within two hours' time. Those interested in the difficulties and form necessary to improve a street should attend this meeting." Members of the society were assigned various positions, such as mayor, aldermen, city engineer, contractors, etc., and each acted his part. The bids were opened by the mayor, tabulated by the city engineer, and the contract awarded. The contractor then went ahead and "improved" the street, all within the two hours' time, students acting as foremen, workmen, etc.

The U. S. house of representatives has passed the rivers and harbors bill, carrying an appropriation of something like $45,000,000. One feature of the bill of interest to Illinois is the vesting of authority in the secretary of war to appoint a board whose members are to be composed of four engineers of the army and four civil engineers taken from civil life, to cooperate with the Illinois authorities in securing a suitable waterways in conjunction with the development of water power by Illinois between Lockport and Utica, for which Illinois has already authorized an appropriation of $20,000,000. The president of the board is to be the same one who was president of the board of five members authorized under an act of March 2, 1907, to examine the Mississippi river below St. Louis and to report to congress a project for a 14-ft. channel.

The U. S. senate is now considering the bill authorizing the issuance of $30,000,000 worth of certificates for the completion of irrigation projects already begun. The supporters of the bill pointed out that in a number of cases reservoirs had been completed, while the ditches to distribute the water had not been constructed. The chief opposition to the bill seems to be the fear that the department might be tempted to enter upon new schemes before the completion of the present enterprises, and thus soon involve the government in further obligations.

Confirmed Reports by Engineers and Contractors

RAILROADS, POWER DEVELOPMENTS, LEVEES, DRAINAGE AND IRRIGATION WORKS.

Railroads—Steam and Electric.

ARKANSAS.

The Arkansas, Oklahoma & Western R. R. has partly completed surveys for the projected 40 mile extension from Rogers to Huntsville. The capital for construction has been secured and work was started on Feb. 1, the W. R. Felker Construction Co., Rogers, Ark., being the contractor. W. R. Felker, Rogers, Ark., is president and M. Hays, Rogers, Ark., is chief engineer.

FLORIDA.

The Florida Ry. Co. has decided to extend its line from Live Oak to Fernandina, and has awarded the contract for the work to the Florida Construction & Realty Co., Dyal-Upchurch Bldg., Jacksonville, Fla. T. P. Alston, Live Oak, Fla., is General Superintendent Florida Ry.

GEORGIA.

We are advised that nothing further has been done on the projected line of the Georgia & Florida Ry., from St. Clair to Blythe, Ga., than to complete the surveys. No decision has been reached as to when construction contracts will be let. W. A. Swallow, Augusta, Ga., is Chief Engineer.

IDAHO.

Surveys have been made and the capital has been secured in part for the construction of a 36 miles electric railway in the vicinity of Idaho Falls, Idaho. The date for awarding construction contracts is uncertain, nor has the chief engineer been selected as yet. The company which is to operate this road was incorporated recently with a capital stock of $1,000,000. J. L. Miller, Idaho Falls, Idaho, is president.

ILLINOIS.

The Hammond, Chicago Heights & Southern Traction Co. is projecting a 30 mile line from Hammond to Momence, Ill., and is planning to have construction work started at once. Ward & Orr, Chicago Heights, Ill., have the contract. Joseph Orr of the construction firm is vice-president; E. J. Kennedy is chief engineer, and W. S. Reed, 1145 First National Bank Building, Chicago, Ill., is president.

The Peoria Railway Terminal Co. is planning the construction of 4½ miles of track in Peoria this spring. The work will be done by the company by day labor. Geo. P. Paradis, Peoria, Ill., is chief engineer.

INDIANA.

Stock subscriptions are being taken for a projected railway to extend from Terre Haute, Ind., to Marion, Ill., and to be about 250 miles long. The company which is to operate the line has not been organized as yet, and it is intended to get about $500,000 in stock subscriptions before this is done. As proposed the road is to run in a general northeasterly and southwesterly course, terminating at the city of Terre Haute, Ind., as its northerly terminus, and at or near Marion, Ill., as its southerly terminus, with a branch line from a point on the main line near Fairfield to the city of Mt. Vernon in Jefferson county, Ill., and to run into, through or across Vigo county, Ind., and the counties of Clark, Crawford, Lawrence, Richmond, Wayne, Jefferson, Hamilton, Saline, Franklin and Williamson, in the state of Illinois. The proposed route has been under consideration for a long time and at several times there has been considerable money spent for surveys and some work started. Henry H. Knipe, 211 North Cross street, Robinson, Ill., in interested.

KANSAS.

The Oklahoma-Kansas Ry. Co. is planning the construction of an electric railway from Galena, Kan., to Holtonville, Okla., via Baxter Springs, Kan. and Rellnin Park, passing through the lead and zinc fields of Oklahoma. The projected length of the line is 23 miles. Surveys have been made from Baxter to the Mission Mines and it is planned to let construction contracts for this portion of the line in April. The capital for construction has not been secured as yet, nor has the chief engineer been appointed. Dr. Charles M. Jones, Baxter Springs, Kan., is president and M. C. Harper, Baxter Springs, is the promoter.

MARYLAND.

The Frederick R. R. Co. has completed surveys and has secured the capital for the construction of a 15 mile extension. Oscar B. Coblentz, Frederick, Md., is chief engineer and W. S. Taylor, Frederick Md., is general manager.

MICHIGAN.

Gust Fredeen, Norway, Mich., has been awarded the contract for constructing a 4.6 mile spur line to the Cleveland-Cliffs Iron Co.'s mine at Ishpeming for the Lake Superior & Ishpeming Ry.

MONTANA.

The Whitefish Polson Electric Ry. Co. is projecting a 60 mile line to extend from Whitefish to Polson, passing through Kalispell and Somers. Surveys are now under way and construction work will be commenced as soon as these are completed and the necessary capital secured. F. E. Marsh, Kalispell, Mont., is chief engineer. Joseph A. Edge, Kalispell, Mont., is interested.

The Gallatin Valley Electric Ry. Co. has completed surveys and has secured the capital for the construction of a 27½ mile extension from Bozeman to Three Forks. Contracts for constructing the extension will be let soon. R. M. Hart, Coeur d'Alene, Idaho, is president. N. C. Van Natta, Bozeman, Mont., is chief engineer, and Charles B. Anderson, Bozeman, Mont., is secretary.

NEW JERSEY.

The M. P. McGrath Contracting Co., 409 Trust Bldg., Easton, Pa., has been awarded the contract by the Delaware, Lackawanna & Western R. R. for fourth-tracking four miles of main line from Port Morris to Chester Junction, N. J.

NORTH CAROLINA.

Wade & Clower, St. Paul, N. C., have been awarded the contract for constructing a 30 mile extension of the Virginia & Carolina Southern R. R. from St. Paul, N. C., to Elizabethtown, N. C. Surveys for the extension are now being made and the capital for construction has been secured. A. W. McLean, Fayetteville, N. C., is president and J. L. Neill, Fayetteville, is chief engineer.

OHIO

Jones Brothers, railroad contractors, 608 Second National Bank Bldg., Cincinnati, O., want 15 team outfits for scraper work in Ohio.

The Minster & Loramie Ry. Co., recently incorporated, projects the construction of a trolley line from Loramie to Minster to a connection at the latter place with the Western Ohio Electric Ry. The company has not as yet effected its permanent organization. F. D. Carpenter, Lima, O., is interested.

OKLAHOMA.

Contracts will probably be let about April 15 for the construction of a portion of the projected 250 mile line of the Sallisaw, McAlester & Southern Ry. M. J. Smith, McAlester, Okla., is chief engineer.

OREGON.

Surveys have been made for the first 97 miles of the projected line of the Coos Bay, Oregon & Idaho R. R. and the capital for construction has been secured. The company, however, is not quite ready yet to let construction contracts. The first 97 mile section will bring the road from Coos Bay to Roseburg; from the last place it is to extend to Boise, Idaho, crossing Oregon. The total projected length is 600 miles. F. A. Haines, Marshfield, Ore., is chief engineer and Francis H. Clark, Marshfield, Ore., is president.

PANAMA.

The Secretary of War now has under consideration the construction of a railroad near the coast along the Pacific slope on the Isthmus of Panama. The projected length is 274.4 miles and the road would be built by the Panama R. R. for the U. S. government. Surveys for such a road were made by W. F. Shunk in 1893.

PENNSYLVANIA.

Surveys have been made and the capital has been secured for the construction of the projected 31 mile line of the Clarion & East Brady Electric Ry. Co. The route is from Clarion through Reidsburg, Sligo, Rimersburg, Phillipson to East Brady. Construction contracts are to be let early this spring. George F. Arnold, Clarion, Pa., is president.

The McNichol Paving & Construction Co., Betz Bldg., Philadelphia, Pa., has been awarded the contract for constructing a third and fourth track for the Philadelphia & Reading Ry. between Valley Forge and Perkiomen Junction, Pa. The work is located at Valley Forge, Pa., and includes 150,000 cu. yds. of rock excavation and 7,000 cu. yds. concrete masonry. None of the work is to be sublet.

SOUTH DAKOTA.

The Aberdeen Street Railway Co. of Aberdeen, S. D., is planning to construct four miles of line this year and two or three miles next year. About $70,000 of stock has been sold and the company proposes to let constructing contracts early in March. The chief engineer has not been selected as yet. Charles N. Herreid, Aberdeen, S. D., is president and general manager.

TEXAS.

The Atchison, Topeka & Santa Fe Ry. has awarded contracts for constructing 100 miles of new line from Lometa on the San Angelo branch to a point 25 miles west of Brady, the successful contractors being as follows: C. H. Sharp Contracting Co., Kansas City, Mo., 40 miles; Morey-Faulhaber Co., St. Louis, Mo., 30 miles; Levy & Owens, Galveston, Tex., 30 miles.

WASHINGTON.

The Lower Yakima Irrigation Co., Downs Bldg., Seattle, Wash., has awarded a contract for the concrete lining of its canal, and work has already been commenced. It is expected to line from eight to ten miles of the canal this spring.

WISCONSIN.

The Minneapolis, St. Paul & Sault Ste Marie Ry. is planning to build a cut-off between Owen and Spencer, Wis., also a cut-off between New Richmond, Wis., and Withrow, Minn. The work will be ready to sub-

mit to contractors for bids within three weeks. Thos. Greene, 317 Second Ave., South, Minneapolis, Minn., is chief engineer, Minneapolis, St. Paul & Sault Ste Marie Ry.

CANADA.

Bids are asked by A. J. McGee, secretary-treasurer, Temiskaming & Northern Ontario Ry. Commission, 25 Toronto St., Toronto, Ont., until noon, Feb. 28, for all and every kind of labor, tools, machinery, and other plant, service and material whatsoever necessary for the due execution and completion of, in a thorough and workmanlike manner, all the grubbing, grading, embankment protection, clearing and culverts necessary for the construction of a cut off on the main line of the Temiskaming & Northern Ontario Ry. between M. P. 60 and M. P. 61. S. B. Clement, chief engineer, North Bay, Ont.

The Arnprior & Pontiac Ry. Co. has partly completed surveys for its projected 75 mile electric railway from Fitzroy Harbor to Graham's Bay, from Fitzroy Harbor to Campbell's Bay, and from Fitzroy Harbor to High Falls. The capital for construction has not been secured, nor has any date been set for letting contracts. The railway is to be constructed in connection with proposed development of the Chats Falls. Louis Simpson, Ottawa, Ont., is president Arthur H. N. Bruce, Ottawa, Ont., is chief engineer.

MEXICO.

F. V. Lister & Co., 20 Don Juan Manuel, City of Mexico, is carrying out the contract for the Cia Baucaria de Fomento y Bienes Raices de Mexico, for constructing that portion of the Durango-Llano Grande extension of the National Railways of Mexico from kilometer 926 to 973 inclusive. The work includes 65,343 cu. meters of earth excavation, 1,006,181 cu. meters of rock excavation, 1,018,512 cu. meters of embankment, 10,598 cu. meters of stone masonry and the following bridges: K. 960 1-17′ I beam, K. 963 4-17′ I beams, K. 964 1-160′ plate girder, 2-30′ plate girders (K. 966), K. 967 1-30′ plate girder, K. 971, 1-17′ I beam. The work is to be completed in 18 months. The award of the contract for this work was noted in our Feb. 9 issue.

Power Developments, Levees, Drainage and Irragation Works.

ALABAMA.

Leo K. Steiner, of the banking house of Steiner Bros., Birmingham, Ala., wishes to let a contract for completing part of Lock No. 3 on the Tombigbee River in Alabama. The original contract was let by the U. S. government on Dec. 4, 1907, the total amount being $350,000. The amount of work done is about $100,000.

COLORADO.

We are advised that only preliminary work is contemplated at present in connection with the Randal Reservoir, filed for the Palmer estate, for the irrigation of lands east of Colorado Springs, as noted in our Feb. 9 issue. E. C. Van Diest, Colorado Springs, Colo., is the engineer.

The Greeley Construction Co., A. A. Howard, superintendent, Greeley, Colo., has the contract for constructing the McGrew Reservoir, as noted in our last issue. This reservoir is the largest of several in the Greeley-Poudre district, and the earthen dam which will be constructed will be about three miles long, 26 ft. at its greatest height, 16 ft. across top, and will contain approximately 500,000 cu. yds. of dirt. It will require about one year to complete the above and the work will cost $100,000. The frost or frozen condition of the ground has just about left it, and the Greeley Construction Co. began active operations on February 21 with about 100 teams of mules and as many men. The camp is already established and dirt will fly soon.

The Austin Mfg. Co.'s New Era Graders and Contractors Dump wagons will be used on the work.

Contracts for the remaining reservoirs and ditches have been let, the Knowlton Construction Co. having all the ditch work. Contracts for the concrete work on the dam which is estimated to cost about $100,000, will be let by D. A. Camfield and S. H. Shield, of the Camfield Development Co., Symes Bldg., Denver. The Greeley-Poudre district which was organized by Canfield and his associates will redeem and water 125,000 acres of otherwise valueless land.

C. F. Tew is attorney for the district, John R. Wortham is District Engineer and C. E. Latham is trustee for the District, all having offices in Greeley, Colo.

GEORGIA.

As previously noted in this paper bids are being asked until noon, March 9, by Col. Dan C. Kingman, U. S. engineer, Savannah, Ga., for dredging in Club and Plantation Creeks, Ga. The work to be done consists in dredging the canal, approximately 450 ft. long, connecting Club and Plantation Creeks, 50 ft. wide at the bottom and 7 ft. deep at mean low water, and the dredging and straightening of Plantation Creek, to the before-mentioned dimensions, beginning at the western mouth and proceeding eastward as far as the available funds will permit. The work requires the dredging of 110,000 cu. yds., chiefly of marsh mud, the depth of which, where the canal and cut-off are to be made, varies from 8 to 11 ft. Below this, and to the project depth, there appears to be a bed of stiff mud or clay. It is believed that all of this material can be readily removed with an ordinary dredge or either the hydraulic or the dipper type.

IOWA.

Bids are asked until 1:30 p. m. March 2, by H. P. Lods, Dallas County Auditor, Adel, Ia., for constructing Drainage District No. 8, the work including the construction of a ditch having a 24-ft. bottom, a ½ to 1 slope, an average depth of 6½ ft. and an extreme depth of 11.1 ft. The ditch will require 272,500 cu. yds. of excavation. In addition there will be 11 dams, spile and earth fill in dams 12,625 cu. yds. Bids will also be opened on March 3 for a considerable amount of tile work in District No. 15 .

Bids are asked until noon, March 16, by the Board of Supervisors, Louisa County acting on behalf of Drainage District No. 12, at the office of the county auditor at Wapello, Ia., for work divided in sections as follows: Section 1, 111,000 cu. yds. of excavation, 6 acres of clearing; Sec. 2, 154,000 cu. yds. excavation, 3 acres of clearing; 127,000 cu. yds. of excavation, 12 acres of clearing; 87,000 cu. yds. of excavation, 30 acres of clearing. H. W. Baker will also be found in this issue.

MONTANA.

Plans have been made for an irrigation system for 20,000 acres of land north of Twodot, Mont., and contracts will be let some time this summer. The work will include the construction of three dams 125 ft. in height and 150 ft, in length; two miles of flumes; three miles of pipe line and twenty miles of main canals. The supply will be obtained from the streams draining the Little Belt Mountains. Lilles & Hatch, Billings, Mont., are the engineers and John Montall, 219 Gilfillan, St. Paul, Minn., is in charge of the work.

MISSOURI.

Bids are being asked by the supervisors of Blackwater Drainage District No. 1, Robert J. Grover, secretary, Warrensburg, Mo., until noon, March 10, for clearing right of way and excavating main ditch and straightening Blackwater Creek. The excavating work consists of a ditch 27 miles long, containing 1,000,000 cu. yds. of earth. The ditch is to be 3 ft. wide at the bottom, with an average depth of 12 ft. and a one to one slope. The laterals consist mostly of farm ditches, ranging from 3 ft. to 5 ft. wide at the bottom and from 3 ft. to 10 ft. deep. These contain about 225,000 cu. yds. of earth. The payments are to be made in cash each month. The labor conditions in the vicinity are normal. The above work was noted under Bids Asked in our Feb. 16 issue.

OREGON.

Bids are now being asked by the Water Board, Frank T. Dodge, superintendent, Portland, Ore., for furnishing materials and labor for the construction of a steel conduit from Headworks to Mt. Tabor, practically parallel with the present Bull Run conduit, a total approximate distance of 24 miles, and consisting of 52,915 lin. feet of 52-in. and 75,379 lin. feet of 44-in. steel pipe and specials in place. Bids for the work are to be opened March 8, as stated in the official advertisement elsewhere in this issue. The approximate statement of quantities is as follows: 195,000 cu. yds. earth excavation and refilling; 5,500 cu. yds. loose rock; 1,500 cu. yds. solid rock; 25,000 cu. yds. gravel backfilling; 40,000 lin. ft. of 3-in. drain tile; 40,000 ft. B. M. lumber; 26,000 cu. yds. excavation for roadway; 30 acres clearing and grubbing; 21,145 lin. ft. of 52-in. steel pipe, ¼ in. thick; 29,657 lin. ft. of 52-in. steel pipe, 5-16 in. thick; 1,338 lin. ft. of 52-in. steel pipe, ⅜ in. thick; 775 lin. ft. of 52-in. steel pipe, 7-16 in. thick; 75,379 lin. ft. of 44-in. steel pipe, ¼ in. thick, including also 134 angles for the 52-in. pipe, requiring total approximate length of 1,655 ft. of curved pipe. 206 angles for the 44-in. pipe, requiring total approximate length of 970 lin. ft. of curved pipe; 206 manholes; 60 4-in. air valves with 4-in. gate valve; 41 8-in. blow-offs with 8-in. gate valves; 2,360 lin. ft. of 8-in. steel blow-off pipe; 60,000 lbs. steel for trestles; 480 cu. yds. concrete; 1,085 lin. ft. of boxing for 52-in. pipe; 1,290 lin. ft. of boxing for 44-in. pipe; 1 Venturi meter for 52-in. pipe; 1 Venturi meter for 44-in. pipe.

UTAH.

There will probably be some delay in letting the contracts for construction of canal of Upper Blue Ranch Irrigation District (successor to Upper Blue Bench Canal & Reservoir Co.), because of a move to consolidate this work with that of Blue Bench Irrigation District No. 1 immediately adjoining on the south, and thus build one large canal instead of two smaller ones as originally planned. The result of these negotiations will not be known until the location survey of the latter district is completed, probably about April 15th. The West Bench Irrigation District, across the DuChesne River from the Blue Bench, is also planning to build their canal this season; as is also the Fruitland Irrigation District of Westerdahl, Utah. The Dry Gulch Irrigation Co., of Roosevelt, Utah, has expended to date the sum of $230,000 and has its main canals, six in number nearly completed. The company expects to expend about $100,000 more on their lateral systems, headgates, drops, etc. The New Hope Irrigation District of Independence, Utah, expects to complete its canal system this season. The District is jointly interested with the United States government in 14 miles of main canal, and this portion has been completed at a cost of $23,000 for their district's portion; the remaining 10 miles to be built alone is not difficult work and will be constructed for an additional $10,000. Ed. F. Harmston, Roosevelt, Utah, is chief engineer for all of the above work.

The Mississippi Western Construction Co., of Meridian, Miss., organized to build a railroad from Meridian to Natchez, Miss., is planning to begin work in March.

The Union Pacific R. R. is reported to have purchased between $300,000 and $400,000 worth of property between 9th and 12th, on the south side of Jackson, at Omaha, Neb., presumably for a new Union Pacific freight house and yards.

The Missouri Pacific Ry., M. L. Byers, chief engineer, maintenance of way, St. Louis, Mo., is stated to be having surveys made for reducing grades and taking out curves in the line south from Nebraska City, Neb.

Items Concerning Contractors and Their Work

RAILROADS, POWER DEVELOPMENTS, LEVEES, DRAINAGE AND IRRIGATION WORKS.

Alabama Notes.

FROM CORRESPONDENTS AND OTHER SOURCES.

The Commercial and Industrial Association of Selma is taking steps to form a company to build a wharf at that city. O. E. Young, Selma, is to prepare plans and estimates.

The Birmingham Southern R. R. has about completed its extension to the mines of the Tennessee Coal, Iron & R. R. Co., near Wylam. Over 6 miles of line have been graded and track laid, with 90 lb. rails. The work involved some difficult pieces of construction, requiring many deep cuts and fills. Jones & Brewer, Birmingham, Ala., Wallace Bros., of Ensley, and the Grant Construction Co., of Birmingham, were the contractors.

Arkansas Notes.

FROM CORRESPONDENTS AND OTHER SOURCES.

The Fort Smith, Van Buren & Eastern Interurban Co., has an application before the city council of Van Buren for a street car franchise. The company wants a 50-year franchise to operate a car line over seven of the principal streets of the city.

Preliminary surveys are stated to have been started for an interurban line from Rogers to Bentonville and Gentry. J. D. Houseman, St. Louis, Mo., is interested.

H. C. McCluer, Nashville, Ark., chief engineer of the Memphis, Paris, & Gulf R. R., with a corps of 20 engineers, has begun surveys for the extension of the line from Murfreesboro to Pine Bluff, Ark.

The Fort Smith Light & Traction Co., J. Walter Gillette, general manager, Fort Smith, is planning to at once begin work on a 1 mile extension.

The Louisville & Nashville R. R. has completed several miles of grading on the extension of the line now under construction from Falco, Ala., to Rome. Work, it is said, will be completed by March.

California Notes.

FROM CORRESPONDENTS AND OTHER SOURCES.

The Twin Peaks Improvement Club of San Francisco, has appointed Lincoln E. Hackett, C. L. Bennett, C. T. Collins and E. F. Kearney to act in conjunction with the Eureka Valley Improvement Club to secure a new car line to connect these districts. A franchise for an electric line in Eureka Street is favored, to take the place of the cable line running over the steep Castro street hills.

Steps are being taken by the Holton Interurban Ry., Holton, for an extension from El Centre to New River, a distance of nine miles.

Surveys have been completed, the capital has been secured, and construction work is under way on the projected line of the Ontario & San Antonio Heights R. R. The C. E. Woodside Co., Los Angeles, are interested.

Residents of the eastern part of the city of Long Beach have petitioned the city council for the erection of a $75,000 pier at Devil's Gate.

The Southern Pacific is said to be planning to double track its road between Bakersfield and Mojave this season. This means that about 46 miles of road would be double tracked but not through the tunnels.

J. P. Snook and E. S. Brown, Sacramento real estate men and owners of the Bossen and Marcuse ranches, have awarded a contract to the Thor Dredging Co. to build a levee around the Bossen and Marcuse ranches, located near Marcuse Station in Sutter county. The levee will inclose 4,000 acres.

The Solano county supervisors have granted August Stremmell and other San Francisco capitalists a permit to construct a wharf at Glen Cove, on Carquinez straits, midway between Vallejo and Benicia. The company is organized to erect a summer resort and bathing place at that point. Darby Layden, San Francisco, has been awarded the contract to build the wharf.

The Nob Hill Tunnel Association of San Francisco has petitioned the supervisors to take action to construct a tunnel under Nob hill. The estimated cost of the work is about $375,000.

Plans are to be submitted to the city council of Alameda for the enlargement of the municipal wharf at the foot of Oak street, and the construction of a ware house on it. I. N. Chapman is city engineer.

The trustees of the Yolo Basin Drainage District are securing consents of property owners for the construction of a canal through Yolo basin to drain overflowed lands. As soon as this is done surveys will be started for the canal which is to be 10 ft. deep and 350 ft. wide and will cost about $150,000. W. E. M. Beardsley, Broderick, is a member of the board.

The Patterson Water Co. has been incorporated with a capital stock of $200,000 and plans to develop water for hydraulic, irrigation and domestic use on the Patterson ranch, a 20,000 acre tract in Stanislaus county. The directors are Vance McClymonds, S. E. Smyth and C. C. Hamilton, all of Oakland.

During the month of January a progress of 213 lin. ft. was made in the tunnel being driven through the Santa Ynez Range to furnish the city of Santa Barbara with a permanent water supply. It is expected that 275 lin. ft. will be driven in February. The Santa Ynez river will be dammed and the water run through the mountain tunnel a distance of about three miles. Much of the stratum consists of shale, with occasional adobe, which makes the timbering problem an unusual one. Lee M. Hyde, Santa Barbara, is the engineer.

The Cotton Land Co., recently organized by W. I. Hollinsworth, W. J. Hole, Louis Evans, H. V. Blenkiron, D. M. Martin and W. J. Burton, all of Los Angeles, has purchased 30,000 acres of land along the Colorado river. The plans include canal and levee construction, the building of a railroad through the property from Topock, on the southern boundary to the north line, the providing of good wagon roads, and the laying out of the town of Cottonia. Contracts for 11 miles of canals and 15 miles of levee have already been let to W. J. Burton, of Los Angeles.

According to a statement made by Chief Engineer Kallright of the San Diego & Arizona R. R., the line has been completed south of the Tia Juana river to Tia Juana, Mex. Work is progressing well on the Robert Sherer & Co. contract eastward from Tia Juana. The first of several big cuts has been completed and approaches have been started for the tunnel to be cut through the mountain at the head of Mantanuco Canyon.

The Southern Pacific Ry. Co. has surveyed 600 miles of branch lines in northern and northeastern California, southern Oregon and western Nevada to cost about $24,000,000. The new mileage as surveyed is as follows: California Northeastern Ry. Co., 90 miles; Oregon Eastern Ry. Co., 150 miles; Modoc Northern Ry. Co., 80 miles; Goose Lake & Southern Co., 160 miles; Fernley & Larsen Railway Co., 120 miles. E. E. Calvin, San Francisco, Cal., is vice-president and general manager of the Southern Pacific.

According to reports from Marysville, Cal., the Western Pacific Co. is making arrangements to lay a line of track on the Brown's Valley grade which will be raised a few feet and widened out considerably.

According to reports current at Vacaville, Cal., Southern Pacific engineers are securing data for the construction of a line in Southern Colusa County, from Rumsey to Colusa Junction. The new line would shorten the route between San Francisco, Cal., and Portland, Ore., considerably, making it unnecessary for trains to travel by way of Davis and Woodland.

Colorado Notes.

FROM CORRESPONDENTS AND OTHER SOURCES.

Preliminary work and surveys may be made shortly for a scenic tramway up Flagstaff mountain, near Boulder. Col. Lewis Ginger, Colorado Springs, who is back of the project to build a scenic road up Cheyenne mountain, near that city, is also interested in the Boulder project.

The Northwestern Terminal Co., which is backed by D. H. Moffat, Denver, president of the Denver, Northwestern & Pacific Ry., is preparing to begin work on the construction of its belt line around the city of Denver.

Amended maps of the Rio Blanco Canal system projected in Rio Blanco and Routt counties have been filed in the office of the State Engineer at Denver. The estimated cost of the project is about $3,500,000 and it will include: The Trappers Lake reservoir, which is to have a dam 60 ft. high and will hold 887,690,000 cu. feet of water. It is estimated that it will cost $60,000 to construct it. The North Fork of the White River is to supply this reservoir with water. The Marvine Lakes reservoir will also have a 60-ft. dam, and will have a capacity of 458,349,500 cu. ft. Marvine creek is the source of supply named, and $75,000 the estimated cost. The pass Butte reservoir is the largest of the group. It is to have a dam 185 feet in height and a capacity of 4,781,275,000 cu. feet of water. The North Fork of White River and Milk Creek, a tributary of the Williams fork of Bear River, are named as the sources of supply. This reservoir is to cost $1,440,639.50. A. L. Fellows, 435 New Century Bldg., Denver, Colo., is the engineer.

C. C. Rogers, Pierce, C. F. Finley and A. Finley, Fort Collins, have filed maps with the County Court at Greeley for three reservoirs to be supplied from Lone Tree Creek. Reservoir No. 1 has a capacity of 91,883,100 cu. ft., and will cost $28,000; No. 2 has a capacity of 24,400,000 cu. ft. and will cost $6,000; and No. 3 has a capacity of 82,101,120 and will cost $26,000.

The Commonwealth Power & Electric Co., of Georgetown, is planning the construction of a power plant on the Grand River near Georgetown for the development of 10,000 H.P. The dam will be 70 feet in height above present low water, 120 ft. long at water level, 158 ft. on top and with the natural fall of the streams to the power house will give a total head of 106 feet. The water will be carried to the power house, a distance of 5,000 ft. from the dam, through a 10x12-ft. tunnel through solid granite. Frank A. Maxwell and C. D. Runkle of Georgetown, are interested.

John F. Church and associates of Denver are stated to have acquired a number of water rights and reservoir sites on the Little Colorado river in northern Arizona, between Springerville and Holbrook, from the St. John's Irrigation Co., the Meadows Reservoir Co. and the Urall Reservoir Co. It is said that between $800,000 and $1,000,000 will be spent by the Denver men on irrigation projects in this stretch of country.

The Colorado Southern Irrigation Co., which is being financed by the Trowbridge-Niver Bond Co. of Chicago, has purchased from the Hill Land and Investment Co. of Denver 25,000 acres of land along the Arkansas River in Pueblo and Fremont counties. The company plans to construct a $12,000,000 irrigation system in the Arkansas valley, which will bring about 300,000 acres of land under ditch, and this is the first move in that direction.

The farmers living in the Golden-Littleton district have voted in favor of the large irrigation project to be built by the Camfield

Construction Co. of Denver to supply water to the Henrylyn and Golden-Littleton districts. The project will cost about $4,000,000 and the actual work of construction will start in a short time. D. A. Camfield, president of the company, was recently in Chicago for the purpose of placing the bonds.

Stockholders of the Vanskike Ditch Co. held a meeting at Fowler on Feb. 21 to vote appropriations for making extensive repairs to the canal.

The Denver, Laramie & Northwestern R. R. Co., recently incorporated, as mentioned in our last issue, has taken over the holdings of the Denver, Laramie & Northwestern Ry. Co., a $5,000,000 corporation. The new company has been incorporated by the stock holders of the old company for $30,000,000, of which amount $22,500,000 will be issued in bonds for building 750 miles of road. The company is planning extensive improvements in Wyoming, with 200 miles of construction work promised for the coming summer. The company expects to build into Laramie this year. The old company was authorized to build only to the Colorado-Wyoming state line. E. A. Buck, Denver, Colo., is chief engineer.

Advices from Denver state that it is reported there that the Gould interests have taken over the uncompleted New Mexico Central R. R. and will use it as one of the links in a new line they are to build from the gulf of Mexico to the Pacific coast. It is said that the New Mexico Central will be extended east of Albuquerque to Roswell and thence northward to Durango. At this point it will connect with the D. & R. G. In the meantime it is also said that the Southern Pacific has completed all its surveys north from Gallup, N. M., and that it is ready to begin building toward Farmington in the near future. This project has been under way for some time and rights of way and terminals have been secured all along the proposed line.

The Colorado & Southern Ry., H. W. Cowen, chief engineer, Denver, Colo., is reported to have engineers in the field laying out a direct line between Pueblo and Denver, which will reduce the present grade from 4 per cent to 3 per cent, and will be several miles shorter than the present route. The new line would necessitate the construction of a tunnel 3,200 ft. long, about a mile east of Palmer.

The work of enlarging the undercut section of Gunnison tunnel was advanced during January as follows: From the east portal 825 lin. ft. and from the west portal 815 ft. Only 48 ft. of the undercut section remained to be enlarged to the end of January.

It is reported that the Atchison, Topeka & Santa Fe R. R. Co. is considering the construction of terminals in Denver, Colo., estimated to cost several million dollars.

Georgia Notes.

FROM CORRESPONDENTS AND OTHER SOURCES.

The Board of Trade of Americus, Ga., is taking steps to secure the construction of an interurban line from Americus to Ashburn, with Brunswick, Ga., as the ultimate terminus.

The Gainesville Midland Ry. is stated to be about to start surveys for an extension from Gainesville, Ga., to Knoxville, Tenn. At present the road operates a main line of 42 miles from Gainesville to Athens, and a line of the same distance from Gainesville to Monroe, via Winder. E. B. Eppes, Gainesville, Ga., is general manager.

The City Council of Atlanta has granted the Georgia Railway & Electric Co. of Atlanta, franchises for four new lines in the city.

Work is to be started shortly to complete the trolley road from Jackson to Indian Springs. The line will be 5 miles long and most of it has been graded. Capt. W. F. Smith, Jackson, Ga., is interested.

The Georgia, Southwestern & Gulf R. R. has purchased the Albany & Northern Ry. and will extend it from Albany, Ga., to St. Andrews Bay, Fla., on the Gulf of Mexico. J. S. Crews, Albany, Ga., is general manager of the Albany & Northern Ry.

Idaho Notes.

FROM CORRESPONDENTS AND OTHER SOURCES.

A proposition has been made to the City Council of Rexburg, Idaho, by Mr. De Coster, of Victor, Idaho, representing the people of Teton basin, regarding the formation of a company to develop electric power, and suggesting that Rexburg, St. Anthony and other towns join with them in the erection of a mutual plant that would furnish light and power for the entire district.

The city of Idaho Falls is considering purchasing a power site at Broadway on the Snake river and erecting an electric plant, capable of developing 1,500 h. p. Edward P. Caltman is mayor.

The Boise & Western Ry. Co. has filed application for right of way over government land in the United States Land office at Boise, Idaho, together with location surveys for a portion of its projected line. The officers of the company are as follows: Col. C. E. S. Wood, president; James McI Wood, secretary; William Hanley, Burns, Idaho; C. W. Mallett and J. W. McCullock, Ontario; Drake C. O'Reilly, Portland, Ore., are directors.

It is reported that track laying is progressing rapidly on the Pittsburg & Gilmore Ry., from Leadore down to the Lemhi Valley and it is expected that steel will be spiked into Salmon, Idaho, by April 1. It is planned by the company to have the line completed to Stanley Basin by another year and providing the Boise-Butte end of the line is pushed with similar energy a meeting will be made at the head of the Salmon river, completing the road from Salmon to Boise.

The Central Idaho Railroad Co., with headquarters at Salt Lake City, Utah, and Pocatello, Idaho, has filed articles of incorporation at Salt Lake City, Utah. The company, which is capitalized at $220,000, will construct a branch line of the Oregon Short Line, from Owinza, a station of the O. S. L. Ry., through Lincoln county, northwest through Big Wood River Valley to the divide between Boise and Big Wood River Valleys, then through Boise, and Middleton to the Payette Canyon county, where connection will again be made with the Oregon Short Line. W. H. Bancroft is presiden; J. A. Reeves, vice-president; C. H. Jenkinson is treasurer; G. K. Smith is secretary; all of whom are directors.

An ordinance has been passed in Moscow, Idaho, granting the Spokane & Inland Empire Ry. Co. a franchise and right of way from its present terminal to Main and Sixth streets, in the southern part of that town.

The Idaho Northern Ry. is reported to have secured the necessary capital for the construction of an extension from Emmett up the Payette River to Smiths Ferry. E. H. Dewey, Nampa, Idaho, is President and General Manager.

Illinois Notes.

FROM CORRESPONDENTS AND OTHER SOURCES.

Green & Sons Paving Co., of Chicago, Ill., has been incorporated with a capital stock of $30,000, to engage in a contracting and construction business, the incorporators being Louis L. Dent, Ernest Peacock and John H. Cummings, Jr.

The Newkirk & Powers Construction Co., Joliet, has been awarded the contract for grading for the enlargement of the East Joliet Yards of the Elgin, Joliet & Eastern R. R. Fourteen sidetracks will be laid in the rear of the McKenna mills, north of the Maple Street crossing, giving an additional switching space sufficient for the accommodation of 900 cars.

The Chicago, Burlington & Quincy R. R. is planning a number of improvements for its Galesburg division this season. The first to be started will be the double tracking of the road between Galesburg and Knoxville, 6 miles, and Galesburg and Henderson, 7 miles.

The Peoria Southern Ry. Co. has been incorporated with a capital stock of $2,500 and headquarters at Peoria, and proposes the construction of a line from a point in or near the City of Peoria, in a generally southerly direction to a point in or near the City of Pekin, in Tazewell County. The Peoria Northern Ry. Co. has also been incorporated with $2,500 capital stock and proposes the construction of a line from a point in or near the City of Peoria, in Peoria County, in a generally northerly direction to a point in or near the village of Bureau, in Bureau County. The incorporators and first board of directors of both companies as as follows: H. E. Chubbuck, General Manager, Illinois Traction System, Peoria, Ill.; W. H. Carnahan, Champaign, Ill.; H. J. Vance, Peoria, Ill.; H. C. Dillon, Peoria, Ill., and W. J. Achelpohl, Peoria, Ill.

Wallace Treichler, C. E., Rock Island, Ill., has started surveys for an interurban line from Galesburg to Muscatine, Ia. The surveys are being made for Buffalo Prairie parties.

H. E. Chubbuck of Peoria, General Manager of the Illinois Traction system and the Western Railways & Light Company has been elected vice president and general manager of both companies. The Western Railways & Light Co. controls city railway lines and light companies in Wichita, Kas., Galesburg, Quincy, Ottawa and a number of other cities. The head office is in Peoria.

The Cleveland, Cincinnati, Chicago & St. Louis Ry. (Big Four) is planning to erect a new round house at Mattoon this year.

Becker & Son, Lafayette, Ind., have set up their dredge boat and have begun with their ditch contract for the Nixon Special Drainage District of Clinton, Ill. It will require several months to complete the contract.

Track Elevation Departments of the Chicago & Alton, Rock Island, Sante Fe, and Michigan Central R. Rs. at Joliet, Ill., have completed nearly all details for the work and active construction will be started and the project rushed to completion as soon as the weather permits.

The Chicago, Rock Island & Pacific Ry. has started work laying 100-lb. rails on its Illinois Division. Steel for 113 miles of line has already been ordered.

A number of contractors have been in Cairo recently for the purpose of placing bids for completing the grading for the Cairo & Thebes R. R. Grading between Cairo and Santa Fe will be taken up and finished as soon as settled weather in spring comes on. Among the contractors bidding on the work were D. B. and C. W. Lacy of Anniston, Ala.; R. H. McRoberts of Mattoon; W. S. Smith and W. H. McDonald of Memphis, Tenn.

Indiana Notes.

FROM CORRESPONDENTS AND OTHER SOURCES.

Grading work is to be resumed shortly on the projected line of the Terre Haute, Merom & Southwestern R. R., and it is planned to have the track laid into Prairieton not later than May. At present the road is graded for more than 28 miles southwest from Terre Haute and the concrete abutments for all bridges are completed. Three miles of track is laid and bridges for seven miles are built. It is probable that steps will be taken to extend the line as far as Merom the coming summer. Donn M. Roberts, City Engineer, Terre Haute, is in charge of the work.

The Gary & Interurban R. R., of Gary, has placed orders for the material for its 5th avenue route in Gary, and as soon as the material arrives will rush the contruction work. The branch will be about three miles long. T. G. Hamilton is chief engineer.

Attorneys Embree & Embree, representing the petitioners have filed a petition with the County Circuit Court at Princeton asking for the construction of a levee on the Indiana side of the Wabash river from New Harmony to the mouth of the Patoka river at East Mt. Carmel, thence up the Patoka river on both sides to Dongola, a small village near the Pike county line. The total length is estimated at 82 miles and the total amount of land effected at 200,000 acres. The cost is estimated at about $350,000.

Reports from Indianapolis, Ind., state that the Cleveland, Cincinnati, Chicago & St. Louis R. R. Co. is to construct car shops at Beech Grove, near that city, to cost about $1,000,000. Improvements have already been made at that

place by the "Big Four" amounting to $2,000,000.

Board of Public Works of Fort Wayne, Ind., has instructed Harry G. Hogan, city attorney for the city's share of the work incidental to the elevation of the Pennsylvania R. R. tracks through that city. Construction work will be started in April.

Iowa Notes.

FROM CORRESPONDENTS AND OTHER SOURCES.

The stockholders of the proposed Des Moines & Sioux City Interurban Ry. Co., are to hold a meeting shortly to devise ways and means to bond the road so that work can be started. J. W. Reed, Ida Grove, Ia., is President.

The Sioux City, Crystal Lake & Homer Ry. Co., Joseph Foye, President, Sioux City, is to have work started early this spring on electrifying its line. At present the road is operated by gasoline power.

The Chicago, Rock Island & Pacific Ry. is stated to have had plans drawn for a cut-off from Atlantic to Council Bluffs, which would reduce the running time between Omaha and Chicago. The proposed cut-off would be in a straight line southwesterly from Atlantic to Council Bluffs. The distance over the main line from Atlantic to Council Bluffs is now 65 miles, but the proposed route, in a line between the two points, would be slightly over 45 miles.

The supervisors of Muscatine County, Muscatine, are taking steps for the construction of a levee along the north side of Cedar River in Orono and Pike Townships.

Surveys are being made of the Des Moines River at Eldon above and to Ottumwa for the purpose of demonstrating the advisability of a dam just above Eldon to be used for power for the city and surrounding country. Mayor Frank Shane, Eldon, is interested.

The Central Interurban Co. has been incorporated with a capital stock of $10,000 and proposes to build and operate interurban lines in Iowa. The company recently asked a franchise at Des Moines. The incorporators are J. B. Green, W. P. Clark, J. H. Phillips, W. M. Taylor and C. R. Keyes of Des Moines.

The Chicago & Northwestern Ry. is planning the expenditure of $250,000 this year for improvements at Hawarden. These will include the erection of a complete and modern roundhouse, a new 80 ft. turntable, new coaling sheds and several miles of new trackage.

It is generally believed in railroad circles that the Chicago, Rock Island & Pacific R. R. will double track its line from Iowa City, the present terminus of the double tracked line on to Des Moines, Iowa, this summer.

The Commercial Club of Marengo, of which C. M. Beam, is secretary, is taking steps to secure the construction of the proposed railroad from Waterloo, Ia., south to tap the coal field of Keokuk and Mahaska counties.

The Chicago, Milwaukee & St. Paul Ry. Co. is planning improvements at Cedar Rapids, Ia., to cost $50,000. The work includes the construction of a new roundhouse, yard office, coal chute and sand drying house.

The Charles City Western R. R. Co. of Charles City, has been incorporated with a capital stock of $300,000 of which $100,000 already has been subscribed by the promoters. The street car service for Charles City is to be in connection with the interurban.

The Supervisors of Muscatine County, Muscatine, have decided to establish Drainage District No. 12 and to build a levee there.

Kansas Notes.

FROM CORRESPONDENTS AND OTHER SOURCES.

J. E. Snedeker, Osawatomie, Kan., division superintendent Missouri Pacific Ry., has announced that the road bed of the line in the vicinity of Salina, Kan., would be improved.

The Motor Grand Traction Co., of Belleville, which proposes the construction of an interurban railroad line between Chester, Neb., and Wichita, has let the financing of the road to a firm of bankers and brokers at Montreal, Canada, and it is thought that the building of the new line will now be pushed as rapidly as possible.

Michigan Notes.

FROM CORRESPONDENTS AND OTHER SOURCES.

The Saginaw-Bay City R. R. Co. has applied to the State Railroad Commission for authority to increase its capital stock $1,100,000 and to issue bonds to the amount of $5,000,000. This company is the result of the consolidation of the Bay City Traction & Electric Co. and the Saginaw Valley Traction Co. The latter company is planning to lay several new tracks in Saginaw.

The Benton Harbor Interurban line has secured practically all the right of way for its projected extension from Eau Claire to Dowagiac and it is said that construction work will be started in May.

The Lake Superior & Ishpeming Ry. Co., R. C. Young, Chief Engineer, Marquette, Mich., has asked the City Council of Ishpeming for permission to erect a trestle and to make a fill, extending over and north of West Division Street, for the proposed railway line to the Cleveland-Cliffs Iron Co.'s North Lake properties.

The Lansing & Northeastern Construction Co., mentioned in our last issue, is making good progress in the construction of the grade for the Lansing-Owosso line. Grading is well along between Morrice and Shaftsbury and one steam shovel is at work north of Morrice. T. A. Atwood, Caro, Mich., is president of the construction company.

Construction work on the Blaney & Southeastern R. R. extension in Schoolcraft county is nearing completion. The line is to extend from Blaney to Germfask, connecting at the latter place with the Manistee Ry. Edwin P. Radford, Hermansville, Menominee county, is chief engineer.

Maps of the route on the Detroit & Bay City R. R. between Bay City and Caro have been filed at Bay City. The route runs straight east on the eighth quarter line to Quanicassee, thence to Akron and on to Caro, a distance of 30 miles. The grading on the low lands on either side of the Quanicassee river has been completed in order that the progress of constructing the road will not be interfered with in the spring by high water. This road, as previously noted, is being built by Handy Bros., coal operators, Bay City.

An ordinance is before the city council of Sault Ste. Marie, requesting the local street railway company to extend its line north on Ashmun street to 12th avenue.

Minnesota Notes.

FROM CORRESPONDENTS AND OTHER SOURCES.

An ordinance has been before the Council Committee on Streets of St. Paul, requiring the Twin City Rapid Transit Co. to build and operate a car line on Maryland Street, from Dale to Rice Streets, in St. Paul.

The Northern Pacific Ry., W. L. Darling, Chief Engineer, St. Paul, Minn., is said to have definitely decided to build a double track this season from St. Cloud to Little Falls, and perhaps to Staples. It has also determined to straighten out the track from Sartell to Rice.

Announcement has been made by officials of the Minneapolis & St. Paul & Sault Ste. Marie Ry. that it was proposed to expend $8,000,000 in improvements during the present year. Three million will be expended on the Chicago division. The rest will be spent in improving the main line, although a good share will be put into the Thief River branch to Duluth. Thos. Green, Minneapolis, Minn, is Chief Engineer.

The Duluth, Missabe & Northern Ry. Co. has six crews at work near Silica, Minn, grading for double tracking the Coleraine line and for the new line which will be built from Hibbing to Silica. Preparations are also being made for grading for the new 26 track yards to be built at Hibbing to receive all the ore sent to Duluth via the Coleraine branch.

The Hill City, Mississippi & Western R. R. which runs from Swan River to Hill city, 20 miles is reported to have been sold to the Armour Packing Co. for the purpose of obtaining shipping facilities for the large pail and tub factory which the company will establish at Hill City.

Missouri Notes.

FROM CORRESPONDENTS AND OTHER SOURCES.

The directors of the Green Bolton Levee and Improvement Association have decided to begin work on the proposed levee as soon as the weather will permit. Charles Hercules, St. Charles, Mo., is interested.

The city council of Kansas City, Mo., is considering appropriating $2,000 for the defraying of expenses for making a preliminary survey of the Kansas City, Memphis & Springfield R. R. into that city.

The Chicago, Burlington & Quincy R. R. Co. is planning the improvement of its Hannibal division. The work includes relaying the sections between Elsberry and Old Monroe and West Alton and St. Louis, Mo., with 90 lb. rails, and the north end of the division between West Quincy and Burlington with 85 lb. rails.

Sam T. McDermott, of Kansas City, Mo., has made a proposition to the citizens of Buffalo to build a railroad from that place from some point on the Frisco. He agrees to build the road if the citizens of Buffalo and Dallas county would purchase the right of way of the old Laclede and Fort Scott R. R. Co. that is now owned by A. B. Lovan of Springfield.

St. Louis Items.

BY A. B. KOENIG.

F. M. Skene, 606 Victoria Bldg., St. Louis, Mo., has an outfit to let for concrete work, pile driving, etc.

The L. J. Smith Construction Co. have shipped a part of its extensive outfit that they had at work on the Outer Belt R. R. in Kansas City, Kan., on to their new Santa Fe work in Arizona and California.

The Missouri, Kansas & Texas Terminal Co., which is asking the Municipal Assembly for a franchise to establish a terminal system in the North End, has filed a brief with City Counselor Walther, questioning the authority of the Assembly to regulate switching rates. The brief declares the Assembly has no such right, and that any provision put into the bill now pending in the House of Delegates would be illegal. Walther had already given an opinion to the railroad committee of the House, saying the Assembly has authority to make provisions for switching rates, and that any provision of the franchise on that subject accepted by the terminal company will constitute a binding contract. After getting the brief, according to a member of the House committee, he still maintains his position. He doubts the authority of the Assembly to regulate rates except through a franchise contract. A maximum rate of $2.00 a car has been put into the Katy bill by the House committee, and the measure will come up for passage at Tuesday night's meeting. The rate applies only to freight originating and consigned to points on the Katy's terminal system and to shipments consigned through the Katy terminal from one railroad to another, but not consigned to or received from the Katy Railroad. The bill considers the Katy terminal as the Katy Railroad under another name, and specifically prohibits any switching charge for car freight handled by the railroad constructing the terminal. When the House committee first declared its intention of prescribing switching charge limitations, the terminal company protested that it could not accept the franchise if passed. The rate considered then was $1.00 a car. On investigation, the committee decided to allow $2.00 a car and make limitations as to what freight should be so charged. The company while still protesting the rate has changed its reasons. Instead of declaring it cannot accept the franchise, it protests the provision is illegal. The switching regulations will likely remain a part of the bill, and if the terminal company accepts the bill it will be required to do so in writing, and a bond shall be filed with

the city register in the sum of $50,000 within ten days. A cash bonus of $140,000 must also be paid into the city treasury at or before the expiration of ten days after it becomes effective, else it will cease, by its own provisions to exist as a franchise. It has not yet been decided whether the bill to grant the Terminal Railroad Association additional facilities in the Ranken tract shall include switching regulations. The franchise is only an extension of the present rights of the Terminal Association, but some members of the committee say it will be a contract when accepted by the Terminal, and any provisions to regulate switching rates or abolish the bridge arbitrary would be legal.

Henry Schweitzer has resumed work at Hillsboro, Ill., on the Big Four R. R.

A meeting was held at La Grange, Mo., on Feb. 12, for the purpose of considering a proposition looking to the formation of a levee district in the Mississippi Bottom between La Grange and West Quincy, Mo. Most of the land owners concerned were present. J. H. Nelen, Deputy Labor Commissioner of Missouri, who has been preparing a special report for that department on the question of drainage and levee in swamp land of the state, was present by invitation, and addressed the meeting. He pointed out the results that had been derived from leveeing the land in various parts of Missouri. His talk was illustrated by maps, which he had prepared for the special report. J. B. Taylor, L. D. Mitchell, W. E. Oyster and others spoke, after which a committee was appointed for the purpose of investigating the feasibility of the proposed levee and to ascertain other information on the subject.

The Missouri Bridge Co., 3118 East 15th St., Kansas City, Mo., secured the contract to build the Interstate Railroad from Kansas City to St. Joe, Mo. They will be ready to sub-let this work within a month.

The Iron Architectural Steel Contractors' Association will not increase the scale of wages paid to employes. This was decided Sunday afternoon when members assembled in the headquarters of the Building Industries Association. About 90 per cent of the contractors in the line of business in St. Louis attended. The union iron and steel workers gave an ultimation to the bosses several weeks ago, demanding an increase of 20 per cent over the present scale. If this were refused, the union declared, it would call men out on strike June 1. The bosses say that the demand is inopportune and without reason. The union men assert the increase is made necessary by the high cost of living. The bosses drew up an agreement yesterday and all members signed it. The agreement binds each contractor to refuse the union's demand and to stand by each other through the fight. A defense fund has been raised, and the fight, if it comes will be conducted through the building industries association. The granitoid, concrete and paint contractors already have declined to consider a raise their employes asked, and have appointed a committee representing each branch to solicit funds to resist a strike.

McCann Bros. Construction Co. are now at West Frankford, Ill.

Sims Bros. have moved their outfit to Hanson, Ky.

Within the next week A. B. Koenig is going to West Baden Springs to rest up for a few days.

Rust & Swift were awarded a contract by the Burlington R. R. for about 2,800 ft. of river enbankment and protection at Ft. Bellefontaine, Mo. The water of the Missouri has baffled the construction crews and engineers of the Burlington R. R. for many years and now a sudden inroad of the currents has made necessary quick work in protecting their bridge at this point.

J. A. Perdue has finished his contract with the Carden Bottom Levee Board on the Arkansas river and is in the market for more work. Pine Bluff, Ark., will catch him.

H. G. "Shorty" Wells, of Maney Bros. & Co., came to town the other day just in time to get one of our new cards just off the press. As usual Shorty was there at the starting.

Montana Notes.

FROM CORRESPONDENTS AND OTHER SOURCES.

The city of Lewistown, Mont., voted Feb. 15, on granting a franchise to John L. Bright for an electric railway from Lewistown to Kendall. A proposition has also been made to the city by S. W. Gebo for the construction of electric lines from Lewistown to Kendall and Hobson.

Advices from Lewistown, Mont., state that surveyors of the Chicago, Milwaukee & Puget Sound R. R. have started active work on the proposed line from the Bitter Root to the Musselshell, either at Terry or Melstone.

L. W. Hill, president of the Great Northern Ry. Co., has, it is said, authorized the statement that a branch railroad will be constructed during 1910, from Montak, N. D., to Glendive, Mont., where it will make a connection with the Northern Pacific, giving the territory two direct routes to the Twin Cities.

Surveys have been completed by the Beaverhead Ranch Co. for a proposed canal from a point on the Big Hole river to the bench near the company's ranch a few miles north of Dillon. It is proposed to build a dam on the Big Hole river and conduct water by means of the canal to reclaim about 10,000 acres of arid land.

New York Notes.

FROM CORRESPONDENTS AND OTHER SOURCES.

Dr. H. E. Batlin, of Albany, has been elected a director of the Callanan Road Improvement Co. of Albany, to succeed the late J. H. Callanan, who was killed last May in the explosion at the company's quarry at South Bethlehem. The other directors were all re-elected as follows: H. C. Callanan, J. R. Davidson, C. W. Mead and F. P. Hitchcock. The company has a number of contracts for state road improvement work.

The state assembly has passed the bill appropriating $500,000 for a site and the construction of a power house for the capitol and education building.

The Westchester & Northern R. R. Co. has been incorporated at Albany, N. Y., with a capital stock of $1,000,000 to build and operate a steam railroad from Danbury, Conn., to White Plains, serving as a connecting line for the New York, New Haven & Hartford Ry.

Work on the projected line of the Rome & Osceola R. R., Rome, N. Y., has been resumed and contracts for 13 miles of the light grading are being let to farmers along the right of way, the remaining 9 miles, which is steam shovel work, to be let to big contractors. Three miles of the right of way was graded last fall and it is expected to have the entire right of way graded and ready for steel by 1911.

Final arrangements are stated to have been partically completed for beginning construction work on the New York Connecting Ry. which is to connect the New York City terminals of the Pennsylvania R. R. and the New York, New Haven & Hartford R. R., and is to be built by the two last mentioned companies. It will take two years to build the new line which will cost over $15,000,000.

Ohio Notes.

FROM CORRESPONDENTS AND OTHER SOURCES.

All right of way is stated to have been secured between Pomeroy and Cincinnati, for the first section of the Pittsburg, Pomeroy & Cincinnati Traction Co.'s projected line, and it is believed that construction work on this section will be started early in April. When completed the road will be 467 miles long, divided into two sections, Pittsburg and Pomeroy, Cincinnati and Pomeroy. The acquiring of the Cincinnati & Eastern Interurban line, 20 miles long, gives the new traction line an inlet into the heart of Cincinnati, the other terminus being at New Richmond. A. O. Kirschner, Cincinnati, O., is the promoter.

The Southeastern Traction Co. is considering extending its line from Crooksville to New Lexington, and from that place to Lancaster. Steps are to be taken at once to secure the necessary right of way.

A $100,000 subway is to be built at North Main Street, Niles, by the Erie R. R. Co., the Baltimore & Ohio, the Mahoning Valley Street Ry. Co. and the city of Niles.

The Pennsylvania R. R. has been making surveys through Wooster preliminary to laying a third track between Smithville and Millbrook.

The Baltimore & Ohio R. R. has been making soundings in the lake on the river frontage at the old ore docks of the company at Lorain, preliminary, it is said, to the preparation of plans for the construction of modern ore docks at the mouth of the river.

According to an announcement of William Cotter, President of the Cincinnati, Hamilton & Dayton R. R., that company had closed contracts for $8,000,000 worth of improvements to be made during 1910. One-fourth of this amount will be used to improve the Cincinnati terminals; $1,000,000 for new yards and warehouses in Toledo; $3,000,000 for new rolling stock, including 30 locomotives, and the balance in road betterments. F. H. Alfred, Cincinnati, O., is Chief Engineer.

R. B. Gordon, of Celina, O., has been awarded the contract at $33,000 for dredging the Wabash river from a point in Mercer county about four miles east of the state line to the bridge spanning the stream in Wabash township at New Corydon.

Engineers on the Lake Shore & Michigan Southern Ry., Samuel Rockwell, chief engineer, Cleveland, O., have completed a survey for a new route to obtain a minimum grade from Ashtabula harbor to Carson six miles south. The route, beginning at a point near the new shipyard site, will follow the valley of the Ashtabula river for more than three miles and then gradually rise to the Carson yards. Should the line be built, ore trains in leaving Ashtabula, will make a great saving in power in reaching the elevation of the Carson yards.

Construction work on the proposed line of the Ohio River & Northern Railroad Co., which was abandoned during 1908 on account of the panic, will be resumed and rushed to completion this spring. As projected the route is from Lorain, on Lake Erie, to West Point, Wellsville and up the Ohio river to East Liverpool, Smith's Ferry and Midland, Pa., and eventually to Pittsburg, Joseph Ramsey, Jr., 15 Wall street, New York, is interested.

The Toledo & Indiana Ry., which recently passed into the hands of C. F. Niles, Toledo, receiver, representing the majority of bond holders, has filed articles of incorporation with the secretary of state thereby taking the first step toward the reorganization of the company. The initial capital is $10,000.

Oklahoma Notes.

FROM CORRESPONDENTS AND OTHER SOURCES.

Harry Bradford, El Reno, Okla., has asked a franchise at Altus, Okla., aand proposes to construct an electric street railway in Altus, provided the city will furnish the power, the city to receive one-half of the proceeds of the line in return for the power furnished and the franchise.

The Commissioners of Oklahoma at Oklahoma City, have been petitioned to have preliminary surveys made with a view to straightening 12 miles up the course of the North Canadian River.

Dr. H. E. Colby, Gotebo, Okla., has asked the city of Mountain View for ten miles of right of way for his projected line of railroad from Fort Worth to Denver, the proposed route crossing Southwestern and Western Oklahoma. It is proposed to have the line pass through Lawton, Weatherford, Thomas, Taloga and Mountain View.

Promoters of the Cherryvale, Oklahoma & Texas R. R. have succeeded in financing the project and, according to reports, construction work will be started on the right of way at once. The road was chartered to build southwest from Caney, Kan., through Pawhuska, Blackburn, Perry, Guthrie, and Geary, Okla. G. A. Masters, Perry, Okla., and Senator

Porter, Caney, Kan., are promoting the project.

C. C. Jones of Oklahoma City, one of the promoters of a line of railroad from Wichita Falls, Tex., to Lawton, has submitted to the chamber of commerce of Lawton a proposition whereby he guarantees to build the road within a year.

Surveys are to be started at once, it is said, for the construction of the proposed line of the Denver, Kingfisher & Gulf R. R. from Oklahoma City, Okla., to a connection with the Kansas City, Mexico & Orient R. R.

The Osage & Western R. R. has permanent locations underway west from Vinita. The company is now said to be ready to begin actual construction and is only waiting for the towns along the proposed route to sign up the the honus contracts. E. J. Noonan, Wimer Bldg., Vinita, is Chief Engineer.

Construction work in the continuation of the Capitol Hill line of the Oklahoma City Traction Co., to connect Oklahoma City and Moore is progressine rapidly and over five miles of grading work has been completed. It is expected that by March 15 all of the grading work will be completed and track laying started. John Shartel, Oklahoma City, is President.

Oregon Notes.

FROM CORRESPONDENTS AND OTHER SOURCES.

The Albany & Interurban Ry. Co. has been incorporated with a capital stock of $25,000 and headquarters at Albany, and proposes to construct a line from Albany to Sweet Home, by way of Brownsville and Holley, and from Albany to Sweet Home by way of Lebanon. The incorporators are P. A. Young, C. E. Sop and Joseph M. Hawkins.

Engineers of the Canby Canal Co. of Canby, have completed surveys to Molalla for the projected electric railroad through from the Willamette River at Canby. An excellent route was found with practically no heavy cuts or fills and in no place is there a curve greater than 30 degrees.

It has been announced that the Oregon Trunk Ry. will this year extend its line to Klamath Falls, practically giving the Hill interests a connection with San Francisco, in that by running a short line to Alturas, Cal., a connection could be made with the Western Pacific, now under construction through the Sacramento Valley. An application has been filed with the Department of the Interior at Washington, D. C., for the right of way through the Klamath Indian reservation. L. W. Hill, St. Paul, Minn., is president of the company.

Pennsylvania Notes.

FROM CORRESPONDENTS AND OTHER SOURCES.

The McNichol Paving & Construction Co., Philadelphia, Pa., has been awarded a contract by the Philadelphia & Reading Ry. for grading and concrete work in connection with the construction of bridges. The railway will add two tracks to its present two-track system from Norristown to Reading. The contract awarded is for grading between Valley Forge and Perkiomen Junction and for the concrete work on abutments and piers along that section of the line. One portion of the work will consist of cutting through 50 feet of solid rock. The contract amounts to about $175,000.

Public meeting will be held shortly by citizens of Altoona to take action on the applications of the Johnstown & Altoona Street Ry. Co. to run its cars through Altoona over the tracks of the Logan Valley Ry. Co. The company proposes to construct a line between Altoona and Johnstown.

The Lehigh Valley Transit Co. of Allentown, is said to be considering making a belt line out of its road in Hellertown. This would be done by extending the road through Leithsville, Springtown and Pleasant Valley to connect with the Philadelphia line at Quakertown.

The Philadelphia & Suburban Elevated R. R. Co., S. S. Neff, President, Philadelphia, which now has an application before the Governor for a charter, is said to have secured the necessary financial backing to carry out the proposed Broad Street subway and its elevated extensions of Lehigh Avenue and Germantown Avenue, at Philadelphia. The company's engineers have for months been at work preparing plans especially for the terminal at Broad and Filbert Streets.

William Ludascher, Philadelphia, has applied to the Dock Department of that city for permission to build two piers on his property between Westmoreland and Ontario. He desires to build one pier 140 ft. wide and another 83 ft. wide.

M. P. McGrath, president of the M. P. McGrath Contracting Co., of Easton, Pa., has incorporated his business under the laws of the state of New Jersey for $125,000. The officers are: President, M. P. McGrath; secretary and treasurer, J. F. Mooney. The company intends to carry on the same class of work as heretofore, namely, railroad work and concrete construction.

The Pittsburg, McKeesport & Westmoreland Street Ry. Co. has taken over the franchise of the Peter Creek Street Ry. Co. and is planning to proceed with construction work early in the spring.

M. S. S. Hershey, the chocolate manufacturer, is reported to have surveyors in the field laying out a trolley line from Hershey through the Northwestern part of Lebanon county.

The Lehigh Valley Railroad Co. is reported to have decided to construct a road from Hazel Creek Junction to White Haven, Pa., to cut off the run to Penn Haven to be for passenger and freight traffic. E. B. Ashby, New York, N. Y., is chief engineer of the company.

A Committee of property owners along the proposed right of way of the extension of the New Park and Fawn Grove R. R., to Delta are to hold a meeting to take up the matter of furnishing right of way for the project.

The Philadelphia & Reading Ry., Wm. Hunter, chief engineer, Philadelphia, Pa., has plans underway for four-tracking Mahanoy Plane with a view to doubling its capacity so that much of the soft coal traffic may be diverted from the Catawissa branch, which is a single track from Milton to East Mahanoy Junction. Work on the contemplated improvements will be commenced about June.

The Committee on Corporations of the Maryland Legislature has made a favorable report on the bill to authorize the Western Maryland R. R. to finance the extension of the road from Cumberland to New Haven, Pa. While new stock might be issued at par without further authorization from the Legislature, the plan of issuing it below par, which is authorized in the pending bill, necessitates such sanction. At a hearing before the committee this morning Mr. George R. Gaither, representing the railroad, said that probably $15,000,000 will be issued. The new stretch is to be 83 miles long and will be completed in about two years according to Mr. Gaither. H. R. Pratt, Baltimore, Md., is Chief Engineer.

South Carolina Notes.

FROM CORRESPONDENTS AND OTHER SOURCES.

The Greenville, Spartanburg & Anderson Ry. Co. has applied for a charter for an electric railway to be built from Spartanburg, S. C., to Greenville, S. C. The project is backed by the Duke interests.

The Spartanburg & Greenville Ry. Co. has been chartered with a capital stock of $100,000 and headquarters at Greenville, S. C., and proposes to operate an electric railway between the city of Greenville and the city of Spartanburg. The officers of the company are: Charles W. Ellis, president; H. H. Price, vice president, and C. H. Yates secretary and treasurer. The road is to be 31 miles in length and starting at the city of Greenville it will pass through the townships of Butler and Chick Springs in Greenville County and Spartanburg in Spartanburg County.

Texas Notes.

FROM CORRESPONDENTS AND OTHER SOURCES.

The Atchison, Topeka & Santa Fe Ry. is said to have decided to locate the shops for its Texico-Coleman cut-off line at a point about 15 miles south of Lubbock just on the edge of the cap rock, the beginning of the great plains. At that point a branch line will diverge, going due south to Tahoka, Lynn County, and La Mesa, Dawson County, a territory now without transportation facilities. The construction near the site of the shops will be somewhat expensive, since a cut some nine miles long will have to be made in getting the road onto the plains. The maximum depth of the cut will be 80 ft.

The Bowers Southern Dredging Co. of Galveston, is now employing three dredge boats on its contract for cutting a channel at Arkansas Pass. The last dredge boat to be employed came from the Southwest Pass of the Mississippi River. It is estimated that the work will be complete in about seven weeks.

W. T. Eldridge, Sugarland, President of the Sugarland Ry., has acquired 8,600 acres near Sugarland and will install a drainage and irrigation system.

The Rivers' and Harbors' committee of Congress has voted to adopt Houston's proposition to subscribe $1,250,000 toward the completion of the Houston ship canal. As soon as the appropriation is made by the federal government work will be started, creating districts at Houston for the purpose of voting bonds for the city's share of this work. Mayor H. B. Rice, of Houston, has already named committees to take action on the matter.

The charter of the Gulf Coast & Provident City Ry. Co. has been approved and filed, granting the company the right to construct a railroad from Pierce, in Wharton County, to Provident City, a total distance of 35 miles. The incorporators of the new company. The company was mentioned in our issue of Jan. 26.

Construction work is progressing rapidly on the Texas Central R. R., west of De Leon, for a distance of 75 miles, and a contract for 200,000 cross ties has been placed with William Cameron & Co., Inc., Waco, Tex.

A proposition is reported to have been made to the citizens of Monahans, Grand Falls and Fort Stockton to run a branch of the Texas and Pacific to Fort Stockton, a distance of 58 miles, forming a junction with the survey of the Kansas City, Mexico & Orient. B. S. Wathen, Dallas, Tex., is Chief Engineer of the Texas & Pacific Ry.

Track laying on the Coleman-Texico cut-off of the Santa Fe R. R. reached Jim Ned creek, 23 miles north of Coleman, on Feb. 10. Further track work will be delayed until the bridge is completed.

The Houston Electric Co. of Houston is planning to extend its South end street car line out Fannin St. through the properties of W. B. Sharp and David Hannah.

C. L. Hopkins, cashier of the State Bank and Trust Company of San Marcos, representing a syndicate of capitalists, has asked the City Council for a franchise to construct a street railway system in the city. The franchise asked provides for trolley lines to be run to the depots a loop through the West End, going out San Jacinto St. and returning on Belvin St.; also a loop taking in the several schools of the city.

The Caro Northern Ry. has ordered preliminary surveys made for the construction of an extension from Mount Enterprise to Pine Hill, connecting with the Timpson & Henderson R. R. John C. Saner, Caro, Tex., is President.

Preliminary surveys for the Waco, Belton & Georgetown R. R. have been completed. The proposed road is to be built by Belton capital if the International & Great Northern can not be interested to build the line.

A preliminary organization is to be perfected shortly at San Marcos for the building of the San Marcos-Luling interurban line. Eastern capitalists are reported to have become interested in the project which is being promoted by Judge B. G. Neighbors of San Marcos and Joseph Jennings of Martindale.

Utah Notes.

FROM CORRESPONDENTS AND OTHER SOURCES.

The City Council of American Fork has been considering the application of Abel J. Evans of Lehi, and S. L. Chipman of American Fork, for right of way through the city for an electric railway.

During the month of January 425 lin. ft. were excavated in the Strawberry Tunnel of the U. S. Reclamation Project in the Strawberry Valley. The material encountered was a combination of blue limestone and sandstone, which is difficult to drill and requires a great deal of powder to break it. The tunnel is over 19 per cent completed. J. L. Lytel, Provo, is Project Engineer.

The Union Pacific Ry. has filed an application in the Land Office at Salt Lake City to change its right of way through portions of Weber and Morgon counties for a distance of 7 miles, 1¼ of which is in Morgan county and 5½ in Weber. The purpose of the application is to secure a better grade for the railroad track through the Weber canyon, and it is the intention of the officials of the road to construct a new track on the north side of the Weber river when the application is granted. The right of way desired lies through the mountains to the east of Ogden, and some of the land asked for is unpatented government land. The proposed new line will give the road a 1 per cent grade for its eastbound trains, and besides double track facilities in and out of Ogden.

Virginia Notes.

FROM CORRESPONDENTS AND OTHER SOURCES.

The City Council of Norfolk, Va., is considering granting a franchise to the Portsmouth Traction Co. of Portsmouth, Va., for extending its tracks in certain streets in Colonial Pl., in the former city. As soon as the franchise is granted the traction company will begin construction work.

Surveys are under way, it is said, by the engineers of the Virginian Ry., for the construction of a connecting link from Moneta, Va., to Bedford City and thence northward to a connection with the Norfolk & Western and the Chesapeake & Ohio Ry. H. Fernstrom, Norfolk, Va., is chief engineer of the Virginian Ry.

The Norfolk Terminal Ry. Co., Norfolk, Va., mentioned in our last issue, as being incorporated with a capital stock of from $50,000 to $150,000, will also construct a $1,000,000 union station and office building to be used jointly by the Norfolk & Western and the Norfolk & Southern Rys. L. E. Johnson, Roanoke, Va., is president of the company.

The Virginian Ry. Co. is planning the construction of a number of improvements at Roanoke, Va., which will include the construction of shops and roundhouses. H. Fernstrom, Norfolk, Va., is chief engineer of the company.

Plans have been completed for the construction of the Mill Mountain Incline Ry., at Roanoke, and contract for the work will be let at once.

The City Council of Richmond has granted the Richmond & Henrico Ry. Co. permission to begin actual track construction in Marshall St. and North 5th St. Material is already on the ground.

Washington Notes.

FROM CORRESPONDENTS AND OTHER SOURCES.

The Yakima Inter-Valley Electric Ry. Co., Henry Lombard, President, Miller Bldg., North Yakima, is considering constructing a gasoline motor line betwen North Yakima and Yakima City. The line would be about 4 miles long and would cost about $100,000.

The Guggenheim interests are planning to begin work March 1 on its power plant at Concrete. A concrete dam 160 ft. high is to be placed across a deep gorge on Baker River, a mile above the Washington Cement Company's plant. This will form a lake six miles long and one and one-half wide and the water will be 150 ft. deep at the dam. A reenforced concrete flume will be built to the power house 4,500 ft. away, with a fall of 150 ft., where the water will turn large turbines to develop 25,000 HP. Simon Guggenheim, Denver, Colo., is interested.

Mathew Dow, Seattle, has been awarded the contract for constructing the new $160,000 dock at Seattle, for the Grand Trunk Pacific Ry. The new dock, which is to be the Seattle landing place of the Sound and ocean-going steamships of the Grand Trunk Pacific will be 625 ft. long and 177 ft. wide, with a building three stories in height, surmounted on the water side by a tower 80 ft. high. The building and wharf will be entirely of timber construction, being erected directly over the water, on concrete piling. Blackwell & Baker, Seattle, are the architects, and James H. Bacon, harbor engineer, will be in charge of the work for the Grand Trunk Pacific.

The Pluvius Development Co., composed of Seattle and Wenatchee capitalists, has started work on its irrigation project in Spring Canyon, on the Columbia river, 17 miles north of Almira. It proposes to irrigate 1,000 acres. The company has acquired control of a natural basin containing about 640 acres, draining approximately 20,000 acres, which will be used for a reservoir.

Port Angeles Power & Electric Co., of Port Angeles, has been incorporated with a capital stock of $30,000, the incorporators being Frank MacKean, R. H. Bethel, George D. Brown, William Tyrrel and Julian R. Becker.

The Yakima Water Users' Association has completed its organization and has elected F. A. Wiggings, of Toppenish, secretary and treasurer. The purpose of the association is to promote the work of construction of the high line canal in Kittitas, Yakima and Benton counties and Toppenish.

Work has just been commenced on the No. 2 tunnel on the Deschutes R. R., about two miles south of Horseshoe Bend, which is 1,000 ft. in length. It is expected that the job will be completed by August.

The Seattle-Tacoma Power Co., Morton Ramsdell, Manager, Tacoma, is to spend $500,000 for the enlargement of its Snoqualmie Falls plant. The first installation will be 10,000 H. P. All the apparatus has been ordered and the company has already begun work preliminary to the construction of the plant. The development will be made by diverting water from the Snoqualmie River at a point about 100 ft. from the existing dam at the falls on the east bank of the river, opposite the original plant. From the new intake and headwork the water will be conveyed through a concrete-lined tunnel 12 ft. in diameter driven through solid rock a distance of nearly a quarter of a mile to the forebay, another large rock excavation. Seven-foot steel pipes, 550 ft. in length, lead from the bluff and down to the new power house. The power house will be built of reinforced concrete. The tunnel, headworks and other construction require a large amount of rock work and for this the power company has already installed a big compressor plant driven by electric motors from the old Snoqualmie power house and has 10 Ingersoll pneumatic drills at work at the present time.

The Northern Pacific Ry. has practically secured all right for its 44-mile Point Defiance line and construction work will be started in the near future. The work will include the construction of a 900-ft. tunnel.

Wisconsin Notes.

FROM CORRESPONDENTS AND OTHER SOURCES.

The Great Northern Ry., A. H. Hogeland, chief engineer, St. Paul, Minn., is said to be planning taking up shortly the work of building double track from Brookston to Swan River. The line would be about 30 miles long and would cost about $200,000. Plans for this work were made in 1907.

Supplies and tools for the commencement of work on the Chicago & Northwestern Ry's. new line from West Allis north for a distance of 40 miles, are being received at Wauwatosa, and it is planned to begin grading work shortly. It is said that about 8,000 men will be employed. John R. Marsch, 181 La Salle street, Chicago, Ill., has the general contract.

The Engineering Department of the Minneapolis, St. Paul & Sault Ste. Marie Ry. has submitted plans to the City Officials of Superior, Wis., for subways under the 21st St. and Belknap St. tracks of the Soo. The 21st St. subway will be 510 ft. long and will cost about $63,000.

Winston Bros., of Minneapolis, Minn., have shipped 13 car loads of construction tools to Beaver Dam, Wis., for work on the new right of way for the C. & N. W. Ry., which passes about two miles south of the city. The tools were unloaded there and will be hauled to the site of their camp, which will be located somewhere along the line.

The LaCrosse & Winona Traction Co., a Minnesota corporation with $100,000 capital and $75,000 interest in Wisconsin has filed a statement to do business in this state. N. J. Ferris of LaCrosse is the Wisconsin representative.

Canadian Notes.

FROM CORRESPONDENTS AND OTHER SOURCES.

According to an announcement of the Canadian Minister of Public Works Canada does not propose to construct the Georgian Bay Canal as a public work. It is probable that the Georgian Bay Canal will be started by a British firm which will have aid from Canada in the form of a guaranty of interest on bonds to the amount of $100,000,000.

The Canadian Pacific Ry. has announced that it will build 300 miles of new road this season in Sackatchewan, Alberta and southern British Columbia, at a cost of $10,000,000.

Stockholders of the proposed Highland Street Railway line at Albuquerque, N. Mex., have accepted propositions of J. H. Barrett, of Pittsburg, Pa., to build the line. According to the proposition the citizens of Albuquerque are to furnish $15,000 in paid up stock. This sum is to be turned over to Mr. Barrett for construction. A. W. Hayden, Albuquerque, N. Mex., is interested.

A bill is to be introduced shortly in Congress to encourage a project for the construction of a railway connecting New York and other cities in this country with the principal points of Chili and Argentine. The project is being promoted by former Senator Henry G. Davis, Elkins, W. Va.

The Fairmont & Clarksburg Traction Co., of Clarksburg, W. Va., has secured the necessary capital for the construction of its projected 20-mile line from Clarksburg to Weston, passing through Mount Claire, Lost Creek and Janelew. Surveys are to be started at once.

Advices from Asheville, N. C., state that the W. T. Weaver Power Co., which is constructing a $400,000 power plant on the French Broad River about two miles below Marshall is making considerable headway with its preliminary work and when the weather opens the company will begin actual construction on the dam. The plant will develop about 3000 HP.

The Rutland R. R. is to build a $60,000 boiler shop at Rutland, Vt.

The Territorial Engineer of New Mexico has approved the application of Levi A. Hughes of Santa Fe, N. Mex., for the surplus waters to fill a reservoir at the junction of Cieneguilla, Bonanza and Santa Fe Rivers, 14 miles south of Santa Fe. The reservoir to have a capacity of 22,611 acre feet and the waters are to reclaim 18,000 acres on the La Bajada grant. The dam is to be 155 ft. high and is to cost $155,000. It is to be of concrete.

Vernon L. Sullivan, Territorial Engineer of New Mexico, has granted the application of George T. Lambert, Dorsey, N. Mex., for permission to use the waters of Tinaja Creek to irrigate 2,500 acres of land at a cost of $45,000. The engineer also granted the appli-

cation of E. A. Clayton, Artesia, N. Mex., for the waters of Runyon Springs.

Commercial club of Biloxi, Miss., is advocating the construction of a railroad from Biloxi to Gulfport, Miss.

The Gainesville Midland Ry., now operating between Gainesville, Ga., and Athens, Ga., is to have surveys started at once for the construction of an extension from Gainesville to Knoxville, Tenn. E. B. Eppes, Gainesville, is General Manager.

The Western Maryland R. R. Co. has purchased property for the extensive improvement of the terminal facilities at Hagerstown, Md. Work of razing the present structures on the property has already been started. H. R. Pratt, Baltimore, Md., is chief engineer of the W. M. Ry.

Surveys are now under way for the construction of the proposed line of the Greenville, Spartanburg & Anderson Ry. Co., from Anderson to Greenville .W. D. Neves, Greenville, N. C., is Engineer of the company, which was mentioned in our January 19th issue.

The Southern Pacific has completed its southern extension to the Santiago river, 1,004 kilometers from Guaymas, Mex., and construction work is to be pushed to Tepie a distance of 96 miles. The distance between Santiago river and the end of the Southern Pacific in Jalisco is 271 kilometers, including the barranca link, which will require two years to construct and will cost about $5,000,000. Sixty-one kilometers of the Southern Pacific in the state of Jalisco, from Oredain, the junction with the National Rys. are now in operation.

The Hendry & Knight Co. of Tampa, Fla., owning extensive docks along the river front in the Garrison section of Tampa, is having estimates prepared for the construction of additional wharfage eastward from the docks now leased to the Penn and Mallory Line Steamship Companies to the lift bridge which connects the mainland with the Seaboard terminals on Seddon island. The company proposes to extend the docks 500 ft. to the east of the Penn line docks.

Officials of the Grand Trunk have filed a petition for a charter for the Southern New England Ry. Co., to be operated in connection with the Grand Trunk System. As proposed the new line will start at Palmer, Mass., a station on the Central Vermont Ry., which is also controlled by the Grand Trunk, and pass through Webster, Mass., Woonsocket, Valley Falls, Salyesville and Pawtucket, R. I., to Providence. Locations surveys for the road will be filed before July 1, 1911.

Huntley, Church, Boyington & McCoy of Spokane, Wash., and Billings, Mont., who have the contract for double tracking the Northern Pacific between Billings and Huntley, Mont., 13 miles, have sublet portions of the work to the following: James Ryan, A. J. Sullivan and J. Werlen of Billings, Mont., and Fred Johnson of Spokane, Wash. The work is to be completed by June 1.

Representatives of different townships interested in the construction of the proposed railroad from Alcolu, through Florence to Georgetown, recently held a meeting in the courthouse at Florence, S. C., where it was decided that the townships should provide for the survey of the line. A bill is now before the legislature providing for the incorporation of the Florence Construction Co., Florence, S. C., which will take up the matter.

Advices from Augusta, Me., state that the Kennebec Development Co., of which O. H. Briggs is President, is planning to begin work in the spring on the construction of three large dams in the Kennebec River. The three dams will be constructed at Indian Pond, Me., a short distance below Moosehead Lake's outlets, where the two outlets come together. Below the falls, at the outlet of this pond, this dam will stand, rising till the water will not only flood out the long stretch of quick water between the east outlet and Indian Pond, but this pond itself will be buried by 125 ft. of water. Below this dam will be built an other 123 ft. high, its highest level just on a level with the tailings of the up-river dam, which in its turn will afford a reservoir for another holding of water and double the capacity of 30,000 HP. allowed by the first dam. Still farther down the river toward the Forks the third dam will be built, also rising to an elevation of 123 ft. Each of these three dams will create a horse-power of 30,000. The total of the reservoir system, as planned, will approximate 56,000 acres.

The Stone-Webster Engineering Corporation, constructing engineers, Stone & Webster Bldg., Boston, Mass., at the end of December, 1909, had construction contracts amounting to $11,341,000. The location and amount of these contracts were as follows: Montana, $3,650,000; Washington, $3,341,000; Rhode Island, $284,000; Massachusetts, $51,000; California, $50,000; New York, $274,000; Georgia, $100,000; Florida, $518,000; Texas, $3,073,000. The classification of the work was as follows: Water powers, $4,140,600; interurban railways, $2,607,700; street railways, $777,700; steam power station, $940,000; buildings, $2,495,000; miscellaneous, $380,000.

The Lincoln Traction Co. of Lincoln, Neb., has asked permission of the City Council of Lincoln, to extend its lines over certain streets. The company agrees to begin construction by Aug. 1, and to complete one mile of track by Jan. 1 next.

According to a statement of George Pittenger, president of the Board of Trade, of Asbury Park, N. J., plans are under way for the building of an electric trolley railroad between Trenton and that city. The proposed road will run from Asbury Park to Freehold through to Hightstown via Englishtown and Jamesburg, and from Hightstown to Trenton, via Allentown, a distance of 41 miles. All the necessary rights of ways and other concession are said to have been obtained and sufficient capital is stated to have been interested to assure the success of the project Work on the road is to be commenced within a short time.

Citizens of Bullett County, Kentucky, have petitioned the Louisville Ry. Co., T. J. Minary, President, Louisville, Ky., to extend its lines between 14 and 15 miles further. The cost would be from $12,000 to $15,000 per mile. The farmers, it is understood, agree to give the company free right of way.

The Babahoyo & Guaranda Electric R. R. Co. has been chartered under the laws of West Virginia, with a capital stock of $1,380,000, and headquarters at Baltimore, Md. The company proposes to construct a railroad 40 miles long in Ecuador, South America, and to own and operate manufactories and engage in a general development business in that country. The Government of Ecuador is said to have guaranteed the principal and interest on 6 per cent bonds running 33 years to the amount of the authorized capital stock. The railroad will open up a rich timber and fruit section. The incorporators are: Julio H. Cardon, of Guayaquil, Ecuador; Benjamin F. Patterson, James G. Pugh, Martin H. K. Paulsen and John B. Timmerman, of Baltimore, Md.

The Chicago, Burlington & Quincy R. R., F. T. Darrow, engineer, maintenance of way, Lincoln, Neb., has announced extensive improvements this year for the Omaha and Lincoln divisions. The work on the Omaha division consists of double tracking between Lincoln and Waverly, the ballasting of 65 miles of road between O'Neill and Sioux City and extensive bridge rebuilding and track betterment. On 85 miles of the main line in the vicinity of Lincoln will be laid new 90 lb. steel rails. West of Lincoln for 100 miles new ballast will be put on the track. The Denton cut-off, the Milford line and several other branches also come in for a large share of new work.

Surveys are under way by a number of eastern capitalists for the construction of the proposed railroad to run from Greeneville, through Parrottsville to Newport, Tenn., where a connection will be made with the Knoxville, Sevierville & Eastern R. R.

The Mexico, Oaxaca & Yucatan Ry. Co., incorporated with a capital of $1,000,000, has filed its articles of incorporation at Lincoln, Neb. W. C. Seaver of New York City is president of the proposed road. The company proposed to build a line through Nebraska from Omaha through Douglas, Sarpy, Cass, Otoe, Johnson and Pawnee counties, thence through Kansas, and to have general offices at Omaha, Topeka, Joplin, Mo., Ft. Smith, Ark., Pascagoula, Miss., and Mobile, Ala. The length of the proposed railroad, including branches, is estimated at 1,314 miles.

A bill is before the State Legislature of Maryland to incorporate the Washington, Marlboro & Drum Point Railway Power & Lighting Co. Under the proposed law this company is empowered to construct and maintain a railroad in Calvert and Prince George counties. It is to run from a point where the Washington, Baltimore & Annapolis road enters the District of Columbia to the Potomac river, and at some point at or near where the Patuxent river empties into the Chesapeake Bay. The company is authorized to construct branch roads and may consolidate with other roads. The incorporators are: Francis S. Carmody, Richard N. Ryan, C. A. M. Wells, Robert W. Wells, E. A. Fuller, C. Francis Owens, Francis E. Baker, William C. Carroll, M. Hampton Magruder, Charles C. Mayer, and Reese Carpenter.

A bill has been introduced in the Massachusetts Legislature providing a plan for the improvement of Boston Harbor by the enlargement of harbor facilities by great railroad terminals on the East Boston flats, with a marginal railroad about the entire East Boston water front. The principal features of the plan are as follows: The construction of a $1,200,000 dock on Commonwealth flats every five years until ten have been built; a marginal railroad, connecting the new docks with the principal railroad lines; a new immigration station in East Boston; two large dry docks; dredging the Bird Island flats and the Governors Island channel and improving the port to accommodate the largest ocean-going vessels afloat. Henry M. Whitney, a leading capitalist of Boston, Mass., is behind the plan.

The Union Dock & Railroad Co. of Morgantown, W. Va., has been incorporated with a capital stock of $100,000 and proposes to construct switching tracks at docks at Morgantown. The incorporators are George C. Sturgiss, S. A. Posten, R. L. Morris, A. Rightmire and Robert A. Vance of Morgantown.

The South Carolina & Western Ry. of Hartsville, S. C., has been organized with a capital stock of $500,000 and proposes to build a road from McBee and Hartsville to Darlington and Florence. The route has already been surveyed and it is said that construction contracts will be let shortly. Samuel Laurence, Hamlet, N. C., is interested. W. R. Bonsal, Hamlet, N. C., president of the North & South Carolina Ry., is also interested.

The capital stock of Florida Ry. has been increased from $2,000,000 to $4,000,000, the increase being made for the purpose of extending the line from Live Oak, Fla., to Ferandina, Fla., via Jacksonville, and equipping the road with rolling stock. The extension of the road will be built as fast as possible. Frank Drew, Live Oak, Fla., is President.

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CONTENTS.

EDITORIAL: Page.
An Editorial Review of the Work of the Sixth Annual Convention of the National Association of Cement Users.....189
Method and Cost of Constructing a Concrete Block Warehouse.....190
A Method of Long Span Light Floor Reinforced Concrete Construction with Comparative Costs.....191
A Method of Heating Broken Stone in Wagons for Concrete Work.....192
Concrete Barges for the Panama Canal Work.....192
Methods and Cost of Sinking the Brier Hill Concrete Lined Shaft, Michigan....193
Comments on Contracts for Concrete Bridge with Description of the Form of Cost Recording.....194
Method of Laying Concrete Under Water with a Tremie, Detroit River Tunnel....196
Method of Trenching for a Sewer at Auburn, N. Y., Using a Revolving Steam Shovel.....198
Method of Making a 14,280 Cu. Yd. Blast in Basalt Rock with Some Data on Costs.199
A New Jaw Crusher Designed Particularly for Contractors' Use.....200
Method of Making a Steam Shovel Cut of Two Lifts in One Lift.....200
Concrete Pavement Construction at Richmond, Ind.....201
Road Engineering.....201
Method and Cost of Road Surfacing with 2-in. Concrete Cubes.....201
Some Notes and Figures on the Valuation of the Water Works Plant at Richmond, Ind.....202
Structural Features of the 24-Mile Steel Pipe Line for the Portland, Oregon, Water Works.....203
Methods of Filing and Indexing Drawings and Photographs, Board of Water Supply, New York City.....205
LETTERS TO THE EDITOR.....206

An Editorial Review of the Work of the Sixth Annual Convention of the National Association of Cement Users.

The National Association of Cement Users justified its existence at the convention just closed. The papers were of a high order and the members present manifested great interest in the meetings. Nearly all the papers will appear in ENGINEERING-CONTRACTING, so no mention of the contents is required at this time.

There were nine sessions and each was devoted to the work of one of the sectional committees. An extra session was held on the evening of Washington's birthday, the exercises consisting of an address on George Washington by Hon. John E. W. Wayman, State's Attorney for Cook County, Illinois, and music, followed by an informal reception.

At the regular sessions a general discussion lasting an hour and a half commenced at 9 a. m., on the subjects to be reported upon by the committee to report that day. At half past ten the reading of papers commenced and the discussions on the papers generally kept the members interested until noon when the committee report was received. This precipitated more discussion, the effect every day being to hold the members in session until about 2 o'clock when adjournment was had until 8 o'clock. After reading and discussing the set papers for the evening, discussion on the report was generally resumed and the time for adjournment was generally long past eleven. This meant from eight to nine hours work daily for five days, on the part of the visiting members, meals at irregular hours, and a visit of an hour or two each afternoon to the Cement show on the part of some. The convention formally ended Friday night, Saturday being given over to sight seeing.

It seems but fair to call attention to the work done in order to show the estimation in which the visitors held the papers and discussions. An attendance of about 300 was shown by the registration book and fully 200 were present at each session. This was unexpected, for the program was so arranged that men interested in only one or two subjects could absent themselves from sessions where other subjects were discussed. It was brought out that all the members were interested in practically every phase of the cement industry. A proposal to hold concurrent sectional meetings would undoubtedly have been voted down. This seemed to be the sentiment among the members though not discussed on the floor.

The arrangement of the program was open to criticism for the reason that the discussion early in the morning before a committee reported was practically duplicated after the report was presented. The arrangement was made with the idea that the committee would receive suggestions for the report. Practically, however, the time was not well spent. It would be well at future conventions to have committee reports made at the 9 o'clock session to be followed immediately by discussions limited to one hour, after which the papers for the day can be read and the discussion following the papers can be a general discussion on the day's work. No reports should be presented at evening sessions but the general discussion could be resumed each evening after papers are heard.

A feature at each convention is the presentation and discussion of proposed standard specifications. At the convention just closed considerable opposition developed to the alleged misuse of the word "Specification" in connection with these papers. It was held that as prepared they should be termed "Recommended Practice," or, "Proposed Regulations" carrying the endorsement of the association. A dictionary definition of the word specification is: "A definite, particularized, and complete statement." From the nature of things such exactness cannot be attained by the so-called specifications of the association and each one contains clauses recognizing the necessity for the exercise of judgment when local conditions render it impossible to adhere to the strict letter of the standard specification. At every meeting when the amendments to the proposed standard specifications came up, the discussions were sustained and vigorous. Each year amendments are made and seem to be rendered necessary because of particularity of statement. The result is that each year the so-called specifications become less dogmatic and consequently less authoritative because misnamed. They should be set forth frankly as being merely guides for specification writing and thus will become popular in all sections of the country. The present system of attempting each year to change the specifications in minor details to suit the ideas of men who could not make them fit in some certain locality, is doing much to bring into disrepute the work of a number of earnest disinterested workers. Several hours were wasted in discussion of sidewalk specifications. Specifications were proposed and adopted for drain tile and for concrete pavements, two documents from which much trouble is presaged the coming year.

The committee on concrete and reinforced concrete made a progress report and indicated lines along which further research work must be done and called attention to lack of data on tests of slabs. At the request of the chairman, representatives of papers present at the convention agreed to make public his desire to obtain information on slab tests. It is known that hundreds of contractors, architects, engineers and manufacturing companies have made tests, the results of which, if made public, would be of great value so the committee hopes the men who have the data will send them to Mr. A. E. Lindau, National Bank of Commerce Building, St. Louis, Mo.

The committee on proposed standard building regulations for reinforced concrete presented the proposed regulations adopted by a small majority last year and considerable discussion ensued, principally over the clauses relating to steel. They were finally amended to omit the words "High Carbon Steel," and in place was substituted "High Elastic Limit Steel," as expressing properly the purpose underlying the use of high carbon steel. This section now reads:

> High Elastic Limit steel shall have an elastic limit of from 50,000 to 65,000 lbs. per sq. in.; an elongation in per cent in an eight (8) inch test piece of $\frac{1{,}000{,}000}{\text{ultimate strength}}$; and shall be capable of being bent cold 180 degrees in a radius of four (4) diameters.

The proposed building regulations as they now stand are admirable and should be adopted at as early date as possible by the thousands of cities in the United States without such safeguards. The result will be a lessening of the number of failures reported and good design will no longer be the exception.

The report on insurance was valuable and the report and discussion on fireproofing brought out little that was new. Parties to whom inquiry blanks were sent did not reply as they should so the committee was given further time. The discussion did bring out the fact that recommendations for fireproofing must recognize the different uses to which buildings will be put, for fireproofing is ex-

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pensive. The discussions on handling, mixing and using concrete brought out the fact that more care is exercised than ever before and grading of aggregates is a subject commanding the attention of even laborers. Long mixing has a value just beginning to be realized and accelerated hardening by steam curing is the rule in factories turning out blocks, tile and architectural concrete work. Waterproofing is as yet a subject on which no man cares to be committed to an opinion. The treatment of concrete surfaces bids fair to rouse interest at the next convention after all the members have had an opportunity to read the full report of the committee handling that subject. As usual in conventions much of the talk was not true discussion but a surprisingly large number of valuable "kinks" and trade secrets were brought out. The various committees of the association are annually collating practice to be some day digested and edited so that, when added to the valuable data produced in the discussions, the training of competent workmen will be a short matter. The proceedings of the association this year it is estimated will fill two 500-page volumes, or nearly double the number of pages of the 1909 Proceedings.

Expansion joints cropped up frequently as a subject for discussion. When and where to provide for expansion did not seem to be known and a few reported cases were remarkable, leading to the conclusion that some cracks are caused by expansion and some by contraction. The air temperature at the time of putting in the concrete is, no doubt, a large factor in this important matter and one to which little attention has been directed. Upon first approaching the subject a man believes that practice in providing expansion joints would largely depend upon locality, there being wide ranges of temperature between the different sections of the country day by day. It is believed that in the warmer portions of Texas and California other methods are adapted than prevail in Maine or North Dakota. Inquiry, however, indicates little difference in practice and information as to troubles encountered is strangely similar. One thing was plainly brought out and it was that on the question of provision for temperature changes in minor structures nearly everything at present is guess work. The working methods of the association lead to a well founded belief that within a short time the element of guess will be largely removed.

The extremely interesting papers on floor construction were valuable contributions. Their character was such that little discussion on the floor was called out but written discussion is expected after the papers are printed. Mr. McMillan presented formulas for plate, or "girderless" floors and showed photographs of buildings in course of erection with floors designed by his theory. Professor Gillespie gave one evening an address on columns which was held by many to be the best during the convention. It tended to prove that cement is the cheapest reinforcing material for concrete columns. The spirally wound column was declared to be inefficient as compared with columns of very rich concrete reinforced with longitudinal steel only. The discusson following his address tended to confirm his conclusions. An entire day was given over to concrete houses for dwellings, etc., and the advance in artistic taste with lowering of cost for this class of work is remarkable.

Concrete and Reinforced Concrete Section

Note: This section is devoted to methods and cost of constructing concrete and reinforced concrete structures. It will cover the selection, testing and proportioning of concrete materials; laboratory tests of concrete; concrete mixing, transportation and placing; fabrication and placing of reinforcement, and form construction and erection. It will also contain articles on new and interesting developments in the design of reinforced concrete.

Method and Cost of Constructing a Concrete Block Warehouse.*

The accompanying photograph shows a one-story concrete block warehouse recently erected by the writer at Austell, Ga., for the purpose of storing cotton, cotton-seed, fertilizers, feed-stuff, and for general storage purposes. The outside dimensions are 51 ft. 4 ins. by 122 ft. 8 ins. and is divided into three rooms each 40 ft. by 50 ft. in the clear, the walls are 14 ft. high and the ceiling height in each room varies from 10 ft. 6 ins. to 13 ft.

The footings are of 1:3:6 concrete, under the outside walls they vary from 3 to 5 ft. in depth, 12 ins. wide on top with an inside batter of 3:24; under the inside walls they vary from 1 to 3 ft. in depth, are 9 ins. wide on top and have a batter of 1:12 on each face; all footings were carried down to a firm hard red clay.

View of Concrete Block Warehouse at Austell, Ga.

The floors are 4 ins. thick consisting of 2½ ins. of 1:3:6 base and 1½ ins. of 1:2½ top, for the top granite screenings were used instead of sand.

The outside walls are laid up with 8x8x20 in. and 24 in. rock face hollow concrete blocks made of a Hercules block machine, the corners are all panel face return blocks showing 20 ins. on one side and 10 ins. on the other, alternating vertically. Plain face blocks alternating 12 ins. and 24 ins. were used at the doorways, one vertical face edge of each block being slightly recessed, when made in the mold, to permit its entrance into the backs of the 8 in. channels that were used for door frames. The division walls were built from plain face 8x8x24 in. hollow blocks and were tied into the outside walls by passing the end block of every second course through and showing it on the outside as a panel face or end, the block above and below on the outside wall being a panel face.

At the south end of the building which faces a street the central half of the outside wall was carried four courses higher than the rest of the wall with panel face blocks and was coped with a course of 7x11 ins. egg and dart stone 4 ft. long which in turn was capped with a 5x11 in. stone having a 3 in. Ogee mold edge, the combination making a very pretty coping and front. The remainder of the outside walls were capped with the Ogee coping 6x11 ins., the division walls being capped with a plain square edge 6x11 in. stone, the cope and cap stones ranging in length from 18 ins. to 4 ft. laid to break bond with the building stone. The window sills and lintels are 8x9½ ins. by 4 ft. 7 ins. and were made in the same block machine, as were also the coping stones.

The windows of which there were only two are metal frame swing sash equipped with wire glass. The six doors are tin covered (iron clad) fire proof doors, endorsed by the Insurance Underwriters, sliding or rolling on a level track, the track being fastened by bolts passing clear through the wall, the door frames, as before mentioned, are made from 8 in. channel irons and are fastened to the wall by hook bolts which engage the hollow spaces in the blocks, three bolts being used on each side; into the back of the top channel was cast the lintel in place, it is 8x10 ins. by 8 ft. of 1:2:4 concrete and contains no reinforcement other than was considered necessary to prevent shrinkage cracks, the channel being sufficient to carry the load.

The roof is covered with tar and gravel Barrett Specification, with galvanized iron flashings, roof boarding is of 1 in. pine rough boards, joists are 2x8 in. pine 18 ft. long lapped and spiked together on beams which are 6x10 ins. made up from 3 pieces of 2x10 in. pine 10 ft. and 20 ft. long spiked together, there are two of these beams in each room running longitudinally of the building, supported in the center by 12x12 in. concrete posts cast in place on the ends they are supported by solid concrete blocks projecting inside the building; the joists rest directly on the beams and at the walls they are fastened to stringer pieces which are also supported by projecting wall blocks. All the drainage from the roof passes through the wall on one side, the roof of each room sloping towards one corner; the two first adjoining rooms slope to adjoining corners thus permitting the supporting blocks for the beams in the division wall to pass through and project on both sides and be uniformly loaded, the same being true of the other division wall where the high sides of the roof coincide; the water is conducted through 4x8 in. flat down spouts to an open concrete gutter at the side of the building which leads to the street drain; at each doorway on this side of the building is a concrete platform for the use of wagons unloading or loading, and the water is carried through the platforms by the use of concrete sewer

*Arranged from an article furnished us by John Wm. Ash, Engineer and Contractor, Austell, Ga.

pipe. The other side of the building is to be served by a spur track, the building being only 15 ft. from the main line of the Southern Railway.

Each room is ventilated by a 24 in. "Dixie" ventilator placed on the center of each roof.

The blocks for the outside walls were all made of the following proportions: facing 1 part Portland cement to 2 parts of granite sand, to which was added a specified amount of waterproofing compound: backing or body of block 1 part cement 3 parts of clean coarse sand and 2 parts of stone from 1 in. down to ¼ in. or small gravel; where no stone or gravel was used the proportion was 1 cement to 4 parts coarse sand, about ½ in. of facing material was used on the back of the blocks which was easily placed on account of the machine being of the down-face type, coping and capping stones were made of the same proportions.

Five men were used in the block shed, four men making blocks and carrying them out and 1 man mixing material; after becoming accustomed to the work the regular days work for ten hours was 100, 24 in. and 125, 20 in. blocks besides carrying out the blocks made the day before; on blocks requiring no facing this was generally increased by about 20 or 25 blocks.

During the erection, the blocks were wheeled directly from the curing yard to the building on wheelbarrows, and up easy runways to the top of the scaffolding, this required two men to keep three masons supplied, one man and a boy kept them supplied with mortar.

Upon the completion of the building after a heavy rain it was found that considerable dampness showed through the blocks on the inside principally near the top and upon investigation it proved to be soaking through the capping and mortar joints which contained no waterproofing, the mortar was made of 1 cement to 3 granite sand, and it was also discovered that several batches of concrete had been made up without using and waterproofing, as there were quite a number of these blocks scattered through the building it was decided to go all over the building with a waterproof wash, which not only accomplished the desired result but improved the appearance of the structure. Below will be found a complete itemized account of the entire cost:

	Total.	Cu. yd.
595 cu. yds. exc. and grading	$ 83.80	$0.139
Concrete Footings (53 cu. yds.):	Total.	Cu. yd.
Labor	$ 44.00	$0.830
Cement	84.80	1.600
Stone	62.30	1.175
Sand	26.50	0.500
Total	$217.60	$4 105
Forms:		
Labor	$ 11.20	$0.211
Material	11.75	0.221
Total	$ 22.95	$0.432
Grand total	$240.55	$4.537
Concrete Floor (5,000 sq. ft.):	Total.	Sq. ft.
Cement	$149.60	$0.0249
Sand	28.25	0.0047
Stone	84.70	0.0141
Labor	53.85	0.0089
Total	$316.40	$0.0526
Forms:		
Material	$ 3.25	$0.0005
Labor	5.75	0.0009
Total	$ 9.00	$0.0014
Grand total	$325.40	0.0540
Molding Blocks (4,485) and 548 ft. Capping and Coping.	Total.	Block.
Labor	$205.45	$0.0431
Waterproof and cement	409.65	0.0806
Sand	68.80	0.0144
Stone	27.00	0.0036
Pallets	45.55	0.0096
Total	$756.45	$0.1513
Laying Walls:	Total.	Sq. ft.
Laying (masons at 35 cts. per hour)	$153.55	$0.0314
Pointing	57.25	0.0117
Tenders and block wheelers	50.50	0.0104
Cement	55.90	0.0111
Sand	15.45	0.0031
Scaffolding, labor and materials	32.25	0.0066
Total	$364.90	$0.0743
Miscellaneous and General.		Total.
Windows, doors and ventilators and down spout		$ 311.25
Labor placing same		35.85
Roof lumber		171.28
Labor laying		37.85
Tar and gravel in place		208.50
Door frames in place		63.25
Concrete gutters, posts, platforms, sills and lintals		47.80
Extra waterproofing of walls		33.65
Miscellaneous labor and material		14.65
Superintendence at block shed		65.00
Superintendence on building		236.00
Total		$1,225.08
Grand total		2,996.18

The cost figures given by Mr. Ash include only the totals named; the extension of these totals to get unit costs has been made by the editors, and in one or two respects they call for explanation. In giving the cost of molding blocks it will be noted that 548 ft. of coping are included in the totals. To permit extension of these totals we have assumed this coping to be equivalent to 274 24-in. blocks. Similarly in figuring the unit costs of laying walls we have figured the total area of a wall 14 ft. high for a 51-ft. 4-in. by 122-ft. 8-in. building. The building being one-story has a floor area of 6,000 sq. ft. which divided into the total cost of $2,996 gives a cost of 50 cts. per sq. ft. of floor area.

A Method of Long Span, Light Floor, Reinforced Concrete Construction, With Comparative Costs.*

While there has been no doubt of the economy and practicability of reinforced concrete for massive construction and where heavy loads are carried, the advisability of its use for light floor loads, especially if the spans are long, has been questioned even by those who favor its use in other instances. The dead weight of the material itself has often operated against its use, especially where the carrying capacity of the soil required the unit pressure to be kept to the minimum, or from other like causes.

We all agree that clear spans of 40 or 50 ft. in buildings are not usual and are generally avoided on account of their increased cost; hence a description of such a span, with its cost as compared with steel girder construction for the same span, is of interest.

While the author does not wish to take any credit for originality in the design of this floor, as the same general scheme has been used many times before for shorter spans, it is because of the unusual length of the span that its details become an important factor in the design.

The spans in question form the floors over the swimming pool and gymnasium of the Turngemeinde Club House, Philadelphia, and are 53 ft. 1⅞ ins. clear span. There are two floors with these spans, of an area of about 4,700 sq. ft. each, having five girders on the first floor and six on the second floor, spaced 13 ft. 9 in. centers. Those of the first floor are only 36 ins. deep below the joist, on account of head room. The top portion or T-head is 5 ft. 4 ins. wide and 14 ins. thick. These girders are reinforced with twenty-one 1⅛ in. square twisted bars, bent as shown by Fig. 1. The stirrups are 1x⅛ in. flat iron, bent and spaced as shown by Fig. 2. Great care was taken to place the bars accurately in position, and the bottom bars were supported in the bottom of the molds on cast cement chairs, while the spacing of the bars and stirrup was maintained by iron rods and the wiring of one bar to the other.

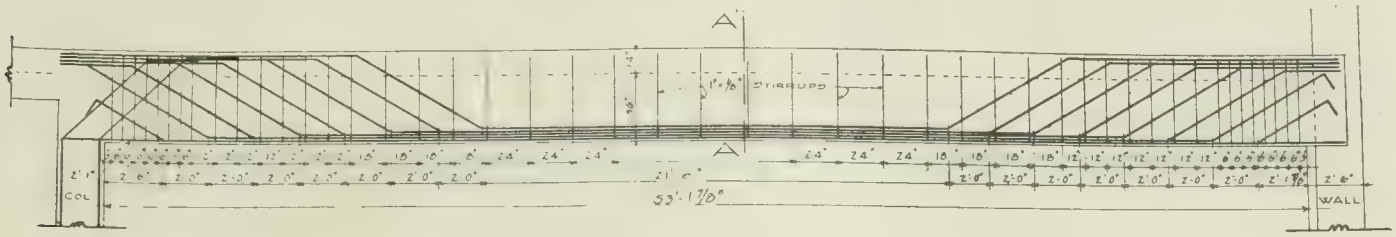


Fig. 1—Longitudinal Section of Long Span Girder.

The floor panels between the girders consist of 5x12 in. concrete joists, with a 2-in. reinforced concrete slab over same, and 12x12-in. plaster block centers between each joist, thus making a flat ceiling between girders. The joists are reinforced with one 11-16-in. square twisted bars and eight ¼-in. stirrups. In the top of every third joist were placed two ¾-in. square twisted bars over the girders to act as tie. These rods were only 5 ft. long but two were used in each case, lapped in the center so as to project beyond the T-head into the joists. The slab is re-inforced with ¼-in. rods run in both directions, 12 ins. on centers or thereabouts.

The girders supporting the auditorium floor, on account of the higher ceiling, are 43 ins. deep, with T-head, 4 ft. 9 ins. wide. The reinforcement in the bottom consists of eighteen 1⅛-in. square twisted bars, bent the same as shown for first floor.

Each floor is designed for a live load of 120 lbs. sq. ft., as the top floor is an auditorium and the floor below a gymnasium.

There seemed to be some doubt amongst the members of the building committee as to the advisability of constructing such long span of reinforced concrete, and one of the committee went so far as to offer to increase his subscription to the building fund by a very large amount, in order to pay for steel girders, but the amount offered was insufficient to pay the extra cost, so the girders were built as originally designed, of reinforced concrete. in order to obtain the actual difference in cost, we designed the girders of Bethlehem steel girder sections, reinforced with top and bottom cover plates and fireproofed. The size of the steel girders was 30 ins. deep, 200 lbs. per foot, with two cover plates on each flange,

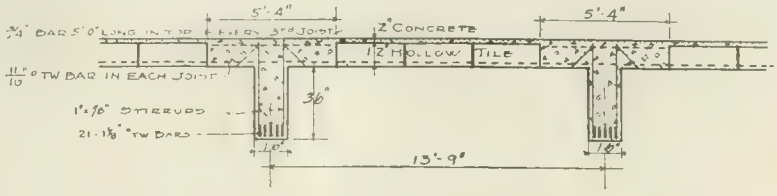


Fig. 2—Transverse Section of Long Span Girder.

*A paper by Emile G. Perrot, read at the annual convention of the National Association of Cement Users, February, 1910.

one ⅝x15 ins. and one ½x15 ins. We obtained bids from the building contractor for the difference in cost of these girders, we having likewise made an estimate of the difference in cost. The contractor's price for them was $6,500 additional to his contract price, although our estimate of the difference was somewhat less, being $4,664, based on prices obtained from outside sources. Taking our figures as a base, as there are 5,400 sq. ft. in the two floors, the difference in cost for the structural steel, fireproofed, is 50 cts. a square foot more than the reinforced concrete, with no increased advantage.

The weight of the structural steel for a girder as compared to the weight of reinforcing steel is as follows: Total weight of steel girders, with strap iron reinforcement for fireproofing and bearing plate, about 17,000 lbs. Total weight of reinforcing steel in one reinforced concrete girder, 36 ins. deep, 5,500 lbs.

This shows that it takes about one-third the amount of steel for reinforced concrete as compared with structural steel for girders and beams. The amount of saving in concrete would be the overhanging portions of the T-head, which amounts to 2¼ cu. yd. per beam, when the extra thickness of concrete on the girders is taken into account due to the wide flanges on the steel girders; likewise there would be additional plaster blocks necessary to take the place of the T-head omitted, the cost of which would have to be deducted from the saving effected by omitting the T-head.

The sub-contractor for the reinforced concrete work gave the cost of the plaster blocks, delivered at the job, as 14 cts. per sq. ft., and setting of same, including the nailing on of a fine wire screen at each end to prevent the concrete running into the hollow part of the block, as 3 cts. per square foot additional.

The plaster block weighs 25 lbs. per sq. ft., as compared with 40 lbs. per sq. ft. for terra cotta tile, which costs the same price as the plaster block but which are not as easily handled, being only 12 ins. long, whereas the plaster blocks are 3 ft. long and can be sawed to fit any position.

The walls of plaster blocks are about 1½ ins. thick, and there are two cells in each block, separated by a vertical wall in the middle which strengthens the block, so that traffic can take place over them and during the time of pouring the concrete.

Immediately before pouring the concrete, it is necessary to thoroughly soak with water the plaster blocks, as they absorb a considerable quantity of water from the concrete if not thoroughly wetted; in fact the parts of the floor where the blocks occur and where they do not, are clearly marked during the earlier stages of the setting of the concrete by the difference in its color, the concrete which does not come in contact with the plaster requiring more time to set.

For moderate spans, the use of concrete joists with either the plaster block or tile filler are desirable, where a flat ceiling is sought and the load light.

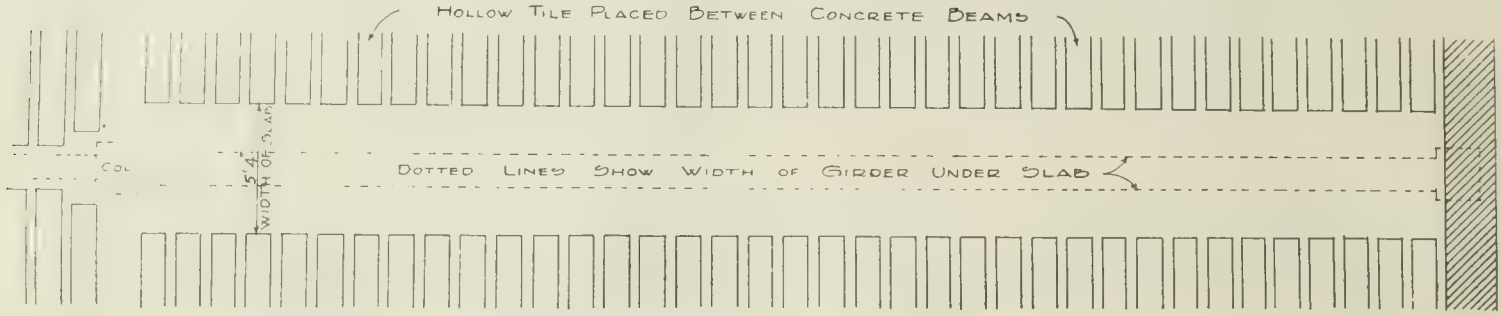


Fig. 3—Plan of Long Span Floor Construction.

A Method of Heating Broken Stone in Wagons for Concrete Work.

BY ROY H. BROWN.*

During the construction work on a recent power development it became necessary in order to carry on winter concreting, to devise some way of heating materials more economically than the usual methods. Our summer method of measuring materials was to charge a single horse dump cart at the crusher bin with the measured proportion of rock. From the bin the cart was driven to the sand pile where enough sand was added to complete the load. Thence the cart went to the mixer where cement and water completed a batch.

Of course one could heat sand and water to any degree but the problem was to find a way of heating the rock quickly and cheaply. It was solved satisfactorily to every one in this way. Taking some 1¼-in. pipe and cast tees a frame was made consisting of a set of 18 pipes crossing to and from the respective headers; ⅛-inch holes were drilled every 1 in. on one side of the pipes. A piece of canvas was riveted to the top of the frame of pipes and one header was connected to a boiler under pressure of 80 lbs. steam. A block and tackle was then attached to the set of pipes. This enabled the operator to move it quickly.

When work began in the morning the cart charged with rock and was driven under the heater. The operator lowered it directly on the cold crushed stone and turned live steam on for ½ min. by his watch. He then raised the heater ready for the next cart.

The rock was thoroughly warmed. All pieces of ice melted and when warm sand and warm water were added, a batch of concrete was mixed that set nicely in the coldest weather. In fact in looking at the finished wall one cannot detect the difference in the concrete mixed during weather of a temperature of 25° and that placed in summer.

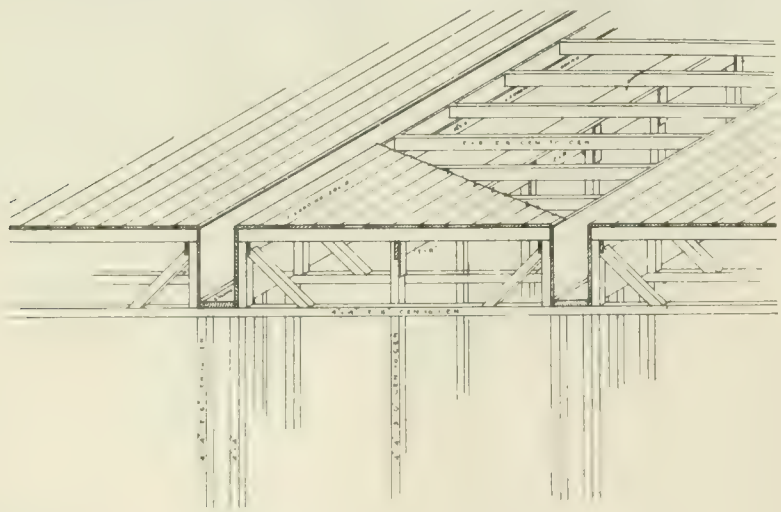


Fig. 4—Form for Constructing Long Span Girder.

*Madison, Me.

Concrete Barges for Dredges for the Panama Canal Work.

Work will be commenced shortly, according to the Canal Record, on the construction of three concrete barges, to be used in supporting the dredging pumps for the hydraulic excavating and pumping plant of the Pacific division of the Panama canal. They will be built near the site of the hydraulic pumping station at a point on the canal, nearly opposite Corozal.

Each of the barges will be 64 ft. long by 24 ft. wide, and will have a depth of 5 ft. 8 ins. The interior beams and columns will have a spacing of 10 ft. longitudinally and 8 ft. transversely. Wooden forms will be used in their construction and the barges will be launched sidewise. Two interior longitudinal walls will extend throughout, with a bulkhead at each end, forming an interior compartment 40 ft. long by 8 ft. wide. The interior form which will be built in collapsible sections, so that the latter can be removed readily as the work advances. The frames for the hull will be constructed first, and the preliminary work will consist of the erection of supports on which wooden forms will be placed.

The wall construction will consist of one layer of ½-in. mesh No. 12 wire cloth; ½-in. transverse rods spaced 8 ins. on centers, and ½-in. longitudinal rods spaced 12 in. on centers, all securely fastened to the reinforced concrete frame work described above. The side walls and bottom of the barge will then be formed by laying on several coats of plaster made of Portland cement mortar, and troweled down to a hard surface. The plaster will be laid on first from the outside, and an additional coat laid on from the inside, so as to thoroughly cover the ½-in. mesh and steel rods.

The deck of the barge will consist of concrete slabs 3½ ins. thick, having spans of 10 ft. in length and 8 ft. in width, reinforced with ½-in. rods, both longitudinally and transversely. Wells are provided for pumping.

The dredging pump, motor and equipment, weighing approximately 60,000 lbs., will be located near the middle of the barge. The maximum draft of the barges when loaded, will be about 3 ft. They can be moved readily from one place to another in the channel, and each will be equipped with four mooring bits situated a few feet back from each corner, secured to the barge by long bolts imbedded in the concrete of the side columns and diagonals.

The barges will be erected on cribbing built for the purpose, and launched from ways, on the west bank of the basin, a short distance south of the Miraflores lock site.

Methods and Cost of Sinking the Brier Hill Concrete-Lined Shaft, Michigan.*

The Brier Hill shaft is being sunk to a depth of 850 ft., and on Aug. 1, 1909—the date of this paper—it was completed to a depth of 692 ft. It is expected that in the future the shaft will be sunk deeper as the conditions of the ore deposits demand.

The shaft is being lined throughout with concrete. Concrete was adopted for safety and permanence, to avoid the danger of fire and the expense of timber replacements. It

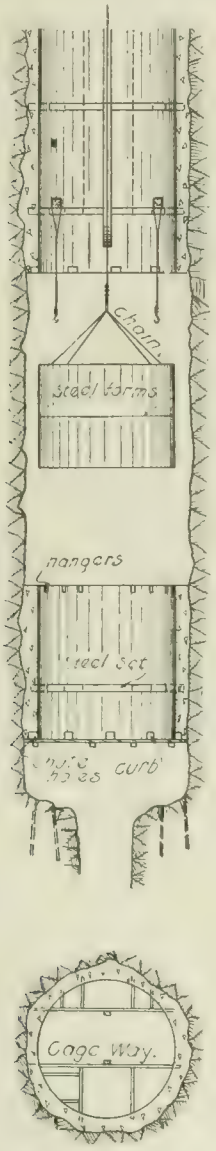


Fig. 1—Sections of Brier Hill Shaft Showing Method of Placing Concrete Lining.

was not used for the purpose of excluding water, as the amount of water in the surface gravel and in the rock measures passed through is inconsiderable. A circular section was adopted so as to use the concrete in compression and avoid the necessity for reinforcement. Even with a circular section there might be conditions of ground which would require the use of reinforcement in a shaft lining but these conditions did not appear in this shaft, except at some points in the roofs of the shaft stations at the different levels.

The shaft is 14 ft. in diameter and is divided into seven compartments respectively for a cage, a 6-ton skip, a ladder way, a pipe way, two balance ways and a compartment which can be used for a small cage or other purposes as later requirements demand. The cage will be large enough for a car to carry mine timber. Fig. 1 illustrates the division of the shaft into compartments. For the conditions presented this circular section is quite as economical of space as any rectangular section would be.

The hoisting of the large cage and the skip will be done by independent drums. The plant is of the ordinary geared hoist form with two cylindrical drums in tandem but operated by a 2,200 volt alternating current motor by means of a rope drive. Attached to each cylindrical drum is a conical drum on which is a rope leading to a counterbalance. The conical drum is designed so that the hoisting rope as well as the cage or skip is practically always in balance. This method of hoisting has the advantages of a simple and efficient method of using electricity, a practically perfect balancing of the dead weights, and requiring shaft space for only a single skip. Safety attachments will prevent excessive speed in lowering and insure the stopping of cage and skip within safe limits at the top and bottom.

Steel sets have been put in 10 ft. 8 ins. between centers, as shown in the plan and vertical section of the shaft Fig. 1. The main horizontal members are composed of 8-in. channels 13¾ lbs. to the foot placed on edge. These sets support the runners or guides of the cage, skip and balance roads, the ladders, pipes and wires and have nothing to do with bracing or reinforcing the concrete. Between the sets are studdles of steel channels to which the wooden runners for the cage are bolted. The vertical members are attached to the horizontal pieces in such a way as to allow for expansion and contraction due to changes in temperature. Ship channels are provided to guide the skip and there will be hardwood pieces attached to the skip to run in the channels. The severest strains to which these sets might be subject would arise in case the hoisting rope broke and the safety catches of the cage operated. While definite data in regard to these strains were not available the sets were figured with the expectation that in case of such an accident, the strains would be transmitted by means of the studdles, to other sets above and below and that four of five sets would withstand any probable strains from this cause. The ladders are built of steel and the ladder way and skip compartment are to be lined with galvanized corrugated sheet steel.

The shaft is to serve a territory which has been explored and partly developed by drifts from another shaft. Some stoping has been done and there are drifts at a depth of about 400, 500 and 600 ft. from surface. It was therefore feasible to make a preliminary opening throughout the entire length of the shaft by raising from these levels and sinking from the surface and the bottom level. This opening was made 6 x 8 ft. The timber used was afterwards recovered and used for other purposes. The ledge is about 60 ft. below the surface, the overburden consisting of gravel and hard pan. After the preliminary opening in the upper part was completed a timbered shaft 20 ft. square was sunk to the ledge. The sets of this shaft required diagonal bracing. Excavation was then carried down for a short distance in the rock and concreting started at a depth of about 79 ft. below the surface. The concrete from this point to the surface was put in during the winter of 1908. The rock, sand and cement were hauled to the shaft by teams from various points. The method of concreting was proved to be a success and further work was suspended until spring when the mixing plant was amplified by the addition of a cement shed with runway from the railroad siding, bins for rock and sand, a crusher on top of the rock bin, and a tram road above the bins leading from the sand pit and rock piles at another shaft. The drawings in Fig. 2 illustrate the arrangement. A car with a cross division in it is used to measure the sand and broken rock for a charge and tram them to the hopper of the mixer. The mixer is set below the surface and a tunnel 35 ft. long connects the mixer pit with the shaft. The mixer dumps the concrete into a kibble which stands on a tram car in the tunnel. The car is trammed to the shaft and the bucket lowered. As with the preliminary opening no mucking was necessary for the upper 600 ft., it was cheaper to bring the rock from another point than to shovel and hoist the rock from the shaft. The accessibility of the material suitable for concrete was a favorable feature of the situation. The mixing plant is available also for foundations and other building operations.

It was aimed to mix the material for the concrete in the proportion of 1 part of cement, to 3 of sand and 6 of stone. The sand contained a varying amount of gravel and the fines in the stone varied. Tests of the voids were made by the engineers from time to time and the proportion of the ingredients in the mixture was changed to correspond.

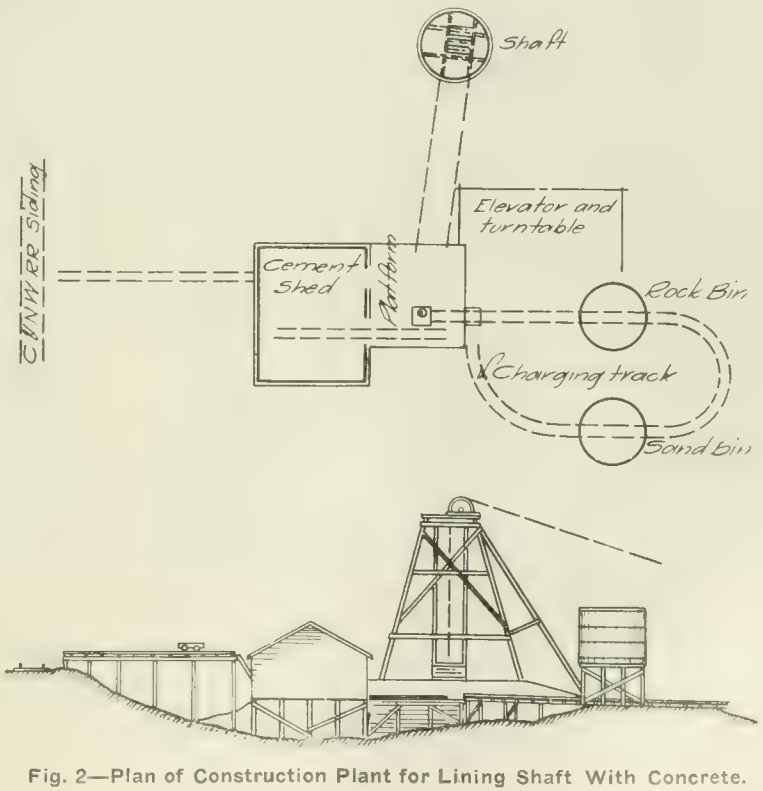


Fig. 2—Plan of Construction Plant for Lining Shaft With Concrete.

The plans for the completed shaft in the rock called for an average concrete lining of 18 ins. thickness with a minimum at any point of 6 ins. No attempt was made to trim the walls smooth as the irregularities of

*Arranged from a paper by William Kelley, Vulcan, Mich., in the Proceedings of the Lake Superior Mining Institute for 1909.

the rock are the support for the concrete. On the other hand too great irregularities in the excavations entail a waste of concrete. Measurements of the actual excavation taken by the surveyors every 3 ft. vertically give an average thickness of the concrete of a little over 19 ins. This is equivalent to a little less than 3 cu. yds. of concrete to a vertical foot of shaft.

Steel forms were used in concreting. These are made of ⅛-in. sheet steel with appropriate bracing as illustrated in Fig. 3. Four forms are used in the circle and in two of the joints pieces of timber or "filling blocks" give space to facilitate the collapsing of the forms after the concrete is set. One round of four forms has a height of 5 ft. 4 ins. and two rounds are used. The outside of the forms is smooth and is painted with black oil each time they are used.

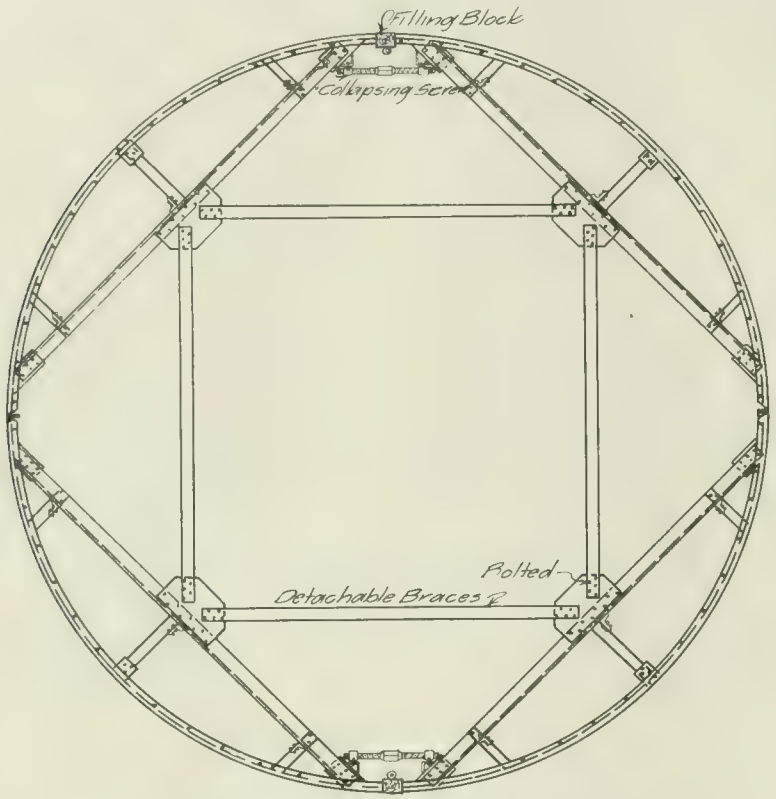


Fig. 3—Transverse Section of Steel Form for Lining Concrete Shaft.

After the excavation of the shaft to the proper size has been carried downward for a distance sufficient to put in three or four sets of steel a platform or "curb" is laid on the outside edge of the shaft all around near the bottom at the proper distance from the concrete above to allow for the number of sets proposed. One round of forms is then set upon this platform. Empty boxes are put in at the bottom to form "chute holes" for putting concrete into the form below at the proper time and a platform of 3-in. plank is laid over the top of the form. The concrete is then lowered in the kibble, dumped on the platform, slushed off and tamped in around the outside of the forms, completely filing the space between the forms and the rock. Before the concrete is quite up to the edge of the top of the forms, boxes are put in just inside the forms to core out hitches for the steel sets. As soon as the concrete is set the forms are collapsed by taking out the vertical strips of wood or "filling blocks" in the two openings. The round of forms is attached to the hoisting rope by chains, hoisted up and suspended from the steel framework in place above. A set of steel is then lowered, laid in the hitches left in the concrete and cemented in. The round of forms is lowered upon this new set, expanded to the proper size and the second round of forms is set up and bolted to the first so that this time concrete is deposited for a height of 10 ft. 8 ins. This can be done in an 8-hour shift, and 12 hours is sufficient time for the concrete to set so that it is possible to concrete 10 ft. 8 ins. of shaft and put in the steel work in considerably less than two days. As the space between the steel sets is 10 ft. 8 ins. and in starting only half this amount of concrete is put in before a set is laid, the work is joined to the older concrete above by one round of forms of 5 ft. 4 ins. This is filled through the spaces or "chute holes" left by the empty boxes previously mentioned.

No attempt was made to make a record of speed. The best work was done in September and October, 1908, which resulted in the excavating (enlarging the original opening) concreting and putting in the steel of 138 2-3 ft. of shaft or an average of 69 1-3 ft. a month. At that time the men were working two shifts a day or eleven shifts a week of 10 hours each. Six men constituted the regular shift in the shaft either for excavating or constructing. In addition to the shaft work proper three stations have been cut out and concreted.

In keeping the record of the cost, the shaft has been divided into three parts; from surface to ledge, 62 ft., from top of ledge to seventh level, 549.5 ft., and from the seventh level down, ultimately, about 238.5 ft. The following is the cost:

SURFACE TO LEDGE—62 FEET.

	Per ft.
Preliminary excavation	$ 13.07
Final excavation	18.19
Steel shaft frames	7.90
Steel forms	.83
Temporary surface structures and equipment	10.18
Construction	56.29
Estimated charge for compressed air	1.00
Total per foot	$107.43
Estimated salvage on shaft timbers	.50
Estimated salvage on temporary surface structures and equipment	2.95
Net total per foot up to date	$104.01

LEDGE TO 7TH LEVEL—549.5 FEET.

Preliminary excavation	$ 18.46
Final excavation	15.10
Steel shaft frames	7.90
Steel forms	.83
Temporary surface structures and equipment	10.18
Construction	25.26
Estimated charge for compressed air	1.00
Total per foot	$ 78.73
Estimated salvage on shaft timbers	.50
Estimated salvage on temporary surface structures and equipment	2.95
Net total per foot up to date	$ 76.28

FROM 7TH LEVEL DOWN—85.84 FEET COMPLETED.

Preliminary excavation	$ 25.67
Final excavation	23.13
Steel shaft frames	7.90
Steel forms	.83
Temporary surface structures and equipment	10.18
Construction	20.93
Estimated charge for compressed air	1.00
Total per foot	$ 89.64
Estimated salvage on shaft timbers	.50
Estimated salvage on temporary surface structures and equipment	2.95
Net total per foot up to date	$ 87.19

The item "Construction" includes the handling of the steel forms, depositing concrete, and setting and erecting the steel frames. These figures include estimates of power and every charge except for general management and engineering. The cost of this circular concrete lined shaft is about the same as a rectangular shaft of the same capacity with steel framing. The small additional cost over a rectangular shaft with timber framing is abundantly justified by the increased safety and permanence. Credit is due to Mr. F. L. Burr for the details of the design and construction.

Comments on Contracting for Concrete Bridges with Description of a form of Cost Recording.*

Contractors should keep complete cost records, showing the distribution of cost against the separate items that go to make up the structure; and such cost records should show the complete cost to date at regular and frequent intervals, i. e., daily or semi-weekly. The contractor should be able at any time to turn to his records and quickly ascertain the cost on each separate item of construction. Such a cost record is essential to a proper understanding of the cost of the structure, is valuable in determining the rating of the foreman in charge, and is the only safe basis for determining bids on future work.

To illustrate in greater detail, let us assume that a small concrete bridge is to be publicly let to the lowest bidder, and that its estimated cost is perhaps $10,000, which must not be exceeded. Some eight or ten bidders may appear, of whom one or two will usually be all that have had any previous experience, and only one perhaps will have kept detailed records of cost. All the others bid on a gamble. John Smith, who has never before built a concrete bridge, but who has had some experience in building a rubble retaining wall, estimates the total measure of concrete in the bridge at 2,000 cu. yds., and, recalling that the actual ingredients contained in a yard of concrete are perhaps a dollar's worth of cement, a little steel, and some gravel from the creek, believes that he can build the structure for $4 per yard, or a total of $8,000. Since this is well within the engineer's estimate, he adds a liberal margin of 10 per cent profit, overlooks all floods and contingencies, forgets about insurance and overhead charges, and perhaps lands the job, and the engineer being also inexperienced, estimates his next proposed bridge by this last one, and thus makes his next estimate on a still lower basis, for he does not wish to appear foolishly high in the eyes of the contractor or the Board. Thus the matter of bids is on a continual down grade, whereas the bidder who estimated his work properly, including all items at a reasonable allowance, bid $18,000, including 25 per cent profit, to which he should be entitled when the dangers of washouts and inclement weather are not otherwise taken into consideration. In view of the engineer's estimate, the high bid, although undoubtedly the best bid, seems foolishly high by contrast.

The contractor who thus estimates his work safely, uses an estimate sheet as follows, Fig. I, in which each and every item that goes to make up the cost of a highway bridge is included:

What each of the items represents in actual cost is known only to the experienced contractor and cannot be given here because it would

*Extracted from a paper by Daniel B. Luten, read at the annual convention of the American Society of Engineering Contractors, Chicago, Ill., Feb. 24 and 25, 1910.

ESTIMATE

Right of Way.
Temporary Bridge.
Removing Old Bridge
Excavation Yards Wet
Yards Dry
Cofferdams.
Sheeting and Shoring
Piling
Falsework Piling
Steel _____ Lbs @ _____
Placing @ _____
Lumber _____ Bd. Ft @ _____
Erection
Concrete _____ Bbls. Cement
_____ Yds. Gravel
_____ Yds. Stone
_____ Yds. Sand.
Labor, Mixing and Placing.
Waterproofing
Filling _____ Yds @ _____
Drains, Conduits, etc
Paving _____ Sq. Yds. @ _____
Sidewalks _____ Sq. Ft. @ _____
Curbs _____ Lin. Ft. @ _____
Railing _____ Lin. Ft. @ _____
Lamps and Wiring
Removal of Centering
Superintendence
Bond, Insurance, etc
Moving Plant, etc
Total Field Cost.

Fig. 1.

be of local value only and would be found misleading for any other field. But even the novice in estimating will come far nearer the truth by making a guess for each item and then taking the total, than if he bases his price on the yardage of concrete alone.

There is a popular notion also that the cost of a concrete bridge may be estimated roughly by multiplying the span in feet by the width of roadway by $2. In other words that the cost approximates $2 per sq. ft. of roadway projected on the span. But this is a dangerous rule, because it gives only the lowest approximate cost for very favorable conditions, and may vary several hundred per cent. The height of the bridge from bed of stream to roadway affects the cost quite as appreciably as the span or roadway. Yet the above rule-of-thumb makes no allowance for height or for numerous other elements that go to make up the cost of the bridge and which vary from place to place. The only safe way to give an estimate on a concrete bridge is to draw it to scale, compute its contents, and then follow the estimate sheet. The contractor who has made a specialty of concrete bridge erection can usually approximate the cost of a proposed bridge by its similarity to some other bridge which he has erected and of which he recalls the details of cost. There is no other safe way.

The low bidder previously referred to, who secures the contract, goes happily to work. Firm in the belief that he has a paying contract, he takes his time on excavation, overlooking the fact that a dollar saved on a profitable contract is just as good as a dollar saved on a losing contract, until he nears the completion of the bridge, when he happens to find by subtracting his bills still to be paid from his money available, that he is already on the wrong side of zero profits. Then begins a scramble to save all he can, just at the very time when most consideration should be given to true lines and good finish, and as a result the bridge that would have been a monument to its designer and to its builder is made an artistic failure because of a profitless contract. Concrete bridges will never attain their deserved success by such methods. And if a contractor will not avail himself of information from more experienced men that will enable him to bid safely, he ought to be everlastingly lambasted by the engineer when he tries to skimp on the wind-up. To the end that he may not again forget!

A desirable form of cost record for concrete bridges is shown in the accompanying forms, Figs. 2 and 3. The foreman in charge is required to send to the office at frequent and regular intervals, say nightly or semi-weekly, a complete, distributed statement of all costs incurred on the work since his last report. This statement of cost is for materials actually delivered on the work to be used in the structure, and for indebtedness incurred for labor, freight, supervision, sundries of any kind whatever actually delivered to the foreman. The form is shown in Fig. 3, and is preferably bound in book form with alternate sheets punctured for removal; and a carbon sheet is provided so that the foreman may retain in book form the duplicates of reports sent in. Each report should have the total cost to date carried forward.

Upon receipt of this report at the office, the totals of each column are transferred to the cost ledger as shown in Fig. 2. A glance at the last sum entered in each column will show the total expenditure for that item to the date of the last report, and thus a statement of cost may be kept complete to within two or three days, regardless of whether materials are pur-

Name of Bridge ..... No.... Work Commenced..... Foundation, Kind....Depth ..... Excavation—No. cu. yds. Est....Rep....Extra .... Estimates Paid.
Date of Contract .....Contract Price.... Work Completed ..... Miscellaneous Description Concrete " " " " .... " .... " ....
County..... State ..... Owner..... Foreman ..... Conditions. Gravel " " " " .... " ....Cost at pit .....
Built over..... No. of Spans ..... Cement " Barrels " Used. " per bbl. .....
Length spans Width of Roadway Steel " Pounds " " " " cwt. .....
Height bed of stream to roadway .....

		Office Charges.	Right of Way and Temporary Bridge.	Removing Old Bridge.	No. of Yards.	Excavating, Wet and Dry.	Cofferdam, Sheeting, Shoring.	Foundation Piling.	Falsework Piling	Steel and Placing	Lumber.	Erection Centers and Forms.	No. of Bags.	Cement.	No. of Yards.	Gravel or Stone.	Sand.	Labor, Mixing and Placing.	Waterproofing.	Filling.	Drains, Conduits.	Paving.	Sidewalks and Curbs.	Railing, Lamps, etc.	Removal of Centering	Superintendence.	Bond, Insurance, etc.	Moving Plant	Totals. Dr.	Totals. Cr.
July 2	Overhead charges	$1500																										$1500	
" 5	Foreman's report	1500		$125	$18	35	$55								45	$ 32	$10											$22		1762	
" 8	" "	1500		175	18	35	55				$ 50				45	32	10											22		1862	
" 11	" "	1500		208	21	35	55	$32	$25		50				110	77	40											22		2030	
" 14	" "	1500		208	21	47	63	32	25	$470	120	$22			113	123	40											22		2646	
	Est. by.....	$1500		$200	$25	120	$150	$85	$480	$330	$650	$1150	$1390	4400	$1500	1200	$1150	$450	$1400	$50	$100	$10	$300	$75	$150	$50	$200	$100	$50		$10405	

Fig. 2.

NAME OF FOREMAN .....
NAME OF BRIDGE.....
3 DAYS ENDING *July 14*, 1909.

Date.	Weather.	Office Charges.	Right of Way and Temporary Bridge	Removing Old Bridge.	No. of Yards.	Excavation, Wet and Dry	Cofferdams, Sheeting, Shoring.	Foundation Piling.	Falsework Piling	Steel and Placing	Lumber.	Erection Centers and Forms.	No. of Bags.	Cement.
		$	$	$		$	$	$	$	$	$	$		$
July 12	Fair.									470				
July 13	Rain										70	22		
July 14	Rain.													
Total					12	8				470	70	22		
Brot Forwd		1500	208	21	35	55	32	25			50			
Total to date		1500	208	21	47	63	32	25		470	120	22		

No. of Yards.	Gravel or Stone.	Sand.	Labor, Mixing and Placing.	Waterproofing.	Filling.	Drains, Conduits, etc	Paving.	Sidewalks, Curbs, etc.	Railing, Lamps, etc.	Removal of Centering	Superintendence.	Bond, Insurance, etc.	Moving Plant	Total
		$	$	$	$	$	$	$	$	$	$	$	$	
53	46													51
														470
														92
Total 53	46													616
Brot Forwd 110	77	40											22	2030
Total to date.. 163	123	40											22	2646

Fig. 3.

used by the office or the foreman, and whether on credit or for cash. The estimated cost of each item should be entered at the extreme foot of each column in red ink. A comparison of the last entry with the estimated cost at the foot of the column will show when an item exceeds its estimate. And since the items in a bridge are usually completed consecutively, a danger signal is thus provided calling attention to this contract. Each item may in turn be divided into its constituents of yardage or board feet, and the amount accomplished be reported each time. But for the average foreman the system then becomes too elaborate to be practical. A careful following of the cost ledger with the occasional visits to the bridge will enable the contractor or field superintendent to determine whether or not the foreman is handling the work properly.

While the foreman should be encouraged to keep a record of the total cost, and should be expected to become thoroughly informed as to the cost of the various items, yet he should not be permitted to have access to the detailed estimate or to the contract price. The foreman is supposed to build a concrete bridge for the contractor, who is making a specialty of concrete bridges, at the lowest possible cost consistent with good workmanship. He should neither be pinched nor pampered by a possible erroneous estimate. He should not be permitted to know, at least not until after completion, whether the contract results in a profit or a loss. He should be given to understand what quality of workmanship is desired, and then should be encouraged to maintain that at the lowest possible cost; but he should not be swerved from his purpose by possible gain or loss.

Since the contract price is usually a matter of record, and will probably become known to the foreman in spite of efforts to prevent it, it is well to start the cost record with a charge of 10 or 15 per cent for office and traveling expenses, in order that the foreman may not gain an exaggerated idea of his importance, since he otherwise invariably overlooks the fact that there are other expenses to be borne besides the actual field cost. The knowledge that he has made a few hundred dollars on the field cost of a bridge frequently converts a good foreman into a bad contractor.

Method of Laying Concrete Under Water Using a Tremie; Detroit River Tunnel.*

When reviewing the great number of subaqueous structures designed and constructed by engineers in the past, one cannot fail to note the hesitancy and diffidence, with which they have approached the problem of depositing concrete under water, and how they apparently have resorted to this expedient, by way of compromise, where none other seemed available, except at an unjustifiable expense. The reasons are obvious; the chief difficulty among the many presenting themselves, being to convey the mass of semi-fluid concrete mixture through the water to its place of deposit in such a manner as to preserve the mixture intact and prevent segregation of its integral parts, which would leave only an inert mass of aggregate. As a consequence the application of the method has been very limited, and the experience gained equally so. Various expedients and devises have been adopted for solving the problem, the principal ones being the use of bags, drop bottom buckets and tremies, all subject to objections peculiar to each.

Laying concrete under water by means of bags involves the use of divers in placing the bags, and is accordingly cumbersome, slow, and expensive; the results are not wholly satisfactory and the method should be classed as obsolete.

Neither is the use of drop bottom buckets all that could be desired; even with the greatest care it is not possible to prevent the mass from dropping a short distance through the water, which thus set in motion has a tendency to remove the cement from the aggregate and produce a lean concrete in spots, where a uniform and homogeneous structure is the ideal sought for. Irregular cleavage lines in the concrete are likely to occur, which objection is also applicable to the use of bags.

The depositing of concrete by means of tremies has heretofore presented difficulties which have not always produced satisfactory results. A tremie is nothing more nor less than a long tube reaching from the place where the concrete is to be deposited, to the surface of the water above, its upper end being provided with a hopper for receiving the mixture; as fast as the concrete escapes at the lower end of the tube it is replenished at the upper end, thus flowing in a continuous stream.

Theoretically this is the ideal way of laying concrete under water, but when reduced to practice the object has not proved so easy of accomplishment. The difficulty has principally been to control the flow of the concrete through the tube and prevent the water from the outside to rush into the tube from below, thus washing the concrete and separating the cement from the aggregate, losing the charge; the concrete would be liable to run out either too fast or too slow. Generally the concrete has been deposited in layers of various thicknesses, governed by the position of the mouth of the tremie with reference to that of the layer below. This also of necessity results in a certain amount of motion of the concrete through the water, with attending loss of cement.

These difficulties were successfully overcome in the construction of the Detroit River Tunnel, more than 100,000 cu. yds. of concrete having been deposited in water by means of tremies; the operation extending over a period of part of three seasons, 1907, 1908 and 1909.

In order to describe the methods used and convey a correct understanding of same, it will first be necessary to give a short description of the tunnel itself and more particularly the subaqueous part of same.

This tunnel is of double track, built for the use of the New York Central System of railway lines, passing under the Detroit River and connecting the City of Detroit, Mich., with the town of Windsor, Canada. It is built as two separate tubes with a center wall between each with an over head clearance of 18 ft. above top of rail, and a length of 8,360 ft. from portal to portal. It consists of three sections, the westerly approach tunnel on the American side, 2,135 ft. long, the section under the Detroit River proper, or subaqueous section, 2,625 ft. long, and the easterly approach tunnel on the Canadian side, 3,600 ft. long.

The westerly approach tunnel and adjoining end of the subaqueous section is on a 2 per cent gradient and the easterly approach tunnel on a 1½ per cent gradient. The subaqueous section has a level grade of some 1,000 ft. merging into the approaching gradients through long vertical curves at either end. It also has a short horizontal curve of 2 degrees curvature at the westerly end. The portals are approached through long open cuts at both ends of the tunnel.

The approach tunnels on both sides of the river were driven through a formation of plastic blue clay by means of shields. The same clay formation extends across the river and overlies bed rock which is found at a depth of some 10 to 30 ft. below the tunnel structure.

The subaqueous section was built on a unique and novel plan never heretofore used, which proved highly successful both as to cost, speed of construction, and safety. It consisted in excavating a trench in the bottom of the river, of the required width and depth, into which steel tubes were sunk; these were thereupon encased in concrete laid under water, pumped out and then lined with concrete on the inside. The whole operation proved to be very simple and easy of execution.

The top of the tunnel structure generally follows the bottom of the river; at the middle it even projects a few feet above the bottom; at the deepest part it is 41 ft. 9 ins. below the surface. The bottom of the structure at this point is about 74 ft. below the surface of the river.

The excavation of the trench was done with an ordinary clam shell dredge, well in advance of the sinking of the tubes. The tubes were circular in form with a diameter of 23 ft. 4 ins. and were arranged and sunk in pairs, one tube for each track; they were built of ⅜-in. steel plates. They were spaced 3 ft. apart between the shells and reinforced on the outside by a series of transverse steel partitions or diaphragms, 12 ft. apart. These diaphragms extended all around the tubes and were approximately of rectangular shape with an extreme depth of 30 ft. 4 ins., and extreme width of 55 ft. 8 ins., thus extending beyond the steel shell 3 ft. at the bottom, 3 ft. on the sides and 4 ft. on the top of the tubes. They were strengthened by means of double angle irons riveted along the edges; wooden sheathing running lengthwise of the tubes was bolted along the vertical edges of the diaphragms. The tubes were built in lengths of 262 ft. 6 ins., and were provided with temporary wooden bulkheads at the ends so that they would float when launched.

For the purpose of sinking the tubes they were equipped with four buoyancy cylinders attached on top, which enabled the tubes when filled with water to be kept in suspension at any point, lowered to the final resting place by means of floating derricks and connected up with the tubes already sunk.

Before sinking, a platform was built in the bottom of trench at the proper level temporarily to support the ends of the tubes. When in their final position the tubes would underneath be from 5 to 7 ft. from the bottom of the trench depending upon how near the correct level this was excavated. The diaphragms crosswise of the tubes and the wooden sheathing on the sides parallel with the tubes would then present in exterior view a series of pockets open at the top and bottom, but with enclosed sides and ends. Into these pockets concrete was poured by means of three tremies, one placed in the middle between the two tubes and one on the outside of each tube, between the steel shell and the wooden sheathing.

The mode of procedure in placing the concrete was generally, first to concrete in the bottom to the under side of the diaphragms, thus sealing the pockets and affording support for the tubes. The buoyancy cylinders holding the tubes in suspension could then be removed, and each pocket filled with concrete in one continuous operation, forming a monolithic mass of a thickness of 3 ft. on the sides of and between the tubes, 4 ft. to 4 ft. 6 in. on top of the tubes, and a thickness of 5 to 7 ft. underneath the tubes, varying with the irregularity of the bottom.

Generally every other tube length was provided with an extra strong bulkhead at the extreme end, capable of resisting the full hydrostatic pressure when the tubes were pumped out, in order to give access to the interior and permit the placing of the concrete lining.

The equipment used for the purpose of placing the subaqueous concrete consisted of a "tremie scow," so called, especially designed and built for the purpose. This scow was 35 ft. in width, 155 ft. in length and 9 ft. 9 ins. in depth, with a free board of about 4 ft. It was equipped with 4 spuds, one in each corner, of 20 ins. square 90 ft. long Oregon fir timbers, and necessary spud hoists. The object of these spuds was to hold the scow steady during concreting, and prevent any rocking motions caused by waves, or the wash from passing steamers. The scow was further held in position against the current by anchors and was equipped with deck hoists for handling. On one side of the scow was built three towers 82 ft. high above the deck, one for each tremie; the front of these towers served the purpose of leaders (similar to those of a pile driver) for the tremie pipes, which could be hoisted clear out of the water or lowered down to the bottom of the trench, as required. There were three concrete mixers, one for the middle tremie with a capacity of about 30 cu. ft. to the batch, and two concrete mixers, one for each of the side tremies with a capacity of about 20 cu. ft. to the batch. The equipment further consisted of an air compressor, a dynamo and an electric conveyor for con-

* Paper by Carl Hoff read at the 1910 convention of the National Association of Cement Users.

veying cement to the charging floor from scows alongside the tremie scow, three hoisting engines for the tremies, two large derricks with hoisting engines for unloading gravel, and a 150 HP. boiler.

Gravel was used for mixing the concrete in preference to broken stone; it was of size grading from that of small walnuts downwards. Mixed with approximately the proper amount of sand it was found and pumped out of the river near Port Huron, Mich., some 60 miles away from the tunnel site and transported in boats or barges down the Detroit River to the tunnel. The tremie scow was designed particularly for the purpose of handling and mixing this gravel as cheaply as possible. The gravel was unloaded directly from the boats to the tremie scow and used up about as fast as unloaded. To this end the tremie scow was equipped with two heavy derricks located about at the quarter points of the scow on the opposite side to that of the tremie towers. These derricks were operated by large hoisting engines located on the deck of the scow, the gravel being unloaded by means of clam shell buckets and discharged into two hoppers located 32 ft. above the deck of the scow, immediately behind the towers. From these hoppers the gravel would fall over inclined screens into receiving bins, being thus screened by gravity, the sand running off into one bin and the gravel into another. There was one sand bin and one gravel bin for each tremie. The bins for the center tremie were of about twice the capacity of the others, because this tremie had to deposit approximately twice as much concrete. The screens below the unloading hoppers were four in number, two for each hopper, inclined in opposite directions so that the gravel would feed one-half to the bin of the side tremie, and one-half to that of the center tremie. The sand and gravel bins were placed a few feet above the charging floor which was located 11 ft. above the deck of the scow, and was on a level with the top of the charging hopper of the concrete mixers. Through gates in the bottom of the bins the proper amount of gravel and sand could be drawn into the charging hoppers. This floor was large enough to hold a sufficient quantity of cement for one pocket. The water tank was also located on this floor, from which water was piped to the mixers.

The concrete mixers were placed directly on the deck and when tilted would discharge into self dumping buckets, placed in the hull of the scow directly in front of the mixers; these buckets could be hoisted up to any point where the receiving hoppers of the tremies might happen to be located and discharged their contents into same.

The total amount of concrete in one pocket was about 342 cu. yds., of which approximately one-half had to be deposited through the center tremie and one-fourth through each of the side tremies.

Each tremie consisted of a 12-in. diameter spiral riveted steel pipe of No. 10 metal 80 ft. long, made in 20 ft. lengths provided with external flanges for bolting up. The upper end of the tremie pipe was suspended from a frame, to which was attached a hopper for charging the tremie, the hoppers with frames running between guides attached to the front of the before mentioned towers. The tremie pipes, hoppers and all could be raised and lowered by means of steel hoisting ropes leading over sheaves at the top of the scow. The buckets in the hold of the scow upon receiving a charge from the concrete mixers were hoisted up inside the towers until they reached the tremie hoppers, which would engage them and trip them forward, discharging their contents into the hoppers; then they would reverse and go down, to their place in the hold of the scow. These buckets ran between guides located inside the towers immediately in the rear of the guides of the tremie hoppers. The concrete in passing from a mixer into the bucket would discharge over an apron which the bucket would trip forward every time it descended and trip back out of the way when hoisted up. The tremie hoppers were provided with a small platform on the outside and a railing around same where a man could stand and watch the concrete in the tremie, whether it was running out too fast or too slow, and give signals accordingly to the engineer who ran the corresponding engine.

The working force for operating the tremie scow when the process of concreting was going on, was 32 men, on an average. The operation was as follows: The tremie scow was anchored across the tunnel tubes in the trench, so that the tremies when lowered into place would come in the middle of a pocket, as already stated, one tremie between the tubes and one on the outside of each tube between the steel shell and the sheathing. The spuds were then lowered to the bottom and forced down sufficiently to take up a considerable load from the scow and prevent any rocking motions. The three tremie pipes were lowered into position until their lower ends rested on the bottom of the trench; the water inside of the tremie tubes would of course be at the level with the water outside. Meanwhile the boat loaded with gravel would be placed alongside the tremie scow on the opposite side. The gravel with its mixture of sand would then be unloaded by means of the clam shells and derricks, and dropped into the hoppers previously described, falling over the inclined screens, the sand and gravel shooting off into their respective bins, from which they would in turn be drawn, as required, into the super-hoppers of the concrete mixers, cement added, and the charge shot into the mixer, where the necessary water was added in the usual way.

A wadding of cement sacks was at first placed in each tremie on top of the water to prevent the concrete from dropping through while filling the pipe. A batch of concrete was discharged from the mixer into the bucket in the hold of the scow and hoisted up until a projecting arm on the receiving hopper of the tremie would cause the bucket to tilt forward and discharge the contents into the tremie hopper and on top of the wadding, the bucket immediately returning to its original place to receive a new charge, already in the process of mixing. When this hopper was about half filled, the tremie and hopper would be raised a trifle, permitting the water in the tremie to escape at the bottom as the weight of the concrete pushed the wadding downwards through the pipe. Meanwhile fresh batches of concrete were being dumped into the tremie hopper. In this manner the tremie was filled with concrete until the wadding reached the bottom and the concrete commenced to run out of the pipes. As fast as the concrete ran out at the lower end of the tremie pipe, fresh concrete would be added at the upper end of same, this process going on until the whole pocket was filled.

This wadding of cement bags was used only at the beginning of the work. It was soon found that one or two very dry batches of concrete would serve the same purpose, and this was used practically throughout the work in charging the tremie at the beginning of an operation.

The concrete except as noted in charging the tremies, was mixed very wet, much more so than would be permissible in concrete deposited in the air. No difficulty, however, was experienced on this account. The gravel showed no tendency to segregate from the mixture, probably because the mass was always in a slow and uniform motion, and when it reached its place of deposit the mass would be under a heavy hydrostatic pressure, that may have had the effect in connection with the loss of weight on account of buoyancy, of making segregation more difficult.

It should be particularly noted that the mouth of the tremie was always buried in the concrete from 2 to 5 ft. forming an effective seal which at all times prevented the outside water from forcing itself into the tremie. It was the duty of the inspector on the platform of the tremie hopper always to be on the look-out that the tremie was full of concrete. If the concrete showed a tendency to run out too fast he would signal the hoisting engineer to lower the tremie and thus choke off the flow; if the concrete did not flow fast enough he would order the tremie raised until the concrete would flow more rapidly.

It is a fact, that after a week or so, when the men on the concrete scow had become thoroughly familiar with their duties not a single charge was lost in depositing more than 100,000 cu. yds. of concrete. The concrete when deposited would take an exceedingly flat slope, in fact practically seek its own level. Occasionally a small mound would be built up around the mouth of the tremie, but the least agitation of same would cause this mound to spread out to a practically level surface. As soon as a pocket was finished the concrete scow was shifted to the next one. No pocket was ever started unless the necessary materials of sand, gravel and cement were on hand to complete it.

In depositing the concrete divers were employed for inspecting the progress of the work, and report when a pocket was completed.

The time required for filling one pocket usually ran from four to seven hours. The largest amount of concrete placed by the tremie scow per day was three pockets or 1,025 cu. yds., working 16 hours. This includes the time required for replacing the gravel boats, alongside the tremie scow. These boats generally held enough gravel for one pocket. The amount of concrete that could be placed depended mostly upon the supply of the gravel. Usually three pockets were concreted in two days, that is one pocket one day and two pockets the next.

As previously stated, the bottom of the trench was first filled with concrete to the under side of the diaphragms; this generally required from four to five days, sometimes a little longer, for each tube length.

The length of time of mixing a batch was usually from 2 to 3 mins. The time for the concrete to reach its place of deposit from the mixer would of course vary greatly, but the average time was probably about 8 mins. with a minimum of 5 mins. and a maximum of 15 mins. The velocity of the flow of concrete in the tremies would average from 14 to 15 ft. per minute. The extremes probably running from 7 ft. to 25 ft.

When the work first commenced the side tremies were made of 10-in. pipe as against 12-in. for the center tremie. This was done because the amount of concrete passing through each of the side tremies was approximately only half of that of the center tremie. After the first section had been completed all three tremies were made 12 ins. in diameter for the sake of convenience, as by that time it was found that the flow of the concrete could be absolutely regulated to suit the requirements.

The wear and tear of the tremie pipes proved very insignificant, the full set of tremies having been renewed only once.

The concrete was mixed in the following proportions: In the bottom of the trench below the diaphragms it consisted of 1 part of cement to 4 parts of sand and 8 parts of gravel. The concrete in the pockets consisted of 1 part of cement to 3 parts of sand and 6 parts of gravel. Gravel of small walnut size was used in preference to crushed stone as it was thought it would cause the concrete to flow easier in the tremies, besides gravel makes a denser concrete than crushed stone.

In some of the pockets at the joints between two sections the concrete was made in the proportion of 1 part of cement to 2 of sand and 4 of gravel. The reason for making the concrete in these pockets richer was simply a matter of precaution, taken to insure a tight joint, the steel work not fitting together as closely as intended. When the tubes were pumped out no water came through these joints, showing that the 1:2:4 concrete was practically impervious to water, although subject to a hydrostatic pressure of about 25 lbs. per sq. in.

For the purpose of determining the quality of the concrete, 6-in. cores were taken out by means of a Davis Calyx drill for the full height of the center wall between the steel tubes. These cores show a remarkable degree of uniformity of the concrete and of high quality both as to density and strength; in fact a better grade of concrete was obtained than would be possible in the open air. It should be noted in this connection that this concrete was compressed and set up under a hydrostatic pressure of from 16 to 30 lbs. per

sq. in., at the top and the bottom of a pocket respectively.

The crushing strength of this concrete when one year old, ran from about 2,800 lbs. per sq. in. minimum, to 4,000 lbs. per sq. in. maximum 1:3:6, according to tests made upon cores taken from the center wall.

A word should be said with respect to the time of setting or hardening of the concrete; this is, to be sure, a debatable subject. However, the consensus of opinion among the engineers connected with the work, including the writer, based upon such tests as could be made by divers, seemed to be that the initial set was acquired in about 10 hours, after the concrete was deposited, and the final set in twenty hours; after 40 hours the concrete was very hard, so that it would ring when struck with an iron bar.

Regarding the matter of laitance, hardly any was observed that would affect the quality of the work; this might be expected considering the manner in which this concrete was deposited, whereby the great mass of it would never come in contact with the water at all.

It may not be amiss to point out the three essential elements that contributed to the successful results in depositing the subaqueous concrete of the Detroit River Tunnel; they are as follows:

First, dividing the exterior of the tunnel tubes, by means of the longitudinal sheathing and the diaphragms, into compartments or pockets. This produced still water, which is absolutely essential for laying concrete under water, and permitted the filling of one pocket at a time with one monolithic mass of concrete. This arrangement further limited the lateral flow of the concrete, as it emerged from the tremie, to the confine of the pocket and reduced the washing out of cement by the water to an absolute minimum, in fact the loss of cement appeared to be negligible.

Second, the use of an equipment complete in every detail and equal to any demand made upon it, more especially an active or quick acting rig for handling the tremie pipes promptly as occasion required.

Third, mixing the concrete so wet, that it would readily flow in the tremies, and the flow controlled by keeping the mouth of the tremie at all times buried in the concrete at a sufficient depth thereby at the same time keeping it sealed and preventing the water from rushing in from the outside.

The demonstration of these highly successful results on such a large scale suggest possibilities of the application of this method to various kinds of engineering works, other than subaqueous tunnels. Numerous instances will undoubtedly from time to time present themselves where this method could be used to advantage, not only as an expedient of construction, but at a great saving in cost over prevailing methods, especially where large and expensive cofferdams would be avoided. The subaqueous concrete of the Detroit River Tunnel was deposited at a considerably less expense, including the cost of the plant, than similar work could have been done for on land.

It may perhaps be permissible, in conclusion, to venture a few suggestions of such applications.

Structures, now frequently built of cyclopean concrete blocks, such as dock and quay walls, break waters, etc., could in many instances be built "in situ" by using steel forms constructed on the compartment or pocket principle, which would result in obtaining monolithic and massive blocks, or sections of structure of far greater magnitude, than otherwise possible. The steel forms could be built extremely light and left in place, or heavier and detachable to permit their being used over again, as economy and expediency might dictate. If piles were required for providing a proper foundation they could be driven after the excavation was done to the required level, the forms set over them and then imbedding them in the concrete.

Similarly drydocks, light house foundations and bridge piers could be constructed, always, of course, depending upon local conditions and circumstances as to the applicability of the method.

Earth and Rock Section

Note: This section is devoted to methods and costs of excavating earth and rock and building embankments. It will cover the grading of roads and railroads, diking and canal work, dredging, building reservoirs and earth dams, sewer and water pipe trenching, quarrying, etc.

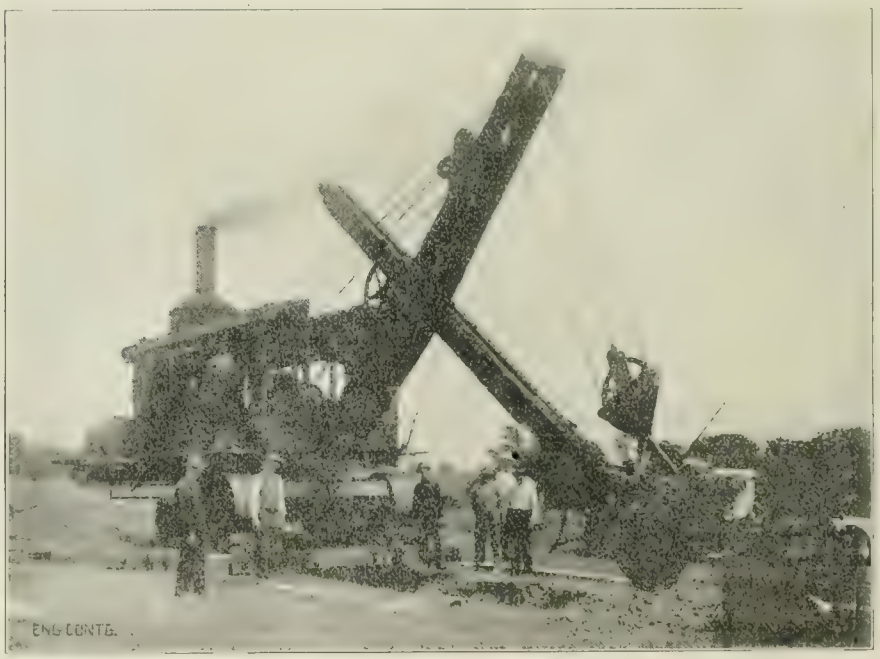
Method of Trenching for a Sewer at Auburn, N. Y., Using a Revolving Steam Shovel.

Interesting and in some respects novel methods of using a revolving steam shovel were employed recently in trenching for some 13 miles of sewer at Auburn, N. Y. The sewer ranged from 5 ins. in diameter for laterals to 24 ins. in diameter at the disposal works. Vitrified pipe was used and the trenches were dug ordinarily 1 ft. wider than the diameter of the sewer; the average depth of trench was 9 ft., and the maximum depth was 19 ft. The material trenched was clay and glacial drift with embedded boulders for the most part, but pockets of quicksand were encountered at places. Generally, the upper 3 to 5 ft. were good digging with the harder material underneath. The quicksand pockets were excavated by hand as was also the stonier parts which had to be blasted.

In going through quicksand, sheeting was necessary; 2-in. cull oak sheeting was used and altogether some 3,000 lin. ft. of trench in quicksand and other wet places were sheeted. The sheeting was set upright and was braced with screw extension braces. Where the shovel was used the width between sheeted trench sides was about 4 ft.

The shovel used was one manufactured by the Vulcan Steam Shovel Co., of Toledo, O., and is known as that company's No. 1 revolving shovel. It has a full circle swing; the accompanying view shows the shovel at work. This shovel weighed 35 tons mounted on traction wheels as shown. It was equipped with a ¾-cu. yd. dipper, and a dipper handle 27 ft. long, or long enough to dig a 16-ft. trench.

Referring to the illustration it will be noted that the shovel was operated on its own traction wheels, and not, with traction wheels unshipped, on a timber frame work on rollers. This mode of operation was permitted by the narrow trench which the wheels could straddle. A rather special timber platform trackway was used, however, for the shovel to travel on. This trackway platform was made in three sections; each section was 8 ft. wide and 16 ft. long and consisted of 12 x 12-in. x 16 ft. timbers bolted together with blocks between. Each section was thus a sort of grid of timbers, over which track planks could be laid for the traction wheels. There was a U-bolt hook in the center of each grid or section to which a length of chain was attached, and on the underside of the dipper handle, just back of the dipper, a hook was fastened. By attaching the chain to this hook, the shovel lifted and swung the timber section as desired. As indicated above, three sections were used, placed lengthwise across the trench side by side. The shovel stood on two sections; when an advance was to be made, the third section was placed close in front, the track planks laid on it, and the shovel run ahead. The advance left the rear section free to be picked up and swung ahead in its turn. The track planks were 8 ft. long, 4 ins. thick and 8 ins. wide, and were moved and placed by hand. It is stated that each move took from 4 to 5 minutes.



View of Revolving Steam Shovel Digging a Sewer Trench at Auburn, N. Y.

The plan of work was to lay the pipe close up with the opening of the trench and to backfill with the shovel directly, and this plan was followed except where the trench was held up by boulders which the shovel could not remove without previous blasting. In a word, when all went well, the shovel deposited each dipperful excavated in the trench at the rear as back-fill. When, however, rock or boulders were encountered, the shovel was not held up, but went ahead and deposited the excavated material at the side of the trench.

From the preceding paragraph it will be seen that no very exact figures can be given of the shovel work proper. Progress was figured in feet of completed sewer per day, and this was from 20 ft. to 150 ft., with occasional spurts of well up to 200 ft. per 8-hour day. The manufacturers of the shovel write regarding progresses as follows:

> The material consisted of blue clay interspersed with boulders from 3 ins. to 36 ins. in diameter, and was very hard to dig. The shovel excavated it without much trouble and was economical with fuel and water. The shovel excavated per 8-hour day from 90 to 125 lin. ft. of trench, 4 ft. wide and from 4 to 10 ft. deep; it excavated from 50 to 75 lin. ft. of trench 4 ft. wide and from 10 to 14 ft. deep; 22-in. by 24-in. tile was laid in place, while the

shovel was working, and the back-fill put in on top of the tile with the shovel. The back-filling was accomplished by excavating the material in front, swinging through a half circle and depositing it in the trench after the tile had been laid.

for the purpose of loosening the strong toe at the portal of the tunnel. After each charge was loaded it was mucked for about 3 ft. back of the charge, then tunnel packed completely to the portal.

The time taken to load the shot was 15 hrs.

Record Excavation on the Panama Canal.—On Feb. 3, seventeen shovels working in the central division excavated an average of 186 cu. yds. each per hour during the eight-hour day. Although the total number of hours under steam was 136, the number

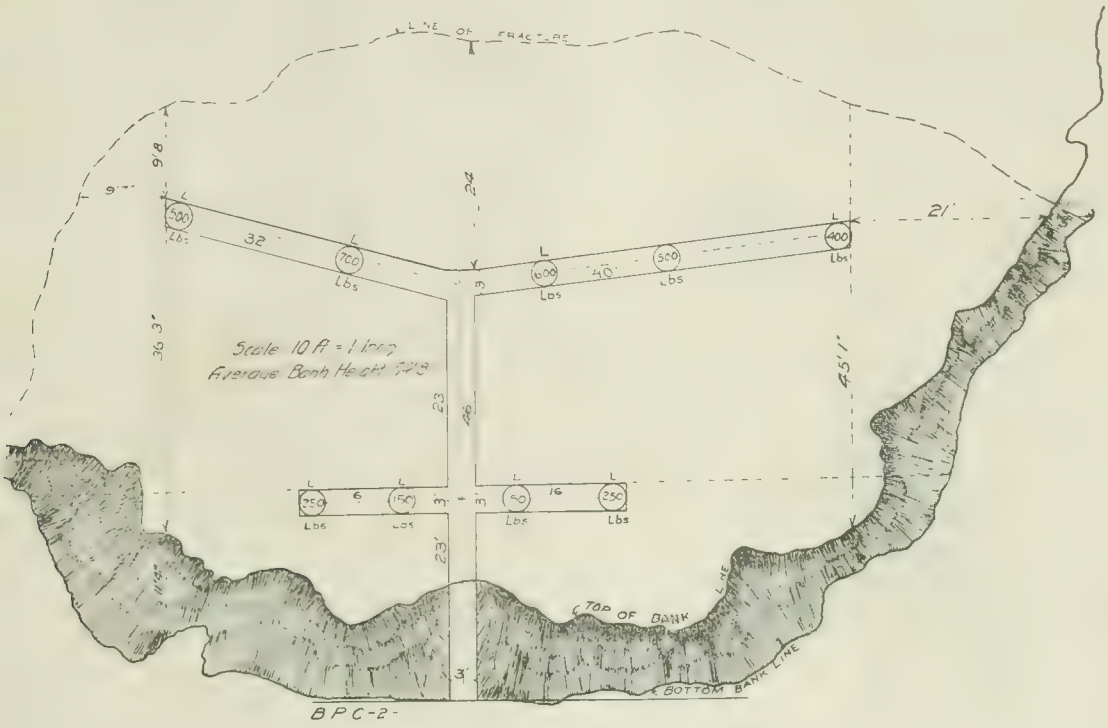


Fig. 1—Plan Showing Arrangement of Tunnels and Charges for Making a Large Blast at St. Helena, Oregon.

A gang of about 20 men was worked. On the shovel there was an operator, and a fireman. Two to three men were required to guide the sections of shovel platform during swinging, and to bring forward and place the track plank. The bracing gang consisted of 4 men placing the sheeting and timber, 2 men placing and screwing up the extension braces and 1 man on the bank carrying planks and braces from the rear when loosened to the front and handing them down to the man in the trench. The pipe-laying gang consisted of 2 men laying pipe, 2 men lowering pipe, 2 men mixing and supplying mortar, and 1 instrument man. All pipe was laid by instrument as the shovel and its operation prevented the stretching of lines. About 1,200 lbs. of coal were used by the shovel per 8-hour day.

The work as described was done by the Rochester Construction Co. of Rochester, N. Y., and occupied from May to December, 1909.

Method of Making a 14,280-Cu. Yd. Blast in Basalt Rock With Some Data on Costs.

The accompanying sketch and view show the method of making a large blast in the crushed stone quarry of the Columbia Contract Co., at St. Helena, Ore. This company is now getting out the stone for the jetty at the mouth of the Columbia river. The rock being quarried is a basaltic formation. It weighs 175 lbs. per cu. ft. and has a specific gravity of; its other properties are, wear 1.8 per cent, hardness, 18.8 and toughness 22. The sketch Fig. 1 shows the plan of the tunnels and the arrangement of the charges. The explosive used was No. 2 formula M. V., bag Trojan powder and the charge was 3,500 lbs.

The shot broke on the exact fracture line as was calculated and shown on drawing. The loading of the shot was also proportioned as shown. It was the intention in loading this shot to shatter the entire formation as much as possible in order to put it through a crusher with the least possible expense, and the work after the shot showed that practically the entire excavation could be handled with steam shovel with scarcely any bulldozing necessary. The first double T was driven 45 min., and the cost of loading was $58. The cost of explosives was, $358.75, making a total cost of $416.75. Exclusive of tunnel driving, the cost of the blast was thus $416.75 ÷33,736 tons = 1.236 cts. per ton. The volume of rock broken was 14,280 cu. yds. so that the cost per cubic yard was slightly less than 3 cts. The blast was loaded and fired under the direction of J. C. Costello and H. Bronstein of the Trojan Powder Works. We are indebted to Mr. Costello for the information from which this account has been prepared.

of hours that the shovels were actually loading was 93 hours and 20 minutes. The total number of cubic yards excavated was 25,274. The excavated material dumped on cars made 1,397 loads.

The Chicago, Burlington & Quincy Ry., according to reports, is to at once let contracts for 60 miles of grading in Natrona and Fremont counties, Wyoming. Headquarters on the construction work on the Kirby-Orin extension will be at Casper, Wyo. T. E. Calvert, Chicago, Ill., is chief engineer.

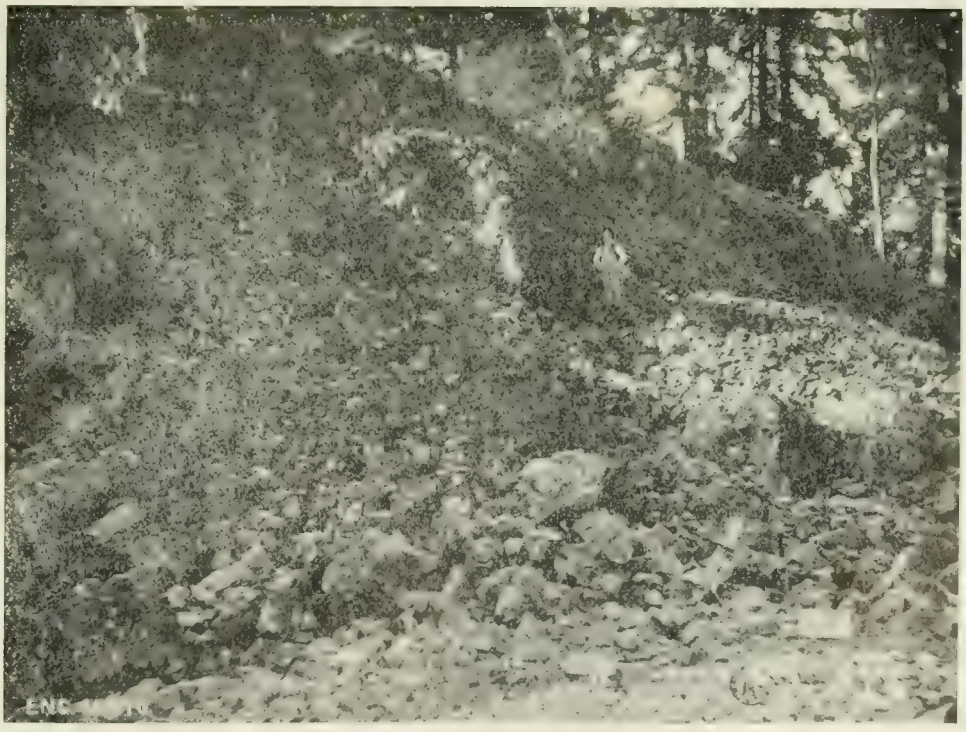
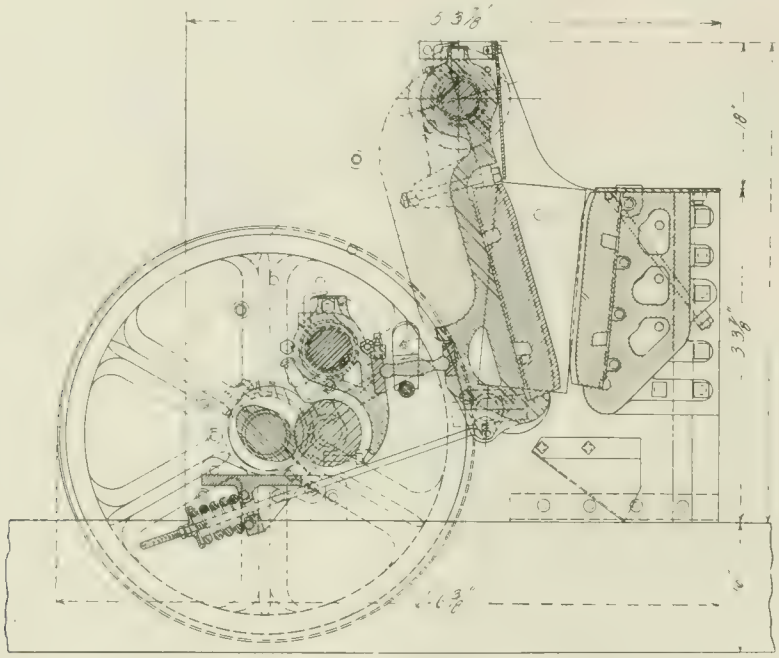


Fig. 2—View of Face of St. Helena Quarry After Blast.

A New Jaw Crusher Designed Particularly for Contractors' Use.

A crusher for contractors' use has to fulfill different requirements than are intended for general quarry use. A contractor's crusher should be of large output, remarkably light in weight, convenient to handle and above all very durable. Particular attention has been paid to these qualities in designing the crusher illustrated in the accompanying cut. A notable feature of this machine is its practically all-steel construction. The main frame or side plates are of rolled steel plates. The large casting that forms the front of the machine, which part is termed the stationary jaw, is of grey iron. The moving or swinging jaw is a steel casting. The tumbler or large lever casting is also of steel. The fly wheels and pedestals are of grey iron. The main cam shaft and the anti-friction roller are steel forgings. The anti-friction roller revolves in boxes made of special bronze material. All shafts from which castings are suspended are of steel. The cheek plates are of special hardened steel, while the toggle seats are also made of special steel.



A New Jaw Crusher for Contractors.

This steel construction makes the machine of tremendous strength in comparison with its size. The feeding mouth is lower, in fact, than in other crushers of equal size. This means that a large saving is effected in delivering stone into the crusher. The crusher will turn out from 150 to 200 tons of crushed material per day of 10 hours. Its weight is 12,500 lbs., and it is furnished either stationary, as shown in the illustration, or with regular mounting and with elevator and screw attachment as may be desired.

In this crusher the power is exerted upon the moving jaw through the rolling action of the double cam-shaft, anti-friction roller, tumbler and toggle. As the cam shaft is elliptical in shape every revolution of the fly wheels means two movements of the moving jaw. The advantages claimed for this feature is that the crusher need only be driven one-half as fast as other crushers to produce the same results and as friction has been reduced by the reduction of speed, the possibilities of wear have been reduced proportionately. This crusher is built by the Good Roads Machinery Co., Kennett Square, Pa., and is known as the No. 4½ Champion.

At a public meeting held at Buffalo, Wyo., Feb. 21, $35,000 was raised for the construction of a railroad by the Wyoming Railroad Construction Co. of a line from Buffalo to Clearmont on the Chicago, Burlington & Quincy R. R. It is said that active work will be commenced April 1.

Method of Making a Steam Shovel Cut of Two Lifts in One Lift.

BY H. MORTON STEPHENS.*

During September, 1909, the E. Purcell Construction Co., secured from the Winston-Salem South Bound Ry. Co., a contract for the construction of part of the above railroad, embracing sections 22 to 30 inclusive. Section 22 is located in the town of Lexington, N. C., on the Southern Ry. The balance of the work runs south through a rolling country, and with the exception of section 22, the work is comparatively light, and with few exceptions would be a team proposition, except for the long hauls.

The outfit was unloaded from a spur track to a cotton mill, and within 100 ft. of the center line on section 22. The outfit consisted of two Model 60 Marion shovels, seven dinkeys, cars, rails, etc., and at the point where it was unloaded there would be a 36 ft. cut, consequently as part of the track, etc., was unloaded it was laid, and materials hauled ahead over same to the grade point at the south end of this cut. This left all necessary track in place for hauling material from the shovel on its first lift. In one week this shovel, which we call No. 1 was operating.

It was decided to send shovel No. 2 to the extreme southern end of the work on section 30, a distance of nine miles, and then work north. This shovel, with the necessary equipment of dinkeys, cars, rails, etc., moved this distance in ten days over the average North Carolina dirt roads.

The first and second cuts taken out by this shovel, contained about 52,000 cu. yds., and were taken out in the usual 8 ft. lift manner. The specifications of the railroad company called for a 20 ft. road bed and 1 to 1 slopes in cuts and would not allow the contractor for the additional width, made necessary by the use of a Model 60 shovel, which requires when using a dinkey track in the bottom of the cut on the last lift a 26 foot road bed.

As the remaining six miles alloted to this shovel were all practically two-lift cuts averaging about 13 ft. in depth, and as some of the cuts were about 3,000 ft. long, it was apparent that some scheme had to be devised whereby this extra unpaid for material would not have to be moved.

Upon investigation it was found possible to raise the boom on the shovel by simply taking out the links or loops in the boom support guy rods or hog rods, at the end where they are attached to the yoke at the apex of the A-frame. It was also found necessary to make two plates to fit on the rim of the swinging circle, at the corners of the aperture in the same under the boom, in order to reduce the angle and prevent the cutting of the cable which operates the swinging circle. This raising of the boom, etc., was accomplished in about two hours.

The shovel then started in on a single track cut about 3,000 ft. long, with an average depth of 9 ft. The deepest cut was 15 ft., and was taken out in one lift by lowering the dinkey track 1½ ft. With the boom raised in this manner it was possible to dig a 13½ ft. lift, and when cuts are, say 16 ft., it is possible to take them out in one lift, by excavating a trench for the dinkey track about 3 ft. deep. The material coming from this trench to be placed inside the slope stakes, and later taken out with the shovel.

By this method one trackage layout is sufficient for a cut of the above nature. There is no moving back, and there is very little extra material taken out even with a road bed specified to be only 20 ft. wide. The shovel is a little faster acting with the boom raised, as described, and there is no additional wear and tear on the machinery.

The material encountered is almost all stiff clay, with a small amount of loose rock. This shovel has averaged about 25,000 cu. yds. per month, and has only had one break down, this being a very small matter. Shovel No. 2 is under the direct supervision of Mr. J. E. Powell, who is superintendent for the E. Purcell Construction Co. The boom on shovel No. 1 has not been raised, as all of the work mapped out for it is very heavy and practically all double track. This is also a Model 60 Marion, and has shown some very high monthly outputs; in one month it moved 36,000 cu. yds., and in another month a little over 40,000 cu. yds. This shovel is under the direct supervision of Mr. E. Mays.

It is not claimed by the author that the arrangement described is any new wrinkle, but it is the first time he has seen it used, and never having noticed any article written in reference to it he hopes this one may prove of some value.

*Resident Engineer Winston-Salem South Bound Ry., Lexington, N. C.

First Annual Convention for the Standardizing of Paving Specifications.

This convention was held pursuant to a call issued by Mayor Busse of Chicago, as noted in previous issues of ENGINEERING-CONTRACTING. Headquarters were at the La Salle Hotel. Little time was wasted in preliminaries and all entertainment features were left to the evening hours. A number of delegates, however, preferred to work all the time, so there were evening sessions of some members of all committees. The convention was dominated by the idea of business and the earnestness displayed was remarked by every one.

Mr. Frank T. Fowler, superintendent of streets, Chicago, was temporary chairman, and Mr. John B. Hittell, chief engineer of streets, Chicago, was temporary secretary. The convention was in session from 10 a. m. of February 21 to noon of February 26. On the first day the organization consumed a greater part of the time and on the second and third days the committees worked behind closed doors, no salesmen of materials or contractors being permitted to be present. This rule was carried out on the inspection trips to view pavements in the vicinity. On the afternoon of the third day a full meeting was held to consider all reports ready and on each of the remaining days two open meetings were held to discuss committee reports.

Ninety-four delegates were present, representing forty-four cities. The work was completed at a too late hour to get the reports and recommended specifications in print this week, but in a later issue all the specifications will be printed with comments.

Surveys for the projected line of the Covington & Big Bone Traction Co. from Covington, Ky., to Big Bone have been completed by J. J. Weaver, C. E., Covington, Ky., and preparations are under way for the construction of the line.

Roads and Streets Section

Note: This section is devoted to methods and costs of road and street construction. It will cover road building in all its details, the construction of pavements, sidewalks and gutters, the testing and use of paving materials and the machinery and tools used in road building and paving.

Concrete Pavement Construction at Richmond, Ind.

The first concrete pavement in Richmond, Ind., was laid in 1896, and is still in service without having required any expenditure for repairs. The natural soil under this first pavement is gravel, so no sub-base was put in. The concrete was proportioned 1-2-5 and deposited 5 ins. thick after ramming, with a top surface 1 in. thick proportioned 1 to 2. It was cut into blocks about 5 ft. square and the surface pitted with an ordinary lug roller. Extreme care was used in all the processes, particularly the minor ones. The pavement gave such satisfaction that during the last eight or ten years small additional amounts have been constructed each year.

In this pavement work various plans of construction have been used, the principal variations consisting in the material for aggregate, thickness of concrete, construction with and without a top surface, thickness to top surface, size of blocks, thickness of joints and material used therefor. In a paper read at the recent annual convention of the National Association of Cement Users, Mr. Fred R. Charles, City Engineer of Richmond, described the developments of the method of concrete pavement construction at Richmond, as follows: One roadway was cut in blocks 8 to 10 ft. square; another in blocks 30 to 40 ft. square; all joints between the blocks, both cross and longitudinally being 1 in. wide and filled with paving pitch. The defect of this method consists in the chipping of the concrete edges at these joints, principally the longitudinal ones. Our experience seems to show the blocks should be as large as possible in order to reduce the number of joints, and that the joints should be as thin as can be made. On the other hand, we find that blocks 10 to 15 ft. square are about as large as can be made without developing temperature cracks in our climate. These latter however, apparently do not injure the pavement, beyond detracting from its appearance, as cracks that have existed for years show no enlarging, and the pavement up to and over the cracks is as solid as elsewhere. Corrugating or grooving the surface is also objectionable for the same reason as are the joints; the edges of the grooves afford an opportunity for the concrete to chip and spawl off by the action of horses hoofs, etc. Also the grooves catch and collect the dirt, interfering with the cleanliness of the pavement, and rendering it more difficult to sweep. Possibly the corrugations afford slightly better foothold for horses, but I think even here the advantage is exaggerated. We obtain a very good surface by using 1 part cement to 2 parts hard-grained, coarse sand, screened through a No. 4 screen; then trowel down to remove all holes, air spaces, etc., and "raise" with a cork or wood float, giving a rough gritty surface, in which horses can maintain their footing as securely as on a cement filled brick, an asphalt, or wooden block pavement when damp. For ordinary traffic pavement we find excellent results are secured by the use of 5 ins. of 1-2-5 concrete, and a top surface 1½ ins. thick, mixed 1 to 2. For automobile travel nothing could be more satisfactory. Of course it is trite and unnecessary to say that care must be used in selecting good aggregate material, proportioning properly to reduce voids to a minimum, and securing good workmanship in all the operations of mixing, placing and finishing the work. I am a firm believer in "wet mix," for this, as well as for most other concrete work. Place this concrete on a well prepared foundation, using suitable straight edges and templates cut to the required crown of the street; tamp or jostle to make a compact mass, leaving the surface rough to provide attachment for the top layer; cut joints through the concrete every 10 to 15 ft. and fill with sand. Before the concrete begins to set, place thereon the top surface, composed of 1 part cement to 2 parts hard, coarse sand, trowel and float, cutting joints directly over those in the concrete, using a small radius "jointer" to leave as thin a joint as possible, and finally finish by means of a "float," leaving the surface as rough as possible. This gives a roadway very suitable for our use. For heavier traffic, 6 ins. of concrete and 2-in. top surface is advantageous. We have also had good results by making the pavement homogeneous, that is, without the top surface. Make the concrete somewhat richer in cement; and quite wet. Tamp until free mortar flushes to the top, then finish with trowel and float. For this purpose the concrete should be free from large stones, as with a large stone at the surface, if one end becomes worn loose, a large leverage is afforded to tear the remainder of the stone from the concrete. As remarked before, the disadvantage of concrete is its lack of toughness, whereby exposed edges of joints and corrugations are prone to chip and wear off. For this reason joints ought to be reduced to a minimum, and especially longitudinal joints should be eliminated wherever possible.

Road Engineering.*

Public sentiment for the improvement of public highways is becoming widespread throughout the South, and there is now but very little difficulty in arousing a community to see the advantages of improved roads and to create in that community a desire for them. There is, however, a woeful lack of appreciation amongst a large majority of those who are now favoring and asking for good roads, in regard to the method of construction of these roads and the ability that is required in constructing them. Too many have the idea that most anyone can build a road, especially if he knows how to do a little surveying; while, in reality, it is just as important that a competent engineer should have the supervision of the construction of our public roads as it is that a competent engineer should be in charge of the construction of our railroads.

Roads must be located; must be graded so as to permit of hauling a maximum load at all times, and prevent wash; they must be thoroughly drained and finally surfaced with suitable material to give them a hard, smooth surface, which will depend upon the location of the road, the amount of travel over it, the cost of material, etc. This surfacing material may be macadam, sand-clay or gravel. These questions of road construction must be solved by a road engineer; for he is the one, and the only one, who can solve them practically, economically, and to the best advantage to the community. Mistakes are costly, and in many instances good roads work has received a very serious set-back by the unwise expenditure of money that had been raised for good road construction, by the bad location of the road or by the poor surfacing of the same. Men who have not been trained to work out such problems are not capable of taking charge of improved road construction. The demand for engineers who are capable of handling these problems is increasing every day, and it will continue to increase with the increased amount of road construction throughout the South, and as the counties and townships realize more thoroughly that to employ a competent road engineer to have charge of the construction of their roads is the wisest and cheapest expenditure that they can make. When a county or township issues fifty to one hundred thousand dollars, or more, of bonds for good road construction, the people desire that this money shall be spent so that it will build as great a number of miles as possible of improved road suitable to their county. In order to accomplish this they should employ a road engineer to plan out their work, and then hold him responsible:

1. That the road is located in the right place.
2. That it is graded properly.
3. That it is thoroughly drained.
4. That it is surfaced with material suitable to the traffic that will go over it.
5. That culverts and bridges are put in the right places and constructed of suitable material.

These are engineering problems that require skilled men to solve them, especially as there is usually a minimum amount of money to accomplish a maximum amount of work. It will often be found to the advantage of a county to employ a road engineer from outside the county, so that he will not in any way be influenced by local opinion in regard to the location of the road. It will be found that the problems to be solved in road construction will vary in nearly every district, so that each road has to be treated as an entirely new problem.

Not only should the road work in the different counties of the South be under the general supervision of a road engineer, but there should also be a road engineer in charge of the actual construction of the road.

I believe it is to the interest of every Southern State to have a highway engineer, who will have general supervision of the engineering problems connected with public road construction throughout the state. He and his assistants should work out for the county authorities and the county road engineer the best kind of road to build in that county, where it should be located, how it should be drained, and take up any other problems that might come up relating to the construction of the road. This is one form of state aid to counties in good roads construction that will prove one of the best investments that any state can make, for it will mean the saving of thousands and often hundreds of thousands of dollars to the different counties, and any saving to a county or township means a saving to the state.

*From Bulletin No. 3 of the Southern Appalachian Good Roads Association, by Jos. H. Pratt, State Geologist of North Carolina, Chapel Hill, N. C.

Method and Cost of Road Surfacing With 2-in. Concrete Cubes.

During the past year a new type of road surfacing was employed in the construction of a section of state highway in Monroe county, New York. This surfacing consisted of 2-in. concrete cubes made from Portland cement and gravel or shale and moulded in machines specially built for the purpose. The idea of using these cubes was evolved by Mr. J. Y. McClintock, county engineer of Monroe county, and the New York State Highway Commission authorized the expenditure of $2,250 for the purpose of making a preliminary demonstration. At the recent annual convention of the National Association of Cement Users, Mr. George C. Wright, consulting engineer, Rochester, N. Y., described the methods employed in constructing and laying these cubes, his information in the main being taken from a report of Mr. McClintock to the State Highway Commission.

The cubes were placed in a section of the Ridge Road northeast of the city of Rochester, N. Y. On this section the original trap rock surface 2 in. thick was completely off at the center and nearly so at the side of the 16 ft. macadam roadway, leaving exposed a good solid lower course of rather large size broken Medina sandstone resting on good gravelly foundation.

The existing surface was somewhat rough and knobby, and over this was spread as thin a layer as possible of screened gravel, which

was rolled down with a 12-ton roller, so that in spots it was 2 in. thick and in other spaces the over knobs it was no measureable thickness The resulting surface had a crown of about 4 in. in 16 ft. width.

On this bed so prepared was placed directly a wearing coat of 2-inch cubes for a width of 15 ft., being laid close together by hand, the edges being held up temporarily by 2-in. planks laid lengthwise with the road. On the cubes was spread a small amount of fine, somewhat loamy, gravel, which was broomed in, after which the heavy roller was slowly passed over the whole of the surface, forcing the cubes to take a full bearing on the supporting gravel. The edges and roller wheel was supported by the planks, then the side-planks were pulled up and moved ahead and coarse gravel ¾-in. to 1½-in. was placed along the sides next to the cubes on the shoulder for a width of about 2 ft. Outside of this a finer gravel spread, feathered off to a width of about 3 ft.; more of the fine loamy gravel was spread on the top and broomed and flushed in until the space between the cubes was thoroughly filled. The gravel on the shoulders was wet and the whole surface thoroughly rolled with the heavy roller.

A stretch of road 1,800 ft. long was surfaced with cubes. On 1,600 ft. Portland cement gravel concrete cubes were used, and on 200 ft. vitrified shale cubes 2¼-ins. in size were used. For a length of 100 ft. a concrete sunken curb 6 ins. by 9 ins. in dimension was used in place of the gravel shoulders. On a 100 ft. length the joints between the cubes were filled with Portland cement grout instead of the fine loamy gravel. For 60 ft. on which the joints were filled with the fine gravel, light asphaltic road oil was sprinkled over.

A machine for making cubes which is an adaptation of the ordinary cement brick machine was furnished. This machine made 68 cubes at one operation, resting on a wooden tray, and the tray was carefully placed on a drying rack without disturbing the freshly made cubes. The cubes remained in racks 24 hours and were then dumped in a pile. This pile was thoroughly sprinkled twice each day.

The number of cubes made was about 7,000 upon the first day but within a few days the same gang was able to make with ease 26,000 of the cubes. Various sizes of screens were tried from ½ in. to 2 in., but it was found that the ½-in. screen gave a product that could best be handled in the machine. Experience showed that the concrete had to be rather dry in order to avoid settling and bulging of the cubes before the concrete set. Seven men and a foreman did all the work. The amount of cement used averaged 2 2-10 bbls. to a cubic yard of concrete. The area covered with cement cubes was 2,652 sq. yds. upon which was laid all of the 730,000 cubes manufactured, except about 5,000 kept for repairs. The cost of cement cubes laid was as follows:

	Per sq. yd.
Cement, 0.088 barrels	$0.121
Cost of factory	0.107
Labor of manufacture	0.161
Gravel, 50c per cu. yd	0.024
Carting	0.027
Laying	0.072
Total cost per sq. yd. laid	$0.512

There was placed on shoulders 219 cu. yds. of gravel covering 1,800 sq. yds., costing $2.12 per cubic yard rolled in place, or 26 cents per square yard.

In considering these figures as the basis for estimating cost it is obvious that there might be reductions made in cost of cement by using a reduced quantity, and in reduced cost of carting, the cost of the factory might be disturbed over many more square yards, and the cost of labor reduced by use of concrete mixer and other labor-saving devices. The cost of gravel in pit is usually nearer 10 cts. per cu. yd. than 50 cts. which was paid here. The cost of laying was very much reduced as the men became experienced, and this could be still further reduced by paying for it on the basis of piece work.

Grading work was started Feb. 15 between Fort McCoy and Palatka, Fla., on the connecting link of the Ocola & Northern Ry. between Ocola, Fla., and Balataka.

Water-works and Sewer Section

Note: This section is devoted to methods and costs of constructing sewers and water-works. It will cover the construction work for all details of water supply and sewerage, including sewage purification and water filtration.

Some Notes and Figures on the Valuation of the Water Works Plant at Richmond, Ind.*

In presenting the subject covered by this paper, it is necessary to give a brief history of the Richmond plant. This company was incorporated in 1883, with a capital stock of $250,000. A franchise was granted by the city, and a contract made for 7 years covering hydrant rental. The plant was put in operation in 1885 and carried a bonded indebtedness of $200,000. On Sept. 21, 1892, a new contract was made for 20 years. The plant in 1885 comprised a brick pumping station, 2½ miles from the center of the city, containing a 4,000,000 Holly pump, two 80 HP. boilers and necessary piping; a 10,000,000-gals. reservoir with bouldered inner slopes, located one mile beyond the pumping station; a 20-in. main connecting the reservoir and pumping station; an infiltration gallery 300 ft. in length; a 20-in. main to the city; and a distribution system with 20 miles of mains from 6 ins. to 16 ins. in diameter, 170 Mathews hydrants with 6-in. branches, and about 80 valves. Since the installation of the system in 1885, three additional galleries have been built aggregating 1,225 ft. in length, and a 16-in. cast iron siphon line 3 miles in length conveys water to the pumping station from a large dug well. Another Holly pump of 6,000,000 gals. capacity was installed in 1894 and two boilers added. The reservoir has had the bottom and inner slopes cemented, and the distribution system has been gradually extended. All parts of the plant have been kept in good condition, and Mr. Dabney H. Maury, who was recently engaged by the city, reported that "the plant as it now stands is in almost every respect above the average for cities of the size of Richmond." Its present length of mains is 37.34 miles of cast iron pipe from 3 ins. to 20 ins., and 3 miles of wrought iron pipe from ¾ in. to 3 ins. in diameter. This does not include 4,713 ft. of 20-in. pipe from pumping station to reservoir. On July 1, 1909, there were 312 Mathews hydrants, 2,360 meters, 4,281 service attachments in use, 23 fire lines and 112 free services for supplying water to school buildings, hose houses, drinking fountains, flush tanks, etc. The consumption for the year, same date, was 778,000,000 gals., of which 351,000,000 gals. were metered. The estimated free water was 60,000,000 gals. for the year.

In March, 1908, a fire occurred in a downtown business block originating in a large stock of paint, and after several hours' work, was gotten under control with a loss of $60,000. Thirteen streams were used under direct pressure. As a result of this fire, the Commercial Club took up the matter of additional fire protection, covering a second main, another pumping engine, an additional hose company, more fire apparatus, and a building code, following very closely the requirements of the State Fire Inspection Bureau's conditions by which Richmond could be placed in Class 2.

A conference was arranged between the Board of Public Works and the water company, and a proposition was made by the latter to cover above requirements, provided a new contract was entered into, the rates therein to be practically as heretofore. The Board of Works considered the proposition unsatisfactory and decided to employ an expert engineer to review the situation. Mr. Maury, of Peoria, Ill., was engaged by the city, and the company retained Mr. John W. Alvord of Chicago. The city desired the company to give it such data as would enable it to obtain the value of the plant. Being confident that the city was acting in good faith, and wishing to convince a doubtful public that it was not seeking a return on an inflated stock and bond issue, the company opened its books for examination by the city's accountant. The action of the company met with hearty approval, and it was agreed that the engineers should work in conjunction in securing the inventory of the plant. There could then be no dispute on the items of facts. Any differences arising would be on valuation only. The preliminary work of the engineers consisted principally in checking and tabulating the data furnished by the maps, records and inventories of the company. Information as to character of excavation, street pavements, etc., was obtained from the city engineer. The work of the accountant consisted in reviewing and auditing the receipts and expenditures from 1904 to 1909, and in examining the investment or plant from date of organization, to see if the entries therein were properly charged to such account. The company has always been conservative in entering up the cost of improvements on the plant account, and depreciations has been taken care of by charging repairs and replacements to the repair account. Under this system, the books of the company on July 1, 1909, showed the plant valued at $553,331.

The report of Mr. Maury was made to the Board of Works in November, 1909, and included a complete inventory of the plant, valuation of same, report of the expert accountant, and recommendations for betterments. In determining the present value of the plant, Mr. Maury and Mr. Alvord took into consideration the cost of reproducing the property, which plan seems to be growing in favor as a most equitable one. Two years were estimated as necessary to complete the new plant, and two more years to secure a revenue equal to that acquired by the existing plant at the end of the same period. Under this method, the cost of reproduction of the physical property is given as follows, in Mr. Maury's report:

Mr. Maury's recommendations for better-

*Extracts from a paper by Howard A. Dill read at the annual meeting of the Indiana Sanitary and Water Supply Association.

Description.	Cost of Reproduction.	Depreciation.	Present worth.
Preliminary costs	$ 10,000 00	$ 1,088.00	$ 8,912.00
Real property, water rights and rights of way...	37,400.00	.....	37,400 00
Interest on real property, etc., during 1½ years construction	2,805.00	.....	2,805.00
The distribution system	328,436.39	27,094.12	301,342.27
The reservoir	50,508.44	3,737.62	46,770.82
Pumping station	65,517.55	13,956.12	51,561.43
The water supply	73,618.87	9,581.97	64,036.90
Meters, stock tools and other property	42,348.89	7,564.29	34,784.60
Engineering, 1½ years construction	30,531.76	3,150.88	27,380.88
Interest during construction	24,418.76	2,520.02	21,898.74
Cost of reproducing the property	$665,585.66	$68,693.02	$596,892.64
Going concern value	110,825.69	.....	110,825.69
Operating capital	10,000.00	.....	10,000.00
Total cost of reproduction	$786,411.35	$68,693.02	$717,718.33

ments cover a new pump, suction well, increase of water supply, a 20-in. main to the city, additional mains to improve circulation, and additional valves and hydrants, the total being estimated at $139,000. Mr. Maury estimates that the present net earnings would yield 8.34 per cent on the physical value of the plant, 6.94 per cent on the valuation including going concern value, and 5.18 per cent on $857,188, which includes the above physical and going concern values, and the amount invested for betterments as recommended.

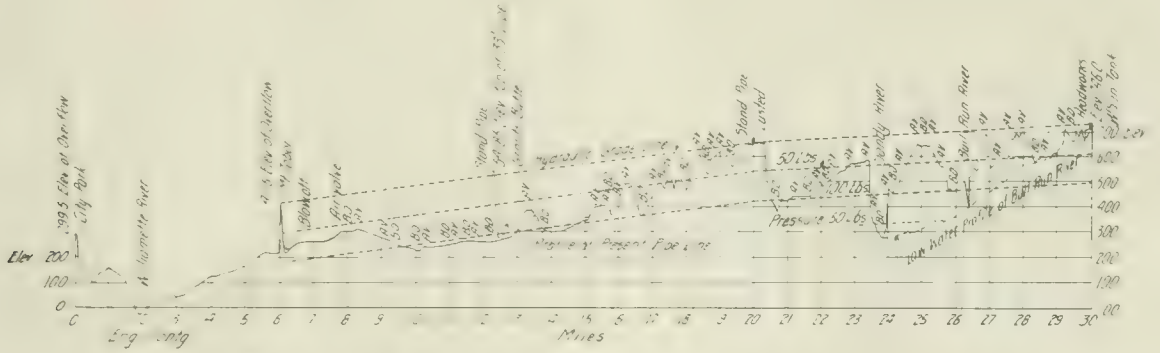


Fig. 1—Profile of 24-mile Steel Pipe Line for the Portland-Oregon Water-Works.

As the Board of Works, to whom the report was submitted in November, was to retire Jan. 1, 1910, no action was taken, except to make a report to City Council, in which it highly commended Mr. Maury for his excellent report, but took exception to the going concern value and charges for depreciation.

The report of the Board of Works claimed, that as the contract of the company expires in 1912, there should be little, if any, allowance made of the plant as a going concern. Some confusion seems to have existed between good will and going concern value. Even if all rights of the present company ceased at any definite period, the going concern value would still exist, for if the city undertook to reproduce the property, it would sustain a loss in revenue estimated by Mr. Maury and Mr. Alvord as $110,825, before the new plant acquired a business equal to that of the existing plant.

The Board of Works, in commenting upon the estimate of depreciation, contended that as the ordinary average annual rate of depreciation on water works plants, taken as a whole, is about 2½ per cent, the same per cent should be applied in this case, and figuring the average investment for the 24 years of the company's existence as $500,000, determined the depreciation July 1, 1909, as being $300,000. And yet the plant is regarded as one of the best of its size.

What will be the outcome of the investigation, the writer cannot state, but it is certain that the friendly action of the city and the company has greatly improved the situation locally, and whether the city purchases the plant, or enters into a new contract, it is certain that the recent valuation has facilitated the adjustment of any differences that may have existed.

Structural Features of a 24-Mile Steel Pipe Line for the Portland, Ore., Waterworks.

The accompanying drawings illustrate the main structural features of one of the longest steel pipe lines for water supply that has been planned in recent years. The line will be 24 miles long; 10 miles 52 ins. in diameter and 14 miles 44 ins. in diameter. It extends from headworks on Bull Run river to the Mt. Tabor reservoir of the Portland, Ore., waterworks. Figure 1 shows a profile of the line, redrawn from the bidding plans and the following data are taken from these plans and form the specifications. Because of the importance of the work we believe that these data are worth study. The engineer of the work is Mr. D. D. Clarke, chief engineer, water board, Portland, Ore.

The steel plates used in the manufacture of the pipe shall be made by the open hearth process, and shall be of the grade known as "soft." The ultimate tensile strength of the steel shall be between 52,000 and 62,000 lbs. per sq. in. The elastic limit shall not be less than 31,000 lbs. per sq. in. The elongation shall not be less than 25 per cent in 8 ins. when measured longitudinally, and 22 per cent when measured transversely, and there shall be a reduction of area at the point of fracture of not less than 50 per cent. The steel must not contain more than 0.05 per cent sulphur, 0.04 per cent phosphorous, 0.10 per cent silica, and 0.5 per cent manganese.

The chemical requirements for rivet steel shall be the same as those specified for the steel plates. The steel shall be "soft" and shall have a tensile strength of between 48,000 and 58,000 lbs. per sq. in.; test bars shall be round, 8 ins. long between measuring points, and of a diameter equal to the full diameter of the rivets. The elastic limit shall not be less than 29,000 lbs. per sq. in., and with an elongation of not less than 26 per cent and with a reduction of cross-sectional area at the point of fracture of not less than 50 per cent.

All plates and rivets must be kept free from rust and be kept under cover from the time of their manufacture until the pipe is dipped and coated. At the place of manufacture the plates must be loaded under cover upon suitable covered cars satisfactory to the engineer or his authorized representative. They must at no time be exposed to the weather or to moisture, and must be delivered under cover at the pipe shop. In case of accidental rust, either during transportation or the process of manufacture, the rust must be removed from the plates at once by brushing with stiff brushes and scrubbing them with diluted acid, followed by mopping or brushing with a saturated solution of soda or other suitable alkali to remove the acid; this to be continued until all the rust has been removed. The alkali must then be washed off and the plates thoroughly dried.

The steel pipe shall be in part 52 ins. and in part 44 ins. in the internal diameter of the inside courses. The thickness of the sheets will vary from ¼ to 7-10 in. The edges of the plates must be properly planed or cut to true lines and beveled for calking all around and at the end of each course where the lap of the longitudinal seam occurs, the plate must be reduced by cold hammering or planing, or both, to a fine edge, through which one of the rivets of the round seams must be driven to insure tightness. In addition to this rivet, still another rivet must be driven through the three thicknesses of the plate at such joints.

All longitudinal or straight seams are to be double riveted, and the round or circular seams single riveted. The length of the rivet

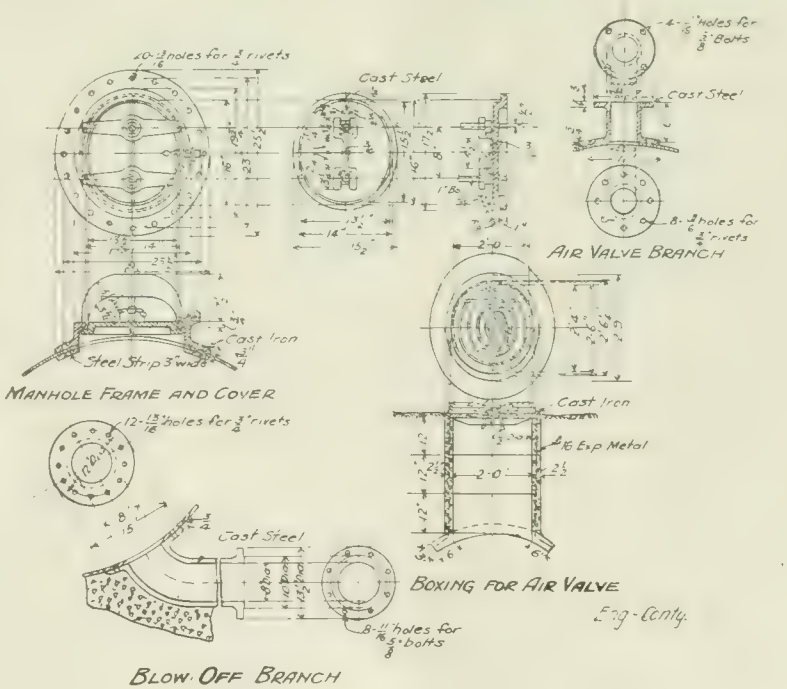


Fig. 2—Details of Air Valve, Manholes and Blow-offs for Steel Pipe Line.

shank shall be such that the height of the finished head shall not be less than 0.6 of the diameter of the rivet hole. Shop riveting must be done with hot rivets by steam, compressed air or hydraulic machinery, capable of exerting a slow pressure sufficient for the formation of perfect rivet heads. The rivet holes must be punched from the side of the plate which is to be placed in contact with another, and all burrs caused by the punch on the lower side of the plate must be removed by countersinking. No drift pin shall be used in forcing rivet holes to coincide at any seam or lap, and all plates will be rejected in which the said holes cannot be made to receive a rivet of the specified diameter with such slight

drifting or reaming as will not, in the opinion of the engineer, materially reduce the strength of the plate.

The plates must be of such dimensions as to admit of being rolled into shapes that will produce what is known as the taper joint pipe, the small end of each section having the full inside diameter called for in each size of pipe. The longitudinal seams will alternate to the right and left, but not more than 6 ins. from a true line along the axis of the pipe, and when laid, they must be on the upper half of the pipe.

Where angles and curves occur in the alignment and grade of the pipe line, the plates must be cut and punched to the required lines for forming a slight oblique angle at the circular seams, of as many courses as may be needed to produce the given total deflection, or curvature in each locality. As soon as riv- ed, the pipe shall be properly calked, both inside and outside, in a workmanlike manner, by the most approved pneumatic machines. All calking to be done by round-nosed calking tools, no split calking being allowed.

Each section of the pipe after completion and before being coated, shall be subjected to a hydrostatic pressure of at least 1½ times its normal working pressure as shown on profile of pipe line, and must, during said test, be absolutely free from leaks or fracture. Unless otherwise directed by the engineer, all pipe for use under 50 lbs. pressure or less shall be tested to 75 lbs. per sq. in.; all pipe for 50 to 100 lbs. pressure shall be tested to 150 lbs. per sq. in.; all pipe for 100 lbs. pressure and above shall be tested to 225 lbs. per sq. in.

Before the pipe sections are coated, they shall be thoroughly cleaned by the sand blast, or other equally efficient means, so as to show in all parts the grayish-white color of the metal. After the above described cleaning and inspection, which must be done under cover, every pipe shall be coated with "Mineral Rubber Coating," or such other material equal thereto in all its qualities, as hereinafter specified. The coating must be free from blisters and bubbles, and must not be affected by exposure nor by the action of the soil or salt water. It must strongly adhere to the pipe under all circumstances, and must not become soft enough to flow at a temperature of 150° F., nor brittle enough to crack or scale off at freezing temperature.

The pipes before being dipped must be clean and free from rust, and no pipe shall be coated unless examined and approved by the inspector immediately before the process of coating begins. They shall be dipped in a bath of the "Mineral Rubber Coating," heated to 400° F., or more, and shall receive a uniform coating not less than 1-16 in. in thickness. While in the bath the pipe shall be so manipulated,

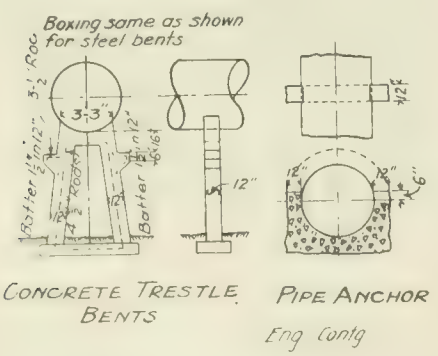


Fig. 3—Details of Concrete Trestle Bent for Steel Pipe Line.

scraped, brushed and redipped, if necessary, in accordance with the directions of the inspector, as to give a sound and perfect coating. After the pipes have been removed from the dipping tank they shall be set vertically while cooling. Proper facilities for handling the pipes and allowing all surplus material to drip off shall be provided by the contractor. The cost of all labor and material involved in the coating of the pipes must be included in the price bid for furnishing and laying said pipes.

At intervals of approximately 500 ft., the contractor shall place on the steel pipe, manholes with covers, gaskets and bolts complete as shown by Fig. 2. The openings for said manholes shall be elliptical, with clear major and minor diameter of 16 ins. and 14 ins. respectively; the joints between the frame and cover must in all cases be made watertight by facing the abutting surfaces and inserting a suitable gasket of sheet copper or lead. Estimated number required, 206. The manholes shall be connected with the pipe by means of steel rings 3 ins. wide, and not less than ⅜ in. thick, placed on the inside of the larger courses and riveted to the steel pipe and flanges of the fittings by hot rivets of suitable size. After the riveting is done, the edges of the sheet shall be chipped and calked on the inside, so that the joints may be perfectly watertight.

Air valves 4 ins. diameter are to be placed on the pipe at points indicated on the profile. The valves are to be of the pattern known as the "Crispin Automatic Air and Vacuum Valve," or some other approved model, with ½ in. bibb. Cast steel branches having flanges to conform to the circumference of the pipe at one end, and the other end to fit the flanges of the valve, shall be used for attaching them to the pipe. Between the check valve and the casting on the pipe there shall be placed a 4 in. double flanged gate valve. Each air valve is to be protected by a concrete well and iron cover, as shown on the plan. Where the pipe is located within 30 ft. of the hydraulic grade 3 in. galvanized iron stand pipes with a 3 in. service cock near the pipe may be substituted for the air valve, if directed by the engineer. These stand pipes to be boxed in with a box filled with sawdust.

Blow-offs 8 inches in diameter are to be placed at the bottom of the pipe in depressions as shown on the profiles. Each blow-off shall be furnished with sufficient 8 in. extra heavy Kalamein pipe, properly laid to point of discharge. Each blow-off, manhole, air valve, gate valve, and other fixture on the pipe, unless otherwise specified, is to be provided with a box of sound cedar plank of suitable dimensions.

In laying the pipe in the trench the pipe sections shall be so handled as to cause the least possible injury to the coating, and if any damage is done, it shall be repaired immediately with Mineral Rubber Field Paint. Before laying, the ends of each length, for a distance of 3 ins., must be carefully scraped inside and outside, and the coating entirely removed, to insure a perfect contact of the steel. Two lengths of pipe must then be riveted together and lowered into the trench, or placed on the grade prepared to receive the same. When lowered into the trench the bottom of the trench shall be to grade shown on profile, and must be free from water.

Field riveting for connecting lengths of pipe, specials, etc., shall be done as far as practicable, in the manner specified for shop riveting. The smaller end of the double length will be forced into the larger course of the pipe already laid, and properly riveted together, the two plates being set up tightly against each other with a set tool. As soon as each joint is riveted and calked it must be thoroughly cleaned and painted with Mineral Rubber Field Paint.

After the pipe has been laid in the trench it must be plugged at the ends and tested with hydrostatic pressure in convenient sections, of such lengths as the engineer may direct, to at least 1½ times the pressure, to which it shall be subjected under the natural working pressure when in operation. Calking must be continued until the pipe is tight at this pressure. Unless otherwise directed by the engineer, all pipe used under 50 lbs. pressure or less shall be tested to 75 lbs. per sq. in. All pipe used under 50 lbs. to 100 lbs. pressure shall be tested to 150 lbs. per sq. in., and all pipe used under pressure exceeding 100 lbs. pressure shall be tested to 225 lbs. per sq. in.

At such points as shall be designated by the engineer, steel trestle bents shall be erected for the support of the pipe at crossing of small water courses or marshy ground. These trestle bents will ordinarily be placed at intervals of 12 ft. and will be supported upon concrete foundations of suitable dimensions. The dimensions of these bents shall conform to the plans to be furnished by the engineer, and the material of which they are constructed shall conform to the standard specifications for structural steel for bridges adopted by the

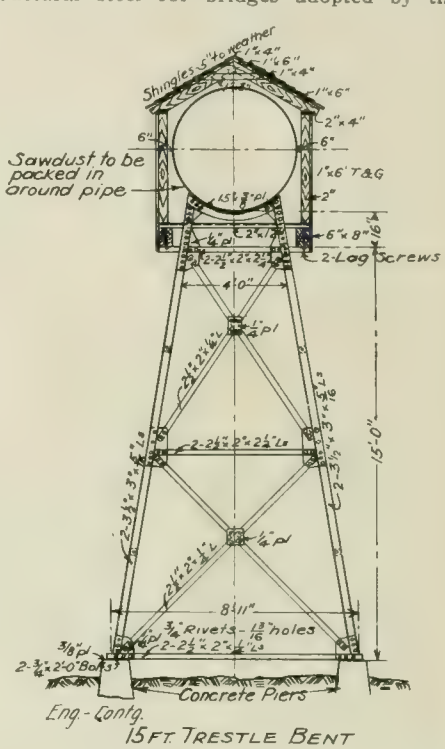


Fig. 4—Details of Steel Trestle Bent for Steel Pipe Line.

American Society for Testing Materials, and shall be subject to the tests therein provided.

Massive Concrete Work.—A recent estimate of the number of cubic yards of concrete needed in the construction of the Pedro Miguel and the Miraflores locks of the Panama Canal discloses some huge amounts. The following, taken from the estimate summaries, will give an idea of the size of the work:

Pedro Miguel Locks:	Cu. yds.
Lock	641,164
Approach walls including core connections with dams	275,002
Total	916,166
Miraflores Locks:	
Approach walls	304,689
Forebay	169,810
Upper lock	481,944
Lower lock	473,756
Total	1,430,199
Miraflores Spillway:	
Main dam	55,000
Piers and foot bridge	4,000
Abutments	1,000
Channel walls	13,000
North approach walls	2,000
Total	75,000

Cast Steel Swing Circles for Steam Shovels.—The extensive work on the Culebra cut of the Panama Canal has given the opportunity for some interesting experiments. Some time ago a swing circle for one of the steam shovels made in a solid casting of cast steel, was mounted in the place of the usual structural steel one. The shovel was worked hard in the Culebra cut for about a year when it became necessary to put it in the shop for repairs. At the same time an examination of the cast circle was made to see how it had stood the heavy wear. The inspection proved a surprise, the circle being in excellent condition and in no need of repairs. For a similar class of work during an equal amount of time structural steel circles will have served out their usefulness and be in need of rebuilding.

Unclassified and General Articles

Note: This section is devoted to methods and cost articles on construction work not properly coming under any of the preceding classifications.

Methods of Filing and Indexing Drawings and Photographs, Board of Water Supply, New York City.*

One employe in each office shall be held responsible for the proper filing of the drawings, and he alone should be allowed to put away drawings. In each office *all* drawings received from other offices should pass first through the hands of a designated employe, possessed of sufficient knowledge, who will see that each drawing is properly introduced into the system of filing and indexing or otherwise attended to.

Drawings are filed in plan cases provided for the purpose and indexed on 3x5 in. cards kept in convenient cabinets. Cases and drawers are numbered. Plan cases have been designed on the unit system.

Besides bearing a file number to show where it is filed, each drawing is given an accession number which distinguishes it from all other drawings and, consequently, is the convenient and certain designation for the drawing in computations, correspondence or conversation. Accession sheets contain complete description and record of every drawing made or acquired by an office of the bureau for permanent filing. There is a double space across the accession sheet for each drawing. Headings are shown by Fig. 1.

An accession number is given to a drawing as soon as it is well started—at any rate as soon as any computations are made relating to it. The exact title and description can be filled out on the accession sheet when they are determined. The tracing of a drawing is given a different accession number. As near the lower left-hand corner of the tracing as possible, usually in the margin, is placed the word "References" followed by the accession numbers, one or more, of the drawing or drawings from which the tracing has been made. For example, if a tracing is made from Acc. 2,000, it will be endorsed "References" Acc. 2,000. If made from 2,000, 3,000 and 4,000 it will be endorsed "References" Acc. 2,000, 3,000 and 4,000. The brown paper studies will be endorsed "Traced as Acc. ———." The same record must be made in the "Remarks" column of the accession sheet. If a drawing is revised or changes or additions made in it, it should be given a new accession number and endorsed with the date of the revision. One should be endorsed "Revised from Acc. ———" and its predecessor should be marked "Superseded by Acc. ———." The same note should be made on the Accession sheet under "Remarks" and on the cards of the index. Revised drawings and prints of any kind upon which additional work is drawn are accessioned like new drawings.

Generally all drawings should be reaccessioned if lines are added or changes made on them, but drawings that show progress (progress diagrams), that is, drawings that are intended to be revised from time to time, should retain their original accession numbers and should be endorsed with the date of the latest change. The cross index cards should be similarly endorsed and also the accession sheets. All previous editions of each drawing should be endorsed "Revised to" (the latest date).

Temporary accession sheets, properly numbered on the line for each drawing, will be kept in each drafting office, on which the draftsman can make entries as needed. When a temporary sheet is filled, a new sheet properly numbered in advance is substituted. The filled sheet is promptly checked and corrected, and then sent to headquarters or some other office having a large flat-platen typewriter, where it is neatly copied in triplicate. One copy, with the original, is returned, the second sent to the appropriate department office and the third retained at headquarters. These copies are kept in suitable loose-leaf covers. After filing the final accession sheets and copies, the temporary sheets are destroyed.

In headquarters department when a study, a map or a similar original drawing is to be accessioned, the designer or plotter takes it to the plan clerk and fills out the accession sheet so far as possible; the file clerk puts on the proper file number. "Description" should be filled out sufficiently for the drawing to be readily recognized when called for. Under "Title," if the title is not determined, shall be written in pencil the name of the individual to whom the drawing is charged. If the title is determined, it shall be entered and the name of the individual placed under "Remarks." An employe shall keep track of all drawings thus charged to him. Likewise, draftsmen shall go to the plan clerk for file and accession numbers for tracings.

Under no circumstances shall a file or accession number be changed except by the plan clerk, who shall make corresponding changes on the accession sheets and the index cards. Every drawing, wherever found in an office, should show by its numbers or other endorsements that it has become a part of the system. Any drawings lacking the plan clerk's marks should be followed up to see why they have not been introduced into the system.

Contract drawings, besides accession and file numbers, are numbered consecutively in each contract set, as follows: "Contract No. 12, Sheet 20, Sheets in set, 45." For general use, contract drawings are lithographed to 11 in. in height, folded as necessary, and bound in pamphlets 8½x11 ins. like contract. Such lithographs, of course, bear the same designating numbers as the tracings from which they are made. Similarly, "working" drawings are photographed to about 7½x11 ins. and blueprinted for convenience and economy on sheets 11x14 ins., thus avoiding the use of larger sheets in the field.

Blue prints and black prints may be given out by the plan clerk when authorized and no record need be kept, unless a print is stamped on its face "File Copy." In using prints for studies, employes should be especially careful to see that when lines are added or other changes made, they are reaccessioned like new drawings, if they are to be kept. The plan clerk, when receiving drawings, should observe file and accession numbers to see that the rules have been followed and to find out whether other copies of the same drawing have previously been received and are on file.

Drawings charged to individuals will be called for at the end of a month, memoranda being sent by the plan clerk to each such individual weekly for drawings falling due during that week. Drawings may be renewed at the end of the month, if necessary. Individuals will be held strictly responsible for drawings charged to them and must afford the plan clerk every facility for locating them at any time. Drawings should not be passed from one individual to another in headquarters office without going through the plan clerk's hands to have proper changes made on the records. It will aid in keeping track of a drawing, while outside the files, to attach a slip of paper reading: "Charged to Mr. ———. Do not remove or borrow."

Detail "working drawings" required under contracts for construction purposes are signed by the chief engineer. Such drawings must be prepared sufficiently in advance of the time when they will be needed to avoid delay to the field engineers and the contractor. If additional information is needed and is not received from the field early enough to allow ample time for the preparation of the drawing, the designing engineer responsible should send a request for the information, stating the time when it will be needed.

Working drawings are marked with the number of the contract in the same manner as the contract drawings. Most working drawings will be explanatory of some contract sheet. Each such working drawing is to be marked with the number of the sheet which it modifies with a letter to indicate its place in the order of progress, as follows: The first working drawing made to explain Sheet 26, Contract 12, is marked, "Contract 12. Sheet 26A. Working Drawing." Later working drawings explaining the same contract sheet shall be marked "26B," "26C," and so on.

Working drawings containing standard details applicable under several contracts will be marked in the upper right-hand corner "Working drawing," without a contract number, and will be designated by their accession numbers. If, under any contract, working drawings become necessary which cannot be considered the modification or explanation of one of the contract drawings, such sheets will be designated by their accession number only, but should contain, in the upper right-hand corner: "Contract No. ———. Working drawing ———."

If changes should become necessary on any signed tracing, especially a tracing which is to be lithographed, the assistant engineer in charge of the drafting room or the designing engineer (including architect, mechanical engineer and landscape engineer) who first gives orders for such change shall put a large blue-pencil cross over the department engineer's signature or the other signature which makes the tracing finally authoritative, thus indicating that it is to be changed. Such cross shall not be removed until the changes have been completed, checked by the designing engineer, and accepted by the party whose signature is crossed. Changes on important tracings which have been signed should be made only for weighty reasons. All errors which can be discovered by checking must be eliminated before the final signature is obtained.

The accession number is put in ink on each drawing in its lower right corner. The entry is made on the accession sheet as directed below.

Under Title, write the title of the drawing in full, excepting the two lines which appear on all drawings made in Board offices: City of New York, Board of Water Supply.

Under Description, write, briefly, enough about the drawing to tell what it shows. Do not repeat what is in the title, but supplement it. Abbreviations which can be readily interpreted may be used here.

In the column headed Purpose of Drawing, use the following abbreviations:

L Land plan, or map.
P Preliminary drawing or study.
C Contract drawing.
W Working drawing.
E Estimate cross-section, progress diagram or similar drawing.
R Record drawing (of completed construction work).
Z Foreign drawing used for reference.

*Extracts from a paper by Alfred D. Flinn read before the Boston Society of Civil Engineers, Jan. 27, 1909, and published in the Journal of the Association of Engineering Societies for October, 1909.

....Department..... ...Division Section..... Date..... 19 No.....

Accession Number	Title	Description Note principal features of drawing	Date	Purpose of Drawing	Scale H-Horizontal V-Vertical	Kind of Paper. Size in Inches	Where File: Case	Where File: Drawer	Index Under	Remarks

Under "Kind of Paper and Size in Inches," use the following abbreviations on the upper line, and on the lower line write the outside dimensions of the drawing:

W	White paper.
B	Brown paper.
T	Tracing cloth.
T P	Tracing paper.
W P	White print.
G P	Gray or green print.
B P	Blue print
Black	Black print
Lith	Lithograph.
Cr-Sec	Cross-section, paper or cloth.
T Cr-Sec	Tracing cross-section, paper or cloth.
Pro	Profile paper.
T Pro	Tracing profile paper.
Neg	Vandyke negative.
M	Mounted on cloth (to be written after other designation).

The column headed "Where File" should be filled *in pencil* with file number as soon as the drawing can be given a place in one of the plan cases. If the drawing should ever be put into another plan case, the numbers on the accession sheet should be changed at once, also the corresponding numbers on the drawing and on all index cards.

In the column headed "Index Under" shall be written a word, to be put on the index card, under which a person would naturally or properly look when searching for the drawing.

The different departments are designated by letters in filing, indexing and accessioning drawings, and have distinguishing colors for index cards. Foreign drawings, meaning those originating outside of this Board's jurisdiction, are designated by an X.

Divisions use their department colors and are designated by an additional initial. For example:

Northern Aqueduct department, **NE**
Esopus Division of ditto, **N**

Each field department office and division will accession all its drawings independently, each having a series of numbers beginning at 1 and using its department and division letter. In headquarters, only one series will be used, the numbers being assigned by the Drafting division. Thus: 491, S 5,440 and R 721 indicate drawings originated in the Headquarters, Southern Aqueduct and Reservoir department offices respectively, and NE 299 is the accession number of a drawing originated in one of the offices of the Esopus division of the Northern Aqueduct department. Division offices will supply section offices with accession numbers by sending temporary accession sheets properly numbered in advance. Section office drawings will be accessioned as though they originated at division offices; that is, a section office will not have an independent series of numbers, but will use blocks of numbers in the division series.

Two indexes are provided for drawings in Headquarters office. First, an index by accession numbers on Form 256 E, with Form 270 E printed on the back, the cards being arranged by accession numbers; and, second, an alphabetical index in which the cards are written under local terms, elemental topics, a predominant feature of the drawing or the most likely subject by which the drawing will be asked for. Several cards may be in the second index for the same drawing. The main card will be of the color of the department in which the drawing originates or is received from a source outside the Board's offices, and the cross reference cards are white. All cross references should be noted on the main card, so that all cards may be readily located in the index. The following form is used for this index:

A TO Z INDEX

TITLE

	ACC.
DATE	SIZE
PURPOSE	FILE
SCALE	KIND

All drawings in each department and division office shall be indexed on "Subject" cards, the distinguishing color of the department where the drawing originated being used. All of these cards are kept in the same index. The guide cards are buff colored.

Cross-references are made in sufficient number to insure the finding of the drawing, plain white cards being used. Index cards are typewritten so far as practicable.

Drawings or copies of drawings from other board offices, if filed in the office where received, are indexed on "Received" cards of the color of the department from which they come, these cards being kept as a separate index. In the Headquarters accession sheet of the department from which they come, note under "Remarks" as follows: Hqs. Copy Case .....Dr.....

Should any drawing be sent to another office for permanent or temporary filing, or taken from its files for any other purpose for any considerable length of time, a proper note should be made on the back of its index card. Receipt should be taken for any drawing leaving its file.

Division engineers may, if they see fit, devise methods of indexing their section office drawings so as to distinguish them from those originating in division offices.

If any drawing which has been given an accession number be destroyed or sent *permanently* from the office in which it was filed, a note of the facts shall be made in "Remarks" column opposite the correct number on the final accession sheet.

Photographs (negatives) are to be of uniform sizes, 6½x8½ ins. for outdoor work and 7x10 ins. for copying drawings. For special work suitable sizes may be permitted. Finished photographs for the official file at Headquarters office are to be printed on 8½x11 ins. heavy mounted Velox, platinum or other paper giving a permanent black or gray picture on white ground. Photographs for department files may be like those for Headquarters, or blue prints.

Each department and each division is to number the negatives taken by its own photographer in a series of its own, beginning at 1 and using the department abbreviations and division initial, and to keep an index of photographs by numbers with the necessary cross-references. Negatives taken by the official photographer are to be numbered in another series, using the abbreviation Hdq., with the initial of the department in which the photograph was taken. Each negative is marked in the lower right-hand corner with the date and accession number. Negatives are stored in Headquarters office.

Official files of photographs in Headquarters and field department offices are kept in standard 8½x11 ins. letter file drawers. Files are divided, so as to keep photographs of real estate, construction progress photographs and photographs for accident and damage cases separate. Each class should be subdivided by metal-tip guide cards, according to locality or subject. In each subdivision the pictures should be arranged in chronological order. An "Out" card should be used if a photograph is taken from the file.

LETTERS TO THE EDITOR.

Bidding Prices for Clearing Land.

Sirs: Some of your readers may be interested in the following items: Some weeks ago I called for tenders for the clearing of 20 acres of land. The object was to show the suitability of the land for factory sites; the bidders were therefore requested to figure on cutting down the smaller trees and the underbrush close to the ground, but were to be allowed to cut the larger trees from 12 to 18 ins. above the ground. All the wood had to be burnt or removed. About 11 acres were covered with tamarack and spruce trees of fairly large size, but very few trees being more than 12 ins. in diameter 18 ins. above ground. Nine acres were covered with close underbrush of alder with a few small birch trees and poplars. The land is situated about two miles from our city and there is no summer road to it, but it may be reached in the winter by driving on Lake Superior along the shore.

Nineteen tenders were received with prices ranging from $15 to $57 per acre; the lowest bidder failed to enclose a marked check with his tender so that the contract was awarded to the next lowest bidder, who offered to do the work for $17 per acre and finish the work before May 1. The other bidders submitted the following prices:

3 Contractors	$18 00 per acre
1 Contractor	19.00 per acre
1 Contractor	19.50 per acre
4 Contractors	20.00 per acre
2 Contractors	24.00 per acre
1 Contractor	25.00 per acre
1 Contractor	29.00 per acre
2 Contractors	30.00 per acre
1 Contractor	40.00 per acre
1 Contractor	57.00 per acre

The highest bidder offered to finish the work on June 15, or in practically four months. He evidently intended to do the work alone and figured to clear one acre every five days.

The wages in our locality are $2 for ordinary laborers for 10 hours, and $2.25 to $2.50 for good axe-men. The tamarack and spruce would make good cordwood, but the other wood is of no value. The sleighing is very good and there is little work of any kind being done now, so that laborers are plentiful.

Two years ago, I had 70 acres of land cleared in the same vicinity but with a lighter growth of birch and poplar, and I specified that all trees over 4 ins. in diameter should be left standing. This work was done for $9 per acre.

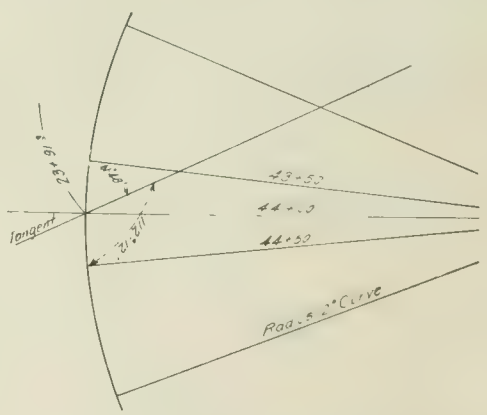
Yours truly,

J. ANTONISEN,
City Engineer.

Port Arthur, Ont., Feb. 19, 1910.

How Should the Draftsman Read These Notes?

Sirs: I desire to submit to you a sketch and explain a matter to settle a controversy in which I find myself engaged. A few days since I made a working sketch or detail outline as shown for the draftsman. We crossed a 12° curve with a tangent, the intersection being at Sta. 44 + 00 on the curve, our Station being 23 + 91.3. I measured the chordal angles between the curve



stations and showed both angles clearly on the map I made; the angles being, respectively, 61° 48′ and 112° 12′, a total of 174° 00′, or 6° less than 180°, which latter of course would have been the sum of the tangent angles.

My map was on a scale of 50 ft. to 1 in. and was accurate, but was only intended as a presentation of a copy of my field notes in an intelligible manner so the draftsman could make his map. Both angles were shown clearly as taken to 50 ft. chords, so that 3° 00′ added to each would have made a tangent angle at that point. In making another map the draftsman marked in only the one angle 61° 48′, the chord angle, as the tangent angle when he should have used 64° 48′. I measured the chordal angles because the 12° curve stakes were on the ground and thus got an absolute check, whereas to obtain tangent angle I would have to turn two angles, one depending on the other. While I do not claim my method to have been the only correct one, I maintain that it was not wrong because by adding my angles the officeman would have clearly seen my work and methods. Kindly give me your opinion.

Yours truly,

J. M. P.

Sutphen, W. Va., Feb. 12, 1910.

(The importance of checking can never be too strongly impressed upon engineers and their assistants. The sketch shows that the

transitman turned in his notes in such a way that the draftsman had an opportunity to add the angles and thus ascertain whether they were chordal or tangential. The draftsman is at fault. The instrument man, however, might have added a word or two to his sketch by way of explanation. In sending in such sketches the writer has found it is not always best to make them to scale, but it is well to exaggerate the details and add a few words in writing when such explanations will assist. —Editors.)

Rifling Delivery Pipe to Prevent Settling of Sand in Making Fills by Hydraulic Dredge.

Sirs: I notice in your editorial of Feb. 16, 1910, a reference to the settling of sand in pipes in connection with hydraulic filling of low land. You may be acquainted with the fact that on many such pipe lines used for filling in California angles are riveted spirally on the inside of the pipe at intervals, to set up a whirling motion in the mixture of water and sand or gravel, which obviates in a great measure the difficulties you speak of. Another point which might be of interest is that the same crude rifling has been much improved, and rifled pipe is used for pumping crude oil. Water is mixed with the oil and it is found that a water skin sets next to the pipe and is kept next to it by the whirling motion produced by the rifling. In this way the coefficient of friction in the pipe is very much lower than it would be for oil in a plain wrought iron pipe. Trusting that this may be of interest to you, I am,

Yours very truly,
LANGDON PEARCE,
Assistant Engineer, Sanitary District of Chicago.

Chicago, Ill., Feb. 23, 1910.

(In Cairo the material pumped was purely sand with a very small admixture of fine gravel. In the work done where the pipes had angles rivetted inside there was so little sand and gravel that the thinner mud formed a skin coat to reduce friction and also protected the metal from undue wear. The placing of angles in the pipes at Cairo was considered but given up because of the abrasive character of the material, although the cases in California both for mud and oil were known of at the time. If any readers can add to this subject we will be glad to hear from them. Less is known about pumping sand than is known about pumping mud.—Editors.)

Some Observations on Sheeting a Cofferdam.

Sirs: I am sending you a view of work being done at present on the excavation of a foundation for the center pier for the new street car and traffic bridge which is to cross the Bow River at this place. The work is in the hands of the Provincial Government, and is to replace the old wooden bridge which spans the river a short distance west of the new work, in line with Fourth street, East. I think the view is of interest, as showing clearly the details of construction of the cofferdam, and the difficulties encountered by the men during the progress of the work. The view is a general view of the excavation, within the cofferdam, on February 12, 1910. It will be seen that there are two rows of wooden sheet piling. The piling was driven 3½ ft. apart, clear, and consisted of 6-in. material tongued and grooved.

The material into which the piling was driven consisted largely of very clean gravel of different sizes, but packed hard, so that the piling drove very slowly, sometimes advancing but a small fraction of an inch at a blow. The result was that the sheeting did not drive straight, and also it separated in the course of its descent. Before much progress was made in the excavation the water started coming in very quickly, and this necessitated the use of one large pumping engine and shortly two. The space between the rows of piling was filled with fine soil, but in many places, in an endeavor to stop the numerous leaks, the soil was taken out, and replaced by packing it hard with heavy rammers. At this time, although the men were working only about 8 ft. below the surface of the river ice, there was from 1 to 2 ft. of water in the bottom of the excavation.

It is interesting to note the behavior of wooden sheet piling in this instance, and to note how imperfectly it kept the water out of the excavated area. It is probable that as the advantages of steel sheet piling become better known here, it will be used more for this class of work, replacing the wooden piling which is somewhat unsatisfactory for obvious reasons.

Yours very truly,
L. E.

Calgary, Alta., Feb. 19, 1910.

The Dam Failure at Dansville New York.

Sirs: Having read in Engineering-Contracting of Feb. 2, 1910, an article signed Q. E. F., in which an explanation of the failure of the Dansville dam was offered, the writer has been moved to give his views on the subject.

The failure of this little dam has caused considerable comment by the engineering press, the reason for which is a much greater mystery to the writer than is the cause of the failure. If before the dam had failed a much greater amount of space had been devoted to an explanation of why the dam did not fail there would have been much good done.

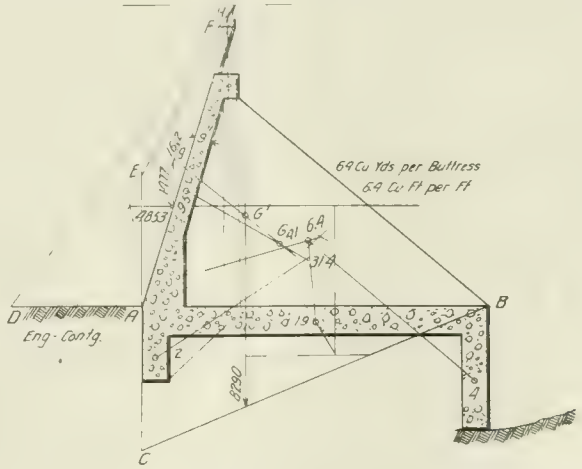
The remarks of Q. E. F. indicate the only possible explanation of why such defective structures are constantly being built, and afford the strongest argument for governmental or state control of all water power developments.

The idea of designing a dam for a soft bottom so that it will act as a beam supported by the abutments, while suited to office building construction, would hardly do for a dam. Dams are built as arches where the abutments are depended on to resist the endwise thrust of the water but such dams are only suited to solid rock bottoms. To design a dam for a soft bottom along the lines suggested by Q. E. F. would mean that, even though the abutment could be made sufficiently strong to resist the down stream thrust on the dam, the beam action would remove all weight of structure from the river bed and unless watertight sheet piling were driven along the upstream side, the water would soon break under and wash out the graved. This thing happened to a dam 60 ft. high built in the east. It was a buttressed dam, built over soft bottom. The water washed out a hole underneath about 50 ft. deep, but the shell of the dam, being very stiff, stood like a bridge, and the builder pointed with pride to this feature of the dam.

While stiffness of structure is an inherent defect in all concrete dams, it is to be regretted; the ideal dam is the one that will settle with the materials in the river bottom. All river bottoms, not solid rock, will settle some, and therefore the idea of making the dam a beam is to insure its undermining.

A safe dam for soft bottoms must consist of three distinct parts: The water raising part, the water tight sheet piling along the upstream edge and the extension mat along the down stream edge of the dam. The first is a part of every dam, but the Dansville dam lacked the two other parts.

A reference to the accompanying sketch of the Dansville dam will indicate the direction and extent of the several pressures acting on the structure at the time of the failure. The trapezoid AEHI is the diagram of vertical water pressure with its center of gravity at g. This diagram (as are all the others) is drawn so that, taking concrete at 145 lbs. per cu. ft., it represents an equal area of concrete. The trapezoid ADFI represents the horizontal down stream push of the water. At G' is the center of gravity of all dam materials and the vertical water weight. The weights acting at this point equal 8,290 lbs. per foot of dam. At the center of gravity of the trapezoid ADFI, 4,853 lbs. act, tending to slide the dam down stream. Owing to the fact that the wall of the Dansville dam along the down stream edge extends deeper than the up stream wall, the water will react on the bottom of the dam and tend to lift or float it. This pressure will be practically the full static pressure due to the full head at the up stream edge and will have some value at the down stream edge, the exact amount of which can not be accurately calculated. To be conservative, however, this pressure has been assumed as zero at B, giving the triangle ABC as the diagram of upward pressure. The amount of this pressure is 6,270 lbs. per foot of dam. Then 8,290 — 6,270 = 2,020 is the effective weight of all materials and superimposed water.



That is, the coefficient of friction between the dam's base and the gravel would have had to have been six times what it could possibly have been to prevent slipping. In all probability the earth was washed out as indicated in the sketch, thus decreasing the friction. Taking these things into consideration and the fact that when the water was over the base of the dam, that part of the concrete lost 62.5 lbs. per cu. ft., and that a vacuum must have formed under the overpour, it seems strange that the

dam did not fail much sooner. The only way to account for its remaining a single day is that there must have been more or less earth piled along the up stream edge and no doubt the flow of water was so small that there was slight undermining until at about the time of the failure.

R. C. BEARDSLEY,
Consulting Engineer.

Cleveland, O., Feb. 11, 1910.

Percentage Bidding from the Contractor's Point of View.

Sirs: Continuing on the subject of percentage bidding referred to editorially in your issue of February 9th, perhaps the best method of illustrating some of its objections may be afforded by basing various bids on the contract cited in the article.

We will assume, first, that the contractor relies on the engineer's judgment of quantities and that the engineer's estimate is advertised as follows:

100,000 cu. yds. of rock at $2.50...$250,000
300,000 cu. yds. of earth at $.75 ... 225,000

Total $475,000-100%

The contractor's estimate is:

100,000 cu. yds. rock at $2.25.....$225,000
300,000 cu. yds. earth at $.80..... 240,000

Total $465,000-98%

On completion of the work, the quantities of earth and rock being transposed, the contractor's payment amounts to:

300,000 cu. yds. rock at $2.45.....$735,000
100,000 cu. yds. earth at $.73½..... 73,500

Total $808,500

the item prices being 98 per cent of the engineer's cost.

Under the unit system the final payment would be:

300,000 cu. yds. of rock at $2.25.....$675,000
100,000 cu. yds. of earth at $.80..... 80,000

Total $755,000

Thus the percentage system would cost the city $53,500 more than the unit system, and as an instance of how it would guard the people it is not convincing.

Again, using the engineer's estimate as the 100 per cent base and the other figures assumed in the article as the contractor's estimate, we have:

100,000 cu. yds. of rock at $1.75..$175,000
300,000 cu. yds. of earth at $.50.. 150,000

Total $325,000-68⅓%

and the final payment, applying the percentage to the items, amounts to:

300,000 cu. yds. rock at $1.71.....$513,000
100,000 cu. yds. earth at $.51¼..... 51,250

Total $564,250

Under the unit system the final payment would be:

300,000 cu. yds. of rock at $1.75.....$525,000
100,000 cu. yds. of earth at $.50..... 50,000

Total $575,000

In this case the contractor loses $11,000 by the percentage system, although his final payment is 20 per cent greater than the engineer's estimated cost; and considering his low price on rock it is fair to assume that he anticipated his price of 50 cts. on earth would more than offset any loss he sustained in the rock, so that his actual loss would be still greater. Under the unit system he would have received $100,000 more than the engineer's estimate (not $50,000, as the editorial states—the earth item being omitted); but even at that he would lose money if the work were in a populated section.

Now, assuming that the contractor had reason to doubt the engineer's quantities and estimated the work would contain 200,000 cu. yds. of rock and 200,000 cu. yds. of earth, under the percentage system he would be unable to get the contract at any fair price, as his estimate, based on the correct quantities, would necessarily be higher than that of a competitor who was not aware of the conditions.

Unbalanced bids which result in a greater cost than estimated are the fault of the engineer, and as an employer is responsible for the acts of his agents, the municipality should bear the burden of such errors and not shift it to the contractor by means of a system calculated to put him on the defensive. Under the unit system he is assured of receiving his price for the work and under the percentage system he is not, if the items vary materially.

The practice of putting the contractor on the defensive is overdone, especially in municipal work, with its one-sided contracts, "club" clauses, penalties and protective methods. In the Borough of Brooklyn, where the percentage system is now in vogue for sewer contracts, a recent report stated eleven cases of unbalanced bids in the two years 1906 and 1907, before the adoption of the percentage system, "resulting in an apparent slight loss to the city." In these two years about 200 sewer contracts were let, approximating $2,000,000, and the slight loss resulting from those eleven unbalanced contracts would hardly seem to justify the adoption of a method to safeguard the people and put the contractor on the defensive. The report of the president of the Borough of Brooklyn for the year 1907 contains a table of the average item costs on 24 sewer contracts let under the percentage system in that year and also the contractor's average bids. In the report for 1908 the Chief Engineer of the Bureau of Sewers says:

When the percentage system of bidding was inaugurated the matter of fixing a price for lumber was given considerable attention. The market price of lumber was high at the time the contract was made and the cost of placing it in the trench was added to the price of lumber rather than to the price of excavation. Experience has shown that in making up percentage bids the cost of placing the sheeting should be added to the cost of excavation and not to the cost of the lumber.

Notwithstanding the fact that the cost of driving the sheeting is now placed on the pipe, the following table shows the engineer's estimate to be reduced on all items. The figures for 1909 are on average of the engineer's cost in about 20 contracts recently advertised.

Item.	Engineer's Estimate, 1907.	Contractor's Bid, 1907.	Engineer's Estimate, 1909.
6-in. pipe	$ 1.00	$ .95	$ .71
12-in. pipe	2.20	2.28	2.06
15-in. pipe	2.70	2.52	2.25
18-in. pipe	3.00	3.00	2.56
24-in. pipe	3.90	4.06	4.08
Sheeting and bracing	30.00	29.53	18.00

It is evident from these figures that the engineer's faith in his cost data is not absolute, but that the tendency is to reduce costs to approach the contractor's bid. The method of arriving at costs is described in the 1907 report as follows:

In preparing such estimates the engineer has to assume that the contractor will have to purchase his materials in the open market and pay the average price for cartage, etc.; also that he will be satisfied with a reasonable profit. All of these things are variable. A contractor may have materials on hand for the work or contracts which enable him to obtain his materials at greater advantage than the engineer can allow for. He may have men and plant which he wishes to keep employed, whether he makes a profit or not, in order that the cost of maintaining the plant may not be at a loss, or he may think that the work offers extra risk and that this should be insured by figuring at a larger profit.

Indeed, it may be stated that where bids all agree nearly with the engineer's estimate there is ground for suspicion that the contractors are taking the engineer's estimate and adding their profit and not figuring for themselves.

All contracts are more or less of a gamble, and the contractor assumes all the risk attendant on the performance of the work. The odds are sufficiently against him when he gambles on the quantities, but his objection is not based so much on the estimate of quantities, as your article states, but on the cost affixed to those quantities which denies him the opportunity to bid as his best judgment dictates.

You apparently miss the greatest objection to the system when you say it might be held to when exact knowledge might be an argument for unit bids, for in the event of an exact estimate the percentage system would be as good as any other. It is because of the impossibility of securing this exact knowledge in advance that the system is objectionable, and while it may prevent a contractor from unbalancing his bid, the final results may prove that the engineer unbalanced his quantities, which is quite as objectionable.

In connection with this acknowledged uncertainty as to final quantities there appeared recently in the Engineering Record a news item to the effect that exact contract quantities instead of approximate estimates must now be furnished to bidders of municipal work in Salt Lake City, and the item states further that the City Engineer has resigned. He doubtless appreciated what he was up against.

The objections to the percentage system are most admirably expressed in an article on the subject by Mr. H. P. Gillette in Engineering News, Nov. 19, 1903, which concludes as follows:

Our argument, in a nut shell, is that the percentage method of bidding will often result in a "heads I win, tails you lose" contract. The method is justifiable only where the engineer has an exact knowledge of cost and where he is fearful of receiving unbalanced bids. It seems to us that these two conditions are mutually contradictory, for the engineer need not fear an unbalanced bid where his surveys and computations have been so carefully made that his estimates of unit quantities are perfectly reliable, but if his surveys have not been so carefully made as to insure perfect reliability in the quantities, then it is altogether likely that his estimates of unit costs are as unreliable as his estimated quantities. Under the first assumption he has nothing to fear from unbalanced bids; under the second assumption he himself is quite likely to unwittingly unbalance the bids in his estimate of costs, thus doing the very thing that he seeks to avoid by using the percentage method of bidding.

And surely the fact that it is less tiresome than to listen to the reading of itemized bids and more fitted to the mental capacity of some public officials cannot be considered a good argument for its retention.

Yours very truly,

C. A. CRANE,
Secretary, The General Contractors' Association.

New York, N. Y., Feb. 24, 1910.

Special Convention of the American Society of Engineering Contractors.

A special convention of the American Society of Engineering-Contractors was held in Chicago at the La Salle Hotel for three days, February 24 to 26, inclusive. An invitation had been received from the Cement Products Exhibition Company to hold a convention during the Cement Show and the railroads gave special rates.

More than sixty members registered and steps were taken to organize a Chicago chapter, an Indianapolis chapter having already been organized. Two sessions were held to listen to a paper on Concrete Bridges by Mr. Luten, which was read by the author, and one on Concrete Chimneys by Mr. Carl Weber, read by the secretary, owing to absence of Mr. Weber. Trips were made to the steel works at Gary, Ind., to the track elevation work in the cities of Chicago and Evanston and to the Southwest Lake and Land Tunnel under construction by Geo. W. Jackson, Inc. The convention closed with a dinner on Saturday night at the La Salle Hotel. The regular annual convention of the society will be held late in the summer, the time and place to be selected by the executive board.

Personals.

Mr. Charles E. Waddell has opened offices for general engineering practice at 78 Patton Ave., Asheville, N. C.

Mr. G. Hamilton Holmes has taken offices at 78 Patton Ave., Asheton, N. C., where he will engage in general engineering practice.

Mr. Nelson O. Tiffany, Jr., following the dissolution of the partnership of Tiffany & Gail, will engage in the profession of civil and contracting engineering, with offices at 13 Erie County Bank building, Buffalo, N. Y.

Sir Robert W. Perks, the noted English engineer, will take charge of construction of the Georgian Bay Canal. Sir Robert was engineer in charge of construction of the Manchester Ship Canal, also of the Rio Janeiro Quays and of the Argentine and Chito Railway.

Mr. W. A. Hoyt has been selected by the U. S. Government to have charge of the design and construction of some large buildings at Rock Island Arsenal. Mr. Hoyt for over ten years past has made a specialty of reinforced concrete work. He was chief designing engineer for the Argo, Ill., plant of the Corn Products Company and has lately completed the erection of a concrete bridge at Cedar Rapids, Ia.

Mr. George A. Kyle has been elected to fill the office of Vice-President and General Manager of the Oregon Trunk Line. Mr. Kyle was formerly Chief Engineer of the road. Mr. Kyle, who has had wide experience in engineering and organization work, was employed for two years by the Rhodes syndicate as engineer in the Transvaal gold mines. He was also for a time with the Alaska Central Railway construction work and with the Grand Trunk Railway in Canada.

Contract News Section

of

ENGINEERING-CONTRACTING

A Consolidation of Engineering-Contracting—Contract News—Engineering World—The Dirt Mover.

Containing Items of Interest to Railroad, Public Works and Other Contractors.

The Doings of the Week.

The principal railway construction contract of the past week appears to be the one secured by Roach & Stansell, Memphis, Tenn. This contract calls for constructing the line of the Kansas City, Mexico & Orient from San Angelo to Eldorado, Tex. Other railroad contracts of the week include the following: Marco Lavorgna, Canton, Me., constructing the 8-mile steam railroad for the Elizabethtown Terminal R. R. from Westport to Elizabethtown, N. Y.; Archie Mason, Portland, Ore., for constructing a 4-mile extension of the State Portage Ry. at The Dalles, Ore.; the Patton-Gibson Co., Atlanta, Ill., for reconstructing a section of the Katy track from Aloho to Limestone Gap, Okla., the contract amounting to about $500,000; John F. Dolan, 160 Broadway, New York, for grading work at the classification yards of the D., L. & W. Ry. at Scranton, Pa.; and Joseph H. Sands, Roanoke, Va., for constructing the 9-mile Petersburg, Va., cutoff for the Norfolk & Western. Ry.—Four large contracts for work on the New York State Barge Canal are now being advertised. These are Contract No. 21, calling for 2.43 miles of canal; Contract No. 39, for 10.84 miles of canal; Contract No. 73, dredging 15 miles in the Champlain Canal; and Contract No. 78, constructing 1.23 miles of dike on the Oswego Canal.—Bids are said to be already in the hands of the officials of the Grand Trunk Pacific Ry. for constructing 135 miles of branch line from Tofield to Calgary, Alberta.—Bids are now being asked for these pieces of railroad construction: The Algoma Central & Hudson Bay Ry. is calling for bids for clearing, grading and bridge work on 31 miles of line in Ontario; the Intercolonial Ry. is calling for bids for constructing 9 miles of line between George's River and Sidney Mines, N. S., and the Brownwood North & South Ry. is calling for bids for constructing 18 miles of line between Brownwood and May, Tex.—Plans for the merging of nine large power companies in Michigan have been presented to the Railroad Commission of that state. The ompany will be known as the Consumers Power Co. and will ask permission to issue $35,000,000 in gold bonds.—It begins to look s though the government would revoke its permission previously given the city of San Francisco for obtaining a water supply from the Hetch Hetchy Valley. The Geological Survey and the reclamaiton service have reported to the Interior Department that it is not necessary that Hetch Hetchy Valley, in Yosemite National Park, should be available to San Francisco for the purpose of a municipal water supply. Secretary Ballinger accordingly has requested the mayor and supervisors of the city and county of San Francisco to show cause why the permission previously granted by the Interior Department for the contingent use of the Hetch Hetchy sites should not be revoked. These officials have been given until May 1 to make reply.

Town Meetings in Boston.

Boston, which recently began doing business under a new charter, has revived the old New England scheme of holding town meetings. The scheme was inaugurated by Mayor John F. Fitzgerald within a few days after his installation, and was made necessary by the fact that under the new city charter it is provided that the mayor and council shall make out the general appropriations for municipal improvements within 30 days after their inauguration. In order to do this town meetings were held in eight sections of the city for the purpose of hearing the wants of those neighborhoods. The mayor and his nine councilmen attended each meeting and heard what the citizens had to say. The purpose of the meeting was clearly set forth by the mayor in his address, in which he said: "We came here to listen to the wants of this neighborhood. You know the provisions of the charter and the necessity of care but haste in these appropriations. In order to expedite business we shall hear representatives of regular organizations first and then individuals. Gentlemen will be brief and rapid and will please confine themselves strictly to the points they wish to make." The scheme worked well, so well indeed that it is to be continued. As a result of it a great deal of time has been saved, and the mayor and council know exactly the various local demands. Of course all of these wants cannot be met, for the council has only about $2,000,000 at its disposal, and each district wanted about that sum.

An Engineering Feat.

We have not yet been accused of being nature fakers, and consequently it is with some misgivings that we reprint the following newspaper account of a truly remarkable "engineering feat": "English sparrows by a remarkable engineering feat rescued a wounded member of their flock from drowning in a rain conductor from the roof of a piazza of a house in the city of Montclair, N. J. During a sudden downpour one sparrow, crippled so that it could not fly, fell down in the pipe. Immediately the whole flock sat down in the gutter near the opening of the pipe, damming the water. Soon the gutter filled. Then, at a signal, the sparrows hopped out together and the great flood of water filled the pipe to overflowing, raising the imprisoned bird to the crest, and it fell to the ground." Now that it has been found that English sparrows, heretofore believed to be of no use whatever, can apply themselves to useful work, it is time to make public the discovery of a Texas contractor regarding bed bugs—the English sparrow of the insect world. This Texas contractor has found a use for bed bugs. He has found that their presence in a grading camp was extremely useful in causing the men to get up early in the morning.

Swamp Land in Missouri.

There promises to be much swamp land reclamation work in Missouri in the near future if the recommendations of the State Labor Bureau are carried out. This bureau has been making an investigation of the swamp and overflow land in the state, with a view to stimulating the land owners to a determination to protect and reclaim the swamp land. According to the special report of the bureau the Missouri alluvial deposits are as deep as the soil in the valley of the Nile and when reclaimed are as productive as the Egyptian land. It is estimated that at the present time in the valley of Missouri streams, including the Mississippi River, there are over 3,500,000 acres of overflow and swamp land that may be reclaimed or protected from overflows and made to produce as abundant harvests as ever were produced in the fields of the Nile valley. In other words, states the report of the bureau, the overflow land of Missouri is capable of sustaining the entire present population of the state.

Funds for U. S. Irrigation Projects.

The bill providing $30,000,000 for the completion of irrigation projects now under way construction by the U. S. Reclamation service has been advanced another stage by the U. S. Senate. As recommended by the Senate committee on finance, the bill is to be so amended as to make the government directly responsible for the payments of the certificates of indebtedness. The proposed amendment will authorize the secretary of the treasury to transfer from time to time from the general to the reclamation fund such amount as may be necessary to complete the projects, providing the aggregate shall not exceed $30,000,000. The secretary is to be authorized to issue certificates bearing not to exceed 3 per cent, the proceeds to be used to reimburse the treasury for the advances made. Ultimately the government is to be reimbursed from the reclamation fund.

Residents along the Belair Road are asking that the United Railways Co., of Baltimore, Md., to extend its line down that road.

Confirmed Reports by Engineers and Contractors

RAILROADS, POWER DEVELOPMENTS, LEVEES, DRAINAGE AND IRRIGATION WORKS.

Railroads—Steam and Electric.

ARIZONA.

The Evans Mines & Smelter Co., Newton Evans, President, Laughlin Bldg., Los Angeles, Cal., has completed surveys and has secured the capital for the construction of a 50-mile ore carrying road from Bill Williams Fork to Mohave Gap. No construction contracts will be let as the work will be done by the company.

CALIFORNIA.

The Humboldt & Eastern R. R. is projecting a railroad 175 miles long to extend east to the Sacramento Valley across Humboldt, Trinity and Shasta Counties. Location surveys have been made and the construction capital has been secured in part. The company intends to place engineers in the field about March 15th or 30th, depending on the weather conditions, to complete the detail work, preliminary to inviting contractors to bid on construction. Wm. O. Clark, Eureka, Cal., is President and J. N. Lentill, Eureka, Cal., is Chief Engineer.

ILLINOIS.

The Sterling & Northern R. R. Co., recently organized, proposes to construct a 40 mile line from Sterling via Emerson, Colita, Milledgeville, Carroll and Savannah. Most of the capital for the construction of the line has been secured and surveys for the line will be made shortly. There will be no construction work before May. Wm. Usborne, Sterling, Ill., is chief engineer and promoter.

INDIANA.

Bids are asked by the Board of Public Works, Henry W. Becker, clerk, Fort Wayne, Ind., until 2 p. m., March 16, for the city's portion of the track elevation work. The work will be awarded under two contracts—the one under improvement resolution No. 1 taking in all of the city's work at Calhoun St. and the other under improvement resolution No. 2 comprising the work of elevating the tracks at Fairfield Ave. and Broadway. Certified checks for $2,100 for the work at Calhoun St., for $700 for the work at Fairfield Ave. and $1,200 for the work at Broadway are required with the bids.

KANSAS

The Wichita, Kinsley, Scott City & Denver Air Line R. R., which projects a 350 mile line from Wichita, Kas., to Denver, Colo., has completed its surveys for part of the line and has secured the capital for construction. Construction contracts are to be let about May 1. T. E. Luttgerding, El Dorado, Kas., is chief engineer, and W. F. Brown, Iuka, Kas., is president.

MISSOURI

Ware & Spencer, Railroad Contractors, Bosworth, Mo., have 30,000 cu. yds. machine and wheeler work to let; short haul, 17 cts. per cu. yd.; 1½ cts. for overhaul after 500 ft.

The Manning, Wellman & Judd Construction Co., of Ottumwa, Ia., promoters of a projected 7½ mile electric railway from Moberly to Huntsville, Mo., will at once let contracts for constructing the line. Surveys have been made and $150,000 of capital has been secured. Chas. A. Wellman, Ottumwa, Ia., is interested.

NEW YORK.

Plans are under consideration for the construction of an electric railway from Oyster Bay, L. I., to Farmingdale. As projected the line will be about 14 miles long. Surveys have not yet been made. Raymond Smith, Oyster Bay, N. Y., is interested.

OHIO.

The Cincinnati, Hamilton & Dayton Ry., Frank H. Alfred, Chief Engineer, Cincinnati, O., has not yet reached a decision concerning its projected improvements in Cincinnati. The company has been awaiting developments of the proposed Union Station, which has been under consideration by the various railroads and interests in Cincinnati.

Construction work is to be started April 1 on the projected line of the Cincinnati, Portsmouth, Pomeroy & Pittsburg Ry. The projected length of this road is to be 438 miles and its route is on the Ohio side of the Ohio River from Cincinnati, O., to Pittsburg, Pa. A. E. Cox, Huntington, W. Va., is Trustee, and C. P. Anderson, Huntington, W. Va., is Chief Engineer. This road has been mentioned several times in these columns.

OKLAHOMA.

The Patton & Gibson Co., Ltd., Pittsburg, Pa., and Atlanta, Ill., has the contract for the Stringtown, Fellico and Limestone Gap revisions on the Missouri, Kansas & Texas Ry., in Oklahoma. The contract includes 500,000 cu. yds. earth excavation, 270,000 cu. yds. rock excavation and 12 concrete bridges. About 100,000 cu. yds. of team work has been sublet to W. C. Williams, Kansas City, Mo. None of the other work is to be sublet. Patton & Gibson started work on Feb. 15 and now have four steam shovels on the job.

OREGON.

The contract for the construction of the extension of the State Portage Ry. has been let to Archie Mason of Portland, Ore. The work consists of about 30,000 yds. of grading, 300,000 ft. B. M. of bridging and four miles of track laying. The new terminal at The Dalles will consist of an incline track down to low water, laid on top of a pile and plank bulkhead filled with rock, any other form of construction being liable to destruction by ice. J. P. Newell, 32 Washington Bldg., Portland, Ore., is engineer for the State Portage Ry. Commission.

TENNESSEE.

Surveys have been made for the projected 30-mile line of the Westmoreland & Redboiling Spring R. R. As projected the road is to extend from Westmoreland, Tenn., on the Louisville & Nashville R. R., to Redboiling Springs, passing through Lafayette. The capital for constructing the line has not been secured as yet, and the time for awarding construction contracts is uncertain. W. A. Smith, Lafayette, Tenn., is President and A. J. Bright, Nashville, Tenn., is Chief Engineer.

TEXAS.

The W. & C. R. R. Co. is building a new line from Blocker to Carthage, Tex. Montgomery Bros., Marshall, Tex., have the contract and have moved their outfit out to the work. Walker & Ervin, Marshall, Tex., are the Engineers.

The Dallas Traction Co., E. L. Lancaster, general manager, 334 Commerce St., Dallas, Tex., will let construction contracts April 1 for two miles of line in Dallas, Tex.

Bids will be received at the office of Brooke Smith, president of the Brownwood North & South Ry., Brownwood, Tex., until 2 p. m., March 10, for clearing, grubbing and grading about 18 miles of standard gage railroad between Brownwood and May, Tex. Profile, etc., at office of Brooke Smith. John Meade, Brownwood, Tex., is chief engineer.

The contract awarded the Morey-Faulhaber Construction Co., Chemical Bldg., St. Louis, Mo., as mentioned in these columns last week, is on the San Saba extension of the Gulf, Colorado & Santa Fe Ry. The work begins at Lometa and extends 230 miles west. The contract includes approximately 850,000 cu. yds. of earth excavation, rock excavation and embankment, wood trestles, concrete masonry, stone masonry and piling. None of the work has been sub-let as yet, but part of it will be in the near future.

Roach & Stansell, North Memphis Savings Bank Bldg., Memphis, Tenn., has been awarded a contract by the Kansas City, Mexico & Orient Ry. for constructing its line from San Angelo to Eldorado, Tex. The contract includes approximately 400,000 cu. yds. of earth excavation and 200,000 cu. yds. road excavation. Roach & Stansell will do the work with their own forces; they are now at work and expect to complete the contract by Oct. 1, 1910.

As stated in our last issue, the Atchison, Topeka & Santa Fe Ry. has awarded contracts for over 100 miles of new line on the Gulf, Colorado & Santa Fe Ry., the contractors being Morey-Faulhaber, Chemical Building, St. Louis, Mo.; Levy & Owens of Galveston, Tex., and the C. H. Sharp Contracting Co., Sharp Bldg., Kansas City, Mo. The contractors will build the line complete with the exception of track laying and surfacing, which will be handled by the railroad forces. F. Merritt, Galveston, Tex., is chief engineer, Gulf, Colorado & Santa Fe Ry.

UTAH.

The Logan Rapid Transit Co., recently incorporated with a capital stock of $100,000 to build an electric railway in Logan, Utah, has just finished about 2½ miles of line in that city. The company does not expect to do any more work this year. David Eccles, Ogden, Utah, is president.

VERMONT.

The Rutland Railway, Light & Power Co. has completed surveys and has secured the capital for the construction of a 7 mile extension from Fairhaven, Vt., to Poultney, Vt. Construction contracts will be let about April 1. G. T. Rogers, Binghamton, N. Y., is president and Geo. S. Haley, Rutland, Vt., is chief engineer and general manager.

WEST VIRGINIA.

Carpenter & Boxley, Glen Alum, W. Va., railroad contractors, have 3½ miles of heavy work at Glen Alum, W. Va., and 2 miles of heavy work, including three tunnels at Big Four, W. Va., and would like to hear from some of their old men.

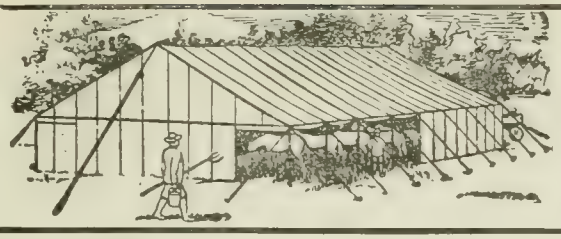
WASHINGTON.

Stone & Webster, Boston, Mass., are planning to double track a short distance on the Tacoma end of their interurban line between Seattle and Tacoma. They will also purchase two interurban cars. R. T. Laffin, 219 Pioneer Bldg., Seattle, Wash., is district manager for Stone & Webster.

CANADA.

Tenders are asked by A. W. Campbell, Chairman Government Railways Managing Board, Ottawa, Ont., up to and including March 15, for the construction of a line of railway for the Intercolonial Ry., between George's River and Sydney Mines, N. S., a distance of 9.09 miles. Plans anl specification may be seen at the Stationmaster's Office at Sydney Mines, N. S., and at the office of W. B. McKenzie, Chief Engineer, Moncton, N. B., where forms of tender may be obtained.

Tenders are asked by C. N. Coburn, Chief Engineer, Algona Central & Hudson Bay Ry., Sault Ste. Marie, Ont., until noon, April 15, for the clearing, grading and bridge work on the 31 mile (more or less) section of the Algoma Central & Hudson Bay Ry. between Hawk Lake Junction, Algoma Central & Hudson Bay Ry., and Hobon, Canadian Pacific Ry.



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ARKANSAS.

The letting of contracts for work in the Plum Bayo drainage district has been indefinitely postponed. Parkes & White, Seuyard Bldg., Pine Bluff, Ark., are the Engineers.

Roach & Stansell, Memphis, Tenn., have 61,000 cu. yds. of U. S. levee work at Wilson, Ark., which they are ready to sub-let. The time for completion is Dec. 1, 1910. Maj. M. L. Walker is U. S. engineer in charge.

The contract for constructing nine miles of levee, containing 165,700 cu. yds. of material, for the Woodson Levee District has been let to Peters & Adams, Fort Worth, Tex., at 16.1 cts. per cubic yard. The contract for constructing eight concrete culverts, eight gates and a reinforced concrete flood gate was let to the Nick Peay Construction Co., Little Rock, Ark., at $13,000.

CALIFORNIA.

The Modesto Irrigation District has awarded the contract for constructing outlet gates to the Dallas and Warner Lake Reservoir to T. K. Beard, Modesto, Cal. The work will be done by force account. The estimated cost is $20,000.

COLORADO.

Bids will be received at the office of the Kiowa Valley Municipal Irrigation District at the residence of Charles T. Walker, Section 13, Township 6 South, Range 63 West, Kiowa, Elbert County, Colorado, until 2 p. m., March 19, for furnishing materials and constructing the several dams, canals and ditches to be built for the district. Plans, etc., are at the office of the District Engineer, F. H. Whiting, Room 239 Century Bldg., Denver, Colo., or at the office of the Kiowa Valley Reservoir & Irrigation Co., 210 McPhee Bldg., Denver, Colo., and at the office of the district after March 12.

J. H. Nations, grading contractor, Swink, Colo., and El Paso, Tex., has been awarded all the concrete work on the Nepesta Ditch & Irrigation Co.'s intake ditches. The work consists of one headgate, one dam and wing walls and various other improvements. J. H. Nations also has the work of enlarging the Timpas Creek Ditch & Land Co.'s headgate and will put in a number of drops and spillways. All of this work is reinforced with ½-in. steel. P. J. Clark, Swink, Colo., is Manager for J. H. Nations.

GEORGIA

As stated in our last issue, bids are being asked by Col. Dan C. Kingman, U. S. Engineers, Savannah, Ga., until noon, March 21, for dredging refractory material in Brunswick Harbor, Ga. The work includes the removal of material as follows: In East River, where there are two lumps with a total area of about 2,300 yds., and where the cutting to be made is from 2 to 8 ft. in depth. In Turtle River, opposite the northwest end of Buzzards Island, there are several lumps, whose aggregate area is approximately 9,000 sq. yds., and where the cutting to be done varies from ½ to 2½ ft. There is quite an extensive lump in the lower shoal in Turtle River, below the mouth of Jointer's Creek, and several shallow shoals which have a total area of approximately 14,000 sq. yds. The depth of cutting at this shoal varies from 1 to 5 ft. The material to be removed is thought to be of a marly formation consisting of shell and sand cemented together.

ILLINOIS

Roach & Stansell, Memphis, Tenn., have 350,000 cu. yds. of levee work at Gale, Ill., which they will sub-let. The work is all open fields for an average 9 ft. levee. The work was let by the East Cape Guardeau and Clear Creek Drainage District, of Cairo, C. E. Farbush being an engineer in charge.

MISSISSIPPI.

Roach & Stansell, Memphis, Tenn., have two or three pieces of levee work in the Mississippi Levee District near Greenville to sub-let.

MISSOURI.

Roach & Stansell, Memphis, Tenn., have 45,000 cu. yds. of U. S. levee work at Crosno, Mo., which they are ready to sub-let. The work is to be completed by Dec. 31, 1910. Maj. M. L. Walker is the U. S. Engineer in charge.

NEW YORK.

The United Engineering & Contracting Co., 17 W. 42d St., New York City, has 150,000 cu. yds. of rock work on the New York State Barge Canal at Lockport, N. Y., which it will let.

Ziba L. Squier, Jamestown, N. Y., has 100,000 cu. yds. of dredging in Chautauqua Lake to let.

Contracts for work on the New York State Barge Canal were let Feb. 16, as follows: Contract No. 75, for guard gates at Spencerport and 1.5 miles of work in Monroe County, J. B. & J. M. Cornell Co., 26th St. and 11th Ave., New York City, at $42,917; Contract No. 49, for 6.18 miles of canal in Monroe County, Bellew & Merritt Co., Tuckahoe, N. Y., at $750,270.

TEXAS.

Roach & Stansell, North Memphis Savings Bank Bldg., Memphis, Tenn., are the contractors for 1,000,000 cu. yds. of levee work in Burleson County, Texas. This levee extends about 25 miles along the Brazos River. Roach & Stansell have their headquarters at Bryan, Tex., and Walter Stansell is in charge and ready to sub-let as many as 500,000 cu. yds. The Chief Engineer of the work is J. E. Nagle at College Station, Tex. The time of completion is Sept. 1st, 1910. Roach & Stansell on Feb. 24 sent a special train over the I. C. from Memphis containing 20 carloads of their own equipment and The Cotton Belt ran a special from Memphis bearing 150 men for this job.

The commissioners of Bernalillo County, New Mexico, have awarded the contract for raising the dike at Alameda, N. M., 2 ft. to J. B. Sanchez, Albuquerque, N. M., at 17¾ cts. per cubic yard. The contract for constructing a wing dam north of the Barelas Bridge was let to the Missouri Valley Bridge & Iron Co., Leavenworth, Kas., at $1,834

A local company has been organized at Valley City, N. D., to build an electric line from down town to the Northern Pacific's new station on the hill.

The Morris County Traction Co., with offices at Park place, Morristown, N. J., is planning to begin the extending of its lines as soon as the weather will permit. It is probable that the company will soon apply to the board of aldermen of Morristown for a franchise to the Lackawanna station in Morris St. Although the company has not as yet adopted any route from the park to the station it has made surveys down South St. to Pine St. and thence to the depot, and from its present line in front of police headquarters down Morris St.

Committees have been appointed at Clinton, S. C., and Greenville, S. C., to secure right of way for building a branch of the Greenville, Spartansburg & Anderson Ry. from Greenville to Clinton.

Local capitalists at Carlsbad, Eddy county, New Mexico, are organizing a company to build to Knowles, Monument and Lovington in the plains country to the Texas line.

The Cheat Valley & Monongahela Valley Ry. Co., has ben chartered and proposes to construct a railroad from Albright, Preston county, West Virginia, along Cheat River to the West Virginia-Pennsylvania line, near Cheat Haven. James W. Flynn and others of Kingwood, W. Va., are incorporators.

As the result of the acquirement of the Pittsfield Street Ry. Co. of Pittsfield, Mass., by the New York, New Haven & Hartford R. R., it is believed that the line of the Berkshire Street Ry. Co., now running from Bennington, Vt., to Great Barrington, Mass., will be extended south into Connecticut, making it a part of the trolley system controlled by the New England holding company of the N. Y., N. H. & H. R. R. Co.

Contractors have work well under way on the double tracking of the Northern Pacific between Billings and Huntley, Mont. The new track will be constructed on the north side of the present track to within a short distance of Huntley, where, it is understood, it will cross over to the south side. The bridge over the Yellowstone river will not be altered, the tracks interlacing on the structure.

Officials of the Union Pacific R. R., according to reports, have announced that engineers have prepared plans for the construction of the improved yards and shops at North Platte, Neb., estimated to cost $1,500,000. Other improvements, such as planting timber around the city for the purpose of raising tie wood for the company, are estimated to raise the expenditure several million dollars. R. L. Huntley, Omaha, Neb., is chief engineer of the company.

The Pennsylvania R. R. is shortly to take up the matter of completing the belt line which runs from Gloucester City, N. J., through Audubon, N. J., to Haddonfield connecting there with the New York division. It is probable that the Pennsylvania R. R. will complete part of the work with its own forces. The La Cato Construction Co., of Audubon, N. J., is reported to have one of the sub-contracts and is said to have received orders to have a large force of men ready. Geo. P. Miller, Jersey City, N. J., is principal assistant engineer.

The New York, Philadelphia & Norfolk R. R., Elisha Lee, superintendent, Cape Charles City, Va., is planning a number of improvements for its lines in Delaware. The double track is to be extended to Princess Anne and there connected with the long siding already existing to King's Creek, making 21 miles of double track south from Delmar, Del. The wooden culvert trestles between Princess Anne and King's Creek are to be replaced by concrete culverts and a concrete sheet pile bulkhead will be built beside the wharf and freight house at Cape Charles, Va.

Items Concerning Contractors and Their Work

RAILROADS, POWER DEVELOPMENTS, LEVEES, DRAINAGE AND IRRIGATION WORKS.

Alabama Notes.

FROM CORRESPONDENTS AND OTHER SOURCES.

C. O. Lynn, J. C. Carrigan and E. F. Emerson have organized the Carrigan & Lynn Construction Co., of Birmingham, Ala., and will engage in a general construction business. The company is incorporated with a capital stock of $20,000, fully paid in.

Definite plans are to be announced shortly for the Columbus, Mississippi & Western Alabama R. R., which projects a line from Winfield to Columbus, Miss., via Vernon, Ala. Charles F. Sherrod, Columbus, Miss., is president.

The Alabama City, Gadsden & Atalia Ry. has secured the material for the new line that is to be constructed to the plants of the Alabama Consolidated Coal & Iron Co. in North Gadsden and work on this extension will begin some time this month. The company is pushing its extensions with all possible speed and will soon have all parts of Gadsden accessible over its lines.

The town of Roanoke has closed an option on a place known as High Shoals, seven miles north of town, containing a considerable fall of water on Wehadkee Creek. The town proposes to utilize the water power for the generation of electricity.

Arkansas Notes.

FROM CORRESPONDENTS AND OTHER SOURCES.

Surveys have been made, right of way secured and some of the material bought for a new railroad to be built by the Doniphan Lumber Co. from Letona, in White County, on the Missouri & North Arkansas, west into Cleburne County, for a distance of about 15 miles. The road, as planned, will touch within a few miles of Quitman and later will be extended to that place.

Arch L. Russell of Farmington, Mo., has purchased the interests of John Ellis in the firm of John Ellis & Co., contractors. A reorganization has been effected and the firm name changed to the Kiamichi Tie & Timber Co. R. A. Clarkson, who was associated with Mr. Ellis, continues with Mr. Russell and will have charge of the office in the American National Bank Bldg., Fort Smith, Ark. Mr. Russell will have active management of the field operations. The Kiamichi Tie & Timber Co. will assume the contract to furnish the Rock Island railroad company with 1,000,000 ties, of which 300,000 are yet to be delivered. The cutting of stumpage for ties is confined to land between Fort Smith and Hugo, the company controlling about 25,000 acres.

The Arkansas State Board of Railroad Incorporators has granted the Central Arkansas & Eastern R. R. Co. authority to construct an extension of its line from McGregor, Lonoke County, to Stuttgart, and thence to a point on the Chicago, Rock Island & Pacific Ry. in Prairie County, a distance of 35 miles. The line is estimated to cost $780,000. Robert M. Foster, Lewis Sachs, W. J. Locke and T. B. Goldsby applied for the permit.

According to reports the Missouri & North Arkansas R. R. contemplates the construction of a branch line from Letona, Ark., on the main line in White County to Bald Knob, a distance of 15 miles. The proposed line will give the Missouri & North Arkansas direct connection with Memphis over that division of the St. Louis, Iron Mountain & Southern Ry. S. W. Lee, Eureka Springs, Ark., is consulting engineer of the company.

Surveys are under way for the new railroad projected between Cotton Plant and the Cache River. The road will leave the Missouri & North Arkansas at the Cotton Plant depot and will extend due west to the Cache River.

California Notes.

FROM CORRESPONDENTS AND OTHER SOURCES.

The Oakland Traction Co., Oakland, is to construct an extension of the present Euclid Ave. car line from Hilgard Ave. to the Berryman reservoir in the Cragmont District.

Test pits are being sunk at Oakland to determine the nature of the strata along that portion of the estuary where the 2,700 ft. of seawall and quay are to be constructed with the money voted at the bond election of Nov. 15th. City Engineer F. C. Turner, assisted by members of his office, is superintending the work of determining the nature of the ground upon which the seawall is to be built. The borings which have already been made in the test pits are said to have revealed the fact that the hard strata is from 12 to 15 feet below the top of the soft mud. The borings are being made to a depth of 45 feet. Plans and specifications for the work are to be drawn up as soon as the money is obtained from the sale of the bonds.

The project for building a steel pier at the foot of American Ave. at Long Beach, has been revived and Col. W. J. Horne, retired, living in that street, has agreed to subscribe the first $1,000 and also promised he will make a canvass for contributions.

Grading work for the extension of the Holton Interurban R. R.—the eastern connection of the San Diego & Arizona R. R.—has begun at El Centro and it is expected the track will be completed to New River, a distance of about ten miles, before summer.

As is well known the Harriman system is planning the construction of many miles of branch lines in northern and northeastern California, Southern Oregon and Western Nevado with primary object of strengthening its hold aginst the prospective aggressions of the Hill combination and of Gould's new Western Pacific road. Five different and separte branch lines have been mapped out as follows: California Northeastern Co., 90 miles; Oregon Eastern Railway Co., 150 miles; Modoc Northern Railway Co., 80 miles; Goose Lake & Southern Co., 160 miles; Fernley & Larsen Railway Co., 120 miles.

The county supervisors at Oakland have advertised for bids for a franchise asked by the Southern Pacific Co., for a line to run through Northrae and connect the present lines in Berkeley and Ocean View.

The Northwestern Pacific R. R. is planning to expend $600,000 on the extension of the Fort Bragg & Southeastern, 14 miles to Willetts. W. C. Edes, San Francisco, is chief engineer.

The Tibbitts Construction Co. of San Francisco has begun work on the Twin Peaks reservoir for the city of San Francisco, in which will be stored the water for the auxiliary fire system. The first work will be the building of two tunnels, which will contain the pipes carrying the water from the reservoir to the outlet 150 ft. lower down the hillside. Each tunnel will be 10 ft. in width and 8 ft. in height. The contractors are allowed 320 days in which to complete the work. The contract price is $158,143.

It is reported that Theodore A. Bell of Sacramento will shortly apply to the city trustees of Vallejo for a franchise to construct an electric railway to Sulphur White Springs.

The Fullerton-Richfield R. R. Co., a subsidiary of the Atchison, Topeka & Santa Fe, has been incorporated and proposes to build a road from Fullerton to Richfield, a distance of five miles, for the hauling of freight. The road when built will cut seven miles from the present distance from Los Angeles to San Bernardino. It is stated that the construction of the road will begin as soon as the contracts can be awarded and the material obtained. The directors of the company are: A. G. Wells, Los Angeles, general manager, A., T. & S. Fe. Ry.; G. Holterhof, W. H. Brenner, J. I. Hibbard and C. W. Jones.

The Rubio Canyon Land & Water Association of Altadena is planning to construct a 3,000,000 gallon storage reservoir at the mouth of Rubio Canyon. The reservoir will cost about $14,000.

The Vallejo & Northern R. R. has an application before the city trustees of Woodland for a franchise on 2d St. in that city.

Preliminary plans have been completed for the proposed tunnel in Stockton St., from Bush St. through the hill to Clay St., at San Francisco. M. Manson is city engineer.

Two miles and one-half of rebuilt Santa Fe Ry. track between San Diego, Cal., and Santa Ana have been thrown open to traffic from Del Mar to Encinitas. There still remains a large amount of work on the Del Mar stretch, including a big fill across Sorrento flats, and laying track to a point where the tunnels are to be bored through the hills between Sorrento and Rose Canyon. The expenditure planned by the Atchison, Topeka & Santa Fe division will amount to about $1,000,000. H. C. Phillips, Los Angeles, Cal., is chief engineer of the company.

The Petaluma & Santa Rosa R. R. is to be shortly extended to Guerneville. The electric road now has its terminus at Forestville, only a few miles distant from the Guerneville section. It is understood that this is only the beginning of the expansion of the road and that eventually it will be extended to the ocean.

Alva Udell, an attorney of San Francisco, has filed notice appropriating 200,000 ins. of the waters of Eagle Lake and the streams flowing into the lake and 200,000 ins. of the waters of Willow Creek. The waters of Eagle Lake are claimed by a prior location made by the Lassen-Willow Creek Water Co., a company formed about four years ago for the purpose of tapping the lake by a tunnel over a mile in length.

The Hallwood Irrigation Co. of Marysville, recently incorporated with a capital stock of $25,000, is planning to have work started shortly on the ditch which is to convey water from the Yuba River at DaGuerre Point onto the lands of the company. The directors of the company are Marshall Diggs, Thomas F. Matthews, Fred D. Groh, E. E. Long and Byron Jakes.

The Southern Pacific Ry. Co. is to issue bonds amounting to $50,000,000, which amount will probably be used for the construction of new terminals at San Francisco on the property purchased several years ago for $2,000,000 and new track work. William Hood, San Francisco, Cal., is chief engineer of the company.

Work is to be started shortly at Colton by the Southern Pacific. The changes include lowering of the racks through the city, keeping up the grade of the double tracks to Bloomington.

E. P. Dewey, city engineer, Long Beach, has prepared plans for a steel and concrete pier to be erected at Devils Gate, Long Beach. The plans provide for a pier proper 700 ft. long and 18 ft. wide, with an outer wharf 40 ft. wide and 106 ft. long. It is a single-deck structure, the deck being 2 ft. higher than the pleasure pier at Pine Avenue. The pier as proposed will be supported by concrete cylinders connected with arches of solid concrete. Over these will be laid a floor of Concrete, flanked on either side by a concrete parapet 3 ft. high. The pier would extend into water 12 ft. deep at low tide.

The Board of Trade of Pomona is now securing right of way between Pomona and Claremont for the Pomona-Claremont-Upland electric line and it is hoped to have the line in operation by July 1. Bonds for the road have been sold and the material has been ordered.

The Vallejo & Northern R. R. is stated to have secured the necessary capital for the con-

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struction of its line and work will be started this year. The company was incorporated to build a double track system from Vallejo to Sacramento. T. T. C. Gregory, Fairfield, is president.

The California Midland R. R. has been securing options on land in Auburn for its depot and yards, and is reported to have let the contract for constructing the road from Grass Valley to Auburn, the work to begin this spring. The road has been surveyed from Marysville through Wolf to Auburn and from Wolf to Grass Valley. Wolf, the junction point on the line, is located about ten miles north of this city, on the Bear River, just over the boundary between Placer and Nevada counties. The grade to Hammonton from Marysville is practically ready for the rails.

Colorado Notes.

FROM CORRESPONDENTS AND OTHER SOURCES.

Advices from Trinidad state that the Yankee Fuel Co., the Santa Fe, Raton & Eastern, the Santa Fe, Raton & Des Moines and associated railroad companies, which some time ago went into the hands of a receiver, are to be reorganized at once. The properties in Colorado and New Mexico are to be improved and developed, over $1,000,000 being spent for that purpose. H. W. Kruse, Raton, N. M., is general manager.

The Denver & Gulf R. R. Co. has closed an agreement with the city of Lamar, Colo., agreeing to have in operation 150 miles of standard gage railroad between Lamar and Texhoma, Tex., on or before July 1, 1911. This with other agreements now in force in Texas, it is said, will insure the completion of 350 miles of the system by the date given. The agreements provide that the road shall be built with a maximum grade of not exceeding 1 per cent per mile, and the curvature will not exceed 3½ degrees per 100 ft. at any point. The distance between Denver and Lamar will be 70 miles less by this road than the present distance by rail. The road is bonded for $40,000 a mile. The agreement required engineers to be in the field at Lamar on or before Feb. 26, 1910, and requires actual physical construction to be begun at Lamar on or before May 1, 1910, and to continue uninterrupted until the entire system is completed.

A meeting of the farmers in the Otero Irrigation District has been held at La Junta to hear the report of George Anderson, Denver, engineer for the district. He reported that it would take $250,000 to put the canal in first class shape. This will include cement headgates, syphons and the straightening and widening of the ditch. The farmers had already voted bonds of $100,000 toward the work and promised to vote an additional $150,000 to have it completed.

Timber men along the right of way of the Missouri Pacific state that they have been requested to submit bids for furnishing ties for the proposed extension of that road westward from Steamboat Springs, Colo., and that engineers are already busy making surveys across the western part of Routt.

The Colorado Fuel & Iron Co. has been awarded contracts by the San Diego & Avijano R. R. of Mexico for 6,000 tons of steel rails, to cost about $300,000. They will be used for an extension of that road. It will require 200 freight cars to carry the shipment to the Pacific coast, from which place the rails will be distributed along the proposed road.

The city council of Greeley has granted Albert Howard and others permission to change the course of the Cache La Poudre River on condition that they bear all expense, and assume all responsibility for damages. Those interested claim the river is washing away their crops. They will undertake the project immediately.

Durango, Colo., Aztec, N. M., and Farmington are taking steps toward raising the required bonus to insure the construction of the Arizona & Colorado Ry. through those places. This company was recently incorporated as mentioned in ENGINEERING-CONTRACTING.

J. M. Gingrich, of Denver, has purchased 4,600 acres of land northeast of Greeley and is planning to spend $50,000 in reservoir improvements on the land.

The citizens of Durango have subscribed $50,000 to secure the entrance of the Southern Pacific Ry. to that city, and will raise an additional $50,000.

Georgia Notes.

FROM CORRESPONDENTS AND OTHER SOURCES.

The city council of La Grange, Ga., has granted a franchise for an electric street railway to Messrs. Aikin and Preston and others of Macon, C. M. Awtrey, G. E. Dallis and others of LaGrange. The company will begin construction of a number of miles of trackage at an early date after the organization is perfected and it is expected the railway will be in operation by the end of 15 months from date of franchise.

The Georgia, Southern & Florida Ry., W. C. Shaw, Jr., chief engineer, Macon, Ga., is to build a $50,000 repair shop at Valdosta. The road is also filling in a large tract of land and this tract is to be converted into freight terminals. In addition to the tracks now in use the road will put in ten new switches.

The Rome & Northern R. R., H. M. Smith chief engineer, Rome, Ga., has surveys under way for an extension from Gore to Tunnel, a distance of about 30 miles. It is said that the extension will be built at once if the people along the route will donate the right of way.

The South Georgia & West Coast Ry., Chas. T. Tillman, purchasing agent, Quitman, Ga., has placed an order for 15 miles of 60 lb. steel rail which will be used to replace some 40 lb. rail now in use.

The construction of a railroad from Elberton to Washington, Ga., is under consideration. The Chamber of Commerce of Elberton, W. O. Jones, president, is advocating the road.

Idaho Notes.

FROM CORRESPONDENTS AND OTHER SOURCES.

According to a reported statement of H. E. Dunn, Payette, Idaho, vice president and general manager of the Payette Valley R. R., construction work will be started as soon as weather permits on building the line from New Plymouth to Emmett, Idaho.

The Nez Perce & Idaho R. R., now under construction between Vollmer, Idaho, and Nez Perce City, 14 miles is to be in operation by April 1. Rails for the line are already on the ground.

Judge J. H. Hawthorne, St. Paul, Minn., has filed at the U. S. Land Office in Boise applications for a site for a reservoir and for right of way for canals to be constructed on an irrigation project in Owyhee county for reclaiming 15,000 acres of land.

Illinois Notes.

FROM CORRESPONDENTS AND OTHER SOURCES.

The construction of an electric railway from Rochelle by way of Earlville to Ottawa is under consideration. H. J. Burdick, Elgin, Ill., is interested.

The Illinois Traction System, H. E. Chubbuck, general manager, Peoria, is planning to expend $150,000 for improvements in Bloomington. These improvements include several extensions, laying of heavy rail on several of the city lines, new pavements, improvements at the power plant and the transformation of the Normal street cars to the pay as you enter variety.

Receivers for the Illinois Tunnel Co. of Chicago probably will ask the court to authorize an issue of $3,000,000 two year 6 per cent receivers' certificates with which to begin the work of installing its projected telephone system.

Plans have been outlined before the city council of Elgin for the projected electric belt line of the Elgin-Evanston R. R. According to the franchise application the company wishes to enter Elgin along a private right of way and the proposed line is to be a direct road from Elgin to Evanston. T. M. Sayer is president.

The Chicago & Alton R. R. has resumed work on its double tracking north and south of Springfield after the halt made necessary by the cold weather. Nearly 1,000 men have been put to work. The double tracking includes 20 miles out of Bloomington and south of the city from Chatham to Carlinville.

The Chicago & Alton R. R., E. L. Crugar, resident engineer, Springfield, is to expend $300,000 for the enlargement of the Ridgely freight yard and for the building of a roundhouse at Springfield.

The Florida Everglades Reclaimed Land Co., of Chicago, has been incorporated with a capital stock of $25,000, and proposes to engage in a general drainage and contracting business. The incorporators are C. D. Forhner, Charles S. Holland and William Butterworth.

Investigations are under way for a route out of Freeport for the proposed Freeport-Dixon interurban line. Chicago capitalists were recently in Freeport looking over the project, which is being promoted by O. T. Smith of Freeport.

Practically all right of way has been secured for the Galesburg-Rock Island interurban line, and it is believed that construction work will be started by May 1. A bonding firm of New York city has made a proposition to finance the road. W. C. McWhinney, Galesburg, is the promoter.

Roach & Stansell, Memphis, Tenn., have been awarded the contract for constructing 350,000 cu. yds. of levee work from Gale to McClure for the East Cape Girardeau and Clear Creek Drainage District. Roach & Stansell have moved outfits of graders, men and teams from Cleveland, Miss., and from Benoit, Miss., onto the work, which is to be completed by July 1. R. H. and G. A. McWilliams, Mattoon, Ill., were awarded the contract for the ditch work at 9 cts. per cubic yard.

Surveys have been under way all winter for the improvement of the Chicago, Burlington & Quincy R. R. Co.'s line between St. Paul and Savanna. It is expected that work will be commenced this spring on the work, which includes considerable double track work and eliminating curves.

According to reports in the vicinity of Carmi, Ill., the Louisville & Nashville R. R. Co. will start surveys in the spring for the construction of a branch line from Maunie, Ill., to Carmi. J. E. Willoughby, Louisville, Ky., is engineer of construction.

Permanent surveys are to be started at once on the Evansville, Mt. Carmel & Northern Ry. Co.'s proposed line from Mt. Carmel, Ill., to Evansville, Ind., a distance of 32 miles. A preliminary line was run by the Big Four engineers in 1906 and that company in conjunction with the New York Central lines will now take up the matter of construction and operation. As projected the line will pass through

an undeveloped farm region of Indiana and at Mt. Carmel, Ill., will make connections with the Cairo division of the Cleveland, Cincinnati, Chicago & Louisville R. R. G. P. Smith, Cincinnati, O., is chief engineer of the C., C., C. & L.

Indiana Notes.

FROM CORRESPONDENTS AND OTHER SOURCES.

The Terre Haute, Indianapolis & Eastern Traction Co. is planning to expend $500,000 this year for a new terminal and traction station on Cherry St. at Terre Haute. Rough plans only have been worked out and no definite details are available at present.

The Fort Wayne & Springfield Traction Co., Wm. H. Fledderjohann, president, Decatur, Ind., is planning to begin work in the spring on its extension from the present terminus at Decatur to Portland. The company has asked the city council of Portland to renew the franchise for the road, giving the company the privilege to use certain streets in that city. The line will in all probability parallel the G. R. & I. railroad tracks and pass through Monroe, to which point the roadbed is already graded, Berne, Geneva and Bryant.

Business men and farmers living in and near Monroe are forming an organization to secure the building of a direct east and west interurban line from Bluffton to Wilshire.

The Wabash R. R., J. C. Sullivan, division superintendent, Peru, Ind., is planning to begin work on its track elevation project at Fort Wayne by April 1. The work will cost about $125,000, and the city is already calling for bids for its share of the work, as noted elsewhere in this issue. The Pennsylvania R. R. will also commence its track elevation work about April 1.

The Lake Shore & Michigan Southern Ry. is to break ground shortly at Elkhart for locomotive and car shops to cost $3,000,000. O. M. Foster, Elkhart, is division master mechanic.

The city council of Portland has granted the new franchise asked by the Fort Wayne & Springfield Ry. Co. for an extension of its traction line from Decatur to Portland.

Iowa Notes.

FROM CORRESPONDENTS AND OTHER SOURCES.

Preliminary details are being worked out for an interurban line south from Dubuque. Chicago parties are reported to have offered to put $2,000,000 into the project if bonuses of $150,000 and right of way are given. J. B. Wellsford, Dubuque, Ia., is interested.

Final surveys for the proposed extension of the Muscatine North & South Ry. to Burlington have been started from Elrich Junction, and it looks as though the extension would be built this year. Charles Howard, Muscatine, Ia., is general manager.

Arrangements are reported to have been completed for beginning construction work in the spring on the projected line of the Sioux City & Des Moines Interurban Ry. Permanent surveys have been completed and terminal facilities have been secured at Des Moines. Franchises have been secured at Ida Grove, Valley Junction, Perry and at practically all other towns along the route. The American Engineering Co., Indianapolis, Ind., has the contract for the engineering and construction work.

The Charles City & Western R. R. Co., recently incorporated, as mentioned in our last issue, has had preliminary surveys made for its line and it is believed that bids for construction work will be asked in the near future. The Hart-Parr Co. of Charles City is interested in the enterprise and has subscribed for $100,000 of the capital stock.

The Chicago, Burlington & Quincy Ry. is to start work as soon as weather permits in improving the division from Sioux City to O'Neill. New 80 lb. rails will be laid, cuts will be lowered and the track ballasted. The improvements will cost about $100,000.

The Southern Iowa Traction Co. has been incorporated under the laws of New Jersey for the purpose of taking over the property of the Albia & Centerville R. R. A number of improvements are to be made and other projects developed. The Russell Sage interests in the Albia & Centerville R. R. were recently acquired by William A. Boland, of New York City, who is president of the new company. Dr. J. L. Sawyers, Centerville, Ia., is secretary.

The Great Western Ry., according to a statement reported to have been made by the company's officials at Des Moines, Ia., recently, is planning the improvement of its system in Iowa, making necessary an expenditure of several million dollars.

Plans have been made for the new yards of the Chicago & Northwestern R. R. at Clinton, Ia. The work, which includes round houses and machine shops, is estimated to cost $1,000,000.

Hershal Clovis, Red Oak, Ia., is busy securing right of way for the proposed line of the Red Oak & Northeastern R. R.

Kansas Notes.

FROM CORRESPONDENTS AND OTHER SOURCES.

Steps are being taken to organize a construction company to build the Kinsley-Denver Air Line R. R. It is hoped to raise $75,000 for the construction company in Kinsley and Edwards county and the balance along the line. W. F. Brown, Naron, Kas., is president.

The Kansas City, Lawrence & Topeka Electric Ry. Co. has obtained an order from the commissioners of Johnson County for the condemnation of a right of way from its present terminus at Shawnee to Zarah, six miles west, on the Atchison, Topeka & Santa Fe R. R. Work will be started on the extension as soon as the weather will permit. It is also said that steps will soon be taken to build the line on to Lawrence.

The Atchison, Topeka & Santa Fe Ry. has been making preliminary surveys for a new line of track from the station at Lake View to Lawrence, with a view to securing a roadbed which will be above the flood line of the Kaw River. Three possible routes have been surveyed. The first two lines would require a new track of about ½ mile in length; the latter route would require the laying of about five miles of new track, but would give a better line into Lawrence, and avoid a sharp curve around the river side of the bluff.

Citizens of Wichita, Kas., are to vote soon on a proposition to authorize the city commissioners to issue bonds amounting to $20,000 for the construction of a concrete dam across the Little River at that place.

Michigan Notes.

FROM CORRESPONDENTS AND OTHER SOURCES.

The Saginaw Valley Traction Co. has been granted a franchise at Saginaw for the operation of a loop line.

The Detroit, Lansing & Grand Rapids Ry., a new cross state electric line, has asked a franchise over the streets of Portland. Dr. Oliver H. Lau, Detroit, Mich., is president.

The city council of Flint has asked the Detroit United Ry. to put in a crosstown line east to west in that city.

The Murdock interurban interests of South Bend, Ind., which have taken over the Southern Michigan line, operating between St. Joseph and South Bend, plan building a line from Niles through to Dowagiac and Kalamazoo, connecting with the Michigan United Rys.

The State Railway Commission has approved the proposed merger of the Saginaw and Bay City Electric Railways. The name of the Bay City Traction Co. is to be changed to the Saginaw-Bay City Traction Co., and the capital stock increased from $1,500,000 to $2,000,000.

Hanady Bros., Bay City, will soon open two new mines two miles west of Unionville and connect them with the Akron mine and main line of road by a spur track. Shafts will be sunk for mines as soon as possible so the bed of coal may be reached by the time their railroad now under construction reaches them, when 650 men will be employed.

The Michigan Central R. R., G. H. Webb, chief engineer, Detroit, Mich., is stated to be planning to build an extension from its Bay City line to some point on the St. Clair river. It is expected an extension will be built from Lenox to Rochester and Utica via Mt. Clemens.

The State Railroad Commission has approved the maps of the Grand Rapids Electric Ry. Co. for the line between Mt. Pleasant and Gladwin, and recently granted the company permission to cross the Pere Marquette R. R. at Clare. The road is to extend from Grand Rapids to Gladwin. It is expected that construction work will be taken up soon. Col. J. W. Boynton, Grand Rapids, is president.

Minnesota Notes.

FROM CORRESPONDENTS AND OTHER SOURCES.

The Duluth, Missabe & Northern Ry., H. L. Dresser, chief engineer, Duluth, Minn., is soon to construct an extension of its line into Chisholm.

The Zumbro River Power Co., recently incorporated, prosposes the erection of a 50 ft. dam across the Zumbro River 15 miles from Rochester and the development of electric power there. Judge Henry O. Cristensen is interested.

M. D. Stoner of Bedmidji has gone to International Falls to resume personal supervision of his contract for the construction of the line of railway which is being built from the Nakota Junction, seven miles south of International Falls, to the mouth of the Black river. Mr. Stoner has some 250 men at work and before long the number will be increased to 400. He has purchased a pile driver, which will be at once put into use driving piles for the many bridges which it will be necessary to construct along the new line of railway. He will have the line ready for the rolling stock not later than May 1.

Duluth and the Ranges.

BY PETER E. MEAGHER.

J. K. Hartridge, representing the American Hydraulic Stone Company, Chicago, was a caller here recently.

Horace Clark, salesman for Macomber & Whyte Rope Company, was a caller here a few days ago. He reported wire rope business very good.

Frank Donald has been appointed General Superintendent for MacArthur Brothers Company, in charge of their mine stripping work in Minnesota. He arrived here last week, and has already assumed his new duties.

H. Hanson, of the Winston-Dear Company, was a caller in Duluth recently. He was on his way to Minneapolis.

C. J. A. Morris, of the contracting firm of Morris & Shepard, was a caller on the writer recently, and said he had some new work, which they would be ready to start on in the very near future.

The writer has just returned from a four days' visit to the Concrete Show at Chicago, and while there met a great many old friends, and made some new ones, I believe. The show was very interesting as well as instructive, and those interested in contracting and in contracting equipment that did not attend missed something.

Captain Roberts of the Roberts-Kingston Company, contractors, has returned from a trip to Milwaukee where he purchased a new Bucyrus Steam Shovel for his work on the Range.

The labor situation and business in general here at the present time is quiet. There are a few men here, and just about enough work to take care of them. There are some new contracts being contemplated, but there will not be very much doing here until about April first, when I expect that business will open up with a rush.

Missouri Notes.

FROM CORRESPONDENTS AND OTHER SOURCES.

Surveys are to be started in the spring, it is said, for an electric railway from Kirksville southeast to Gibbs. The project is being promoted by C. M. Coe, a contractor of Denver, Colo.

The city council of Kansas City has been working on an ordinance for a special election

to vote on issuing bonds for public improvements. Among other things it is proposed to issue $500,000 of bonds for park purposes and $75,000 for rebuilding the levee.

The city council of Webster Groves has passed an ordinance ordering the abolishment of two grade crossings. The road will be lowered at the crossing of the Rock Hill road over the Missouri Pacific tracks and at the crossing at Percival Ave. over the Frisco tracks.

The Blackwater Drainage District of Warrensburg, Mo., has sold $190,000 of bonds. These bonds were issued for the purpose of draining Blackwater River valley for a distance of 47 miles with a ditch 37 ft. wide and 17 ft. deep.

The Kansas City Belt Line Ry. has been formally transferred to the Kansas City Terminal Ry. Co., the organization that is to build the union passenger station and railway freight terminals at Kansas City. The consideration is said to have been $3,000,000. H. L. Harmon is president of the Terminal Co.

The Inland Construction & Realty Co. has been organized with Dr. P. A. Herrington, Houston, Mo., as president and E. E. Young, Licking, Mo., as secretary. The company will purchase lands and lay out town sites, additions to towns already started and develop the country along the line of the proposed new Missouri Inland Ry., to be built from Rolla to Houston, Mo. The company will also have charge of all surveys, the grading and all the construction work of the new railroad. The present intention is to start work on the new road about the first of April, 1910.

The Hannibal & Northern Missouri R. R. Co. has made a proposition to the citizens of Hannibal asking for a stock subscription of $75,000, in return for which the company agrees to construct an interurban line between Palmyra and Hannibal. The company was organized last June and has had its preliminary surveys made, and final grade stakes set from Palmyra to Bethel. Capt. F. W. Latimer, president.

The Chicago, Rock Island & Pacific Ry. has set aside an appropriation of approximately $4,000,000 for the reconstruction and shortening of its line between St. Louis and Kansas City. Plans are also said to have been completed for an independent terminal system at St. Louis covering 36 acres.

St. Louis Items.

BY A. B. KOENIG.

Morey, Faulhaber & Co., 1212 Chemical Bldg., St. Louis, Mo., secured 30 miles of grading and trestle work on the Santa Fe R. R. west of Lameta, Texas. They will sublet part of this work in quantities to suit outfits and they expect to open an office at Lameta, Texas, the forepart of next week.

The Missouri, Kansas & Texas Terminal Co. bill passed the House of Delegates with only one vote against it, after it had been amended so as to place the maximum switching charge of $2.00 until such time as a court or commission, or other body having jurisdiction, should decide that the rate was unfair. The bill must go back to the Council to have the amendments approved. A two-hour debate followed the favorable report by a majority of the Committee on Railroads Tuesday night, because Delegate Hamilton opposed fixing a maximum rate in the bill. He offered a minority report in which he suggested that a "reasonable rate" be allowed for switching between points along the line of the Katy Terminal system. When Hamilton was voted down he offered another amendment, which was practically the same as that accepted last week by the House of Delegates, which gives the company the franchise and leaves it up to the courts or legally authorized body to determine the validity of justice of the rate. An additional feature of the amendment adopted last week was that the M. K. & T. Terminal Company is not permitted to contest the rate in court, but an individual, corporation or officer of the company may ask the courts to pass upon the question, and any rate fixed by court in lieu of the $2.00 rate must be accepted by the company. This gives the company the right to establish terminals here and enjoy the franchise for a term of eighty-three years, the length of the lease of the M. K. & T. Railway for the use of the Burlington tracks north of the city limits. It is expected the Council will accept the bill in its present form. Under the terms of the franchise the company is permitted to establish yards in the extreme northern end of the city, between Doddridge and Aurora Avenues; to build a freight depot and install spur tracks east of Broadway, between Mellanphy and Brooklyn Streets and to connect up its system with the tracks of the Terminal Railroad Association. According to Jos. L. Bryson, attorney for the M. K. & T. Terminal Company, property has been purchased to carry out the scheme at an aggregate cost of $3,000,000. He says the company expects to expend about $7,000,000 additional in improvements and establishment of yards in this city. The company agrees to pay the city $140,000 cash; to build a viaduct at the north end of the property, and to abolish any grade crossings that they may be called upon by the city to remove and puts a maximum switching charge of $2.00 per car on all freight moved from one point of the system to another point on the same system. The company further agrees to make no charge for handling freight from points along the line of the M. K. & T. R. R. to points along the system of the Katy Terminal Company. When the bill came up for final passage last night, Delegate Mischel of the Seventh Ward was the only member to vote against it.

With the first sign of fair weather the first caisson for the Municipal free bridge will be sunk on the east side of the river. The contractors have been ready for the thaw for several days, but could not begin work until the thermometer was well above freezing point. President Reber of the Board of Public Improvements says the caisson will be sunk just as soon as the weather will permit the mixing of the concrete. He says it would be unsafe to undertake the work unless the danger of the concrete freezing had passed. The Missouri Valley Bridge & Iron Co., which is constructing the piers, has experienced much difficulty in progressing with the work, both on account of high water and the unusually cold weather which has lasted almost continuously throughout the winter. Had there been a few bright and balmy days the pier builders could have made some progress, but they have had to stop repeatedly.

The Board of Local Improvements of East St. Louis let to the three East St. Louis construction companies contracts for street improvements that will cost $203,666.55. Mayer & Thomas were given a contract to improve Belmont Avenue from Columbia place to the Venice and Carondelet Railroad tracks for $25,112.70. J. and P. Keeley got the contract to improve Illinois Avenue, Twenty-ninth Street, Louisiana Boulevard and Thirty-third Street for $127,175.50, and Meyer & Thomas will improve Twenty-fifth Street, Waverly Avenue and Fortieth Street at a cost of $51,378.35. The cost of the three contracts, $203,666.55, is about $16,000 lower than the probable cost estimated by the Board of Local Improvements several weeks ago. It is understood work on all three of these improvements will be started immediately.

Assistant City Engineer Wiliford A. Thompson of East St. Louis, who also is County Surveyor of St. Clair County, has returned from Springfield, Ill., where he helped to organize the Association of County Surveyors of Illinois. Mr. Thompson was elected first vice-president of the organization.

The Board of Public Improvements last Friday caused ordinances to be introduced in the Council authorizing the letting of contracts for sewers in the Glaise Creek and North Harlem Creek joint sewer districts, for two sections of the River des Peres foul water sewer, aggregating $1,408,000. The River des Peres sewer runs from the Mississippi River at Catalan Street to Tennessee, estimated to cost $324,000, and from Tennessee to Greenwood, near Forest Park, estimated to cost $615,000, making a total cost for the foul water sewer of $939,000. This does not include any provision for storm water. The two sections of North Harlem Creek sewer are to cost $141,000 and $148,000, respectively, of which the city pays $10,955. It drains 1,096 acres, of which 41 is in St. Louis county. The Glaise Creek sewer is to cost $180,000. The estimated drainage area of the River des Peres sewer is 110 square miles, or nearly double the total area of the city. Of this amount, 84 square miles, or just one and one-third times the area of the city, is in St. Louis County. The area is large because of small streams emptying into the river in its course through St. Louis County, and even after it comes into the city,

Nebraska Notes.

FROM CORRESPONDENTS AND OTHER SOURCES.

T. P. Kennard, Lincoln, Neb., is promoting a project for the construction of an interurban line from Lincoln to Auburn, Neb., passing through Cheney, Bennet, Dunbar, Talmage and Brock.

The Nebraska Transportation Co. has an ordinance before the city council of Fremont, Neb., giving it a franchise to construct an interurban road through the city.

The Missouri Pacific Ry. is reported to be considering extending its line from Virginia to Beatrice, Neb., 15 miles.

Nevada Notes.

FROM CORRESPONDENTS AND OTHER SOURCES.

Preliminary surveys for the proposed extension of the Tonopah & Goldfield R. R., F. T. Armistead, engineer, maintenance of way, Tonopah, Nev., from Tonopah Junction to the Morio County line have been somewhat retarded by heavy snows, and have only reached a point about 35 miles west of Tonopah Junction.

The Eureka & Palisade Ry., G. D. Abbott, superintendent, Palisade, Nev., is said to be planning to build a branch line into the new camp of Buckhorn. The branch will leave the main line at Blackburn and will be 17 miles long. It is stated that steel has already been ordered to complete the job, work upon which will be started within the next two months.

City Engineer Mann of Reno has been running a preliminary line for the proposed canal to divert the waters of Peavine creek, which now flows through the city.

New York Notes.

FROM CORRESPONDENTS AND OTHER SOURCES.

The contract for the construction of the Elizabethtown Terminal R. R., an 8 mile steam railroad between Westport and Elizabethtown, Essex County, New York, has been let to Marco Lavorgna, railroad contractor of Canton, Me. Construction is to be begun by April 1 and the road is to be in operation by Aug. 1, 1910. V. R. Coon, Elizabethtown, N. Y., is general manager of the railroad.

The Grade Crossing Commission of the city of Buffalo and the Erie R. R. are completing final arrangements for grade crossing improvements within the city limits, which will cost about $1,000,000. The work involves the elimination of all grade crossings along what is known as the Erie Belt Line, or Niagara Falls branch. There are nine crossings along that part of the line lying within the limits of the city. At each of the crossings the street will be depressed and the tracks run overhead. Edward B. Guthrie, Buffalo, is engineer for the commission.

The New York Connecting R. R. Co., mentioned in our last issue, has filed with the State Public Service Commission the necessary property consents required under the franchise. The railroad is to be about nine miles long and when constructed will extend from a connection with the Long Island R. R. near the boundary line between the boroughs of Brooklyn and Queens, through the latter borough to Astoria, thence crossing the East River at a clear elevation of 135 ft. to Randall and Ward's Islands, and thence over Little Hell Gate and Bronx Kills into The Bronx, to a connection with the New Haven railroad near its Oak Point yards, Port Morris. It

will also be connected with the New York tunnel extension of the Pennsylvania R. R. by a branch in Sunnyside yard.

The Schenectady Ry. Co. of Schenectady has certified to the state department that it proposes to extend its road in that city from the intersection of Lyon St. and River Road and Washington Ave., thence along Lyon St. to Edison Ave. to its tracks at South Center St.

The Pennsylvania R. R. is said to be planning the expenditure of $500,000 for improvements on its Buffalo division. Improvements are to be made between Hinsdale and Cadiz, a distance of five miles, and include eliminating curves, lowering the grades and putting in additional tracks. Between Buffalo and Olean $400,000 is to be spent and $50,000 will be used on similar work between Cadiz and Lime Lake. From Olean to Emporium additional main tracks and interlocking devices will cost $225,000; additional main track sidings and interlocking improvements between Relay and Keating Summit will cost $125,000.

Contracts are to be let this spring by New York city for a large amount of new subway construction in that city. Detail section drawings of the subway plan are about completed and it is planned to advertise the work soon. The estimated cost and mileage of each line, as computed by the Public Service Commission, is as follows: Broadway-Lexington Ave. Line—Battery to Harlem River, with branches to Woodlawn Cemetery and Pelham Bay Park; 22 64-100 miles; estimated cost, $75,000,000. Canal Street Crosstown Subway—Hudson River to Manhattan end of Manhattan Bridge, near Centre St.; one mile; estimated cost, $7,000,000. Broadway-Lafayette System—From Brooklyn end of Williamsburg Bridge under Broadway to its intersection with Lafayette Ave., there turning and following a return course under Lafayette Ave. to Flatbush Ave., and there meeting with the Fourth Ave. Subway; length, 4 96-100 miles; estimated cost, $13,000,000. Branches of the Fourth Ave. Subway—From Fourth Ave. at about Fortieth St. to New Utrecht Ave., to Eighty-sixth St. and thence probably as an elevated line to Coney Island. Fort Hamilton branch from the Fourth Ave. subway at Forty-third St. out Fourth Ave. to Fort Hamilton. Length of these branch lines, 9 17-100 miles; estimated cost, $18,000,000.

It is probable that a proposition for a new dam in the creek in the rear of the Municipal Building will be submitted again to the tax payers of Batavia at the coming election.

The Erie R. R., according to reports, during the coming summer will continue the work of double tracking the line between Hornell and Jamestown. The double track will be extended from Olean to Carrollton. The distance from Hornell to Olean is already double tracked, as is also the line between Carrollton and Salamanca.

The State Canal Board has approved plans for Barge Canal Contract No. 63, providing for the improvement of the Erie Canal from the west line of Wayne County to King's Bend, at an estimated cost of $2,186,383. The work is in Monroe County. The board also approved plans for Contract No. 90 for furnishing and establishing the equipment for the operation and lighting of several locks on the Erie, Oswego and Champlain canals at a cost of $180,630. The locks are No. 24, Erie Canal; Nos. 1, 2, 7 and 8, Oswego Canal, and Nos. 9, 11 and 12 of the Champlain Canal.

The Road of Contract and Supply of Albany has awarded the contract for the improvement of the State St. Pier to John Dyer, Jr., Albany, at $96,166.

Ohio Notes.

FROM CORRESPONDENTS AND OTHER SOURCES.

The Sandusky, Norwalk & Mansfield Ry. Co. has asked the city council of Shelby for a franchise to construct a street railway line in that city from Smiley Ave. through the city to the west corporation line. The line is a part of the proposed new line which the company is planning to build from Shelby to Mansfield and from Shelby to Bucyrus.

The Ohio & Southern Ry. Co. is to extend the electric railroad running from South Columbus to the Hartman stock farm in the early spring south to Shadeville, a distance from Columbus of 7½ miles. The line is now 4½ miles long and the extension will be thus 3 miles. The right of way has practically all been secured.

Engineers have been in the field running preliminary lines between Crooksville and New Lexington for an extension of the Southeastern Ohio Traction Co. of Zanesville.

Surveys are being made for a manufacturers' independent belt line railroad which will extend from Youngstown to Lawrence Junction and will tap a number of large plants in the Shenango and Mahoning valleys. Robert Bentley, president of the Ohio Iron & Steel Co. of Lowellville, has already acquired much right of way.

The Kanawha & Michigan Ry., N. Monsarrat, president, Columbus, O., is to spend $100,000 to eliminate heavy grades and sharp curves. The new work will consist of elevation of track and straightening of track.

The Ohio Electric Rys. Co. has filed a mortgage for $15,000,000 and it is believed a considerable part of this sum will be spent for improvements, which will include a large amount of double tracking.

The Pennsylvania R. R. is to commence work this spring on elevation of its tracks through Piqua from Summit west to Jordan east, a distance of six miles. The work will involve the expenditure of a large amount of money.

Both the Northwestern Ohio Electric Ry. Co. and the Cincinnati, Dayton & Fort Wayne Electric Ry. Co. are reported to have secured the necessary capital for beginning construction work in the spring. As projected, the Cincinnati, Dayton & Fort Wayne is to connect Cincinnati and Fort Wayne and the Northwestern Ohio Electric is planned to connect Defiance and Montpelier, passing through Bryan. The two lines are to be connected, according to the project, by a line from Defiance to Fort Wayne. Dr. S. F. George, Dayton, O., is reported to be interested.

An ordinance has been before the city council of Cleveland authorizing the director of public service to expend $100,000 for dredging in the Cuyahoga River.

The Chesapeake & Ohio R. R. is reported to have closed negotiations for taking over the Chicago, Cincinnati & Louisville R. R. and the directors of the former road are said to have made an appropriation of $4,000,000 for putting the C., C. & L. in good condition.

The Cleveland & Chagrin Falls Ry. Co. of Cleveland has been incorporated with a capital stock of $10,000, the incorporators being A. M. Snyder, R. R. Moffets, Nora L. Young, W. J. Budd and E. G. Deer.

The Pittsburg, Chicago, Cincinnati & St. Louis R. R. is to at once make plans for the construction of additional trackage in Chester, O. The company already has a right of way 100 ft. in width and several hundred yards in length.

Oklahoma Notes.

FROM CORRESPONDENTS AND OTHER SOURCES.

The Kansas, Lawton & Gulf Ry. Co. of Walter, Okla., has filed amended articles of incorporation in Guthrie, with $5,000,000 capital stock, to build a line 250 miles in length, commencing near Randlett, in Comanche county, extending northwest through Comanche, Kiowa, Caddo, Washita, Custer, Dewey, Woodward and Harper counties, terminating on the northern border of Harper county; also branch lines beginning in the southern part of Comanche county, running northeast through Comanche, Stephens, Grady, McClain, Cleveland, Oklahoma, Logan, Payne, Pawnee and Osage counties to the state line. The directors are Dr. A. W. Green, F. F. Grossman Dr. C. M. Beckman and E. F. Sawyer of Walter and J. M. Bellamy of Lawton.

The Red River Valley & Texas Railroad Co. has been chartered with a capital stock of $50,000, proposes to build a line of 120 miles in length from Ardmore through Carter, Jefferson, Comanche and Tillman counties to Chillicothe, Tex., at an estimated cost of $16,000 per mile. The headquarters are at Erick and the directors are Frank L. Meyer and Lee DeBaum, of Davidson; Eugene Blazier, of Lawton, and T. B. Trueblood, of Grand Forks, N. D.

The Altus, Wichita Falls & Hollis Ry. Co., of Altus, has been chartered and proposes to build west from that point to the state line, 112 miles, connecting with the Wichita Falls & Northwestern at Altus. The capital is $45,000 and the estimated cost of construction $672,600. The directors are J. A. Henry, C. C. Hightower, J. H. McMahan, Cage Beach, of Altus; J. A. Kemp, Frank Kell and C. C. Huff, of Wichita Falls, Tex. Construction work on this road is reported to be already under way under the direction of Kemp & Kell, of Wichita Falls, Tex.

The J. W. Maxey Co., engineers, Houston, Tex., has engineers in the field northwest of Ardmore making preliminary surveys for a railroad from Ardmore to Lawton.

The Patton-Gibson Construction Co., Atlanta, Ill., is stated to have a $500,000 contract for practically reconstructing the Katy track from Atoka to Limestone Gap, Okla.

The Oklahoma City & Panhandle Ry. Co., with $250,000 capital and headquarters at Oklahoma City, has been chartered and proposes to build a line from Oklahoma City southwest through Oklahoma, Canadian, Grady, Caddo, Kiowa, Jackson, Greer and Harmon counties to the west line of the state. The length of the proposed road is 160 miles and the estimated cost $2,000,000. The directors are: A. Key, J. B. Johnson, T. R. Anderson, S. P. Bennett, Joseph Fain and E. J. Dupree of Oklahoma City and H. E. Chapman of Altus.

According to a statement reported to have been made by General Superintendent Wanamaker of the Mountain, Valley and Plains R. R. permanent location of the right of way for the proposed line has been determined from Guthrie to Kingfisher, Okla., and engineers are now at work on the line on to Hitchcock.

Devol, Okla., is engaged in raising the necessary bonus for the construction of the Wichita Falls & Northwestern R. R. branch from Devol to Lawton, giving that city a direct connection with Wichita Falls. In case Lawton, which is also requested to subscribe for the project, fails to meet the demands of the company, the line will probably be built through Walters and Chickasha to Oklahoma City, Okla. R. A. Thompson, Wichita Falls, Tex., is chief engineer of the company.

Oregon Notes.

FROM CORRESPONDENTS AND OTHER SOURCES.

Work upon the Pacific & Eastern Ry. extension is progressing rapidly and nearly 1,000 men are at work. It is expected that the road will be completed to Butte Falls by June and then work will be rushed on the extension over the Cascades to an eastern connection. J. R. Allen, 49 Wall St., New York, is president.

The American Development Co., recently incorporated at Portland, and in which British Columbia capital is said to be interested, has applied to the Jackson county commissioners for a franchise over the roads of the county for a proposed electric line to extend through Jackson and Josephine counties to a point southeast of Ashland. John R. Allen, 49 Wall street, New York, owner of the Medford-Eagle Point or Crater Lake R. R., has also announced his intention of building a system and has been seeking franchises in several cities of the valley which he hopes to connect by electric roads to be built, it is announced, at the earliest possible date.

The American Development Co., recently incorporated, has about a blanket franchise for a trolley line over the roads in Jackson and Josephine counties. The company is said to have also acquired about 15,000 acres of land as well as water rights on the Rogue river. It is believed that this land is to be irrigated and that the object in securing the railway franchise is to open up the land. E. M. Runyan, Marquam Bldg., Portland, Ore., is one of the incorporators.

The Washington & Oregon Traction Co. has placed orders for 52 miles of rails and will at once start construction work on the city line at Pendleton. The company has given bonds in the sum of $50,000 to complete at least six miles of the road within Pendleton and vicinity, to have cars in operation and to establish a

city park within one year's time, and to have the line electrified within two years. The road will first be extended westward to Echo, Stanfield, Hermiston, Umatilla and other west end towns, while another branch will be constructed southward through Pilot Rock and Camas Prairie into the John Day country.

Grading has been started on the Oregon Railway & Navigation Co. between The Dalles and Celilo. A big force of men is at work and hundreds more will be on the ground soon. When it is completed the entire road bed will be changed. G. W. Boschke, Portland, Ore., is chief engineer of the company.

Pennsylvania Notes.

FROM CORRESPONDENTS AND OTHER SOURCES.

The Eastern Pennsylvania Rys. Co. to double track Centre St. at Pottsville.

A special meeting of the stockholders of the Lehigh Valley Transit Co. is to be held April 21 at Allentown, to approve a proposed increase of indebtedness from $9,000,000 to $15,000,000. The money will be used to refund the improvement bonds, defray consolidated mortgage bonds and provide for improvements and extensions. The company now has 200 miles of tracks from Philadelphia north to Slatington and from Nazareth on the east to Macungie on the west. The money for improvements will go largely into new construction in the way of eliminating curves, stronger bridges, new rolling stock and general development. The system is owned chiefly by E. B. Smith & Co. and Brown Brothers & Co. of Philadelphia.

The Pennsylvania R. R. is stated to have completed arrangements for double tracking the Allegheny division between Kittanning and Templeton and between East Brady and Oil City, and the work is to commence soon.

The Pittsburg, Shawmut & Northern R. R. now being built from Brookville, Pa., to Freeport, Pa., has filed a $12,000,000 mortgage, thus confirming in a measure the report that the line will connect with the Bessemer & Lake Erie R. R. and thus gain an outlet for the Pittsburgh district. The new line in Butler county will be 10 miles long, from Freeport to Houseville. It is said the road will be extended from Houseville to Mars, where connection will be made with the Baltimore & Ohio railroad. In this way, it is claimed, the line will effect an entrance into Pittsburgh, as the old Pittsburgh & Western franchise provides that other lines shall be given the privilege of the use of its tracks in Allegheny county.

The Midland Pennsylvania R. R. has been chartered with a capital stock of $430,000 and proposes the construction of a line from Millersburg, Dauphin county, to Ashland, Schuylkill county, through the towns of Killinger, Berrysburg and Gratz, Dauphin county, and the towns of Sacramento, Valley View, Hegins, Weisample, Maple and Gordon in Schuylkill county, 43 miles. The incorporators are Walter E. Harrington, Pottsville; John F. B. Atkins, Franklin C. Dively, William M. Sheahan, William A. Radford, Philadelphia; Edward A. Price, Chester; Robert J. Ritchie, Frank A. Apple, Joseph B. Lanning, Philadelphia, and Harry B. Reeves, Woodbury, N. J.

The Gloucester Ferry Co. of Philadelphia has had plans made for a 1 story steel ferry house to be erected at the foot of South St., Philadelphia, at a cost of about $50,000. The new house will have two slips and a freight pier will be constructed at the south side of it.

Tennessee Notes.

FROM CORRESPONDENTS AND OTHER SOURCES.

Right of way from Memphis, Tenn., to the corporate limits of Jackson, Tenn., has been secured for the projected interurban line between those two cities. It is hoped to have the line in operation within 18 months. Dr. J. D. Hopper, Jackson, Tenn., is interested.

The Nashville & Adairville Ry. Co. with main offices at Nashville, Tenn., recently chartered to construct a railroad between Nashville and Adairsville, has had its charter amended giving it power to extend its proposed lines into Kentucky and connect with the Illinois Central at Owensboro. The extension provides for the line to run through Morgantown, Butler County, thence to or near Beaver Dam, thence to or near Hartford, Ohio County, thence through Daviess County to Owensboro.

Owners of bottom lands along the Forked Deer River are to form a drainage district. Surveys for the proposed canal have been made by W. P. Farrar, Jackson, Tenn. According to these the canal would be about 26 miles in length and would drain 18,000 acres of land. The canal will be from 32 to 35 ft. at the top and 25 ft. at the bottom and the estimated cost is $90,000.

Texas Notes.

FROM CORRESPONDENTS AND OTHER SOURCES.

The Stone & Webster Engineering Corporation, Boston, Mass., has secured practically all right of way for its interurban line between Houston and Galveston, and will probably start construction work next month. An ordinance is now before the city council of Houston for an entrance to that city. The cost of construction is estimated at about $2,000,000. This will include terminals at both ends and three subpower stations, besides the main station at Texas City, but will not include the cost of passenger depot at Houston. Mark Lowd, First National Bank Bldg., Houston, is engineer in charge of the work.

Roach & Stansell, Memphis, Tenn., have been making good progress with their grading contract for the Orient and it is expected that the grade between San Angelo and Mertzon will be ready for the steel by the middle of March.

W. O. Cox and W. S. Banks, of Temple, are organizing the Temple & Northwestern R. R. Co. for the purpose of constructing a line of railroad from Temple through Gatesville to Hamilton in Hamilton county, a distance of approximately 65 miles. The promoters have already obtained the necessary bonuses from Temple, Hamilton, Gatesville and other points through which the new road will traverse.

It is reported in Austin that the Santa Fe line being extended west of San Angelo to Sterling City is to go to Pecos on the Texas & Pacific and there connect with the Pecos River line, a Santa Fe road. The Pecos River line is the Santa Fe system road from Western New Mexico, connecting Pecos with Carlsbad and Roswell, N. M., and from there to Amarillo, via Canyon City. By building across from San Angelo the New Mexican lines in question would have a direct Gulf line, and it would open a new section of country.

The Commercial Club of Aransas Pass has started to raise a bonus of $50,000 to be given to the first railroad making connections with that port.

E. G. Hammock, Little Rock, Ark., has accepted a proposition of the Commercial Club of Colorado, Tex., to build a railroad from that city to Robert Lee.

Work is now under way completing the Estacado & Gulf R. R. into Roby. Grading work and track laying reached a point about four miles from Roby some time ago. With the road completed to Roby, W. A. Butts, president, Stamford, will be in a position to consider extensions to the east and west.

Surveys have been completed for the projected railroad between Waco and Georgetown.

The Mission Canal Co. of Mission has been incorporated with a capital stock of $331,422, the incorporators being John J. Conway, James W. Holt and W. E. Pope.

A petition is being circulated among land owners along the Trinity River in the vicinity of Arlington, which will be forwarded to Congressman Gillespie, asking that the Department of Agriculture prepare estimates of the cost of levees to protect the bottom lands from overflow during periods of high water.

The Commercial Club of Pyote, Tex., has received a proposition from eastern railroad promoters offering to construct a railroad from Pyote north, connecting with the Chicago, Rock Island & Pacific Ry. at Tucumcari, N. M. A large bonus has already been subscribed for the project and work will first be started between Pyote and Duval, a new town in Winkler County.

Roach & Stansell, Memphis, Tenn., have been awarded a contract by the Kansas City, Mexico & Orient Ry. to construct 50 miles of line connecting up a gap between Edwards and San Angelo, Tex. This is the second contract Roach & Stansell have secured from the Kansas City, Mexico & Orient R. R. Their first was a similar one calling for constructing a gap of 50 miles.

The Kansas City, Mexico & Orient R. R. has filed an amendment to its charter providing for the construction of a branch line from San Angelo to Del Rio instead of Uvalde, as recited in the original articles of incorporation. The line will be extended ultimately into Mexico to a connection with the Mexican National, traversing the great Trevino estate in northern Mexico to get there. C. H. Webster, Sweetwater, Tex., is chief engineer.

An amendment of the charter of the Pecos & Northern Texas R. R., a subsidiary company of the Atchison, Topeka & Santa Fe Ry., has been filed with the secretary of state, providing for the construction of a branch line from Lubbock, Tex., on the Texico-Coleman cutoff to a point in Dawson County, a distance of 55 miles. This extension with the line from Canyon to Lubbock, 105 miles; branch from Plainview through Hale, Floyd and Crosby to Dickens, 70 miles; branch from Lubbock west through Hockley County to the Texas state line, 75 miles, and the Lamesa extension, set out the Texico-Coleman cutoff at 300 miles.

C. E. Ensminger, Quanah, Tex., chief engineer, Quanah, Acme & Pacific Ry., who has been making surveys for the southwestern extension of that road from Paducah and Roswell, has forwarded his report to officials at St. Louis, Mo. Construction work will be started as soon as possible in order that the road will be completed into New Mexico by Jan. 1, 1911.

Utah Notes.

FROM CORRESPONDENTS AND OTHER SOURCES.

An agreement has been reached between the Knight interests and the Evans-Chipman interests for an interurban franchise through Utah County and into Salt Lake County, and Jesse Knight, Provo, has been elected president of the company which will build and operate the line.

E. O. Howard, assistant cashier of the Walker Brothers Bank, Salt Lake City, has filed a petition for a franchise for an interurban road to run from Salt Lake City to Provo and take in all of the rural settlements in the southern and eastern parts of the county. According to the terms of the franchise it is proposed to run branches of the line to Garfield, Holliday, Mill Creek, Cottonwood, Riverton, Taylorsville, Murray, Sandy and Draper.

Virginia Notes.

FROM CORRESPONDENTS AND OTHER SOURCES.

The Southern Ry., W. H. Wells, engineer of construction, Washington, D. C., is said to be planning to immediately begin double tracking its line from Orange to Munroe in Amherst County. The Chesapeake & Ohio Ry., H. Pierce, engineer of construction, Richmond, Va., is also said to be contemplating double tracking its road from Orange to Charlottesville.

The Lynn Haven Terminal Corporation, of which Alvah H. Martin is president, has applied to the city council of Norfolk, Va., for a right of way for a tunnel under the Elizabeth River from Norfolk to Pinners' Point. It is the object of the company to permit trains of the Southern Ry. and the Atlantic Coast Line to run directly into the city instead of having to transfer passengers and freight by ferry, as at present. The corporation also proposes to divert traffic toward Cape Henry, and plans for building breakwater and harbor facilities are being considered.

J. R. Sarpell & Son, Louisville, Ky., who were recently awarded the contract by the Norfolk & Western R. R. for three miles of double track and several tunnels east of Huger, W. Va., are stated to have declined the

contract, and it has been awarded to Carpenter & Boxley, Roanoke, Va.

Joseph H. Sands, Roanoke, Va., has been awarded the contract by the Norfolk & Western R. R. for the construction of the Petersburg cutoff or low grade line, 9 miles in length. The work will require several months and will cost in the neighborhood of $750,000.

Washington Notes.

FROM CORRESPONDENTS AND OTHER SOURCES.

According to a report of the Northwest Corporation at Portland, Ore., the Walla Walla interurban railroad is to be extended over the Blue mountains, through the Grande Ronde valley and Wallowa country and perhaps through the Powder valley into Baker City. Surveys have already been run over the Blue mountains to a point above Summerville.

The Northern Pacific Ry., B. L. Crosby, division engineer, Tacoma, is to spend about $50,000 for the improvement of its yard service at the head of the bay in Tacoma. The improvements include 30,000 ft. of sidetracks to cost about $40,000 and an improved water system, including a 100,000 gallon tank, for the upper yards.

All of the property and rights of way of the Priest Rapids R. R. Co. has been transferred to the Chicago, Milwaukee & Puget Sound R. R., thus placing under control of the new transcontinental road the branch line extending from West Beverly, where the Milwaukee crosses the Columbia, to the Hanford district. This transfer confirms previous reports that the Milwaukee road intended to build a line from West Beverly to the Columbia via Hanford, North Yakima and the Ahtanum Valley outlet to the south. A section of the new line has already been completed and contractors for the Milwaukee have secured rights of way into the city of North Yakima. A good grade into the Yakima Valley has been secured over the Saddle mountains, and the line south and west from North Yakima has been surveyed. It is believed that this line will eventually extend into Portland, with possibly a branch tapping central Oregon.

The Wenatchee Valley Railway & Power Co. of Wenatchee has been incorporated with a capital stock of $2,500, the incorporators being H. A. Chapin, Ralph Vermilya, A. J. Linville, John Godfrey and L. J. Nelson.

The Spokane Railway & Power Co. of Spokane has been incorporated with a capital stock of $2,000,000, the incorporators being H. L. Moody, D. M. Drumheller and Alfred Coolidge.

Practically all of the necessary $400,000 subscription to assume the construction of the Bellingham-Skagit interurban line has been secured and it now seems practically certain that the road will be built. The line is to be built by the Stone & Webster Engineering Corporation of Boston, Mass., of which R. T. Laffin, Seattle, Wash., is district manager.

The Commercial Club of Monroe has decided to ask the co-operation of Snohomish in draining 13,000 acres of fertile marsh land between Monroe and Snohomish in this district. The tract begins about a mile west of Monroe and extends as far down Snohomish as the mouth of Pilchuck.

Peter Sims, Spokane, is stated to have been awarded the contract for constructing the Northern Pacific Ry.'s new water grade line out of Tacoma via Point Defiance and the Narrows through the eastern portion of Thurston County. As stated in our last issue, the work will include the construction of a 2,000 ft. tunnel.

The Stone & Webster Engineering Corporation, Boston, Mass., is said to be planning to begin active construction work on its Lake Tappa power projects in April, when 2,000 men will be put at work. Preliminary work has been under way all winter. Lake Tapps is located five miles northeast of Sumner and is about one mile wide and 3½ miles long. It is the intention of the power plant people to raise the fall of the lake 30 ft. by forcing the waters of the White River into the lake and then allowing it to flow back into the channel of the river at some point below the lake. The plant proposed will develop 25,000 hp. to being with and can later be increased 60,000 hp. The plant is to be completed in

The Wenatchee Valley Railway & Power Co., recently incorporated, is planning the construction of an electric street railway in Wenatchee. It is also proposed to extend the line to Leavenworth, Wenatchee, Lake Blemett and other points in the Wenatchee Valley.

Wisconsin Notes.

FROM CORRESPONDENTS AND OTHER SOURCES.

John Marsh, 181 La Salle St., Chicago, Ill., who has the general contract for the construction of the belt line of the Chicago & Northwestern railway around Milwaukee and of the main line as far as Clyman, as noted previously in this paper, has opened an office in a suite of rooms on the third floor of the Public Service Building at Milwaukee. P. Strang will be the superintendent in charge of the work, and the office will be in charge of A. L. Braskey.

The Milwaukee Western Electric Ry. Co., which was given a franchise some months ago to enter Waukesha, has filed with the register of deeds there maps and blue prints of its proposed route from Beaver Dam to Milwaukee and Waukesha to Sussex. The route by which the company proposes to enter Waukesha follows the north shore of the Fox River to Barstow street, thence west on Barstow to Broadway, where it will terminate at the intersection of Broadway and South street.

Canadian Notes.

FROM CORRESPONDENTS AND OTHER SOURCES.

The Penticton Ry. Co., the chief promoters of which are A. H. MacNeill of Vancouver, solicitor for the Great Northern, and J. H. Kennedy, chief engineer in charge of the railway's works in British Columbia, have applied to the legislature of British Columbia for permission to build from Penticton, a terminal point of the Kettle River Valley road, to the lower end of Okanagan lake and south from that lake to the boundary, with a spur north from Oroville, Wash., to provide another connection. Construction of the proposed new line will give the V. V. & E. alternative routes through to the coast and also with the American system with which the V. V. & E. interests are affiliated.

The Canadian Pacific Ry. has announced an extensive construction program for this season in western Canada. The program includes some 346 miles in Saskatchewan, 45 miles in Alberta, 174 miles in British Columbia and 56 miles in Manitoba, the latter being double tracking. Some of the details of the work as given out by Wm. Whyte, second vice president, Winnipeg, Man., are as follows: Complete the line from Regina by a 15-mile cut-off from Craven to Bulyea. A line from Craven on the west side of Last Mountain lake, northwesterly to Colinsay, on the line between Winnipeg and Saskatchewan, 110 miles. A line westerly 93 miles from Outlook and from that point north to Macklin on the Saskatoon-Wetaskiwin line. A line from a point 26 miles west of Weyburn, where the present line ends, 25 miles farther. On the Lauder colonization line the road will be continued from Tilston, 24 miles west. From Regina a line will be built southeast to Craven on the cutoff between Weyburn and Stoughton, 79 miles. In Alberta the program includes a line running north from Langdon, which already extends 30 miles to Rirricana in the irrigation country. This will be extended 15 miles easterly and will eventually be carried north to connect at Red Deer with the Calgary and Edmonton line. Another line will be built on the Kipp extension west of the Belly river viaduct, which now stops at Carmangay on the Little Bow River. This will be extended northerly 30 miles to take care of the Alberta fall wheat district. In British Columbia in the Columbia and Kootenay valleys a line will start from near Elcho on the Crow's Nest pass line up to Fort Steele, to meet the line already started southward from Golden, making a connection between the two main lines, a total distance of 174 miles.

Work will be started as soon as summer breaks on the 179 miles of line which will bring the Grand Trunk Pacific Ry. to Yellowhead Pass. Tenders for the remaining 135 miles of the branch line from Tofield to Calgary are in and it is expected that contracts for this work will soon be awarded, the line to Calgary to be completed by the end of this year. B. B. Kelliher, Winnipeg, Man., is chief engineer.

The colonial assembly of Newfoundland has passed a resolution authorizing the construction of 250 miles of branch railways as an extension of the present system in Newfoundland.

A company has been formed at Niagara-on-the-Lake to build an electric railway from that city to Queenston and it is expected that work will shortly begin on the construction of the extension. Edward Garrett, former superintendent of the Canadian division of the International Ry. Co., has been elected president of the new company.

Eastern capitalists have applied to the city council of Moose Jaw, Sack., for a franchise for a street railway.

The Niagara, St. Catharines & Toronto Ry., E. F. Seixas, general manager, is to build an extension of its electric railway from Niagara Falls, Ont., to Crystal Beach, and expects to have the line in operation by July 4.

A number of bills affecting street railways are now before the Massachusetts legislature, among them being the following: A bill to authorize the Worcester & Southbridge Street Ry. Co. or one of its leased lines to purchase a trolley line running from the Massachusetts-Connecticut line to Thompson, Conn. A bill to permit the Springfield Street Ry. Co. to purchase the Suffield Street Ry. Co. in Connecticut. A third bill authorizes any street railway company to purchase from a foreign street railway company so much of its line as is operated in this state, and a fourth bill prohibits the granting of street railway locations at the side of any highway within one mile of the center of any city or town of more than 5,000 inhabitants or within half a mile of the center of smaller towns.

A resolution is to be brought before the city council of Providence, R. I., by Councilman William F. Sears of Ward 6 to determine the cost of providing a subway system from near Market square to Cathedra square for express service on the electric lines running in the suburbs and to outlying towns. This is but a tentative proposition, to be considered as to engineering possibilities, costs and the future needs of Providence.

Le Roy Ferry, a banker of 49 Broadway, New York city, has placed a loan of $5,000,000 in London, the proceeds of which will be used toward the construction of a contemplated railroad in Honduras. The railroad is to be built between the towns of Tinjillo and Juticalps, a distance of 350 miles, running from the gulf towards the Pacific. It will take two years for the completion of the road, which will then connect with the old Port Cortez Railroad, which reaches the Pacific, so that in three years' time there will be a trans-Honduras railroad. The controlling interest in the railroad is stated to be held by ex-Vice President Fairbanks and his associates. In addition to this control, Mr. Fairbanks and his associates own and control a $20,000,000 development corporation which plans to devote a large part of its capital to development of the country.

A bill is before the Maryland legislature to incorporate the Northern Maryland Railway & Power Co. The company proposes the establishment of an electric road from Baltimore, Md., to Havre de Grace and that section. The incorporators are Thomas H. Robinson, Michael H. Fahey, Omar D. Crothers, Richard Dallam, Samuel C. Rowland, Murray Vandiver and Clarence C. Pusey.

Engineers of the Louisville & Nashville Ry. have been instructed to start surveys at once for the construction of the proposed line to Owensboro, Ky., from Nashville, Tenn. As projected, the line will pass through Adairville, Morgantown, Beaver Dam and Hartford. R. Montford, Louisville, Ky., is consulting engineer.

BIDS ASKED.

Bridges.

Bids are asked on following work, the notes being arranged alphabetically by states:

Phoenix, Ariz.—Until 11 a. m., March 16, by Board of County Supervisors, for the construction of a reinforced concrete bridge across the Salt River at Center St. This structure will be 2,150 ft. long with a causeway approach of 1,000 ft. Mayberry & Parker, 764 Pacific Electric Bldg., Los Angeles, Cal., are the Engineers for the work.

Streator, Ill.—Until 5 p. m., April 4, by John B. Patterson, City Clerk, for building a bridge across the Vermillion River at Bridge St. and for grading and paving the approaches. Bond for $15,000 required of successful bidder. Official advertisement will be found elsewhere in this issue.

Topeka, Kan.—Until March 7, by City Council, for the construction of the Melan Bridge extension.

Towson, Md.—Until noon, March 10, by E. Stanton Bosley, Secretary, Board of Highway Commissioners, for improving the public highway between Broadway and Beaver Dam bridge, known as the Falls Road.

Albuquerque, N. M.—Until March 11, by County Commissioners for the construction of two steel spans as approaches to the new Alameda bridge. The spans will be 75 ft. in length.

Grand Forks, N. D.—Until 10 a. m., March 22, by Hans Anderson, County Auditor, for the construction of steel bridges for which all bids rereceived Feb. 16 were rejected.

Everett, Wash.—Until 10 a. m., March 14, readvertisement of bids asked Feb. 28, by John F. Birney, County Engineer, for the construction of the Snohomish River swing span.

St. Thomas, Ont., Can.—Until noon, March 5, by James A. Bell, County Engineer, for the construction of reinforced concrete abutments for a 133-ft. span of a roadway bridge with sidewalk, to be built over Otter Creek, in Pt. Burwell; also for a 60-ft. arch bridge to be built over Kettle Creek in Lynhurst, adjoining St. Thomas.

Buildings.

Bids are asked on following work, the notes being arranged alphabetically by states:

Fort Mason, San Francisco, Cal.—Until noon, April 1, by Maj. George McK. Williamson, Constructing Quartermaster, for the construction of an administration building and two storehouses, including grading, installing plumbing, heating, electric wiring and conduits, elevators and fire extinguishing systems in same at army supply depot.

Washington, D. C.—Until 2 p. m., March 3, by District Commissioners, for the construction of addition to Chevy Chase School, on Connecticut Ave., between McKinley and Northampton Sts., N. W.

Chicago, Ill.—Until noon, March 5, by Special Park Commission, A. W. O'Neill, Secretary, for furnishing all labor and material for the construction of an office building at the Washington Municipal Playground, located at Carpenter St. and Grand Ave.

Chicago, Ill.—Until 1.30 p. m., March 7, by Board of County Commissioners, for fire escapes and alterations at the Cook County Hospital, at Wood and Harrison Sts.

Fort Benjamin Harrison, Ind.—Until 11 a. m., March 22, by Capt. J. V. Heidt, Constructing Quartermaster, for the construction, plumbing, heating and wiring of one four-set officers' quarters at this post.

Peru, Ind.—Until 3 p. m., March 30, by James Knox Taylor, Supervising Architect, Treasury Department, Washington, D. C., for the construction complete, including plumbing, gas piping, heating apparatus, electric conduits and wiring, of the United States Post Office at Peru, Ind.

Baltimore, Md.—Until 11 a. m., March 9, by Board of Awards, J. Barry Mahool, President, for the construction of an addition to the Patterson Park field building.

Brainerd, Minn.—Until 3 p. m., March 31, by James Knox Taylor, Supervising Architect, Treasury Department, Washington, D. C., for the construction complete, including plumbing, gas piping, heating apparatus, electric conduits and wiring of the United States Post Office at Brainerd.

Wayzata, Minn.—Until 1 p. m., March 19, by F. H. Snure, Clerk of the School Board, for the construction and completion of a school building.

Hattiesburg, Miss.—Until 3 p. m., April 4, by James Knox Taylor, Supervising Architect, Treasury Department, Washington, D. C., for the construction, including plumbing, gas piping, heating apparatus, electric conduits and wiring of the United States Post Office at Hattiesburg, Miss.

Independence, Mo.—Until 3 p. m., April 5, by James Knox Taylor, Supervising Architect, Treasury Department, Washington, D. C., for the construction complete, including plumbing, gas piping, heating apparatus, electric conduits and wiring, the U. S. postoffice at Independence, Mo.

Jefferson Barracks, Mo.—Until 11 a. m., March 10, by Capt. S. H. Ford, Constructing Quartermaster, for the construction of addition and improvements to bakery building at the post.

New York, N. Y.—Until 11 a. m., March 19, by Bureau of Yards and Docks, Navy Department, Washington, D. C., for rebuilding Chemical Laboratory, Building No. 34, at the United States Navy Yard, New York, N. Y.

New York, N. Y.—Until 3 p. m., March 23, by James Knox Taylor, Supervising Architect, Treasury Department, Washington, D. C., for two additional steam freight elevators at the U. S. appraisers' warehouse, New York.

Fort Hamilton, N. Y.—Until 11 a. m., March 18, by Constructing Quartermaster, for the construction and plumbing of brick extension to ordnance shop at Fort Wadsworth, N. Y.

Fort Totten, N. Y.—Until 2 p. m., March 23, by Constructing Quartermaster, for the construction, plumbing, heating and wiring, with fixtures, of two double non-commissioned officers' quarters and the construction and plumbing of an extension to the ordnance shop at Fort Totten, N. Y.

Myton, Utah.—Until noon, April 1, at the Myton State Bank, Myton, Utah, for the construction of a bank building at that place.

Fort D. A. Russell, Cheyenne, Wyo.—Until 9:30 a. m., March 21, by Capt. V. K. Hart, Constructing Quartermaster, for the construction of the following buildings at Fort D. A. Russell: (One) for construction, plumbing, heating, electric wiring and electric fixtures for two quarters for field officers; (two) for the construction of two bandstands.

Roads and Streets.

Bids are asked on following work, the notes being arranged alphabetically by states:

Fort Morgan, Ala.—Until 1:30 p. m., March 10, by Capt. H. B. Chamberlin, Constructing Quartermaster, for the construction of brick roads pavement, board walk and terra cotta pipe drain at Fort Morgan, Ala.

Montgomery, Ala.—Until noon, March 21, by J. T. Bullen, County Engineer, for graveling 12 miles of road and for grading and graveling 2 miles of road.

Montgomery, Ala.—Until noon, March 7, by Robert Tait, City Treasurer, for the paving of the roadway of Bibb St., from Moulton St. to Wilkerson St., with asphalt, bitulithic, brick, Blome granitoid, mineral rubber or wood block pavement, together with all necessary curbing, headers, storm water sewers, etc.

Marion, Ia.—Until March 8, by F. J. Cleveland, City Clerk, for the construction of 24,000 sq. yds. of brick block pavement on concrete foundation with sand filler. The work includes little grading and about 1⅓ miles of curbing. S. N. Parsons, Marion, Ind., is the Engineer.

Palatka, Fla.—Until 11 a. m., March 5, by Board of Trustees, S. Worden, Clerk, for the construction of hard surfaced roads over the routes indicated below: (1) Palatka, Fla., to Bostwick, Fla., 12 miles; (2) Francis, Fla., to Keuka, Fla., 12 miles; (3) San Mateo, Fla., to and including both approaches to Dunne's Creek bridge, 4 miles.

Grinnell, Ia.—Until 7:30 p. m., March 7, by City Council, L. D. Kemmerer, Mayor, for the construction of cement and brick sidewalks in the city of Grinnell, Ia.

Richmond, Ind.—Until 9 a. m., March 10, by Board of Public Works, for the construction of a 6-ft. cement sidewalk on N. 13th St., from North G St. to North H St.

Richmond, Ind.—Until 9 a. m., March 10, by Board of Public Works, for grading, graveling and bouldering the alley between South 7th St. and South 8th St., from South C St. to a point 530 ft. south.

Faribault, Minn.—Until 8 p. m., March 10, by D. F. MacKenzie, City Recorder, for paving a system of streets with vitrified breck, blome concrete pavement, creosote wood block, sandstone paving block, mineral rubber, macadam and other kinds of material. The work includes 25,700 sq. yds. of pavement, 5,070 lin. ft. of cement granite or sandstone curbing, 2,500 to 5,000 cu. yds. of excavation.

Mankato, Minn.—Until 2:30 p. m., March 10, by A. H. Scherer, Clerk, Board of Public Works, for furnishing all necessary labor and material for paving with brick Second St., from Cherry to Jackson St., and from Jackson to Plum St., and for paving Main St., from Broad St. to the tracks of the C., M. & St. P. Ry. The work includes 21,045 sq. yds. of pavement.

St. Paul, Minn.—Until 10 a. m., March 7, by County Commissioners, for macadamizing Bald Eagle Ave., from Smith's Hotel to Bald Eagle Junction; Lexington Ave., from Manomin Road north to Turtle Lake Road; Centerville Road, from Manomin Road north to the Anoka County line. Edward G. Krahmer is County Auditor.

Charleston, Miss.—Until March 7, by Board of County Supervisors, for working public roads of the county, from March 10, 1910, to March 9, 1914.

Corning, N. Y.—Until 11 a. m., March 17, by Board of Public Works, for constructing ½ mile of brick pavement with cement curbs, and ½ mile of bituminous macadam pavement with cement curbs and gutters. The sections include 12,000 and 8,520 sq. yds. of pavement respectively.

Port Chester, N. Y.—Until 8 p. m., March 7, by Thomas F. J. Connolly, Clerk, for regulating, grading, macadamizing and otherwise improving Putnam Ave., from Willett Ave. to King St. in this village.

Cincinnati, O.—Until noon, March 18, by County Commissioners for the improvement of Madison Road, from Cooper Ave. to Cornell Ave., in Sycamore Twp. Fred Dreihs is Clerk.

Cincinnati, O.—Until noon, March 7, by Director of Public Service, John J. Wenner, Clerk, for furnishing the necessary labor and material for the improvement of Jerome St., from Celestial St. to St. Gregory St., by grading, setting granite curb, paving the roadway with brick and constructing necessary drains and inlets.

Cincinnati, O.—Until noon, March 7, by John J. Wenner, Clerk, Directors of Public Service, for furnishing necessary labor and material for the improvement of North Pearl St., from Central Ave. to Elm St., by grading, curbing with granite and paving with granite blocks and constructing the necessary drains and inlets.

Joseph, Ore.—Until March 14, by James Aram, for the construction of a wagon road from Rice Creek Crossing to meridian line on Dounecq, a distance of 1½ miles. The roadbed is to be 8 ft. wide. Tools and powder furnished.

Gallatzin, Pa.—Until 8 p. m., March 5, by Harry F. Conrad, Borough Secretary, for the paving with vitrified brick block and ligonier block of portions of South Main, East Chestnut, West Chestnut, Jackson, Church and North Main Sts.

Oil City, Pa.—Until 7:30 p. m., March 24, by City Controller, for grading, curbing and paving certain streets, the work including 14,600 cu. yds. excavation, 8,800 cu. yds. fill, 16,000 lin. ft. curb and 29,000 sq. yds. paving. Official advertisement will be found elsewhere in this issue.

Olympia, Wash.—Until 2 p. m., March 23, by H. L. Bowlby, State Highway Commissioner, for the improvement of the following State Aid roads: Mitchel state aid road, Kitsap county; East Trunk road, King county; Cowlitz-Olympia road, Lewis county; State road, 15, Cowlitz county.

Olympia, Wash.—Until 2 p. m., March 16, by H. L. Bowlby, State Highway Commissioner, for the improvement of the following State Aid roads: Yakima City road, No. 59, and Sunnyside-Mabton road, No. 60, Yakima county; macadamizing only of Euclid road, Benton county; territorial road, Whitman county; Asotin creek road, Asotin county; Spangle south road, Forker road, Regal road and Regal road extension, Spokane county.

Sewers.

Bids are asked on following work, the notes being arranged alphabetically by states:

Montgomery, Ala.—Until noon, March 7, by Robert Tait, City Treasurer, for paving the sidewalks on both sides of Lee St., from Tallapooga St. to the property of the Louisville & Nashville R. R. Co., together with all necessary granite curbing, storm sewers, brick walls, etc.

Greeley, Colo.—At once, by W. A. Hotchkiss, City Clerk, for furnishing the material and labor for the construction of several lines of sewer in Sewer District No. 45 in this city. George M. Houston is Mayor.

Madison, Fla.—Until March 16, by City Council, for the construction of 6 miles of sewers. Plans have been made by Engineer H. S. Jaudon, P. O. Box 582, Savannah, Ga.

Metropolis, Ill.—Until 2 p. m., March 17, by the Secretary, Board Local Improvements, for constructing Sewer District No. 1, consisting of brick and tile sewers, estimated to cost $63,000. Municipal Engineering Co., Woolner Bldg., Peoria, Ill., is the Engineer. Official advertisement will be found elsewhere in this issue.

Rockford, Ill.—Until 11 a. m., March 4, by City Engineer, for furnishing necessary labor and material for the construction of sewers in portions of Leavitt St., State St., Hinckley Ave. and Mulberry St. The work includes approximately 480 ft. of 42x36-in. concrete sewer, 850 ft. of 27-in. sewer pipe and 150 ft. of 18-in. pipe; one manhole.

Richmond, Ind.—Until 9 a. m., March 10, by Board of Public Works, for the construction of a sewer in the alley between South 7th St. and South 8th St., and in South C St., thence north to South C St., thence west to South 7th St., in South C St.

Alliance, Neb.—Until noon, March 2, by F. W. Irish, City Clerk, for the construction of 5,426 ft. of 8-in. sewers and the construction of a sewage disposal plant, including septic tank, pumping plant and reservoir.

Monticello, N. Y.—Until 8:30 p. m., March 17, by the Board of Sewer Commissioners, Dr. Russel W. Allan, Secretary, for the construction of a portion of the sewer system and a sewage disposal plant. Certified check for $5,000 required with bid.

Cleveland, O.—Until noon, March 3, by A. B. Lea, Director of Public Works, for the construction of sewers in the following named streets, roads and courts: Baldwin Rd., S. E., from Ingersoll Rd., S. E., to Quincy Ave., S. E.; Bragdon Ave., S. W., from W. 46th St. to W. 48th St.; Cannon Ave., S. E., from E. 86th St., to east end 89th St.; Colonial Ct., S. E., from Woodhill Rd., S. E., to Frank Ave., S. S.; Erin Ave., S. W., from W. 38th St. to Fulton Rd., S. W.;

Elk Ave., N. E., from E. 99th St. to E. 105th St.; E. 50th St., from Dalton Ave., S. E., to Towl Ct., S. E.; E. 51st St., from Dalton Ave., S. E., to Towl Ct., S. E.; E. 52nd Pl., from Dalton Ave., S. E., to Towl Ct., S. E.; E. 86th St., from Harvard Ave., S. E., to 216 ft. north of Seager Ave., S. E.; E. 89th St., from Union Ave., S. E., to St. Catherine Ave., S. E.; E. 100th St., from St. Clair Ave., N. E., to Garfield Ave., N. E.; E. 101st St., from St. Clair Ave., N. E., to Elk Ave., N. E.

Guthrie, Okla.—Until 5 p. m., March 3, by A. A. Leer, City Clerk, for the construction of storm sewer on Oak St., from Vilas Ave. to Harrison Ave.

Milwaukee, Wis.—Until 10:30 a. m., March 11, by Board of Public Works, for the furnishing of material and labor for constructing house drains and water service connections on North Fourth St., from Keefe Ave. to Concordia Ave., in the 21st Ward. Charles J. Poetsch is Chairman of the Board.

Toronto, Ont.—Until March 6, by city, for the construction of sewers in Hugo, Follis, Mavety, Boultbee, Beresford, Seymour and Baxter Sts. C. H. Rust is City Engineer.

Water Supply.

Bids are asked on following work, the notes being arranged alphabetically by states:

Columbus, Kan.—Until noon, March 21, by F. H. Hawkins, City Clerk, for necessary labor and material for the installation of an extension to the water works system. The following approximates quantities are included: 32 ft. 6-in. water mains; 7,400 ft. of 4-in. mains; 2 6-in. valves with boxes; 4 4-in. valves with boxes; 16 hydrants.

Henryetta, Okla.—Until March 15, by City Council, for the furnishing of materials and labor for constructing steel stand pipe, 2,500 gals. capacity, power pumps and gas engines and for constructing 35 ft. earth dam and for the completion of its water works system. W. E. Harlan, Henryetta, Okla., Resident Engineer; Granbery Jackson, City Engineer.

Miscellaneous.

Bids are asked on following work, the notes being arranged alphabetically by states:

Fort Wayne, Ind.—Track Elevation Work.—Until 2 p. m., March 16, by Board of Public Works, Henry W. Becker, Clerk, for the city's portion of the railroad track elevation work under Resolutions Nos. 1 and 2. Work is also noted under Confirmed Reports.

Hartford, Ky.—Teams.—Until 2 p. m., March 8, by W. B. Taylor, Supervisor of Roads in Ohio County, for teams to pull road graders for Fordsville Magisterial District at Fordsville; also 2 p. m., March 10, by Taylor for teams to pull road graders for Bartlett's Magisterial District at Ralph; until March 12 for teams for pulling road grader for Centertown Magisterial District at Centertown.

Grand Forks, N. D. — Light Plant.—Until March 7, by City Council, for the construction and installation of additional electric light equipment at the city power plant.

Norfolk, Va. — Retaining Wall.—Until noon, March 15, by Board of Control, Norfolk, Va., for the construction of a bulkhead or retaining wall on both sides of The Hague, in Norfolk, Va. W. T. Brooks is City Engineer.

Wheeling, W. Va.—Boat.—Until 11 a. m., March 30, by Capt. F. W. Altstaetter, U. S. Engineers, Wheeling, W. Va., for building a quarter boat and a hull for the Kanawha River improvement.

Wheeling, W. Va.—Boat with Derricks.—Until 11 a. m., March 24, by Capt. F. W. Altstaetter, U. S. Engineers, Wheeling, W. Va., for the furnishing and delivering of three wooden hull maneuver boats with derricks, engines, etc., for dams Nos. 8, 11 and 26, Ohio River.

Brownwood, Tex.—Railroad Work.—Until 2 p. m., March 10, by Brooke Smith, President, Brownwood North & South Ry., Brownwood, Tex., for clearing, grubbing and grading about 18 miles of standard gauge railroad between Brownwood and May, Tex. Further details will be found under Confirmed Reports in this issue.

Ottawa, Ont.—Railroad Work.—Until March 15, by A. W. Campbell, Chairman, Government Railways Managing Board, Ottawa, Ont., for the construction of a line of railway for the Intercolonial Ry., between George's River and Sydney Mines, N. S. Further details of the work will be found under Confirmed Reports in this issue.

Sault Ste. Marie, Ont.—Railroad Work.—Until noon, April 15, by C. N. Coburn, Chief Engineer, Algoma, Central & Hudson Bay Ry., for clearing, grading and bridge work on the 3-mile section between Hawk Lake Junction. Further details of the work will be found under Confirmed Reports in this issue.

Saskatoon, Sask.—Stand Pipe.—Until 7:30 p. m., March 21, by J. H. Trusdale, City Clerk, for furnishing material and labor for the construction of a stand pipe.

Excavation, Earth and Rock.

Bids are asked on following work, the notes being arranged alphabetically by states:

Denver, Colo.—Irrigation Work.—Until 2 p. m., March 19, by Charles T. Walker, Kiowa, Colo., for furnishing all necessary labor and material for the construction of several dams, canals and ditches for the Kiowa Valley Municipal Irrigation District. Further details will be found under Confirmed Reports in this issue.

Wilmington, Del. — Dredging.—Until noon, March 18, by Maj. R. R. Raymond, U. S. Engineers, Wilmington, Del., for dredging St. Jones and Murderkill Rivers, Delaware.

Wilmington, Del. — Dredging.—Until noon, March 18, by Maj. R. R. Raymond, U. S. Engineers, for dredging Mispillion and Appoquinimink Rivers, Delaware.

Fort Screven, Ga.—Until 11 a. m., March 23, by Constructing Quartermaster, for the construction of a rip-rap revetment in the seawall.

Garner, Ia.—Tile and Ditch Work. — Until March 12, by Thomas Duff, County Auditor, for cutting and excavating drain ditches and laterals for furnishing and laying tile in Drainage Districts Nos. 3 and 4, in Hancock County.

Sibley, Ia.—Drainage Work. — Until noon, March 9, by V. A. Burley, County Auditor, for the construction of a ditch in Drainage District No. 10 (Ocheyedan River). The main ditch will be 30,045 ft. long, cut averaging 6.94 ft., lateral A. 2,666 ft. long, cut averaging 6.25 ft.

Albany, N. Y.—Canal Work.—Until noon, Mar. 29, by F. C. Stevens, Superintendent of Public Works, for Contract No. 21, Erie Canal, Sec. 9, for excavating the canal prism and constructing guard lock, highway bridge abutments and all appertaining work between the Genesee River and east end of Contract No. 6, 2.48 miles long; for Contract No. 39, Oswego Canal, Sec. 1, for dredging a channel in the Oswego River and performing work incidental thereto, between Three Rivers and Fulton, 10.84 miles long; for Contract No. 73, Champlain Canal, Sec. 1, for dredging channel in the Hudson River and performing work incidental thereto from Northumberland to Stillwater, 15 miles long; for Contract No. 78, Oswego Canal, Sec. 1, for the construction of a dike along the Oswego River in the vicinity of Fulton, 1.23 miles long.

Lockport, N. Y.—Rock Work.—At once, by United Engineering & Contracting Co., 17 W. 42d St., New York City, for 150,000 yds. of rock work on the Barge Canal at Lockport, N. Y. The work is also noted under Confirmed Reports.

Redwood Falls, Minn.—Ditch Work.—Until 1 p. m., March 17, by L. P. Larson, County Auditor, for digging and construction of the tile branches to the judicial ditch No. 1, of Redwood and Brown counties. The work includes the following approximate quantities: 7,930 ft. of 12-in. tile, 7,152 ft. of 10-in. tile, 4,200 ft. of 8-in. tile. The work is estimated to cost approximately $4,180.

Materials, Machines, Supplies, Etc.

Bids are asked on following work, the notes being arranged alphabetically by states:

Washington, D. C.—Ties, Rails, Cable.—Until 10 a. m., March 8, by Bureau of Supplies and Accounts, Navy Department, Washington, D. C., for furnishing at the navy yard, Brooklyn, N. Y., a quantity of naval supplies as follows: Schedule 2270: Ties, rails, frogs, etc. Schedule 2271: Wire, cable, stuffing tubes, insulators, clusters, lanterns. Schedule 2274: Slab zinc, solder, nails, glass, hardware, paint. Schedule 2276. Gasoline. Schedule 2277: Stationery.

Washington, D. C.—Hoisting Engine, Pumps, Motors, Etc.—Until 10:30 a. m., March 21, by Capt. F. C. Boggs, General Purchasing Officer, Isthmian Canal Commission, Washington, D. C., for hoisting engine, pumps and motors, spiral riveted pipe and fittings, foot valves, dredging sleeves, push cars, revolving screen sections for rock crusher, steel, iron switches, track frogs, tie plates, angle bars, track bolts and spikes, wooden tie plugs, piles, etc.

Washington, D. C.—Electrical Supplies.—Until March 4, by War Department, Capt. C. DeF. Chandler, Signal Corps, U. S. A., for furnishing 500 star expansion anchors, 10 gross do., 2-in., 20 gals. mogul paint, 10 gals. do., 10 gals. asphaltum compound, 2 coal supports, 17 covers for cells, 12 telegraph keys, 300 rubber nipples, 200 rings, 10 battery syringes, 1,725 renewals for cells and 300 connecting wires.

Washington, D. C.—Boiler.—Until March 7, by Capt. F. C. Boggs, General Purchasing Officer, Isthmian Canal Commission, Washington, D. C., for the furnishing of one vertical fire tube boiler, 56 in. diameter by 8 ft. 6 in.

Washington, D. C.—Derrick Material.—Until March 3, by Capt. F. C. Boggs, General Purchasing Officer, Isthmian Canal Commission, Washington, D. C., for furnishing miscellaneous repair parts for guy derrick, also for 6 engines, 8¼x10-in. cylinder, 6,000 ft. of hoisting cable, galvanized plow steel ⅝ in., and 6,500 ft. of steel guy rope, lin. in diameter and galvanized.

Chicago, Ill.—Arc Light Carbons.—Until 11:30 a. m., March 9, by Department of Electricity, William Carroll, City Electrician, for furnishing the following quantities of arc light carbons: 1,440,000 14x⅝-in. copper coated carbons; 250,000 12x½-in. copper coated carbons; 50,000 12x⅝-in. plain forced carbons; 50,000 10x½-in. plain forced carbons; 175,000 12-in. x .510-in. to .520-in. cored carbons; 175,000 12-in. x .510-in. to .520-in. solid high-grade carbons, 60,000 12-in. x .510-in. solid high-grade carbons, special grade.

Chicago, Ill.—Boiler.—Until 11 a. m., March 5, by Fire Department, Chicago, Ill., James Horan, Marshal, for removing the old boiler and furnishing and installing one Scotch marine boiler in the fireboat M. M. Conway at 95th St., Calumet River.

Galesburg, Ill.—Engine, Generator, Etc.—Until noon, May 21, by B. J. Huff, Jr., City Clerk, for furnishing a Corliss valve steam engine, a tandem compound automatic steam engine, one A. C. generator and exciter, one combination unit of steam turbine, generator and exciter, and one switchboard. Official advertisement will be found elsewhere in this issue.

Joliet, Ill.—Steam Header.—Until 7:30 p. m., March 7, by Matt. Berscheid, City Clerk, for furnishing of all material, labor and erecting complete in place a new steam header with auxiliary piping and connections to the various engines and compressors at the main water works station.

New Orleans, La.—Steel Rolling Doors.—Until 7:30 p. m., March 15, by Board of Commissioners of New Orleans, La., for furnishing and erecting steel rolling doors in certain steel sheds on the river front.

Duluth, Minn.—Portland Cement.—Until noon, March 24, by Lt.-Col. Graham D. Fitch, U. S. Engineers, for furnishing 10,000 bbls. of American Portland cement for Superior Entry, Wis. Official advertisement will be found elsewhere in this issue.

Miles City, Mont. — Street Grader.—Until March 10, by City Council for furnishing a street grader.

New York, N. Y.—Gate Valves.—Until 11 a. m., March 8, by Board of Water Supply, Room 910, 299 Broadway, New York, N. Y., for Contract 42, for furnishing and delivering eight 3-ft. by 8-ft. twin sluice gates, eight 20-in. hand operated gate valves, ten 60-in. gate valves, with operating mechanisms, four 60-in. gate valves with individual electric drive, four 60-in. gate valves with gang drive, two 60-in. hydraulically operated gate valves and appurtenances, and 3 lines of floor drive shafting, for structures at Ashokan reservoir, near Brown's Station, Ulster County, and at Croton Lake siphon, Westchester County, New York.

Wheeling, W. Va.—Steel Bolts, Etc.—Until 11 a. m., March 14, by Capt. F. W. Altstaetter, U. S. Engineers, for furnishing and delivering structural steel forgings, castings, bolts, etc., for bear trap weir foundation and piers, dam No. 26, Ohio River.

Saskatoon, Sask.—Cast Iron Pipe, Etc.—Until 7.30 p. m., March 14, by J. H. Trusdale, City Clerk, for furnishing under Contract B, cast iron pipe and specials; Contract C, fire hydrants, gate valves and valve boxes; Contract D, material for sewer pipe and junctions.

CONTRACT LET.

The following contracts have been let recently:

BRIDGES.

Oakland, Cal.—Bridge.—Hyde, Harjes & Co., at $2,377, for replanking the Bay Farm Island bridge. This contract will require 77,000 ft. of lumber.

Salinas, Cal.—Bridge.—Clarence W. Swain, Ione, Cal., at $5,293, for repairing the Carmel bridge and the construction of small bridge near Carmel bridge in Carmel and Sur Road Districts. Bids were opened Feb. 8.

Larned, Kan.—Bridge.—Topeka Bridge & Iron Co., at $5,200, for the construction of a concrete bridge across the Pawnee, west of town.

Duluth, Minn.—Bridge.—G. H. Tounsberry, Duluth, Minn., at $20,070, for the construction of a reinforced concrete bridge over Fischer's Creek on East Superior St. The bridge is to be 66 ft. wide, having an 84-ft. span and a 172-ft. spandrel wall. Bids were opened Feb. 18.

St. Charles, Mo.—Bridge.—The Carmi Construction Co., Carmi, Ill., for strengthening the $2,000,000 Wabash Railroad bridge at this city. The structure will be reinforced with concrete.

Sspringfield, Mo. — Bridge.—Canton Bridge Co., Kansas City, Mo., at $2,400, for the construction of a steel bridge across James River at the Caldwill crossing, 14 miles southeast of Strafford, near the Webster county line. The bridge will be 114 ft. in length and 14 ft. wide. Concrete abutments will be constructed on each end.

Rye, N. Y.—Bridge.—Kennedy & Easton, Albany, N. Y., at $5,000, for the construction of a reinforced concrete bridge at this place.

ROADS AND STREETS.

San Jose, Cal.—Curbs and Gutters.—M. Montoya, at $.75 per lin. ft. for the construction of cement curbs and gutters on several streets.

Stockton, Cal.—Road.—Cyrus Moreing, Sr., at $36,000, for improving the Manteca group of roadways, consisting of 13 miles. Grading will be done by the Highway Commission.

Burlington, Ia.—Paving. — Burlington Construction Co. is reported to have received the contract for the grading, curbing and paving with mineral rubber asphaltic concrete.

East St. Louis, Ill.—Paving.—Following improvement contracts have been awarded by the

Board of Local Improvements: J. & P. Keeley, at $127,176, Illinois Ave., from 13th St. to Waverly Ave., Meyer & Thomas, at $51,379, 25th St., Waverly Ave. and 40th St.; Meyer & Thomas, at $25,113, Belmont Ave., from Columbia Place to V. & C. Belt. Work will be commenced as soon as the weather will permit.

Louisville, Ky.—Walks.—Following contracts have been awarded by the Board of Public Works for the construction of granitoid walks in the city: Henry Bickel Co., the north side of Market St., between Floyd and Preston; both sides of Shelby, between Main and Washington; east side of Floyd, between Main and Market; south side of High, between 16th and 17th; both sides of Main, between 19th and 20th; both sides of Center, between Walnut and Chestnut; east side of Center, between Walnut and Chestnut; south side of Magazine, between Logan and Swann; northeast side Bassett, between Longest and Ransdell; both sides of Fourth Ave., between Oldham and St. Catherine; south side of Grayson, between Eighth and Ninth; both sides of Hickory, between Mulberry and Texas; east side of Vine, between Breckenridge and Page. Staebler & McDonald: South side of Fulton St., between Hancock and Shelby. J. W. Gleason: West side of Mary St., between Swan and Dandridge; east side of Midland, between Bardstown and Everett; both sides of Fourth Ave., between K and L Sts.; south side of High, between 37th and 38th. L. R. Figg & Co.: East side of 34th St., between Rudd and High; east side of Center, between Green and Walnut; both sides of 22nd, between Duncan and Griffith; south side of O'Hara, between 16th and 17th; south side of 22nd, between Main and Rowan; both sides of Walnut, between 16th and 17th; west side of 11th, between Main and Rowan; east side of 28th, between Walnut and Madison; both sides of 22nd, between Rowan and Duncan.

Towson, Md.—Paving.—Fisher & Carozza, American Bldg., Baltimore, Md., are reported to have received the contract for the grading and macadamizing the Falls road, sec. 2, between Mount Washington and Brooklandville, a distance of 3.20 miles. Bids were opened Feb. 17.

Westminster, Md. — Paving. — Walsh Bros., Westminster, Md., at $14,779, for grading and macadamizing the public highway between New Windsor and Uniontown road, a distance of one mile. Bids were opened Feb. 14.

Jefferson Barracks, Mo. — Roads.—Ruprecht-Voirol Construction Co., St. Louis, Mo., at $4,673, for the construction of roads, walks and grading at this place.

Toms River, N. J.—Paving.—Following contracts have been awarded by the Board of County Freeholders: L. W. & F. T. Holman, Whitesville, at $6,984, for resurfacing with stone the eastern section of Lakewood and Point Pleasant County road, from Westpoint Pleasant and extending westward to the intersection of the roads at Burrsville, a distance of 19,505 ft.; J. L. Le Compte, Lakewood, at $10,488, for resurfacing with stone the western section of Lakewood and Point Pleasant road, beginning at the intersection of the roads at Burrsville and extending westward a distance of 15,532 ft.

Albany, N. Y.—Road Work.—Following contracts for the improvement of public highways have been awarded by the State Highway Commission; bids opened Feb. 16: Road No. 735, Potsdam-Colton, St. Lawrence County, 7.90 miles, A. J. Rockwood, Rochester, N. Y., $91,000. Road No. 5,032, Potsdam-Canton, St. Lawrence County, 5 miles, P. H. Murray, Rochester, N. Y., $54,961. Road No. 762, Craryville-State Line, Columbia County, 6.02 miles, Joseph Walker, New Paltz, N. Y., $71,487. Road No. 5,004, Blue Stores-Livingston, Columbia County, 2.50 miles, Joseph Walker, New Paltz, N. Y., $30,600. Road No. 776, West Plattsburg, Clinton County, 7.26 miles, Brown & Lowe, Schenectady, N. Y., $68,356. Road No. 775, Golden's Bridge-Croton Falls, Westchester County, 4.42 miles, Frank G. Fowler Contracting Co., Mt. Kisco, N. Y., $41,537. Road No. 789, Mariaville-Montgomery County Line, Schenectady County, 5.75 miles, Joseph Walker, New Platz, N. Y., $60,978. Road No. 5,030, Scotia-Wyatt's, Schenectady County, 2.25 miles, Brown & Lowe, Schenectady, $20,862. Road No. 797, Hunter-Windham, Sec. 2, Greene County, 3.39 miles, S. B. Van Wagonen, Rondout, N. Y., $39,543. Road No. 5,027, Catskill-Saugerties, Part 1, Greene County, 2 miles, DeGraff & Hogeboom, Bloomington, N. Y., $27,000. Road No. 798, Kent-Towner, Putnam County, 2.78 miles, H. B. Sproul, Peekskill, N. Y., $40,990. Road No. 804, Luzerne-Lake George, Sec. 1, Warren County, 7.13 miles, S. B. Van Wagonen, Rondout, N. Y., $73,604. Road No. 820, Hogansburg-Bombay, Franklin County, 6.52 miles, James Anderson, New Haven, N. Y., $50,102. Road No. 5.031, Malone-Moira, Part 2, Franklin County, 2 miles, Buckley Construction Co., Plattsburg, $33,743. Road No. 821, Saranac Lake-Blookingdale, Essex County, 5.58 miles, T. S. Huston, Havana, Cuba, $59,427. Road No. 841, Crown Point-Port Henry, Essex County, 4 miles, T. L. Huston, Havana, Cuba, $556,972. Contracts for the construction of the following roads were not awarded: Road No. 780, White Plains Town Line-Harrison, Westchester County, 2.91 miles. Road No. 5,003, Armonk-Byram Lake, Westchester County, 3.44 miles. Road No. 5,006, Croton Falls-Brewster, Putnam County, 1.80 miles. Road No. 5,011, Ausable Forks-Jay, Essex County, 3.45 miles.

Albany, N. Y.—Road Work.—Following contracts have been awarded by the State Highway Commission, for the improvement of public highways; bids opened Feb. 18: Road No. 5,009, Pawling Village, Dutchess County, 1.50 miles, H. P. Burgard Co., Buffalo, $20,874. Road No. 5,010, Slingerlands-New Scotland, Albany County, 2 miles, Thomas F. Shaughnessy, Albany, $22,400. Road No. 5,012, Fleming-Auburn, Cayuga County, 2.75 miles, J. G. Hayes & Co., Big Run, Pa., $35,040. Road No. 5,014, Chittenango-Oneida, Part 1, Madison County, 3.15 miles, James Anderson, New Haven, N. Y., $43,300. Road No. 5,016, Camillus-Fairmount, Onondaga County, 3.09 miles, John A. Wiedman, Syracuse, $39,000. Road No. 5,017, Clyde-Savannah, Part 2, Wayne County, 3 miles, M. F. Dollard, Albany, $37,033. Road No. 5,018, Reading-Dundee, Part 1, Yates County, 2 miles, Monroe Roads Co., Pittsford, $26,059. Road No. 5,019, Lake Shore-Lackawanna City, Erie County, 1.89 miles, Hagaman, Miller & Hagaman, Rochester, $36,163. Road No. 5,020, East Pembroke-Pembroke, Genesee County, 3.46 miles, F. J. Mumm, Buffalo, $39,774. Road No. 5,021, Le Roy-Caledonia-Mumford, Livingston County, 3.98 miles, James Anderson, New Haven, N. Y., $45,830. Road No. 5,025, Albion-Holley, Orleans County, 2.46 miles, Thomas Hucknall, Albion, $24,000. Road No. 5,024, Le Roy-Warsaw, Wyoming County, 2.67 miles, Thomas Murray, Le Roy, $33,000. Road No. 5,022, Binghamton-Windsor, Part 2, Broome County, 3 miles, Creeden & Pitou, New York, $41,890. Road No. 5,026, Corning-Painted Post, Steuben County, 3.56 miles, F. V. E. Bardol, Buffalo, $48,500. Road No. 5,043, Oneida-Castle Village-Vernon Village, Oneida County, 1.5 miles, M. F. Dollard, Albany, $16,632. Road No. 5, 5,035, Monticello-Liberty, Part 1, Sullivan County, 2.5 miles, De Graff & Hogeboom, Bloomington, N. Y., $32,989. Contracts for the construction of the following roads were not awarded: Road No. 5,007, Newburg-Cedar Hill Cemetery, Orange County, 3.28 miles. Road No. 5,013, Bainbridge-Unadilla, Part 1, Chenango County, 4.13 miles. Road No. 5,023, Cuba-Black Creek, Part 1, Allegheny County, 2.67 miles.

Glen Cove, N. Y.—Road.—Meserole & Underhill, of this city, at $2,049, for the widening of Glen St., at this place.

Hamilton, O.—Road. —A. Wirtz & A. Trunck, at $15,049, for the improvement of the Hamilton and Millville road for a two-mile reconstruction under the state roadway aid laws, with water-bound macadam.

Anadarko, Okla.—Paving.—J. F. Hill Co., for the construction of 60,000 sq. yds. of pavement in this city.

Klamath Falls, Ore.—Walks.—O. A. Harris, by the Klamath Development Co., for the construction of 60,000 ft. of cement sidewalks in their additions.

Dallas, Tex.—Paving.—Texas Bitulithic Paving Co., for paving Austin St., between Jackson and Commerce Sts., with Coffeyville vitrified blocks, at the following figures: $2.52 per sq. yd. for the paving; $.60 per lin. ft. for concrete curb, and $.45 per lin. ft. for straight curb.

Dallas, Tex.—Grading.—Cullom & Bavousett, for grading East Side Ave., in the paving district, at $.23½ a cu. yd.; or, if the city uses the dirt, at $.33 1-3; free haul, 1,000 ft., and overhaul, 1½ cents per ft.

Denton, Tex.—Paving.—M. B. Whitlock & Co., of this city, by the Texas & Pacific and Missouri, Kansas & Texas Railways, for 500 yds. of crushed stone to be used in macadamizing the railoads' part of the work on East Hickory St.

Orange, Tex.—Road.—Ben Wallis & Tom Semmons, Orange, Tex., for grading the Orange and Terry public road; work to begin immediately.

Oconomowoc, Wis.—Paving.—E. L. Bartlett, Watertown, at $9,514, for the paving of Collins and South Main Sts., from the Milwaukee Road tracks to Milwaukee St. Collins St. is to be paved with vitrified brick with a Portland cement base and concrete curb and gutters. Main St. will be paved with creosoted block with cement base.

SEWERS AND WATER SUPPLY.

Boone, Ia.—Sewer.—A. J. Gary, at $36,511, for the construction of the Fifth Ward sewer.

Grinnell, Ia.—Sewer.—Guy F. Smith, Indianapolis, Ind., at $5,232, is reported to have received the contract for the construction of a sewer in North Grinnell. Other bids received are: C. E. Decatur, $5,248, and the O'Farrell Construction Co., $5,335.

Canby, Minn.—Sewer.—Tanner Bros., at $24,000, for constructing the trunk sewer in this city.

St. Louis, Mo.—Sewer.—Thomas Flynn, at $23,319, for the construction of Glaise Creek, District 3, sewer.

Vandalia, Mo.—Water and Sewer Systems.—W. C. Juchsch, Times Bldg., St. Louis, Mo., at $23,780, for the construction of a water works and sanitary sewer system for this city. The work includes pipe line valves and hydrants, steel tower and tank, Weber subterranetan air pump and air compressor for the water works and vitrified sewer pipe, manholes and septic tank for the sewer system. Bids were opened Feb. 24.

Omaha, Neb.—Sewers.—J. J. Hanighen, at $15,893, for the construction of sewers in the wholesale district of the city.

Cincinnati, O.—Sewer.—W. S. Hollaender, at $11,540, for building a storm water sewer on Harrison Ave., Urweiler Ave., Stathem Ave. and Poplar Ct.

Norfolk, Va.—Sewers.—F. J. McGuire, Norfolk, at $12,570, for the construction of sewers in the Greater Ghent section af the city. The work will include 860 ft. of 12-in. pipe, 9,230 ft. of 8-in. pipe, 7,500 ft. of 4-in. pipe, 10 manholes, 100 flush tanks and 14 clean-out basins.

San Antonio, Tex.—Sewer Systems.—Rees & Peters, at $23,537, are reported to have received the contract for the construction of sewer systems in improvement district Nos. 12 and 13. Other bidders were: F. H. Dillon, $23,714; Trueheart & Jackson, $23,762; W. G. Schuwirth & Co., $24,942; W. B. Kroeger & Fincham, $25,372.

Hamilton, Ont.—Sewer.—F. H. Dickenson, of this city, at $125,504, for the construction of the outfall sewer in connection with the sewage disposal works at this city.

Erie, Kan.—Water Works, Electric Plant, Sewers.—Bids were received Feb. 17 by this city, Burns & McDonnell, Consulting Engineers, Kansas City, Mo., for furnishing materials and constructing water works, electric plant and sewers, contracts being let as follows: Power house, Fred M. Clark, Savannah, Mo., at $4,700; tower and tank, Penn Bridge Co., Dallas, Tex., at $3,370; electric equipment, consisting of 75 K W. generator and exciter, switchboard, 17 transformers, 1-125 KW., Fred M. Clark, Savannah, Mo., at $3,000; lighting equipment consisting of six 6.6 ampere arc lamps, one 25 light regulator and 55 series tungstens, Fred M. Clark, Savannah, Mo., at $694; 125 HP. high speed engine, Fred M. Clark, Savannah, Mo., at $1,250, pumps, (two) 300 G.P.M. Hor. pumps, two boiler feed pumps and valves and fittings, f. o. b., Fred M. Clark, at $1,400; 42 in. x 80 ft. chimney erected, Wiederholdt Construction Co., Kansas City, Mo., at $1,200. For water works and lighting construction, the following bids were received: (1) Standing for Kansas City Plumbing & Supply Co., Iola, Kan., (2) for Lund & Cunyan, Blackwell, Okla., (3) for Squire Electric Co., Kansas City, Mo., (4) for Fred M. Clark, Savannah, Mo. (awarded contract), (5) for Freeborn Engineering Co., Kansas City, Mo., and (6) for O'Bannon & Foster, Blackwell, Okla.:

BIDS RECEIVED FEB. 17 AT ERIE, KAN., FOR WATER WORKS AND LIGHTING CONSTRUCTION.

Specification.	Quantities.	(1)	(2)	(3)	(4)	(5)	(6)
Furnishing and laying 2-in. galv. pipe	2,950	$0.28	$0.21	$0.22	$0.28	$0.29	$0.30
Hauling and laying 4-in. C. I. pipe	12,550	.16	.14	.17	.15	.14¼	.16
Hauling and laying 6-in. C. I. pipe	1,160	.20½	.16	.19	.17	.16½	.18
Hauling and laying 8-in. C. I. pipe	2,640	.23	.19	.22	.20	.22¼	.22
Hauling and setting hydrants	36	2.00	3.00	3.00	5.00	1.50	2.50
Hauling and setting 2-in. gate valves	4	.75	.50	1.00	1.00	.60	1.00
Hauling and setting 4-in. gate valves	15	1.25	1.00	1.00	1.00	.60	1.80
Hauling and setting 6-in. gate valves	2	1.25	1.50	1.00	1.00	.60	2.56
Hauling and setting 8-in. gate valves	3	1.25	2.00	1.00	2.00	.70	3.00
Furnishing and setting 25-ft. poles	55	3.30	3.50	4.50	4.00	2.73	4.25
Furnishing and setting 30-ft. poles	250	4.36	5.00	6.00	5.00	3.97	4.80
Furnishing and setting 35-ft. poles	20	7.71	7.00	8.50	9.00	7.25	8.25
Furnishing 4-pin cross arms	480	.70	.80	.75	1.00	1.06	.70
Furnishing 2-pin cross arms	100	.55	.60	.65	.75	.70	.60
Furnishing guy anchors	90	2.40	4.00	3.00	3.00	2.70	2.25
Furnishing brake arms	65	.50	1.00	.50	1.00	.63	.65
Furnishing and setting lightning arresters	15	5.57	8.00	5.00	10.00	3.85	6.00
Hauling and hanging Tungstens	55	.55	1.25	1.00	1.00	.70	1.50
Hauling and hanging arcs	6	6.00	8.00	3.00	6.00	3.50	7.50
Hauling and hanging transformers	16	2.25	5.00	3.00	5.00	2.40	3.50
Furnishing and stringing No. 8 wire	10,000	.19½	.19	.20	.20	.1955	.19
Furnishing and stringing No. 6 wire	350	.19½	.20	.20	.20	.20	.19
Furn. and setting two 72x18-in. boilers	.....	3,260	3,400	3,200	4,500	3,417	3,600
Furn. and setting 200 hp. heater	.....	328	240	200	50	250	400
Furnishing and installing steam piping	.....	1,500	600	1,400	600	1,175	1,800
Furnishing and laying 6-in. sewer	400	.40	.60	.25	.25	.48	.30
Furnishing and laying 8-in. sewer	80	.40	.70	.50	.40	.57	.50
Installing electrical machinery	.....	238	350	200	200	320	500
Installing pumping machinery	.....	325	270	300	200	325	500
Portland concrete	85	6.00	7.00	5.50	5.00	8.00	8.00
Pump pit well	.....	2,326	3,000	3,000	1,750	2,500	3,000
Flooring, etc.	.....	350	185	500	200	646	800
5x16-in. curb	700	.35	.60	.25	.30	.36	.80
4-in. rock macadam	450	1.25	2.05	1.00	.75	.58	1.90
Grading	.....	.50	1.00	.90	1.00	.110	1.00
Total	.....	$17,935	$20,617	$18,850	$17,119	$17,964	$20,467

For sewer construction at Erie, Kans., the following bids were received: (1) Standing for P. A. Johnson & Co., Lindsboro, Kan., (2) for Kansas City Plumbing & Supply Co., Iola, Kan., (3) for F. W. Yale, Coffeyville, Kan., (4) for Fred M. Clark, Savannah, Mo., (5) W. W. Cook & Son, Junction City, Kan. (awarded contract), (6) W. F. Hall, Clinton, Mo., (7) Stephen Schulte, Chanute, Kan., (8) McGuire & Stanton, Leavenworth, Kan., (9) H. C. Gass, Belleville, Ill., (10) Lund & Cunyan, Blackwell, Okla.:

Peck, Idaho.—The Peck Bridge Co. at its annual meeting elected directors to arrange for the immediate financing of the project to construct the proposed bridge over the Clearwater River, estimated to cost $15,000. Dr. J. M. Lyle is one of the Directors.

Chicago, Ill.—The Federal Government has instructed that the Lake and Indiana St. bridges be removed and has appropriated $360,000 and $250,000 respectively for the purpose. The con-

Portsmouth, O.—County Commissioners have recently accepted the plans and specifications for the four new steel bridges to be constructed, one acress Rocky Fork in Brush Creek township, one over Geneatts Creek in Green township, one over Miller's Run, Valley township; one over Spruce Creek in Brush Creek township.

Shawnee, O.—A. L. Methany, City Engineer, is preparing plans for the construction of the new bridge over the Ottawa River.

BIDS RECEIVED FEB. 17 AT ERIE, KAN., FOR SEWER CONSTRUCTION.

Specification.	Quantity.	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
6-in. vitrified sewer pipe	....	....	....	....	....	....	....	....	....	....	....
8-in. vitrified sewer pipe	29,820	$0.13½	$0.21	$0.15	$0.14	$0.15	$0.15	$0.16	$0.12½	$0.20	$0.19
10-in. vitrified sewer pipe	2,950	.19	.28	.21	.18	.20	.20	.19	.17	.30	.26
12-in. vitrified sewer pipe	1,156	.25	.36¼	.25	.22	.24½	.25	.25	.20	.35	.32
15-in. vitrified sewer pipe	5,082	.35	.55	.35	.32	.35	.39	.35	.33	.45	.44
8-in. C. I. pipe	290	1.65	.93¾	1.25	.90	.88	1.25	.35	1.00	1.20	1.00
16-in. C. I. pipe	12	2.75	1.60	2.25	.50	2.00	3.25	.50	2.00	3.00	2.50
Excavation under 6 ft.	5,146	.13	.21¼	.14	.15	.12	.16	.16	17.	.20	.17
Excavation, 6 to 8 ft	15,833	.19	.32½	.22	.23	.17	.21	.25	.20	.27	.24
Excavation, 8 to 12 ft.	11,919	.33	.43¼	.32	.37	.30	.32	.37	.35	.40	.50
Excavation, 12 to 16 ft.	6,228	.57	.62½	.65	.62	.75	.45	.60	.60	.50	.65
Excavation, 16 to 20 ft.	220	1.00	.93¾	.95	.90	1.20	.65	1.10	1.00	.70	.80
6-in. on 8-in. Y connections	817	.42	.37	.25	.50	.35	.70	.55	.30	.55	.72
6-in. on 10-in. Y connections	150	.53	.60	.35	.70	.45	.90	.75	.45	.75	.90
6-in. on 12-in. Y connections	48	.65	.75	.50	.85	.55	1.10	.90	.60	1.00	1.25
Portland concrete	10	9.00	8.00	.....	6.00	7.00	8.50	10.00	8.00	10.00	7.50
Manholes	95	29.00	45.00	....	30.00	30.00	30.00	35.00	32.00	35.00	35.00
Lamp holes	9	6.00	10.00	....	20.00	7.00	7.50	10.00	4.50	10.00	8.00
Flush tanks	14	67.00	70.00	....	75.00	60.00	65.00	65.00	65.00	65.00	70.00
Lumber	10M	28.00	25.00	....	30.00	25.00	30.00	30.00	30.00	30.00	30.00
Flood gate	....	....	178.75	....	....	.....	.....	75.00	.....	.....	.....
Septic tank complete	....	....	....	....	....	.....	.....	.....	.....	.....	.....
25-foot poles	14	6.50	3.06	....	4.00	3.75	7.50	5.50	5.00	5.00	3.50
30-foot poles	10	8.75	4.06	....	5.50	4.00	9.00	6.00	6.00	6.00	5.00
4-pin cross arms	80	2.50	.70	....	.90	.75	1.25	3.00	3.00	3.00	.80
No. 8 copper line wire	1,604 lbs.	.28	.20¾	...	.18	.23	.30	.17½	.17½	.17½	.20
7,130 ft. iron wire	....	....	42.90	....	15.00	40.00	75.00	.....	.....	.....	65.00
Guy anchors	5	6.00	2.40	....	1.00	1.00	5.00	8.00	8.00	8.00	3.00
Totals		$27,225	$36,480	$28,555	$27,788	$26,745	$29,699	$30,169	$27,228	$32,520	$33,435

EXCAVATION, MISCELLANEOUS, MATERIALS.

St. Louis, Mo.—Boilers, Machinery, Etc.—Board of Public Improvements awarded contracts for the following public work: John O'Brien Boiler Works Co., at $22,800, for installing boilers in the insane asylum pumping station: Brownell Co., at $4,438, for installing an automatic engine in the same; Ruemmeli-Dawley Manufacturing Co., at $8,800, for installing an ice-making machinery in the asylum plant.

Summit, N. J.—Crushed Stone.—Larson Trap Rock Co., Springfield, for supplying crushed stone for the city at the following figures: One-quarter in., $1.25 one-half in., $1.25; three-quarter in., $1.20; one in., $1.20; one and one-half in., $1.15; two ins., $1.10; and two and one-half ins., $1.05.

Albany, N. Y.—Buildings.—Bliss & Griffiths, 225 Fifth Ave., New York, N. Y., at $282,000, by the State Lunacy Commission, for the construction of four buildings to house 600 chronic insane patients in the Kings Park, L. I., State Hospital.

Eugene, Ore:—Light Fixtures.—Thomas Day Co., San Francisco, Cal., at $982, for the installation of light fixtures in the U. S. public building at this city.

Frankford Arsenal, Philadelphia, Pa.—Chain Drives and Bearings.—Standard Roller Bearing Co., 50th St. and Lancaster Ave., Philadelphia, Pa., at $1.70 each, for furnishing four chain drives and six grooved ball thrust bearings. Bids were opened Feb. 17.

Dallas, Tex.—Pipe.—United States Cast Iron & Foundry Co., for furnishing the city with 5,534 tons of water pipe.

Kaysville, Utah.—Pipe and Fittings.—Portland Wood Pipe Co., Portland, Ore., for furnishing pipe and fittings to this city. The amount of pipe is 24,085 ft. of 4-in., 11,070 ft. of 6-in., 9,745 ft. of 8-in., with valves, specials, etc.

Sheboygan, Wis.—Power Plant.—The Optemberg Iron Works, for the remodeling of the entire power plant of the Oostburg Canning Co., of Oostburg. The work will include the installation of a new 150 horsepower Corliss engine and an additional new boiler. When completed the plant will be increased from 30 to 150 horsepower.

Sheridan, Wyo.—Light Fixtures.—Cascade Gas and Electric Fixture Co., Seattle, Wash., at $1,857, for the installation of light fixtures in the U. S. public building at this city.

Wetaskiwin, Alta.—Well.—J. A. Grant, Walsh, Alta., at $7.50 per ft., for drilling a well for natural gas to a depth of 2,000 ft. Bids were opened Feb. 15.

PROJECTED WORK.

Bridges.

Items Arranged Alphabetically by States.

Phoenix, Ariz.—Board of Supervisors and J. A. Jaeger, Prescott, Ariz., Chief Engineer, Santa Fe, Prescott & Phoenix Ry. have made an agreement regarding the proposed plans for the Center street bridge at this place.

Hartford, Conn.—City Council is planning the construction of a bridge over Farmington Ave., which is estimated to cost $18,000.

Columbus, Ga.—The proposition to issue $100,000 worth of bridge bonds was carried.

struction of new bridges at Washington, La Salle and Wells Sts. is also under consideration by the City Council.

Hartford, Ind.—County Commissioners have taken up the matter of constructing two bridges over the Salamonie River, a concrete structure over the old channel and a steel bridge over the new channel, the latter having two 80 ft. spans. Plans for the work will be prepared by W. H. Bladders, Portland, Ind.

New Albany, Ind.—Officials of the railroads controlling the Kentucky and Indiana Bridge over the Ohio River between New Albany and Louisville recently held a meeting at Louisville, and although no definite action was taken, it was decided that the structure be rebuilt in the near future.

Des Moines, Ia.—According to plans and estimates prepared by City Engineer J. W. Budd, a steel trussed span across the Des Moines River at College Tve. can be constructed for $65,000 and the same style bridge at University Ave. will necessitate an expenditure of $115,000.

Hutchinson, Kan.—City Commission has approved plans of City Engineer G. L. McLane for the construction of the proposed concrete bridge at Main St. Bids for the work will probably be advertised soon.

Salina, Kan.—Local Commercial Club has petitioned the County Commissioners to construct a bridge over the Salina Creek in Salina Canyon. Road Commissioner will take up the matter.

Wichita, Kan.—A proposition is to be submitted to the citizens of this city to vote on issuing bonds amounting to $40,000 for the construction of a concrete bridge over the Little River.

Elizabethtown, Ky.—County Commissioner William C. Montgomery is arranging for letting contracts in the spring for the construction of a bridge over Salt River at West Point, connecting Hardin and Jefferson Counties.

Lansing, Mich.—City Council is discussing the matter of constructing a bridge over the Grand River either at South or Robert Sts. Plans have already been prepared for a $1,130 foot bridge, and a general traffic bridge is also under consideration.

Duluth, Minn.—The Canadian Northern Ry., recently granted a franchise for the entrance of its road into Duluth, will take immediate steps toward the reconstruction of the Oneida St. bridge.

Minneapolis, Minn.—The Chicago, Milwaukee & St. Paul Ry. will construct a concrete girder bridge over the canal between Lake of the Isles and Lake Calhoun and also a similar structure for the St. Louis road near Cedar Lake.

Maryville, Mo.—County Commissioners are considering the construction of two bridges on the Graham road east of the Maitland Bridge.

Sibley, Mo.—In connection with the double track work between Kansas City and Chicago, Ill., the Atchison, Topeka & Santa Fe Ry. is planning the construction of a double track bridge across the Mississippi River at this place. A. F. Robinson, Chicago, Ill., is Engineer of Bridges of the A. T. & S. F. Ry.

West Point, Miss.—H. J. Kornegay, County Treasurer, will sell bonds amounting to $40,000 for the construction of bridges.

Grand Forks, N. Dak.—Grand Forks County Commissioners have rejected all bids received for the construction of bridges and bids will be soon readvertised.

Troy, O.—At the Troy Business Men's request, the County Commissioners have instructed the County Engineer to inspect the site for the proposed bridge across the canal at West Main St.

Youngstown, O.—Engineer Wilson is preparing plans and maps for the proposed high level bridge on S. Main St.

Muskogee, Okla.—County Commissioners are to construct three small bridges over creeks on the Spaulding Bridge road five miles north of this city.

Altoona, Pa.—The Pennsylvania R. R. has submitted a proposition to the City Council offering to pay $25,000, one-third the cost, toward the construction of the proposed Seventh St. bridge.

Mckees Rocks, Pa.—City Council has passed an ordinance permitting the Pittsburg, Chartier & Youghiogheny R. R. to construct a bridge over the tracks of the Pittsburg Railways Co. in Chartiers Ave. and another at Andrew St. The work will require a total expenditure of about $125,000.

Pittsburg, Pa.—A rehearing is to be held March 8 by Col. W. H. Bixby, U. S. Engineers, Federal Bldg., on the proposed changes by the secretary of war in the bridges over the Allegheny River from Sixth St. to 43d St.

Pittsburg, Pa.—Plans have been completed by the City Bridge Department for the new Point bridge, which will span the Allegheny River about 50 ft. above the site of the old Union bridge. The government has approved the plans and contracts for the substructure and masonry work will be let early this spring. It is planned to have the piers completed before next fall. The cost of the new bridge will be $1,000,000. The bridge will be about one-half mile long with two spans resting on a pier in the center of the channel, and piers at each water edge. Each span will be 531 ft. long. The structure will be 60 ft. wide, providing a 36-ft. roadway and two 12-ft. sidewalks. It will have a clearance of 70 ft. above pool level. Each approach to the new bridge will be about 900 ft. long.

Wilkesbarre, Pa.—County Commissioners have decided to construct a bridge over the Susquehanna River at Plymouth, Pa. Scofield Engineering Co., Philadelphia, Pa., is Engineer.

Cleburne, Tex.—Commissioners of Johnston County have been petitioned for the construction of a substantial steel or concrete bridge over the Nolan River at Granbury Road Crossing.

Sherman, Tex.—The Municipality and the Texas Traction Co. have made arrangements in the matter of constructing a bridge over the Postoak Creek on West Lamar St. The structure will be of concrete and is estimated to cost $3,500, of which amount the traction company will pay $1,500.

New Westminster, B. C.—Residents of Annacis Island will petition the provincial government for assistance in constructing the proposed $40,000 bridge to connect the island with New Westminster, via Lulu Island.

Vancouver, B. C.—Municipality is considering the construction of a bridge over the Narrows to connect Vancouver and North Vancouver. The structure is estimated to cost $1,250,000 and the Dominion Government has promised to pay $250,000.

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HALBERT P. GILLETTE
CHAS. S. HILL
ERNEST McCULLOUGH
C. T. MURRAY
F. A. SMITH
} EDITORS

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CONTENTS.

EDITORIAL
Reinforced Concrete Columns.....209
A Notable Article on Tunnel Excavation..209
CONCRETE SECTION.
A Comparison of the Efficiency and Economy of Different Designs of Reinforced Concrete Columns 210
EARTH AND ROCK SECTION:
Methods and Cost of Excavating Twin Tunnels Through Trap Rock for the Pennsylvania R. R. Tunnel Entrance to New York City 214
ROADS AND STREETS SECTION:
Data on Street Cleaning in St. Louis, Mo.221
Data on Steam Road Roller Practice of English County Councils 221
Suggested Standard Specifications for Macadam, Brick and Granite Block Pavement, Creosoted Wooden Block Pavement and Concrete Pavement 222
WATER-WORKS AND SEWER SECTION:
Method and Cost of Constructing a Concrete Water Tower at Victoria, B. C.....224
The Lowering of Well Water Supplies and the Use of Air Lift Pumps.....226
Notes from the Springfield, Ill., Water-Works Report 227
GENERAL SECTION:
Plans and Specifications for Early Timber, Earth and Masonry Dams Built in Connecticut 227
PERSONALS 232
CATALOGS WORTH HAVING.....232

Reinforced Concrete Columns.

The question of cost is paramount in deciding between the use of concrete columns and steel fireproofed columns for buildings having floors and frame of reinforced concrete. This is a question to be settled for each structure. Concrete being selected, the battle of the reinforcing systems begins, for the number is great.

Theory indicates that a concrete column reinforced with longitudinal rods or bars will be strengthened by the steel in proportion as the areas are influenced by the ratio of deformation of the steel and concrete. This ratio is preferably named by Professor Talbot "the ratio between steel stress and concrete stress"; if a concrete is selected, such that 500 lbs. per sq. in. is considered a safe working stress, then with a stress ratio of 15 the steel stress will be 15×500=7,500 lbs. per sq. in. The uneconomical use of the steel is manifest and theories of column reinforcement have not been confined to an endeavor to make the ratio smaller. Strangely enough the idea has been to use more steel so placed that it will confine the concrete to permit of the use of higher stresses. To increase the amount of cement and improve the quality of concrete did not appeal with enough force to investigators and the number of patented columns on the market and the energy with which they are pushed blinded the eyes of many designers to obvious facts.

The theory of the hooped column is that the bands or wire hooping will confine the concrete and prevent or retard bursting. A cylinder filled with sand compressed by a close fitting plunger is taken as an analogous example. In a spiral wrapping of course the sand would not hold and the tight outside cylinder confining the sand is replaced by a coil inclosing the concrete, the cohesiveness of this material destroying the completeness of the analogy. The use of concrete possessing high value in cohesion was not deemed of great importance and when used its value was not appreciated. The hooped or wound column is very expensive and its widespread use is another example of the value of good advertising. All tests made on hooped columns showed, at ordinary working loads, such reinforcement to be expensive. It really served no useful purpose until the deformation was so great that equal deformation in a structure would lead to condemnation as unsafe Hooping merely "toughens" the column and renders possible the use of higher stresses, amounting in effect to a lower factor of safety under ordinary loading.

Here and there experimenters have announced that by using a better concrete higher stresses might be used in this material, with a lessening of steel. This opinion has been gaining in force until at the Chicago convention of the National Association of Cement Users two weeks ago Professor Gillespie presented a paper which will go far towards settling the matter. His paper is printed in this issue and is worthy of careful consideration. He advocates a rich, dense concrete for columns and the longitudinal reinforcement is used merely to guard against possible flexure and to provide toughness to resist shocks. In the discussion some question was raised as to difficulties that might be encountered in securing in actual work as good a concrete as was obtained in the laboratory.

The objectors lost sight of the speaker's point that cement is the cheapest and most efficient reinforcement for columns. Professor Withey of the University of Wisconsin showed this very plainly. Professor Berry of the University of Pennsylvania within the past few weeks demonstrated the fact that reinforcement adds very little to the actual strength of concrete, the function of reinforcement being principally to guard against sudden failure. Manufacturers of reinforcing for columns publish results of tests to prove that spiral reinforcement wonderfully strengthens columns, but always the fact appears that the best results occur with the best concrete.

Flexure does not enter. Building ordinances limit the ratio of l/d and the case is one of compression pure and simple. Professor Gillespie proportioned his concrete by weight, 70 lbs. of cement and 70 lbs. of trap rock from ⅛ in. to ¾ in., making 1 cu. ft. of concrete, with the necessary water. The comparative costs given in his paper show how much can be spent on cement and how materially the cost is reduced by comparison with a highly reinforced column of leaner concrete. There should be little difficulty in securing in actual building operations a concrete having an ultimate strength of 4,000 lbs. per sq. in. and over by paying some attention to grading of aggregates. Such concrete it would be sinful to wrap in wire bands.

A Notable Article on Tunnel Excavation and the Opportunities That It Suggests.

Engineering literature contains few articles on rock tunneling more replete with useful and well analysed data than the article published in our earth and rock section this week. We mention this not only to commend the character and quality of the drilling and blasting data here presented to tunnel men, but to point out the opportunities that lie open in every piece of work for observing methods and results and recording them in useful form.

This tunnel had nothing unique about it. True it was a work of magnitude, but it was plain, straightforward rock tunneling. No intricate and stubborn problems of timbering were introduced by unstable material or sliding rock strata. There were no difficulties due to subterranean heat or water and the problem of ventilation was ordinary. The work was located on the threshold of supply for machinery, power and labor. All the "features" that make "copy" for the space writer were lacking. Yet the article which we publish is not only valuable, but it is interesting. Why?

In seeking the answer we are not without selfish interest. The editors of this journal have no more difficult task than that of securing really good articles on earth and rock excavation. This is not because such work is rare, rather, perhaps, it is because rock and earth excavation are so common. Almost no engineering construction is without a certain amount. The aggregate expenditure involved is enormous. The influence of good management, the getting of the highest efficiency from men and machines, is paramount. A knowledge of details is vital. Yet when we are searching for articles on earth and rock excavation we have over and over again the claim presented that this or that work was plain, straightforward rock work or earth work—that there is nothing to write about. And, considering the opportunities, how little is written that is at all superior.

The engineer rarely writes an article on excavation, yet the publications devoted to engineering are filled with engineer's articles on bridges and on concrete work which are scarcely more than commonplace. The contractor seldom writes, more is the pity, about excavating work or anything else. The editors of this journal are candid in saying that they wish articles on earth and rock excavation from both engineers and contractors. They do not wish general discriptions, but articles that con-

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tain data on methods, output, efficiency and particularly costs which are the only true measure of efficiency. Such articles can be written. The article which we mentioned in our opening paragraph as published in this issue is evidence, and we can name many others from the columns of our earth and rock section. Yet altogether these are few to what the number might be.

There is an explanation for this and we believe that it may be inferred from the very article to which we have referred above. We have read dozens of articles on efficiency in drilling, blasting, mucking, work and not found a single item of data on efficiency in drilling, blasting, mucking, etc., that was of general value. Many of our readers can confirm this experience. We have read articles on this same tunnel work which gave none of these data. They are contained in Mr. Lavis' article. This is not because he had opportunities and privileges not enjoyed by other engineers on similar work, but because he had a different conception of the work. He saw it not as an assemblage of tasks but as a single effort of many interdependent processes acting together to form a mechinasm designed to produce a certain thing and he analyzed the efficiency of the mechanism. Holding this veiwpoint the work ceased to be commonplace. So does every work of earth or rock excavation. There is a rock cut to excavate. Consider the assemblage of drills, compressors, derricks, cars and what not as a factory and the workmen as its operatives and study the whole from the point of view of its efficiency in turning out finished excavation. Or take any one element of the mechanism, say the drill plant and its operation, and analyze its efficiency and how this efficiency is influenced by conditions. Does not the work take on a dignity quite as great as the two or three spans of Pratt truss bridge in the valley beyond? Does it not present as much to write about? Indeed it does. And the subject matter is not less worthy from any point of view.

The engineer need not wait for the "100,000-yard cut" for his opportunity. The "1,000-yard scraper job" will give it to him, and an enlightening article on the 1,000-yard job will find ten appreciative readers where an account of the greater work will find one. In one of the early issues of this journal we published an article on methods and cost of cellar digging with a steam shovel. We should say off-hand that we have had more requests for copies of that article than for any but a few others on earthwork, and these others were mostly small jobs. There is no littleness in writing of the small thing that is unusual, littleness comes in writing of the commonplace thing because it is big.

The subject of this talk is one easy to wander in and we have explored only a few of its paths—we have gone far enough, however we think, to show that the opportunity exists for engineers to write instructively and without lack of dignity on earth and rock excavation. To be personal again, they can find a place in this journal for every bit of good matter they can turn out, and they will be paid for all that we publish.

Concrete and Reinforced Concrete Section

Note: This section is devoted to methods and cost of constructing concrete and reinforced concrete structures. It will cover the selection, testing and proportioning of concrete materials; laboratory tests of concrete; concrete mixing, transportation and placing; fabrication and placing of reinforcement, and form construction and erection. It will also contain articles on new and interesting developments in the design of reinforced concrete.

A Comparison of the Efficiency and Economy of Different Designs of Reinforced Concrete Columns.*

In the study of the elastic properties of any material, the stress-strain curve is a very importand aid. Straightness on such a curve is evidence that Hooke's law of proportionality of stress to deformation obtains. The steepness of the curve with respect to the axis of strain is the measure of the rigidity of the material— perpendicularity to this axis denoting infinite stiffness and parallelism to the same axis, complete plasticity. The "elastic limit" is indicated by the departure of the curve from the straight line. The true elastic limit is in most instances not definitely marked; but, in the case of soft steel and wrought iron, the position of the so-called "apparent elastic limit" or "yield point" need never be mistaken. The "return path" is plotted by observing simultaneous values of stress and strain under decreasing loads. The intercept, if any, of this path on the axis of strain is the measure of the "permanent set." A repetition of the stresses and a replotting will show to what extent, if at all, the properties of the material have altered because of the process of restressing.

Since, in the discussion of efficiency and economy in concrete column design, the elastic and other properties of the material to be employed are of vital importance, there is shown by way of illustration, in Fig. 1, the the data for which were obtained from *Tests* the date for which were obtained from *Tests of Metals* for 1904. The upper curve is for a 1:1 cement and sand mortar of ultimate crushing strength, 6,940 lbs. per sq. in. The lower is for a 1:2:4 cement, sand and gravel mixture, which failed at 1,700 lbs. per sq. in. It will be observed that while the former continues straight up to a stress of 2,500 lbs. per sq. in., the latter deflects almost from the start. That the former is at the outset, almost twice as steep as the latter, will be interpreted as meaning that the modulus of elasticity of the richer concrete is nearly twice as great as that of the poorer. That there would be a permanent "set" for relatively small stresses in the case of the latter would be anticipated. As might also be ex-

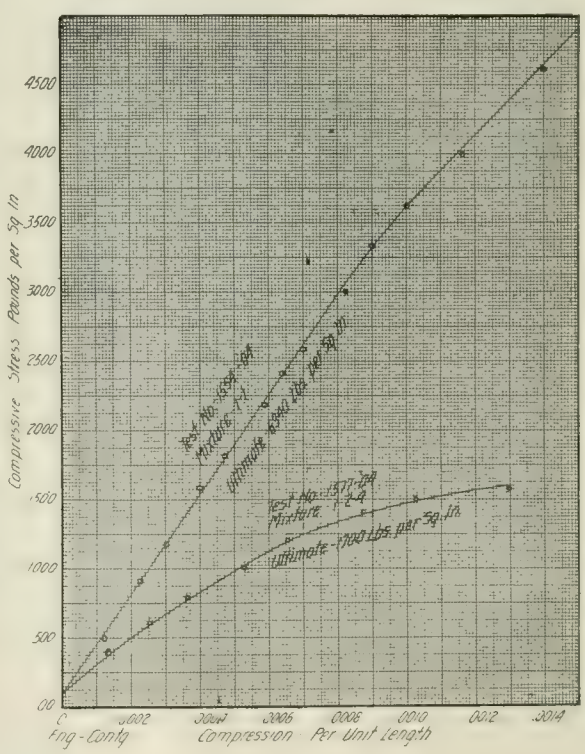


Fig. 1—Curves Showing Typical Behavior of Rich and Lean Concrete Under Stress.

*A paper by Prof. Peter Gillespie, read at the annual convention of the National Association of Cement Users, February, 1910.

TABLE I—SIMULTANEOUS STRESSES IN CONCRETE AND STEEL.
(Mixture variable. Percentage of metal in longitudinals, 0.97 to 2.09.)

Test No.	Mixture.	Average Stress lbs. per sq. in.	Steel Stress lbs. per sq. in.	Concrete Stress lbs. per sq. in.	Steel Stress Concrete Stress.	Ultimate Strength lbs. per sq. in.
1613	1 : 1 : 2	600	3,540	556	6.4	2,890
1612	1 : 2 : 3	600	6,360	516	12.3	2,010
1582	1 : 2 : 4	600	5,040	557	9.0	2,180
1581	1 : 2 : 4	600	5,520	549	10.1	1,990
1584	1 : 2 : 4	600	4,320	527	8.2	2,830
1579	1 : 2 : 4	600	3,780	532	7.1	2,760
1610	1 : 2 : 4	600	5,220	532	9.8	1,820
1616	1 : 2 : 4	600	9,060	476	19.0	2,095
1608	1 : 3 : 6	600	11,100	446	24.9	1,370
1617	1 : 3 : 6	600	4,860	516	9.4	2,290
Average			6,000	530	11.6	

pected, a much closer approach to complete recovery was realized in the other instances after even moderately large stresses.

For the reinforcement of concrete columns, two methods have been adopted, viz.: by longitudinal rods and by hoops or spirals. Frequently, indeed, the two methods are employed in combination. The former depends for its effectiveness on the fact that when two dissimilar materials deform together, they take stresses in proportion to their relative rigidities. That is to say, if the steel in the longitudinal reinforcing of a concrete column be ten times as rigid as the surrounding concrete, its stress for a given deformation will be ten times that of the concrete. Experiments conducted on columns of concrete of the grade ordinarily manufactured and reinforced with longitudinal rods show that the stresses in the steel, accompanying stress in concrete of such intensity as is commonly specified, are very much lower than good practice will endorse or economy recommend. In Table I are given some data taken from *Tests of Metals* for 1904. In parallel columns are shown simultaneous values of stress in concrete and in steel longitudinals in compression members having from 0.97 to 2.09 per cent of reinforcing.

From this table, it is seen that the average stress existing in steel longitudinals in columns carrying 600 lbs. per sq. in. over the gross area was only 6,000 lbs. per sq. in. In structural and bridge work, working stresses at least twice this would not be considered excessive. It is undoubtedly true that metal is sometimes employed in structures for emergency purposes, and ordinarily may sustain stresses which are very small indeed or absent altogether. In the case of concrete columns, this is partly true. To take care of bending stresses due to eccentric loading or to possible inequalities in the concrete, longitudinal rods are necessary; still, if the working stresses in them could be increased somewhat past the limit given in the accompanying table, it could be felt that more of the advantages of the use of the metal were being realized, particularly since, even when stressed to the maximum which good practice favors, it carries a load in compression at about twice the cost of concrete.

By employing a better grade of concrete, thus permitting the utilization of higher working stresses, a partial remedy is secured. An improvement in quality is, however, accompanied by a marked increase in the elastic modulus as well as in the ultimate strength, as is indicated in Figures 1 and 2, the latter being a typical stress graph for a plain 1:1 concrete of age three months, plotted from a test made by the writer. The aggregate was a hard trap rock, with the fine crusher dust screened out, the size of aggregate varying from ¼ to ¾ in. The member was first stressed up to 2,200 lbs. per sq. in. when the load was released. The magnitude of the "set" is almost insignificant, it being observed that the second curve, is plotted from a new origin. The prolonged straightness of the curve is one of its most noticeable features. The increase in stiffness which occurs whenever the quality of the concrete is improved, will mean a reduction in the stiffness ratio for the two materials so that the increase in the steel stress due to the employment of a richer mixture, is not as great as might at first be supposed.

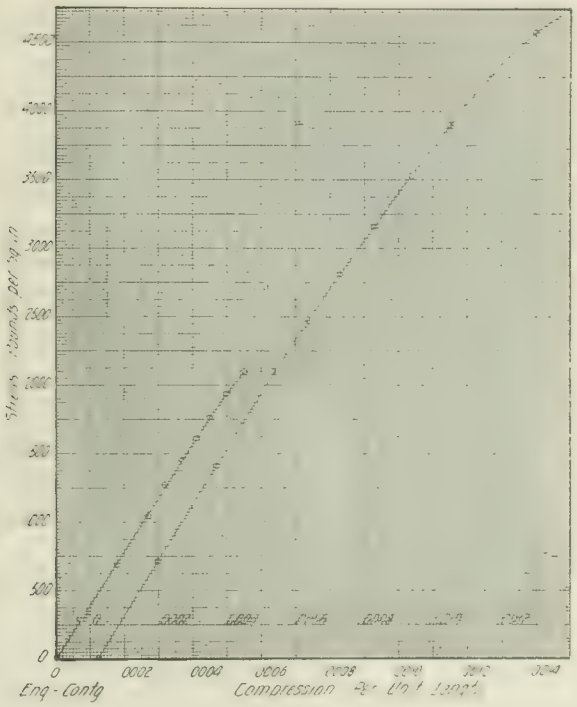


Fig. 2—The Stress-Strain Curve of a 1 : 1 Mixture.

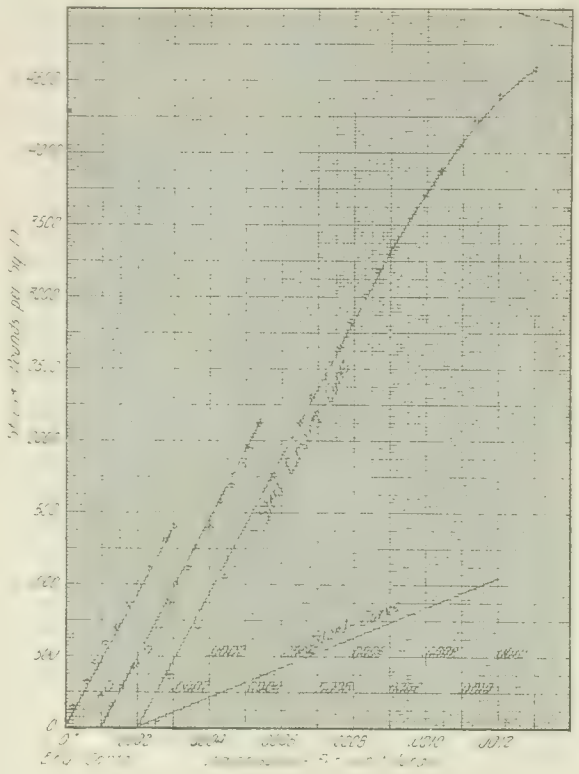


Fig. 3—Curve Showing the Behavior of a 1 : 1 Concrete Column with Longitudinal Reinforcement.

In Table II are given the results of a few compression tests made by the writer on columns of this grade of concrete. The specimens were 6 ins. in diameter and 21 ins. long.

As the average strength is well over 5,000 lbs. per sq. in., it would seem that a working stress of 1,250 lbs. per sq. in. is not excessive.

To determine the manner in which such material will behave in combination with steel, longitudinally placed, a number of columns were constructed and tested. Nine determinations of the modulus of elasticity for this concrete plain, gave an average value of 3,900,000 lbs. per sq. in. with the smallest value 4 per cent lower and the largest 4½ per cent higher than the mean of all. Eight determinations of the elastic modulus in columns reinforced with from 0.88 per cent to 4.42 per cent of steel, gave an average value of 3,600,000 lbs. per sq. in., showing that apparently the concrete is less rigid in the reinforced column than it is in the plain. In the latter case, the smallest value was 13 per cent less and the greatest, 11 per cent more

TABLE II—COMPRESSION TESTS ON SHORT COLUMNS.

(Mixture 1 : 1, Age, 6 mos.)

Specimen No.	Crushing Strength lbs. per sq. in.
A	4,900
B	5,075
C	5,150
D	6,160
E	4,120
F	5,180
Average	5,300

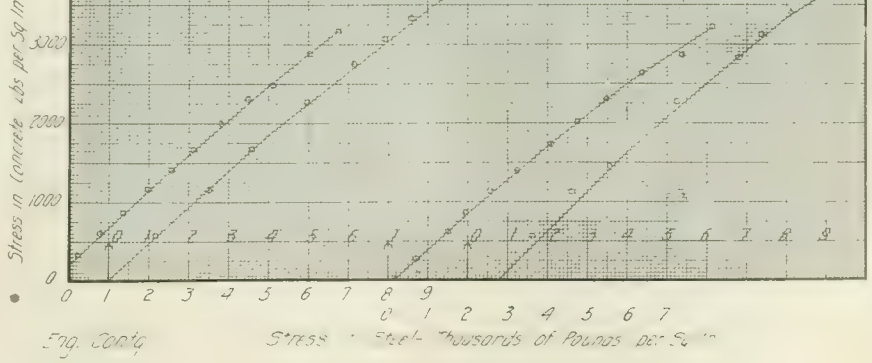


Fig. 4—Curve Showing Ratio of Steel Stress to Axial Compressive Stress in Concrete in a 1 : 1 Hooped Column.

than the mean of all. Typical stress-strain curves for these columns are shown in Fig. 3. It will be noticed that the "set" following the stresses indicated in the first two applications of load, is practically zero. The "steel curve" is drawn in such a way that that portion of the average or gross stress between it and the curve proper, is the measure of the stress in the concrete. In this way, it is possible to determine the simultaneous stresses in the two materials since the steel stress may be found by multiplying the unit deformation by the elastic modulus of that material. This method of graphical segregation is always possible and it will be evident that the steel curve will be steepest where the quantity of metal is greatest. Table III shows in a few other representative cases, the magnitude of the stress in the longitudinal reinforcement accompanying a stress of 1,250 lbs. per sq. in. in the concrete.

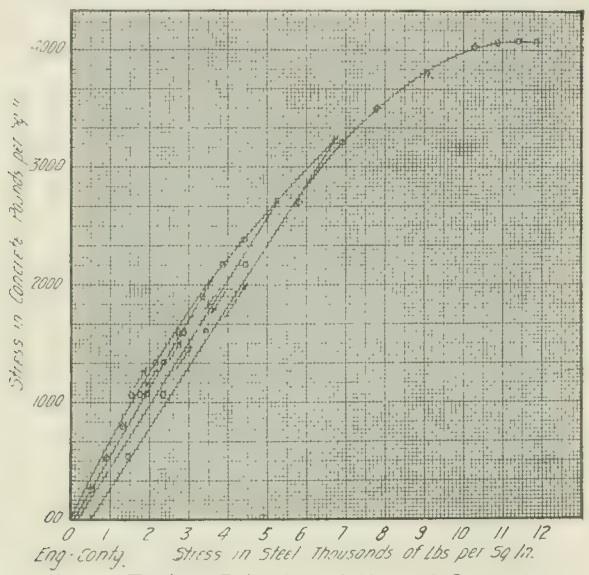


Fig. 5—Typical Behavior of Hooped Concrete Under High Compressive Stress.

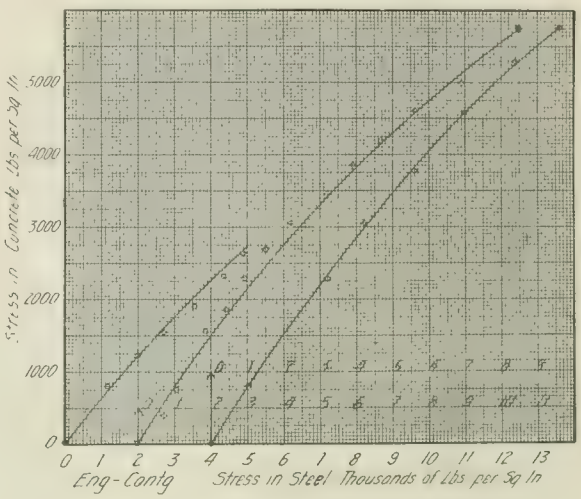


Fig. 6—Curve Showing Ratio of Steel Stress to Axial Compressive Stress in a 1 : 1 Hooped Column.

On account of the increased working stress in the concrete, the average stress in the steel is substantially greater. The attainment of such stresses, rendered possible through the employment of a better grade of concrete, must be considered a step toward the economical use of steel in concrete columns.

TABLE III.—SIMULTANEOUS STRESSES IN CONCRETE AND STEEL LONGITUDINALS. (Mixture 1 : 2. Percentage of metal, 0.88 to 4.42.)

Design-ation.	Stress in Concrete lbs. per sq. in.	Stress in Steel lbs. per sq. in.	Steel Stress Concrete Stress.
M	1,250	9,200	7.4
J	1,250	9,600	7.7
H	1,250	10,500	8.4
N	1,250	10,500	8.4
Q	1,250	12,000	9.6
R	1,250	10,800	8.6
O	1,250	10,500	8.4
P	1,250	10,500	8.4
Average	1,250	10,100	8.4

Another matter of some consequence is the amount of "set" taken by the concrete after the stress is relieved. The most satisfactory materials for the purpose of the engineer are those which have for moderate stresses, the power of perfect recovery. Of concrete, as ordinarily manufactured, this can scarcely be said. It will be observed in Table IV, that the average "set" for the rich concrete after a stress of 2,000 lbs. per sq. in., is approximately half as great as that of the poorer grade after a stress of half the magnitude. The data were taken somewhat at random from the Report of the Watertown Arsenal for 1904, but are believed to be fairly representative of the two grades of material.

The function of hoops in compression members is to resist the lateral expansion which accompanies longitudinal compression due to load. For most materials, there is a more or less constant ratio between the lateral and the longitudinal strain. This is known ordinarily as Poisson's ratio and for most materials of construction is about 1-3 or ¼. Let us assume a concrete column reinforced with hoops and with longitudinal rods. When it is stressed by loading a longitudinal shortening takes place which sets up stresses in both steel and concrete, the ratio between them being the ratio of their relative rigidities. If the hoops were absent, a lateral expansion would have taken place, which, per unit of diameter would be only a fraction of the aforementioned shortening per unit of length. The hoops reduce this to some extent (otherwise they would not serve their purpose), and, consequently, the unit deformation in them must be of even smaller extent. From this it is manifest that hoop stress will be very much less than the compressive stress carried at the same time by the longitudinal rods, and if some misgivings are had as to the wisdom of employing longitudinal steel in columns, certainly greater doubt might be entertained regarding the use of hoops. For while the fabrication of hooped reinforcement is usually more expensive than where longitudinal rods are used, the safeguard against bending due to eccentric loads and defective materials locally, is very inadequately afforded.

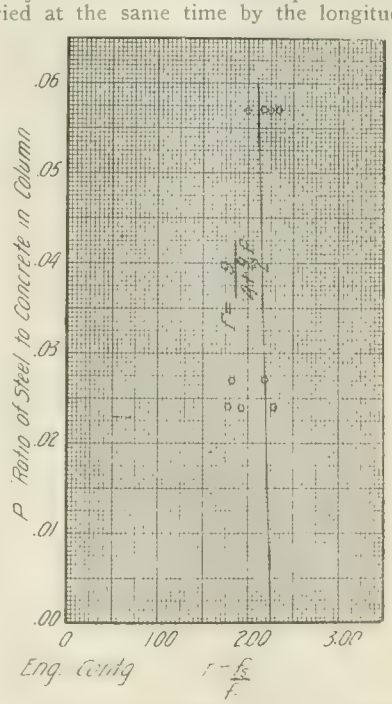


Fig. 7—Curve Showing Theoretic Effect of Change in Percentage of Metal on the Ratio of Steel Stress to Concrete Stress in 1 : 1 Hooped Concrete.

In the hooped columns, the tests on which are referred to below, a 1 :1 mixture of small size trap rock and cement was used. The hoops were welded from steel flats and were of two thicknesses, 0.05 and 0.12 ins. The quantity of metal relative to the core within the hoops varied from 0.024 to 0.057. No longitudinal metal was employed save three strips of thin hoop iron which were employed as spacers for the hoops. In order to measure the stresses in the hoops, certain of the rings were left exposed, partly or completely, and to these mirror extensometers were attached. Longitudinal deformations were measured by means of compressometers fixed to a gage length of about 50 ins. In the curves of Figs. 4, 5 and 6, an opportunity to see the manner in which the steel stress varies with the compressive stress in the concrete is afforded. In every case as the concrete was subjected to higher compressive stresses, a tendency on the part of the curve to deflect downward, manifested itself. In some cases, the curve became parallel with the axis of steel stress. This would indicate that the concrete, under high compressive stresses, had reached a state of partial plasticity within the hoops. The fact that, on release of load after heavy stressing, the extensometers did not usually completely recover, would indicate that this apparent tendency to flow had left the steel in a state of residual tension, since usually the steel stress had not even approached the elastic limit. In Fig 5 the continued increase in steel stress under a constant load is shown.

TABLE IV.—SHOWING THE AMOUNT OF "SET" AFTER THE RELEASE OF STRESSES IN TWO GRADES OF CONCRETE.
(Specimens all 12 ins. long.)

After 2,000 lbs. per sq. in.			After 1,000 lbs. per sq. in.		
Mixture	"Set" ins.	Ult. Strength lbs. per sq. in.	Mixture.	"Set" ins.	Ult. Strength lbs. per sq. in.
1 : 1	.0006	6,940	1 : 2 : 4	.0028	1,210
1 : 1	.0013	4,800	1 : 2 : 4	.0020	1,700
1 : 1	.0014	4,360	1 : 2 : 4	.0010	1,480
1 : 1	.0004	6,400	1 : 2 : 3	.0012	1,680
Average	.0009			.0017	

From purely theoretical considerations, if the elastic properties of the materials and the quantity of hooping present are known, it is possible to establish a simple relation between the compressive stress in the concrete and the accompanying stress in the encircling bands. In the evolution of the equation which follows, the stiffness ratio for this material was assumed to be 9. A number of determinations of Poisson's ration gave ¼ for an average value. For these materials, it can be shown that

$$\frac{f_s}{f_c} = \frac{9}{9 \over 4 + \frac{p}{2}}$$

where f_s is stress in steel bands, f_c is axial compressive stress in the concrete and p is the ratio of metal to concrete within the bands. Since p is usually small with respect to the other numbers involved, it follows that the usual changes which p might undergo, do not affect the ratio $f_s \div f_c$ in a very conspicuous way. In Fig. 7, the manner in which this ratio changes, consequent on variation of p, is shown. The points plotted adjacent to the curve show to what extent the theoretic investigation agrees with the results of experiment. In Table V are given a few simultaneous values of hoop stress and compressive stress in concrete. The figures are representative of a somewhat large number of determinations and broadly speaking, show, as is indicated on figures 6, 7, 8 and 9, that for the materials employed, the hoop stress is approximately twice that in the concrete.

TABLE V.—SIMULTANEOUS STRESSES IN CONCRETE AND STEEL HOOPS.
(Mixture, 1 : 1; Percentage of Metal in Hoops, 2.4 to 5.7.)

Concrete Stress lbs. per sq. in.	Hoop Stress lbs. per sq. in.	p	Steel Stress Concrete Stress.	State of Hoop.
2,400	5,500	.057	2.28	Part. Expd.
3,000	7,000	.024	2.30	Com. Expd.
1,900	4,300	.057	2.26	Part. Expd.
2,300	5,000	.057	2.18	Part. Expd.
2,000	4,700	.057	2.34	Part. Expd.
3,000	6,000	.057	2.00	Part. Expd.
3,250	4,000	.057	1.23	Com. Expd.
2,600	5,000	.024	1.92	Part. Expd.
2,300	5,000	.027	2.17	Part. Expd.
2,800	5,000	.024	1.77	Com. Expd.
2,750	5,000	.027	1.82	Com. Expd.
Average			2.02	

Tests made by Professor Talbot in 1907 on hooped concrete colums, using a 1:2:4 mixture, showed that the ultimate strength was increased about 570 lbs. per sq. in. for each per cent of hooping employed. Similarly, tests made at the Watertown Arsenal in 1906, show that one per cent of metal in the form of hoops increased the strength of the member to the extent of 1,020 lbs. per sq. in. Professor Withey, in 1909, reported that for each per cent of metal employed in the form of spiral reinforcing, the increase in ultimate strength on an average was 1,320 lbs. per sq. in. for 1:2:4 concrete. From these and other tests which might be cited, a generous allowance for hooping would be 1,000 lbs. per sq. in. gross strength for each per cent of metal employed. Tests conducted on hooped columns reinforced also with longitudinal rods indicate that greater efficiency is obtained from the rods than when employed without the hoops.

A comparison of costs between the rich mixture concrete column, carrying light longitudinal reinforcement and a hooped structure of estimated equivalent ultimate strength is interesting. The materials laid down have been assumed to cost as follows:

Cement, $1.50 per bbl.
Aggregate, $2 per cu. yd.
Sand, $1 per cu. yd.
Plain reinforcing, 3 cts. per lb.
Hooping, fabricated, 5½ cts. per lb.

For a 1:1 cement and rock mixture, the cost per cubic yard will be:

Cement	$8.10
Rock	1.58
Labor	2.00
Plain steel, ½%	2.03
Total	$13.71

Since the metal is added chiefly as emergency material, it will not be figured in the ultimate strength, which will be taken at 5,000 lbs. per sq. in. A 1:2:4 concrete (the ultimate strength of which plain may be assumed at 2,000 lbs. per sq. in.) will be rendered equivalent in strength to the 1:1 mixture by the use of 3 per cent of hooping metal. The cost per cubic yard will then be:

Cement	$2.52
Rock	2.00
Sand	.50
Steel hoops	22.28
Labor	2.00
Total	$29.31

In addition to the greater cost, this column will not possess the stiffness and probably, not the margin of safety against bending stresses which are found in the cheaper column.

In order to compare the areas of three different types of column, and their cost per foot of height, it will be assumed that a 10-story building with dead and live floor loads at 200 lbs. per sq. ft. and a roof load of 100 lbs. per sq. ft. is to be constructed. Assume also square floor bays of 15 ft. to a side. It will be seen that the load sustained by a column on the ground floor will be 427,500 lbs. This may be carried (a) by a structural steel column; (b) by a column of the poorer grade of concrete; (c) by a column of the richer mixture.

A reference to the Carnegie Handbook, p. 141, shows that a steel column consisting of two 10-in. channels and two ⅞-in. plates will be adequate. This column weighs 121 lbs. per running foot. The cost per foot of height will be:

Steel at 5 cts. per lb.	$6.05
Fireproofing 2 ins. thick.	.58
Total	$6.63

A 1:2:4 concrete column with 1 per cent of longitudinal metal will be figured at 450 lbs. per sq. in. for the concrete and $450 \times 15 = 6{,}750$ lbs. per sq. in. for the steel. The average stress will therefore be $450\ (1 + .14) = 513$ lbs. per sq. in. The gross area required will be $427{,}500 \div 513 = 833$ sq. ins. Hence, a column 29 ins. square will be adequate. Allowing 1 in. additional for fireproofing, we have a clumn 30 ins. square, the cost of which per foot of height would be:

Concrete, including 1% steel and labor...	$2.55
Forms	.46
Total	$3.01

The third method employs a 1:1 mixture, the working stress on which will be taken as 1,250 lbs. per sq. in. The area required will be $427{,}500 \div 1{,}250 = 342$ sq. ins. This is the area of a square of 18.5 ins. to the side. Allowing 1½ ins. for fireproofing, we obtain a column 20 ins. square, the cost of which per foot of height, with ½ per cent of longitudinal steel, would be:

Concrete, including ½% steel and labor..	$1.30
Forms	.32
Total	$1.62

The areas of the cross-sections in the three cases are:—(a) 1.8 sq. ft.; (b) 6.3 sq ft.; (c) 2.8 sq. ft.

It is thus seen that the difference between the smallest cross-section and the largest is 4.5 sq. ft., an item of considerable importance in districts where the rental of floor space is high. On the other hand, the difference in cross-sectional area between the most expensive method of carrying the load, and the cheapest, is 1.0 sq. ft. Having regard then to the fact that the rich mixture column costs only one-fourth as much as the steel structure, there would seem to be a good deal to be said in favor of the stronger mixture.

The writer desires to state that of the experimental work referred to above, part was conducted in the Testing Laboratory of McGill University in Montreal, and part in the Laboratory of Applied Mechanics in the University of Toronto, the former being done under the general supervision of Professor E. Brown of the Department of Civil Engineering.

Consideration is invited to the following inferences to which an examination of the data at hand seems to lead. Since the experimental evidence supporting these conclusions is, in the opinion of the writer, scarcely extensive enough upon which to base broad generalizations, they are not advanced as being final and conclusive.

(1.) The rich mixture is more uniform in its elastic properties than the lean mixture and for proportionate stresses, the permanent set is likely to be very much less. The parabolic feature of the stress-strain curve is also less noticeable.

(2.) The employment of a rich mixture in columns permits of the more economic stressing of the steel longitudinals. It is very probable that a strength equal to that obtained by the use of a 1:1 mixture can be secured by the careful grading of the aggregate and the use of less cement.

(3.) The experiments cited indicate that, for the materials employed, the stress in the steel hoops was approximately twice the axial compressive stress in the concrete core. The steel is, consequently, not economically employed.

(4.) Theoretically, and experimentally, the variation in the relation of steel stress to axial compressive stress, did not vary greatly with variation in the percentage of metal.

(5.) A given ultimate strength can be more cheaply secured by a rich mixture lightly reinforced by longitudinals than by the utilization of hooping. The former also secures greater rigidity and safety against bending.

(6.) For equal safe loads on columns, the lean mixture is probably intermediate in cost between the steel column and the rich mixture lightly reinforced by longitudinals, the latter being the cheapest.

(7.) The cross-sectional area of the steel column is least for a given loading and the lean mixture greatest. The difference between the cross-sectional areas of a steel, fireproofed column and a rich mixture concrete column is the least of all.

Relay Pumps for Hydraulic Fill.—The progress of work on the hydraulic fill of the Gatun dam of the Panama Canal has made it necessary to add three auxiliary or relay pumps to the ones in use in order to operate against the increasing head. The three 20-in. dredges originally installed were designed to overcome a head including friction of 75 ft. When the total reached 100 ft. the output of the dredges was materially reduced and it became necessary to add more pumps. Accordingly three 20-in. centrifugal pumps, each direct connected to a 550-HP. induction motor, were installed at such elevations and distances as to take an average of about half the load. Additional relays will be installed as the higher parts of the dam are reached. The dam is to be built up to 115 ft. above sea level. This makes the actual maximum lift about 160 ft., but the total head to be overcome will be far in excess of that. The friction in the pipes has been equivalent to a 2 or 2½-ft. lift per 100 ft. The length of pipe lines used for the first 100 ft. of head varied between 2,000 ft. and 4,500 ft., so that the friction to be overcome amounted to nearly half the dredge lifting power.

Steam Shovel Records On the Panama Canal.—The total amount of material excavated by steam shovels in the central division of the Panama Canal during the month of January was 1,461,389 cu. yds. The best record for one shovel during the month was in the Culebra district where 50,933 cu. yds. of rock were removed in 25 days by shovel No. 223. Shovel No. 219 had the second best record with 50,270 cu. yds. of rock excavated in 25 days. In the 70-ton class the best work was done by shovel No. 111 working in the Bas Obispo district which excavated 27,688 cu. yds. of earth in 23 working days. The high record for one day was 3,009 cu. yds. of rock excavated on Jan. 8 by shovel No. 218 in the Empire district.

A Municipal Reference Library for Milwaukee:—A municipal reference library, a new department for the investigation of municipal problems, has been created in the city of Milwaukee. The object of the department is to collect all possible data bearing on municipal reform and civic betterment. The department aims to cooperate with the heads of departments in other cities in the effort to obtain useful information along these lines. A classification of charters, laws, ordinances, etc., together with reports and statistics obtainable from other cities will be made. The information thus obtained will be used as an aid in securing better laws and municipal government for the improvement of the city.

Earth and Rock Section

Note: This section is devoted to methods and costs of excavating earth and rock and building embankments. It will cover the grading of roads and railroads, diking and canal work, dredging, building reservoirs and earth dams, sewer and water pipe trenching, quarrying, etc.

Methods and Cost of Excavating Twin Tunnels Through Trap Rock for the Pennsylvania R. R. Tunnel Entrance to New York City.*

There are two parallel single-track tunnels. The center line is a tangent, and nearly on the line of 32d St., New York city, produced, its course being N. 50° 30′ W. The elevation of the top of the rail at the Weehawken Shaft, on the west bank of the Hudson River, is about 64 ft. below mean high water; and at the Western Portal, or Hackensack end, the rail is about 17 ft. above; the grade throughout is 1.3 per cent, ascending from east to west. The length of each tunnel between the portals is 5,920 ft.

The contract for this work was let on March 6, 1905, to the John Shields Construction Co.; it was abandoned by the receiver for that company on Jan. 20, 1906, and on March 20, of that year, was relet to William Bradley, who completed the work by Dec. 31, 1908.

Geology.—Starting west from the Weehawken shaft, the tunnels pass through a wide fault for a distance of nearly 400 ft. The broken ground of the fault, which consists of decomposed sandstone, shale, feldspar, calcite, etc., interspersed with masses of harder sandstone and baked shale, gradually merges into a compact granular sandstone, which, at a distance of 460 ft. from the shaft, was self-supporting, and did not require timbering, which, of course, had been necessary up to this point.

A full face of sandstone continued to Station 274 + 60, 940 ft. from the shaft, where the main overlying body of trap appeared in the heading. The full face of the tunnel was wholly in trap at about Station 275 + 30, and continued in this through to the Western Portal, where the top of the trap was slightly below the roof of the tunnel, with hardpan above. The contact between the sandstone and the overlying trap was very clearly defined, the angle of dip being approximately 17° 40′ toward the northwest.

The character of the trap rock varied considerably. At the contact, at Station 275, and for a distance of approximately 200 ft. west, corresponding to a thickness of about 60 ft. measured at right angles to the line of the contact, a very hard, fine-grained trap, almost black in color, was found, having a specific gravity of 2.98, and weighing 186 lbs. per cu. ft. The hardness of this rock is attested by the fact that the average time required to drill a 10-ft. hole in the heading, with a No. 34 slugger drill, with air at 90 lbs. pressure, was almost 10 hrs. The specific gravity of this rock is not as high as that of some other specimens of trap tested, which were much more easily drilled. This rock was very blocky, causing the drills to bind and stick badly, and, when being shoveled back from the heading, as it fell, it sounded very much as though it were broken glass.

The remainder of the trap varied from this, through several changes of texture and color, due to different amounts of quartz and feldspar, to a very coarse-grained rock, closely resembling granite of a light color, though quite hard. The speed of drilling the normal trap in the heading was approximately 20 to 25 mins. per ft., as compared with the 60 mins. per ft. noted above, the larger amounts of quartz and feldspar accounting for the greater brittleness and consequently the easier drilling qualities of the rock. The normal trap in these tunnels has a specific gravity varying from 2.85 to 3.04, and weighs from 179 to 190 lbs. per cu. ft.

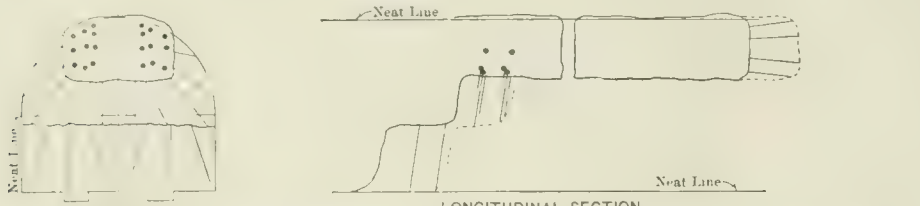
Timbering.—These tunnels have been excavated entirely by the center top heading method, almost invariably used in the United States. Timbering, where required, was of the usual segmental form with outside lagging. In a few places it was necessary to hold the ground as the work progressed, and, in such cases, crown bars were used in the headings. There was some little trouble at the Western Portal, where the top of the rock was very near the roof of the tunnel. A side heading was driven at the level of the springing line until a point was reached where the roof was self-supporting, and the timbering was brought out to the face of the portal from that point.

Drilling.—Where no timbering was required, several different methods were used in drilling and excavating the solid rock though in all cases a center top heading was driven. The four diagrams, Figs. 1, 2, 3, and 4, gave typical examples of these methods and show, in the order of their numbers, the general tendency of the development from a small heading kept some distance ahead of the bench to a large heading with the bench kept close to it. The notes on each diagram give the general details of the quantity of drilling and power used, methods of blasting, etc.

All the drills used throughout the work by Mr. Bradley were Rand No. 34 sluggers, with 3⅝-in. cylinders, and the steel was that known as the "Black Diamond Brand," 1⅜-in., octagon. It was used in 2, 4, 6, 8, 10 and 12-ft. lengths; toward the end of the work it was proposed to use 14-ft. lengths, but owing to some delay in delivery this length was never obtained. The starters, 18 to 24 ins. long, were sharpened to 2¾ to 3-in. gage, which was generally held up to depths of 6 ft.; then the gage gradually decreased until it was 1¾ to 2¼ ins. at the bottom of a 12-ft. hole. Frequently, as many as three or four starters were used in starting a hole, and generally two sharpenings were required for each 2 ft. drilled, after the first 6 ft. It is estimated that about ¼ in. of steel was used for each sharpening, and that there was an average of one sharpening for every foot drilled.

The total quantity of steel used up, lost, or scraped on the whole work was almost exactly 1 ft. for each 10 cu. yds. excavated, equal to 1¼ in. of steel per yard, distributed approximately as follows:

Sharpening	¾ to ⅞ in.
Other losses	½ to ⅜ in.
Total	1¼ in. per cu. yd.



Drilling Method No.1: Small heading, 60 to 80 ft. long. Two columns used in heading, with two drills on each. Drills on sub-bench and main bench mounted on tripods.

	Per Round				Per Cubic Yard		Per Linear Foot of Tunnel		
	Total Depth Drilled	No. of Cubic Yards	Pounds of Dynamite	Advance	Linear Feet Drilled	Pounds of Dynamite	Cubic Yards	No. of Feet Drilled	Pounds of Dynamite
Heading	110-135	18-21.6	93-131	5-6	8-9	5-6	3.6	29.-32	18-22
Bench	110-120	53-60	76-97	3½-4	2	1.4-1.6	15.4	30.-31	21.5-24.6
						Total	19	59.-63	39.5-46.6
						Per cubic yard, whole tunnel section		3 to 33	2.1-2.5

Blasting Notes:	Number of Sticks
Heading: First Round: 6 sticks, 60% in each cut hole, cut generally fired twice	36 to 72
Second Round: 3 side holes each side, 5 sticks, 40% each	30
Third Round: Rest of side holes and dry holes, 5 sticks, 40% each	40
Stub holes, say	5 to 15
Total Sticks	111 to 157
Total Pounds	93 to 131
Sub-bench: 4 widening holes, 2 to 3 sticks each, 40%	10 to 12
6 down holes 5 to 7 sticks, each, 40%	30 to 42
Bench: 6 holes 6 to 8 sticks each, 40%	36 to 48
Taking up bottom, average, say	15
Total Sticks	91 to 117
Total Pound	76 to 97

Fig. 1—Drilling Method No. 1.

TABLE I.

Method	Date.	Number of shifts covered by observations.	Place.		Average number of hours worked per shift.	Average depth drilled per hour per drill.	Average depth drilled per yard.
No. 1 and 2-drill	Aug. '06	44	Hackensack,	N.	5.69	2.78	10.1
	Sept. '06	33	Hackensack,	N.	5.80	3.77	11.1
	Aug. '06	43	Hackensack,	S.	5.60	2.89	9.1
	Sept. '06	36	Hackensack,	S.	6.18	2.65	8.7
	Jan. '07	16	Central Shaft E.	N.	5.99	2.99	8.2
	Jan. '07	20	Central Shaft E.	S.	6.05	2.9	7.1
	Apr. '07	48	Central Shaft W.	N.	4.92	3.3	6.7
	Apr. '07	48	Central Shaft W.	S.	5.00	3.2	7.7
No. 2 and 3-drill	Dec. '06	54	Weehawken,	N.	4.95	2.16	4.52
	Dec. '06	54	Weehawken,	S.	5.23	2.14	4.54
	Dec. '06	52	Hackensack,	N.	5.03	2.2	5.77
	Dec. '06	54	Hackensack,	S.	5.90	1.82	5.67
No. 4-7-drill	June '07	56	Weehawken,	N.	4.77	2.55	4.23
	June '07	58	Weehawken,	S.	4.82	2.26	3.88
No. 8-drill	May '07	66	Hackensack,	N.	4.67	2.44	5.00
	May '07	60	Hackensack,	S.	4.54	2.57	4.80

*Condensed and rearranged from a paper by F. Lavis, Proceedings, American Society of Civil Engineers, Vol. xxxvi, p. 262.

An "Ajax" drill sharpener was used, and proved very satisfactory. Rubber and cotton hose, covered with woven marlin, was used for the bench (3 ins. inside diameter, in 50-ft. lengths), for drills (1 in. in diameter, in 25-ft. lengths), and for steam shovels (2½ ins. in diameter, in 50-ft. lengths). Hose coverings of wound marlin, and of woven marlin with spiral steel wire covering were tried, but were not satisfactory, owing to the unwinding of the marlin and the bending of the steel covering.

The average quantity of powder used on the whole work was about 2.9 lbs. per cu. yd. The tables on the diagrams, Figs. 1, 2, 3, and 4, show that the quantity actually used in making the advance at the main working faces was about 2.5 lbs. The difference is accounted for by the larger percentage of powder used for trimming the sides, breaking out the cross-passages between the tunnels, and the excavation of the ditches, the latter operation not being done until the concrete lining was about to be put in.

There was some time, too, during the earlier stages of the work, when it is believed that an excessive quantity of powder was used; for one or two months it ran up to 4 lbs. per cu. yd.

The dynamite used was "Forcite." At first, both 40 per cent and 60 per cent were used, the 60 per cent generally only for blasting the cut in the headings; during the latter part of the work, however, the 60 per cent was used exclusively.

The rock as a rule broke very well, and only a comparatively small quantity could not be handled by the shovels without being broken up further by block-holing. In the sandstone the quantity of powder per cubic yard was much more than for any of the trap.

In drilling the Central shaft, a 6-hole cut was made approximately on the center line, east and west, the enlargement requiring about 18 more holes, which were generally about 6 ft. deep, the average advance being about 4 ft. per day of 24 hours.

The drills were run by steam until a depth of about 150 ft. had been reached, air from the plant at Hackensack being available after that time. Four drills were used most of the time, and six later when air was available. This work was done entirely by the John Shields Construction Co., and a depth of 205 ft. was sunk in 6 months (from July 15, 1905, to Jan. 15, 1906). A derrick was used for hoisting and lowering men and tools during the sinking, elevators being put in later.

Drilling Data.—During the progress of the work, both general and detailed observations were made of the drilling, the results of which are shown in the tables. Table I has been compiled from the records as platted daily on the chart from the inspectors' reports. Table II contains some data relating to the drilling in the headings.

The general results of these observations show that the average time the drills were "actually working" was 5.2 hrs. per shift, and that they were actually "hitting the rock" about half of this time, or about 2.5 hrs. per shift. The average depth drilled per hour, during the time the drills were "actually working," was 2.66 ft.

The "actual working time," as noted above covers the period from the time the drills were first set up in the heading after blasting until they were taken down for the next blast; it does not include the time occupied in setting up or taking down, which would probably average 30 mins. more per shift. It is believed that this figure will also apply very closely to drills working on the bench, though no actual observations were taken to determine this, on account of the irregularity with which they were worked.

The actual working time of the drills in the 736 shifts (7,360 hrs.) covered by Table I, was 3,826 hrs., or 5.2 hrs. per shift. The average depth drilled per yard, as shown in the last column of Table I, agrees fairly well with the figures on the diagrams, Figs. 1, 2, 3 and 4.

Table II has been compiled from detailed timed observations of individual drilling of down holes in the bench, for periods of 7 or 8 hrs. each, in January, 1907. The work at that time was in fairly normal condition at all points.

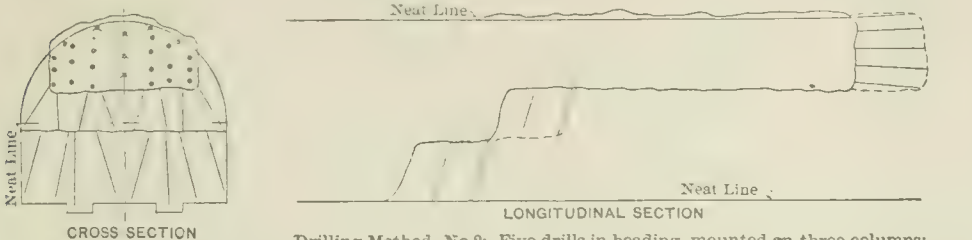
The figures in the third column of Table II include the time required for moving from one hole to another, when this occurred during the observation, the time required for changing bits, oiling drills, etc., and all delays of all kinds. A close record of the delays was kept, and it was considered that, of the 93 hrs., 48 mins. in Table II the unnecessary delays amounted to 5 hrs., 7 mins., or about 5½ per cent.

As a check on the average figures obtained from various sources, the following estimate of the cost of drilling per cubic yard was made up from these average figures, for comparison with the actual average cost on the whole work. The cost records show this to be about $2.25 per yd., exclusive of power for running the drills, almost exactly what the following estimates give for theoretical average conditions, although no effort was made to have this latter compare so closely.

ESTIMATED COST PER DRILL PER DAY

Drill runner, 1 at $3.50 per day	$3.50
Helper, 1 at $2.00 per day	2.00
Nipper, 1-5 at $1.75 per day	0.35
Heading foreman, 1-1[illegible] at $5.00 per day	0.42
Walking boss, 1-50 at $7.50 per day	0.15
Blacksmith, 1-12 at $4.00 per day	0.34
Blacksmith helper, 1-12 at $2.00 per day	0.16
Machinist, 1-1[illegible] at $3.00 per day	0.25
Machinist helper, 1-24 at $1.75 per day	0.07
Pipe fitter and helper, 1-50 at $5.00 per day	0.10
Oil, waste, blacksmith coal, etc.	0.24
Drill steel, 6 in. per shift	0.20
Total	$7.78

Average number of feet drilled per cubic yard . . . 3 to 3.5
Number of feet drilled per drill per shift . . . 10.5 to 12
Number of yards per drill per shift . . . 3.5‡
$7.78
Cost of drilling, per yard . . . $2.22‡
3.5

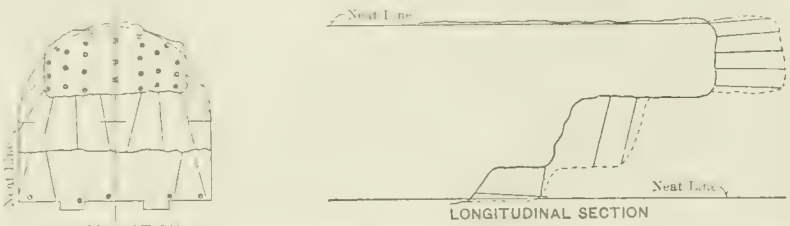


Drilling Method, No.2: Five drills in heading, mounted on three columns; the holes marked with a cross (X) were drilled with the drills on the center column

	Per Round				Per Cubic Yard		Per Linear Foot of Tunnel	
	Total Depth Drilled	No. of Cubic Yards	Pounds of Dynamite	Advance	Linear Feet Drilled	Pounds of Dynamite	No. of Feet Drilled	Pounds of Dynamite
Heading	190-220	55-42	134-196	[illegible]	5.4-6.0	3.9-5.0	5.3	28 to 32.	20.7-26.5
Bench	110-130	55	79-106	4	2.-2.4	1.4-2.0	13.7	27. - 33.	19.2-27.4
						Total	19	55. - 65.	39.9-53.9
						Per cubic yard, whole tunnel section		2.9 - 3.4.	2.1-2.8

Blasting Notes.	Number of Sticks
Heading: First Round, 2 to 3 relieving holes sprung with 4 to 5 sticks each	8 to 15
8 cut holes, 7 sticks each (sometimes shot twice	56 to 112
First side round, 6 holes, 6 sticks each	36
Widening and dry holes, 10 to 12 holes, 6 sticks each	60 to 72
Total Sticks	160 to 235
Total Pounds	134 to 196
Sub-bench: 8 holes, 4 to 6 sticks each	32 to 48
Bench: 8 holes, 6 to 8 sticks each	48 to 64
Taking up bottom, average	15
Total Sticks	95 to 127
Total Pounds	79 to 109

Fig. 2—Drilling Method No. 2.



Drilling Method No.3: Heading same as second method, but larger lift taken off bench, and lift holes drilled in bottom bench in order to get down to grade in floor. Bench kept closer to heading.

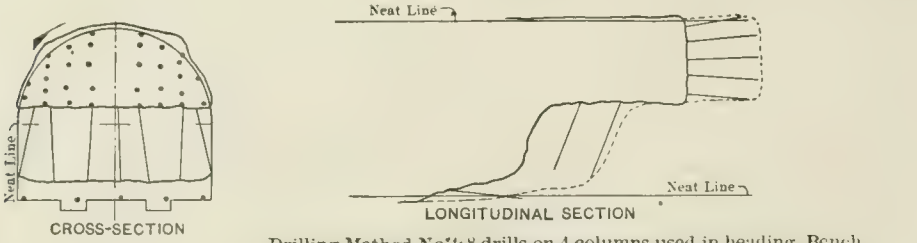
	Per Round				Per Cubic Yard		Per Linear Foot of Tunnel	
	Total Depth Drilled	No. of Cubic Yards	Pounds of Dynamite	Advance	Linear Feet Drilled	Pounds of Dynamite	No. of Feet Drilled	Pounds of Dynamite
Heading	190 to 220	55 to 42	131 to 196	[illegible]	5.4 to 6.0	3.9 to 5.0	5.3	28 to 32	20.7 to 26.5
Bench	145 to 190	90 to 210	118 to 167	[illegible]	3.6 to 4.1	1.9 to 1.8	13.7	22 to 36	17.8 to 24.7
						Total	19	50 to 58	38.5 to 51.2
						Per cubic yard, whole tunnel section		2.6 to 3.1	2.0 to 2.6

Blasting Notes:	Number of Sticks
Heading: First Round, 2 to 3 relieving holes sprung, with 4 to 5 sticks each	8 to 15
8 cut holes, 7 sticks each (sometimes shot twice)	56 to 112
First side round, 6 holes, 6 sticks each	36
Widening and dry holes, 10 to 12 holes, 6 sticks each	60 to 72
Total Sticks	160 to 235
Total Pounds	118 to 167
Sub-bench: 4 widening holes, 4 to 5 sticks each, 2 rounds	32 to 40
6 down holes, 5 to 7 sticks each, 2 rounds	60 to 84
Bench: 4 down holes, 5 to 7 sticks each,	40 to 28
6 to 8 lift holes, 5 to 6 sticks each	30 to 48
Total Sticks	162 to 200
Total Pounds	118 to 167

Fig. 3—Drilling Method No. 3.

In all the foregoing tables and computations, the quantities used have been those paid for. The quantity taken out, however, has been 10 per cent more than that paid for, and 28 per cent more than the contractor was actually required to take out.

Linear feet drilled per cubic yard	5.0	6.0
Pounds of dynamite per cubic yard	3.4 to 5.7	8½
Average depth drilled with one sharpening	12 ins.	6½ ins.
Total number of men per day of 24 hours*	450	3.300



Drilling Method No. 4: 8 drills on 4 columns used in heading. Bench taken off in one lift. Bottom taken up with lift holes

	Per Round				Per Cubic Yd.		Per Linear Foot of Tunnel		
	Total Depth Drilled	No. of Cubic Yards	Pounds of Dynamite	Advance	Linear Feet Drilled	Pounds of Dynamite	Cubic Yards	No. of Feet Drilled	Pounds of Dynamite
Heading	310-320	63-71	215-357	8-9	4.5-5.1	3.4-5.7	7.9	35.6-45.	26.9-45.0
Bench	190-210	89-100	107-155	8-9	1.9-2.2	1.2-1.7	11.1	21.1-24.	13.3-18.9
						Total	19	56.7 69.	40.2-63.9
Per cubic yard, whole tunnel section								3.-3.6	2.1-3.4

Blasting Notes:	Number of Sticks
All holes of whole round are cleaned and loaded before blasting is started	
First Round 5-6 lift holes, 7 to 9 sticks each	35 to 54
First row, sub-bench, 6 holes, 6 to 8 sticks each	36 to 48
Second Round Second row, sub-bench and widening holes, 8 to 10 holes, 6 to 8 sticks each	48 to 64
Stub holes	10 to 20
Bench Total Sticks	129 to 186
Total Pounds	107 to 155
Third Round 8 cut holes, 7 sticks each, often requires 3 to 4 charges	112 to 224
Fourth Round: 8 holes, First side round, 5 to 7 sticks each	40 to 56
Fifth Round 8 holes, Second side round, 5 to 7 sticks each	40 to 56
2 dry holes 5 to 7 sticks each	10 to 14
Sixth Round 4 to 6 widening holes and dry holes, 6 sticks each	36 to 48
Stub holes	20 to 30
Heading Total Sticks	258 to 423
Total Pounds	215 to 357

Fig. 4—Drilling Method No. 4.

The specifications required that the excavation should be taken entirely outside of the neat line, but not necessarily beyond this line, but that the contractor would be paid for rock out to the standard section line, which is 1 ft. larger on the sides and top and 6 ins. deeper in the bottom than the neat line.

A great deal of the extra quantity was due to rock falling from the core-wall side whenever one working face was behind the other. Blasting at the face behind generally loosened more or less rock on the core-wall side of the tunnel which was ahead, in one or two instances breaking entirely through, the hole in the core-wall in this case being utilized by building a storage chamber in it.

Table III gives some of the statistics of drilling in the Simplon Tunnel, as compared with the drilling on this work, the figures for the Simplon being taken from papers read before the Institution of Civil Engineers of Great Britain.

TABLE III.

	Bergen Hill.	Simplon.
Drills set up in heading, per cent of total elapsed time	50%	60%
Actually drilling the rock, per cent of total elapsed time	25%	50%
Average advance per round (attack)	8.5 ft.	3.8 ft.
Average time for each attack	36 hrs.	5 hrs.
Average advance per day of 24 hours	5 ft.	18.4 ft.
Depth of holes	10 ft.	16 ft.
Diameter of holes	3 ins.	2¾ ins.
Linear feet drilled per hour, per drill	2.7	7.0

The figures in Table III are for "heading only" in both cases, except for the last item (number of men), the heading in the Simplon Tunnels being about 60 sq. ft., as compared with the heading of Method No. 4 (which has been used for comparison), of 210 sq. ft.

Mucking and Disposal.—The conditions affecting the disposal of the muck, after blasting, were quite different at the two ends, the grade descending in the direction of the loads at Weehawken and ascending at the Hackensack end. At the Weehawken end the mouth of the tunnels was at the bottom of a shaft some 80 ft. deep, the muck in the tunnel cars being hoisted by elevators to a platform at the top from which it was dumped into standard gage cars supplied by the Erie Railroad, as shown by Fig. 5; or later hauled to the crusher or storage pile, some 500 ft. distant. At the western end, the cars were hauled directly to the surface through the approach cut, and the material, except that required for concrete and rock packing, was deposited in the embankment across the Hackensack Meadows, a haul of from 1,000 to 3,000 ft. beyond the portal.

All disposal tracks were of 3-ft. gage, the main running tracks being generally laid with 60-lb. second-hand rails, although some of lighter weight were used.

Except for about 1,000 ft. in each tunnel at the Weehawken end, where the muck was loaded by hand, four steam shovels, operated by compressed air, were used, one at each working face. One of these was a "Marion, Model No. 20," weighing 38 tons, the others were "Vulcan Little Giant," of about 30 tons each. All these shovels were on standard-gage track, and were moved back from 300 to 500 ft. from the working face during blasting.

At Weehawken, previous to the time the shovels were installed, the muck was shoveled by hand into the cars from the bottom of the bench, and the heading muck was dumped into them from a movable platform. There were three loading tracks at the face. The cars used at that time were similar to that shown by Fig. 6, but were about two-thirds the size and had no end door; stop-planks were supposed to be placed in the ends but seldom were. The loads averaged about ½ cu. yd. (measured in place). After the shovel was installed the cars shown by Fig. 6 were used, and the loads averaged nearly 1 cu. yd.

Th empty cars were pushed up to the shovel by hand from the storage track. When loaded, they were given a start with the bucket of the shovel, and were then allowed to coast by gravity out to the storage track near the shaft, where they were stopped by placing rolls of cement bags or burlap on the rails. After the lining was started, the loaded cars were stopped on the inside of the lining and only sent out over the single track through this latter at stated intervals, when several cars followed in close succession, with a long interval, which permitted the concrete to be brought in. The empty cars were hauled back to the storage track near the working face by mules, one mule usually hauling two cars at a time.

Up to the time the trap rock was reached, about 1,100 ft. from the shaft, the excavated material was disposed of by loading it on flat cars. All the trap, however, was stored to be used later for concrete and ballast.

When the tunnels were in full working order, 60 muck cars of the type shown by Fig. 6 were in use, about evenly divided between the two tunnels. For some time the work was greatly hampered by lack of cars, and even with the 60 finally obtained, there were many times when extra cars could have been used to advantage to keep the shovel working.

When mucking by hand, the mucking gangs consisted of from 15 to 20 men. The maximum output was 50 cu. yds. and averaged about 35 cu. yds. per shift; there was a great deal of trouble in keeping the gangs full, as labor at that time was very scarce, and the tunnels were quite wet. The maximum output of either of the shovels was 159 cu. yds. in one shift, and the best average in any month—which was between July and December, 1907, during which time only the enlargement and bench of the Central Shaft headings was being taken out from the western end—was 60 cu. yds. per shift. As the shovels were generally idle for one shift out of three, the quantity actually handled averaged 90 cu. yds. per shift during the shifts the shovel worked. All these quantities were "measured in place," and as previously noted, would be about equal to twice as much measured loose in the cars.

The shovels at both ends were usually worked with three crews for the two tunnels; two day crews, one at each shovel, and a night crew which was used in either tunnel as occasion required. The day crews generally averaged from 45 to 60 hrs. overtime during the month, one of them working during the early part of the evenings in the opposite tunnel to the night crew. For a short time, when the ventilation at the western end was very bad, four crews were worked, day and night crews in each tunnel; but, as a general rule, the method of working three crews was preferred by the men, and was less expensive for the contractor.

At the Hackensack end, 4-yd., Allison, one-

*On Bergen Hill Tunnels, for two full working faces at the Hackensack end, about 3,000 ft. in from portal (March, 1908). At Simplon, two full faces and two headings, at distance of about 5,000 ft. in from the portal (January, 1909). These both include lining as well as excavation. The lining of the Bergen Hill Tunnels progressed about twice as fast as the excavation; it is inferred that on the Simplon it progressed at about the same rate as the excavation.

†At the Italian end, in Antigoric gneiss, which is stated to be very hard rock.

TABLE II.

Date.	Place.	Total working time. Hours.	Minutes.	Number of feet drilled.
Jan. 14th, 1907	Weehawken N.	8	[illegible]	15
Jan. 15th, 1907	Weehawken N.	[illegible]	32	12
	Weehawken N.	[illegible]	22	14
Jan. 12th, 1907	Weehawken S.	[illegible]	0	20
	Weehawken S.	8	0	11
	Weehawken S.	8	0	10
Jan. 11th, 1907	Hackensack N.	8	0	13
Jan. 17th, 1907	Hackensack N.	[illegible]	10	10
	Hackensack N.	[illegible]	5	11
	Hackensack N.	[illegible]	10	10
Jan. 16th, 1907	Hackensack S.	4	20	10
	Hackensack S.	6	9	10
	Hackensack S.	[illegible]	[illegible]	8
Totals		93	48	154

Average, 36.6 min. per ft. drilled, or 1.64 ft. drilled per hour.

way, dump cars were used, being handled by dinky locomotives, of which there were three in use up to October, 1907, and four after that. One 15-ton Porter engine, with 10x16-in. cylinders, was used outside the tunnels for handling the trains (from 6 to 8 cars) on the dumps and to the crusher; the other three, 12-ton Vulcans, 9 x 14-in., were used in the tunnels. About 30 dump cars were in use, and of these there were generally from 3 to 6 under repair.

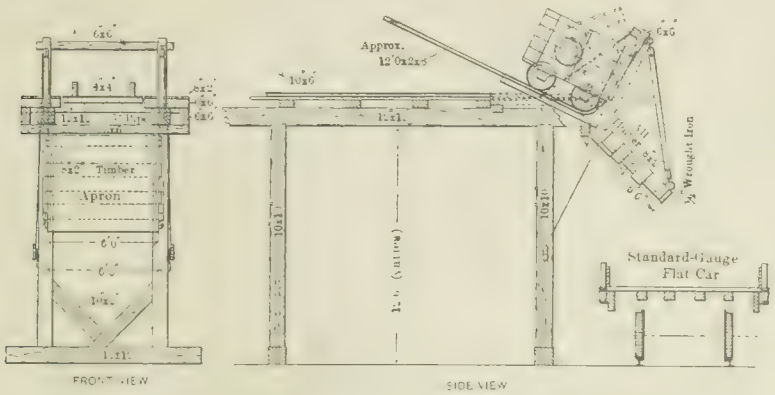


Fig. 5—Method of Emptying Dump Cars at Weehawken Shaft.

Generally, 4 cars were hauled out together, although 5 and occasionally 6 were handled. The work was generally arranged so that the heavy mucking shift alternated in the two tunnels, the two engines being worked there and a single engine in the other tunnel.

The tunnel engines left the cars on a track just outside the portal, from which they were made up into trains of from 6 to 8 cars and taken to the dump or crusher by the large dinky.

The muck from the Central Shaft headings was loaded by hand into cars similar to that shown by Fig. 6, but smaller and having no door at the forward end. A double elevator took the cars to a platform about 20 ft. above the surface, where they were dumped by revolving platforms, similar to those at Weehawken, into storage bins or directly into wagons. The muck was all hauled away in wagons; part of it was used to fill some vacant lots, and part was hauled to the crusher at the Western Portal.

The method under which the best results were obtained was that in which a full round was blasted every 36 hrs., securing an advance of practically 9 ft. of full section. During the first shift of three, as soon as the blasting had been completed and lights strung, the shovel was moved forward, and cleaned up the floor to the main pile of muck, the material from the blast being scattered from 150 to 300 ft. back from the face; during this shift, also, the drillers mucked the heading and set up their drills, the muckers helping to carry in the columns and drills. During the second shift the main pile of muck was disposed of, leaving not more than 2 or 3 hrs. work for the shovel on the third shift. This left nearly the whole of the third shift for drilling the lift holes.

Ventilation.—At Weehawken considerable difficulty was caused by fog and smoke accumulating in the tunnels after blasting. This was generally worse on days when the barometric pressure was low outside, and worse in the North than in the South Tunnel. A 6-ft. fan, driven by an electric motor, was installed in the cross-passage at Station 274, 900 ft. from the shaft, the headings at that time being about 300 ft. in advance of this point, to force the air from the South into the North Tunnel, drawing it in at the mouth of the South tunnel and discharging it at the mouth of the North Tunnel, thus insuring a circulation in both tunnels, as shown in plan by Fig. 7.

This necessitated, of course, that the cross-passages between that in which the fan was placed and the mouths of the tunnels should be blocked tight. There was some difficulty in keeping this blocking tight, owing to the force of the blasting blowing out the bulkheads. The fan, however, did good service when it and the bulkheads were in good order. The compressed air discharged from the drills kept the headings fairly clear, as well as that part of the tunnel between the headings and the fan. The fan was moved ahead to the next cross-passage at Station 277 when the work had progressed far enough, and was used there for some time; it was found, however, that by the time the excavation had reached Station 280, about 1,500 ft. from the shaft, there was practically no further difficulty from fog and smoke. No satisfactory explanation was found for this, as it would rather be expected that the ventilation and trouble with smoke and fumes from blasting would be worse as the distance increased between the mouth of the tunnel and the working face. One explanation was offered: That the blasting of the softer sandstone tended to create more and lighter dust than the heavier trap rock; whether or not this was so, it is a fact that there was far less trouble with fog and smoke after the sandstone was passed.

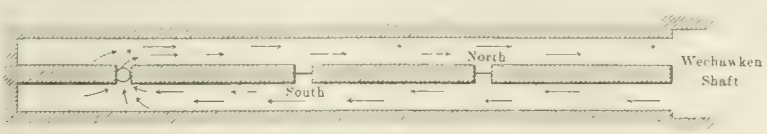


Fig. 7—Plan of Ventilation.

At Hackensack, the principal cause of trouble was the smoke from the "dinky" locomotives. As the tunnels progressed, this gradually became worse, until a connection was made with the Central Shaft headings. A fan was installed in the cross-passage at Station 316 (700 ft. in from the portal), but was never worked properly. Apparently, the men, at least the walking bosses and foremen, had little faith in the fan as a means of ventilation; no real attempt was made to keep it in order or operate it properly, and a great deal of time and money was lost groping around in the smoke and fog, the density of which increased, not only with the state of the atmosphere, but also with the direction of the wind. On some days the tunnels easily cleared themselves, and on others the smoke was so thick that a candle held at arm's length could not be seen. At this end the South Tunnel was generally worse than the North. After the headings were holed through between the portal and the Central Shaft there was very little trouble, there being usually a strong up-draft through the shaft. This was so pronounced when the wind was blowing toward the portal, that the moisture-laden air, as it ascended from the mouth of the shaft, presented the appearance of a heavy rainstorm with the rain ascending instead of descending. When the wind was blowing away from the portal, that is, from the southeast, the effect of the shaft as a chimney was neutralized, and consequently, the smoke accumulated in the tunnels. To overcome this, a large blower, with a fan 9 ft. in diameter, and with blades 4 ft. wide and 2 ft. 3 ins. long, operated by a vertical 12-HP. engine, was installed at the top of the shaft, and this kept the tunnels reasonably clear of smoke at all times. After the bench and enlargement had passed the bottom of the shaft the use of the fan was abandoned, as it was found that the tunnels cleared themselves fairly well, probably owing to the larger cross-section reaching all the way to the shaft. What little fog and smoke there might be did not cause enough trouble to warrant the cost of running the fan, which, owing to its location, required the whole time of a mechanic in attendance day and night.

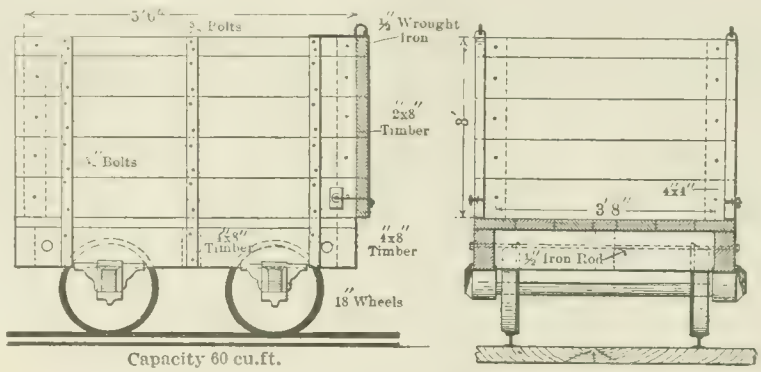


Fig. 6—Muck Car Used at Weehaken Shaft.

Lighting.—During the earlier stages of the work, gasoline lamps and Kitson lights were used. The former, of the familiar banjo type, and a modification of this, with a section of wrought-iron pipe for the reservoir, were very unsatisfactory, and were out of repair and leaking a large proportion of the time. The Kitson lights were given only a short trial, but were found unsatisfactory, owing to the necessity of moving them frequently and having to set them up in insecure positions. Electric lights were installed by Mr. Bradley, on his assumption of the contract.

The number of lamps maintained in each of the tunnels for the excavation was approximately as follows:

At the main working face	From 8 to 10
On and around the shovel	From 9 to 12
Between the portal and the working face	From 60 to 80

The cost of lighting for the whole work averaged about 15 cts. per cu. yd., which is quite large. This was mainly due to the fact that current was brought from outside sources during a large part of the time (one-third of the yardage). Part of this current cost 5 cts. per kw.-hr., and there were fairly heavy charges for connecting the tunnel wiring system with the source of supply. Current bought from the Public Service Corporation

cost from 10 to 12 cts. per kw.-hr. delivered at the mouth of the tunnel.

Pumping.—The quantity of water encountered during the excavation of the tunnels, measured somewhat roughly, was approximately as follows:

At Weehawken . . . . . 74 gal. per min.
At Central Shaft . . . . . 1 gal. per min
At Hackensack . . . . . 18 gal. per min.

The water at the Weehawken end had to be pumped from the bottom of the shaft, a lift of about 90 ft., while at the Hackensack end it had to be pumped back from the face up grade to the portal.

The cost of pumping was about $100 to $125 per month for labor for the whole work, besides the cost of the plant (about $1,200) and the power for running it.

PROGRESS.

The total time elapsed from the time of starting work at the Weehawken end, in May, 1905, to the completion of the excavation, in May, 1908, was almost exactly three years. Of this time about 40 days were lost in February and March, 1906, when work was stopped by the Receiver of the Shields Company, the total number of days actually worked being about 940, giving an average progress of 6.26 ft. per working day in each of the two tunnels, which, omitting the Central Shaft headings, gives an average rate of progress for each working face, of 3.13 ft. per day.

These 940 days include practically all the time elapsed, except Sundays and such few holidays as were observed. For some of this time, work was being carried on at only one or two points; the time, therefore, represents practically the total possible working time during the period covered.

Progress at Weehawken.—At Weehawken the total number of days worked was 763, divided as follows:

186 days in timbered section, about 426 ft., an average rate of 2.3 ft. per day in each tunnel;
176 days in hard sandstone, about 563 ft., an average rate of 3.2 ft. per day in each tunnel;
112 days in hard trap, about 267 ft., an average rate of 2.4 ft. per day in each tunnel;
289 days in ordinary trap, about 1,316 ft., an average rate of 4.55 ft. per day in each tunnel.

Progress at Central Shaft.—At Central Shaft the average length driven per day in each of the four headings is shown by Table IV.

Progress at Hackensack.—At Hackensack the total number of days worked on the tunnels proper, all in trap rock (omitting the cut and cover) was about 792, divided as shown in Table V.

The best months' work in each location was as follows, the actual yardage excavated and paid for being reduced to equivalent linear feet of full section. The tunnels were generally taken out to full section, except for a small amount left in the bottom, which latter reduced the equivalent linear feet of full section to about 95 per cent of the actual advance at the face.

Weehawken:—

	Lin. feet.	Ft. per day.
Full timbered section, North Tunnel, Nov., 1906	87	= 3.0
Sandstone, North Tunnel, Nov., 1906	109	= 3.9
Trap (normal), South Tunnel, July, 1907	144	= 5.3

Hackensack (All trap):—

	Lin. feet.	Ft. per day.
Portal to Central Shaft headings, South Tunnel May, 1907	139	= 5.0
*Enlargement of headings, South Tunnel, Nov., 1907	175	= 6.0
Central Shaft headings to Weehawken headings, North Tunnel, April, 1908	145	= 5.2

Central Shaft Headings.—During April, 1907, 122 lin. ft. of heading, averaging 3.8 cu. yds. per lin. ft., were taken out in the South Tunnel, west of the shaft. This was equal to 5 ft. per day for the 24 days worked.

TABLE IV.

Location.	Number of days worked.	Total length of heading, in feet.	Av. length of heading driven per day worked in feet.
N. E.	227	438	1.96
S. E.	168	356	2.06
N. W.	272	768	2.82
S. W.	234	698	2.98

TABLE V.

Location.	Number of days worked.	Advance.	Av. advance per day.
Station 323 to Central Shaft headings	492	1 450	2.9
Bench and enlargement of Central Shaft headings	159	1 150* 906†	7.2* 5.7†
Central Shaft headings to Weehawken headings	145	640	4.4

*Actual advance. †Equivalent linear feet of full section tunnel.

The Best Week's Work.—The best week's work at either of the main working faces, when the full section was being excavated in trap rock, was 803 cu. yds., equal to 41.8 lin. ft. of full-section tunnel, or an average of 6 lin. ft. of full section per day; this was from the South Tunnel at Hackensack for the week ending Jan. 11, 1908.

The Best Yardage.—The largest number of yards taken out in any one week from one working face was 1,087, equivalent to 56.6 lin. ft. of full section per day. This was bench and enlargement only (Central Shaft headings) in the North Tunnel, Hackensack, for the week ending Oct. 19, 1907.

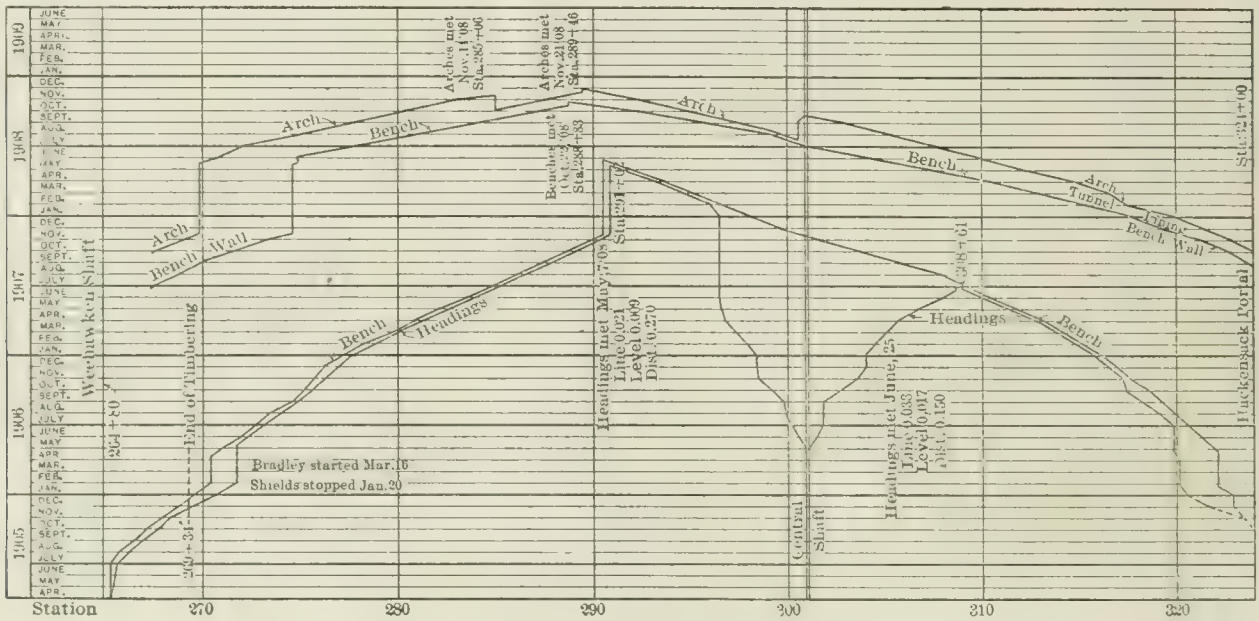


Fig. 8—Progress Profile of North Tunnel.

The largest yardage for the whole work in any one week was 3,238 cu. yds., from four working faces—two at Weehawken in full section and two at the Hackensack bench and enlargement (Central Shaft headings). This was equivalent to 168.4 lin. ft. of full-section tunnel, or an average of 6 ft. per day from each working face.

The Best Month's Work.—The best month's work with each of the four methods of drilling the headings, as shown in Figs. 1, 2, 3 and 4, where the work was straight forward and the full section was being taken out, was as follows:

Method No. 1, about 90 ft. in sandstone.
Method No. 2, about 140 ft. in trap.
Method No. 3, about 137 ft. in trap.
Method No. 4, about 145 ft. in trap.

In regard to these figures it should be noted, as stated previously, that the organization of the men and plant was not properly completed until near the time Method No. 4 was put in operation.

In Fig. 8 is shown graphically the relation of the progress to the time elapsed in the North Tunnel, the diagram for the South Tunnel being almost exactly the same.

PLANT.

The plant installed by the John Shields Construction Company, and taken over by Mr. Bradley, was composed very largely of second-hand material, and eventually most of it had to be replaced. Insufficient and inefficient plant and delay in installation were largely responsible for the small progress made by the Shields Company, and Mr. Bradley's endeavor to utilize this plant not only caused much delay during the first 8 or 10 months after he started work, but also involved large expense.

Power Plant.—At Weehawken the plant installed by the Shields Company consisted of three old locomotive boilers, each having a nominal capacity of about 125 h. p., and one Rand and one Ingersoll-Sergeant compressor, each of a rated capacity of about 1,250 cu. ft. of free air per min. compressed to 100 lbs. To this Mr. Bradley added two more second-hand locomotive boilers, and another Rand compressor of the same type and capacity as the first. The theoretical steam capacity of each of the five old locomotive boilers was about 4,250 lbs. per hour, or a total capacity of 21,250 lbs. per hour.

Theoretically, the demand on this steam was:

	Pounds per hour.
Three compressors, about 5,600 lb. per hour each	16,800
One dynamo, about	1,000
One 500-g.d. pump, about	1,000
One hoisting engine for elevators, about	2,000
Total	20,800

Actually, there was considerable deficiency of steam when an endeavor was made to work the three compressors at their full capacity. A separate boiler was afterward installed to run the hoisting engine for the elevators and the pumps thus leaving a requirement of only approximately 18,000 lbs. of steam per hour, but even this was beyond the capacity of the boilers, especially as one was almost always out of commission.

The two Rand compressors were 24 x 24 by 30-in., straight-line, one-stage, steam-driven, with a nominal capacity of 1,250 cu. ft. of free air per min. at 80 rev. per min. The Ingersoll-Sergeant was of similar type and capacity. Therefore, the theoretical quantity available was 3,750 cu. ft. of free air per min. The theoretical air requirements (as taken from manufacturers' catalogues) were:

	Cubic feet of free air per minute.
20 Rand slugger drills (22 by 174)	2,088
2 Little Giant shovels (taking air two-thirds of the time)	1,100
Total	3,188

This estimate, based on the assumption (given in the catalogues) that the drills would be working about three-fifths of the time, and the shovels about two-thirds of the time, left apparently an ample margin between the full capacity of the compressors and the requirements for the drills; as a matter of fact, however, it was seldom that more than 80 lbs. of air was available, and the pressure often dropped to 60 or 50 lbs. at the compressors. During the time this plant was in use the greatest distance to the drills was about 1,500 ft.

As this plant proved to be entirely inadequate to the demands, an arrangement was made with the O'Rourke Construction Co. on Aug. 17, 1906, whereby they agreed to supplement the air supply by 1,000 cu. ft. of free air per min. at 100 lbs. pressure. This arrangement was not altogether satisfactory, and finally (on Dec. 5, 1906) an arrangement was made with the same company to supply air up to 4,000 cu. ft. of free air per min. at 100 lbs. and the old plant was shut down.

The new plant had been in use previously in the construction of the River Tunnels. The air from it was compressed to 40 lbs. by lower pressure machines, one being used all the time and two when necessary. These machines were built by the Ingersoll-Sergeant Co., the engines being of the Corliss duplex type, cross-compound steam, with simple duplex air cylinders, each compressor having a capacity of nearly 4,000 cu. ft. of free air per min. This air, at 40 lbs. was delivered to an Ingersoll-Sergeant high-pressure machine, having Corliss cross-compound engines, 14 x 26 x 36-in., with air cylinders of the piston inlet type, 13¼ x 36-in., which compressed it to 100 lbs. The capacity of this latter machine, taking air at normal pressure, is 920 cu. ft. of free air per min. working at 85 rev. per min.; by taking the air at 40 lbs. and working at a somewhat higher speed, this machine alone supplied all the air used at the Weehawken end (approximately 4,000 ft.) from December, 1906, to November, 1907, and, with very few exceptions, the pressure was steadily maintained at from 90 to 100 lbs. there being no breakdown of any kind.

At Hackensack the plant taken over by Mr. Bradley consisted of six old locomotive boilers and four Rand compressors, all of the same type as those at Weehawken. To this he added two second-hand marine boilers, each of a state capacity of about 350 h. p., and two more Rand compressors of the same type and capacity as the others, making the total theoretical steam power available approximately 1,450 h. p., with a compressor capacity of approximately 7,500 cu. ft. of free air per min., equal to about 1,500 h. p., allowing for 15 per cent of loss.

Nowhere near the theoretical steam power was ever developed from the boilers. The tubes of the old locomotive boilers were filled with mud in many cases, and were always leaking. The marine boilers were not properly installed to give the best results, and it was seldom possible to work more than four compressors at once, or to keep the air pressure at the power house much greater than from 70 to 80 lbs. at any time.

This plant had been built by the Shields Company on the meadows alongside the Erie and New York, Susquehanna and Western Railroads, and the foundations were not made sufficiently strong to resist the effect of the vibration caused by the passing trains. It was impossible to keep the steam connection tight, and there was not only the loss of steam due to leaky joints, but positive danger of one of the main steam lines breaking entirely. After attempting to operate this plant for nearly 5 months, Mr. Bradley determined to abandon the site and the boilers, and build a new plant, farther back from the railroad, on solid ground, in such a position that a spur track could be built to a coal trestle in front of the boilers.

Two pairs of Stirling boilers, with a capacity of 2,000 h. p., were installed. As a rule, at times of maximum demand, three of the boilers were in use; after the Central Shaft was stopped, two were generally sufficient, until, toward the latter part of the excavation, the losses in the transmission of the air made it necessary to keep three going.

Eight compressors (the six old ones with two brought from Weehawken), were installed in the new power house. All were of the same type, namely, Rand, straight-line, steam-driven, 24 x 24 x 30-in., each of with a nominal capacity of 1,250 cu. ft. of free air per min. Seven of these were generally worked to their full capacity in order to keep up the necessary supply of air.

The maximum requirements of air at this end were primarily estimated as follows:

Central Shaft, four headings	24 drills.
Hackensack, two working faces	20 drills.
Total	44 drills.

	Cubic feet of free air per minute.
44 Slugger drills (22 by 174)	4,356
2 Steam shovels	1,600
Pumps and machine-shop, say	1,000
4 Hoisting engines, placing concrete	2,000
4 Derricks	2,000
Total	10,956

The theoretical capacity of the whole eight compressors was:

1,250x8=10,000 cu. ft. of free air per min.

It was considered that not more than two-thirds of the above equipment would be working at the same time; the actual requirement, therefore, was taken at about 8,000 cu. ft. of free air per min., thus leaving a margin of one spare compressor.

As actually worked out, there were probably never more than eight drills working at any one time at the Central Shaft, and this work was entirely suspended in June, 1907, before there was any demand for power in connection with the tunnel lining. The heaviest actual requirement, therefore, was approximately as follows:

	Cu. ft. of free air per minute.
40 Drills (22 by 174)	3,520
2 Shovels	1,600
Pumps and machine-shop, say	1,000
2 Derricks	1,000
Total	7,428

(B) After November, 1907 (after completion of enlargement of Central Shaft headings):

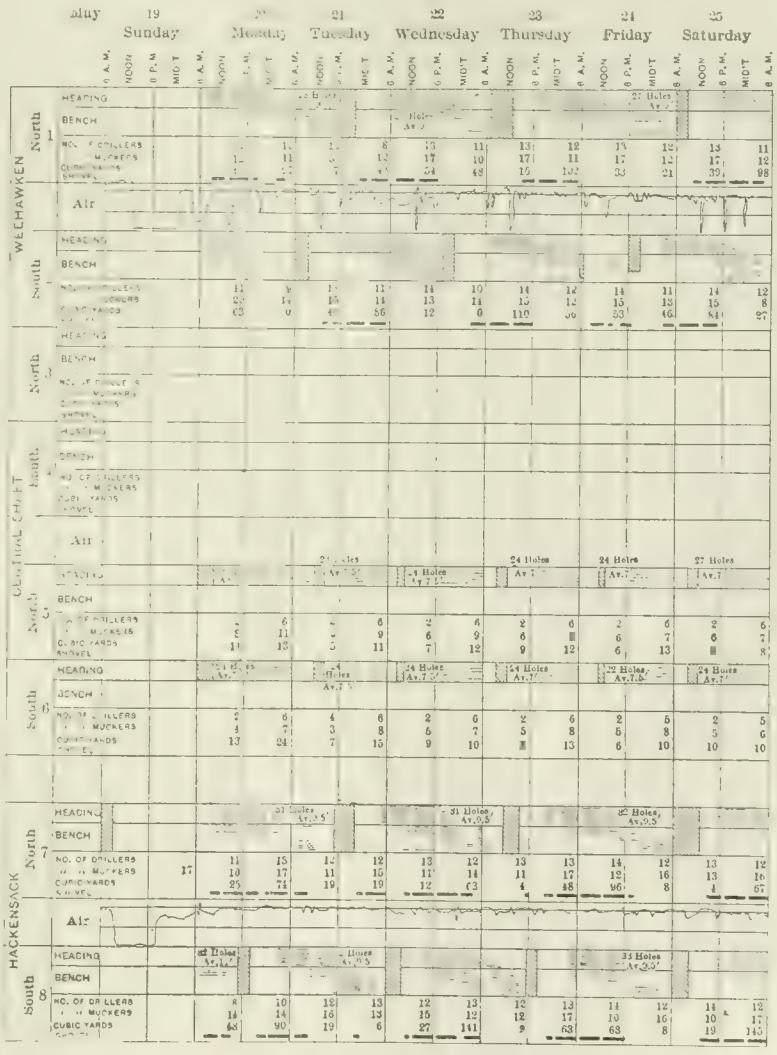


Fig. 9—Blank for Recording Drilling, Air Pressure, Mucking, Etc.

	Cu. ft. of free air per minute.
32 Drills, 6½ by 8½	2,958
2 Shovels	1,800
Pumps, etc.	1,004
3 Hoisting engines on concrete, each working one-third time	500
2 Derricks	1,000
Total	7,078

The average number of drillers per shift was about 25 at the two main working faces. There were also from 5 to 10 drills trimming and cleaning up for concrete, say an average of 7, making 32 in all.

After Nov. 1, it actually required three boilers under steam all the time, and not less than seven compressors running at full capacity, to keep the air at proper pressure, the theoretical capacity of the compressors being 8,750 cu. ft. of free air per min., as against 7,000 to 7,400 cu. ft., the theoretical maximum requirement.

Some of this deficiency was due to losses in transmission, part also was due to the fact that the actual was probably considerably below the theoretical capacity of the compressors.

Contractor's Organization.—The work was in general charge of a superintendent, and, during the time it was being carried on at both ends, an assistant superintendent had charge at night. At each end there was a day and a night walking boss, who had general supervision of the men in the tunnels, the day walking boss being the superior, and responsible for the general conduct of the work at his end, both day and night. Two 10-hour shifts were worked, thirteen shifts every two weeks, no work being done on alternate Sundays and Sunday nights. With the exception of the walking bosses and the master mechanic, all the men changed from the day to the night shift every two weeks. The organization was approximately as follows, for each shift:

General—Both Tunnels.

1 Master mechanic (days only).
1 Machinist,
1 Engine runner,
2 Firemen,
2 Oilers,
1 Electrician and helper,
1 Drill machinist and helper,
3 Blacksmiths and helpers,
1 Powderman,
4 Locomotive engine runners.
1 Walking boss,
4 Brakemen,
1 Switchman,
1 Foreman on dump,
6 Men on dump,
1 Foreman on track,
6 Men on track.

In Each Tunnel.
Drilling and Blasting.

1 Foreman,
12 Drillers,
12 Helpers,
1 Nipper,
1 Pipe-fitter.

Mucking.

1 Shovel engineer,
1 Cranesman,
1 Muck boss,
12 Muckers.

RECORDS.

The records of the work have been based largely on the reports of the day and night inspectors, which were made out in regular forms.

A daily report card was made out each morning and forwarded to the office of the chief engineer. It covered the work done for the previous 24 hours, up to 6 o'clock each morning.

A telephone report was made to the resident engineer by the inspectors each day at 8:30 a. m., giving the conditions, number of men, etc., at the opening of the day's work.

A daily progress profile, on 10 by 10 to the inch cross-section paper, covering the whole length of the tunnels, was kept in the office of the resident engineer. This was mounted in sections, on a piece of composition board, and hung on the wall for convenient reference. The information, showing the progress up to 6 o'clock each morning, was shown on the report of the night inspector, and was plotted on this profile at 7 o'clock each morning. The plotting was left in pencil, and each month's work was colored in. A progress profile was taken by the men of the alinement corps each Saturday morning and plotted by them, alternate weeks being in red and blue ink on the same profile.

A chart showing the number of drills working, time worked, blasting periods, etc. (Fig. 9), was plotted each morning and was extremely useful, not only in keeping in touch with the work, but in compiling many of the statistics used in the preparation of this paper. These cross-section sheets were ruled 12 by 12 to the inch, thus giving one space per hour horizontally. In the top vertical space are shown the heading drills, their time of stopping and starting, and their number, each heavy line representing one drill. In the next space below are shown the drills on the bench, lift holes, etc.

The blasting time is shown by the portion hatched (shown in red on the original), which covers the whole vertical space when a complete round of both heading and bench is blasted, and only part, top or bottom, as the case might be, if only one or the other. The number of drillers and muckers at the main working face is shown, and below that (in red ink on the original) the number of cubic yards handled each shift. The time the shovel is working is shown by the heavy line filling a whole space; and the air pressure, platted from the recording, gauge charts, is shown in the space below.

A combination daily and weekly report, showing the total number of men working on each section, and the number of cubic yards excavated, was entered every day and kept on a filing board in the office of the resident engineer, and a copy was sent to the main office at the end of the week, with such notes on the back as might be necessary, or of interest.

A report was made out weekly and sent to the contractor's superintendent, showing any deviations from grade, any tight places, and the station of bench and headings.

A monthly report was made to the chief engineer, giving detailed statistics of the amount of work done, etc., plant installed, and short notes of any matter of interest affecting the work in any way.

Some Data on Water Purification from Poughkeepsie, N. Y.

From the 1909 report of the Board of Public Works of Poughkeepsie, N. Y., the following data have been obtained on the operation of the water purification plant. The highest recorded amounts of chlorine were 19 parts per million on Dec 12, 1908. The general average has been 12 parts per million. The raw water is subject to considerable variations in turbidity and bacteria; the periods of low turbidity being in general coincident with periods of low bacteria. The maximum turbidity recorded was 400 on Feb. 25, 1909, the maximum bacterial count being 120,000 two days previous. The minimum turbidity was 12 on May 19, 1909, and the minimum bacterial count was 600 on July 6, 1909. The sedimentation basin provides storage for about twenty-four hours' flow on the average. The results of the study of silt in the basin was as follows:

Total number of gallons of water	914,552,299
Total volume of sludge, cu. yds.	551
Total weight of sludge, tons	524
Total weight of dry material, tons	140
Per cent. of total deposit in 1/6	58.4
Per cent. of total deposit in ⅓	74.4
Per cent of total deposit in ½	82.9
Cubic yards sludge per million gals.	0.6
Tons dry material per million gals.	153
Average turbidity raw water	37.2
Average turbidity settled water	18.7
Per cent. removed	49.7

The low per cent removal probably on account of clear water during a great portion of the year.

Based on experience of 1908 the following coagulant table was prepared:

Turbidity.	Grs. per gal.
40	1.00
50	1.15
60	1.30
75	1.55
100	1.75
125	1.85
150	2.00
200	2.20

The turbidity was determined by the standard turbidity rod. The color by comparison with permanent "platinum cobalt" standards. The alkalinity according to standard methods, using lacmoid as an indicator. The chlorine was also determined by standard methods. Bacterial counts on gelatine at 20° C. and again at 37° have been made daily throughout the year; the 20° gelatine in duplicate.

The general averages of temperature, turbidity, color and alkalinity of the raw and settled waters for year ending Dec. 1, 1909, were as follows:

	Raw Water.	Settled Water.
Temperature	53.6	53.6
Turbidity P. P. M.	35.4	16.3
Color P. P. M.	49.4	38.6
Alkalinity P. P. M.	51.5	47.3

The general averages of turbidity and bacterial counts from Sept. 1, 1908, to Dec. 1, 1909, were as follows:

	Raw Water.	Settled Water.
20°	9853	1569.
Per cent. rem.		84.2
37°	551	2.15
Per cent. rem.		60.8
Turbidity	37.9	19.9
Per cent. rem.		47.5
Coag. grs. per gal.	1.224	
Number days coag. used	12.7	
Free P. P. M.		0.46

Experiments with chlorine as a disinfectant were begun Feb. 1, 1908, and continued until the 12th, using the coagulating tanks for the applying of the chlorine. Later a crude tank was used to permit the use of the coagulent until a disinfectant house could be built. The removal from the first to the twelfth was an average of 96.4 per cent in the settled water, and in the same number of days previous the per cent removal was 53.3. At the present time two large vats are used alternately with a capacity of 990 gals. each, with proper pipe connections and apparatus to carry the solution directly over the flow of water into the basin. The use of chlorine was continued during the summer months while the basin was out of service by laying a line of 1-in. pipe across the road into the small intake basin. Not the slightest trace of chlorine can be found after an 8-hour flow.

From Dec. 1, 1907, to May 1, 1909, thirty-two counts were made in which the counts before cleaning were less than counts after cleaning and six counts were greater before than after cleaning, the total number of counts being 38, a per cent of 84.2, in which an increase was shown after cleaning. During the year filter No. 1 was scraped seven times; No. 2 six times, No. 3 six times, and No. 4 seven times. The following table gives data regarding average length of runs and millions of gallons of water filtered between scapings.

	Filters 1	2	3	4
Days elapsed	54.7	57.0	66.4	59.2
Days actual operation	51.9	54.1	58.5	56.3
Mill. of gals. per acre filt.	89.8	91.1	126.3	79.4
General average of days elapsed	57.8			
General average days operation	55.2			
General avg. mill. gals. per acre filt.	96.6			

The general average removal of dirty sand at each scraping has been, approximately:

	Filters 1	2	3	4
Thickness removed (feet)	0.10	0.14	0.08	0.09
Cubic yards removed	54.5	77.0	41.0	42.0

No. 1 and No. 2 filters were resanded to make a depth of sand of 5.33 ft. above the bottom of the pillars, 497.8 cu. yds. being placed on No. 1, and 511 cu. yds. on No. 2. No. 3 and No. 4 were resanded the year before. Four-inch cast iron water pipe was laid on top of filters used as a supply for the new sand-washing apparatus, which consists of an ejector, a distributing box and 200 ft. of fire hose, with 8-in. pipe for waste. This apparatus is said to have greatly reduced the cost of resanding and is expected, with a few improvements, to effect a total saving of 40 per cent. The heaviest deposits of silt are at the effluent ends of all the filters. The policy has been followed of letting the filters with the lowest "co-efficient of conditions" deliver the most water.

The foregoing data on the operation of a slow sand filter plant are of value, but the cost items are omitted. In the portion of the report devoted to bookkeeping and financial statements the items are not given in sufficient detail to give satisfactory ideas of unit costs.

Roads and Streets Section

Note: This section is devoted to methods and costs of road and street construction. It will cover road building in all its details, the construction of pavements, sidewalks and gutters, the testing and use of paving materials and the machinery and tools used in road building and paving.

Data On Street Cleaning in St. Louis, Mo.

The work being done in the city of St. Louis in keeping the streets clean is attracting attention. The following details have been furnished by Mr. Jas. C. Travilla, street commissioner.

The appropriation for 1909-10 was $535,000, apportioned as follows:

General cleaning	$290,000
Patrol system, "White Wings"	170,000
Municipal stables (44 per cent of appropriation for garbage removal)	75,000
Total	$535,000

The amount of work done with this money is shown in the following tabulation:

	Miles.	Sq. yds.
Streets Cleaned.		
Asphalt	9.46	125,332
Bitulithic	38.69	807,249
Granite blocks	70.02	1,334,318
Wood blocks	3.26	61,901
Vitrified brick	142.02	2,742,450
Total	313.45	6,191,250
Alleys Cleaned.		
Granite blocks	8.89	85,325
Vitrified brick	113.58	1,085,555
Granitoid	1.31	11,528
Limestone	60.92	537,022
Total	184.70	1,719,430

The cleaning includes snow removal.

Methods and Organization.—Weather permitting, pavements in the business districts are cleaned twice a week, the work being done at night; and in the residential district, pavements are cleaned once a week. All important traffic streets are included in the Patrol System. Alleys are cleaned about once a month.

Street and alley cleaning is done by day labor with flushers, squeegees, machine sweepers, hand sweepers and patrol system.

The city is divided into four cleaning districts in charge of district superintendents, who report to a general superintendent in charge of all the work. The district superintendents have supervision over inspectors in charge of men and machines. In the general superintendent's office is stationed a man familiar with the work, the city and the most convenient places for disposing of sweepings. The district superintendents and inspectors report by phone to him twice a day, and in addition, there are written reports received daily from the inspectors of the work done showing the number of laborers, teams and machines employed. The unit cost of the work is ascertained monthy.

The street flushing is done by eight crews, the organization and wages being as follows:

4 Flushers at $7 per day	$28.00
12 Laborers at $1.50 per day	18.00
4 Mud wagons at $4 per day	16.00
2 Inspectors at $3 per day	6.00
Total	$68.00

Two inspectors are required with such a gang; one in charge of the flushers and four laborers. Two of the laborers keep the sewer inlets screened and free from rubbish and two of them follow the flushers, brooming the water down the gutters and off of the street crossings. The other inspector has charge of eight laborers and four mud wagons.

Two crews are engaged in squeegee work. The organization of the squeegee crew and wages paid are as follows:

1 Sprinkler at $5 per day	$ 5
2 Squeegees at $7 per day	14
2 Pickup wagons at $4 per day	8
4 Laborers at $1.50 per day	6
1 Inspector at $3 per day	3
Total	$36

In the machine sweeping four crews are engaged, the organization and wages being as follows:

1 Sprinkler at $5 per day	$ 5
2 Machine brooms at $5 per day	10
12 Laborers at $1.50 per day	18
6 Pickup wagons at $4 per day	24
2 Inspectors at $3 per day	6
Total	$63

Two inspectors are required: one in charge of sprinklers and machine brooms, the other looking after the laborers and pick-up wagons.

Eight crews are engaged in the hand sweeping and scraping, the wages being paid and makeup of the force being as follows:

12 Laborers at $1.50 per day	$18
2 Pickup wagons at $4 per day	8
1 Inspector at $3 per day	3
Total	$29

The alley flushing is done by six crews, organized as shown below, and paid as there shown:

2 Flushers at $7 per day	$14
6 Laborers at $1.50 per day	9
2 Mud wagons at $4 per day	8
1 Inspector at $3 per day	3
Total	$34

The average number of men employed daily on the patrol system—"white wings"—is 309, these being 19 patrolmen under (1) inspector and one pick-up wagon for every six patrolmen. Patrolmen are paid $1.50 per day; inspectors, $3.50 per day, and pick-up wagons, $4.00 per day. The patrolmen are in uniform. The minimum area given one patrolmen is 2,000 sq. yds.; the maximum area given one patrolman is 11,000 sq. yds., and the average area given one patrolman is 6,000 sq. yds.

The general superintendent receives $150 per month and district superintendents receive $85 per month. Eight hours constitutes a working day.

Average Unit Costs.—The average unit costs of the street cleaning work are as follows:

	Per 1,000 sq. yds.
Streets.	
Flushing	$1.00
Squeegee	0.45
Machine sweeping	0.81
Hand sweeping	1.58
Patrol system	0.25
Alleys.	
Flushing	$1.94
Hand sweeping	1.70

Flushers are used on the granite block, vitrified brick and sheet pavements. The squeegees are used exclusively on sheet pavements. The cost of flushing, if restricted to sheet pavements, would not be much in excess of the cost of the work done with the squeegees. No charge is made for water.

Mr. Travilla states that the whole success of street cleaning depends upon a proper organization and constant work to realize the highest possible efficiency. He believes that the entire plant necessary for maintaining the streets and alleys in a sanitary and cleanly condition should be owned by the city, and with that end in view, there has been established a municipal stable with 400 horses and mules, 200 wagons, 10 machine brooms and 4 squeegees, for the above purpose and for the collection of garbage, which comes under the direction of the street commissioner.

Modelling Structural Work in Paper.—Messrs. Linforth & Milburn, Butte Mont., have perfected a method for making heavy paper models of head frames, cars, cages, ships, bridges and roofs. The structures are made of heavy drawing paper and connected by gluing, all rivets being marked in ink. Many engineering schools are purchasing samples of the work.

Data On Steam Road Roller Practice of English County Councils.

In England the steam road roller plays an important part in the maintenance of rural highways. Nearly all of the county councils, which have charge of the rural main roads, maintain several steam rollers and keep them constantly employed practically the year round. In a recent issue of the *Surveyor* Mr. Walter J. Fletcher, county surveyor of Dorset, gives some data on the general practice of these councils as to steam road roller work, and from that paper we have taken the matter that follows:

The county council of Anglesey county owns one steam road roller. The initial cost of the roller with van was $2,430. The roller is worked the year round; when not engaged on highway work, it is used for driving the stone-breaker, or is hired out.

Berkshire county owns three steam rollers, the initial cost of each roller with motor cart and sleeping van being $2,785. The average cost of rolling is 12 cts. per ton, this including driver's wages, repairs, repaying capital and interest, water, insurance, oil, etc. Coal cost $5.04 per ton. The average number of days worked per year per roller was 242. In addition, the council hires some road rollers for its work.

Buckinghamshire county owns six rollers, the initial cost being $2,430 each for 10-ton single cylinder Averling & Porter roller, van and water cart. The average cost of rolling is 22 cts. per cu. yd., this including attendants, fuel, repairs and water carting. The average numbers of days work per year per roller is 200. This county also lines rollers to assist in its work.

Bedfordshire county owns four steam rollers, the initial cost being $2,469 for a set consisting of roller sleeping van, water cart and scarifier. The rollers are worked from the beginning of November to the end of June. In addition the county council hired rollers the past year for a total of 429 days at $4.80 per day.

Carnarvonshire county owns three steam rollers. The initial cost was $2,644 for rollers, sleeping, two water carts and road wagon. The set of three rollers and plant cost $7,932. The total yearly cost of the upkeep was $3,645, including driver's wages, repairs to rollers, fuel and oil. This is $1,215 per roller per year. Coal cost $4.32 to $6.24 per ton. The rollers were worked all the year round except when undergoing repairs and during frosty weather. Cheshire county owns four road rollers, the initial cost being $2,673 for rollers, sleeping vans, water cart and hose. The total yearly cost of upkeep is $1,458 per roller, this including wages, fuel, interest and depreciation, etc. The rollers are worked all the year. During the past year the county council also hired rollers at a cost of $1,458.

Cardiganshire county owns four steam rollers, the initial cost being $17,496 for four engines—2 roller tractions and two tractions convertible into rollers—six traction wagons and three sleeping vans. The total cost of upkeep for the year was $14,668 for the four engines, including wagons, materials and steel plating roller wheels. This would be about $1,167 per roller per year. The rollers are worked all the year, breaking and hauling stone in the summer and rolling during the winter months.

Durham county owns two sand rollers, the initial cost of the plant being as follows:

Two 15-ton compound steam rollers	$4,001
One Morrison scarifier	428
One traction wagon	170
Two water carts	257
One sleeping van	267

The total cost of upkeep per year is about $1,215 for each roller, this including depreciation, repayment of capital and interest, driver's and assistant's wages, repairs, fuel and water for rolling. The coal costs $2.88 to $3.48 per ton. The council also hires rollers at $5.40 per day, this including driver's wages, fuel, oil, stone, water and use of water cart.

Denbigshire county owns one steam roller and one convertible traction. The initial cost was $2,235 for roller sleeping van and two water carts. The total cost of upkeep is about

$1,701 per year for both engines; this including wages of driver and flagman, repairs, coal, etc. The average cost of coal is $4.80 per ton. The rollers are worked all the year, being only stopped by frost and snow. The county also hires some of its rolling done at a cost of about $194 per mile.

Derbyshire county owns seven rollers, a plant consisting of roller, scarifier, water cart and sleeping van. The average cost of upkeep in 1909 was $1,157 per roller, this cost including wages, fuel, repairs, etc. The driver was paid $1.20 per day and the flagman 84 cts. per day. Coal cost $3.84 to $4.32 per ton. The rollers are worked all the year, being stopped only in the case of frost and snow. The council also hires additional rollers, paying $4.32 per day and furnishing fuel.

Dorset county hires all the rollers for its road work, paying on an average 24 cts. per cu. yd., for stone rolled in place, this including water cart and horse and sweepers. The average number of rollers hired is 14 and these are worked during autumn, winter and spring.

Essex county owns ten steam rollers. The average initial cost of a roller with scarifier attached is $2,040. Sleeping vans cost $243 each and coal wagons cost $97 each. The working expenses for the year ended March 31, 1909, were $9,370, or $937 per roller. The rollers are worked practically all the year, being idle only for cleaning purposes. The county also spent for the year over $17,000 for hired roller.

Flint county owns two steam rollers. An average of 18 tons of granite is rolled per day by each roller. The rollers are worked all the year round.

Glamorgan county owns nine steam rollers. The initial cost of the plant was $26,288 for nine rollers, eight sleeping vans, eight coal bunkers, and nine watering carts. The total yearly cost of upkeep of the plant is about as follows:

Wages of drivers and other men with rollers	$12,296
Haulage of water and fuel	4,582
Cost of fuel, oils, etc.	2,445
Repairs	2,338
Total	$21,991

This would be about $2,445 per roller per year. The coal cost on an average $4.38 per ton. The rollers are worked all the year unless stopped by frost or repairs.

Gloucester county owns 18 steam rollers, the initial cost of the plant including rollers, water carts, Dobbin carts and pumps being $45,684. The cost last year of working 17 rollers was $19,027 or $1,119 per roller. This cost includes, wages, fuel, etc. The cost of coal varied from $2.88 to $6.00 per ton. The rollers are worked all the year, except when idle for repairs. Practically all of the rolling is done by the rollers owned by the county; but rollers are occasionally hired at $5.88 per day.

Kent county owns ten 12-ton compound steam rollers, the initial cost of the rollers being $23,814 or $2,381 each. The vans cost $2,965. The average daily cost of working the rollers, including repairs, coal, waste, scarifying, driver and attendant is $4.80. The average cost of coal is $5.28 per ton. The rollers are worked the year round. About 9/10 of the rolling in this county is done by county rollers. Rollers are hired at about $5.40 per day for the rest of the rolling.

Monmouthshire county owns three steam rollers, the initial cost of the plant including rollers, water carts and sleeping vans, being $7,515. The rollers are worked all the year if water is obtainable. All the rolling done by this county last year cost about $12,986. A total of 51,486 tons of granite and limestone was consolidated, the cost thus being 23.2 cts. per ton. Middlesex county owns three steam rollers, the initial cost of the plant being as follows:

Rollers, each	$1,871
Scarifiers, each	161
Sleeping vans, each	274
Water carts, each	137

The average cost per day for the past five years for steam rolling has been $4.50, this sum including scarifying, but not depreciation. The rollers are worked throughout the year. Practically all of the rolling is done by the county, but in some cases rollers are hired at $5.40 per day and 1½ cts. yer yard for scarifying.

Middlesex county owns three steam rollers. The initial cost of a single cylinder roller with Morrison's scarifier was $2,430. The total cost of rolling, including sweeper, in this county, has been 30 cts. per ton. Coal costs $3.12 to $4.20 per ton. The cost of operating the rollers has been about $3.84 per day. The county also hires several rollers, paying $5.76 per day.

Notts county owns four steam rollers, the initial cost of the plant being as follows:

Rollers, each	$1,700
Sleeping van	237
Watering cart	143

The total number of tons consolidated by the rollers was 36,858, the cost per ton being 17 cts. The four rollers worked 1,211¾ roller days during the year, the average cost per day being $5.19. Coal cost from $2.64 to $3.84 per ton.

Northamptonshire county owns two rollers and has one other on order. The initial cost of the roller plant was as follows:

12½-ton compound roller	$2,050
Scarifier	340
Traveling van	364
Two water carts	267

The average cost of upkeep per year, including wages, fuel, repairs, etc., has been $875. Coal has averaged $3.60 per ton. In this county one roller serves for 90 miles of road. The average number of tons rolled per year is 9,000 for each roller. This would make the cost of rolling about 9 cts. per ton.

Norfolk county owns 12 rollers, the initial cost of the roller being $20,200. The average cost of the upkeep per year for the 12 rollers for the past six years has been $2,410. The average cost per year of each roller has been $212.

Pembrokeshire county owns two steam rollers, the initial cost of the plant being $6,405, this including the cost of two 10-ton compound rollers, two living vans, two water carts and two coal carts. The average cost of upkeep for this plant for the past six years has been $2,075, this including driver's wages, water, fuel, oil, waste repairs, and removal of plant. This figures out about $1,037 per year per roller and coal costs from $5.28 to $6.00 per ton. Owing to the scarcity of water rolling is stopped early in June and not commenced again until in August. The rollers are worked steadily for the remainder of the year.

Shropshire county owns six steam rollers. The average cost of upkeep for the past three years has been $1,414 per year per roller, this including driver's wages, fuel, oil, waste, haulage of water, coal and repairs. Coal costs from $3.60 to $4.32 per ton. The rollers are worked all the year round. This county does all of its own rolling, only occasionally hiring a roller.

Staffordshire county owns seven steam rollers. The initial cost of the plant, which includes seven rollers, six coal wagons, six sleeping vans, 12 water carts and six roller sheds, was $19,000. The average cost of upkeep per year of the plant, including wages, repairs, fuel, etc., has been $6,850, or about $978 per roller. Coal costs from $3.84 to $4.08 per ton. The rollers are worked all the year, except when stopped by frost or repairs. The Table I. shows the number of steam road rollers owned by each county, and the yearly cost of operating the rollers. The latter figures include interest, wages, fuel, repairs, depreciation, etc., and is the actual cost of rolling per year. It should be borne in mind that wages in England are about one-half what they are in this country, roller engineers receiving about $1.25 per day and laborers about 87 cts.

TABLE I.

County.	Number steam rollers owned by county.	Mileage of rural main roads.	Miles per county roller	Cost of working per roller per year.
Berkshire	3	349	*116	.....
Breconshire	1	169	*169	.....
Buckinghamshire	6	466	*77	.....
Bedfordshire	1	735	*184	.....
Carnarvonshire	3	216	72	$1,215
Cheshire	4	511	*128	1,458
Cardiganshire	4	234	59	1,167
Durham	2	62	*31	1,215
Denbighshire	1	123	*61	850
Derbyshire	7	510	*73	1,157
Dorset	14	164	34	.....
Essex	10	679	*68	937
Flint	2	200	100	.....
Glamorgan	9	183	20	2,415
Gloucester	18	1,037	57.5	1,119
Herefordshire	12	502	41.8	.....
Monmouthshire	4	263	66	.....
Middlesex	3	47	16	.....
Northumberland	4	570	*192	.....
Notts	4	326	82	1,571
Northamptonshire	3	272	90	875
Norfolk	12	1,412	117	.....
Pembrokeshire	2	118	59	1,037
Shropshire	6	700	116	1,414
Staffordshire	7	606	86	978

*Also hires rollers. †Hires all rollers.

Suggested Standard Specifications for Macadam, Brick, and Granite Block Pavement, Creosoted Wooden Block Pavement and Concrete Pavement.

An important step toward the standardizing of street paving specifications was taken at a convention of city officials held at Chicago on Feb. 21 to 26. This convention was called at the suggestion of Mr. Frank T. Fowler, Superintendent of Streets, of Chicago, for the sole purpose of taking action looking to the standardization of street paving. Invitations were sent to all cities having a population of 50,000 or more and 94 delegates representing 44 cities represented. The majority of the delegates were city engineers, or men directly connected with municipal street improvement work. The convention was formally organized under the name of the "Organization of City Officials for Standardizing Paving Specifications," and standing committees were appointed to draft standard specifications for various types of pavements. Each committee gave careful consideration to all phases of the type of pavement assigned to it, and reported recommended specifications to the convention. In drawing up the specifications the committee endeavored to meet as many conditions as possible by a sufficient number of standard arrangements which would permit the selection of one standard closely meeting the requirements of any particular locality. With this end in view several of the committee recommended only the principles upon which the specifications should be drafted, thus enabling the local engineers to adapt them to conditions in his particular city.

MACADAM PAVEMENTS.

The committee on macadam specifications consisted of J. L. Darnell, chairman, Kansas City, Mo.; Wm. H. Brooks, vice chairman, Philadelphia, Pa.; H. R. Peterman, St. Joseph, Mo.; H. S. Richards, Chicago, Ill.; Walter J. Leininger, Chicago, Ill.; Ellis R. Dutton, Minneapolis, Minn.; H. W. Klausman, Indianapolis, Ind.; Wm. Mungle, Newark, N. J.; Thos. P. Wriggins, Trenton, N. J.

In submitting its report this committee stated: Your committee unanimously concurs in the belief that a modern macadam pavement can hardly be considered finished until it has been given some binding treatment, and the specification has been prepared with an ultimate treatment with some bituminous compound in view. We have considered treatment by penetration only, however, as other methods would more properly come before your Committee on Asphalt and Bituminous Macadam. In the limited time at the disposal of your committee it has been impossible to go fully into the merits of the various tar and bitumens offered by the manufacturers for macadam road treatment. In this specification, we have endeavored to indicate a method of application which would generally be attended with successful results. However, in the use of these materials it is

recommended that the engineers consult with the manufacturers and so amend this specification that it will comply with their requirements. It is further recommended that careful consideration be given the physical and chemical requirements of the bituminous treatment and that they be specified by such requirements rather than by trade name.

The specifications recommended by the Committee were as follows:

Sub-Grade.—The portion of the roadway indicated shall be excavated from the present surface thereof to a sub-grade which, when properly prepared, in the case of Telford foundation, shall be 14 ins., and in Macadam foundation, shall be 12 ins., below and parallel with the surface of the completed pavement. Said completed surface shall conform to the general cross-section of the street as indicated, and shall be thoroughly cleaned, all stumps, roots and sod or other vegetable matter removed and the sub-grade shall be rolled with a steam road roller weighing 10 tons, so the surface shall be exactly parallel with the proposed finished surface. All soft or spongy places shall be excavated and refilled solidly with gravel, broken stone or approved earth before the completion of the rolling. If, by reason of steep grades, or other circumstances, it is deemed impracticable to use the steam road roller, the contractor will be permitted to use an approved horse-roller upon application to and with the consent of the proper authority.

Telford Foundation.—Upon the sub-grade thus prepared, rolled and accepted, there shall be placed a foundation of clean, hard, sound stone, broken into sizes which shall come within the following dimensions: 4 to 8 ins. in width, 8 to 14 ins. in length, and not less than 8 ins. in depth. The stone shall be placed by hand vertically upon the broad edge and lengthwise across the roadway, so as to form a close, firm foundation from gutter to gutter. The projection of the stones above and below surface 8 ins. above the sub-grade shall be broken off with napping hammers and the pieces so broken off, together with other stones of suitable size and shape, shall be used as wedges to firmly fix the stone of the foundation in proper position, so that its top surface will be parallel to the sub-grade of the roadway and 8 ins. above it.

Upon the roadway thus prepared there shall be spread a layer of good, clean earth, preferably clayey loam, not to exceed 1 in. in thickness. The foundation shall then be thoroughly rolled with a steam road roller weighing not less than ten tons. In places where rolling is impracticable, the foundation shall be rammed with suitable rammers with the approval of the proper authorities.

Macadam Foundation.—Upon the sub-grade prepared in the manner above described shall be spread a layer of broken stone, which when thoroughly compacted as herein provided shall be not less than 6 ins. in depth. The stone in this layer shall be practically uniform in quality and as near an approach to a cube as possible, and broken so that its greatest dimension shall not exceed 4 ins. and the smallest dimension not less than 2 ins.; all to be free from dust, dirt and screenings. All stones which do not approach uniformity of measurement shall be rejected and removed from the roadbed. No stones shall be allowed to remain which are not sound, strong and equable in size and quality. This layer of stone shall be thoroughly rolled with a steam road roller weighing not less than ten tons without the application of water.

Second Course.—On the above described foundation shall be placed a layer of broken stone whose greatest dimension shall not exceed 2 ins. and the least dimension shall not be less than ¾ in. to a depth which when compacted as herein specified shall be 4 ins. This stone shall be thoroughly rolled with a 10-ton steam road roller and sufficient clean stone screenings and water shall be spread over its surface to afford, when the rolling is completed, a practically smooth, dense and hard surface. When the second course as herein specified is completed, there shall be spread upon it a layer of stone ranging in size from 1 in. to ½ in. in the greatest dimension, which when compacted shall be 2 ins. in depth. This latter shall be thoroughly rolled and compacted with the 10-ton roller without the application of water until the stone ceases to creep before the rolls of the machine.

Bituminous Filler.—After the macadam as above specified shall have been thoroughly rolled and when it is in a bone-dry condition, it is to receive a bituminous treatment applied as follows: The surface must be clean, free from dust, dirt or foreign matter, the bitumen applied in an approved manner and at a temperature of not less than 00 degrees Fahrenheit, and in sufficient quantity to cover all parts of the surface and in quantity not less than 1½ gals. and not more than 2 gals. to a square yard of surface. After the application of the bitumen and after it has had time to set, there shall be applied a coating of clean stone chips whose greatest dimension shall not exceed ½ in. and whose smallest dimension shall be no less than ¼ in., sufficient to absorb all of the excess of bitumen, and the whole shall be rolled and rerolled until it presents a smooth, hard, dense and granular surface.

The rolling herein specified must be generally begun at the curb or gutter line and rolled from curb to crown, the shoulders first being rolled so as to prevent the spreading of the stone.

VITRIFIED BRICK PAVEMENT.

The committee on vitrified brick and stone block paving applications was composed of the following: B. T. Fendell, chairman, city engineer, Baltimore, Md.; M. F. McKenna, city engineer, Bridgeport, Conn.; D. M. Roberts, city engineer, Terre Haute, Ind.; John Minwegen, Board of Local Improvements, Chicago; M. R. Sherrerd, chief engineer, Department Public Works, Newark, N. J.; Edward H. Christ, member Board Public Works, Grand Rapids, Mich.; A. N. Aldrich, mayor, Aberdeen, S. D.; W. K. Seitz, assistant city engineer, St. Joseph, Mo.; John B. Hittell, chief engineer of streets, Chicago; J. A. Hooke, assistant sewer commissioner, St. Louis.

The report of the committee recommended brick paving specifications as follows:

Brick.—All brick must be strictly No. 1 pavers of the size commercially known as block, the widths of which must not vary more than ⅛ in. They must be thoroughly annealed, tough and durable, regular in size and shape and evenly burned. When broken the block shall show a dense, stone-like body, uniform in color inside, free from lumps of uncrushed clay, lime, air pockets, cracks or marked laminations; kiln marks or surface cracks must not exceed 3/16 in. in depth. All blocks so distorted in burning as to lay unevenly in the pavement shall be rejected.

All blocks shall be tested for abrasion and absorption, the limits of loss by abrasion test and amount of absorption to be determined by the engineer in charge of the work.

The abrasion test shall be made with the rattler recommended by the National Paving Brick Manufacturers' Association* and of the following shape and dimensions: A regular 14-sided polygon, circumscribed around a circle 28 ins. in diameter and the barrel to be 20 ins. long with ¼-in. spaces between each side, and where cast iron staves are used the engineer in charge of the work shall require greater loss from abrasion than when steel is used.

All blocks shall be laid on a 6-in. concrete base with sand cushion. The sand cushion shall be clean, sharp sand, spread to a uniform surface to conform to the cross section of the finished pavement, the sand cushion to be slightly moistened and rolled with a hand roller weighing not less than 10 lbs. per inch of width, the depth of sand to be not less than 1½ ins. nor more than 2 ins. after rolling.

Cement Filler for Brick Pavements.—The filler shall be composed of one part each of clean, sharp sand and Portland cement. The sand should be dry. The mixture, not exceeding ⅓ bu. of the sand, together with a like amount of cement, shall be placed in the box and mixed dry, until the mass assumes an even and unbroken shade. Then water shall be added, forming a liquid mixture of a consistency of thin cream. The sides and edges of the brick should be thoroughly wet before the filler is applied by being gently sprinkled. From the time the water is applied until the last drop is removed and floated into the joints of the pavement, the mixture must be kept in constant motion.

The mixture must be removed from the box to the street surface with a scoop shovel, all the while being stirred in the box as the same is being thus emptied. The box for this purpose shall be 4 ft. 8 ins. long, 30 ins. wide and 14 ins. deep, resting on legs of different lengths, so that the mixtures will readily flow to the corner of the box, the bottom of which should be 6 ins. above the pavement. This mixture, from the moment it touches the brick, should be thoroughly swept into the joints. Two such boxes shall be provided in case the street is 20 ft. or less in width; exceeding 20 ft. in width, three boxes should be used.

The work of filling should thus be carried forward in line until an advance of 15 to 20 yds. has been laid, when the same force and appliances shall be turned back and cover the same space in like manner, except to make the proportions two-thirds Portland cement and one-third sand.

To avoid the possibility of thickening at any point, there should be a man with a sprinkling can, the head perforated with small holes, sprinkling gently the surface ahead of the sweepers.

Within one-half to three-quarters of an hour after this last coat is applied and the grout between the joints has fully subsided and the initial set is taking place, the whole surface must be slightly sprinkled and all surplus mixture left on the tops of the brick swept into the joints, bringing them up flush and full.

After the joints are thus filled flush with the top of the brick and sufficient time for hardening has elapsed, so that the coating of sand will not absorb any moisture from the cement mixture, ½ in. of sand shall be spread over the whole surface, and in case the work is subjected to a hot summer sun, an occasional sprinkling, sufficient to dampen the sand, should be followed for two or three days.

Note.—Or if a stronger filler is desired pure cement may be used where streets can not be kept closed long enough to permit cement grout to properly set, or on account of any other local conditions, a bituminous filler may be used.

After brick in pavements are inspected and the surface is swept clean, the pavement shall then be rolled with roller weighing not less than three nor more than five tons in the following manner: The brick next the curb should be tamped with a hard wood tamper to the proper grade. The rolling will then commence near the curb at a very slow pace and continue back and forth towards the center, until the center of the street is reached, then passing to opposite curb and repeat in the same manner to the center of the street. After this first passing of the roller the pace may be quickened and the rolling continued until each brick is firmly imbedded in the sand cushion. The pavement shall be rolled transversely at an angle of 45 degrees from curb to curb, repeating the rolling in opposite 45 degree direction. Before and after this transverse rolling has taken place, all broken or injured blocks must be taken up and replaced with perfect ones. The substituted blocks must be brought to the true surface by tamping.

Expansion joints shall be placed parallel with and at each of the curb lines and shall be not less than 1 in. in width. Said joints shall be filled completely with bituminous cement.

(To be continued.)

*In view of the fact that the National Paving Brick Makers' Association is now considering a modification as to dimensions and materials of the "Rattler" now and for some time in use, the committee advised that questions touching the "Rattler" be not considered until after the association had reached a conclusion and made a recommendation as to this appliance.

The steel for the Nez Perce & Idaho R. R. has been delivered in Vollmer, Idaho, and the tracklaying will be inaugurated as soon as weather conditions will permit. The company now plans to have the line in operation for regular traffic on April 1.

Water-works and Sewer Section

Note: This section is devoted to methods and costs of constructing sewers and water-works. It will cover the construction work for all details of water supply and sewerage, including sewage purification and water filtration.

Method and Cost of Constructing a Concrete Water Tower at Victoria, B. C.*

The tower, as built, consists of a hollow cylinder of plain concrete, 109 ft. high, and having an inside diameter of 22 ft. The walls are 10 ins. thick for the first 70 ft. and 6 ins. thick for the remaining 39 ft., and are ornamented with six pilasters (70 ft. high, 3 ft. wide, and 7 ins. thick), a 4-ft. belt, then twelve pilasters (12 ft. high, 18 ins. wide, and 7 ins. thick), a cornice, and a parapet wall. A steel tank of the ordinary type is embedded in the upper 40 ft. of this cylinder. To form the bottom of this tank, a plain concrete dome is thrown across the cylinder at a point about 70 ft. from the base, the thrust of this dome being taken up by two steel rings, ½ in. by 14 ins. and ⅜ in. by 18 ins., bedded into the walls of the tower, the latter ring being riveted to the lower course of the tank. The tank is covered with a roof of reinforced concrete, 4 ins. thick, conical in shape, and reinforced with ½-in. twisted steel bars.

The tower is built on out-cropping, solid rock. This rock was roughly stepped, and a concrete sub-base built. This sub-base consists of a hollow ring, with an inside diameter of 20 ft., the walls being 5 ft. thick. It is about 2 ft. high on one side and 7 ft. high on the other, and forms a level base on which the tower is built. The forms for this sub-base consisted of vertical lagging and circumferential ribs. The lagging is of double-dressed, 2x3-in. segments, and the ribs are of 2x 12-in. segments, 6 ft. long, lapping past one another and securely spiked together to form complete or partial circles. These ribs are spaced 2 ft. center to center.

Similar construction was used to form the taper base of the tower proper, except, of course, that the radii of the segments forming the successive ribs decreased with the height of the rib. Tapered lagging was used, being made by double dressing 2x6-in. pieces to 1¾ x 5 13/16 ins. and ripping on a diagonal, thus making two staves, 3 ins. wide at one end and 2¾ ins. wide at the other. This tapered lagging was used again on the 4-ft. belt and cornice forms, the taper being turned alternately up and down.

The interior diameter being uniform up to the bottom of the dome, collapsible forms were used from the beginning. These forms were constructed in six large sections, 6 ft. high, with one small key section with wedge piece to facilitate stripping, as shown in Fig. 1. There were three tiers of these, bolted end to end horizontally and to each other vertically.

Above the taper base and except in the 4-ft. belt and cornice, collapsible forms were used on the outside also. There were six sections extending from column to column and six column sections, all bolted together circumferentially and constructed as shown in Fig. 1. Three tiers of these were also bolted together both vertically and horizontally.

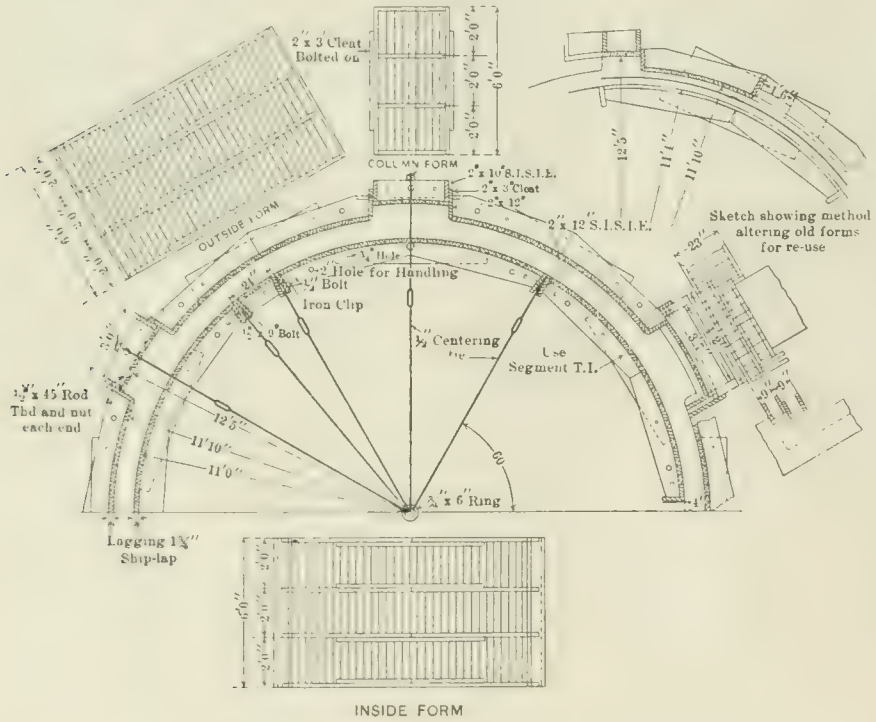


Fig. 1—Movable Forms for Shaft of Concrete Water Tower.

Having filled the top tier, the mode of operation was as follows: All horizontal bolts in the lower inside and outside forms were removed, as was also the small key section on the inside; this left each section suspended to the corresponding one immediately above it by the vertical bolts before mentioned. It is thus seen that in each case the center tier performed the double duty of holding the upper tier, which was full of green concrete, and the sections of the lower tier, until they were hoisted up and again placed in position to be filled.

These lower forms were then hoisted by hand—four-part tackles being used—and placed in position on the top forms, their bottom edges being carefully set flush with the top edge of the form already in position, and then bolted to it. On the outside, the column forms, and on the inside, the wedge and key sections were set last. A 3-lb. plumb-bob and a fine line were suspended from the inner scaffold and carefully centered over a point set in the rock at the base. This line was in the exact center of the tower, and the tops of all the forms, after each shift, were carefully set from it by measurement, thus keeping the structure plumb.

The first 23 ins. of the barrel of the tower was molded with special outside forms, constructed so as to form the bases of the large pilasters. After eleven applications of the 6-ft. forms, these 23-in sections were reversed to form the capitals, thus making these pilasters, 69 ft. 10 ins. over all.

The forms of the 4-ft. belt and beading were made in twelve sections of simple segments and vertical lagging, as shown in Fig. 1.

Two sets of the outside forms were split longitudinally, as shown in Fig. 1, and used to form the small pilasters. The first set was put in place, filled, and the concrete allowed to harden. The bolts were loosened and the forms raised 5½ ins. vertically, again bolted up, and the second set was placed in position, bringing the top of the second set up to the bottom of the cornice. The bases and capitals of the small pilasters were molded on afterward.

The cornice forms are clearly shown in Fig. 1. The small boxes separating the dentils are made of light stuff, and tacked into the cornice forms so that, in stripping, they would remain in place and could be taken out separately, in order to prevent the breaking off of the corners of the dentils. A number of outside and inside sections were sawed in half horizontally in order to provide forms for the parapet wall.

The inside diameter of the tank is 8 ins. greater than the inside diameter of the base. Two sets of inside forms were split longitudinally and opened out as shown in Fig. 1, and another small section was added to complete the circle. The remaining set was left in place to support the dome forms.

The dome forms were made in twelve sections, bolted together to facilitate stripping. All ribs and segments were cut to size on the ground, put together in place, and then covered with lagging and two-ply tar paper. The lagging on the lower sharp curve was formed of a double thickness of ⅝-in. spruce, the remainder being 1x4-in. pine, sized to a uniform thickness of ⅞ in. Figure 2 shows the construction of these forms and the method of putting on the lagging.

The roof forms were made in eight sections and bolted together to facilitate stripping. All ribs and segments were cut to size on the ground, put together in place, and covered with 1x4-in. lagging, dressed to a uniform thickness of ⅞ in., and two-ply tar paper. Figure 2 shows the construction of these forms. The segments being put in horizontally instead of square with the lagging, gave circles instead of parabolas, making them much easier to lay out, and giving a form which was amply stiff.

The question of using an inside scaffold only was carefully considered, but owing to the considerable amount of ornamentation on the outside, necessitating a large number of individual forms, it was not thought that any economy would result. Fig. 3 shows clearly the construction of the scaffolding.

All concrete was mixed wet, in a motor-driven, Smith mixer, and handled off the outside scaffold, being sent up in wheel-barrows on the ordinary contractor's hoist and placed in the forms through an iron chute having a hopper mouth. This chute was built in three sections bolted together, either one, two, or three sections being used, depending on the distance of the forms below the deck. When the top of the forms reached the elevation of any deck, the concrete was put in through the chute from the deck above. The chute was light and easily shifted by the wheel-barrow men, assisted by the man placing the concrete, during the interval between successive wheel-barrows.

The concrete, except that for the roof and parapet, was composed of sand and broken

*Abstracted and rearranged from a paper by A. Kempkey, Proceedings, American Society of Civil Engineers, Vol. XXXVI, p. 176.

rock, the run of the crusher being used. That for the roof and parapet was composed of sand and gravel. The only reason for using gravel for the concrete of the roof was the ease with which it could be obtained in small quantities, the supply of broken rock having been used up, and this being the last concrete work to be done.

The concrete used was as follows: 1: 3: 6 for the sub-base and taper base; 1: 3: 5 for the barrel of the tower and tank casing; and 1: 2: 4 for the dome and roof. The dome was put in at one time, there being no joint, the same being true of the roof. Vancouver Portland cement, manufactured on the island about 15 miles from the city, was used throughout the work.

Before filling, the inside of the tank was given a plaster coat, consisting of 1 part cement to 1¾ parts of fine sand. This proved to be insufficient to prevent leakage, the water seeping through the dome and appearing on the outside of the structure along the line of the bottom of the rings. Three more coats were then applied over the entire tank, and two additional ones over the dome and about 8 ft. up on the sides, and except for one or two small spots which show just a sign of moisture, the tank is perfectly tight.

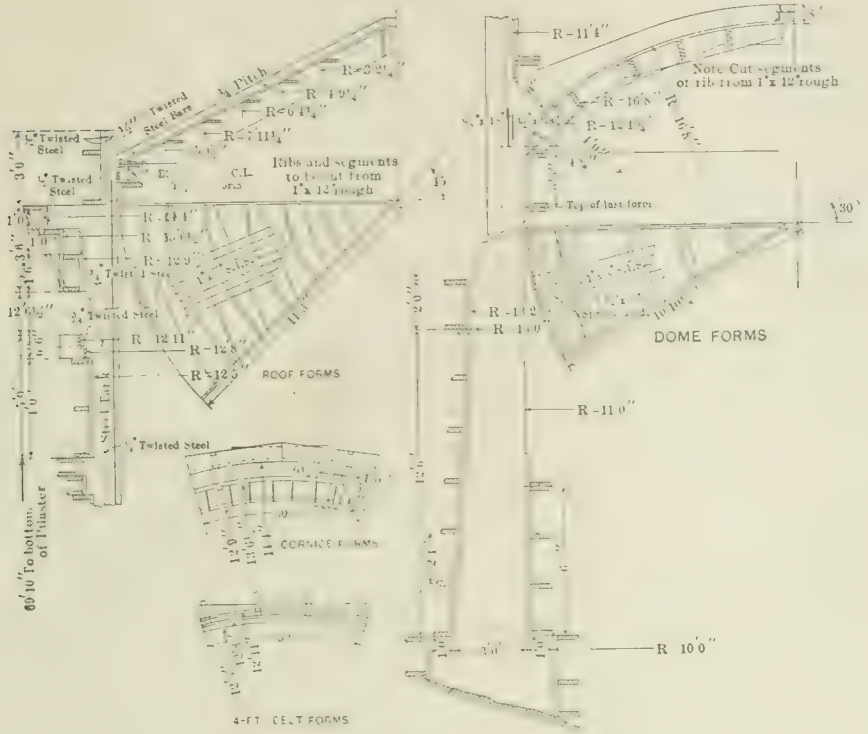


Fig. 2—Details of Base, Dome and Roof Forms for Concrete Water Tower.

The barrel of the tower was carried up to a height of 66 ft. A special set of inside forms, about 2 ft. high, extending to the springing line of the dome, was then put in, and the dome forms were set up on it. The idea was that this 2-ft. form could be knocked out piece by piece and the weight of the dome form taken on wedges to the last 6-ft. form, these wedges being gradually slackened down in order to allow the dome form to settle clear of the dome. As a matter of fact, this was done, but the dome forms, being very tight, did not settle, and had to be pried off a section at a time. A similar method was used for slacking down the roof forms, with similar results.

After the dome forms had been put in, the concrete was carried up approximately to the elevation of the bottom of the rings. Small neat cement pads were than put in and accurately leveled, and on these the steel rings were placed, and the steel tank was erected.

In order to insure a perfectly round tank, each course was erected against wooden templates accuratedly centered and fastened to the inside scaffold. The tank is the ordinary type of light steel, the lower course being 3/16-in., the next, No. 8 B. W. gage, the next, No. 10 B. W. gage, and the remaining four, No. 12 B. W. gage.

Work on the foundation was started on Aug. 15, 1908, and the tower was not completed until April 1, 1909. Much time was lost waiting for the delivery of the steel, and also owing to a period of very cold weather which caused entire cessation of work for about one month.

The tower as completed presents a striking appearance. In order to obliterate rings due to the successive application of the forms and to cover the efflorescence so common to concrete structures, the outside was given two coats of neat cement wash applied with ordinary kalsomining brushes, and, up to the present time, this seems to have been very effective in accomplishing the desired result. Irregularities due to forms are unnoticeable at a distance of 200 or 300 ft., and the grouting gave a very uniform color. The application of two coats of cement wash cost, for labor, $97.68, and for material, $15.18, or $1.32 per 100 sq. ft., labor being at the rate of $2.25 per 8 hours and cement costing $2.53 per bbl. delivered on the work.

The tower was designed by Arthur L. Adams, M. Am. Soc. C. E., under whose direction the plans for all the work of remodeling the water-works system were prepared and executed. The forms, scaffolding, etc., were designed by the writer, who was also in immediate charge of the erection.

Tenders received for the construction of

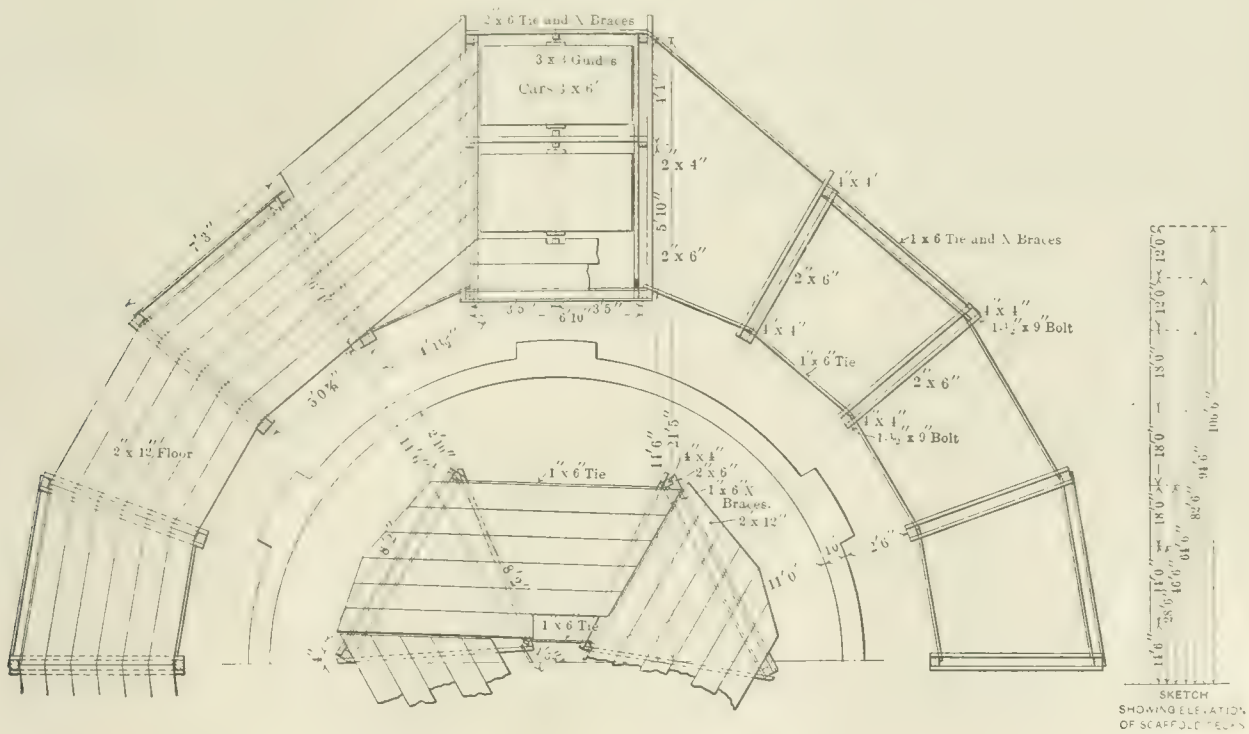


Fig. 3.—Details of Scaffold for Constructing Concrete Water Tower.

the tower covered an extremely wide range, and indicated at once the utter lack of knowledge on the part of the bidders of the cost of a structure of this kind. Inasmuch as none of them had had previous experience in this class of construction, the engineer deemed it the part of wisdom and economy to retain the construction under his immediate supervision, and, therefore, the work was done by day's labor.

The following tables give the cost of the structure. The total herein given will not coincide with the total cost as shown by the city's books, for the reason that various items not properly chargeable to the structure itself have been omitted, the principal ones of which are the cost of the site, the laying of about 600 ft. of sewer pipe to connect with the overflow, and considerable expense incident to the construction of a wagon road to the tower.

The rates of wages paid, all being on a basis of an 8-hour day, were as follows:

Common labor	$2.25 and $2.50
Carpenter	4.00
Carpenter's helper	2.75
Boilermaker	3.50
Holders on	2.50
Boilermaker foreman	5.00
Plasterers	6.00
Plasterers' helpers	3.00

The cost of material was as follows:

Cement, per barrel	$ 2.53
Sand, per yard	1.47
Rock, per yard	0.80
Lumber, per 1,000 ft. B. M.	$14.00 and 16.00

All these prices are for material delivered on the work.

An examination of the cost data, as given, will show that for the most part the unit costs are very high. This is due chiefly to the continued interruption of the work, during its later stages, owing to bad weather, particularly in the case of the erection of the steel tank. The material cost in this case was also exceedingly high. In the case of the concreting, inability to purchase a hoist and motor and the high cost of renting the same, together with the delays mentioned, added greatly to the unit cost. When it is considered that the cost of plastering covers that of four coats over the entire inside of the tank and three more over about one-third of it, it does not appear so high, especially in view of the high rate of wages paid. The cost per yard for concrete alone was $25.126, and this is probably about 25 per cent in excess of the cost of the same class of work executed under more favorable conditions as to location, weather conditions, etc.

The following costs have been rearranged and further analyzed by the editors of ENGINEERING-CONTRACTING from the tables given by the author:

Preliminary work	Total	Per cu. yd.
Labor, carpenter at 50 cts. per hour	$ 11.00	
Labor, common at 24.4 cts. per hour	64.94	
Labor, common at 28.1 cts. per hour	249.67	
Total labor	$ 325.61	$ 0.720
Materials	133.62	0.324
Total labor and materials	$ 459.23	$ 1.114
Forms Building, Shifting, Stripping:		
Labor, carpenter, at 50 cts. per hour	$1,832.99	
Labor, common, at 34.4 cts. per hour	80.85	
Labor, common, at 28.1 cts. per hour	563.84	
Total labor	$2,477.68	$ 6.014
Materials		
Lumber	$ 583.49	
Hardware	325.51	
Miscellaneous	13.90	
Total material	$ 922.90	$ 2.240
Grand total	$3,400.58	$ 8.254
Scaffold Erecting and Tearing Down:		
Labor, carpenter at 50 cts. per hour	$ 698.00	
Labor, common, at 34.4 cts. per hour	350.59	
Labor, common, at 28.1 cts. per hour	117.27	
Total labor	$1,160.86	$ 2.818
Materials.		
Lumber	$ 487.77	
Hardware	202.79	
Total materials	$ 690.56	$ 1.676
Grand total	$1,851.42	$ 4.494
Concreting:		
Labor at 50 cts. per hour	$ 142.00	
Labor at 34.4 cts. per hour	11.00	
Labor at 28.1 cts. per hour	947.81	
Total labor	$1,100.81	$2.672
Material:		
Rock	$ 317.30	
Sand	335.72	
Cement	1,591.97	
Total material	$2,244.99	$ 5.449
Hoisting:		
Rental motor and hoist	$ 406.56	
Power	83.53	
Total power	$ 490.09	$ 1.189
Grand total	$3,737.89	$ 9.316
Grand total concrete	$9,449.12	$23.178

These figures do not include apparently any charge for superintendence which with perhaps some other items may account for the difference between the final total and the cost of $25.126 for concrete given by the author of the paper.

The cost of plastering 3,000 sq. ft. was as follows:

Labor:	Total.	Per sq. ft.
Plasterers, at 75 cts. per hour	$116.50	
Labor at 46⅔ cts. per hour	15.00	
Labor at 37½ cts. per hour	198.52	
Labor at 28.1 cts. per hour	105.66	
Total labor	$435.68	$0.1452
Materials:		
Sand	$ 8.64	
Cement	66.10	
Alum and potash	16.00	
Total material	$ 90.74	$0.0302
Grand total	$526.42	$0.1754

The cost of washing 8,560 sq. ft. with cement wash was as follows:

Labor:	Total	Per sq. ft
Common at 43¾ cts. per hour	$ 50.00	
Common, at 28.1 cts. per hour	47.68	
Total labor	$ 97.68	$0.0114
Material:		
Cement	$ 15.18	$0.0018
Grand total	$112.86	$0.0132

The itemized cost of the steel tank, 20,000 lbs., was as follows:

Labor:	Total.	Per lb
Carpenter at 50 cts. per hour	$ 124.24	
Helper at 34.4 cts. per hour	2.75	
Boilermakers	382.57	
Holders on	117.33	
Labor	10.61	
Foreman at 62.5 cts. per hour	186.25	
Total labor	$ 883.75	$0.0441
Materials:		
Tank, rivets, etc	$1,740.69	$0.0870
Grand total	$2,624.44	$0.1316

The various miscellaneous items of cost were as follows:

Windows, Doors, Etc.:	Total.
Labor	$ 49.00
Material	47.26
Total	$ 96.26
Equipment, 10% of $161.46	$ 184.58
Ironwork: (Spiral stairway, inlet and overflow pipes, radiator, reinforcing steel, etc.):	
Labor:	
Machinists at 50 cts. per hour	$ 89.50
Helper, at 34.4 cts. per hour	240.16
Labor, at 28.1 cts. per hour	100.79
Total labor	$ 430.45
Material	$ 1,814.71
Grand total	$ 2,245.16
Grand total (tower and tank complete)	$16,578.29

The Lowering of Well Water Supplies and the Use of Air Lift Pumps.

At the recent (1910) meeting of the Indiana Sanitary and Water Supply Association, Mr. Charles Brossman, consulting engineer, Indianapolis, Ind., gave it as his opinion that one large factor in the lowering of deep well supplies in the drainage of farm lands. He stated that he has seen farms drained, underlying which was a splendid stratum of gravel ordinarily taking care of the greater portion of the water. At present nearly all the water is taken rapidly to the nearest water course and none goes down to the gravel; the small amount retained in the soil being absorbed by vegetation. The following instances were given of lowering of water:

Kentland	15 ft. drop in 5 years
Elwood	10 ft. drop in 12 years
Greensburg	10 ft. drop in 10 years
Marion	28 ft. drop (time not given)
Remington	8 ft. drop in 10 years
Marion	6 ft. drop in 20 years
Butler	4 ft. drop in 10 years
Bourbon	3 ft. drop in 8½ years
Linton	some wells show 30 ft. drop in 6 years
Kokomo	some wells show 15 ft. drop in 14 years

The cause of the drop at Marion is given as due to waste from other wells. A number of plants have installed air lifts or other deep well pumps. Mr. Brossman concluded his remarks by saying:

> Is it necessary that wells should be uncapped and allowed to flow, or is it necessary that all the water falling on rural lands be run off at once into the nearest waterway, without some attempt at having it serve some useful purpose? The lesson of natural gas has been learned in Indiana. Do the facts that we have learned in regard to water supplies merit a further investigation to determine if conditions can be improved? Do they warrant the placing of the situation before the state authorities?

As bearing upon the subject Mr. J. B. Marvin, C. E., of Frankfort, Ind., gave the following data, based on his personal experience at Frankfort since 1886:

At certain low levels in and around Frankfort the water flowed as late as 1890. It was observed, however, prior to that date the head of the ground water was gradually receding. My concern was rendered acute on the water supply question, made so by having in charge the management of the water-works at Frankfort during these years.

The water supply is obtained from a coarse gravel and sand stratum reached at a depth of fifty feet; at the point where the works are located near the center of Frankfort, and continues to a depth of eighty ft., thus giving 30 ft. of most excellent water producing gravel and sand. Immediately above this stratum lies 20 ft. of blue impervious clay; below is found a greater thickness of the same kind of clay. These conditions prevail throughout a large area of our section, the water bearing stratum varying somewhat in thickness. From this it would appear that the supply of water in this locality was reasonably well assured. However, I have no theory to exploit, either scientific or theoretical, as to the ultimate permanency of the supply, nevertheless I have a decided opinion. I know that by 1892 the head of the water had fallen to a depth where it was necessary to use artificial means to aid the flow.

At this period of the declining ground water level, compressed air was employed to accelerate the flow of the water and the same was used with varying degrees of success until 1907, and abandoned at that time on account of the ineffectiveness of the method and in consequence of the excessive cost, but most of all the never ending trouble caused by an offensive odor and disagreeable taste in the water. Be it here understood that at no time prior to the using of air was there even a suggestion of trouble from algae, and it entirely disappeared with the discontinuance of the use of air. During the period air was used our storage consisted of two reservoirs of brick construction, puddled on the outside with blue impervious clay and water proofed within; bottoms made secure, both reservoirs covered and never neglected in the point of being regularly cleaned. Mention is made of the reservoirs and their construction and condition so that it would be self-evident that the presence of algae in the water could not be charged to sunlight. Often in the autumn months the offensiveness, both to taste and smell, was almost past endurance, and even in the winter months the odor and taste in the water could be readily detected at the hot water faucet. At the time of the greatest distress, a suggestion was offered to very high authority, that the trouble might be traced to the compressed air, that is that the fungi might be carried in from the open atmosphere with the compressed air and its growth encouraged and propagated by the warmth imparted by the frictional heat. At that time the suggestion met with a strong negative opinion.

Since then this theory has been under the expert's scrutinizing investigation and experiments and it has been conclusively demonstrated that certain forms of algae live and thrive best without light, and when once im-

parted to the water finds congenial elements for growth in the dark recesses of the water mains. It is a demonstrated fact that our trouble came from the compressed air source, for, as stated before, there was no trace of algae prior to its use, and it entirely disappeared with its discontinuance.

A somewhat extensive experience in other fields, not only in this, but other States, has convinced me that compressed air is a breeder of trouble, that in almost all cases, if not every case, where compressed air is employed for raising water, the presence of algae in some form and to some extent can be found, and this whether the storage is covered or open.

The ground level of the water has lowered about one foot per year during the last twenty years; at first more rapidly, of late very slowly, until at the present time the static head is 26 ft. It seems certain that the next 24 ft. to the point of the beginning of the water-bearing stratum will offer stubborn resistance to further decline, on account of the large area that supports this subterranean supply. The statement of "large area" is made for the reason that this stratum is drawn upon for water all over Clinton county, and the uniform lowering of the head is well observed.

Deep well augur or impeller pumps, driven by vertical electric motors, direct connected, have been in use since February, 1907, one 6-in. and one 8-in. being sufficient to furnish the present requirements. Before installing these pumps 19 walls were used. A sufficient supply can be obtained now by running the 8-in. pump from 6 A. M. to 6 P. M., which delivers 700 gals. per minute, and the 6-in. pump from 6 P. M. to 6 A. M. delivering 408 gals. per minute. The 6-in. pump has 60 ft. of shafting and requires 9.9 HP. for operating, using $3 per ton run of mine coal. The fuel cost per 1,000 gals. for raising water into storage reservoirs, based upon a daily average pumpage for 1909, of 755,756 gals., was 2 9/10 mills, or 22 HP. for 12 hours, and 10 HP. for 12 hours, an average of 16 HP. The last year compressed air was in use, with the static head of the ground water very much higher, the fuel cost per 1,000 gals. for raising the water into the same reservoirs was 4½ mills. A Band Duplex Air Compressor with Keyer gear was used. The size of the steam cylinders being 12x16 ins. air end 14x16 ins., having a capacity of 570 ft. of free air per minute, at 100 revolutions, with 60 lbs. of air and 80 lbs. of steam pressure.

Notes from the Springfield, Ill., Water Works Report.

Springfield, Ill.—In the 1909 annual report Mr. J. W. Southwick, superintendent of water works, recommended that when rehabilitation of the electric light plant becomes necessary it should be installed at the pumping station. This will result in a saving of fuel, will require but one or two additional firemen and no increase in the number of engineers, although some increase will be needed in steam power for three months in the year. In his opinion the overflow of water at the new dam can be utilized to produce all the electricity required during nine months of the year. To protect the water supply septic tanks are recommended for the outlet of the new large sewer in the south part of the city. The cost for 400 tons of cast iron water mains averaged $23.95 per ton f. o. b. Springfield. The total expenses for the year were $123,420, of which improvements cost $62,976. Total collections for the year amounted to $117,535, leaving a deficit of $5,885. New mains cost $31,274 and the new dam, the improvement of Spring Creek and new work on the power plant cost $31,701, so the deficit was only apparent, for it was a year of extraordinary expenditure on work of a permanent nature. In 1905 Springfield, Ill., was credited with a population of 38,234. The number of meters in use in 1908-9 was 869, of which 534 were in business houses and only 155 in residences and flats. In 1908-9 there were laid 7,021 ft. of 10-in. mains, 26,499 ft. of 6-in. and 667 ft. of 4-in., the total in the city of all mains, public and private, being 92 miles.

Unclassified and General Articles

Note: This section is devoted to methods and cost articles on construction work not properly coming under any of the preceding classifications.

Plans and Specifications for Early Timber, Earth and Masonry Dams Built in Connecticut.

Three of the dams described in the following text and illustrations were built between 1860 and 1870, and nine were built between 1881 and 1891. All of these dams were designed by Harry T. Potter, nine of them while he was a member of the Connecticut State Board of Engineers, having supervision of dams and reservoirs. As examples of the work of an older generation of engineers, these dams are worthy of record, and we describe them here from a paper read at the recent annual convention of the Connecticut Society of Civil Engineers, by Mr. C. E. Chandler of Norwich, Conn.—Editors).

Between 1860 and 1870, Mr. Potter designed and superintended the construction of three dams on the Shetucket River, two of them about 25 ft. high and one of them about 15 ft. high, and the Ousatonic dam on the Ousatonic River, about 24 ft. high. These dams are still among the very largest in the state; the drainage area at the first three dams being 459, 477 and 526 square miles, respectively, and at the latter dam 1,560 square miles. All these dams were built on a rather poor gravel foundation.

Stream flow data in this country were scarce in the 60's, and only the smaller streams had, as a rule, been developed.

Accidents occurred in the building of these larger dams that made Mr. Potter's experience more valuable than it would otherwise have been. As the law does not require that members of the State Board of Engineers should report their doings to any one, there is no convenient way to find out how many, or what dams have been brought to their attention officially. From such plans as Mr. Potter left among his papers, kindly loaned me by his family, from my own personal knowledge and from certificates on the Land Records of the various towns in the district, it appears that Mr. Potter had some official connection with nine dams.

The first dam was built in 1881 and 1882 on the Shetucket River in Norwich at a point where the drainage area is about 1,250 square miles. The rollway is 400 ft. long by 12 ft. high. The height of abutments has since been increased 4 ft. The material for the foundation was loose gravel more than 60 ft. deep. The dam was built of rubble masonry laid in cement mortar coped with granite. The specifications did not call for full mortar joints, as the writer remembers them, but simply required that the stones be well bedded in mortar. There was a concrete facing on the upstream side of the dam, and earth filling as shown by the original plan, Fig. 1. This

Fig. 1.

plan calls for the base of the dam to be 1 ft. below the bed of the stream, and to be 15 ft. wide including 1 ft. of concrete facing and 15 ft. high. The crest is of granite blocks 7½ ft. wide across the dam, inclining upstream on a slope of 5 to 1.

The apron is 22 ft. wide and is a crib of three layers of 12-in. timbers at right angles to each other 6 ft. apart; the lower layer cut into the bed of the stream and the others filled with stone and covered solid with 12-in. timbers, laid parallel with the stream. The 7 ft. of timbers furtherest downstream had an upstream slope of 6 ins. to keep standing water on the apron. The form of the timber apron

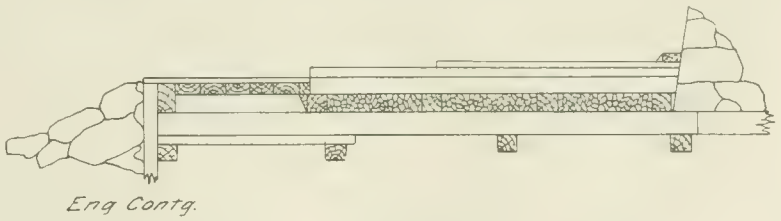


Fig. 2.

was changed in 1885 to that shown in Fig. 2. The new apron had no back slope.

About 200 ft. of this rollway went out in the great freshet of 1886, and it was replaced by a timber dam, built in accordance with Fig. 3. The new work is an immense timber crib 200 ft. long, 68 ft. wide, and 24 ft. high, entirely filled with stones and gravel. The whole crib was built in place, stick by stick, and it floated on the water in the excavation made by the washout until it grounded. This timber crib was extended along the remaining 200 ft. of the dam so that the external appearance is uniform, and the relative position and magnitude of the new and old sections is

shown in Fig. 4. As about one-half of this dam went out and the balance remained undamaged, it is fair to assume either that the material under the balance was poorer than that under the balance, or that something

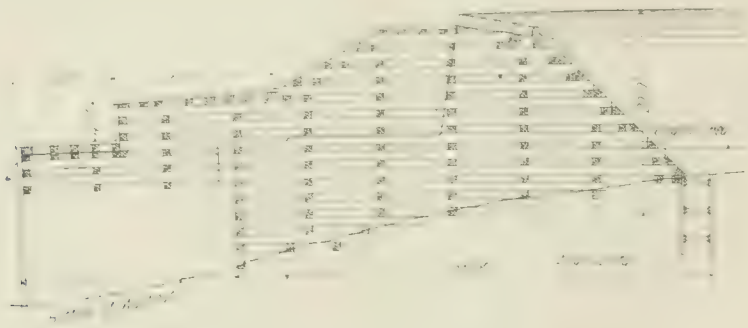


Fig. 3.

happened to one part that did not happen to the other. As during the freshet large quantities of drift passed by, including whole trees, parts of bridges and buildings, the latter may be the case. It is claimed by some that an oil tank floated over the dam and broke the apron.

The second dam was on the Quinebaug River in the town of Thompson, where the drainage area is in the neighborhood of 175 square miles. No plans of it exist so far as the writer knows. My recollection of it is that there was no core wall, except a low one to break the joint between the natural ground and the embankment. A highway occupies the top of the embankment. There was considerable seepage at the foot of the slope and a drain was laid to carry the water into the river.

The following account of this dam is from Professor Dwight Potter's description of the water power on streams tributary to Long Island Sound.

At the site of the new dam the river-bed is gravel, with some quicksand. The dam was carried down 3 or 4 ft. below the surface of the apron into the river-bed and protected by sheet-piling, in the usual manner. The rollway is 200 ft. long, rises 15 ft. above the apron, is 4 ft. wide on top, 30 ft. wide at the base, and has front and back slopes of 20 ft. each. The back slope is covered with 2½-in., the top with 4-in., and the face with 3-in. chestnut planking. In interior construction the dam is a log crib-work filled with stone. An apron projects 16 ft. beyond the foot of the dam, and has a permanent covering of 4-in. chestnut plank, over which is a temporary layer of 2-in. white oak plank, easily renewed when worn out. From the rollway there extends a gravel embankment 900 ft. long, about 20 ft. high, 60 ft. wide at the base and 24 ft. at the top, the inner slope of which will be riprapped.

The third dam Mr. Potter was called to act on was in Woodstock, on a stream of about 7 square miles drainage area. It does

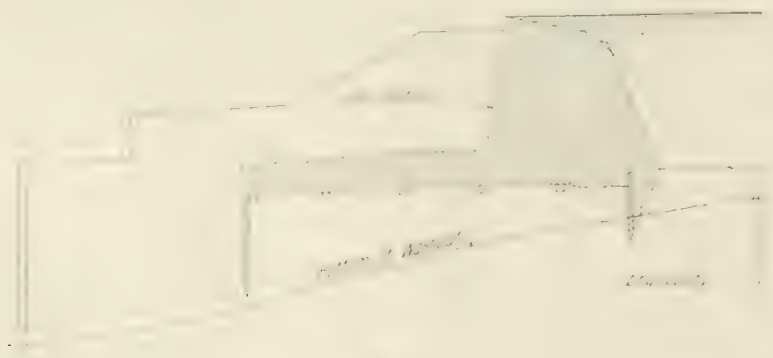


Fig. 4.

not appear that state approval was asked on the original plans. The plan from which the dam appears to have been originally built is shown in Fig. 5. The specifications read as follows:

The masonry to be good rubble work laid in a good workmanlike manner to be 20 ft. thick at the base for a height of 32 ft. and in that proportion; top to be 40 ins. thick. Batter on water side 5⅝ ins. per foot. The lower side to be perpendicular for 12 ft.; above that batter of 1½ ins. per foot. On upper side of dam logs of 12 ins. in diameter laid horizontally 5 ft. apart and planked perpendicularly with good chestnut plank 2 ins. thick. The whole to be graveled to within 2 ft. of top and puddled for 3 ft. in width from planking. Top of graveling to slope on an angle of 30°. For further details reference is made to a plan enclosed herewith.

The foundation appears to be ledge. The rubble was evidently intended to be dry as no mortar is mentioned. The proposed length of wasteway is not given, either in plan or specifications, but it now measures 113 ft. with abutments 2½ ft. high. Among Mr. Potter's papers is a pencil sketch made, probably, by Mr. Potter which is shown in Fig. 6. They built the dam like the original drawing, and after it had bulged from *A* to *B*, they consulted Mr. Potter and braced it up by adding 10 ft. on downstream side at bottom, taking down the old part to *C*.

The privilege has not been in use for many years. The mill owner below was afraid of the dam and its owner dug a channel through it about 37 ft. wide at the top and 25 ft. deep. The experience on this dam plainly teaches, however unnecessary the lesson appears to be, that a dry wall 32 ft. high with a 20 ft. base, and a vertical downstream face for a third of the way up is wholly inadequate.

Dam number four was built on the Pachaug River in the town of Griswold, at a point where the drainage area is 62 square miles. The legal length of the rollway is 82½ ft. The plans call for a rollway 110 ft. by 5 ft The 82½ ft. were placed at the legal height and the balance about 1 ft. higher. The foundation is ledge rock. The cross section is shown in Fig. 7. For a height of 23 ft. it calls for a base of 19 ft. and a 9 ft. coping

Fig. 5.

sloping 2 ft. The specifications were as follows:

The masonry of the face of the dam to be of granite and shall have an average thickness of 3½ ft. It shall be cut and laid with joints not exceeding ¾ of an inch in thickness for a distance of 12 ins. back from the face. The courses shall be laid breaking joint and shall have headers not less than 2 ft. 6 ins. long on face and extend back into the body of the dam not less than 4½ ft. Headers to average not more than 10 ft. apart in each or the same course and alternate in succeeding courses.

The back of the dam and abutments shall be of good rubble work thoroughly laid in cement mortar and properly bonded to interior. All spaces in the interior to be well filled with medium size and smaller stone and thoroughly grouted with cement grout, to make when complete a solid mass of masonry.

The stone piling walls as shown on the plans to be laid with suitable size stone, thoroughly laid in cement mortar and all spaces completely filled.

The coping will be of granite of thickness and length as shown on plans, cut on front edge and top bevel, and thoroughly bedded and secured to other stone work of the dam. The vertical and top joints not to exceed ½ in. in thickness.

After the masonry is in place a filling of earth

and stone is to be put in at back of dam as shown on plans.

The rock under dam and abutments to be excavated to such depth as to give a good footing for the base and toe of the dam. The bottom of the river will be stepped or channeled as shown by plans as decided advisable by the superintendent in charge, in order to guard against

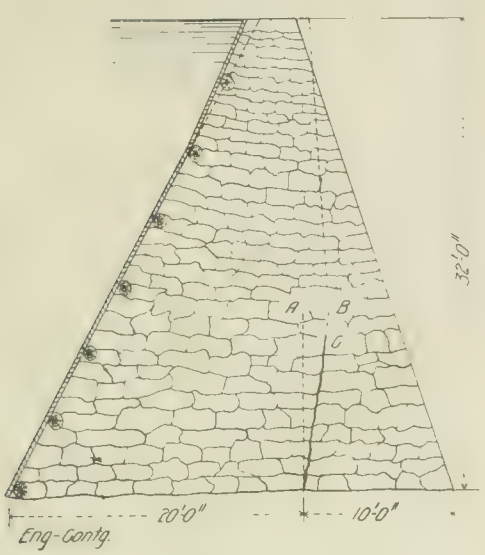


Fig. 6.

leakage between the dam and rock and all hollows and channels thoroughly filled with grouted work.

The top surface of the filling of dam will be protected by riprap of stone suitably laid and extending back a distance of about 6 ft. from back line of coping.

All mortar to be composed of hydraulic cement of some approved manufacture and good clean sharp sand mixed in the proportion of two of sand to one of cement. The mortar to be prepared only as fast as wanted and none having once set to be mixed and used in any part of the work.

This is a first-class dam on a first-class foundation.

The fifth dam was on the Pachaug River where the drainage area is 61 square miles.

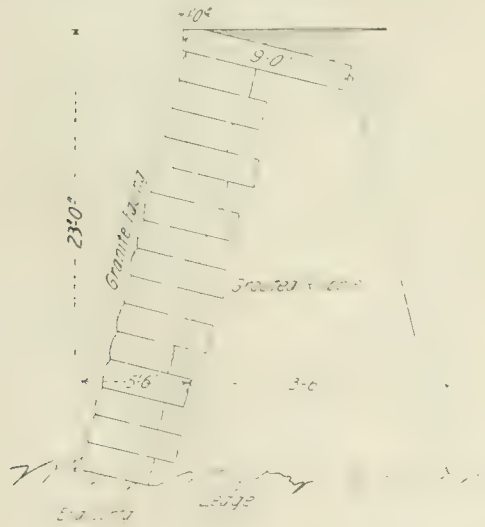


Fig. 7.

The spillway is 111 ft. long by 7 ft. high. The cross section of the spillway is shown in Fig. 8. The foundation is excellent blue gravel. The specifications were as follows:

The whole ground to be occupied by rollway, abutments, and apron is to be excavated to the depth of bottom of mudsill under old apron, which is to be known as the grade line.

The priming or sheet piling under dam and abutments is to be set 4 ft. from upper face of dam in the middle of a trench excavated 3 ft. wide at a level 3 ft. below grade line or as much lower as may be necessary to get to good material.

Except that if boulders too large to be readily removed without blasting are met, the piling may be scribed to them, and the joints well cemented.

Piling to be sound chestnut plank 3 ins. thick, free from unsound knots and wormholes and accurately jointed, or of 3-in. spruce plank tongued or carefully hand spliced and grooved, and free from loose knots.

The piling is to be pointed and cornered and driven as far below bottom of trench as is practicable with an 8 or 10-lb. hammer in such a manner that it may and shall be watertight.

The top of piling is to be spiked to a 3 x 4-in. scantling.

The trench is to be backfilled with blue gravel and carefully puddled. The piling shall extend through the abutment and connect with a 12-in. priming beginning at a depth of bottom of plank and stepping up into embankment as shown on plans.

The top of brick priming to come within 1 ft. of top of abutments and is to be built into a groove 1 ft. deep in back of abutments.

The brick shall be hard and well burned and laid solid in good cement mortar.

The stone used in rollway and abutments are to be good, sound, durable large rock, carefully laid in cement mortar or grouted. The first course of stone in rollway and abutments to be laid in cement mortar. The stone in both faces of rollway and abutments to be laid in mortar for a distance of 12 to 18 ins. and the remainder grouted. All voids in the stone work to be entirely filled with mortar or grout. All stones to be laid with their largest surfaces horizontal and in such a manner as to have good, firm bearings and bond well.

Coping is to be good, sound granite, not less than 7 ft. long, 3 ft. wide and 1 ft. thick, with side joints not more than ⅜ in. thick.

The rollway masonry is to be 20 ft. thick at base and 8 ft. thick at top.

The abutments are to be 12 ft. thick at base and 4 ft. at top.

All mortar or grout used shall be composed of not less than 1 part good fresh burned hydraulic cement to 2 parts clean, sharp sand.

The apron is to consist of 13 or 14 sticks of chestnut or oak timbers called mudsills 28 ft. long and 10 ins. thick, hewn on two sides their whole length. They shall be bedded in the ground parallel with the stream with their tops at grade line and level both ways. The backfilling must be carefully puddled under and around them. They shall extend 8 ft. under the dam and all have their largest ends upstream. They shall have a face on both sides of at least 10 ins. for at least 18 ft. and at small end at least 9 ins. on upper side and 3 ins. on under side.

The stones laid on them shall have good beds to give a good bearing on the timber and earth and there shall be no joints in the first course over the timber.

The cross-sills shall be of good, sound oak or white chestnut 10 ins. thick, and shall be spaced substantially as shown on plans. They shall have a face of at least 10 ins. on upper side and have a face or be spotted at each intersection a width of at least 10 ins. on lower side. The cross timbers at lower edge of apron shall be hewn on three sides.

At least two of the cross-sills beginning at lower edge of apron must be fastened to mudsills with 1⅜-in. bolts with threads and nuts at both ends; the remainder may be fastened with ⅞-in. iron tree nails 20 ins. long.

The cross-sills are to extend at least 1 ft. into the abutments. Where necessary to splice them it shall be done by halving them together as shown on plans over the mud-sills. These splices must be so arranged as to break joints.

The top timbers are to be of oak 10 ins. thick laid to a close joint parallel with the stream. They may be of any width at widest end but not less than 9 ins. at narrowest end.

The wane must in no case exceed 1 in.; yellow pine 12 ins. square may be substituted for the oak.

The upper timbers are to be fastened to the cross timbers at each intersection with ⅞-in. iron tree nails 20 ins. long. Wherever tree nails are used the holes in upper timbers are to be bored small enough so that some force will be necessary to drive irons into them and the holes in cross timbers to be 1/16-in. smaller.

Tree nails are to be slightly pointed cold and the heads heated and sufficiently broomed to take a firm hold on the timber.

The piling at lower edge of apron shall be of 3-in. unjointed chestnut or spruce set in same manner as that under rollway and fastened to cross-sill with 7-in. spikes.

This piling must go 4 ft. below under side of mud-sill, except in case of large boulders as mentioned for piling under rollway.

This trench may be backfilled with concrete, grouted stone work or puddled blue gravel.

All backfilling not otherwise specified must be well puddled blue gravel.

Should the foundation at the grade line be anything softer than blue gravel said softer material shall be removed and replaced with puddled blue gravel or masonry.

The whole of said work both as regards quality of material and mode of operation is to be performed in the most thorough, substantial and workmanlike manner and shall be watertight.

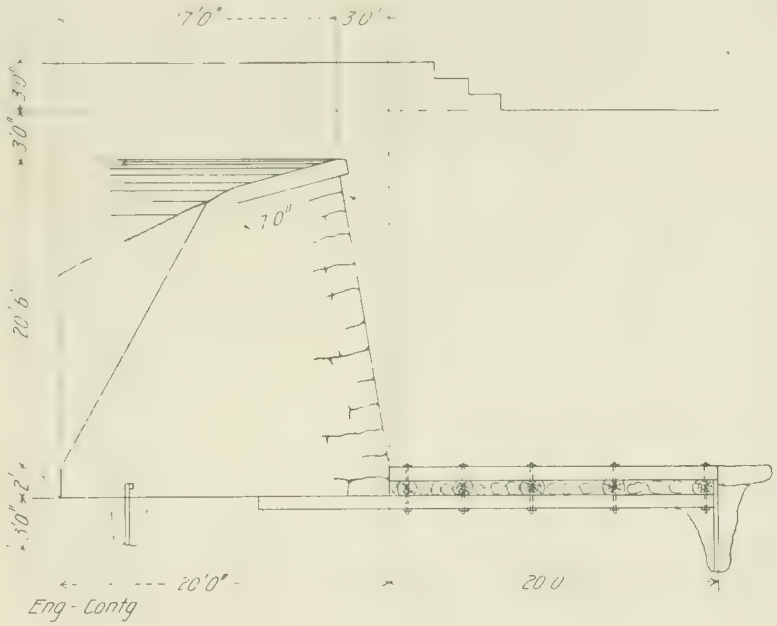


Fig. 8.

This is an excellent dam and is Mr. Potter's ideal dam on a good blue gravel foundation.

The sixth dam was on the Pachaug River at a point where the drainage area is 51 square

miles. No plans of this dam are in existence so far as the writer knows.

The dam was built under Mr. Potter's direction, probably as near as possible like No. 5.

Dam number seven was to be built on the Moosup River at a point where the drainage area is about eighty-six square miles. The cross section for dam drawn under the direc-

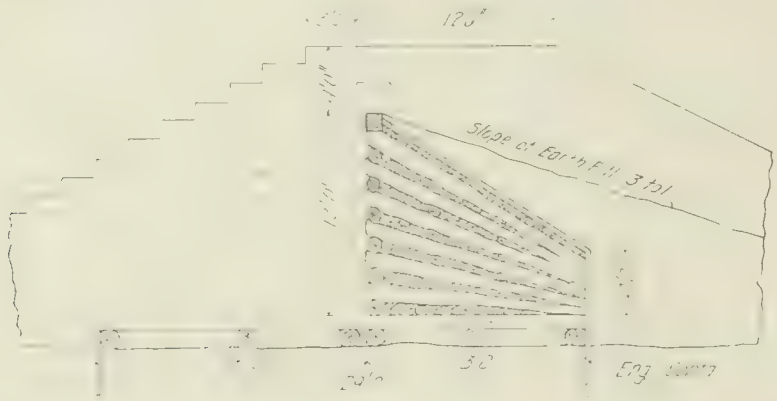


Fig. 9.

tion of the owner, is shown in Fig. 9. The cross section suggested by the engineer employed by the owner is shown in Fig. 10. Both plans call for a crib dam of logs filled with stone. In Fig. 9 the base is 13 ft. for a height of 12 ft. at the crest and 4 ft. at the upstream end, and in Fig. 10 the base is 20 ft. for the same heights. They call for aprons 16 ft. wide of 12-in. timber fastened to logs trenched into the bed of the stream. The writer does not know which plan was followed. The plans called for a rollway 180 ft. long and 4 ft. high. The specifications were as follows:

Foundation for Rollway and Abutments.—The whole ground to be occupied by the rollway and abutments is to be cleared of all loose material and excavated to the level of lowest point in bed of stream, after removal of loose material.

This level, provided the ground proves suitable will be known as the grade line, and will be the level of the top of the mudsills.

Mudsills.—The mudsills are to be of good, sound chestnut or oak timber not less than 10 ins. in diameter at small end hewn on top so as to have a face of at least 6 ins.

They must be properly spliced together, and the splices must break joints with splices in adjoining sills.

The mudsills at toe of dam will extend to connect with the priming under abutments, and it will face on the upper side at least 10 ins.

The mudsills at lower edge of apron will be faced on the lower side at least 6 ins.

All mudsills will extend about 1 ft. into abutments except that at toe of dam.

The mudsills are to be firmly bedded in

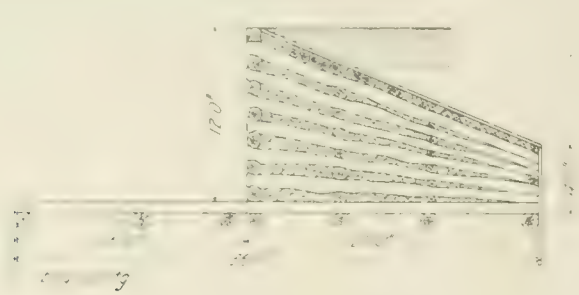


Fig. 10.

trenches excavated for the purpose with their tops at grade line.

Sheet Piling.—All sheet piling is to be of sound chestnut plank free from unsound knots and wormholes. Except at lower edge of apron it is to be accurately jointed or grooved and tongued or spliced. The piling is to be pointed and cornered and driven as far below the bottom of trench as is practicable with an 8 or 10-lb. hammer in such a manner that it may and shall be watertight.

The trench is to be excavated 3 ft. wide at a level 3 ft. below grade, or as much lower as may be necessary to find proper material.

The priming must be set in the center of the trench and the backfilling must be carefully puddled with best available material on both sides of the piling.

The piling at toe of dam will be spiked to upper mudsill as shown on plan and will be 3 ins. thick.

The piling at lower edge of apron will be 2 ins. thick and be spiked to lower mudsill.

The piling under abutment will be 3 ins. thick and be spiked to a 3 x 4-in. scantling, which scantling will be spiked to upper mud-sill.

Apron.—The apron is to be laid solid with good, sound chestnut or oak timber 10 ins. thick.

At each bay of 7 ft. the timber will extend back to mudsill under center of rollway and then be spliced to the corresponding timber of the rollway. The largest ends of these timbers to be laid upstream.

All other apron timbers are to extend 1 ft. under caplog. The apron timbers may be wider at one end than the other, but in no case less than 6 ins. wide. They must be laid with close joints and not have more than 1 in. wane. They will be fastened to the mudsills at each intersection with ⅞-in. iron tree nails 18 ins. long. The tree nails will be slightly pointed cold and the heads heated and sufficiently broomed to take a firm hold on the timber. The holes in apron timbers are to be bored 1/32 in. smaller than the tree nails, and the holes in mudsills ⅛ in. smaller than the tree nails.

Rollway.—The timber used in the rollway will be good, sound chestnut or oak of the dimensions shown on plans, and hewn or spotted at all intersections and tree nailed as specified for apron at all intersections. It will be planked on top and upstream side with good, sound 3-in. plank. All spaces between timbers are to be entirely filled with stone well packed to height 5 ft. above top of apron and with stone or gravel above that height.

Timbers running across the stream must break joints, and those at upper and lower sides of dam must be continuous.

Masonry.—The abutments below face of retaining walls and above toe of dam, and the retaining walls are to be good, dry rubble on a good foundation. The abutments are to go at least 1 ft. below the grade line.

The abutments above face of retaining wall and below toe of dam and the priming, are to be good rubble, thoroughly grouted in the following manner.

The bottom and both faces are to be laid in mortar composed of 1 part first-class hydraulic cement and 2 parts clean, sharp sand, thoroughly mixed before wetting.

The interior is to be filled with a grout made by adding just sufficient quantity of water to the above described mortar to make it flow freely.

It shall be grouted in sections not more than 10 ft. long and not more than 18 ins. thick.

All of the grouted walls must be laid in trenches at least 1 ft. below the grade-line or level at which the embankment begins.

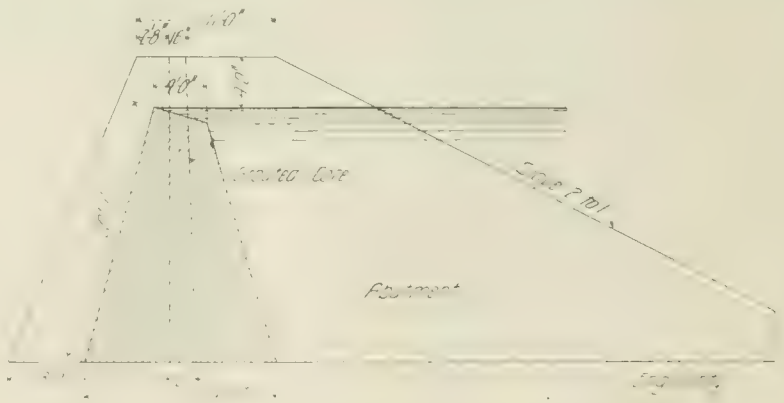


Fig. 11.

In priming and abutments above face of retaining walls no stone is to go entirely through the wall.

Embankment.—The whole surface to be covered by embankment, including the space above the rollway must be entirely clear of turf, brush, roots, and loose material of every kind.

The best available material must be used in the embankment which must be carried up level in every part.

It must be put on in layers not exceeding 6 ins. in thickness by dumping a single load of material in a place and leveling it off.

The embankment is to be 12 ft. wide at the top exclusive of the retaining wall and have a slope of 2 horizontal to 1 vertical.

The loose material removed must not be used above the rollway nor in any part of the embankment proper.

The whole of the work both as regards quality of material and mode of operation is to be performed in the most thorough, substantial and workmanlike manner.

Mr. Potter's eighth dam was for a storage reservoir on a stream with only 3½ square miles of watershed, at a location distant from any village or railroad in the town of Lebanon. The cross section is shown in Fig. 11. It calls for a dam consisting of a dry rubble retaining wall 24 ft. high, 13 ft. wide and base 40 ins. at top. A mortared rubble cut off wall or priming about 20 ins. thick and an earthern embankment on the water side 7 ft. wide at top with a slope of 2 to 1.

The rollway was of mortared rubble 20

ft. high, 15 ft. thick at base and 4 ft. at top. There are some discrepancies between plans and specifications, and the writer does not know which controlled. The essential parts of the specifications were as follows:

The whole ground to be occupied by masonry and embankments is to be cleaned of brush, turf, roots and all loose material.

The ground to be occupied by the masonry is to be excavated to solid rock or to material suitable for a foundation. If the material on which the foundation for mortar work is begun, should be a seamy rock, the seams must be thoroughly filled with cement mortar.

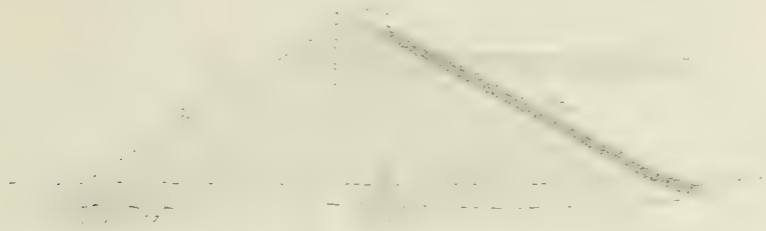


Fig. 12.

The priming wall will be 16 ins. thick at top and have a batter of 3/16 in. per foot on each side, and its foundation will go at least 3 ft. below the bottom of embankment, unless the material is rock. The priming must be smoothly faced on both sides and plastered with cement mortar. No stones shall go entirely through the priming. The backfilling on both sides of priming wall is to be carefully puddled with the best available material.

The rollway will be 4 ft. thick at top and 12 ft. thick at bottom, and 30 ft. long at top.

The rollway must start on a level or stepped foundation on lines parallel with the stream. The mortar work of rollway will extend at least 1 ft. into the face of abutments where it will connect with the priming wall; that is, a part of the abutments of section equal to the section of rollway will be built as directed for rollway to a vertical line 1 ft. back of face of abutment at top and a section equal to that of the priming will be built in same manner to the same point, making a perfect watertight connection between rollway and priming.

All masonry is to be good rubble work. All stones are to be laid on their largest surfaces, and are to be of good, sound stone with angular surfaces, and are to be well boned and so built as to make good, strong work. No unbroken boulders are to be used.

The rollway and priming is to be built as follows: The bottom course and faces are to be laid in cement mortar composed of one part good hydraulic cement and two parts clean sharp sand thoroughly mixed before wetting.

The interior of these walls is to be entirely filled with a grout made by adding sufficient water to the above mortar to make it run freely. The work shall be grouted in sections not more than 2 ft. thick in the rollway and 18 ins. thick in the priming, and not more than 10 ft. long in either.

The abutments are to be 4 ft. thick at the top and the east one 11 ft. thick at the base and the west one 12 ft. thick at the base.

The top of priming is to be 1 ft. below top of embankment and top of rollway 3½ ft. below top of embankment. The embankment will be 15 ft. wide at the top, with a slope of 1½ to 1 on the downstream side and 2 to 1 on the upstream side.

The coping of the rollway is to be of good stones not less than 4 ft. long across the wall and be laid with ½-in. side joints.

The embankment shall be built of the best available materials in level layers of not more than 6 ins. deep, thoroughly rammed by carting over it to deposit the material and by thorough hand ramming at points not driven over.

The embankment must not be carried up on one side more than 1 ft. in advance of the other side.

If the material is not carted with teams it must be kept carefully leveled and thoroughly and evenly wet.

The whole of the work, both as regards manner of work and quality of materials, shall be performed in the most thorough, substantial and workmanlike manner, and must be watertight.

In case it should be decided to substitute a dry wall for the embankment on lower side of the dam the priming will occupy the same position and be of the same dimensions, except that all of the batter will be on the upstream side and the priming will extend to the top of the embankment.

The top of the wall including priming will be 4 ft. thick and have a batter on the downstream side of 5 ins. per foot.

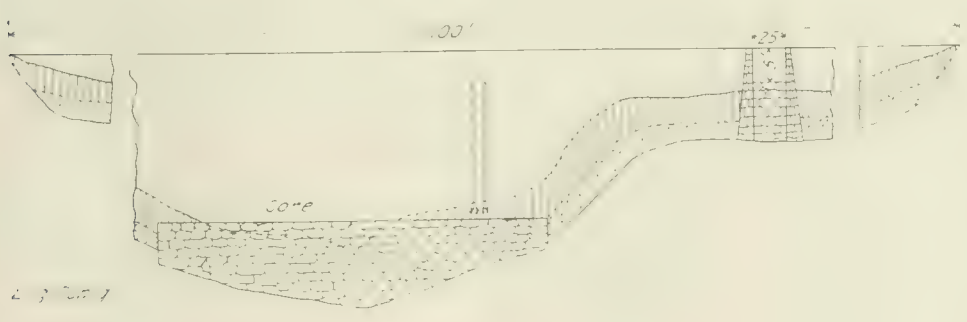


Fig. 13.

The rollway will be of the same dimensions as the retaining wall including priming.

The dry wall and the priming may be built together, well bonded, or they may be built separately. If they are built separately the joint between them must be perfectly vertical, well faced, and smoothly plastered.

In this case there will be no wings below the face of retaining wall, but the pipe and buttresses will be put in the same as heretofore described.

The retaining walls must be finished off with stones not less than 4 ft. long across the walls.

The face of the dry masonry is to be well pointed.

The owner did not think an engineer or inspector necessary. The first time the reservoir filled the whole rollway went out, and the reservoir was emptied as promptly as any automatic flush tank. There was a rumor that, owing to a delay in arrival of cement, several feet of the dam was built up dry and an attempt was made to grout it later. The rollway was rebuilt according to the same plans and specifications under continuous inspection and is still on duty.

The ninth dam was a water supply reservoir on a watershed of one-quarter of a square mile, in the town of Norwich. The specifications were as follows:

The entire surface to be occupied by the dam shall be well cleaned of top soil, etc., to hard pan, or to a surface satisfactory to the engineer. It is thought that a depth of about 4 ft. will be sufficient, and it is so indicated on the plans, but it must go down to a satisfactory material whether more or less than the said 4 ft.

Trench for Core Wall in Hard Pan.—This trench is shown on the plans. It is to be about in the middle of the dam, dug into the hard pan to a depth of 3 ft. and about 8 ft. wide, the entire length of the dam. The width of about 8 ft. will be exactly determined by the engineer. The filling is to be thoroughly rolled for puddling, lengthwise throughout the entire length of the dam. Selected material is to be put into this trench in 6-in. layers and wet and rolled.

After the core wall has been laid the whole surface of the puddling can be rolled close up to the wall and when the puddling has been brought above the top of the core wall there will be no barrier to the entire rolling of the puddle which must be done in a uniform and thorough manner.

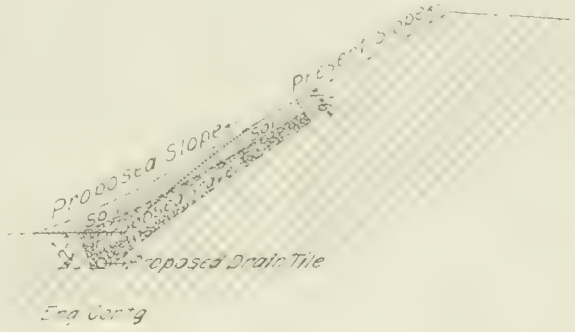


Fig. 14.

Core Wall.—The location for the core wall is shown on the plans. It is to be 3 ft. wide and about 360 ft. long and a general average of 8 ft. high, except at the center of the dam at the deepest place, where it will be higher, as shown by the plan. The trench for the core wall is to be 3 ft. wide and 1 ft. into the hard pan below the bottom of the puddle trench, making 4 ft. into the hard pan. The core wall is to be laid well, using field boulders, etc., on the ground, but well placed to make a good, solid, well-bonded wall, laid in cement mortar of 3 parts of suitable sand to 1 of cement. The outside of the wall to bond in well with the puddling filling the trench solid.

Selected Material.—The upstream side of the dam is to be selected material from the downstream edge of the level top, vertically down to the bottom, shown on the plan of the section by a heavy dotted line. All the material above this place is to be carefully selected and to be suitable material for a dam, no top soil or fine sand to be used. This material is to be placed wet and rolled as described for trench. The material below this division may be what is left, and the stones and boulders not used in the core wall, the stones and heavy material at the bottom nearest the core wall and the filling well rammed in between them, and as soon as possible the filling to be put on in layers and rolled as above division.

Upper Slope of Dam.—This is to have a true and even slope of 2 to 1 to be covered with a layer of small stones and above that with suit-

able filed stone paving as sufficiently shown on the plans.

Lower Slope.—This slope is to be graded to a true and even slope of 1½ to 1 and top soiled, well raked and graded and sown to grass. The level space on top of the dam will be treated in the same way.

Overflow.—This is to have a waterway 25 ft. wide with side walls with dimensions as shown on the plans. These side walls are to be extended down until they reach the ledge on which they are to rest. The ledge is to be cut away to secure an even plane on which to rest the walls. There is to be a wall built lengthwise of the overflow, as shown by the dotted lines on the plans. This wall is to extend down to the ledge for a foundation. The slopes shall be paved as indicated on the plans.

Figure 12 is the section shown on the original drawings. It calls for an earth embankment 10 ft. wide on top with the lower slope 1½ to 1 and the upper 2 to 1 with core wall ending 24 ft. below top of embankment. Fig. 13 shows a small amount of core wall and a spillway 25 ft. by 5 ft.

The dam was built without any spillway and Mr. Potter is said to have refused a certificate on that account. Probably the owner's theory was that a blow-off pipe was sufficient for so small a watershed. After the superintendent had spent one rainy night with the blow-off open and the water apparently just ready to go over the embankment, they put in a spillway 11 ft. long and 3 ft. high.

There was some percolation through the embankment. It was sufficient to make meadow grass grow and the ground at foot of slope was quite wet. One day a patch of soil about 10 ft. by 30 ft. slid off the embankment so rapidly that it went on to level ground some distance from the foot of the slope, and piled itself up in a heap.

Figure 14 shows how this section of embankment was treated. The slope was flattened by the addition of 6 ins. to 2 ft. of very coarse gravel and the soil replaced. This was successful so far as making the embankment dry and permanent is concerned. The leaks were led away in a drain pipe. Experience with this dam indicates injurious percolation is liable to exist in an earthen dam without a core wall.

It is interesting to note that the eminent civil engineer who made the original plans thought it desirable to provide a spillway 25 ft. by 5 ft. The experineced mill owner thought none necessary, while the engineer later consulted thought a spillway 11 ft. by 3 ft. was ample. In some cases differences in length of spillway adds very little to the cost of the dam. In this case it would add considerable. The most important difference in the ideas of the first and last engineer is in the level of the spillway in relation to the top of the embankment.

The difference of 2 ft. makes a difference of 15,000,000 gals. in the capacity of the reservoir which is quite important when one-quarter of a square mile of watershed supplies 3,000 people with water.

Personals.

Mr. Gerhard M. Dahl has been appointed city street railroad commissioner of the city of Cleveland.

Mr. David Sloan has been appointed consulting engineer and Mr. W. G. Sloan has been appointed chief engineer of Mac Arthur Brothers Co., Chicago, Ill.

Frank Dever, head of the engineering corps of the Lehigh Valley Coal Co. in the Hazleton, Pa., district, was killed Feb. 26 by a dynamite explosion in the Buch Mountain colliery.

Messrs. G. H. Fehr, M. W. Cluxton and V. R. Lynch have formed the Fehr Construction Co., and have opened offices at 567 Washington St., Chicago, Ill. The company will engage in a general [illegible] of sewers, tunnels, foundations, retaining walls and concrete work, pile driving, steam shovel and railroad work.

Mr. S. H. Knight, Mem. Am. Soc. Engr. Conts., and Mr. E. J. Riner, C. E., formerly Contracting Engineer and Superintendent, respectively, of the Northwest Bridge Works' Spokane office, have severed their connection with that company and will engage in business for themselves under the firm name of the Engineering Construction Co., with headquarters at Spokane, Wash. They will make a specialty of electric railways, irrigation works, bridges, foundations and reinforced concrete work.

Mr. F. D. Brown of Minneapolis, Minn., has been employed by the Aberdeen Street Ry. Co. as chief engineer and superintendent of construction. Mr. Brown has been connected with the Twin City Transit Co. during the last four years.

The U. S. Civil Service Commission, Washington, D. C., will hold an examination on March 29, 30, 31, 1910, at various cities throughout the country, to secure eligibles from which to make certification to fill eight vacancies in the position of skilled draftsman, at salaries ranging from $900 to $1,200 per annum, in the Office of the Chief of Ordnance, War Department, and vacancies requiring similar qualifications as they may occur in that office.

Mr. M. R. Ramsay, Mr. W. S. Grant and Mr. A. L. Freret have entered into partnership for the practice of mining engineering in the city of Birmingham. Mr. Ramsay, who is one of the best known mining engineers in the Birmingham district, has been in practice at Birmingham for a number of years. Mr. Grant, who is an electrical engineer, has been superintendent of power stations of the Textile Mills Corporation of New Orleans and later in charge of the power plant of the Birmingham Railway, Light and Power Company.

Mr. Chas. A. Alexander, Mr. A. R. Shumway and Mr. C. P. Utz have formed a company incorporated under the name The Alexander, Shumway & Utz Co., for the purpose of engaging in reinforced concrete engineering and contracting. Mr. Alexander has formerly been privately engaged in this work. Both Mr. Shumway and Mr. Utz are engineers experienced in reinforced concrete construction, having been employed by the Ransome & Smith Co. and The Turner Construction Co. The offices are at 16 State St., Rochester, N. Y.

Catalogs Worth Having.

Engineers and contractors should have on file the latest catalogs of machines, tools and supplies that they use. In sending for catalogs reviewed or advertised in this paper, you will confer a favor on us if you will write directly to the advertisers and state that you saw the catalog mentioned in ENGINEERING-CONTRACTING. If you are in the market for tools, machinery or supplies, tell us and we will notify promptly the leading manufacturers.

Spiral Conveyors.—Paper, 3½x6 ins., 20 pp. Jeffrey Mfg. Co., Columbus, Ohio.

A pamphlet containing order and price lists of spiral conveyors and conveyor parts made by this company. A cut of each part listed is shown.

Aggregate.—Paper, 6x9 ins., 6 pp. Edison Portland Cement Co., New Village, N. J.

This little booklet contains a set of twenty-four beautiful illustrations showing the use of cement in the building of country and of town residences.

Motor Driven Air Compressors.—Paper, 6x9 ins., 36 pp. National Brake & Electric Co., Milwaukee, Wis.

Contains complete description of motor driven air compressors manufactured by this company. Details of all working parts are explained by the aid of cuts and sectional drawings. Also explains minutely the operation of the different classes of machines. Some useful tables on capacities and cylinder dimensions at various pressures are included.

Specifications for Reinforced Concrete.—Paper, 5½x7¼ ins., 32 pp. Trussed Concrete Steel Co., Detroit, Mich.

Gives standard specifications for reinforced concrete as well as specifications for Hy-Rib floors and roofs, ceilings and walls of all kinds, cement stucco and waterproofing work in which products of this company are used. Some of the more important of the Kahn System Products are mentioned along with a few remarks as to their use in concrete construction.

Technical Paints for Metal.—Paper, 6x9 ins., 50 pp. National Paint Works, Williamsport, Pa.

An exhaustive discussion on metal paint requirements, causes of paint decay and paint ingredients. A large number of extracts from engineering society papers and quotations from other good authorities are given in support of conclusions reached. Following this is given information concerning the use of different metal paints made by this company. The list number, ingredients, quality, class of work best suited for, demand for, instances where used, with results, etc., are some of the points dealt with.

Crushing Machinery.—Paper, 6x9 ins., 71 pp. C. G. Buchanan, 90 West St., New York, N. Y.

This book gives an elaborate description of rock and ore crushers, magnetic separators, screens, conveyors, hoists, etc., made by the Geo. V. Cresson Co., Philadelphia, Pa. The construction and action of each type of machine is explained in detail by the aid of cuts and sectional drawings, lists of the sizes, weights, capacities, speeds, etc., being attached in handy table form. Diagrams with explanatory notes are provided to show the installment of machinery in crushing plants and separating mills for any desired daily capacity.

Clam Shell Buckets.—Paper, 7¼x9¾ ins., 23 pp. The Owen Bucket Co., Cleveland, O.

This pamphlet describes and illustrates the Owen grab bucket. Particular attention is paid to explanation of the construction of the bucket, along with well presented arguments on its digging power. A number of views are given showing the bucket in operation on different classes of work. A table of dimensions and capacities of different sizes of buckets made is included.

Contractors' Machinery, Tools and Supplies.—Paper, 7x9¾ ins., 288 pp. Harold L. Bond Co., Boston, Mass.

A complete and extensive catalog of machinery and tools for all kinds of construction work, also of railroad, mill and contractors' supplies. Contains full information with cuts of all articles listed, also price and order lists. The order lists show such dimensions, weights, capacities and other properties of aid in ordering from catalog lists.

Collapsible Steel Centering.—Paper, 6x9 ins., 30 pp. Blaw Collapsible Steel Centering Co.

This pamphlet contains an article on cut and cover construction on the Catskill aqueduct in Ulster County, N. Y. An explanation of the general nature of the work is given, followed by a detailed description of the methods of construction used during the progress of the work. Illustrations are used profusely to show the methods of handling and placing the materials and of setting and removing the forms. Along with this is given a full description of the collapsible steel forms and form moving machinery in use. Sectional drawings and views show the design of the different parts of the forms.

Gas Manufacture. — Paper, 6x9 ins., 20 pp. Hawkeye Manufacturing Co., Waterloo, Iowa.

Contains a description of machinery for making gas from gasoline in private plants. Explains the working parts of the different machines, showing by the aid of cuts how the plant is set up and how safety from explosion is assured by placing the plant underground. Also describes the process of making gas, compares the cost of gas with other illuminating means and gives costs on installation of machines of different capacities. Some gas using appliances are also shown.

Crushing and Road Building Machinery.—The Good Roads Machinery Co., Kennet Square, Pa.

This company sends a two-page circular describing and illustrating a new reversible, three-wheel, two-horse road grading machine. Aside from meeting the demands for a light road machine, other advantages are claimed by the manufacturers.

Industrial Railways.—Paper, 3¼x6¼ ins., 17 pp. Ernst Wiener Company, 50 Church St., New York, N. Y.

Describes and illustrates tracks, turntables, cars of different type and industrial track supplies made and sold by this company, a large stock of which is kept on hand for prompt shipment.

Hydraulic Valves and Fittings. — Paper, 6x9 ins., 130 pp. Watson Stillman Co., 50 Church St., New York, N. Y.

An extensive catalog of hydraulic valves and fittings, complete in description, price lists and illustrations. Gives extensive hints as to the best piping arrangements, what types or combinations of valves are best suited to certain work and how to arrange valves so as to operate a number of cylinders or machines automatically.

Drawing Materials.—Paper, 6 x 9 ins., 240 pp. Keystone Blue Paper Co., Philadelphia, Pa.

A complete illustrated catalogue of drawing instruments, drawing paper and drawing supplies, engineer's field books, engineer's and surveyor's instruments and blue print machines. Also contains a list of scientific books in stock, sold by this company.

Concrete Highway Bridges.—Paper 3½ x 6 ins. 16 pp. Northwestern Expanded Metal Co., Old Colony Building, Chicago, Ill.

This booklet contains a great many valuable data on concrete bridges from spans of 10 to 150 ft. Tables are given, showing complete dimensions of girder bridges and arch bridges with all necessary reinforcement.

Leveling Instruments.—Paper, 5¼x7½ ins. 16 pp. Gurr & Bluhm, Troy, N. Y.

This is an accurate explanation, illustrated with half sectional view and half tone engravings, of the construction of wye levels made by this firm. A price list is included.

Amiesite.—Paper 7x8 ins. 12 pp. Amies Road Co., 576-582 Bourse Bldg., Philadelphia, Pa.

A description of a material for making dustless and auto-proof roads, neatly illustrated with photographic views of streets and roads where the product of this company has been used.

Permanent Docks and Bulkheads.—Paper, Raymond Concrete Pile Co., Chicago, Ill.

A two page pamphlet devoted to argument on the permanency and other good qualities of concrete docks and bulkheads. Contains illustrations showing some reinforced concrete dock construction work done by this company.

Engineering-Contracting Monthly Review Index of Civil Engineering Literature.

A classified index and review of the civil engineering papers, articles, reports, pamphlets and books published during the month just passed is given in the succeeding pages. The literature indexed and reviewed—with the exception of books—relates solely to civil engineering. In the section devoted to Book Reviews all books in all branches of engineering are listed as received and such of them as seem worthy are reviewed as fully as due regard for conciseness will permit. In choosing books for review rigid selection is exercised. Next to careful choice of books for review timeliness of review is sought. All books are reviewed within a month of their receipt. The same statement is true of the articles and papers that are indexed. Also, as in choosing books for review, the choice of articles and papers for indexing is based on merit. Numerical strength in "titles indexed" is not sought; excellence of selection is sought.

The purposes of the Monthly Review Index are: First, to inform civil engineers and contractors of the articles and papers of merit that are published each month, in such a way as will give a clear idea of their character and scope; second, to supply the user with the date and place of publication, the length of each article and the cost at which it can be secured. The name, adopted abbreviations, place of publication and price per number of each periodical examined for civil engineering articles are given in the list immediately following. The other information is given in the index proper for each article separately.

Books reviewed will be sent post paid on receipt of price by the Book Department of ENGINEERING CONTRACTING; periodicals, etc., containing articles indexed should be ordered direct from the publishers.

LIST OF PERIODICALS INDEXED.

American Architect (Am. Arch.), New York, N. Y.; w; 7x10 in.; 15 cts.
American Builders' Review (Am. Bldrs. Rev.), San Francisco, Cal.; m; 7x10 in.; 50 cts.
American Carpenter and Builder (Am. Car. & Bldr.), Chicago, Ill.; New York, N. Y.; m; 7x10 in., 20 cts.
American Engineer and R. R. Journal (Am. Engr. & R. R. Jl.), York, N. Y.; m; 7x10 in.; 20 cts.
American Gas Light Journal (Am. G. L. Jl.), New York; N. Y.; w; 10x13 in.; 10 cts.
American Institute of Electrical Engineers Proceedings (Am. I. of E. E. Proc.), New York, N. Y.; m; 4x7 in.; 50 cts.
American Machinist (Am. Mchst.), New York; w; 7x10 in.; 15 cts.
American Society of Civil Engineers Proceedings (Am. Soc. C. E. Proc.), New York, N. Y.; m; 4x7 in.; 75 cts.
American Society of Mechanical Engineers Journal (Am. Soc. M. E. Jl.), New York, N. Y.; m; 4x7 in.; $1.
Annales des Ponts et Chaussees (An. P. & C.), Paris, France; m.
Applied Science, Toronto, Ont.; m; 6x9 in.; 20 cts.
Architects and Builders Journal (Arch. & Bldrs. Jl.), Baltimore, Md.; m; 9x12 in.; 20 cts.
Architects and Builders Magazine (Arch. & Bldrs. Mag.), New York, N. Y.; m; 5x8 in.; 20 cts.
Architect and Engineer of California (Arch. & Engr.), San Francisco, Cal.; m; 5x7 in.; 15 cts.
International Railway Congress Bulletin (Int. Ry. Cong. Bul.), Brussels; m; 50 cts.
California Journal of Technology (Cal. Jl. of Tech.), Berkeley, Cal.; m; 4x7 in.; 25 cts.
Canadian Architect (Can. Arch.), Toronto, Ont.; m; 7x19 in.; 20 cts.
Canadian Cement and Concrete Review (Can. Cem. & Conc. Rev.), Toronto, Ont.
Canadian Engineer (Can. Engr.), Toronto, Ont.; w; 7x11 in.; 20 cts.
Canadian Machinery and Manufacturing News (Can. Mach. & Mfg. News), Toronto, Ont.; m; 7x10 in.; 15 cts.
Canadian Mining Journal (Can. Min. Jl.), Toronto, Ont.; bi-w; 7x10 in., 20 cts.
Canadian Municipal Journal (Can. Mun. Jl.), Montreal, Que.; m; 6¾x10 in.; 10 cts.
Canadian Society of Civil Engineers Proceedings (Can. Soc. C. E. Proc.), Montreal; m; 4x7 in.; 50 cts.
Carpentry and Building (Carp. & Bldg.), New York, N. Y.; m; 11x8 in.; 10 cts.
Cassier's Magazine (Cas. Mag.), New York; m; 5x8 in.; 25 cts.
Cement, New York, N. Y.; bi-m; 5x8 in.; 25 cts.
Cement Age (Cem. Age), New York, N. Y.; m; 4¾x8 in.; 15 cts.
Cement and Engineering News (Cem. & Eng. News), Chicago, Ill.; 7x10 in ; 25 cts.
Cement Era (Cem. Era), Chicago, Ill.; m; 7x10 in.; 10 cts.
Cement-Record (Cem. Rec.), m; 4¾x8 ins.; 15 cts.
Cement World (Cem. Wld.), Chicago, Ill.; m; 9x11 in.; 10 cts.
Chemical Engineer (Chem. Engr.), Chicago, Ill.; m; 4x7 in.; 15 cts.
Clay Worker (Cl. Wkr.), Indianapolis, Ind.; m; 7x10 in.; 20 cts.
Compressed Air (Comp. Air), New York, N. Y., m; 5x7 in.; 10 cts.
Concrete, Detroit, Mich.; m; 6x9 in.; 15 cts.
Concrete Age (Conc. Age), Atlanta, Ga.; m; 9x11 in.; 10 cts.
Concrete and Constructional Engineering (Conc. & Cons. Eng.), London, England; m; 5x7 in.; 25 cts.
Concrete Engineering (Conc. Eng.), Cleveland, O.; m; 7x10 in.; 10 cts.
Contract News, Chicago, Ill.; bi-w; 7x10 in.; 10 cts.
Contractor (Contr.), Chicago, Ill.; bi-w; 7x10 in.; 20 cts.
Cornell Civil Engineer (Cor. Civ. Engr.), Ithaca, N. Y.; m; 4x7 in.; 25 cts.
Domestic Engineering (Dom. Engr.), Chicago, Ill.; w; 6x9 in.; 10 cts.
Electrical Age (Elec. Age), New York, N. Y.; m; 7x10 in.; 10 cts.
Electrical Review (Elec. Rev.), New York, N. Y.; 8x10 in.; 10 cts.
Electric Railway Journal (Elec. Ry. Jl.), New York, N. Y.; w; 7x10 in.; 10 cts.
Electrical World (Elec. Wld.), New York, N. Y.; w; 7x10 in.; 10 cts.
Electric Traction Weekly (Elec. Trac. Wkly.), Chicago, Ill.; w; 7x10 in.; 10 cts.
Engineer (Engr. Lon.), London, England; w; 4x11 in.
Engineer (Engr.), Chicago, Ill.; bi-w; 7x10 in.; 20 cts.
Engineering (Eng.), London, England; w; 8x11 in.
Engineering-Contracting (Eng.-Contg.), Chicago, w; 7x10 in.; 10 cts.
Engineering Digest (Eng. Dig.), New York; m; 5x8 in.; 20 cts.
Engineering and Mining Journal (Eng. & Min. Jl.), New York; w; 7x10 in.; 15 cts
Engineering Magazine (Eng. Mag.), New York; m; 5x7 in.; 25 cts.
Engineering News (Eng. News), New York; w; 8x11 in.; 15 cts.
Engineering Record (Eng. Rec.), New York; w; 8x11 in.; 10 cts.
Engineers' Club of Philadelphia Proceedings (Engr.'s Club, Phila. Proc.), Philadelphia; qr; 4x7 in.; 25 cts.
Fire and Water Engineering (F. & W. Eng.), New York, N. Y.; 8x11 in.; 10 cts.
Le Genie Civil Paris, France; w.
Good Roads Magazine (Gd. Rds. Mag.), New York, N. Y.; m; 7x10 in.; 10 cts.
Industrial Magazine (Ind. Mag.), Cleveland, O.; m; 4x7 in.; 10 cts.
Industrial World (Ind. Wld.), Pittsburg, Pa.; w; 7x10 in.; 10 cts.
Insurance Engineering (Ins. Eng.), New York; m; 4x6 in.; 25 cts.
Iron Age, New York, N. Y.; w; 7x11 in.; 15 cts.
Iron Trade Review (Iron T. Rev.), Cleveland, O.; w; 7x10 in.; 15 cts.
Irrigation Age (Irr. Age), Chicago, Ill.; m; 7x9 in.; 10 cts.
Journal Association of Engineering Societies (Jl. Assoc. Engr. Soc.), Boston, Mass.; m; 4x7 in.; 30 cts.
Journal Franklin Institute (Jl. Frank. Inst.), Philadelphia, Pa.; m; 4x7 in.; 50 cts.
Journal New England Waterworks Association (Jl. N. E. W. W. Assoc.), Boston, Mass.; q; 4x7 in.
Journal Western Society of Engineers (Jl. W. Soc. Engrs.), Chicago, Ill.; bi-m; 4x7 in.; 50 cts.
Journal of Electricity, Power and Gas (Jl. Elec., P. & G.), San Francisco, Cal.; w; 7x10 in.; 10 cts.
Journal of Worcester Polytechnic Institute (Jl. W. P. I.), m; 4x7 in.; 20 cts.
Machinery, New York, N. Y.; m; 7x11 in.; 20 cts.
Marine Review (Marine Rev.), Cleveland, O.; w; 7x10 in.; 15 cts.
Mines and Minerals (Mi. & Mis.), Scranton, Pa.; w; 7x9 in.; 20 cts.
Mining and Scientific Press (Min. & Sci. P.), San Francisco, Cal.; w; 7x11 in.; 15 cts.
Mining Reporter (Min. Rep.), Denver, Colo.; w; 7x10 in.; 15 cts.
Mining World (Min. Wld.), Chicago, Ill.; w; 7x10 in.; 10 cts.
Modern Machinery (Mod. Mchy.), Chicago, Ill.; m; 7x10 in.; 10 cts.
Municipal Journal and Engineer (Mun. Jl. & Eng.), New York, N. Y.; w; 7x10 in.; 10 cts.
Municipal Engineering Magazine (Mun. Eng. Mag.), Indianapolis, Ind.; m; 4x7 in.; 25 cts.
Ores and Metals (O. & M.), Denver, Colo.; bi-w; 6x10 in.; 10 cts.
Pacific Building Engineer (Pac. Bldg. Engr.), Seattle, Wash.; w; 9x11 in.; 15 cts.
Popular Mechanics (Pop. Mech.), Chicago, Ill.; m; 5x7 in.; 10 cts.
The Polytechnic (Poly.), Troy, N. Y.; m; 5x8 in.; 15 cts.
Power and Engineer (Pwr. & Engr.), New York; m; 7x10 in.; 20 cts.
Railway Age Gazette (R. R. Age Gaz.), New York; w; 8x11 in.; 15 cts.
Railway Master Mechanic (Ry. M. M.), Chicago; m; 7x10 in.; 10 cts.
Railway and Engineering Review (Ry. & Eng. Rev.), Chicago, Ill.; w; 9x11 in.; 10 cts.
Railway and Locomotive Engineering (Ry. & Loco. Eng.), New York, N. Y.; m; 7x10 in.; 20 cts.
Railway and Marine World (Ry. & M. Wld.), Toronto, Ont.; m; 7x10 in.; 15 cts.
Railway Engineering and Maintenance of Way (Ry. Eng. & M. W.), Chicago, Ill.; m; 7x10 in.; 10 cts.
Roadmaster and Foreman (Rd. & For.), Chicago; 7x10 in.; 10 cts.
Rock Products (Rk. Prod.), Chicago, Ill.; bi-w; 9x11 in.; 10 cts.
Rose Technic, Terre Haute, Ind.; m; 4x7 in.; 15 cts.
School of Mines Quarterly (Sch. Min. Quart.), New York, N. Y.; qr; 4x7 in.; 50 cts.
Schweizerische Bauzeitung, Zurich; w.
Scientific American (Sci. Am.), New York; w; 9x14 in.; 10 cts.
Scientific American Supplement (Sci. Am. Sup.), New York, N. Y.; w; 9x14 in.; 10 cts.
Sibley Journal of Engineering (Sib. Jl. Eng.), Ithaca, N. Y.; m; 4x7 in.; 20 cts.
Stevens Institute Indicator (Stev. Inst. Ind.), Hoboken, N. J.; m; 4x7 in.; 20 cts.
Street Railway Bulletin (St. Ry. Bul.), Boston; m; 6x10 in.; 10 cts.
Surveyor (Surveyor), London, England; w; 8x11 in.; 10 cts.
Technology Quarterly (Tech Qr.), Boston; qr; 4x6 in.; 35 cts.
U. S. Department of Agriculture Bulletin (Dept. Agr. Bul.), Washington, D. C.; 4x7 in.
U. S. Geological Survey Bulletin (Geo. Surv. Bul.), Washington, D. C.; 4x7 in.
Waterproofing and Fireproofing (W. P. & F. P.), Detroit, Mich.; m; 7x10 in.; 10 cts.
Zeitschrift d. Oest. Ing. u. Arch. Ver. Vienna; w
Zeitschrift d. Ver Deutscher Ing.; Berlin; w.

ROADS AND STREETS.

Method of Constructing Macadam With Asphaltic Oil Binder at Pasadena, Cal. — Eng.-Contg., Feb. 23, 1910. ½ p.

Describes in detail method of constructing base and wearing surface with statement of quantities of oil used, etc.

Summary of Tests Made at New York City of Machines for Cleaning Streets by the Use of Water.- Eng.-Contg., Feb. 23, 1910. ⅓ p.

Gives in tabular form results of tests of five different flushing machines.

Proposed Standard Specifications for Portland Cement Curb and Gutter.—Eng.-Contg., Feb. 23, 1910. 1 p.

Reprint of specifications presented by a committee of the National Association of Cement Users at the last convention.

English Methods of Using Tar as a Binder in Macadam Road Construction.—Eng.-Contg., Feb. 16, 1910. ¾ p.

Gives results of experience in Northumberland, England, of using tar by the three methods of tar painting, tar macadam and tar grouting.

Work of the Municipal Asphalt Plant of San Francisco in 1909.—Eng.-Contg., Feb. 16, 1910. ½ p.

Statistics, with comment, showing output and unit costs of operation for the municipal asphalt plant of San Francisco, Cal., for seven months of 1909.

Directions for Working Steam Road Rollers and Steam Traction Engines.—Eng.-Contg., Feb. 16, 1910. 2⅓ pp.

Gives a series of rules and directions for working steam road rollers, covering, making ready of boiler, injector and engine for starting work, management on the road, priming, firing, oiling, adjustment of bearings, washing out boiler and shutting down after work and precautions for safety.

Notes on the Construction of Macadam Pavement and a Table Showing the Amount of Stone Required.—By Geo. B. Pike. Eng.-Contg., Feb. 9, 1910. ⅓ p.

Gives some general discussion on requirements for excavation and on allowance to be made for volume of stone required for macadam. The table shows thicknesses and quantities of loose stone required—coarse stone and screenings separately—for thicknesses of compacted macadam varying from 3 ins. to 12 ins.

Paving Along Street Railway Tracks.—Eng.-Contg., Feb. 9, 1910. ⅔ p.

Discusses conditions to be met in paving along street railway track and describes a construction used with success in recent work in Indianapolis, Ind.

Methods and Costs of Sidewalk Construction in Chicago. Eng.-Contg., Feb. 2, 1910. 1⅓ pp.

Describes in detail structure of and method of constructing cinder walks and cement walks in Chicago, Ill., and gives itemized average costs of both kinds of walks.

Notes on State Highway Work in 1909.—Eng.-Contg., Feb. 2 and 9, 1910. 2⅔ pp.

Gives statistics of and general description of road work done by highway commissioners in Delaware, Kentucky, Maryland, Massachusetts, New York, Utah, Wisconsin, Illinois, Maine and Pennsylvania.

Method of Repairing Openings in Pavements.—Eng.-Contg., Feb. 2, 1910. ⅓ p.

Describes in detail the work of procedure in the work of the Chicago street department in repairing openings in asphalt pavements.

Detailed Cost of Constructing 2,070 Sq. Yds. of Brick Pavement at Carlisle, Pa.—By C. A. Bingham. Eng.-Contg., Feb. 2, 1910. ½ p.

Describes character of construction and methods of preparing the work and gives itemized unit costs for each part of the work.

How Chicago Builds Sidewalks and Their Cost.—Contractor, Feb. 5, 1910. 4 pp.

Abstract of paper before the 1910 convention of the Illinois Society of Engineers and Surveyors, by Mr. N. E. Murray, superintendent of sidewalks, Chicago. Replete with valuable data.

Notes on Street Paving.—By Thos. B. McMath. St. Ry. Jl., Feb. 5, 1910. 1 p.

Abstract of a paper read Jan. 27, 1910, at the annual meeting of the Central Electric Railway Association, Columbus, O. The author is chief civil engineer, Indianapolis Traction & Terminal Co., and the paper deals with paving between street car rails. A good paper for city engineers.

Sidewalk Practice in Chicago.—By N. E. Murray. Eng. News, Feb. 17, 1910. 1¼ pp.

Abstract of a paper read at the January, 1910, annual meeting of the Illinois Society of Engineers and Surveyors. The author is superintendent of sidewalks, Chicago, Ill., and explains fully the practice in his department.

Effect of Motor and Horse Drawn Vehicles on Roads.—By Logan Waller Page. Eng. Rec., Feb. 26, 1910. 1 p.

A paper summarizing present knowledge and conclusions on this important subject.

SEWERS.

The Efficiency of Day Labor Maintenance of Chicago Sewers With Particular Reference to Cleaning Catch Basins and Sewers. — Eng.-Contg., Feb. 23, 1910. 1 p.

Abstract of report of engineer of the Chicago Commission on City Expenditures showing waste of time and money due to insufficient work of city laborers.

Design and Construction of the Improved Sewage Works at Columbus, Ohio, With Unit Costs.—Eng.-Contg., Feb. 9, 1910. 7½ pp.

Gives a full description of the design and construction of this important new sewage disposal plant, with 20 illustrations of structural features. Total and unit costs for the main features of the work are tabulated.

Baltimore Sewage Plant.—Contractor, Feb. 1, 1910. 5½ pp.

A general description of the construction features involved in constructing a part of the Baltimore sewage disposal works covering 25 acres. The work described is concrete handling and mixing.

Brooklyn's Bureau of Sewers.—Mun. Jl. & Eng., Feb. 2, 1910. 6½ pp.

This article gives information about the sewer pipe testing laboratory, the percentage system of bidding, cost data on sewer and catch basin cleaning.

Sewer Construction in Baltimore.—Mun. Jl. & Eng., Feb. 2, 1910. 12 pp.

An exceedingly good description of construction methods used on a modern sewer system.

Sewer Work by Day Labor and by Contract.—By Harrison B. Eddy. Mun. Jl. & Eng., Feb. 2, 1910. 4½ pp.

Gives a very interesting analysis of day labor and contract sewer work in Boston and other New England cities and towns and favors contract work.

Sewerage Statistics.—Mun. Jl. & Eng., Feb. 2, 1910. 3½ pp.

This article contains data from the 1907 report of the United States Census Bureau on sewers and sewage treatment in the 158 largest cities in the United States.

Concrete Sewers at Richmond, Ind.—By Frederic R. Charles. Eng. News, Feb. 3, 1910. 1 p.

This is an abstract of a paper read at the January, 1910, meeting of the Indiana Engineering Society and gives methods and costs of constructing concrete sewers from 36 ins. to 54 ins. in diameter.

Disposal of Manufactural Wastes and Sewerage at Gloversville. III.—Eng. Rec., Feb. 5, 1910. 3 pp.

This third installment concludes an interesting and valuable contribution to sanitary science.

The Sewerage Problem of Greater Pittsburg.—Eng. Rec., Feb. 12, 1910. 2 pp.

This is interesting as showing the degree of supervision now exercised by boards of health in settling details of plans for sewage collection and disposal.

Standards for Sewage Effluents.—Eng. Rec., Feb. 12, 1910. 1 p.

An abstract of a paper read by Dr. John C. Thresh at the 1909 annual meeting of the Association of Managers of Sewage Disposal Works, England. He presents and discusses three methods for testing effluents, his own method being remarkably simple.

Purification of Sewage for Power Plant Purposes. Eng. Rec., Feb. 19, 1910. 1 p.

The plant described is at the Allis-Chalmers plant in West Allis, Wis. It purifies 450,000 gallons per day, handling all drainage sewerage and rain water from the plant and delivering the purified effluent to the condensing water reservoir.

The Design of Small Intermittent Sewage Filters.—Eng. Rec., Feb. 19, 1910. 1½ pp.

Abstract of paper read by Mr. Paul Hansen at the February, 1910, meeting of the Ohio Engineering Society. An instructive paper for engineers in small places.

WATER-WORKS AND HYDRAULICS.

Depth of Water Pipe.—Eng.-Contg., Feb. 16, 1910. 2 pp.

An account of practice, with statistics, in the matter of depth of water pipe in relation to temperature.

Some Costs of the New Water Purification Works at Columbus, O.—Eng.-Contg., Feb. 9, 1910. 2 pp.

Gives general description of the works with general plans and some structural details including an interesting form of expansion joint for concrete work. Unit costs of the main features of the work are given, also tables of sizes of filter gravel and filter sand and operating averages for 1906 by months.

Some Construction Details and Costs of the Scioto River Storage Dam and Reservoir, Columbus Water Works.—Eng.-Contg., Feb. 2, 1910. ¾ p.

Describes structural features and general method of construction of concrete dam 1,006 feet long, and gives total costs by items and unit costs per million gallons of water impounded.

Sterilization of Water by Chloride of Lime.—By James Caird. Mun. Jl. & Eng., Feb. 23, 1910. 1⅓ pp.

A good review of the present state of knowledge of the value of chloride of lime to sterilize water. It is good for polluted waters, but cannot take the place of filtration systems; in fact can be used only as an adjunct to filtration. As an algicide it is not so cheap and efficient as copper sulphate.

Electrolysis by Earth Currents.—By Wm. A. Del Mar. El. Wld., Feb. 17, 1910. 3 pp.

In the Journal of the Institution of Electrical Engineers, London, September, 1909, there appeared an article by Messrs. J. G. and M. G. Cunliffe describing an electrolytic survey of Manchester. This article by Mr. Del Mar is written with the idea of introducing the conceptions of these investigators and discusses the cure for electrolysis.

Disinfection of Water and Sewage.—Mun. Jl. & Eng., Feb. 2, 1910. 1 p.

Abstract of paper read by Mr. Clyde Potts before the New Jersey Sanitary Association, December, 1909, summarizing present data on disinfection of water and sewage.

The Story of the Folsom Power Plant.—By Archie Rice. Jl. El. P. & G., Feb. 26, 1910. 7 pp.

An interesting and detailed description of a California hydro-electric plant that commenced operation in 1895.

Relation of Typhoid Fever and Water Supplies in Illinois.—By Edward Bartow. Eng. News, Feb. 10, 1910. ⅔ p.

Abstract of a paper read at the January, 1910, convention of the Illinois Society of Engineers and Surveyors. A connection is drawn between the low death rate in certain counties and the fact that water in these counties is obtained from deep wells in glacial drift.

Steel Penstocks.—By R. A. Wright. Eng. News, Feb. 10, 1910. 2⅔ pp.

This is a good article for designers and contains useful tables.

The Type Characteristic of Impulse Wheels and Its Use in Design.—By S. J. Zowski. Eng. News, Feb. 10, 1910. 3pp.

A mathematical article on design of impulse wheels.

The Design of Pressure Tunnels of the Catskill Aqueduct. Part II.—Eng. Rec., Feb. 5, 1910. 2⅔ pp.

Completes an article dealing with concrete lined tunnels and shafts to work under pressure on the New York City water supply.

The New Coagulating Works of the St. Louis Water Department.—Eng. Rec., Feb. 12, 1910. 6 pp.

The Mississippi River at St. Louis furnishes a water good for all uses, but containing large amounts of matter in suspension. This article is abstracted from a paper by Mr. Arthur I. Jacobs

before the Engineers' Club of St. Louis describing in detail the plant installed for adding lime and iron sulphate to the water to clarify it, no filtration being necessary.

Pumping With Gasoline Engines.—Eng.-Rec., Feb. 26, 1910. ⅔ p.

Abstract of a report on cost of pumping with gasoline engines, in Bulletin 181 of the Office of Experiment Stations, Department of Agriculture, Washington, D. C.

Water Sterilizing Plant at Montreal.—Eng. Rec., Feb. 26, 1910. 1 p.

Description of a plant for sterilization of 19,200,000 U. S. gallons of water in 24 hours, with a solution of hypochlorite of lime.

The Discharge of a 12-ft. Wood Stave Pipe.—By H. H. Cochrane. Eng. Rec., Feb. 26, 1910. ⅔ p.

In 1906 the Madison River Power Co. in Montana put in a 10-ft. wood stave pipe and recently measured the flow to find the value of the coefficient for roughness to use in the Kutter formula. This was found to be 0.0116, so the new pipe for additional capacity was made 12-ft. in diameter.

Steel Pipe Lines and River Crossing, Little River Water Supply, Springfield, Mass. — Eng. Rec., Feb. 19, 1910. 2½ pp.

The pipe is 42 ins. and 30 ins. in diameter. Interest attaches to this work because of the use of sections of wood stave pipe to prevent a flow of electric current, as an insulator against danger from electrolysis. Methods of laying pipe at river crossings are shown.

DRAINAGE AND IRRIGATION.

Proposed Standard Specifications for Reinforced Concrete Drain Tile.—Eng.-Contg., Feb. 23, 1910. ⅔ p.

Reprint of the specifications presented by a special committee of the National Association of Cement Users at the last convention.

The Protection and Drainage of Lands Subject to Overflow.—Eng. Rec., Feb. 26, 1910. 1⅔ pp.

Abstract of paper by C. W. Brown read before the February, 1910, meeting of the Illinois Society of Engineers and Surveyors. Experience gained in the Mississippi valley has been drawn upon in the preparation of this paper.

RIVERS, HARBORS AND CANALS.

Some Types of Sea Wall and Their Structural Characteristics and Cost.—Eng.-Contg., Feb. 16, 1910. 1½ pp.

Illustrates and describes five constructions of sea walls, discusses their respective utility and gives some general costs of construction.

Methods and Cost of Constructing a Concrete Lock and Timber-Crib Dam With Appurtenant Structures Employing Day Labor.—Eng.-Contg., Jan. 26 and Feb. 2, 1910. 6 pp.

This article describes the construction of a crib dam and concrete lock constructed in the Federal improvement of the White River in Arkansas. The work involved concrete construction, excavation, riprap, crib work, protection mats, etc., and the article gives itemized total and unit costs for each kind of work.

Interlocking Steel and Concrete Pile Construction for Sea Walls and Foundation Work.—Eng. News, Feb. 3, 1910. 2 pp.

This article describes a bulkhead wall in Chicago constructed of interlocking piling that forms a solid and continuous wall. A steel shell with a groove on one side and a tongue on the other is used. It is partly filled with concrete during the sinking, being completely filled when down the proper depth.

Preliminary Report of the United States National Waterways Commission. — Eng. News, Feb. 3, 1910. 6⅓ pp.

This is a digest of the report made to Congress of the 12 congressmen and senators appointed under the act of Congress, March 3, 1909, to investigate waterways in this country and abroad.

Some Practical Views as to Transportation on Western Rivers.—By Thomas P. Roberts. Eng. News, Feb. 17, 1910. 3½ pp.

Traffic on the Ohio River.—By John Howe Peyton. Eng. News, Feb. 17, 1910. 2½ pp.

The above two papers make very interesting reading, the author of the first being a U. S. assistant engineer, the author of the second paper being assistant to the president, Louisville & Nashville R. R. The writers hold opposite views on the expediency of river improvement.

Paxton Creek Flood Controlling Works, Harrisburg, Pa.—By R. M. Riegel. Eng. News, Feb. 17, 1910. 4 pp.

Reprinted from the "Cornell Civil Engineer," October, 1909. Paxton Creek flows through Harrisburg and is subject to sudden and rather severe floods, the controlling works to regulate same being well described.

Inland Waterways Transportation in the United States.—Eng. Rec., Feb. 5, 1910. 3 pp.

Synopsis of the reports of the National Waterways Commission dealing with the decline in inland waterways transportation and on canal transportation.

The Improvement of American Waterways and Harbors.—Eng. Rec., Feb. 12, 1910. 5 pp.

Contains the recommendations of the United States National Waterways Commission, with data from abroad.

The Sea Wall in Connection with Buildings.—By George A. Orrok. Eng. Rec., Feb. 26, 1910. 2 pp.

A paper read at the February, 1910, meeting of the Connecticut Society of Civil Engineers, describing six standard forms of bulkheads, principally pile.

Fighting the Paris Flood.—By Warren H. Miller. Eng. Rec., Feb. 26, 1910. 2 pp.

A graphic description of work performed to minimize the danger caused by the recent severe floods in Paris.

The Evaluation of Water Rights.—By Arthur Halsted. Eng. Rec., Feb. 26, 1910. 1⅔ pp.

The author discusses water rights and the cost of steam, steady and intermittent, and the cost of combined steam and water power. A diagram is presented showing cost of combined steam and water power.

The Locks and Gates of the Panama Canal.—Eng. Rec., Feb. 26, 1910. 8⅓ pp.

A description of the structures and explanation of the principles governing their design. The article is well illustrated and there are two inset sheets, one of details and the other a colored general map of the Canal Zone.

A Telpherage System for Handling River Traffic.—Eng. Rec., Feb. 26, 1910. 1 p.

One big argument against the improvement of inland streams is the cost of handling freight from boat to shore, for all buildings must be above high-water mark. The system described here is a cantilever frame extending over the river with trolley rails, being essentially an extension of the overhead tracks now such a common feature in shops. Hand labor is practically eliminated. This telpher system has been installed by the Illinois Central R. R. three miles below Memphis.

RAILWAYS.

Reinforced Concrete Bridge Construction, Track Elevation Work, C., B. & Q. R. R., Chicago, Ill.—Eng.-Contg., Feb. 23, 1910. 4⅔ pp.

Gives economic comparison of three proposed styles of bridge construction and of three designs of concrete retaining wall. Illustrates type of construction and describes method of construction in some details.

The North River Tunnels of the Pennsylvania R. R. Tunnel Entrance to New York City.—Eng Contg., Feb. 2, 1910. 4⅔ pp.

Gives profiles and sections and a general description of the series of tunnels from the Jersey side across the North River into Manhattan by which the Pennsylvania R. R. enters New York City. The general structural features of the work are described and the reasons for them are explained.

Seasoning and Preservative Treatment of Ties.—By F. J. Angier. Ry. & Eng. Rev., Feb. 26, 1910. 3½ pp.

This is a reprint of a paper read Feb. 18, 1910, before the New York Railway Club by Mr. Angier, who is superintendent of Tie Preservation, Burlington system. A summary with tables is given of all preservative processes now used; the article being a good statement of practice and costs. A 3½ page digest of same paper appears in the Railway Age-Gazette, Feb. 25, 1910.

Books For
Architect, Builder and Contractor

By H. G. RICHEY,
Superintendent of Construction,
U. S. Public Buildings.

A Handbook for Superintendents of Construction, Architects, Builders, and Building Inspectors

16mo, v+742 pages, 357 figures.

Morocco, $4.00.

The Building Foreman's Pocketbook and Ready Reference Edition

16mo, ix+1118 pages, 656 figures.

Morocco, $5.00.

The Building Mechanics' Ready Reference Series

Carpenters' and Woodworkers' Edition

16mo, vi+226 pages, 118 figures.

Morocco, $1.50 net.

Cement Workers' and Plasterers' Edition

16mo, vi+458 pages, 193 figures.

Morocco, $1.50 net.

Plumbers', Steam-Fitters' and Tinners' Edition

16mo, vi+529 pages, 201 figures.

Morocco, $1.50 net.

Stone and Brick Masons' Edition

16mo, v+251 pages, 232 figures.

Morocco, $1.50 net.

JOHN WILEY & SONS
43 and 45 E. 19th Street
NEW YORK

The Experimental Catenary Line of the Connecticut Company.—El. Ry. Jl., Feb. 26, 1910. 8½ pp.

This is a very complete illustrated description of an elaborate service test of a catenary suspended system for electric trolley lines in Connecticut. The total trial section is about 11,000 ft. long, of which 10,050 ft. are over the Valley Branch (steam) of the N. Y., N. H. & H. R. R. and 950 ft. over public highways. Six prominent manufacturing companies each erected about 1,700 ft. of test line.

Trackless Trolleys in Austria.—El. Wld., Feb. 17, 1910. 1 p.

A very good description, with costs, of a system of traffic in Austria in which large cars are propelled by overhead trolley without tracks in the streets.

Specifications for Steel Rails.—Ry. & Eng. Rev., Feb. 5, 1910. 2 pp.

This is a revision proposed in Bulletin 118 by a committee on Rail of the American Railway Engineering and Maintenance of Way Association.

Colfax Grade Revision; Southern Pacific.—By Bradford Boardman. Ry. Age-Gaz., Feb. 18, 1910. 7¾ pp.

A good description of a piece of heavy railroad work 30.8 miles long. A table is presented showing the equipment used and number of men employed.

The Electrification of Trunk Lines.—By L. R. Pomeroy. Ry. Age.-Gaz., Feb. 18, 1910. 4 pp.

Abstract of an address before the Engineering Society of Columbia University, containing many valuable data and costs. The same paper is given in the February, 1910, issue of the American Engineer and Railroad Journal, occupying 5½ pp.

Area of Contact Between Car Wheels and Rails.—By E. L. Hancock. Eng. News., Feb. 10, 1910. ½ pp.

Describes experiments made with car wheels so arranged that the bending of the axles might be taken into account.

Track Elevation at Evanston, Ill.; Chicago, Milwaukee and St. Paul Ry.—By E. O. Griefenhagen. Eng. News, Feb. 10, 1910. 9½ pp.

A detailed and valuable description of an important work. An analysis is given of different types of subway bridges and reasons given for selecting reinforced concrete.

Strengthening Track for Higher Train Speeds.—By M. L. Byers. Eng. News, Feb. 3, 1910. 5 pp.

An abstract of a paper published in "Bulletin of the International Railway Congress Asociation" for September, 1909; being a complete and valuable presentation of the subject.

The Design of the Stations on the Evanston Track Elevation Work; C., M. & St. P. Ry.—By E. O. Griefenhagen. Eng. News, Feb. 17, 1910. 2 pp.

These stations are of a type made necessary by peculiar conditions incident to track elevation work. They are of reinforced concrete and partly under the tracks.

Railway Ties.—Eng. News, Feb. 17, 1910. 1 p.

Two articles. One describes concrete ties made in vibrating molds and compound ties of wood and steel. The other describes a combination steel and concrete tie on the Pittsburg, Fort Wayne & Chicago Ry.

The Sewells Point Coal Pier, Virginian Railway.—Eng. Rec., Feb. 5, 1910. 4 pp.; ill.

This is a description of a terminal for handling annually 4,500,000 tons of coal. All the principal details are given.

The Construction of the Evanston Subway Bridges, Chicago, Milwaukee & St. Paul Railway.—By E. O. Griefenhagen. Eng. Rec., Feb. 5, 1910. 3 pp.

Previous articles described the design and other general features. This article takes up the working methods in building the reinforced concrete subway bridges.

The Economy of Treated Cross Ties.—Eng. Rec., Feb. 26, 1910. 1 p.

Abstract of paper by Mr. F. J. Angier, superintendent of timber preservation for the Chicago, Burlington & Quincy R. R., presented before the New York Railroad Club, Feb. 18, 1910. Gives valuable cost data.

Diagrams for Designing Reinforced Concrete Structures

Including

Diagrams for Reactions and Strengths of Steel Beams

By G. F. DODGE, M. West. Soc. Engrs.

This book is the outgrowth of diagrams prepared by the author for his own use while serving as a designing engineer for a reinforcing company. A man need not be experienced in mathematics to use these diagrams successfully.

The author says in his preface:

"Many methods have been and are in use at present, but all of these, whether in tabular or diagrammatic form, are based on more or less inflexible approximate formulae which introduce quite considerable errors if the proportions of the composite structure vary materially from those assumed in deriving the formulae on which the method is based.

"A method to be universally acceptable must be based on theoretically correct formulae and embody all of the requirements that occur in the building ordinances that govern construction in the various localities. It must be rapid and accurate in its applications, and if possible give at a glance the final result of changing any one or more of the assumed variables of design.

"In the following diagrammatical treatment of the subject is offered a solution that is believed to fulfill all of the above requirements."

TABLE OF CONTENTS

FORMULAE AND DISCUSSION.

STRAIGHT LINE VARIATION OF STRESS.

Slabs, Stone Concrete 1
Slabs, Cinder Concrete 1
Rectangular Beams 2
T-Beams 3
Compressive Reinforcement 4
Shear Stresses 6
Short Columns, Longitudinal Reinforcement 8
Hooped Columns, Ultimate Loads 8
Hooped Columns, Working Loads 9

PARABOLIC VARIATION OF STRESS, ULTIMATE LOADS.

Slabs 10
Rectangular Beams 11

MISCELLANEOUS.

Deflection 11
Impact 12
Reactions and Strengths of Steel Beams 13
Moments of Resistance of Steel Beams and Channels in Ft.-Lbs. 14
Bending Moment and Shear Formulae 15

DIAGRAMS.

Slabs, Straight Line Law, Working Loads, $n = 12$ 24
Slabs, Straight Line Law, Working Loads, $n = 15$ 38
Slabs, Straight Line Law, Working Loads, $n = 18$ 52
Slabs, Straight Line Law, Cinder Concrete, $n = 30$ 62
Rectangular Beams, Straight Line Law, Working Loads, $n = 12$ 27
Rectangular Beams, Straight Line Law, Working Loads, $n = 15$ 41
Rectangular Beams, Straight Line Law, Working Loads, $n = 18$ 55
T-Beams, Straight Line Law, Working Loads, $n = 12$ 30
T-Beams, Straight Line Law, Working Loads, $n = 15$ 44
T-Beams, Straight Line Law, Working Loads, $n = 18$ 58
Compressive Reinforcement, Straight Line Law, $n = 12$ ... 35
Compressive Reinforcement, Straight Line Law, $n = 15$ ... 49
Shear Stresses 64
Short Columns, Longitudinal Reinforcement 68
Hooped Columns, Ultimate Loads 70
Hooped Columns, Working Loads 72
Slabs, Parabolic Law, Ultimate Loads, $n = 12$ 74
Slabs, Parabolic Law, Ultimate Loads, $n = 15$ 80
Slabs, Parabolic Law, Cinder Concrete, $n = 30$ 86
Rectangular Beams, Parabolic Law, Ultimate Loads, $n = 12$. 76
Rectangular Beams, Parabolic Law, Ultimate Loads, $n = 15$. 82
Deflection 88
Impact 90
Weights and Volumes of Slabs, Beams and Columns 93
Metric Conversion 96
Reactions and Strengths of Steel Beams 99
Appendix 102

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Terryville Tunnel, New York, New Haven & Hartford Railroad.—Eng. Rec., Feb. 26, 1910. 1¾ pp.

Description of the driving of a double track concrete lined tunnel through rock.

The Re-Located Panama Railroad.—Eng. Rec., Feb. 19, 1910. 2 pp.

Abstract of paper presented by Mr. Ralph Budd at a meeting of the Western Society of Engineers, Feb. 2, 1910.

A Water Tank with a Dome Supported Bottom.—Eng. Rec., Feb. 26, 1910. 1 p.

Describes reinforced concrete water tanks 27 ft. in diameter and 14½ ft. deep used on the Southern Pacific R. R. of Mexico. The tanks are carried on circular rubble walls and the bottom is supported by a dome instead of the usual beams and girder construction. The cost for a single tank is higher than for steel plate tanks, but when several are built so forms are used more than once the cost is less than for steel.

Demolition of the Old Union Station, Worcester, Mass.—By C. H. Gilman. Eng. Rec., Feb. 26, 1910. 1 p.

This beautiful building erected in 1877 is being removed because the grade elevation work renders a new station necessary. The contractor's methods are described for removing old steel roof trusses and a large cut stone arch.

BRIDGES, BUILDINGS AND FOUNDATIONS.

Diagrams for Estimating the Approximate Cost of Mill Buildings.—Eng.-Contg., Feb. 23, 1910. 1¾ pp.

Gives a series of tables and diagrams for estimating the approximate cost of mill buildings.

Emergency Repairs to a Bascule Drawbridge Over the Chicago River; Chicago Terminal Transfer Ry.—By F. H. Avery. Eng. News, Feb. 3, 1910. 3 pp.

This bridge with a span of 275 ft. was struck by a steamer. In 24 hours it was opened for boats, and this article describes the methods used by the men doing the work.

Erection Appliances for the Belly River Viaduct at Lethbridge, Alberta.—Eng. News, Feb. 24, 1910. 2 pp.

This description of an erection traveller and assembling cage on an important piece of work should interest contractors.

Some Deductions From Professor Marburg's I-Beam Tests.—Eng. News, Feb. 24, 1910. 1⅔ pp.

Professor Tildren shows mathematically that the highest stresses in a steel beam are not on the edges, but are near the junction of web and flange. Professor Marburg discusses this letter.

Proportioning Latticed Columns by Weight per Foot.—By Benton Lattin. Eng. News, Feb. 24, 1910. 1 p.

The author presents data to prove his belief that the strength of a good latticed column is proportional to the mean weight per foot.

A Pier Type of Abutment for Highway Bridges.—Eng. Rec., Feb. 5, 1910. 1 p.

Describes an abutment used for steel highway bridges over the New York State Barge Canal. The abutment consists essentially of a short reinforced-concrete span carried on piers at the four corners. A minimum restriction of water way is thus created.

A Table of Moments of Inertia of Flat Rectangles.—By H. Loewenherz. Eng. News, Feb. 24, 1910. 1 p.

This is a table of moments of inertia of rectangles about an axis parallel to the long side, with widths from 6 ins. to 40 ins. and depths from ¼ in. to 3 ins.

Moving a Railroad Bridge Transversely.—Eng. Rec., Feb. 12, 1910. ½ p.

Describes the moving of a double track, 1.36 ft. 6 in. span railroad bridge 39½ feet transversely on steel rollers.

Concrete Pile Foundation for the Evansville Filters.—By F. H. Stephenson. Eng. Rec., Feb. 19, 1910. 1 p.

Describes, with details, the construction and driving of piles of reinforced concrete to carry the Evansville, Ind., water filtration plant.

CONCRETE AND REINFORCED CONCRETE.

Use of Reinforced Concrete in the Subways Recently constructed on the Track Elevation Work of the Illinois Central R. R. in the City of Chicago, Ill.—Eng.-Contg., Feb. 23, 1910. 1⅔ pp.

Describes the general method of bridge construction across streets of separately molded reinforced concrete slabs on concrete piers.

Method of Putting a Reinforced Concrete Jacket on a Cracked Chimney.—Eng.-Contg., Feb. 16, 1910. ⅔ p.

Describes character of damage to original construction and outlines methods of work and forms employed in placing the new jacket. The work is chiefly interesting for the form construction and for the method of handling the forms.

Reinforced Concrete Bridges for Track Elevation, in Evanston, Ill., for the Chicago, Milwaukee & St. Paul Ry.—Eng.-Contg., Feb. 16, 1910.

Gives economic analysis of several possible plans of construction and describes adopted plan. Shows various essential structural details and describes methods of construction with illustrations of forms, machines and plant employed. A valuable article on track elevation work.

Formula for Determining the Crown Thickness of Reinforced Concrete Arches. — Eng.-Contg., Feb. 9, 1910. 1-6 p.

Gives formula for crown thickness suitable for all ratios of rise to span and explains conditions assumed.

Method of Making Watertight by Grouting the Yonkers Pressure Tunnel of the Catskill Aqueduct.—Eng.-Contg., Feb. 9, 1910. 2 pp.

Illustrates and describes the grouting machines, grouting pads and system of embedded pipes to be used in grouting rock crevices and voids in packing behind the concrete lining of the high pressure tunnel named. The grouting pad is a particularly interesting device.

Method of Constructing and Driving Combination Timber and Concrete Piles with Some Results of Tests.—Eng.-Contg., Feb. 9, 1910. ⅔ p.

The combination pile is formed by rolling a timber pile in a blanket of concrete on wire mesh. The article describes in detail the method of construction and gives results of tests to show column strength of the pile and the strength of adhesion between the wooden core and the reinforced concrete covering.

A Novel Method of Striking Steel Centers for 150-ft. Concrete Arch Spans.—Eng.-Contg., Feb. 9, 1910. 1⅓ pp.

Gives strain sheets and make-up of steel arch centers used on a concrete arch railway bridge of seven 150-ft. skew spans. These centers are notable chiefly for the means devised for lowering them away from the finished concrete arch. This means consists of a peculiar toggle construction of the crown panel members and this construction is described in detail.

Design of and Method of Constructing a Reinforced Concrete Aqueduct Lining, with Some Data in Costs.—Eng.-Contg., Feb. 2, 1910. 1⅔ pp.

Describes the general design and the structural features of the reinforced trunk or trough used in the aqueduct bridges for the Illinois & Mississippi Canal. A number of data are given on construction methods and on general costs.

Method and Cost of Reinforced Concrete Highway Bridge Construction Under the Direction of the Illinois Highway Commission.—Eng.-Contg., Feb. 2, 1910. 3⅓ pp.

Describes the design, construction and structural characteristics of the standard through girder reinforced concrete bridges adopted by the Illinois Highway Commission, and gives itemized cost of some 37 of these bridges already built. A valuable and suggestive article to road officials.

Hume Lake Multiple Arch Dam.—By John S. Eastwood. Feb. 12, 1910. Jl. El. P. & G. 4½ pp.

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Last year in the above paper there was an article on a concrete dam at Hume Lake, Calif., consisting of a series of arches, not reinforced. In the issue of Oct. 30, 1909, several engineers discussed the dam, and this present article is a reply to these discussions.

Effect of Twisting on Iron and Steel Bars.—[illegible] Feb. 3, 1910. 2 pp.

Gives results of tests made in San Francisco, Cal., in which some remarkable increases were noted in tensile strength and elastic limit. The bars were twisted and untwisted, bent and straightened and each operation produced an increase in strength and elastic limit.

Cost of Concrete Highway Bridges.—A. N. Johnson. Contracting, Feb. 1, 1910. 2 pp.

This is an abstract of paper read at the January, 1910, meeting of the Illinois Society of Engineers and Surveyors at Cairo, Ill. Gives costs of concrete girder highway bridges in the state of Illinois.

Design and Cost of Reinforced-Concrete Highway Bridges.—By A. N. Johnson. Eng. News, Feb. 10, 1910. 1⅓ pp.

Abstract of a paper presented at the January, 1910, convention of the Illinois Society of Enginers and Surveyors. Cost data are given for 38 bridges built in Illinois in 1909.

Reinforced Concrete Girder Bridge at Stakeford, England.—Eng. News, Feb. 17, 1910. 1 p.

Describes with details a girder bridge of six skew spans, four of 44.4 ft. and two of 42.4 ft. with slab floor carrying a macadam roadway 18 ft. wide and a sidewalk 4 ft. wide.

The Albelda Reinforced-Concrete Siphon for a 97-ft. Head, Tuena, Spain.—By B. A. Etcheverry. Eng. News, Feb. 17, 1910. 2½ p.

This inverted siphon is 2,363 ft. long, 13.12 ft. in diameter and subject to a maximum pressure head of 97 ft. Details are shown.

A Covered Bridge of Reinforced Concrete, Southbridge, Mass.—Eng. News, Feb. 17, 1910. 1 p.

This bridge is unique in that it is pipe gallery for a manufacturing company carried across a river on piers. The inside dimensions are 10 ft. wide by 8 ft. high, with two 40-ft. and two 57-ft. spans.

Reinforced Concrete Aqueduct Lining.—By H. D. Rockey. Eng. News, Feb. 3, 1910. 1½ pp.

Abstract of a paper presented at the January, 1910, meeting of the Illinois Society of Engineers and Surveyors. It describes aqueduct construction with steel framing and reinforced concrete lining; Illinois & Mississippi Canal.

Some Cost Data for Reinforced Concrete Highway Bridges.—By A. N. Johnson. Eng. Rec., Feb. 5, 1910. 1½ pp.

A paper read at the January, 1910, meeting of the Illinois Society of Engineers and Surveyors, giving cost data on 38 girder highway bridges erected in 1909.

Construction of Reinforced-Concrete Dam at Fredericksburg.—Eng. Rec., Feb. 12, 1910. 1⅓ pp.

The dam is of the gravity type 808 ft. long, varying in height from 23 ft. to 43 ft.

Tests of Concrete Columns Made Under Building Conditions.—By H. C. Berry. Eng. Rec., Feb. [illegible] 1 p.

Describes tests made on three plain concrete columns; three longitudinally reinforced columns and three hooped columns. The results showed that little additional strength was furnished by reinforcement and that hooped columns [illegible] forced columns.

Design of Retaining Walls for the Steptoe Smelter.—By S. Severin Sorensen. Eng. Rec., Feb. 19, 1910. 1 p.

A diagram is presented for designing reinforced concrete walls of any height up to 30 ft. A typical example is given with comparisons of cost of reinforced and plain concrete walls 20 ft. high.

Experiments on the Coarser Particles in Cement.—By George Sydney Binckley. Eng. Rec., Feb. 19, 1910. 1 p.

Some remarkable results were obtained with intermediate sized material and it would seem that a good field for investigation is here of-[illegible]

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EARTH AND ROCK EXCAVATION.

Some Notes on Specifications for Earthwork in Railroad Construction.—Eng.-Contg., Feb. 23, 1910. ⅔ p.

Gives suggestions for specifications covering cleaning and grubbing, classification of material, etc.

Methods and Cost of Hydraulic Filling at Cairo, Ill.—By Jean M. Allen. Eng.-Contg., Feb. 16, 1910. 2⅔ pp.

Describes hydraulic filling job notable for long length of delivery pipe, for the use of a relay pumping station and for the successful handling of sand long distances in small pipe. Costs of the work are given.

Design and Construction of Open Ditches to Reduce Maintenance, with a Description of Methods of Maintenance and Some Costs.—Eng.-Contg., Feb. 2, 1910. 1 p.

A well written argument for the design of ditches to reduce future maintenance costs, with some data on methods and costs of maintenance.

Modern Shaft Sinking.—By Francis Donaldson. M. & Min., February, 1910. 3 pp.

This installment deals with lifting water and the handling of pumps in shaft.

The Use of Miniature Excavating Buckets.—Eng. Rec., Feb. 26, 1910. ⅔ p.

A novel method was employed in sinking 350 cylindrical steel and concrete piles and about 14 ins. in diameter. Owing to lack of headroom ordinary well driving machinery could not be used, so small orange peel buckets were made, each weighing 28 lbs., and proved a success.

Operating Costs of U. S. Seagoing Dredges.—Eng. News, Feb. 24, 1910. 1 p.

Extracts from report of Chief of Engineers, U. S. A., giving performance of 23 dredges for year ending June 30, 1909. Unit costs are presented in tabular form.

SURVEYING AND DRAFTING.

Colliery Surveys.—By David C. Harrington. M. & Min., February, 1910. 2¾ pp.

The concluding article written in a very practical style, giving the methods used by an experienced man.

COST KEEPING AND MANAGEMENT

A System of Cost Keeping for Engineering Construction.—Eng.-Contg., Feb. 23, 1910. ¾ p.

Outlines requisites of a successful cost-keeping system and gives an example of classification for keeping costs.

Methods of Cost Analysis as Applied to Construction.—Eng.-Contg., Feb. 23, 1910. 2¾ pp.

A valuable general discussion of a system of cost recording, cost analysis as applied to labor and cost analysis as applied to labor, material and expense.

MISCELLANEOUS.

Sanitary Considerations in the Establishment of Contractors' Camps.—Eng.-Contg., Feb. 16, 1910. 1⅔ pp.

A general review of the requirements for sanitation, with suggestions for meeting them.

Seven Months' Work of the Permanent Finance Commission of Boston.—Eng.-Contg., Feb. 16, 1910. 1⅓ pp.

Abstracts, with comments, from the report of the commission outlining improvements made in methods of awarding contracts and the economies thereby secured and stating failures in administration.

Percentage Bidding.—Eng.-Contg., Feb. 9, 1910. 1¾ pp.

Two letters discussing and criticising various features of the percentage method of bidding on contract work.

Cost of Constructing a Service Telephone Line in Cuba.—Eng.-Contg., Feb. 2, 1910. 1 p.

Describes method of constructing a 13.36-mile telephone line for communication during construction between the city of Camaguey, Cuba, water offices and the reservoir and pumping plant. Itemized total and unit costs are given of each class of work.

The Relative Corrosion of Wrought Iron and Steel Pipes.—Ir. Tr. Rev., Feb. 24, 1910.

This is a report of tests made by a committee of the American Society of Heating and Ventilating Engineers. Contrary to accepted beliefs, the steel pipe showed up as well as the iron pipe and the tests suggest that the durability of a pipe depends primarily upon the quality of the metal.

Economics in the Use of Steel in Mine Timbering.—By R. B. Woodworth. Min. Wld., Feb. 5, 1910. 2½ pp.

The author is an engineer with the Carnegie Steel Co. and this article is an abstract of a paper read by him at the Huntington meeting of the W. Va. Coal Mining Institute, illustrating the use of steel I-beams for mine framing and giving the advantages steel possesses over wood for this purpose.

Compressing Air by Water.—By George C. McFarlane. Min. & Sci. Pr., Feb. 19, 1910. 3½ pp.

Describes methods whereby waterfalls and running streams may be utilized to compress air for mining and contracting purposes.

Boston Refuse Disposal Report.—Mun. Jl. & Eng., Feb. 16, 1910. 2½ pp.

A digest of a very valuable report containing data as to costs of collection and amount of refuse per capita in Boston. By districts garbage varies from 150 lbs. to 450 lbs. per capita per annum and ashes from 600 lbs. to 1,800 lbs. In Eng. News, Feb. 10, 1910, is a three-page abstract of same report.

Treating Timber with Crude Petroleum.—By C. Marshall Taylor. Eng. News, Feb. 3, 1910. ¾ p.

Abstract of a paper at the Chicago meeting, Jan. 19, 1910., of the Wood Preserver's Association. Discusses qualities of woods and oils.

PUBLICATIONS RECEIVED.

Industrial Engineering and The Engineering Digest.—Industrial Engineering, formerly published in Pittsburg, and The Engineering Digest, published by The Technical Literature Company in New York, have consolidated and the first issue of the joint publication appeared in January, under the title of Industrial Engineering and The Engineering Digest. Mr. William Kent and his son, Mr. Robert Thurston Kent, have become interested in the publication of this magazine and in its editorial work. Mr. Harwood Frost, who was the founder of The Engineering Digest and one of its editors since the first issue, has been forced, by the pressure of his duties in connection with Engineering News, to devote the whole of his working hours to that paper, and will relinquish the office of Managing Editor to Mr. R. T. Kent.

Mr. Kent has had a valuable journalistic experience, first as Associate Editor of the Electrical Review, then published in New York, then for nearly four years as Managing Editor of the Iron Trade Review (Cleveland), and since its first issue as Managing Editor of Industrial Engineering.

Mr. William Kent, who will regularly contribute editorial notes and special articles, is well known throughout the engineering profession as the author of Kent's Mechanical Engineers' Handbook. For eight years (1895-1903) he was Associate Editor of Engineering News, and for five years (1903-1908) he was Dean and Professor of Mechanical Engineering in the School of Applied Science of Syracuse University.

Test of Two Types of Tile-Roof Furnaces Under a Water Tube Boiler. By J. M. Snod-

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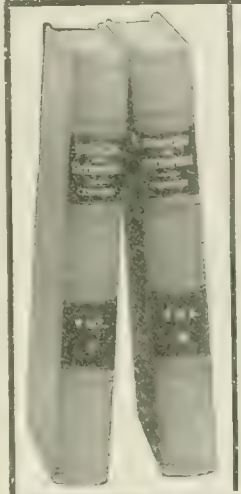

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Reforestation of the Marginal Lands of the Wachusett Reservoir of the Metropolitan Water Works, Boston, Mass.: With Discussion
E. R. B. ALLARDICE. Boston Society of Civil Engineers.

Discussion on "Cement and Sand for Concrete"

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grass. Bulletin No. 34. Urbana, Ill. University of Illinois Experiment Station. Paper. 6x9 ins. 20 pp., illustrated.

A Study of Base and Bearing Plates for Columns and Beams.—By N. Clifford Ricker. Bulletin No. 35. Urbana, Ill. University of Illinois Experiment Station. Paper. 6x9 ins. 36 pp., illustrated.

This bulletin is of value to engineers and architects. New formulas are given by which to design bearing plates.

A report on "The Influence of Forests on Climate and on Floods." By Willis L. Moore, LL. D., Sc. D., Chief of the U. S. Weather Bureau, Washington, D. C. Government Printing Office. Paper. 6x9 ins. 38 pp., illustrated.

Report on Examination of North Dakota Test Fences.—Bulletin No. 25. Philadelphia, Pa. Scientific Section, Paint Manufacturers' Association of the United States. Paper. 6x9 ins. 60 pp., illustrated.

Scientifically Prepared Paints and Laws Governing Their Manufacture.—A special bulletin for engineers, architects and master painters. By Henry A. Gardner, Philadelphia, Pa. Scientific Section, Paint Manufacturers' Association of the United States. Paper. 6x9 ins. 19 pp., illustrated.

The Fire Tax and Waste of Structural Materials in the United States.—Bulletin 418, U. S. Geological Survey. By Herbert M. Wilson and John L. Cochrane. Washington, D. C., Government Printing Office. Paper. 6x9 ins. 30 pp.

The Public Utility of Water Powers and Their Governmental Regulation.—Water Supply Paper 238, U. S. Geological Survey. By Rene Tavernier and Marshall O. Leighton, Washington, D. C., Government Printing Office. Paper. 6x9 ins. 161 pp., illustrated.

Proceedings, Tenth Annual Meeting of the National Civic Federation, Nov. 22 and 23, 1909.—New York, N. Y. The National Civic Federation, 1 Madison Ave. Paper. 5½x7¾ ins. 347 pp., illustrated.

Report of a Fire, Load and Water Test Upon Reinforced Cinder Concrete Floor Arches.—New York, N. Y. Trussed Concrete Steel Co. Paper. 6x9 ins. 28 pp., illustrated. 25 cents.

Baltimore's Municipal Dock Improvements.—A description of the financial and engineering features of the work. New York, N. Y., Raymond Concrete Pile Co. Paper. 8x11 ins. 26 pp., illustrated.

BOOK REVIEWS.

Concrete in Water Works Construction.—By William Curtis Mabee. Indianapolis, Ind., The Author. Paper. 6x9 ins. 34 pp., illustrated.

This booklet contains a reprint of a paper read by Mr. Mabee before the 1909 convention of the American Water Works Association, and is reprinted from the Proceedings. There are 5 large folding sheets of plans and 23 illustrations in the text; the paper being a description of the construction of concrete work on the Indianapolis water works aqueduct, filters, etc.

The Corrosion of Iron and Steel.—By Alfred Sang. New York, McGraw-Hill Book Co. Cloth. 5x7½ ins. 141 pp. $1.

This essay is based on a paper read by the author before the Engineer's Society of Western Pennsylvania, at Pittsburgh, Dec. 15, 1908, and published in the Proceedings. It brings together all the theories of corrosion and in the back is given a portion of the bibliography on the subject published by the Carnegie Library of Pittsburgh, Pa. Because the author has collected a lot of heretofore scattered printed matter, the book is worth buying. It is not satisfying, however, and after reading it through one feels it is merely a directory to enable seekers after information to go to original sources.

Wrought Pipe Drainage Systems.—By J. J. Cosgrove. Pittsburgh, Pa. Standard Sanitary Mfg. Co. Cloth. 5½x8½ ins. 151 pp., illustrated. $2

This book should be owned by every contractor. The title does not properly describe the book for it is really a good working hand book on how to handle and place piping in buildings.

Pattern Making.—By G. H. Willard. To which are added chapters on Core-Making and Molding. By Professor F. D. Crawshaw. Chicago, Ill. Popular Mechanics. Cloth. 5¼x8 ins. 214 pp., 312 illustrations. $1.

Pattern making today is considered one of the foremost of all the skilled mechanical trades. This book is very complete and apparently should be excellent as a text book and reference for pattern makers, apprentices and for use in trade schools.

Designer's Charts for Reinforced Concrete. Joint Committee Standards.—By H. B. Andrews. Boston, Mass. The Author. 166 Devonshire St. Paper. 9x12 ins. 23 pp., illustrated. $1.

The Joint Committee on Reinforced Concrete represents the American Society of Civil Engineers, American Society of Testing Materials, American Railway Engineering and Maintenance of Way Association, Association of American Portland Cement Manufacturers; and this committee has approved certain specifications and certain formulas for the design of reinforced concrete slabs, beams and columns. In this book Mr. Andrews gives a number of excellent diagrams for use in design according to the foregoing standards. The whole book is very good, but, of course, the scope is limited to the recommended fiber stresses. A number of useful tables are included. His table of quantities is based on a bag of cement being equal to 0.95 of a cubic foot, whereas it is usually considered to be a foot and is so declared in the National Association of Cement Users specifications. In giving expanded metal information the standards of one company are given and the new uniform standards are not mentioned.

The Flow of Water.—A New Theory of the Motion of Water Under Pressure and in Open Conduits and Its Practical Application. By Louis Schmeer, C. E., New York, N. Y. D. Van Nostrand & Co. Cloth. 6x9 ins. 228 pp. Numerous figures and tables in the text. $3.

The author was unfortunate in using the words "A New Theory" as a part of the title without stating in his book just what he meant. A careful reading shows he has done a great deal of work in developing a simple exponential formula. An immense amount of painstaking work is shown and the tables presented will greatly reduce the labor involved in hydraulic calculations. On the page preceding the index, in setting down the notation used in the book, the printer has used a subscript 1 instead of a comma which leads to a little confusion until the error is discovered.

After noting the labor performed by the author, the reviewer wrote, offering him space in which to set forth in a few words his aim and objects in getting the book out. His reply follows:

Water flowing down an inclined plane is retarded in its motion by resistances due to its internal cohesion and to its inertia. The resistance due to cohesion or viscosity are entirely independent of the nature of the surface in contact with the fluid or its degree of roughness and are proportional to the area of the surface in contact and the speed of flow. The resistances due to inertia vary with the degree of roughness of the surface in contact and are proportional to the area of the surface and the square of the speed of flow. The combination of the two resistances per unit area at unit velocity in terms of loss of head gives a term (Z) which is called the coefficient of friction. The square root of the reciprocal of the coefficient of friction, multiplied by the square root of double the acceleration due to gravity gives the coefficient (C), commonly called the Chezy coefficient. The circumstance that two factors proportional to different powers of the velocity enter, the one affected by the degree of roughness of the surface, the other not, makes the problem of an exact evaluation of the coefficients (Z) and (C), a task of great difficulty.

The variations of the coefficients (Z) and (C) were first revealed by Coulomb and the experiments of Buossot and Dubuat, but no serious attempt was made to define these variations until the middle of the last century. The formulas relating to flow in conduits under pressure now in common use are those of Weisbach and Darcy. The formula of Weisbach is theoretically correct, but he assumes the coefficient of friction to vary only with the velocity and to be constant for any diameter and any degree of roughness. Darcy's comprehensive investigations enabled him to deduce a formula defining not only the variation of the coefficient of friction with the velocity, but also with the diameter of the conduit, and to some extent, with the degree of roughness of the wet perimeter. Darcy's experiments were made with great care and precision, but they were limited to conduits of comparatively small diameters, and his formula gives accurate results only for these.

Darcy, and his successor Bazin, carefully investigated the influence of different degrees of roughness of the wet perimeter on the motion of water in small open conduits. The results of these investigations were summed up by Bazin in several special formulas, each relating to flow in a channel of a particular degree of roughness of the wet perimeter. Kutter in Switzerland investigated the motion of water in torrential mountain streams and similar channels, and in collaboration with Ganguillet elaborated the formulas based on all the experimental data known in his time. Both these formulas aim to define the variation of the coefficient (C) with the velocity, the degree of roughness of the wet perimeter, and the mean hydraulic radius of the conduit. According to one, which never came into use, the value of the coefficient (C) decreases with increasing velocity irrespective of the degree of roughness or the value of the mean hydraulic radius. According to the other the value of the coefficient (C) increases irrespective of the degree of roughness of the wet perimeter if the mean hydraulic radius is less than 1 meter (3.281 feet) and decreases if its value is greater than 1 meter.

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By A. V. BLEININGER,
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This formula is extremely cumbersome and is usually solved by graphical methods. For calculations relating to flow in open conduits it has almost superseded all others; it has even been applied to calculations of flow in long conduits under pressure. It does, however, not embody any true law of flow. The theory that the value of the coefficient (C) increases with increasing velocity irrespective of the degree of roughness of the wet perimeter if the mean hydraulic radius is less than 1 meter and decreases if its value is greater than 1 meter is not supported by any evidence to be found in the numerous experimental data at present available. A very careful analysis of all these data indicates that the coefficient (C) varies with the velocity of flow as follows:

1. The coefficient (C) increases with increasing velocity for smooth, long, fairly straight conduits of all descriptions irrespective of the diameter of the conduit or the depth of water in it. The increase is greatest for the smoothest surface; it diminishes rapidly with increasing roughness of the wet perimeter. The increase is also greatest for the circular and semi-circular section, less great for the semi-square and the trapezoid whose sides are tangent to a semi-circle, and least for other rectangles and trapezoids.

2. The coefficient (C) decreases with increasing velocity if the conduit is very short, if it has sharp elbows or bends or other obstructions producing shocks, if the bed of the channel is unstable, loose sand or earth, or else very rough.

It has been the aim of the author of "The Flow of Water" to declare a simple and flexible expression embodying all the variations of the coefficient (C) as indicated in the experimental data at present available; both those relating to flow in conduits under pressure and open conduits. Darcy's formula was sufficient for his time; we in our time have new types of conduits; we have the large riveted conduits, the conduits of planed staves and reinforced concrete, and to these Darcy's formula does not apply. The formula of Kutter is cumbersome and defective; it gives good results only when applied to calculations relating to flow in rivers and similar channels.

The formula deduced by the writer is simple and accurate, easy of solution, very flexible, it admits of being transformed in various ways, it may be transformed so it can be solved by graphical methods. Countless special formulas may be derived from it which admit of rapid solution by means of logarithms or the slide rule.

Technical Society Meetings.

The list following names those technical societies in which engineers and contractors are most interested, whose meetings are to be held within three months of the date of this issue. There are given for each society listed the date and place of meeting and the name and address of the secretary, to whom all communications and inquiries should be addressed.

American Institute of Mining Engineers.
March 1-5. Annual meeting at Pittsburg, Pa. Secy., R. W. Raymond, 29 West 39th St. New York City.

American Railway Engineering and Maintenance of Way Association.
March 15-17, 1910. Annual convention at Chicago, Ill. Secy., E. H. Fritch, 962 Monadnock Block, Chicago, Ill.

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Containing Items of Interest to Railroad, Public Works and Other Contractors.

The Doings of the Week. The U. S. Senate on March 2 passed the bill authorizing the issuance of $35,000,000 worth of certificates of indebtedness for the completion of irrigation projects of the government already under way.——One of the largest drainage contracts that has been let for some time was secured by the Northwestern Drainage Co., of Grand Rapids, Wis. This contract called for the construction of Judicial Ditch No. 11 in Marshall and Betrami Counties, Minnesota, and involves 5,094,102 cu. yds. of earth excavation. The contract price was 10.3 cts. per cubic yard.——Among the principal railroad construction contracts awarded since our last issue are the following: J. D. MacArthur, Ltd., Winnipeg, Man., for the extension of the Tofield-Calgary line of the Grand Trunk Pacific from Camrose south to Calgary, Alberta, 135 miles; Horace C. Henry, Seattle, Wash., for building the Everett, Wash., extension of the Chicago, Milwaukee & Puget Sound Ry.; Foley, Welch & Stewart, St. Paul, Minn., for building two cut-offs for the Minneapolis, St. Paul & Sault Ste. Marie Ry., one being from Richmond, Wis., to Withrow, about 18 miles, and the other from Spencer to Owen, Wis., about 19 miles; the Pinkerton Construction Co., for constructing the 43-mile line of the Midland Pennsylvania R. R.; the Oscola Construction Co., Lincoln, Neb., for constructing the projected line of the Omaha, Western & Lincoln Ry.; the Pennsylvania Excavating Co., Allentown, Pa., for grading about 50 miles of line for the Huntingdon, Lewistown & Juniata Traction Co.; the Western Indiana Construction Co., Room 12, 6 Sherman St., Chicago, Ill., for the recently incorporated Illinois Oil & Coal Belt Ry., of McLeansboro, Ill.——Bids are now being asked by the Abilene Central Ry. for the labor and materials for the construction of 50 miles of main line and six miles of sidings and switches, between Abilene, Tex., and Rising Star. The bids are to be opened at Abilene, on March 21.——The Board of Estimates of New York City decided to refer to two expert engineers and a geologist for consideration the plan of the Board of Water Supply to build a big tunnel beneath Manhattan to distribute the Catskill water supply, as mentioned on this page some time ago. The mayor will make the appointments.——The total value of work on the New York State Barge Canal, put under contract up to Feb. 1, according to an official bulletin just issued amounts to $54,189,719. The total value of the work done to Feb. 1 amounts to $16,603,675; the work done during January amounted to $312,360.——The San Pedro, Los Angeles & Salt Lake R. R., which lost nearly 90 miles of roadbed in the Meadow Valley in Nevada by a washout some two months ago, has announced that the line would be opened to transcontinental traffic June 1.

The Poets of the Railroad Construction Camps.

Nearly all railroad construction camps some eight to twelve years ago, before the Irish and other foreign hobo laborers drifted to the cities and became ward politicians and policemen, had its hobo poet. These artists usually selected some smooth board or plank that happened to be lying around the camps, the sides of wagon boxes, bottoms of new wheeled scrapers and the surfaces of any other tool or board about the camp that a lead pencil could be worked over. These verses would be the talk of the camps for weeks, and all the "men of letters" about the camps could repeat them by heart; but they seldom got into print and the rains, sand storms and natural wear on the equipment soon blotted out all records, and those who wrote them and the ones that learned to repeat them were too busy writing and learning other verses after a week or two of "blowing in" at Chicago, Kansas City, Denver or other points where they happened to migrate to spend the dollars they had made during the summer months.

During the construction period of the Missouri & North Arkansas R. R. south from Leslie, Ark., to the Mississippi River at Helna, Ark., there was a considerable passing about of poetry, some of which dated back to the time "when Homer smote his blooming lyre." Very few of what is known as "hobo laborers" were used on this line, as colored labor was used on nearly all of the work south of Heber, Ark., and between Heber and Leslie the work was principally hand mucking or steam shovel work, and Austrians, Bulgarians, Italians, Greeks and other foreign labor was used. The poets of this line were the subcontractors and the civil engineers in the field, and their poems, instead of being written on wagon boxes or on other similar surfaces, were usually typewritten and enclosed in an envelope and mailed to the general superintendent in charge of the work for the contractors, Messrs. Burke & Joseph. While the authors did not sign their names to the poems, it was generally known on the line who was responsible for them. The first poem that was received by Mr. J. B. Ricards, General Superintendent, for the head contractors, Burke & Joseph, was signed "Sub-Contractor" and was dedicated to the engineers of the railroad. The first verse was as follows:

Who comes with Faber sharpened keen,
With profile long and sober mien;
With transit, level, book and tape,
And glittering axe to swat the stake?
The Engineer.

Within less than a week after the first poem had been received, and had been shown and read to the different engineers and contractors on the line, the engineers "came back" and a poem was received through the mail by Mr. Ricards, the first verse of which was as follows:

Who is it that cusses the engineer,
And says that the classification is weird and queer:
Who signs a contract dashing, gay and bold
And later swears specifications stale and old?
Who takes Class "D" at a sure losing price,
And wants it called "A" so his profit will be nice?
The Contractor.

Under the contract and specifications for the Missouri & North Arkansas R. R. work, they used an alphabetical classification: Class "A," being what is usually known as solid rock; Class "B," loose rock; Class "C," earth or common material, and Class "D," being an intermediate classification between earth and loose rock and intended to cover more particularly mixed material and bluff debris, etc.

One of the last and best poems received by Mr. Ricards while on this work was from a firm of sub-contractors on whose outfit Burke & Joseph held a mortgage for moneys advanced them to pay off other claims against the same equipment before they moved to the North Arkansas work. The poem was handed to Mr. Ricards by one of the members of this particular firm at the time they had been asking him for additional advances and had been refused by him. We are glad to report, however, that this same firm owed Burke & Joseph $5,000 when they moved on the work, and that they stayed with them, regardless of the refusal of further advances at one time, until the completion of the North Arkansas work, and paid off their note of $5,000 to Burke & Joseph and left the line with a little over $10,000 in cash and a few more mules and equipment than they started in with. The poem referred to reads as follows:

WHAT THE SUB SAID HE SAID TO HIS PRINCIPAL.

With visions of big estimates and gentle treatment you skillfully please us
And Oh! the soft, oily words with which you gleefully grease us;
While hints of big feasts, wild revels, and big diamonds tactfully tease us,
Weekly we yield—bad weather, low estimates, disasters—grievous;
Drive us in desperation to beg that you kindly relieve us,
With just a trifling advance. No fairy tales you trouble to weave us
But with stony stare and scornful words cruelly you freeze us,
And at last tell the Sheriff, with all our plunder, summarily to seize us;
Nor cease while there's wheeler, slip or mule: everlasting to squeeze us;
It is wicked and wrong, and we do protest, by thunder*.

*Poetical license for the benefit of the clergy.

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ARKANSAS.

The Fort Smith & Interurban R. R. Co., has completed preliminary surveys for its projected 25 mile line and construction contracts will be let in the near future. The route is from Fort Smith, Ark., through Bonanza, Jenney Lind and Greenwood, Ark. George Sengel, Fort Smith, Ark., is President.

GEORGIA.

The Gainesville Midland Ry., which projects an extension north of Gainesville to some timber lands at Robertson, Ga., has made preliminary surveys for the line. The capital for construction has not been secured as yet and the time for awarding contracts is indefinite. Aaron Johnston, Gainesville, Ga., is Chief Engineer; Geo. J. Baldwin, Savannah, Ga., is President, and E. B. Eppes, Gainesville, Ga., is General Manager.

ILLINOIS.

The Illinois Oil & Coal. Belt Ry., of McLeansboro, Ill., recently incorporated, has awarded contracts to the Western Indiana Construction Co., Room 12, 6 Sherman St., Chicago, Ill. Surveys have just been started from Terre Haute, Ind., to Cairo, Ill.

IOWA.

The Omaha, Council Bluffs & Sioux City R. R. Co., projects a 100 mile line, the route being from Omaha, Neb., through Council Bluffs, Beebeetown, Logan, Magonial, Little Sioux and Onawa to Sioux City. M. H. Miller, Des Moines, Ia., is President.

The Red Oak & Northwestern Ry., which projects a 107 mile line from Red Oak, northeast to Des Moines, Ia., has completed surveys and has secured two-thirds of the capital for the construction of the line. Construction contracts will be let about Aug. 1. H. H. Von Hipple, Red Oak, Ia., is Chief Engineer; W. L. Battin, Greenfield, Ia., is President and W. L. Sonntag, Red Oak, Ia., is General Manager.

MINNESOTA.

The Minneapolis, St. Paul & Sault Ste. Marie Ry., has awarded a contract to Foley, Welch & Stewart, St. Paul, Minn., for constructing two cut-offs on the Wisconsin Central. The New Richmond to Withrow cut off will be about 18 miles and the Spencer to Owen cut off will cover about 19 miles.

NEBRASKA.

The Omaha, Western & Lincoln Ry. has completed surveys for its projected electric railway and has awarded construction contracts to the Osceola Construction Co., Lincoln, Neb. The total projected length of this line is 219 miles and it is to extend from Omaha through Nahoo, David City, Osceola, Aurora and Hastings with a branch from the river through Ashland to Lincoln. W. H. Fuller, Hastings, Neb., is Chief Engineer and Frank E. Schaff, Lincoln, Neb., is President.

NEW MEXICO.

The Citizen's Traction & Power Co., is to construct two miles of line in the Highland section of Albuquerque. Construction contracts are to be let when the company is incorporated which will be about April 1. A. W. Hayden, Albuquerque, N. Mex., is President.

NEW YORK.

The contract for constructing the 8-mile line of the Elizabethtown Terminal R. R. has been let to V. R. Coon, general manager, Elizabethtown, N. Y. The sub contractor for the work is Marco Lavorgna, Canton, Me. The contract includes 120,000 cu. yds. earth excavation and embankment, 6,000 cu. yds. rock excavation, 500 ft. of wood trestles and 82,000 lin. ft. of piling. Sub contracts for the trestle and a few miles of the work will be let about April 1.

OKLAHOMA.

Surveys are being made for the projected 35 mile line of the Wichita Falls & Lawton Ry., from Deval, Okla., to Lawton, Okla. The capital for construction has been received and construction contracts will be let within 45 days. J. A. Kemp, Wichita Falls, Tex., is President and R. A. Thompson, Wichita Falls, is Chief Engineer.

PENNSYLVANIA.

The Midland Pennsylvania R. R., recently chartered, as mentioned in our last issue, has completed surveys and is now securing the capital for the construction of its projected 43-mile line from Millersburg, Pa., to Ashland, Pa. The contract for constructing the line has been let to the Pinkerton Construction Co. Dodge & Day, Philadelphia, Pa., are the engineers, W. E. Harrington, the St. James, Philadelphia, Pa., is President and John H. Williams, Pottsville, Pa., is Secretary and Treasurer.

SOUTH CAROLINA.

Preliminary surveys have been made for the projected 34 mile line of the Greenville & Spartanburg R. R. The route is from Greenville, S. C. via Greers, Taylors, Duncans, Fair Forest and Spartanburg Junction to Spartanburg. Construction contracts are to be let as soon as final surveys and estimates are completed. Chas. W. Ellis, Greenville, S. C., is President and Will D. Neves, Greenville, is Chief Engineer.

TENNESSEE.

McCorkle & McGimpsey, Gatliff, Tenn., have a nice piece of steam shovel work 62 miles north of Knoxville on the L. & N. R. R.

TEXAS.

The Wichita Falls & Northwestern Ry will probably not let the contract for an extension from Altus, Okla., west to Wellington, Tex., 60 miles for several weeks. The work of grading this extension will be sub-let by the company to small contractors, giving them a few miles each and the track laying, bridging and building will be done by the Company forces. R. A. Thompson, Wichita Falls, Tex., is Chief Engineer. This work was mentioned in our Feb. 2 issue.

D. F. Johnson, Brownwood, Tex., secretary of the Brownwood Commercial Club, advises us that the Brownwood Southwestern has just been chartered to build from Brownwood to the Colorado River, near Rockwood, a distance of 30 miles. A contract has been made with Brownwood and the people along the line to build the road by Col. R. A. Love, who promoted and built the "Sunflower" road from Milas to Paint Rock. An engineering crew will be placed in the field at once and it is believed that grading may be started within 60 days.

Bids are asked until noon, March 21, by J. M. Wagstaff, Chairman, Abilene, Tex., for the labor and material complete for the construction of 56 miles main line and 6 miles siding and switches for Abilene Central R. R., between Abilene and Rising Star. The approximate quantities are as follows: Clearing and grubbing, 500 acres; earth excavation and embankments, 972,000 cu. yds.; loose rock excavation, 24,000 cu. yds.; solid rock excavation, 36,000 cu. yds.; galvanized iron culverts, 36-in. diameter, 2,400 lin. ft.; galvanized iron culverts, 24-in. diameter, 1,200 lin. ft.; trestles as per Standard plans, 5,600 lin. ft.; ties—Standard 80 per cent heart pine (or equal), 174,600; steel rail, 60 lbs., A. S. C. E., 5,846 tons; joints complete, 17,500; switches complete, 60; spikes, 1,860 kegs; track laying and surfacing, 62 miles;. Cattle guards, buildings, fencing, etc., will be let on separate bids. Further information can be obtained from H. J. Bradshaw, Engineer, Abilene, Tex.

WISCONSIN.

The Prairie Farm & South Western Ry Co., of Prairie Farm, Wis., previously mentioned in these columns, has bought the old right-of-way and grade from Graytown to Emerald, a distance of 17½ miles, and also what is known as the Glenwood spur. The company has also purchased a gravel pit to be used in the construction of the road, work on which it is hoped to have started soon. G. E. Scott, Prairie Farm, is president.

Power Developments, Levees, Drainage and Irragition Works.

COLORADO.

The Otero Irrigation District, J. D. Craighead, president, has ready for issue or authorized bonds to the amount of $300,000 for the purpose of enlarging its ditch from 12 ft. to 20 ft. in width and for putting in concrete works at head gate, stream crossings and so forth. Several syphons will be put under streams and over 1,750 ft. of earth tunnel will be bored. A general overhauling of the entire system will also be made in order to put the canal into perfect condition in conformity with modern engineering practice. Geo. G. Anderson, irrigation engineer of Denver, has charge of the work. Bids will be received up to March 17, 1910. Specifications and plans can be obtained from Mr. Anderson or from H. P. McKeen, resident engineer, Rocky Ford, Colo.

The Commonwealth Power & Electric Co., M. Sidney, president, Georgetown, Colo., has done considerable preliminary work toward the construction of its power plant in Black Tail Canon, 139 miles from Denver on the Moffat road, and is now selling bonds to complete the plant. The company proposes to build a dam in the canon 70 ft. in height above present low water, which with the natural fall of the stream to the power house will give a total head of 106 ft. The water is to be conveyed from the dam to the power house through a tunnel in solid granite, 5,000 ft. long, large enough to carry 1,500 cu. ft. per second. The dam will be 120 ft. long at water level and 158 ft. on top, founded on granite and both ends anchored in granite ledges. The dam will be built of monolithic concrete. As far as can be determined without actual excavations, the bed rock foundation is not far below the bed of the river. To carry the river during the construction of the dam a diverting tunnel 12x14 ft., 154 ft. long, has been driven, which will be fitted with proper gates and used as a wasteway. Trails and roads have been built, two crosscut tunnels driven to the line of the main tunnel to aid in disposing of waste rock and facilitate the driving of the tunnel by allowing work from different headings. Frank A. Maxwell is engineer. The work was noted in our Feb. 23 issue.

DELAWARE.

As stated in our last issue, bids are being asked until noon, March 18, by Maj. R. R. Raymond, U. S. Engineers, Wilmington, Del., for dredging of St. John's and Murderkill rivers and for similar work in Mispillion and Appoquiniminte rivers. These are small contracts, about $3,500 being available for the work in each of the above rivers.

ILLINOIS.

A. J. Kleutschy, Cairo, Ill., has been awarded the contract for cleaning out and reconstructing open ditches for Union Drainage District No. 2 of the towns of Harvel and King. The work includes 49,880 cu. yds. of dredging. Bids were opened March 1.

INDIANA.

H. E. Deneen, Imlay City, Mich., has been awarded the contract for the construction of the Swanson-Lampore Ditch in Porter County, Indiana. The contract price was $6,859.40 and the work includes 68,594 cu. yds. of excavation with a dry land dredge. Bids were opened March 1.

IOWA.

Bids are asked by A. W. Chamberlain, Auditor of Clay County, at Spencer, until March 18, for constructing the Ocheyedan River improvement known as District No. 6. The district is divided into seven sections, six of which will be let, as a whole, and the other as a separate contract. The ditch is 11.55 miles long with side slopes 1 to 1, and 6 ft. berm. The soil is black dirt and gravel. The work includes the following:

				Width.	
Sec.	Y'dage.	Max. Cut.	Av. Cut.	Bottom.	Top.
1	69,301.1	11.95	5.65	8 ft	20 ft.
2	227,233.9	11.75	....	....	....
3	83,058.3	11.20	8.20	25 ft.	41 ft.
4	74,489.8	11.70	9.20	23 ft.	41 ft.
5	100,985.0	11.40	8.45	22 ft.	39 ft.
6	55,685.7	12.05	8.50	21 ft	39 ft.
..	.....	....	9.55	20 ft.	39 ft.
7	11,167.2	6.90	8.60	18 ft.	35 ft.

MINNESOTA.

Contracts for constructing County Ditch No. 45, bids for which were opened March 1 by the county auditor, at Oliva, have been let as follows: Jerry Sherwood, Litchfield, Minn., main ditch and lateral No. 1; J. J. Hankerson, Glencoe, Minn., the other laterals; C. F. Clay, Renville, Minn., for the tile work. The contracts include 278,299 cu. yds. of earth excavation and 14.3 miles of tiling.

The Northwestern Drainage Co., Grand Rapids, Wis., has been awarded the contract for constructing Judicial Ditch No. 11 for Marshall and Beltrami counties. The work is located in the eastern part of the first named county and in the western part of the last named. The contract includes 5,094,102 cu. yds. of earth excavation and was let at 10.3 cts. per cubic yard. Bids for the work were opened at the office of the county auditor, at Warren, Minn., on March 1.

NEW YORK.

The contract for improving the State St. pier at Albany for that city has been let to John Dyer, Jr., Albany, at $96,166. Bids for the work were opened Feb. 21, as previously noted in these columns. Mr. Dyer's itemized bid was as follows:

Removal of southern portion of pier	$6,120.00
Round piling, 50,000 lin. ft.	.19
Sheet piling, 206 M. ft. B. M.	53.00
Walling timbers, 30.5 M. ft. B. M.	70.00
Wrought iron bolts, ladder irons, etc., 40,000 lbs.	.05½
Rip rap, 700 cu. yds.	2.00
Concrete, Class A, 800 cu. yds.	9.60
Concrete, Class B, 4,000 cu. yds.	7.25
Steel reinforcement, 12,000 lbs.	.04½
Snubbing posts, 34	15.00
3-in. sub drains, 4,000 lin. ft.	.09
4-in. sub drains, 300 lin. ft.	.30
6-in. vitrified pipe drains, 40 lin. ft.	.60
Sod, 1,450 sq. yds.	.32
Concrete pavement, 43,000 sq. ft.	.11
Settees, 70	10.00
Flagpoles, 4	35.00
Electric light poles and arc lamps, 6.	110.00
Electric light conduits and cables	700.00
Water piping	995.00
Shelters, 2	2,140.00
Lavatory building	2,800.00
Filling	4,200.00

TENNESSEE.

Bids are asked until noon, March 18, by Mayor M. L. Walker, U. S. Engineers, Memphis, Tenn., as stated in our issue of Feb. 23, for one piece of levee enlargement near Kangaroo Point, White River levee district, containing about 115,000 cu. yds. This work will be built to an 8-ft. crown with 3 to 1 slopes on both sides, and a 1-ft. topping added to the 8-ft. crown. About 4 acres of light grubbing; grubbing will be measured from the toe of the old slope to a line 5 ft. beyond the new slope line. The fill will have an average rise over old levee about 4 ft. to the new 8-ft. crown. Work will be completed not later than Jan. 1, 1911.

WEST VIRGINIA.

Bids were opened Feb. 24 by Capt. F. W Altstaetter, U. S. Engineer, Wheeling, W. Va., for constructing pile and crib guide walls for Locks Nos. 4-11, Kanawha River, the bids received being as follows: G. & W. Mfg. Co., New York, $49,348; E. L. Foley, St. Albans, W. Va., $33,062; The Ohio River Contract Co., Evansville, Ind., $31,598; M. F. Leonard, John V. Dale and C. R. Niday, Gallipolis, O., $29,613; Pfaff & Smith, Charleston, W. Va., $33,822; Clifton Bros., Zanesville, O., $25,922. The itemized bid of Clifton Bros was as follows:

White-oak timber, 211,863 ft. B. M.	$38.00
Riprap, 1,500 cu. yds.	2.00
Iron and steel, 34,000 lbs.	.06
Round piling, 32,900 lin. ft.	.39

The Louisville, Lincoln Farm and Mammoth Cave Traction Co., recently incorporated, proposes to build an electric railway from Glasgow, Ky., to Hodgenville, Ky., a distance of 50 miles. It is estimated that the cost of building and equipping the road, powerhouse and all will be $1,000,000. The road will pass by the Lincoln farm and connect with the Illinois Central railroad at Hodgenville. The right of way from Glasgow to Hodgenville has been secured by Charles Brandenburg. L. W. and J. C. Preston, Glasgow, Ky., are interested.

F. W. Hurlburt, representing New York capitalists, has been at Wadesboro, N. C. investigating a proposition to build a hydro-electric plant on Rocky River. The proposed plant is to develop 6,000, and it is estimated that the cost of the plant will be less than $600,000.

The Baltimore & Ohio, the Pennsylvania and the Pittsburg & Lake Erie railroads have about completed plans for the joint construction of a railroad from Fairmont, W. Va., to a point near the northern boundary of the state at a cost of about $3,000,000. When completed the line, which will be about 32 miles long, will traverse the heart of the rich coal property taken over by the three roads from the Little Kanawha syndicate. The road will be a part of the Buckhannon & Northern Ry. and by the plans now being prepared it will run through Morgantown, Fairmont and Rivesville to the state line. S. D. Brady, Parkersburg, W. Va., is chief engineer. This extension was noted in our issue of Feb. 16.

The Carolina, Clinchfield & Ohio Ry., M. J. Caples, General manager, Johnson City, Tenn., has decided to establish its coal terminals at Charleston, S. C., using temporary facilities at first at Adger's wharves while its terminals are being constructed on the big water front tract between the Atlantic Coast Line wharves and the plant of the Standard.

The Chicago, Milwaukee & Puget Sound Ry. is planning to improve its roadbed over the entire division between Deer Lodge, Mont., and Avery. During the coming season it is planned to move at least 400,000 yds. of gravel and rock ballast, together with a large number of yards of rip rap rock, which will be used to protect the base of the grades next to the water edge. The company will open and operate two gravel pits on the west and may use one or two more on the east from which to secure a supply of the proper material for ballasting purposes. It is expected that six work trains will be operated on the division, three between Missoula and Deer Lodge, Mont., and the same number between Missoula and Avery. The work will last about two months.

Advices from Pensacola, Fla., state that J. M. Kinney and Charles W. Merritt have been awarded a contract by the Pensacola, Mobile and New Orleans Ry., to grade for the roadbed which is now being built, the contract extending for a number of miles into Baldwin County, where the road is now being constructed. The contractors began work March 1, and are to grade approximately five miles per month on the road.

The Lantry-Sharp Co., of Kansas City, Mo., has begun work on its contract for double tracking the Santa Fe between Gallup, N. Mex., and Albuquerque, N. Mex. The contract involves second track west for a distance of about 75 miles. Work was started at Rio Puerco.

Residents of Wildwood, N. J., Holly Beach, North Wildwood and Wildwood Crest have formed the Wildwood & Delaware Bay Short Line R. R. Co., to construct a double-track railroad from Wildwood, N. J., to the mainland to connect with the Reading about three miles north of Rio Grande station, and also a 50-ft-wide boulevard. The rights of way have been secured the entire distance. The preliminary surveys, preparing plans, taking the soundings on the meadows to learn the amount of filling necessary, and securing estimates for the work, have been accomplished, and as soon as the full amount of $100,000 is subscribed the work of construction will be started. Subscriptions have already been received for nearly the full amount. The officers of the company are: President, Curtis T. Baker; vice president, Warren D. Hann; treasurer, R. W. Ryan; engineer, Harry E. Weir; secretary, V. G. Reynolds.

The Cumberland Calley R. R., G. C. Coons, Engineer, Chambersburg, Pa., is considering abolishing all grade crossings at Hagerstown, Md., and building a high line through the city. At present the Cumberland Valley and Western Maryland cross each other in the northern suburbs on grade. The Cumberland Valley proposes in building its "high line" through the city to build over the Western Maryland tracks.

The city of Dillon, Mont., has raised a bonus of $10,000 for the extension of the Gilmore & Pittsburg R. R. from Amstead, Mont., to Dillon.

Residents of Addison and Chaffee, N. Dak., are considering forming a company to build an electric railway to Fargo, N. Dak.

Extensive plans for improvements have been announced by the Frederick Railroad Co., recently formed by merging the Frederick and Middletown and Braddock and Jefferson trolley lines and the Washington, Frederick and Gettysburg steam road. These plans include the extension of the Jefferson line to Brunswick, 6 miles, and the building of a freight yard and car shops in the eastern suburbs of Frederick, Md. Walter J. Taylor, Frederick, Md., is General Manager.

Advices from Morgantown, W. Va., state that Harry R. Warfield has purchased from Congressman George C. Sturgiss the Sabraton railway and trolley line with all its rights and franchises, the consideration being $70,000.

The Atlantic Northern R. R. Co., has been incorporated with a capital stock of $50,000 and headquarters at Kingwood, W. Va., and proposes the construction of a railroad from a point near Parsons in Tucker County along the Cheat River to a point at or near Rowlesburg in Preston county. The incorporators are William M. Schaeffer, William S. Downs, E. M. Lantz, James W. Flynn and Julius K. Monroe, all of Kingwood, W. Va.

Items Concerning Contractors and Their Work

RAILROADS, POWER DEVELOPMENTS, LEVEES, DRAINAGE AND IRRIGATION WORKS.

Arkansas Notes.

FROM CORRESPONDENTS AND OTHER SOURCES.

Surveys for the projected interurban line between Bentonville and Rogers have been completed and surveys are now under way to bring the line to Gentry. The road will be 28 miles long, and it is believed that construction work will be started this month. G. G. Sutherland, St. Louis, Mo., is president, and Dr. Z. T. Martin, Bentonville, Ark., is secretary. It is reported that the Rosedale Contracting & Supply Co., of St. Louis, has been given the contract to build the road.

Surveys have been under way for some time by the Memphis, Paris & Gulf Ry. Engineers for the proposed line between Carthage and Arkadelphia. After the completion of preliminary surveys in this section work will be started between Pine Bluff and other points east of Carthage. H. C. McCluer, Nashville, Ark., is Chief Engineer of the company.

Committee of the Business Men's League, DeWitt, Ark., is taking steps to secure the $25,000 bonus required by the Memphis, Paris & Gulf R. R. About $7,000 of the amount has already been raised. J. M. Landis is Secretary of the Committee.

California Notes.

FROM CORRESPONDENTS AND OTHER SOURCES.

The Southern Pacific Ry. is to begin work about July 1, removing its railroad yards, roundhouses and branch repair shops from Red Bluff, and will establish them at Alfalfa, a new town now being built between Red Bluff and Tehama. The change is made necessary by reason of the lack of sufficient room at Red Bluff to extend the switching yards.

Capitalists of Coalinga propose to build an electric road to connect the California Oil Fields, limited, with the town of Coalinga. The road will cost $400,000, and application for a franchise has been made to the supervisors.

Rights of way for the new electric street railway, which is an extension of the Mission Street, San Francisco, line to Visitacion valley have been conveyed by the owners of the lands lying along the boundary line between San Francisco and San Mateo counties to the San Francisco Electric Railways.

The Vallejo Traction Co., recently incorporated with a capital stock of $200,000, has asked the City Council of Vallejo for permission to construct and operate over and upon the streets of the city a standard gage railroad, to be propelled by either steam, motor or electricity. The company will at once begin the construction of a line from White Sulphur Springs, six miles northeast of Vallejo, to tidewater in Mare Island channel. The incorporators and directors of the company are H. M. Meacham, former assessor of Napa county, and president of the James H. Goodman & Co. bank of Napa; Theodore Bell, San Francisco; C. E. Doty of Vallejo, and Dr. E. Z. Hennessey and Joseph Levinson of Napa.

The Board of Public Works of San Francisco has approved the plans of M. Manson, city engineer, for the dam at Lake Eleanor.

The Abbot Kinney Co., has awarded the contract for extending the amusement pier at Venice to Charles Corbaley. The pier will be extended 100 ft. into deep water, at a cost of about $15,000.

The Los Angeles Pacific Ry. Co., P. H. Albright, engineer, Los Angeles, is planning to make extensive repairs to its wharf at Santa Monica. At least 2,000 new piles will be placed to replace those destroyed by teredoes.

The Pacific Light & Power corporation, with a capital stock of $40,000,000, has been organized for the purpose of acquiring the properties of the Pacific Light & Power Co., subject to outstanding bonds and enlarging these properties in order to adequately take advantage of the growth of the territory.

The Southern California Contracting & Grading Co., of Brawley has been awarded a contract for grading the eastern section of the San Diego & Arizona R. R. from El Centro to New River, a distance of 8 1-2 miles. The contractors undertake to complete the job by April 15.

The Town Trustees of Suisun have granted the Vallejo and Northern R. R. Co. mentioned in our last issue, a franchise to construct and maintain an electric railway line within the town limits for a period of 50 years. The new franchise covers the same privileges given by a similar franchise granted the company two years ago, which had expired. By the provisions of the franchise work is to be commenced within six months and the road completed within three years.

Advice from Oroville state that the South Feather Land & Water Co., is planning to change the main ditch line to higher ground. The purpose of the company is to run the main ditch as high as possible through the country under the system.

The Pacific Electric Ry., G. E. Pillsburg, Chief Engineer, Los Angeles, has secured right of way from Pillsbury through the Olinda oil fields, towards Riverside. It is probable that the 6 mile extension will be constructed at once.

W. H. O'Brien and his associates, who are farming about 20,000 acres to grain in the swamp district south of Tulare Lake in Kings county, are reported to have secured an agreement from the Santa Fe in which the railroad undertakes to lay the rails for a spur track from the main line to the grain fields, provided Mr. O'Brien and his partners grade the roadbed and supply the ties.

The Lakeside Farmers' Mutual Water Co., of Lakeside, has been organized with $25,000 capital stock, for the purpose of constructing ditches, reservoirs, etc. George J. Bach, F. J. Lebert and O. E. Busenberg are interested.

The recently incorporated Fullerton-Richfield R. R., mentioned in the last issue of ENGINEERING-CONTRACTING, has, it is said secured the last strip of right of way and construction work will be started at once. The line will be 5 miles in length extending from Fullerton to Richfield, Cal. A. G. Wells, Los Angeles, Cal., General Manager, Atchison, Topeka & Santa Fe, is one of the directors of the new company, which is subsidiary to the A. T. & S. F. Ry.

The Southern Pacific, it is said, is considering the immediate construction of a double track line between Colton, Cal., and Bloomington. William Hood, San Francisco, Cal., is Chief Engineer of the Southern Pacific Ry.

The Tecopa R. R. Co. has filed its certificate of incorporation with the secretary of state. The company has a capital stock of $500,000, and proposes building a line from the Noonday and Gunsite mining companies' properties in San Bernardino county to a point on the Tonopah & Tidewater railroad, near Tecopa.

Colorado Notes.

FROM CORRESPONDENTS AND OTHER SOURCES.

The Costilla Estates Co., H. Alexander Smith, Secretary, Champa street, Denver, Col., has begun laying steel on the San Luis Southern R. R., and it is planned to run the first train into San Acacio April 1. The San Luis Southern is a standard gage railroaad being built by the Costilla Estates Co. It connects with the Denver & Rio Grande at Blanca and will eventually be extended to Santa Fe, where it will connect with the Atchison, Topeka & Santa Fe and the New Mexico Central. Enough steel has been received to complete the line to San Acacio, which is on the estate. The company will continue to build the road to the territorial line, 34 miles, with its own money. Questa and Taos are the principal towns that will eventually be on the route.

Allan & Lafferty, of Pueblo, have started work at Dent on their sub contract for grading the Union Pacific branch line to Fort Collins.

The Denver Gas & Electric Light Co., Frank W. Frueauff, General Manager, Denver, is to expend about $700,000 in improvements in and around Denver in 1910. These improvements will include the construction of about 25 miles of gas mains.

A stockholders' meeting of the Kansas Colorado Railroad Co. will be held in Pueblo March 22, for the purpose of authorizing the issuance of bonds to build the road into Fremont county.

The Colorado & Southern Ry., H. W. Cowan, Chief Engineer, Denver, is planning extensive improvements for this year, and a budget submitted to the stockholders calling for the expenditure of $2,000,000 for new equipment and about $3,000,000 for improvements to track and equipment now in use was approved by the board, and the money will be utilized in the perfection of the system in this state. The budget provides for laying heavy steel on various divisions of the system and new tracks, bridges, spurs and new buildings, both in Colorado and Texas. The Pueblo-Walsenburg division, where a new double track will be built by the Rio Grande and Colorado & Southern together, is independent of these expenditures, and will represent another $5,000,000.

Good progress is being made with construction work on the Kansas-Colorado R. R. and track laying is completed some distance from Pueblo. The company expects to have the road completed to Turkey creek, 18 miles out of Pueblo, by the first of May and trains running at that time. The road will then be built on to Canon City during the summer.

A. B. Hicks, Engineer of the Denver & Gulf R. R., has been in Lamar making locations for the terminal in that city.

Work on the Union Pacific Crow Creek branch, which was suspended last Fall on account of the cold weather, has been resumed and will be pushed to Briggsdale. The Pleasant Valley branch in Colorado, will also be extended north one mile. G. F. Maitland, Ogden, Utah, is Division Engineer of the Union Pacific.

Chamber of Commerce of Windsor, Colo., is to take steps to induce the Union Pacific Ry. to construct a spur from the proposed Brighton-Fort Collins line to Windsor.

The Boulder Land, Irrigation & Power Co. of Boulder, Colo., has been incorporated with a capital stock of $200,000, the incorporators being Thomas V. Wilson, Fred. A. Fair and H. A. Anderson.

H. A. House, Pueblo, representing the Colorado Power Co., has filed in the office of the county clerk, at Aspen, maps for three large reservoirs on Roaring Fork river and two sites for dams on the Roaring Fork. The reservoirs are to have a capacity of 33,000,000 cu. ft. of water, which will be used for power and irrigation purposes.

It is believed here in Denver that the Santa Fe is planning to have a direct line into Colorado from Texas. It would not be necessary to do much construction work, as the Gulf, Colorado & Santa Fe could be utilized as far as Dawson, N. Mex., and from there a line 35 miles long could be constructed to connect with the Colorado & Wyoming, owned by the Colorado Fuel & Iron Co., but with which a trackage agreement could be made, thus bringing the Texas traffic into Trinidad and onto the main line of the Santa Fe, giving it an outlet to either the east or to the coast.

Georgia Notes.

FROM CORRESPONDENTS AND OTHER SOURCES.

The Middle Georgia Interurban Ry. Co., L. W. Roberts, President, Atlanta, Ga., has filed a petition with the State Railroad Commission in Atlanta to be allowed to issue first mortgage bonds to the extent of $1,050,000; also for the right to issue stock to the extent of $200,000. This is the first definite step in the direction of building the trolley line from Griffin to Social Circle via Jackson, Indian Springs and Monticello. If the matter is acted on favorably it is said that work will at once be taken up on the line, which has been graded two-thirds of the way from Indian Springs to Jackson.

Advices from Cordele state that engineers in the employ of the D. G. Zeigler Co. lines completed surveys on the Flint River near Warwick, ten miles from Cordele, with a view of building a dam across the river for a large power plant. This plant will furnish lights and electricity for manufacturing purposes to all the small towns within a radius of 50 miles of Cordele. It is said that the total expenditure in establishing this enterprise will reach considerably above $1,000,000.

Providing people along the route will donate right of way, surveys will be started at once by the Rome & Northern for the construction of an extension to that line from its present terminus, Gore, Ga., to Tunnel Hill, a little town 20 miles north of Dalton, where a natural pass through the mountains is located. H. M. Smith, Rome, Ga., is Chief Engineer of the company.

Idaho Notes.

FROM CORRESPONDENTS AND OTHER SOURCES.

H. M. Byllisby & Co., Inc., Electrical Engineers, 218 La Salle street, Chicago, Ill., have purchased the interests and plant of the I. P. T. Co., at Idaho Falls, and also at Rexburg, Sugar City and St. Anthony. It is stated that the company will expend $1,500,000 within the next 18 months on the plant, for new improvements, and on the new electric road to be constructed.

Mark Means, Lewiston, has asked the City Council of that city for a franchise on five miles of city streets for an electric railway.

According to reports from Payette, Idaho, the Central Idaho R. R. Co., has decided to construct a new line branching off of the Oregon Short Line at Owinza and connecting with the main line again at Payette, thus placing Boise on the main route of the Oregon Short Line again. J. P. Congdon, Pocatello, Idaho, is Supervising Engineer.

Illinois Notes.

FROM CORRESPONDENTS AND OTHER SOURCES.

The Illinois Traction Co., H. E. Chubbuck, General Manager, Peoria, is planning to expend $150,000 this year on extensions and improvements to its system in Quincy.

The Illinois Oil & Coal Belt Ry. Co., recently incorporated with a capital stock of $1,000,000 and headquarters at McLeansboro, Ill., is stated to have awarded contracts to the Western Indiana Construction Co., of Chicago, Ill., which will at once put surveyors in the field. The new company proposes a railroad connecting Terre Haute, Ind., Robinson, Olney, Fairfield, McLeansboro and Cairo, Ill., a distance of 190 miles. The incorporators and first board of directors are: James R. Campbell, McLeansboro; Isaac H. Webb, McLeansboro; Carroll C. Boggs, Fairfield; Aden Knopf, Olney, and Joseph B. Crowley, Robinson.

The U. S. War Department has taken favorable action on the application from the Iroquois Iron Co., 3267 E. 95th St., Chicago, for permission to build a dock and bulkheads and to fill submerged land on the south side of the entrance to the Calumet River, at Chicago.

The Springfield Traction Co. has been incorporated with a capital stock of $10,000, and headquarters at Springfield, and proposes to build an electric railroad from Springfield to Taylorville, thence to Pana, paralleling the B. and O. S-W. and another line to Pawnee, thence through Harvel and Hillsboro to Vandalia. C. E. Hazlett, Rochester, Ill., is President, and A. M. Fitzgerald, Springfield, is Secretary.

The Chicago, Indiana & Southern R. R., R. B. Seymour, Chief Engineer, Gibson (Lake County), Ind., is to double track its Danville division from St. Johns to Cheff. Work is to be started as soon as weather will permit.

Engineers for the Murphysboro & Southern Illinois Ry., recently chartered, have completed surveys of the route from Du Quoin to Pinckneyville, and as soon as weather permits will take in the route from Pinckneyville to Murphysboro. Another party is surveying from Du Quoin to Herrin.

The City Council of Charleston has granted a franchise to the Mattoon City Ry. Co. for the construction of an electric line extending from that city to Paris, thus establishing, when the line is completed, direct connection by trolley between Mattoon and Indianapolis.

The Cleveland, Cincinnati, Chicago & St. Louis Ry., Geo. P. Smith, chief engineer, Cincinnati, O., according to reports, is to receive bids tomorrow (March 10) for the construction of the branch from Evansville, Ind., to Mount Carmel, Ill., a distance of 32 miles. The line has already been surveyed and most of the right of way has been secured.

The Vandalia R. R. is securing land at Decatur for a new freight terminal.

James Ward, who was engaged in constructing the Burlington roadbed near Metropolis, has moved his outfit to Madisonville, Ky., where he will work on a contract for building 4 miles of roadbed for the Louisville & Nashville R. R.

According to reports, current at Robinson, Ill., The Illinois Central Ry. is considering the extension of its line from Meron to that city and ultimately to Terre Haute, Ind. A. S. Baldwin, Chicago, Ill., is Chief Engineer of the I. C. Ry.

Indiana Notes.

FROM CORRESPONDENTS AND OTHER SOURCES.

As soon as the weather will permit work will be resumed on the extension of the St. Joseph Valley R. R., from Angola to connect with the Toledo & Western at Pioneer, O. When this connecting link is completed there will then be a direct line from Toledo to Chicago.

The Indianapolis Traction & Terminal Co., of Indianapolis, is planning an extension of the East Michigan Street car line from Keystone Ave. to a point just west of the Belt railroad tracks this year, and a further extension to Irvington after the tracks at Michigan St. and the Belt railroad have been elevated, is to be made.

Efforts are being made to have the Central Indiana Lighting Co. of Columbus extend its street car line from the nearest point to the site selected by the Bartholomew County Fair Association for its fair ground, a distance of about one mile.

The Vandalia R. R. will shortly resume work on the completion of its new $500,000 round house in the east yards at Terre Haute.

Iowa Notes.

FROM CORRESPONDENTS AND OTHER SOURCES.

The Omaha, Council Bluffs & Sioux City Ry. Co. has been incorporated with a nominal capital stock of $10,000, and proposes to construct an electric railway. The incorporators are B. J. Ness, Des Moines, Ia.; M. H. Miller, Des Moines, and J. W. Russell.

Surveys have been completed and estimates of cost made for the projected interurban line between Ottumwa and Iowa City, a distance of 74 miles. Efforts are now being made to finance the line. Frank Tanner, Iowa City, and D. T. Davis, Sioux City, are interested.

The Black Hawk Construction Co. of Waterloo, has been incorporated with a capital stock of $25,000, the incorporators being Stanley D. Moore and Louis Moore.

The Supervisors of Crawford County, with headquarters at Denison, are planning in conjunction with Harrison County to make a new channel for the Boyer River. In Crawford the improvement will be eleven miles long and is estimated to cost $95,000. It will extend from Arion station, on the C. & N.-W. and Illinois Central roads, to just above Dunlap. The channel is to be dug out 40 ft. wide at the top and 20 ft. at the bottom.

The Southern Iowa Traction Co., mentioned in our last issue, as incorporated to take over the Albia & Centerville R. R., has recorded a mortgage for $500,000. and it is believed that this sum will be used for improving the line, putting in power plants, motor cars, terminals and extensions.

According to reports from Des Moines, Ia., the Chicago & Northwestern Ry. has begun active construction work on the extensions of its line in Monroe County, Ia., through the coal fields near Albia, Ia. The line from Belle Plaine will ultimately be extended to Albia, on the Chicago, Burlington and Quincy Ry.

Kansas Notes.

FROM CORRESPONDENTS AND OTHER SOURCES.

The Nebraska, Kansas & Southern Ry., which now has 15 miles of its projected 162 mile line in operation, has re-elected the following officers: J. C. Hopper of Ness City, Kan., president; T. T. Kelly, Paola, Kan., first vice president; J. Q. Adams of Stockton, Kan., second vice president; E. J. Williams of Stockton, treasurer, and F. T. Burnham of Kansas City, secretary and attorney. When completed the road will extend from Garden City to Stockton, Kan.

Work is to be started at once, it is said, on the construction of the Cherryville, Oklahoma & Texas R. R., south from Cherryville. Capital to the extent of $200,000 is said to have been secured in France by State Senator S. M Porter, with which to begin this work. B. L. Dalton, Lawrence, Kan., and R. H. Worley, Kansas City, are the engineers.

An agreement has been entered into between the Kaw Valley Drainage Board and the Chicago, Rock Island & Pacific Ry., whereby the last obstacle in the way of widening the channel and improving the Kaw River was removed. The final settlement of the dispute assures a channel widened to 734 ft. and an improved river from the mouth to the Fifth St. bridge at Kansas City. The agreement makes it possible for the drainage board to at once advertise and place on sale the $325,000 in bonds voted by the people of the drainage district six years ago and also to vote whatever additional bonds may be necessary to continue the work of river improvements to the mouth of the Kaw. The remainder of the $200,000 in bonds voted for the purpose of erecting a dike to protect the property of the drainage district also will be placed on sale. W. H. Daniels, Kansas City, is president of the Kaw Valley Drainage Board and A. M. Bunn is engineer.

Haskell County has voted to issue $48,000 of bonds to aid the Garden City, Gulf & Northern R. R. It is believed that location surveys from Garden City to Liberal will be completed by March 10. L. L. Graham, Syracuse, N. Y., is in charge of the location work, and W. H. Cose, New Albany, Ind., is Chief Engineer.

Michigan Notes.

FROM CORRESPONDENTS AND OTHER SOURCES.

The Michigan United Rys. Co. is stated to have made a tentative offer for the purchase of the Kalamazoo, Lake Shore & Chicago R. R., with the idea of electrifving the latter through to South Haven and Benton Harbor.

The Detroit United Ry. of Detroit, has formally accepted the ordinance by which double tracking is to be la'd on Harper and Mt. Elliott Aves., Detroit.

The Saginaw Valley Traction Co., J. F. Collins, General Manager, Saginaw, is to build a loop line in Germania and Franklin streets with tracks extending south to Janes avenue, at Saginaw.

Officials have decided to reconstruct the Wabash R. R. between Adrian and Detroit, Mich, and a meeting will be held soon to let the contracts for the work which will include the construction of bridges and trestles and laying of double tracks straight through from Detroit to Adrian. Grading and filling in-

volved in the work will require about six months' time. A. O. Cunningham, St. Louis, Mo., is Chief Engineer of the company.

Surveys of the Detroit United Ry. have been considering routes in Flint for a cross-town line.

Minnesota Notes.

FROM CORRESPONDENTS AND OTHER SOURCES.

The Twin City & Lake Superior Ry. Co., 440 Railway Bldg., Minneapolis, Minn., which projects an electric air line from St. Paul and Minneapolis to Duluth, has filed a $4,000,000 trust deed. It is stated that $300,000 has already been expended in work on the right of way, with 50 miles of grade work completed, and that as soon as spring opened up, operations would be continued with the expectation of finishing the road within 18 months. The officers of the company are as follows: President, L. N. Loomis, Minneapolis; Vice President, J. H. Bradt, Rockwell City, Ia.; Secretary-Treasurer, E. E. Sidman, Minneapolis. Directors—M. C. Towne, Des Moines, Ia.; A. R. McConnell, Mitchell, S. D., and F. A. Griswold, Minneapolis.

The Minneapolis, St. Paul & Sault Ste. Marie Ry. is said to have sent out a party of engineers from Viking, the first station west of Thief River Falls on the wheat line of the Soo, to begin a survey southwest from that point in the direction of Grand Forks, N. Dak.

The Drake & Stratton Co., which has extensive shipping contracts in the Mesaba range, as previously noted in these columns, will employ about 1,000 men at mine stripping on the range this year. The work will be confined to the Dale-Uno and the Morris mines, both of them near Hibbing. The contractors expect to move about 3,000,000 cubic yards.

Missouri Notes.

FROM CORRESPONDENTS AND OTHER SOURCES.

Trunk & Heim, Architects, Hughes Bldg., St. Joseph, have prepared profiles for a retaining wall for the McKinley school grounds in St. Joseph.

The Board of Supervisors of the Phelps City Dyke & Drainage District of Phelps City, have made a levy of about $60,000 for the purpose of straightening the Nishnabotna river from just below Watson to opposite Phelps City. The work will commence early this spring.

Business men of Kirksville have been in conference with C. M. Coe, Denver, Colo., regarding his proposed interurban line from Kirksville, mentioned in our last issue. It is proposed to build the line from Kirksville to Gibbs this summer and it is probable that a bonus of $60,000 and free right of way will be asked. If these are secured, it is proposed to have the road built to Gibbs by September 1.

St. Louis Items.

BY A. T. KOENIG

Conferences between H. D. Sexton, president of the East Side Levee and Sanitary District Board, and officers of railroad and ferry companies, regarding the scheme of flood protection for East St. Louis, Ill., Granite City and Madison, have disclosed arrangements whereby the Terminal Railroad Association will acquire ample acreage in East St. Louis for freight yards to contain 20,000 cars. The association has had surveys completed, and is preparing to start the East Side improvements. The acquisition of space for 20,000 cars by the Terminal is incidental to the comprehensive project for levee improvements. The East Side Levee and Sanitary District Board has practically approved plans for the construction of a concrete retaining wall, 45 ft. high and five miles long, following the Illinois shore from Merchants bridge to Pittsburg dike, near Eads bridge, and this structure will, the board's engineers report, protect East St. Louis, Madison and Granite City from inundation. The Terminal also has bought land in East St. Louis for yards, to acommodate 4,000 cars. The East Side Levee and Sanitary District Board of which W. D. Sexton is president, has virtually approved the plans of John A. Ockerson, its consulting engineer, to save the East Side towns from inundation. Bids will be received in a few days for part of the work, and negotiations are pending with the Atlantic, Gulf & Pacific Dredging Co. of New York City for the levee operations. The plans specify that Indian and Cahokia creeks shall be diverted, so as to rid East St. Louis, Granite City and Madison from devastating floods. A new bed with a pair of high containing walls, will be constructed to the Mississippi River at Oldenburg, near the south of the Missouri River, to furnish a course for one stream, and a similar bed, with high retaining walls, will be formed behind the bluffs, taking the stream in the rear of the East Side towns and emptying it into the Mississippi River on the south at Falling Springs. East St. Louis, Granite City and Madison will be left high and dry, according to the reports of Mr. Ockerson and other engineers, and they will not be in hazard of inundations. The diversion of Indian and Cahokia creeks, the building of their walls and the construction of the immense levee wall along the Mississippi River will entail an expenditure of about $8,000,000. The sanitary district will incur about $6,000,000 of the expense and the property owners along the river front about $2,000,000. The retaining wall will be constructed from the Merchants bridge to the Pittsburg dike, near the Eads bridge. Made of concrete, it will attain a height of 45 ft., with a slope of 250 ft. from the inner harbor line to the outer. The wall will be 5 ft. above the high water mark of 1844, and its length will be approximately five miles. This structure will, in the opinion of the engineers, make the East Side levee 16 ft. higher than the St. Louis. The filling behind the wall, to create 598.2 acres of new land, will require about 15,000,000 cu. ft. of dirt. H. D. Sexton, president of the East Side Levee and Sanitary District Board, has notified interested property owners that the plans have been approved and proposals for construction will soon be received. The intention is to begin work as soon as the contracts can be let and have the whole improvement finished in a few years. The Illinois Legislature has authorized the financing of the enterprise.

The Board of Public Improvements last Thursday laid out ground at the western end of the free bridge for the unloading of material. Work is to be started on the west land pier in anticipation of delays on the East Side during high water, which is expected next month. Material for another caisson has been ordered and will be on the ground near the foot of Chouteau Avenue in a few days. Each foot of rise in the stage of the river adds nearly half a pound per square inch to the necessary air pressure in the caisson. At a depth of 50 or 60 ft. in the caisson at the east land pier work will be very difficult at a high stage of the river necessitating a high air pressure. The contractor expects to get the west caisson in place and to sink the excavation the 30 or 40 ft. to the water level on the west shore pier by the time work is stopped on the East Side. It is proposed to build the caisson for the east river pier, just east of the middle of the river, during high water. It is to be built on barges to a height of more than equal to the depth of the water at the pier site and then will be dropped from the barges into position. The contractor now has only a year to complete the four piers.

Walter Dennison spent a couple of days in town and left here for Lubbock, Tex., where he has a contract on the Santa Fe to build a cut-off between Coleman and Texico, Tex.

Columbus S. Jones has finished his government work at Glasscock, La., and is in the market for more work. 1931 Marcus Ave., St. Louis, Mo., will catch him.

The Walsh Construction Co. got in on 700,000 yards of steam-shovel work on the Soo Line 20 miles out of St. Paul, Minn. List & Gifford Construction Co. are going to do this work for them.

The L. J. Smith Construction Co. of Kansas City placed an order with Koenig's Labor Agency last Sunday for 2,000 laborers to be shipped to their various camps at work ballasting the Missouri Pacific R. R. in Kansas and Colorado. This is probably the largest order that has ever been placed at one time for laborers by a single contracting firm in this country. Koenig filled the order in three days. Pretty fast work.

Bills to compel the Missouri Pacific R. R. to abolish the Chouteau Avenue grade crossing were introduced in the House of Delegates last Friday by the Board of Public Improvements. Two bills were introduced, so the Municipal Assembly may have its choice, one requiring the road to pay all of the expense, including the land damages, and the other providing that land damages shall be paid by the city. Bills from the Board of Public Improvement cannot be amended, and by affording a choice, delay is avoided and the bill decided upon may be passed before the end of the session next month. The bills provide for a viaduct in Chouteau Avenue over the railroad tracks, 56 ft. wide, 42 ft. for the roadway and the balance for two 7-ft. sidewalks. It is to start 290 ft. west of the center line of Tiffany St. and to run 42 ft. east of the center line of Manchester Ave., making the completed viaduct 1,244 ft. long. The lowest part of the viaduct at the railroad tracks is to be 18 ft. above the rails. The cost is estimated at $204,240, not including property damages. Four months is allowed after the passage of the bill for the presentation of plans by the railroad for the viaduct.

Nevada Notes.

FROM CORRESPONDENTS AND OTHER SOURCES.

Good progress has been made with the plans for a new railroad out of Winnemucca, and it is probable that a portion of the line will be constructed this year. As proposed the road will start at a point about one mile east of Winnemucca and, after crossing the Humboldt River will pass near the Reil ranch, thence up the Little Humboldt River to near the Toll House. From there the road will extend to Paradise valley, making a considerable loop into that section, and will cross the low divide of the Cottonwood range at a point near what is known as Paradise Hill. From there the road will run directly northward through Quinn River valley to the mouth of Three-mile Creek canyon, that leads to the camp of National, and from there on to McDermitt and finally on to Caldwell, Idaho, a total distance of 249 miles. R. E. Tilden, C. E., Humboldt, is interested.

New York Notes.

FROM CORRESPONDENTS AND OTHER SOURCES.

The St. Lawrence River Power Co., is planning to begin work early this spring on the construction of a concrete dam at Massena, extending eastward from the power house for a distance of 250 ft., then at right angles to this and extending northerly into the river bank a distance of 150 to 200 ft., the whole dam to be about 50 ft. high and resting on bed rock, excepting perhaps a portion of the wing where it goes into the bank.

Work is to be started about April 15 on the construction of the New York Central & Hudson River R. R., station at Rochester. The work will involve the expenditure of abort $1,000,000. J. B. Reinhardt is Resident Engineer, and J. W. Pfau, New York city, is Engineer of Construction.

The Buffalo, Rochester & Pittsburg Ry., E. F. Robinson, Chief Engineer, Rochester, is planning extensive improvements for its terminals at Rochester.

The Long Island R. R., J. R. Savage, Chief Engineer, Jamaica, N. Y., is planning to spend about $3,000,000 in the next few months in improving its facilities at the Jamaica terminal. Of the above sum, $701,000 is to be expended on a new terminal, $730,000 in eliminating grade crossings, about $645,000 on other grade work; for new trackage $22,000 and for a freight handling yard, $170,000.

The New York Central and Hudson River R. R. and Lehigh Valley R. R. have plans

under consideration for new passenger and freight terminals in Buffalo which will involve the expenditure of between $7,000,000 and $8,000,000. The New York Central is said to have secured options on property on the lower terrace between Erie and Church streets, upon which it will build a $6,000,000 station. The Central trains are to run into the station through the Terrace subway, and on additional tracks which the road will ask the city to permit to be laid. It is said that the Lehigh Valley has not perfected its plans. It may share the Central station, or it may build a new one, to cost about $3,000,000 on or near its present station.

Residents of East Meadow, L. I., are asking that the New York & Long Island Traction Co. extend its line from Hemstead to that place.

Surveys have been completed for the construction of a railroad siding from the Chenango Valley branch of the New York Central R. R. to the gypsum beds two miles east of Fayetteville, N. Y., and at the next meeting the Board of Trade will attempt to induce the railroad to lay tracks.

Hearing is to be held April 1 by Board of Estimate and Apportionment of New York City upon the petition of the New York and Queens County R. R., for a franchise to construct an additional track from Flushing, N. Y., to College Point, and from Jamaica to Flushing. Headquarters of the company are at New York City.

Ohio Notes.

FROM CORRESPONDENTS AND OTHER SOURCES.

Citizens of Price Hill have requested the Cincinnati Traction Co., of Cincinnati, to lay a double track street car line on Glenway Ave., from Wilder to the junction of Warsaw, Glenway and Seton Aves.

City Engineer Brewer of Niles, is preparing plans for a subway at North Main St., to eliminate grade crossings.

The Mahonning & Shenango Ry. & Light Co. is planning a number of improvements for its street railway lines in Youngstown and vicinity this year. One of the most important improvements will be a double track on the Park & Falls line from the Public Square to Idora Park. The Market St. viaduct will be double tracked and also Market St., from the viaduct to the end of the present double track near Myrtle Ave.

The Breakwater Construction Co. of Cleveland, which is building the jetties and breakwater at Cold Spring Inlet, for the entrance to the Cape May Harbor, New Jersey, has expended $75,000 on new and improved equipment with which to resume work this spring.

The Akron, Canton & Youngstown R. R. has secured a complete right of way between Mogadore and Youngstown and has also secured some right of way east of the former place. Right of way has also been secured in Akron. New York capitalists were over the proposed route recently and it is believed that construction will be started this spring. The new road will be six miles shorter between Akron and Youngstown than the B. & O., and there will be but six curves between the city limits of the two cities. The maximum curvature is only 1 degree and the maximum grade will be 3-10 of 1 per cent. Work was started on the proposed new road in 1893, which was then the Akron & New Castle. Later the right of way was purchased by the present company, but the panic greatly interfered with the project. Z. W. Davis, Cleveland, is President, and H. B. Stuart, Canton, is vice president.

A bill is before the State Senate which if passed will permit the railroads in Ohio to construct as many tracks along their right of way as they please. The present law allows only the construction of two tracks, with sidings and the necessary turnouts. The bill proposes to allow more than two, with no limitation as to how many.

J. J. Turner, Vice President, Pennsylvania Lines, West of Pittsburg, Pittsburg, Pa., is reported to have stated that the company is negotiating for a new entrance to Cincinnati, O.

The Chesapeake & Ohio R. R. has decided to begin work on the double tracking of the Cincinnati Division of the road. The work as proposed includes the construction of a new outside terminal at Silver Grove, near Cincinnati, O. Board of Directors of the company recently granted an appropriation of $5,000,000 for the work. F. I. Cabell, Richmond, Va., is Engineer M. of W.

Work is to be started in the spring by the Pennsylvania R. R., in the elevation and double tracking of six miles of line through Piqua.

Oklahoma Notes.

FROM CORRESPONDENTS AND OTHER SOURCES.

The citizens of Woodward have offered to give $25,000 to the recently chartered Woodward Interurban Ry. Co., which proposes to build an electric line from Woodward northwest to Fort Supply, where one of the state insane asylums is located. J. H. Spurlock, W. H. Pyne and J. A. Innis are interested.

The Chamber of Commerce of Altus has recommended that the city accept the proposition of Harry Bradford of El Reno, to construct an electric street railway in Altus, provided the city will furnish the power, the city to receive one-half of the proceeds of the line in return for power and the franchise.

Surveys have been completed for the Webbers Falls-Warner R. R. J. R. McClaren, Warner, is interested.

The Railroad Committee of the Commercial Club of Anadarko and the officials of the recently incorporated Oklahoma City & Panhandle Ry. Co., have signed contracts relative to the building of the road to West City. By the contract, the road will get right of way through the county, terminal facilities in Anadarko and a $60,000 bonus.

The Osage Western Ry. Co., of Pawhuska, has awarded contracts for grading between Nowata and Vinita and which is to be started at the latter place. Bonuses have been secured at Vinita, Nowata, Bartlesville and Powhuska, Clarence Walters, Pawhuska, is General Manager.

The Davis Contractors Co., at present engaged in grading for the projected line of the Shawnee Electric Ry. Co., of Shawnee, near Spencer, has been awarded another five mile section. The company is also preparing to let a 10 mile section shortly.

The city of Lawton has entered into a contract with J. A. Kemp and Frank Kell, of Wichita Falls, Tex., for the construction of a new line of railroad from Lawton to Wichita Falls.

Engineers engaged in the permanent survey for the Cherokee Belt and Interurban railroad which is proposed to be built from Pryor Creek to Skiatook, reached Claremore on Feb. 24, having completed the survey from Skiatook east to the Verdigris river. The bonuses have been raised by the several towns along the proposed route, and most of the right of way secured.

William Kenefick, President, Missouri, Oklahoma & Gulf R. R., and his associates are promoting the construction of a railroad from Coalton, the terminus of the Missouri, Oklahoma & Gulf R. R., to Preston, Okla., the new oil town on the Frisco, via Okmulgee. It is understood that bonuses amounting to $57,000 have been secured.

Oregon Notes.

FROM CORRESPONDENTS AND OTHER SOURCES.

An ordinance has been before the City Council of Portland to permit the Alameda Land Co. to extend the Broadway street car line from Fremont St. through the Alameda tract to Mason St. The proposed line will be operated as a part of the system of the Portland Railway, Light & Power Co.

The Oregon Electric Ry. Co., Guy W. Talbot, General Manager, Portland, is giving favorable consideration to the matter of extending its lines from Salem to Albany and from Tigard to McMinnville this year. The extensions would require the expenditure of $2,225,000 and the building of 57 more miles of electric railway to the Willamette Valley. Surveys for the lines have already been made.

Good progress is being made on the construction of the O. R. & N. Co.'s line from The Dalles to the mouth of the Deschute River. Twohy Bros., Spokane, Wash., have the general contract. They have sublet the entire work, but their outfits will be used on the job and all operations will be in charge of John Twohy, Jr.

The Carlton & Coast R. R. Co., with a capital stock of $500,000, has filed its contracts of the corporation at Salem. The company proposes to build a steam road from Carlton, west through Yamhill and Tillamook Counties to Fairdale on the Pacific Coast. The Carlton Consolidated Lumber Co. has been incorporated by the same parties for the purpose, it is understood, of taking over the Carlton Lumber Co., W. Carlton, W. D. Dennis, Fred Russell and S. B. Linthicum are interested.

William Galvin, a foreman, well known to all railroad contractors in the central states, died at Madres, Ore., about Jan. 16, of heart failure. Mr. Galvin has two brothers, Timothy and Michael, and they can obtain information regarding Mr. Galvin's death by writing to James Houston, Camp Timber, Ore.

Engineers of the Corvallis & Eastern R. R. have finished the second survey from Yaquina to Newport and have removed their camp to Elk City, 18 miles above Newport. They will continue a survey of the road to Blodgetts' with the plan of eliminating a number of curves in the road, the idea being to shorten the road some ten or more miles. W. W. Bosshke, Portland, Ore., Chief Engineer.

The Orchards Watering Co., of Brogan, has been incorporated with a capital stock of $50,000 to acquire water rights and impound water. The incorporators are R. B. Hoyt, F. L. Grimes and E. R. Hamilton, all of Vale Ore.

The Commissioners of the Port of Nehalem have adopted resolutions providing for the sale of $50,000 of its bonds to secure funds to construct a jetty at the mouth of Nehalem Bay to provide a ship channel to the sea with a depth of 20 to 22 feet. The bonds will be sold to the highest bidder April 16, and contracts for construction work will be let soon after that date.

The Hood River Farmers' Irrigating Co. held a special election at Hood River on March 5, to consider the matter of piping its irrigating system through the farming section of the valley.

Plans and blue prints have been prepared and are on file at the offices of the Oregon Railroad & Navigation Co., for the construction of railroad shops, round house and extensive system of side tracks at Ontario, Ore. G. W. Boschke, Portland, Ore., is Chief Engineer of the company.

Pennsylvania Notes.

FROM CORRESPONDENTS AND OTHER SOURCES.

The Lehigh Valley R. R., G. L. Moore, Engineer Maintenance of Way, South Bethlehem, Pa., is said to have decided to spend about $1,000,000 for tunnelling Bear Mountain near Mauch Chunk. The tunnel, which will be about a mile long, will extend from the station at East Mauch Chunk half way to Packerton, and will cut off the three-mile curve around the mountain.

The Johnstown & Altoona Street Ry. Co. has about completed arrangements for its proposed electric line between Johnstown and the Mountain City. The last obstacle to the construction of the line will be removed with the granting of the ordinance now pending in Altoona council, which will give the Johnstown & Altoona Co. permission to enter that city with a third rail over the Logan Valley system.

The Johnstown Traction Co. has been chartered to operate electric lines in Johnstown and vicinity. The capital stock of $500,000 is nearly all held by E. M. Dupont.

The stockholders of the West Pennsylvania Ry. Co. have decided to spend a large sum of money for improvements and extensions. A new power house and several substations are

to be built immediately, and the intention is to extend the lines east and west until a network of trolley lines is laid over the entire coke district of western Pennsylvania.

The Pittsburg & Lake Erie R. R., J. A. Atwood, Chief Engineer, Pittsburg, is said to be planning building a loop on its lines this coming summer that will leave the main line north of Koppel and will run through that town and will then parallel the Fort Wayne road to College Hill and passing through that town on the left, will enter Beaver Falls at 25th street and occupy the right of way owned by the company through the north end and connect with the main line again near the site of the old paper mill at 17th street.

Grading for the construction of the second track between McCalmont, a point three miles south of Butler, Pa., and the Allegheny River, a distance of 18 miles on the Bessemer & Lake Erie Ry., has been started. The new track will avoid curves and will require heavy cuts and fills. The estimated cost of the work is $1,000,000. H. T. Porter, Greenville, Pa., is Chief Engineer of the company.

City Engineer McKinnon of York, Pa., is preparing a map of the proposed extension of the New Park and Fawn Grove R. R. from Fawn Grove to Delta, a distance of 8 1-2 miles.

According to reports, the officials of the Baltimore & Ohio R. R. are again considering the construction of a tunnel through the hill below the McKeesport Hospital, McKeesport, Pa., for which plans were prepared three years ago. Paul Didier, Pittsburg, N. S. Pa., is Assistant Chief Engineer B. & O.

Work on the Western Maryland Ry. extension into Pennsylvania will be started this spring, it is thought. The extension will be 83 miles long and will cost $12,000,000. H. R. Pratt, Baltimore, Md., is Chief Engineer. It is believed in some quarters that the contract has already been let to William McAdoo, New York City, the builder of the Hudson River tunnels of the Pennsylvania R. R.

Citizens of Bridgeville and Carnegie have requested the commissioners of Allegheny County, to build a tunnel which will connect the Bridgeville and Carnegie territory with Pittsburg. The project would cost $1,500,000. The scheme originally contemplated the building of a bridge over the Monongahela River at Liberty street, Pittsburg. The advocates of the tunnel have abandoned this plan and now propose to connect the tunnel with the Point bridge. The tunnel would be 4,000 ft. long and would run from a point near the Point bridge to Banksville. The tunnel would connect with the bridge by a spur running above the tracks of the Panhandle railroad. J. G. Chalfant, Pittsburg, is County Engineer.

The new owners of the Gettysburg Trolley & Lighting Co. of Gettysburg, have effected a re-organization. Jas. F. Hallowell, of Philadelphia, was elected president; C. Taylor Leland, of Philadelphia, secretary and treasurer; C. J. Craft, George W. Roydhouse, Jas. F. Hallowell and C. T. Leland, all of Philadelphia, directors.

Rights of way and franchises have been received for the projected electric railway from New Castle to Mercer, with a branch to Sharon, and it is understood that the J. G. White Co., New York City, will finance and build the line. The electric railway will be capitalized at 1,000,000.

The Chambersburg, Greencastle and Waynesboro Electric Ry. Co., is to increase its capital stock from $600,000 to $2,500,000 and the bonded indebtedness from $1,000,000 to $2,500,000. The money will be used to extend the road from Pen-Mar to Blue Ridge Summit and Monterey.

Tennessee Notes.

FROM CORRESPONDENTS AND OTHER SOURCES.

The Appalachian Ry. Co., of Knox County, has been incorporated with a capital stock of $10,000 and proposes to build a road from Obion Springs in Anderson County to Landing, in Morgan County. The incorporators are J. W. Prevost, J. M. Cassil, C. M. Franklin, E. E. Ferguson and John W. Green.

The Union Land & Improvement Co., of Memphis; proposes, at its owns expense, to extend the New Raleigh road street car line from its present terminus at Evergreen St. to the property recently acquired on the Belt line.

The Tennessee Central R. R. has secured right of way for the construction of a line from Harriman, Tenn., to Knoxville and it is believed that the road is planning the construction of a through route from Harriman, via Kingston through Loudon County to Knoxville and on through Sevierville into and through North Carolina to the Atlantic Seacoast. L. F. Lonnbladh, Nashville, Tenn., is Chief Engineer of the company.

The Tennessee Developing Co., with a capital stock of $10,000, has filed application for a charter of incorporation. The incorporators are W. H. Payne, Jr., J. L. Foust, W. C. Foust, E. F. McClure and Charles F. Higgins. The charter gives the company the power of improving and developing the water powers of the rivers and streams of the state and the right to manufacture electricity for all purposes.

The Louisville & Nashville R. R. is said to be making surveys for a freight route from Madison, Tenn, to Brentwood, in order to avoid terminal delays in Nashville. The plan contemplates bridging the Cumberland River above Nashville. The route as projected would eliminate the Maplewood grade, but would cost about $1,000,000 to construct.

Texas Notes.

FROM CORRESPONDENTS AND OTHER SOURCES.

The International & Great Northern R. R., H. A. Genung, Engineer Maintenance of Way, San Antonio, Tex., has had surveys made at Taylor, with the intention of reconstructing the general yard plan and the installation of much new trackage upon the completion and installation of the new railroad shops of the company, now in course of construction.

The Belton-Temple Traction Co., of Temple, has begun the work of paving between its tracks in the business section of Temple. New and heavier steel is also to be laid in certain portions of the city.

President Owsley of the Chamber of Commerce of Denton, has been raising a preliminary fund of $5,000 for making the necessary surveys and other preliminary work for an interurban line between Fort Worth and Denton. Fort Worth capital has been interested in the project and it is said that if the money can be secured at Denton for the preliminary work capital has been promised to put the line through. The distance is about 35 miles.

The Central Construction Co. of Moobeetic has been incorporated with a capital stock of $30,000; the company proposes to build railroads and railroad bridges. M. F. Stanley, J. E. Stanley and T. E. Durham are incorporators.

A permit to do business in Texas has been granted to the Falls City Construction Co., of Louisville, Ky. The principal Texas office is Panhandle; capital stock is $50,000.

The Texas Central R. R., C. H. Sharman, Chief Engineer, Waco, has closed contracts for right of way for the branch line from De Leon through Sipe Springs, Rising Star and Cross Plains. The locating party of engineers is making rapid progress. All ties and rails have been purchased, and the contract for the grading will be let in a short time.

The Enid, Ochiltree & Western R. R., has filed an amendment to its charter providing for an extension of 55 miles from Ochiltree eastward to the Oklahoma State line.

Steps are being taken to have construction work started on the Abilene Central R. R. Morgan Jones, Abilene, is interested.

The Louisiana Rio Grande Canal Co. of McAllen, has been incorporated with a capital stock of $20,000, the incorporators being H. N. Pharr, John J. Conway and J. C. Kelly.

The Grigsby Construction Co., Dallas, Tex., has been awarded the contract for constructing the Temple Northwestern R. R. from Temple to Hamilton.

The Beaumont & Great Northern R. R. has filed an amendment to its charter providing for an extension, 52 miles in length from Trinity to Jewett, through the counties of Trinity, Walker, Houston and Leon. R. C. Duff, Houston, Tex., is General Manager.

The Board of Trade of Fort Worth has raised $125,000 for the projected Fort Worth Mineral Wells interurban line, and dates are now being prepared preparatory to calling for bids for contracting the line. It is said that contracts for doing this will be let within 60 days. The road will pass through Springtown, Azle, Poolville, and Peasten and will have its terminus at Mineral Wells, J. S. Handford and Paul Hurley are the promoters.

Advices from Houston, state that a deal has been closed in that city for the purchase of all supplies except ties, for the railroad line in oNrth Texas, which is to run from Graham to Roswell. The movement for this line was started at Haskell, Tex., and some construction work has already been done there. M. R. Hemphill, Haskell, is interested.

A project is under construction for the constructing of a railroad from Gainesville to Weatherford, via Decatur. Col M. P. Kelley, President of the Commercial Club of Gainesville, is interested.

Train service on the Orange & Northwestern Ry., a new Santa Fe line, was started on Feb. 21.

H. J. Rix, Tyler, has commenced work on his contract with the Cotton Belt for the grading work from Bonner Spur, 2 1-2 miles south of Athens, to the Boone lignite mines.

Joel W. Hicks, Weatherford and the Mitchell-Pigg Construction Co. have made a proposition to the proposed Chicago, Weatherford & Brazos Valley R. R. whereby they will build, grade, construct and lay the steel ready for the rolling stock, upon said railway from Weatherford northward to Bridgeport or to an intersection with the Rock Island railway at some other point in Wise county, Texas.

E. S. Johns has begun work on his sub contract on the levee to be built in the Brazos River opposite Bryan. Roach & Stansell, Memphis, Tenn., are the general contractors for the work.

S. A. Anderson, formerly assistant chief engineer of the Texas and Pacific, has accepted the position of chief engineer for the Pecos Valley Southern Ry, and is in Pecos to personally superintend the construction of the road out of Pecos. The location survey is completed and the grade work is being pushed rapidly.

Commissioners of Atascosa County have granted J. F. Edwards, President of the San Antonio, Rio Grande & Tampico R. R., permission to enter Jourdanton, Tex., via Crouch avenue, to Main street, where terminals will be constructed.

Citizens of Del Rio, Tex., are subscribing liberally toward the required bonus of the Kansas City, Mexico & Orient R. R., $33,000 of required amount having already been subscribed.

Contracts have finally been signed by the city of Temple, Tex., and the promoters of the Temple Northwestern Ry., which insure the construction of the road. Citizens of the place have subscribed $175,000 for the project.

Utah Notes.

FROM CORRESPONDENTS AND OTHER SOURCES.

Announcement has been made that the San Pedro, Los Angeles & Salt Lake R. R. would be reopened to transcontinental traffic by June 1. The company will build a temporary track through Meadow Valley, in Nevada, where 90 miles of roadbed was washed out two months ago. A permanent roadbed will be built over the same route. E. G. Tilton, Los Angeles, Cal., is Chief Engineer.

The City Council of Provo has granted Jesse Knight a franchise for an interurban right-of-way through the city. This gives the Knight road right-of-way through all towns in the country with the exception of Springville.

Virginia Notes.

FROM CORRESPONDENTS AND OTHER SOURCES.

The Virginia Ry. is to have work started shortly on the erection of shops and a roundhouse at Roanoke, Va.

The Roanoke & Bent Mountain R. R. Co. organized to build a railroad from Roanoke, Va., to Floyd Courthouse, 50 miles, effected its organization at Roanoke, as follows: President, Arthur L. Sibert; Vice-President, R. H. Angell; Secretary and Treasurer, C. M. Armes; General Manager, C. G. Ogden. Directors—A. L. Sibert, C. M. Armes, C. G. Ogden, V. C. Lawson, L. C. Stewart, J. Coles Terry, M. M. Caldwell, J. B. Botts and E. A. Thurman.

Business men in Amherst, Va., have formed a company and will ask a charter for the construction of an electric railway through Amherst County. It is proposed to have the Southern terminus at or near Lynchburg, and to extend the line through in a northern direction to the Nelson line, and possibly into that county.

Washington Notes.

FROM CORRESPONDENTS AND OTHER SOURCES.

The Tacoma Pile Driving & Construction Co., Tacoma, has been awarded the contract for driving the piling for the new passenger dock to be erected at Tacoma by the Commercial Dock Co.

The Wenatchee Valley & Northern R. R. has increased its capital stock to $300,000. D. Mackey, Leavenworth, Wash., is General Manager. This company, according to recent reports, had 18 miles of standard gage line in operation and seven miles additional under construction.

Plans for improvements at Hillyard, to cost about $300,000, have been submitted to the St. Paul office of the Great Northern. The improvements will involve new trackage facilities, additional roundhouses, engine shops and alterations.

The City Council of Renton has granted a franchise to the Valley Railway & Power Co., to build and operate a railroad from Renton to Kent. Practically all right of way has been secured.

Horace Henry, Seattle, Wash., has been awarded the contract for constructing the Chicago, Milwaukee & Puget Sound Ry.'s branch to Everett. The branch will be 45 miles long, and will leave the main line at Moncton. It will cost about $35,000 per mile. Work will begin March 15, and is to be completed in nine months.

Residents of Waterville have raised $80,000 for the construction of a 6½-mile line to a connection with the Great Northern at Douglas. All material has been ordered and construction will be started about April 15. A. L. Rogers, Waterville, is interested.

The Great Northern Ry., A. Stewart, Assistant Chief Engineer, Seattle, Wash., is said to be planning to expend $2,500,000 this year in improving its system through the Cascade Mountains. It is said that the company proposes to make radical alterations in right of way east of Scenic Hot Springs, to avert continued destruction of rolling stock and trackage by the slides. The company proposes to clear and grade a strip of land 500 ft. in width along a portion of this particularly dangerous right of way to eliminate further troubles. The company further intends spending a considerable sum building spurs and new passenger stations. Further double tracking facilities are also soon to be undertaken.

The Pacific & Eastern R. R. has been completed for a distance of six miles up Mill Creek, beginning at a point on the Willapa River, six miles above Raymond. This road is a common carrier and will eventually be extended from South Bend to Chehalis. It is owned by the Siler Mill Co., the Willapa Lumber Co., and the Columbia Box & Lumber Co., of Raymond.

The Commonwealth Power & Water Co., has been incorporated with a capital stock of $5,000,000 and is said to have acquired a power site somewhere in the Inland Empire which it will develop in connection with an irrigation project. The incorporators are, J. E. Burns, E. F. Waggoner and F. W. Dewart, all of Spokane.

The City Council of Olympia has passed an ordinance for the construction on the Swantown fill, and bids for the work will be asked at once. The estimated cost is $66,000.

The U. S. Department of Interior has approved the plans of reclamation engineers providing additional storage capacity for 40,000 acre feet of water for lands under an extension of the Sunnyside canal. The storage will be obtained at Lake Kaches by deepening the drainage channel. It will cost about $60,000. Ernest McCullough, Sunnyside, Wash., is Project Engineer.

Reports have reached Chehalis, Wash., that a route for the double track over the Napavine hill has been definitely decided upon by the Northern Pacific. The new route will be identical with the old one excepting at a point near Napavine where it will veer to the west. Right of way men are now busy closing deals for right of way and grading will be started in the Spring. The project will involve some heavy grading.

Officials of the Harriman System, according to reports, have announced that plans have been completed for great railroad yards and extensive car shops for the Puget Sound and Grany's Harbor lines at South Tacoma, Wash. According to the plans the storage capacity of the yards, which will be the first gravity switching yard on the Pacific Coast, is 2,200 freight cars, and it will cost $1,000,000.

Board of Directors of the Great Northern at a recent meeting were given authority to revise the surveys for the construction of a line through the Okanogan Valley, Washington. As projected the line will run from Orville to Vancouver, B. C., then to Brewster, a little to the southeast of the Colville Indian Reservation traversing a distance of approximately 50 miles. Work will be started in the Spring as soon as the weather permits and it is expected to have the line in operation next year.

Preliminary surveys for the Ritzville-Ellensburg cut off on the North Pacific Ry. have been submitted to the N. P. officials at St. Paul. It is believed that work will be started this summer.

Wisconsin Notes.

FROM CORRESPONDENTS AND OTHER SOURCES.

The Minneapolis, St. Paul & Sault Ste. Marie Ry. is to construct its own track between Neenah and Hilbert Junction, a distance of 20 miles. At present the Soo trains are run over the Milwaukee track between the stations named to connect with the Soo line to Manitowoc. This will give the Wisconsin & Northern road, which will be built to Neenah this summer, a direct line to Manitowoc.

The stockholders of the Chippewa Flambeau Development Co., organized to build dams on the Chippewa and Flambeau rivers to create reservoirs for the purpose of storing water during times of excess and letting out water during times of scarcity, have elected the following officers: President, J. T. Joyce, Eau Claire; vice-president, David Douglas, Eau Claire; secretary and treasurer, D. Buchanan, Jr., Chippewa Falls. The company now has a bill pending before a special legislative committee on forestry and water powers by which it is given the right to build dams on rivers and to maintain reservoirs to create uniform flow of water throughout the entire year.

Canadian Notes.

FROM CORRESPONDENTS AND OTHER SOURCES.

The Grand Trunk Pacific main line has now been completed as far as Edson, 120 miles west of Edmonton. From this point Foley, Welsh and Stewart, Contractors, St. Paul, Minn., have 1,000 teams hauling supplies and cacheing them along the survey as far west as Tete Jaune Cache, which is over the hill beyond Yellowhead.

The Canadian Board of Railroad Commissioners has approved the route of the Niagara, St. Catherines & Toronto Electric Ry. Co. for its projected road from Welland, Ont., to Bridgeburg, by way of Port Colborne. The link between Welland and Port Colborne is already under construction. The remaining section between Port Colborne and Bridgeburg will be proceeded with as soon as the weather renders work possible. The distance between Bridgeburg and Port Colborne is approximately 20 miles.

The Canadian Pacific Ry. is to spend $4,000,000 this year in improvements on its Western Division. Of this amount $133,000 will be spent in Calgary, $80,000 being appropriated for an extension to the station and the balance principally on the roundhouses and machine shops in East Calgary. At Medicine Hat from $40,000 to $60,000 will be spent on machine shops; at Red Deer, $20,000 on a new station; at Moose Jaw, $200,000 on freight sheds; at Regina, $200,000 on freight sheds; at Canmore, $26,000 on a railway Y. M. C. A.; at Banff, $30,000 on a new station. About $500,000 will be spent on ballasting and renewing with new steel, the line between Calgary and Medicine Hat receiving attention. About $117,000 will be expended in improving the wire system between Medicine Hat and Swift Current. A. Price, Calgary, Alberta, is General Superintendent Western Division.

A bill has been before the Canadian Parliament to incorporate the London Lake Erie Railway and Transportation Co. This company recently took over the South-western Traction Co.'s line from London, Ont., to Port Stanley, on Lake Erie, and it is the intention to build also other radial lines out of London and to operate boats from Cleveland to Port Stanley.

The Montreal Underground Elevated Railway Co., has applied to the Canadian Parliament for a charter. The company will have a capital stock of $20,000,000 and asks charter rights to build and operate by electricity or other motive power, underground and elevated railways through the city and the island of Montreal. L. T. Col. T. B. Butler, Montreal, Que., is attorney for the applicants.

The railway legislation promised by the British Columbia provincial government for the aid of the Canadian Northern railway was introduced in parliament on Feb. 28. The program consists of three bills, one an act ratifying the provisional agreement entered into between the government and Mackenzie and Mann, the second an act incorporating the Canadian Northern Ry. Co., and the third a bill ratifying the agreement between the government and the Kettle River Valley Ry. Co.

The Grand Trunk Pacific Ry. has awarded the contract for the extension of the Tofield-Calgary line of Alberta from Camrose south to Calgary, to J. D. McArthur, Ltd., and the work of connecting Calgary with the main line will be rushed the moment the frost leaves the ground. About 135 miles of line is to be constructed.

The Provincial Government of British Columbia has granted a franchise to the Hill interests to build a line of railroad from Princeton, to the point where the international boundary line is intersected by the Skagit River. The securing of the franchise indicates strongly that the Great Northern is to build from Princeton, the terminus of the Canadian Great Northern at present, down the Skagit river to a connection with the Anacortes-Rockport branch.

J. N. Logan, Winnipeg, Man., is busy securing right of way for the partly constructed railroad between St. Paul and Prince Albert, Can.

The Dominion Atlantic Ry. will start surveys shortly for its projected North Mountain branch. The branch will join the main line at Centreville, N. S., and will go north and west, passing through Billtown, Lakeville, Woodville and Grafton and will join the main line at a western point. P. Gifkins, Kentville, N. S., is General Manager.

Mexico Notes.

FROM CORRESPONDENTS AND OTHER SOURCES.

Engineers of the National Ry's of Mexico, and Jas. M. Reid, chief engineer, City of Mexico are making preparations for the opening of

work on the Magdalena and Tlacolula extensions of the Oaxaca y Oriente Ry., now under lease to the interoceanic. The engineers have instructions to survey the lines as far as San Dionisio, about 20 miles southwest of Tlacolula.

The Torres & Priestas Ry., a 38-mile narrow gage line extending east from Torres, Sonora, Mex., is to be extended east through the Barranca region to a connection with the Yaqui River extension of the Southern Pacific. J. T. Symonds, Torres, Sonora, Mex., is assistant General Manager.

The City Council of Fremont, Neb., has granted a franchise to the Nebraska Transportation Co., for the construction of an interurban car line into Fremont. The proposed line is to be operated between Omaha and that place. The franchise calls for the completion of the line in 1912.

Following bids were received Feb. 23, by Capt. F. W. Altstaetter, U. S. Engineers, Wheeling, W. Va., for furnishing and delivering structural steel, forgings, bolts, etc., for Dam Nos. 8 and 11, Ohio River.

	Dam No. 8	Dam No. 11
The Richard Mfg. Co., Bloomsburg, Pa.	$0.055	$0.0525
Independent Bridge Co., Pittsburg, Pa.	.0332	.0236
Penn. Bridge Co., Beaver Falls Pa.	.0369	.0314
American Bridge Co., of New York Pittsburg, Pa.	.0274	.0274
New Jersey Foundry & Machine Co., New York, N. Y.	.0363	.0363
Hoisting Machinery Co., New York, N. Y.	.0577	.067
Lawrence D. Weaning, Cleveland, O.	.035	.0315

The Watson Contracting Co., of Birmingham, Ala., has been incorporated with a capital stock of $5,000, fully paid in, and will engage in contracting business for road work, railroads, etc. The incorporators are W. L. Woodruff, W. L. Watson and C. W. Woodruff.

The Fernwood Lumber Co., Fernwood, Miss., has taken bids for grubbing and grading about four miles extension of the Fernwood & Gulf Ry., in the west side of Marion County, Miss. The work is high and well drained and averages about 12,000 cu. yds. per mile.

The Harrison Southern R. R. Co., has been incorporated with a capital stock of $100,000 the incorporators being, P. H. Wall, M. K. Wall and A. A. Crane of Harrison, Idaho. The company proposes to construct a road from Harrison to Bell Creek and hence to the junction of the Chicago, Milwaukee & Puget Sound Ry. at St. Maries.

According to advices from Butte, the Montana Rapid Transit Co., has secured enough capital to assure the beginning of construction this spring for the electric line between Helena and Butte. The route for the new road will be over the old grade of the Northern Pacific R. R., which was made at the time the Northern Pacific Co. fought with the Montana Central, now the Great Northern, for an entrance into Butte. It will pass through Jefferson City, Corbin, Wickes and Amazon. The road will have a length of about 75 miles. Among those behind the project are officers of the United Missouri River Power Co., from which company the projected electric road will get its power.

The Norwich, Colchester & Hartford Traction Co., is making good progress with the promotion of its line, and is said to have already received subscriptions of $270,000 for its prefered stock. The estimated cost of construction is $985,000 and it is planned to have construction work started in April. The road is to connect Hartford, Conn., and Norwich, Conn., and of its line, 26 miles will be on tangent or straight track; twelve miles on light curves which will permit high speed; and the remainder of the distance on curves not ordinarily classed as light, including the curve work necessary in towns. Mayor Lippitt of Norwich, Conn., is President of the company.

The Stokes, Surry & Rockingham County Ry. Co., is to be organized in North Carolina for the purpose of building a trolley from Stoneville, N. C., on the Roanoke & Southern to Spray, Draper and Leaksville, a distance of ten miles. The project is backed by New York capital and it is probable that the road will be extended from Stoneville to Mount Airy a distance of 30 miles.

The Paducah & Illinois R. R. Co. filed a charter in the County Clerk's office at Louisville, Ky., listing its capital at $10,000, divided into shares of $100. The company is authorized to bond its enterprise. The incorporators and their holdings are: T. B. Toon, 82 shares; M. K. Gilbert, 3 shares; J. B. Hampton, 3 shares.

The Alexandria & Western R. R. has 600 tons of steel on the ground at Alexandria, La., for its projected line which is to traverse the Bayou Rapide territory in Louisiana in a westerly direction and may extend to Texas points. G. F. Cotton, Fort Worth, Tex., is President.

According to reports a project is under consideration involving the construction of a railroad from Miles City, Mont., to Sheridan, Wyo. E. E. Lonabaugh of Sheridan, Wyo., is interested in the project, it is said.

Surveyors are now at work running a line from the vicinity of Ashland, Neb, through Nebraska City and south. It is supposed that the party is setting stakes for the line which has been projected through Cass and Otoe Counties from Omaha.

BIDS ASKED.

Bridges.

Bids are asked on following work, the notes being arranged alphabetically by states:

San Jose, Cal.—Until 11 a. m., April 5, by Board of County Supervisors for the construction of a reinforced concrete bridge over the Coyote River at San Jose and Oakland Road. Henry A. Pfister is Clerk.

La Porte, Ind.—Until April 4, by County Commissioners, for the construction of a bridge over the Kankakee River at English Lake. H. C. Miller is County Auditor.

Ames, N. Y.—Until March 15 by Town Board of Canajoharie, N. Y., for the construction of a steel and concrete bridge and abutments on highway No. 347 at Ames, N. Y. The structure will be 33 ft. long and 24 ft. wide. W. A. Gage is Supervisor.

Niagara Falls, N. Y.—Until 7:30 p. m., March 15 (readvertisement of bids called March 1) by Thomas H. Hogan, City Clerk, for the construction of the old Fourth St. bridge across Gill Creek at East Falls.

Muskogee, Okla.—Until March 29, by County Commissioners, for the construction of four bridges as follows: 160-ft. steel bridge over Dirdnie Creek, near Webbers Falls, Okla.; one 90-ft. steel bridge over Pecan Creek; one 120-ft. steel bridge over Coody Creek; one 36-ft. arch concrete bridge over a slough. J. J. Brotherton is one of the Commissioners. W. E. Looper is County Clerk.

Kalama, Wash.—Until 10 a. m., April 5, by Clerk of County Commissioners, for the construction of a steel bridge over the Cowlitz River at Castlerock, Cowlitz County, Wash.

Buildings.

Bids are asked on following work, the notes being arranged alphabetically by states:

Fort Smith, Ark.—Until April 7 by Board of School Directors for the erection of a manual training and science school building at Fort Smith, Ark.

Emeryville, Cal.—Until 7:30 p. m., March 14, by Board of Trustees for the necessary labor and material for the construction of a fire engine house on San Pablo Ave. F. H. Farr is Town Clerk.

San Francisco, Cal.—Until noon, March 25, by Light House Engineer, San Francisco, Cal., for constructing reinforced concrete light building, frame for signal building, frame principal keeper's dwelling, two frame assistants dwellings, frame blacksmith and carpenter shop, frame building and three frame outbuildings at Punta Gorda Light Station, Cal.

Fort Oglethorpe, Ga.—Until 11 a. m., April 1, by Capt. George Vidmer, Constructing Quartermaster, for screening quarters for field officer and two lieutenants at this post.

Fort Barrancas, Fla.—Until 11 a. m., March 25, by Constructing Quartermaster for the construction of a quartermaster's storehouse at Fort Barrancas, Fla., and installing plumbing, clothing closets, electric wiring and electric lighting fixtures therein.

Brookville, Ind.—Until 1 p. m., May 12, by Board of County Commissioners for the construction, heating and plumbing of a court house at Brookville, Ind.

Lyons, Kan.—Until noon, March 29, by County Commissioners for the necessary labor and material for the construction of a court house to be located at Lyons, Kan.

Browns Valley, Minn.—Until 7:30 p. m., March 30, by N. O. Nelson, Clerk, for the erection of a brick school building at Browns Valley, Minn.

Wayzata, Minn.—Until 1 p. m., March 19, by F. H. Snure, Clerk School Board, for the construction and completion of a school building at this place.

Columbus, Neb.—Until 3 p. m., April 14, by James Knox Taylor, Supervising Architect, Treasury Department, Washington, D. C., for the construction complete, including plumbing, gas piping, heating apparatus, electric conduits and wiring, of the United States post office at Columbus, Neb.

York, Neb.—Until 2 p. m., March 24, by A. H. Dyer, Architect, Fremont, Neb., for the erection of an Odd Fellows Home bldg. at York, Neb. George L. Loomis is Chairman of the Building Committee.

Ithica, N. Y.—Until 12:30, March 21, by E. L. Williams, Treasurer Cornell University, Ithica, N. Y., for the enlargement of the north wing of the State Veterinary College Building, Cornell University. The work will include heating, plumbing and lighting.

New York, N. Y.—Until 3 p. m. by Park Board, Arsenal Bldg., Manhattan Borough, New York, for furnishing all the labor and materials for the erection and completion of a shelter in the botanical garden in Bronx Park in this city.

New York, N. Y.—Until 11 a. m., March 14, by E. V. Frothingham, President, Borough of Manhattan, City Hall, New York, for repairs and alterations, restoration and redecoration of the offices of the President of the Borough of Manhattan in the City Hall.

Bismarck, N. Dak.—Until 2 p. m., March 30, by Department of Interior, Office of Indian Affairs, Washington, D. C., for furnishing and delivering the necessary materials and labor required to construct and complete a barn at the Bismarck Indian School, N. Dak.

Ashtabula, O.—Until 3 p. m., April 11, by James Knox Taylor, Supervising Architect, Treasury Department, Washington, D. C., for the construction complete, including plumbing, gas piping, heating apparatus, electric conduits and wiring of the U. S. Post Office at Ashtabula, O.

Fort Sam Houston, Tex.—Until 11 a. m., March 31, by P. W. Guiney, Constructing Quartermaster, for the construction, plumbing, hot air heating, electric work in one double set of hospital corps, sergeants' quarters at Fort Sam Houston, Tex.

Saskatoon, Sask.—Until March 21, by Board of Governors, University of Saskatchewan, for the erection of the college building, students' residence, power house, live stock, pavilion, agricultural engineering building on the university grounds. David R. Brown and Hugh Vallance, Canada Life Bldg., Montreal, Can., are the Architects.

Roads and Streets.

Bids are asked on following work, the notes being arranged alphabetically by states:

Danville, Ind.—Until 10 a. m., March 15, by Board of County Commissioners for the construction of the following highways in Hendricks County: Frank P. Reichard et al, road 6,656 ft.; David Hadley et al, road 4,497 ft.; Charles F. McCleland et al, 8,518 ft.; Charles A. White et al, 6,791 ft. William H. Nicholas is County Auditor.

Michigan City, Ind.—Until 10 a. m., March 22, by H. M. Miles, City Engineer, for 4,375 sq. yds. of brick paving.

Muncie, Ind.—Until March 9, by Joseph E. Davis, Auditor, Muncie, Ind., for the construction of 11,846 sq. yds. brick and concrete pavement. As planned, the work includes 5,719 lin. ft. of curbing. John O. Potter, Muncie, Ind., is Engineer.

Towson, Md.—Until noon, March 10, by the County Highway Commission for the improvement of the public highway between Broadway and Beaver Dam bridge known as the Falls Road. E. Stanton Bosley is Secretary.

Baltimore, Md.—Until noon, March 24, by John M. Tucker, Chairman State Roads Commission, for twelve sections of State Road aggregating 50½ miles.

Kirksville, Mo.—Until March 21, by J. C. Carothers, City Clerk, for constructing 15,000 sq. yds. of brick paving on 5 in. concrete base and 12,000 lin. ft. concrete curb and gutter.

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CONTENTS.

EDITORIAL:
The Practice of Engineering-Contracting in the Matter of "Write-ups" and "Mentions" of Commercial Devices and Methods 233
CONCRETE SECTION:
A Concrete Bucket With Controllable Center Discharge 234
Results of Tests of Model Concrete Arches Made in Connection With the Design of the Medina Aqueduct, New York Barge Canal 234
A Concrete Cart With a Self-releasing Leg. 238
The Efficiency and Cost of Concrete for the Preservation of Piles Exposed to Seawater 238
EARTH AND ROCK SECTION:
Methods of Open Cut Rock Excavation at the Pennsylvania R. R. Terminal Station at New York With Some Data on Drill Performance 239
ROADS AND STREETS SECTION:
Method and Cost of Constructing a Shell Macadam Pavement at Annapolis, Md... 241
Work of the Municipal Asphalt Repair Plant of Brooklyn, N. Y., in 1909, With Detailed Costs of Repair and Maintenance of Asphalt Pavements..... 241
Suggested Standard Specifications for Macadam, Brick and Granite Block Pavement, Creosoted Wooden Block Pavement and Concrete Pavement..... 243
RAILWAY SECTION:
Method of Constructing Concrete Lining for Bergen Hill Tunnel, Pennsylvania R. R. Tunnel Extension to New York City..... 245
Some Notes on Cost of Treating Ties With Preservatives 253
GENERAL SECTION.
New Formulas for Base and Bearing Plates. 254
LETTERS TO THE EDITOR 255
TECHNICAL SOCIETY MEETINGS..... 256
PERSONALS 256
CATALOGS WORTH HAVING..... 256

The Practice of Engineering-Contracting in the Matter of "Write-Ups" and "Mentions" of Commercial Devices and Methods.

Scarcely a mail passes that does not bring to the editors of this journal letters asking for the publication of submitted articles on or notices of devices or materials being marketed for the use of engineers and contractors. Often the matter submitted is published in some form, but quite as often it is not published. The manner in which these articles and notices are submitted and particularly the manner in which their acceptance or rejection is commented on indicates so frequent a misunderstanding of the reasons that must and should control the editors' action that we have thought it useful to state these reasons briefly.

Every article or item published in ENGINEERING-CONTRACTING is chosen because in the editors' opinion it contains news or data interesting or useful to its subscribers. This must be so. These subscribers pay for their paper—there is no "free list"; none receives the paper regularly who does not give money or service in payment. These buyers demand and they are entitled to demand that the matter for which they pay shall be the best that the editors can furnish them. The editor who chooses articles for publication on any other basis than its interest and value to his subscribers is defrauding those subscribers. An editor who defrauds a subscriber loses gradually the confidence of that subscriber and sooner or later he loses the subscriber himself. This is plain business sense. No engineering journal ever yet succeeded that did not keep faith with its readers; none can succeed permanently that does not hold and nourish their confidence in its faithfulness to them.

But—we have been asked this—does the paper not owe its advertisers a service as well as its subscribers? They are also buyers of the paper and buyers who, both individually and in the aggregate, pay it far more money than the subscribers. Yes. It owes its advertiser the service of placing his advertisement in the form he desires it regularly and promptly before every one of its readers. It owes him the duty of maintaining its list of readers and of increasing that list and of improving its character. It does not owe him space in its reading columns, but if he has developed some new or improved useful device or product of importance it does owe it to its readers to acquaint them with that device or product. It owes them this service whether the maker of this device or product advertises in the paper or does not. There is no other sound principle on which to handle the question. There can be no other. It is the only principle that in the long run works a benefit to the advertiser. Consider for a moment.

There was on the editor's desk, when he began writing, a letter requesting that a certain material be mentioned in our reading columns because the firm selling it is paying for space in our advertising pages. There has come with the last mail a letter asking that a certain device be described on the plea that the firm selling it will soon be in position to advertise in ENGINEERING-CONTRACTING. Within a few days another manufacturer seeking notice in these columns for his product has had himself introduced by a personal acquaintance of the editor. This is the story of every week, almost every day, in the year. Were we to publish the first article because the person interested buys advertising space, the second because that person promises to buy, and the third to please a friend, where shortly would be our service to anybody? The line cannot be drawn by noticing one advertiser's product and not the products of two or three hundred others who take space with the paper. Each has as good a right as a customer to receive mention as any of the others. With every advertiser equally a customer what shall follow? Shall better mention be made of the advertiser who takes larger space than of the one who takes small space? This is wholly logical if we admit that buying of advertising space entitles the purchaser to notice in the reading columns. Then why not the paid write-up to boom a certain product or to condemn its rivals? Is it not plain that there is but one rule to govern this matter? The readers' interests and their interests alone shall govern the selection of articles for publication.

This journal is glad always to receive notices and descriptions of new devices and materials. Their availability for publication will depend upon their degree of interest to its readers. All the items that go in the editors' opinion to make one article available and another article not available cannot be stated, but some of the general reasons can be stated. The news element is important first. A device or material that has been so long in use and so well advertised that it is generally known obviously is not of much news value; it gains news value, however, if it be applied to a new and unexpected use. A new device that has been described in half a dozen contemporary papers before it is presented for description to this paper has lost much of its news value. This brings us to the question of exclusive publication. An article which has been distributed broadcast for publication is less desirable than one which has been submitted to only three or four papers, and the latter is less available than one which has been submitted to this paper alone.

The manner of presenting the information is another thing that affects the availability of matter of the class being considered. The editor does not wish a page from a trade catalog itemizing the parts, their dimensions, the kind of material of which they are fabricated; these things can be told in trade catalogs and advertisements, the maker should make use of the reading space which he solicits to tell something else. The reading article should tell the nature and purpose of the device or material, its superiority for that purpose and how and why this superiority comes about. Then it should present evidence of the successful use of the material or device in actual work—not a general claim of success, but specific evidence. No better way of doing this can be found than by describing some specific engineering work in detail, bringing in every available bit of data, illustration and comparison that proves the utility and economy of the new material or device in prosecuting this work. Remember that the editor is seeking reading matter of interest and value to his readers first; if this reading matter carries an advertisement—and all reading matter does which mentions the successful use of some device or material—so much the better. But in his eyes the interest and value of the reading matter must exist first, the advertising feature is subordinated.

Most articles of the class we are considering are prepared without thought; they are of the stuff that comes to mind quickest and is turned off easiest. It is rare that an article of this kind comes to this journal which is not partly or wholly rewritten; quite as often as not more information is sought and obtained from the manufacturer and from those who have used his device or product. The article that appears is far different from that submitted by the manufacturer; it is more com-

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plete and more useful and instructive to our readers, and frequently the manufacturer acknowledges that it is more useful to him by printing it in place of his own in his trade catalogs and circulars. Now the manufacturer in most respects is in much better position to write an interesting and useful article than is any editor, but it is only occasionally that he does it in the copy he sends out to bid for space in the reading columns of an engineering journal. Did the editor not see in the article received by him an item of value to his readers and for their interest develop the clue, often at much trouble, fewer of these "notices" of commercial devices and products would be published than are now published.

Very seldom does the manufacturer submitting an article for publication make any effort to cater in quality, form or style to the standards of the paper to which he sends it. Every good paper has its standards, and the nearer these standards are met in the article submitted the better are the chances that that article will be published. Only less rarely does the manufacturer make an effort in sending an article for reading space to appeal to the characteristic clientele of that paper. The subscribers to ENGINEERING-CONTRACTING are men engaged in engineering construction; the subscribers to one of our contemporaries are men chiefly interested in machine design. Recently both papers received the same article for publication. We know this because we saw the article in our contemporary, an article which we did not publish because it treated of the mechanical design of the device and not of its applicability, economy and efficiency for doing a certain kind of construction work.

We have written in some detail and with greater frankness because we have thought it wise to make our position clear. The editors of this journal fully realize that the engineering manufacturer is doing a large amount of inventive and research work of the highest interest and value to the constructing engineer and contractor in the field. They are eager to present the work of one to the attention of the other. They must, however, choose the more important from the less, the more available from the less. They are not infallible and doubtless err at times in their choice—giving space to the less interesting and useful. They must at times also be bound by considerations of space and time and trend of interest on their subscribers' part.

Advices from Rutherfordton, N. C., state that the Isothermal Traction Co. has been formed and proposes the construction of an interurban line from Rutherfordton to Gastonia, a distance of 50 miles. The promoters met recently in Rutherfordton and completed plans for the permanent organization of the company. At that time officers were elected as follows: K. S. Finch, president, and general manager; John C. Mills, vice president; J. F. Flack, secretary and treasurer. Other promoters are W. H. Harrill, E. B. Harris, C. F. Greer and Dr. Young. Preliminary surveys are to be made shortly.

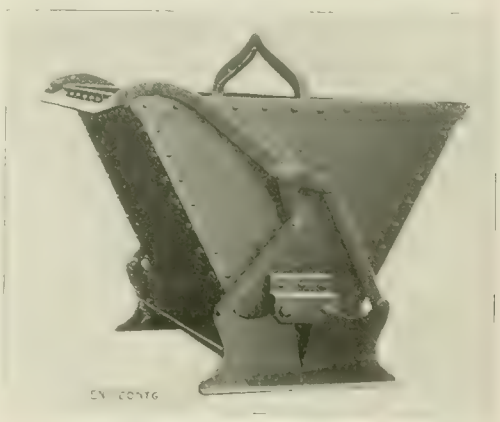
One of the largest private irrigation enterprises ever undertaken has just been placed under contract. The work calls for the construction on the irrigation systems on the Colorado Southern Irrigation Co., to the Canon City, Florence & Pubelo Water Co., and is located in Colorado. The contract was secured by Kenefick, Quigley & Russell of Denver, the contract price being [illegible]

Concrete and Reinforced Concrete Section

Note: This section is devoted to methods and cost of constructing concrete and reinforced concrete structures. It will cover the selection, testing and proportioning of concrete materials; laboratory tests of concrete; concrete mixing, transportation and placing; fabrication and placing of reinforcement, and form construction and erection. It will also contain articles on new and interesting developments in the design of reinforced concrete.

A Concrete Bucket with Controllable Center Discharge.

For depositing concrete in forms a bucket is desirable which permits the discharge to be controlled both in speed and in amount and which loses its contents vertically downward. With a vertically downward discharge the concrete is deposited midway between the walls of the forms and flows both ways against them without shock. There is moreover no back kick or recoil due to side discharge to bang the bucket against the forms. Control of the speed and the amount of the discharge permits the concrete to be placed as fast or as slowly as is desired and in small quantities of desired. The bucket shown by the accompanying cut is



Concrete Bucket with Controllable Center Discharge.

a controllable center discharge bucket having several points of merit in the way of simplicity and in the arrangement of the levers controlling its operation.

Referring to the illustration, it will be seen how the bottom gates are so hinged that they open by drawing apart symmetrically right and left. The total width of opening is 12 to 18 ins. and it may be made any width from these maxima down to as narrow as an inch. The action of the gates, it will also be noticed, is positively controlled by the levers; there are no springs or other motion actuating devices. Another point to be noted is that the handle operating the levers is at the top of the bucket. This permits the bucket to be lowered well down between the walls of the forms without placing the handle where it cannot be got at. This tends to reduce the drop of the concrete and waste from splashing when handling wet mixtures. A final important feature to be noted is that when the gates are closed the bucket has a quite wide, flat bottom on which it can stand without braces or supporting platform. This permits the bucket to be set on flat cars and run with its contents from the mixer to any part of the work.

This bucket is made entirely of steel in five sizes, ranging from 15 to 45 cu. ft. actual capacity, and weighing from 390 to 1,140 lbs., according to size. The dimensions of the bucket vary of course with the size. A 1 cu. yd. bucket holding actually 28 cu. ft. stands 51 ins. high and is 49x54 ins. in its largest lateral dimensions. It weighs 800 lbs. These buckets are made by the Acme Equipment & Engineering Co., Cleveland, O.

Results of Tests of Model Concrete Arches Made in Connection with the Design of the Medina Aqueduct New York Barge Canal.*

At Medina, N. Y., the Barge canal will cross a deep gorge and the topography is such that this cannot be avoided. After a careful consideration of various types of steel and concrete aqueducts and also a high earth embankment, it was decided by the State Engineer and the Advisory Board of Consulting Engineers, that a concrete arch of single span, carrying a reinforced concrete trunk with the necessary approaches, is to be preferred to other possible types of construction.

The load to be carried consists of a prism of water, having a maximum depth of 13 ft. 2 ins. and weighing 825 lbs. per sq. ft., in addition to the weight of the trough, piers, and arch ring. The total weight of water to be carried by the single span is 12,400 tons, while the total load, including the weight of the structure, is 46,000 tons. The water load may at times be removed, and is to this extent a live load, although it is always uniform for the full length of the structure and is never accompanied by impact.

The span, center to center, is 290 ft. 6 ins. The clear span of 285 ft. cannot properly be reduced. The rise is 53 ft. 5 ins. The total width of the structure is 129 ft.

Other notably long span concrete arches are the Walnut Lane bridge, Fairmount Park, Philadelphia, and the arch over Rocky River, at Cleveland. The Walnut Lane bridge was completed in 1909. It has a clear span of 233 ft. and a total width of 60 ft. The live load is 100 lbs. per sq. ft. The total live load carried by the structure is 700 tons and the total load, including the weight of the structure, is 12,000 tons. The Rocky river bridge is now being built. It has a clear span of 280 ft. and a total width of 60 ft. It carries a live load of 150 lbs. per sq. ft., a total live load of 1,200 tons and a total load, including weight of structure, of 16,000 tons. It is known that there are other long spans projected, but definite data concerning them are not available at this writing.

Thus it will be seen that by virtue of the length of span, the total width, the great load to be carried and the necessarily great cost, the Medina aqueduct may properly be considered the most important piece of concrete arch construction ever undertaken. It was therefore deemed both advisable and necessary not only to develop the design with the greatest care along the lines of the most approved theory of arch construction, but to make a series of tests on concrete prisms and model arches, for the purpose of obtaining additional information concerning the behavior of concrete under certain conditions of stress.

At the meeting of the American Society of Civil Engineers, held Sept. 15, 1909, a paper was presented, entitled "Walnut Lane Bridge, Philadelphia." This paper contained the following statement:

Tests of concrete model arches, made in order to determine questions of design, indicated that it is wise to treat the components of the direct arch stress at the abutment as so much shear acting in a beam. Regarded as such, the vertical component or reaction at the spring of the main arch ribs of this bridge amounts to

*Arranged from the "Barge Canal Bulletin" for February, 1910.

108 pounds per square inch of arch section in shear at the face of the skew-back, which would be high for simple concrete, but is allowable for the hybrid* material.

There was no discussion by any member of the society challenging this opinion.

To construct at Medina an arch of sufficient thickness to carry the heavy loads and to keep the shear at the low value indicated by the foregoing quotation is decidedly impracticable. Inasmuch as failure by "shear"—or more properly speaking, by "diagonal tension"—in a compression to destruction. Just what is meant in such cases by the word shear is not always clear.

Since no satisfactory evidence could be found of adequate tests ever having been made to prove that the arch would not fail by shear near the spring under shearing stresses of comparatively small intensity, as intimated by the foregoing quotation, it was believed to be still more necessary to obtain further information by tests, both on prisms and on model arches, which should be exact stress, it was considered advisable to include in the series of concrete prisms some which should be loaded eccentrically.

Six model arches, without reinforcement, have already been made and tested to destruction. Three of these were reduced in section near the springing for the purpose of encouraging failure at that point by vertical shear. These tests, on account of certain difficulties with the testing apparatus and other difficulties encountered in making the models, all of which have since been overcome, were

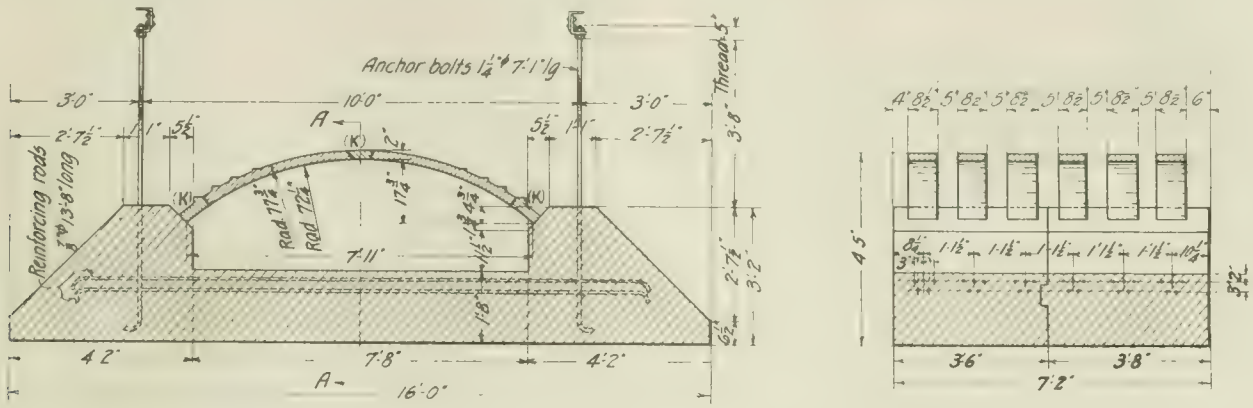


Fig. 1—Elevation Showing Arrangement of Abutments and Test Arches.

reinforced concrete beam has been clearly shown by repeated experiments to commence in the tensile portion of the beam, even where the cracks, once started, extend into the compression side of the beam, and inasmuch as the arch rib should be approximately compared in the nature of its stresses with the compression side of a beam and not at all with the tension side, it is believed that the statement quoted is incorrect and that there is no danger of failure by so-called shear in a properly designed arch. The term shear, as here used, has nothing to do with the phe-

counterparts, except as to size of the ribs of the proposed arch at Medina.

For various reasons it was not believed that the compressive resistance obtained in the test would show the actual unit strength of the full-sized structure. However, it was believed that important information could be secured in regard to the kind of failure and the ultimate strength of arches, as compared with cubes made of the same material, at the same time and by the same experimenter.

It is well known that, on account of the variations of the modulus of elasticity of

not entirely satisfactory and should not be accepted as conclusive in all respects. They will be followed by another series to be made in the near future, the results of which will be published in a future report. The tests already made, however, do conclusively show that, whatever the ultimate cause of failure, it does not occur until the model has developed a high unit resistance in compression. It is therefore evident that, if reasonable values are chosen for the intensity of the allowable working compressive stress per square inch, no attention need be paid to the intensity of

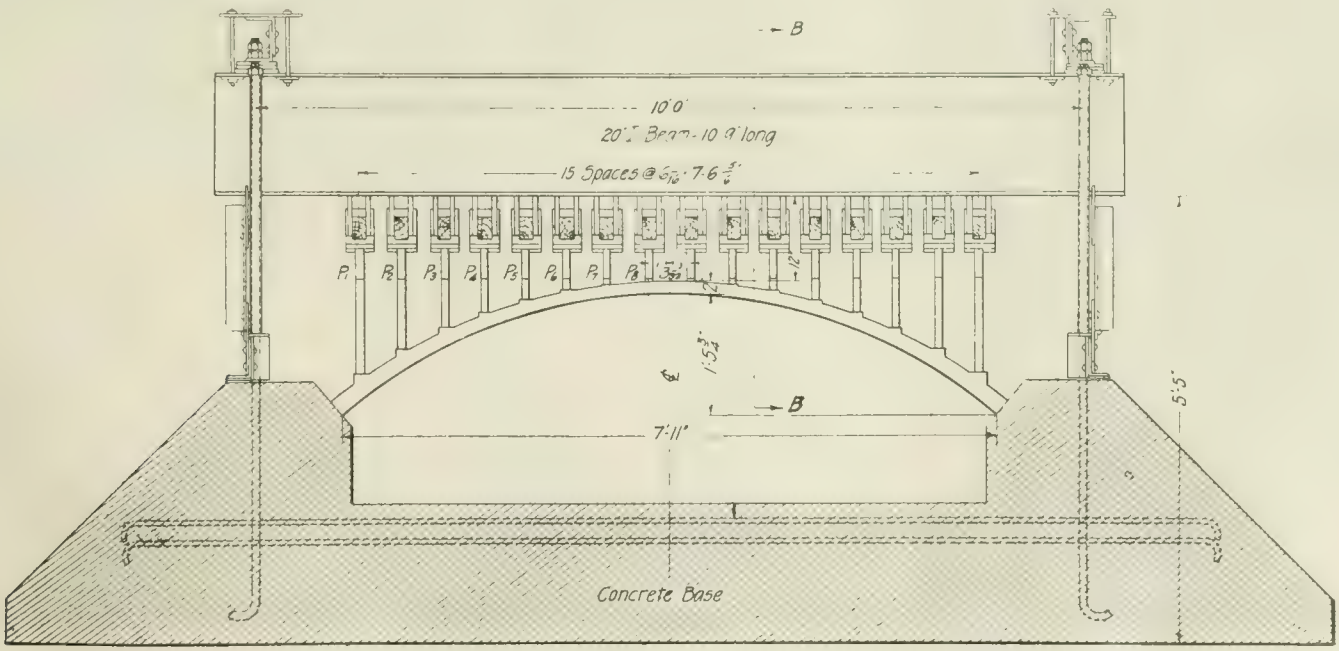


Fig. 2—Sketch Showing Method of Applying Load to Test Arches.

nomena observed in connection with true compression failures under high intensity of stress, and relates only to the possibility of failure along some diagonal plane, before the true compressive resistance of the concrete is fully developed. The literature of concrete frequently refers to the failure of cubes and prisms by shear, when tested by

concrete under varying intensity of stress, the distribution of stress in the compression side of a reinforced concrete beam does not follow the straight line law. It was believed that a similar condition exists under high compressive stress in the case of prisms, columns or arch ribs carrying eccentric loads. In order, therefore, to determine more definitely the allowable working stress in the arch under eccentric stress caused by extreme conditions of temperature and loading, as compared with the allowable average working

the shearing stresses at the springing. A complete description of the apparatus for testing the model arches and a discussion of the results will be found in this article under their respective headings.

When the concrete prisms were tested, a few specimens were provided with diagonal grooves, made for the purpose of encouraging failure by diagonal shear. While the tests are not to be considered conclusive in all points until corroborated by an additional series of tests, which also will be made in the

*Hybrid material, as here used, means concrete in which are embedded flat stones, packed close, with bed of stones at right angles to arch thrust.

near future, yet it is believed that two important conclusions can be drawn at this time, as follows:

(1) Whatever the kind of failure, it does not occur until the prism has developed a high compressive resistance. This conclusion, therefore, amply reinforces the conclusion hereinbefore drawn from the tests on arch

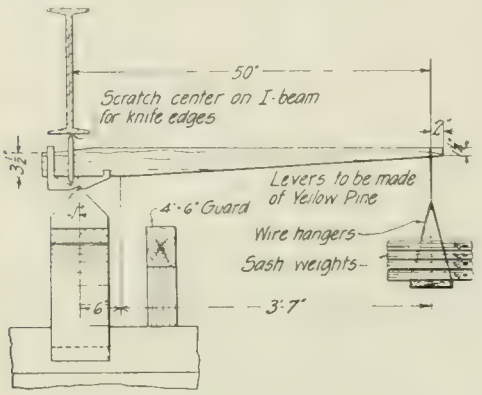


Fig. 3—Section BB of Fig. 2.

models with respect to the danger of failure by shearing near the springing.

(2) The apparent intensity of compressive approximately 33 per cent higher for prisms with one inch eccentricity and over 50 per cent higher with two inches eccentricity. This seems to demonstrate conclusively that the distribution follows substantially the same law as is known to exist for the compression side of reinforced concrete beams. A discussion of the tests on prisms will be found later under its proper heading.

resistance by the extreme fiber under eccentric loading when figured upon the assumption of a straight line distribution of stress, is much higher than the average resistance per square inch for prisms loaded centrally, being

General Description of Arches and Apparatus.—Each dimension of each of the model arches was 1-36 of the corresponding dimension of the proposed Medina arch. The large arch will carry a total average load of about 2,450 lbs. per sq. ft. This load is considerably greater toward the springing than at the crown, on account of the greater thickness of arch rib and the greater weight of the piers which carry the trough. Under this load an average stress of about 500 lbs. per sq. in. will be produced in the large arch and approximately the same stress will exist in the models under the same load per sq. ft. with the same distribution. The weight of the model rib itself is so small as to be almost neglible. If, then, the concrete in the model has an ultimate average strength of 2,500 lbs. per sq. in., an average load of approximately 12,250 lbs. per sq. ft. will be required for destruction. It is impossible to apply so great a direct load with any certainty that the loads are applied as intended. For this reason a system of sixteen independent levers and knife edges (multiplying the loads by fifty) was arranged, as shown in Fig. 2.

The knife edges were made of hardened steel. The special casting for the levers were designed so as to bring the two knife edge bearings and the applied load in the same plane. In this manner the ratio was kept constant and the loads applied to the arch were kept vertical, with errors so slight as not appreciably to affect the results.

The building in which the tests were made was an old shed which had no floor. It was full of cracks and was unheated. The temperatures during the making and testing ranged from about zero to 40 deg. F. However, the models were thoroughly protected and were not frozen.

The abutments were made of 1:3:6 concrete and were cast directly on the ground. They were made massive and were heavily reinforced so as practically to reproduce the unyielding abutments of the large arch. However, there was a slight yielding under the extreme loads required for the destruction of a model and small additional stresses similar to those produced by the rib shortening were thus introduced.

The general dimensions of the model arches and abutments are shown in Fig. 1. In the first series six arches were cast, made of mortar composed of 1 part American Portland cement and 2 parts of Albany sand. In order partially to eliminate stresses due to shrinkage, three sections, or keys, were provided, one at the crown and one at each springing, which were filled two days after the body of the arch was cast.

During the test it was found that some of the keys had not been quite thoroughly filled. This was particularly true of the keys at the springing. The imperfect contact at this point undoubtedly led to lower results than would otherwise have been secured.

begun. The length of time required for this work was considerably greater than had been anticipated and some of the material had taken an initial set before the work was finished. While it is probable that this did not greatly weaken the material, yet the tests apparently showed the effect of the initial set at the time of failure by the splitting of the ribs in several cases along the line of separation between layers.

As might have been expected with a new piece of testing apparatus, certain modifications were found necessary in order to secure the best results. Such modifications as were necessary have been made and the difficulties met with during the first series have been so overcome that the projected series will doubtless be of more value than the first.

When the first arch was tested, the loads were applied by means of sand poured gradually according to a carefully prepared program into bags suspended from the ends of the levers. This plan was generally successful, but on account of difficulties in handling the sand and objectionable dust, cast iron sash weights of various sizes were used for the other tests. These weights were carefully applied, also according to program, by hand, one at a time, so as to avoid shock and keep the line of pressure very nearly in the desired position. The desired ratio of loads was computed after several trials and was so chosen as to keep the line of pressure as close as possible to the axis of the arch at all points. The ratio was approximately maintained throughout the entire application of the loads, the per cent of variation from the ratio constantly decreasing during application.

However, additional bending stresses were

TABLE I.—TESTS OF MODEL ARCHES.

(Arches 7 ft. 11 in. clear span, 2 in. thick at crown. All models composed of 1 part Portland cement and 2 parts sand.)

Arch No.	Age, Days.		Loads in Pounds. P_1	P_2	P_3	P_4	P_5	P_6	P_7	P_8	Total Load on Arch, Lbs.	Load on Arch per sq. ft., Lbs.	Maximum Unit Stress. At Point P_7. Top.	Bottom.	At Springing. Top.	Bot'm.
		Loads on arch by weight of arch, plates, levers, etc.	256	240	225	217	211	207	204	203	....	.....	238	34	159	85
1	33	Weight on levers at failure	150	150	145	140	150	135	150	145	....	.....	....	....	....	....
		Total load on arch	....	....	....	....	....	....	....	....						
2	36	Weight on levers at failure	97½	103	88½	82½	82½	73½	73½	64½	70,076	12,500	4,378	1,804	2,710	3,664
		Total load on arch	5,131	5,390	4,650	4,342	4,336	3,882	3,879	3,428						
3	42	Weight on levers at failure	87	90	82	80	80	69	69	57	64,926	11,600	3,370	1,454	1,953	2,451
		Total load on arch	4,606	4,740	4,325	4,217	4,211	3,657	3,654	3,053						
4	39	Weight on levers at failure	79	85	75	70	70	63	63	52	59,226	10,580	3,111	1,264	752	4,104
		Total load on arch	4,206	4,490	3,975	3,717	3,711	3,357	3,354	2,803						
5	46	Weight on levers at failure	79	85	75	70	63	57	57	47	56,826	10,140	2,722	1,350	19 (ten.)	4,595
		Total load on arch	4,206	4,490	3,975	3,717	3,361	3,057	3,054	2,553						
6	49	Weight on levers at failure	71	77	67	63	63	57	57	47	53,726	9,600	2,839	1,139	729	3,687
		Total load on arch	3,806	4,090	3,575	3,367	3,361	3,057	3,054	2,553						

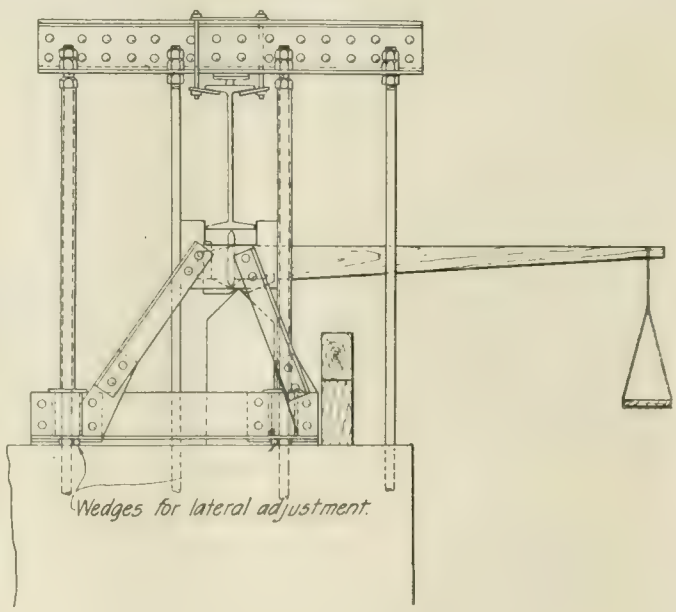


Fig. 4—End View of Fig. 2.

The six arches were cast in one continuous operation. Each arch was constructed in two layers, the first layer of all the arches being deposited before the second layer of any was momentarily produced and the ultimate breaking loads, therefore, were probably slightly less than would have been found, had a more ideal method of loading been followed. All of

the arches had open joints at the keys, caused by shrinkage and fall in temperature. These joints closed under moderate loads.

Arches Nos. 4, 5 and 6 were reduced 38 per cent in section near the springing, in order, if possible, to encourage failure by shear on a vertical plane. The loading for these was identical with that for the others and the eccentricity of the reduced section has been considered in computing the stress on the extreme fiber.

All stresses given in the table are computed for actual loads at time of failure. The formulas used may be found in Church's *"Mechanics,"* Johnson's *"Framed Structures,"* and Turneaure Maurer's *"Principles of Reinforced Concrete Construction."* As is customary, the variation of modulus of elasticity of concrete under varying intensity of stress has been ignored and a straight line distribution assumed. The effect of rib shortening has been included. The effects of shrinkage and temperature are comparatively small and have not been included. Allowance was not made for the reduction of restraint due to the reduction at the springing of models Nos. 4, 5 and 6. The tabular stresses are therefore believed to be somewhat too high.

Detailed Description of Arch Tests.—Arch No. 1 was heavily loaded three times. Sufficient allowance was not made for the deflection of the levers and the 20-in. I-beam was not properly braced horizontally. The multiplying ratio of the levers was therefore maintained only through a portion of the test. The vertical knife edges were thrown out sufficiently to produce a severe horizontal thrust on both I-beam and arch. The arch finally rotated about an axis (M-M, Fig. 5),

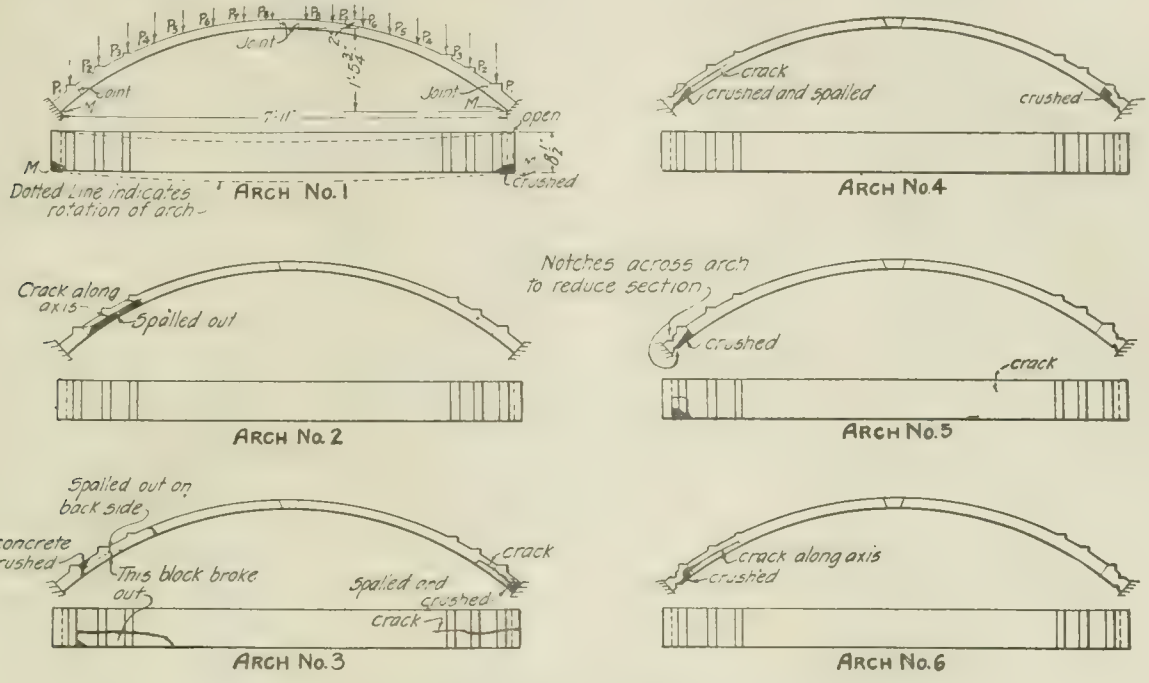


Fig. 5—Diagram Showing Kinds of Failures of Test Arches.

TABLE II.—TESTS OF PLAIN CONCRETE PRISMS AND CUBES.

(Prisms, 6 x 6 x 36 in. Cubes, 6 x 6 x 6 in. Composition: 1 part American Portland cement, 2 parts Albany bank sand, 4 parts ¾-in. limestone. Tested at Rensselaer Polytechnic Institute, Troy, N. Y., Nov. 11, 15 and 19, 1909. Age of all specimens was 21 days.)

Specimen Number. 1st batch.	2d batch.	3d batch.	Size.	Description.	How loaded.	Load at incipient failure.....	Load at ultimate failure.....	Stress per sq. in. at incipient failure.....	Stress per sq. in. at ultimate failure.....	Average stress at ultimate failure.....
						Lbs.	Lbs.	Lbs.	Lbs.	
1	..	.	6" x 6" x 6"	Plain sides.....	Centrally.....	82,300	82,300	2,280	2,280	
..	13	..	Do.	.....do.....	.....do.....	73,500	100,200	2,040	2,780	2,520
..	...	25	Do.	.....do.....	.....do.....	90,230	90,230	2,500	2,500	
2	...	..	6" x 6" x 36"	Square ends, plain sides.	....do.....	39,500	39,500	1,100	1,100	.....
..	14	...	Do.		....do.....	76,170	76,170	2,110	2,110	2,075
..	...	26	Do.		....do.....	73,570	73,570	2,040	2,040	
3	...	...	Do.	.....do.....	Eccentrically 1"...	51,190	51,190	2,840	2,840	
..	15	...	Do.	.....do.....	.....do.....	49,280	49,280	2,740	2,740	2,780
..	...	27	Do.	.....do.....	.....do.....	49,640	49,640	2,760	2,760	
4	...	...	Do.	.....do.....	Eccentrically 2"...	25,600	29,970	2,840	3,330	
.	16	.	Do.	.....do.....	.....do.....	25,810	25,810	2,870	2,870	3,107
..	...	28	Do.	.....do.....	.....do.....	28,040	28,040	3,120	3,120	
5	...	...	Do.	Square ends, sides grooved 1" deep, 39° with vertical.	Centrally.....	52,270	52,270	1,784	1,784	
..	17	...	Do.		....do.....	74,800	74,800	2,532	2,532	2,259
..	...	29	Do.		....do.....	72,910	72,910	2,461	2,461	
6	...	...	Do.	.....do.....	Eccentrically 1"...	50,100	50,100	3,150	3,150	
..	18	.	Do.	.....do.....	.....do.....	44,600	44,600	2,480	2,480	2,913
.	..	30	Do.	.....do.....	.....do.....	49,450	49,450	3,110	3,110	
7	...	...	Do.	.....do.....	Eccentrically 2"...	24,100	24,100	3,160	3,160	
..	19	...	Do.	.....do.....	.....do.....	18,000	21,950	2,000	2,439	2,706
..	...	31	Do.	.....do.....	.....do.....	19,200	19,200	2,520	2,520	
8	...	...	Do.	Square ends, sides grooved 1" deep, 33° with vertical.	Centrally.....	59,180	59,180	1,983	1,983	
..	20	...	Do.		....do.....	74,900	75,900	2,480	2,540	2,248
..	...	32	Do.		....do.....	66,290	66,290	2,220	2,220	
9	...	...	Do.	Square ends, sides grooved 1" deep, 45° with vertical.	....do.....	54,590	54,590	1,865	1,865	
..	21	...	Do.		....do.....	72,350	72,350	2,460	2,460	2,322
..	...	33	Do.		....do.....	77,400	77,400	2,640	2,640	
10	...	...	Do.	B'v'led ends, plain sides.	Eccentrically 1½".	40,120	40,120	2,970	2,970	
..	22	...	Do.		....do.....	39,890	39,890	2,950	2,950	2,960
..	...	...	.....		.....	.....	.....	.....	.....	
11	...	...	Do.	B'v'led ends, sides grooved 1" deep, 39° with vertical.	....do.....	40,220	40,220	2,980	2,980	
..	23	...	Do.		....do.....	41,180	41,180	3,050	3,050	3,015
..	...	...	.....		.....	.....	.....	.....	.....	
12	...	...	Do.	B'v'led ends, sides grooved 1" deep, 33° with vertical.	....do.....	40,600	40,600	3,010	3,010	
..	24	...	Do.		....do.....	39,000	41,450	2,890	3,070	3,040
..	...	...	.....		.....	.....	.....	.....	.....	

Arch No. 2 first showed signs of failure by splitting along the axis near the key at the springing. On account of difficulties of adjusting the apparatus, not entirely overcome when this arch was tested, the piers were not properly centered on the arch. The eccentricity of loading thus caused, increased the stresses at the extreme fiber by about 20 per cent at the crown and 35 per cent at the springing. Allowance has been made for this eccentricity in computing the tabular stresses. As previously explained, the concrete was deposited in layers and the splitting was encouraged by this fact.

Arch No. 3 failed and collapsed suddenly by crushing at the joint between rib and key at the springing. This arch was accidentally overturned and broken when an adjacent arch failed. It was put together and tested. The contact at the joints was necessarily imperfect and this somewhat accounts for the lower ultimate resistance of this arch as compared with the others.

Arch No. 4, one of the three reduced in section, failed by crushing at the joints between rib and keys at the spring and collapsed suddenly. Before the test began it was seen that the area of contact at these joints was very much reduced by imperfect workmanship. The tabular stress was based on the eccentricity of the reduced sections.

Arch No. 5 was one of those reduced in section. It failed by crushing between the reduced section and the adjacent joint and collapsed suddenly. After failure began, the rib twisted forward and cracked, as shown in plan (Fig. 5).

Arch No. 6 was also one of those reduced in section. The first sign of failure was a crack along the axis just above the key at the springing. This crack grew wider rapidly; it was quickly followed by crushing at the reduced section and a complete collapse.

Six 6-in. cubes were cast of arch material at the time the ribs were cast. They showed an average ultimate strength in compression, at 28 days, of 2,080 lbs. per sq. in. These tests were not entirely satisfactory and are not to be accepted as conclusive.

Description of Prism and Cube Tests.—The results of tests on prisms and cubes are crushing the concrete at these points to such an extent that the model was useless for further tests. It is impossible to determine even approximately the maximum unit resistance developed.

shown in the Table II. In computing the tabular stresses it has been assumed that a straight line distribution of stress obtains and, except where the maximum unit tension is small, that the concrete takes no tension whatever. That the former assumption is incorrect, due to the variation of the modulus of elasticity with variation of stress intensity, is clearly indicated by the fact that the maximum calculated resistance of plain-sided prisms with one inch eccentricity is 34 per cent greater and with two inches eccentricity is 50 per cent greater than with similar prisms centrally loaded. The average calculated resistance for six prisms, both with and without grooves, all having 1½ ins. eccentricity, is 44 per cent greater than the plain-sided prisms centrally loaded.

The theory of distribution of stress in the grooved prisms is complex and the tabular stresses are approximate only, having been computed from the moment of resistance of a plane at right angles to the axis at the point where failure occurred.

Test specimen No. 2 failed at a low load by splitting, on account of the use of too thin a cap plate. Hardened steel plates 2 ins. thick were used on all other prisms.

Much care was taken to secure the greatest possible uniformity in the character of the test specimens. It will doubtless be of interest to notice the great uniformity of the tests, as shown by prisms Nos. 10, 22; 11, 23; and 12, 24.

The value of these tests does not lie in the absolute values obtained in resistance to compression, but in the general conclusions indicated; namely: (1) that, if a straight line distribution be assumed, the working unit stress on the extreme fiber, when the line of pressure passes at the edge of the middle third, may be considered as at least 30 per cent higher than the allowable working stress, when the line of pressure lies on the neutral axis; this will undoubtedly be as true for arches as for prisms; (2) that, if reasonable values be chosen for unit stresses in compression, no account need be taken of so called shear for an arch rib or column sustaining a thrust parallel or nearly parallel to the axis.

Final values of working unit stresses will not be chosen until the second series of tests on both arches and prisms are completed.

A Concrete Cart with a Self-Releasing Leg.

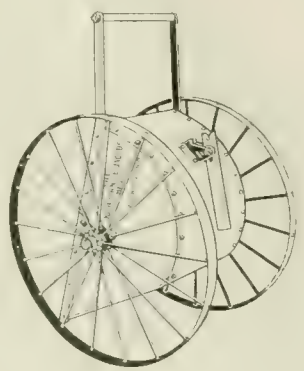
The wide use of hand carts instead of barrows for handling concrete directs attention to any new device that promises additional usefulness to them. In the accompanying cut we show a new concrete cart that is novel in having a leg which swings free either forward or back when the cart is being wheeled or dumped and which becomes fixed and rigid when the cart is standing unsupported. This leg consists simply of a strong bar hung by bolt in a lug bracket bolted to the plate of the cart bowl. The bolt hole in the bar is slotted and the top end of the bar extending above the bolt is notched. When the cart is standing, with the leg vertical, the bolt bears against the bottom of the slotted hole and the notched top engages a projection up inside the lug bracket; the leg is held rigid. Immediately the cart is "raised" for wheeling, the leg drops by its own weight the full length of the slotted hole, its top becomes disengaged and the leg hangs free and will swing aside if any obstruction is encountered. It also swings down against the bowl and out of the way of the wheels in dumping, as shown by the illustration. The leg swings back to "standing" position as the cart is lowered to the horizontal and locks itself automatically as it takes its load. The cart itself is of 6 cu. ft. capacity, weighs 245 lbs. and is 34¼x55½ ins. in lateral outside dimensions. It is manufactured by the Kilbourne & Jacobs Mfg. Co., of Columbus, O.

The Langhorn & Waugh Construction Co. has begun work on its contract for building two miles of yards at Silver Grove, ten miles from Covington, Ky., for the Chesapeake & Ohio Ry.

The Efficiency and Cost of Concrete for the Preservation of Piles Exposed to Sea Water.

It has long been the aim of engineers and builders to find some method of treating or protecting wooden piles or other wood structures from the destructive attack of marine borers, of which the teredo and the limnoria are the chief representatives. Many methods have been tried, and success more or less marked has attended some of them, the principal methods being the chemical treatment of the wood fibre and the mechanical protection of the pile or timber by a protective covering of metal, treated wood or concrete. However, we are only interested in the application of concrete or cement and will pass over the other methods with but brief mention.

Under the head of chemical treatment, creosote should be given first place, which proves very effective until by abrasion or dissolving out, the pile loses its sheath of impregnated creosote and becomes open to attack by the destructive ship worm. A pile so treated is effective for approximately 15 years, if it has received no mechanical injury to split or otherwise damage it. The metal-coated pile, as well as those covered by asphaltic compositions, are open to the same objection as the creosoted pile, but have also the added drawback of a still shorter life.



Concrete Cart With Flexible Leg.

With this brief review of older methods, we will now consider the concrete covering of wooden piles, of which there are quite a variety and several classes, and we will endeavor to describe several, which are more or less practical. We will classify them A, B, C, and D, merely to distinguish them and not according to their relative merits.

Class A.—A wooden pile covered with a jacket of concrete, made by placing a mold around the pile and filling with concrete reinforced with steel or not, as desired, applied before driving. This makes a pile that can be inspected without trouble, but has the drawback in that it is heavy and difficult to handle and drive, and will sink, presenting the same difficulty as a solid concrete pile in this respect. Furthermore, the same precaution must be observed in driving it as in the purely concrete pile. It is difficult to give exact costs, as these will vary with the size of the pile, the length covered on each, the varying cost of materials, the proportion used in the concrete, the use or omission of reinforcing, cost of labor, etc. We will endeavor, however, to give a relative cost of the several methods, so that a comparison of the various classes may be made.

Class B.—This class includes piles covered after they have been driven and before the superstructure has been built. The covering is applied by lowering over the pile a continuous concrete, wood or steel jacket, so proportioned as to leave an annular space between the pile and jacket of from 2 to 4 ins., preferably the latter, this space being then pumped out and filled with concrete.

This method presents some difficulties where deep water is encountered, due to the liability of the jacket to collapse, if built of wood or steel. Furthermore, it is difficult to exclude mud and water if the sea bottom is soft or if the casing is not perfectly tight. It is sometimes found necessary to seal the bottom with cement and allow it to set before pumping out the annular space. This should be as complete as possible for the best results.

Class C.—This is a modification of Class B in that it uses the same type of jacket, with the exception that it is made sectional and in two parts to admit of its application to wharves, already built or where the superstructure is in place. A tile jacket is sometimes used in addition to the others of Class B.

The jacket is applied by placing the sections around the pile and is lowered section by section, by suitable means, until the submerged portion of the pile is covered and sufficient penetration is obtained into the sea water; the annular space is then filled with concrete without first pumping out the sea water. With this style of construction it is impossible to exclude the water and mud, which is a serious drawback. The concrete is liable to be of inferior quality, especially at the bottom, the very point that should be made the most impregnable, the mud line being the principal point of attack of that most destructive of wood borers, the teredo.

Class D.—This is a class distinctly by itself and is of more recent origin than any of the previously described methods of armoring. It consists of a light steel sectional jacket, fitted at the bottom with a self-adjusting diaphragm, made to accommodate itself to the irregularities of the pile. The method of procedure is to fit the bottom section containing the diaphragm around the pile and fill with concrete, the section being suspended from above by suitable means, usually by winches. The first section is then lowered sufficiently to permit the addition of another section, which is filled with concrete; this is repeated until the submerged portion of the pile is covered and the desired penetration is obtained into tthe sea bottom. The annular space between the pile and the jacket should be at least 4 ins. and in large piles of say 18 to 20 ins., 5 or 6 ins.

This method renders the concreting of piles very simple and effective and obviates the principal difficulties of the three other classes of covering. It is especially adapted to the repair of old wharves badly eaten with either the teredo or limnoria. The San Francisco Harbor Board has adopted this latter method for the repair of their old wharves and finds it economical, easily applied and durable. Classes A and B are not suitable for the repair of old wharves, the expense being prohibitive. Between classes C and D, the latter may be applied for approximately 20 per cent less per lineal foot than the former.

For new work, classes A, B, and C would cost approximately the same, with a slight possible advantage in favor of Class A. Class D may be applied to new construction more cheaply than on repair work, and would run 20 to 25 per cent cheaper than any of the other methods.

The San Francisco Harbor Board is paying $1.55 per foot for Class D work on all sizes of piles. This includes profit and royalty, the actual cost ranging from $1 to $1.25 per lin. ft.

*A paper presented by the Healy-Tibbets Construction Co., at the 1910 convention of the National Association of Cement Users.

The Powell Process of Wood Preservation.—A new method of treating wood has been invented and tried with success in Australia according to a report made by Consul John F. Jewell at Melbourne. The essential part of the Powell wood process consists in boiling the wood and allowing it to cool and absorb a saccharine solution, after which it is dried, rendering the wood thoroughly seasoned within a few days after cutting, increasing its strength, and stopping all warping and shrinking. The sap in the wood is driven out and replaced by an antiseptic, owing to the saccharine solution boiling at a higher temperature than water, thus making the wood impervious to dry rot and to the attacks of white ants and other parasites which prey on ordinary lumber.

Earth and Rock Section

Note: This section is devoted to methods and costs of excavating earth and rock and building embankments. It will cover the grading of roads and railroads, diking and canal work, dredging, building reservoirs and earth dams, sewer and water pipe trenching, quarrying, etc.

Methods of Open Cut Rock Excavation at the Pennsylvania R. R. Terminal Station at New York with Some Data on Drill Reformance *

The work described involved the excavation of an approximately rectangular pit having an area of 6.3 acres to a depth of something over 50 ft. The total amount of excavation was 521,000 cu. yds., of which 87 per cent was solid rock. The rock may be classed as gneiss; it varied in character between granite and mica schist. The strata had an inclination of about 60° with the horizontal. The location of the work was between 9th and 10th avenues and 31st and 32d streets in New York city, which was a completely built up area, so that preliminary to excavation some 94 buildings had to be wrecked. The contract included not only the excavation but also retaining walls on all sides of the pit and a large amount of structural steel work. This article refers to the excavation work alone.

The excavation work was divided into two parts: (1) The strip underlying 9th Ave. having an area of 0.9 acre, and (2) the 5.4-acre area between this strip and 10th Ave.

Work Under 9th Ave.—This work involved the excavation of a strip 375 ft. long, the full width of 9th Ave. and 58 ft. deep, and the construction over this area and about 24 ft. below original street surface of a steel viaduct to support the original 9th Ave. structures. These structures comprised 340 ft. of 3-track elevated railway structure, a 2-track street railway, a 48-in. brick sewer, a 24-in. cast iron water main, and various smaller pipes and conduits.

The method of work is shown by Figs. 1 and 2. At first the east side of the avenue was closed and excavated down to rock, the earth was mined out under alternate yokes of the surface railway structure, and temporary posts were placed under the yokes to support the structure while the remainder of the earth was being removed. Then needle beams and posts were placed under each yoke. The concrete forming the track structure was then inclosed with planking to prevent it from cracking and falling. I beams were then placed under the needle beams carrying the structures, and these were carried on posts; they were changed alternately until the excavation had been taken out to a depth of about 16 ft. below the surface. In placing these I beams, heavier blocking was used in the center of the span than at the ends where the bents would come, to prevent the subsidence of the track owing to the sag in the I beams. As much excavation, to a depth of about 20 ft., was taken out adjoining the elevated railway foundations as could be done with safety. The 48-in. brick sewer was broken and the sewage was pumped across the excavation.

The overhead girders, B, were then put in place and two of the girders, C, were used as temporary shoring girders at each column. These were placed parallel to the elevated railway, with blocking between them and the girders, B. Double bents, independent of each other, were placed under the ends of these temporary shoring girders, and these were braced securely to prevent possible dislodgment during the removal of the rock. The weight of the structure was then taken by jacking up the girders near the bents until the column was lifted off the old foundation; blocking was put in between the girders and the bents during the jacking, so that when the jacks were released the base of the column was still clear of the old foundation. One 80-ton jack was used for this purpose.

Temporary raker braces were placed against the structure to prevent lateral movement. Four sets of these temporary shoring girders were used in this manner, two sets starting at the north end and two sets at about the middle of the work, and these sets were moved south as they were released.

The columns being thus supported on temporary shoring girders, the old foundations were removed and the excavation was taken down to a level about 16 ft. below the surface.

Two sets of three of the girders, C, were then put in place under the avenue at each column, each set being placed on four concrete piers 6 ft. square with spaces of 4 ft. between them, so that the outside of the outside pier would be 18 ft. from the center of the avenue and 32 ft. from the house line. This is shown on Fig. 2. Four small piers were used, as they could be more easily removed than one continuous pier. The girders, C, were set to line and grade, and the piers were built under them, great care being taken to get the concrete well under the girders so as to give a firm bearing.

After these girders, C, were in place it was necessary to remove the temporary shoring girders before the bents could be erected on girders C to support girders B, being in the same plane, and provision had to be made to support the structure while this was being done. Therefore double bents were erected directly beneath the columns, as shown by Fig. 2. These were built with their sills resting on the girders, C, and blocking was put in between the sills and the rock to carry the full weight of the structure. Later when the weight of the structure was carried on the permanent bents, this blocking was knocked out, but the bents were left in to carry the weight of the column itself, which was swinging more or less from the structure above. The weight of the structure was placed on these bents directly beneath the columns by jacking up the temporary girders again, putting blocking between the bents and the base of the columns, and taking out the blocking which had been put in previously under the temporary shoring girders. The 24-in. water main was carried over the excavation on cables from the temporary shoring girders, except when they were being jacked up, at which time posts were placed beneath it.

Anchor bolts were put in place between the column bases and the bents directly beneath,

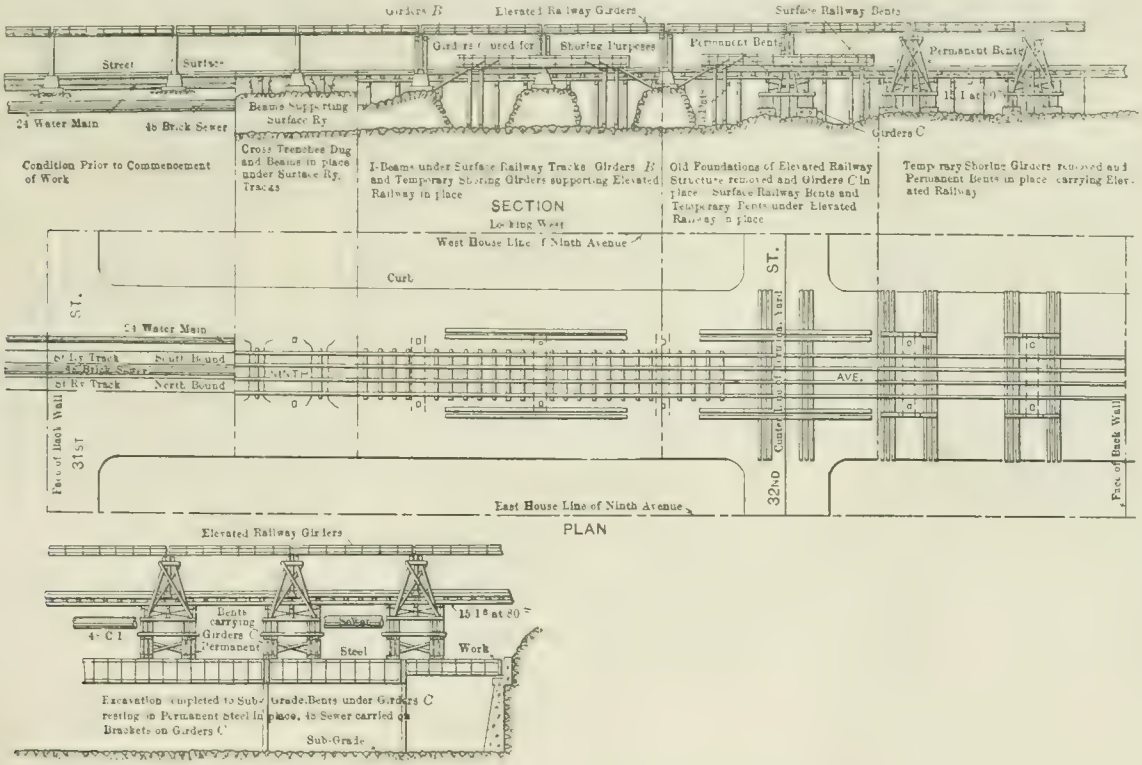

Girders B
Elevated Railway Girders
Surface Railway Bents
Girders C used for Shoring Purposes
Permanent Bents
Permanent Bents
Street Surface
24 Water Main
48 Brick Sewer
Beams Supporting Surface Ry.
Girders C
Condition Prior to Commencement of Work
Cross Trenches Dug and Beams in place under Surface Ry. Tracks
I-Beams under Surface Railway Tracks Girders B and Temporary Shoring Girders supporting Elevated Railway in place
Old Foundations of Elevated Railway Structure removed and Girders C in place Surface Railway Bents and Temporary Bents under Elevated Railway in place
Temporary Shoring Girders removed and Permanent Bents in place carrying Elevated Railway
SECTION
Looking West
West House Line of Ninth Avenue
Curb
9TH ST.
24 Water Main
48 Brick Sewer
Face of Back Wall
31ST
32ND
AVE.
Face of Back Wall
East House Line of Ninth Avenue
PLAN
Elevated Railway Girders
Bents carrying Girders C Permanent
Steel
Work
Excavation completed to Sub-Grade. Bents under Girders C resting on Permanent steel in place. 48 Sewer carried on Brackets on Girders C
Sub-Grade

Fig. 1—Plan and Elevations Showing Sequence of Operation in Excavating Under Elevated Railway Line.

*Abstracted from a paper by B. F. Cresson, Jr., in Proceedings American Society of Civil Engineers, Vol. XXXVI, page 208.

in order to increase the lateral stiffness, and raker braces were also used. This having been done, the temporary shoring girders were moved south to the next column, where the process was repeated. The timber bents were then put in place as shown by Figs. 1 and 2. These bents were framed as tightly as possible, using generally a 20-ton jack, and they were erected simultaneously at each pair of columns. The weight was taken on these columns by jacking up directly beneath the column base and taking out the blocking between this base and the bent directly beneath the column. On releasing the jack the weight was transferred to the permanent timber bents, and the east and west columns of each pair were transferred on the same day. One 80-ton jack was used on the easterly columns and two were necessary on the westerly columns, one on each side of the 24-in. water main. The raker braces of these permanent bents were not framed as tightly as the main posts, in order that the main post should carry the entire weight and the raker braces merely steady the structure.

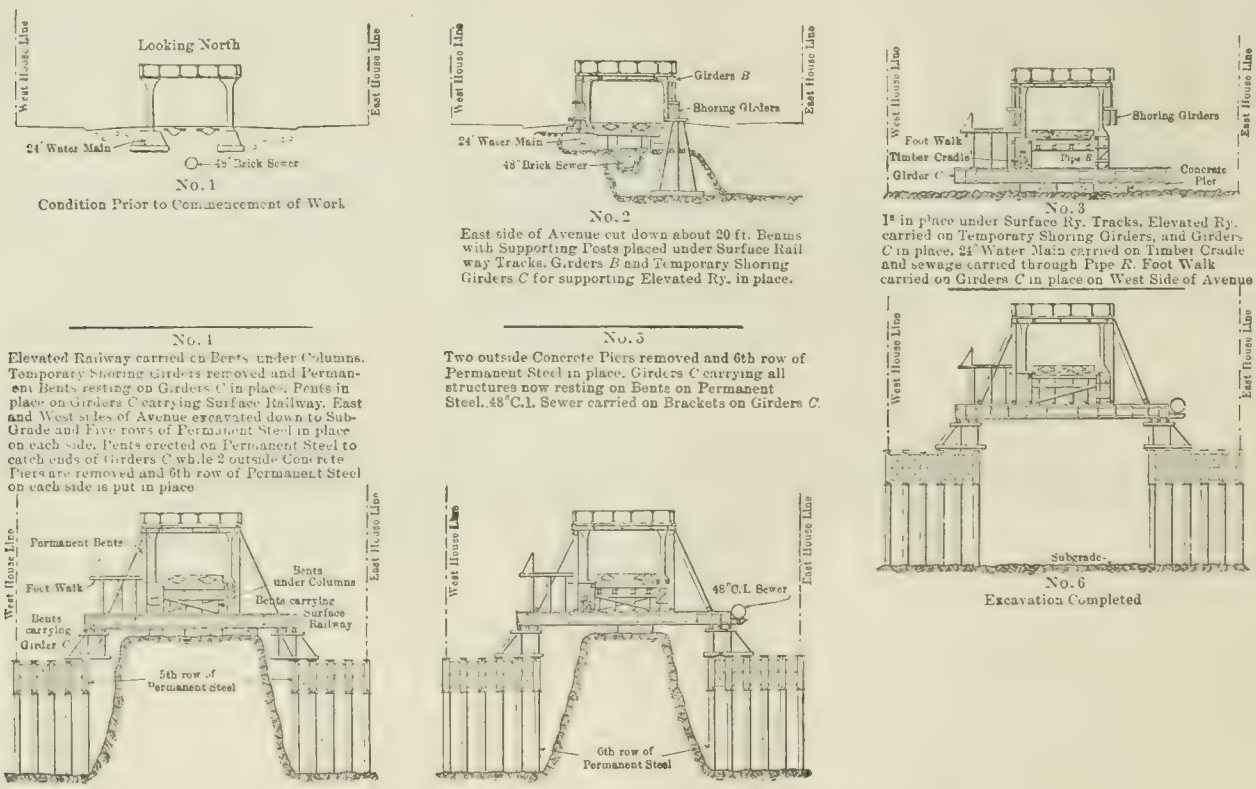
Timber bents were erected on girders C to the bottom, and at the center of 32d St. it was about 42 ft. high.

It was the original intention to excavate a sufficient width of the sides of the avenue to erect six rows of the permanent steel viaduct, 5 ft. c. to c., and this was done on the south portion of the work. On the north portion, however, the rock was of poor quality, and it was thought best to excavate for only five rows at first, to erect the five rows of permanent steel and put the timber bents in place under the ends of the girders, C, in order to give them some support while the outside concrete piers were being removed and the excavation was being widened out to permit the erection of the sixth row. Additional raker braces were put in these bents temporarily, and were removed when the sixth row of steel had been erected. This is shown on Figs. 1 and 2.

The excavation of the sides of the avenue having been completed and six rows of permanent viaduct girders erected on both sides, timber bents, as shown on Figs. 1 and 2, were erected on this steel to support the ends of the girders, C, and carry the structure while

The work involved covered an area of 5.4 acres excavated to a depth of 50 ft. The stripping of the overlying earth from the rock was done by steam shovel. The plan of rock excavation was as follows: At several points cuts were made to subgrade, and these cuts were widened out to complete the work.

The excavated material was loaded by derricks on cars at the top of the excavation, these cars being on tracks having a direct connection with the disposal trestle. As soon as it could be done, derricks were placed at the bottom of the excavation; tracks were then laid out there, and the excavated material was loaded on cars at the bottom and hoisted by derricks to cars on the disposal trestle. In general, the disposal tracks were maintained about on the center line of 31st St. until the excavation had been carried as close to them as possible, then they were shifted to the extreme north side of the work. A portion of the old trestle was left in place near 10th Ave., a derrick was erected thereon, and the tracks were used for cars to receive the excavated material hoisted from sub-grade. The disposal trestle was maintained in this position



No. 1
Condition Prior to Commencement of Work

No. 2
East side of Avenue cut down about 20 ft. Beams with Supporting Posts placed under Surface Rail way Tracks. Girders *B* and Temporary Shoring Girders *C* for supporting Elevated Ry. in place.

No. 3
I[s] in place under Surface Ry. Tracks. Elevated Ry. carried on Temporary Shoring Girders, and Girders *C* in place. 24" Water Main carried on Timber Cradle and sewage carried through Pipe *R*. Foot Walk carried on Girders *C* in place on West Side of Avenue

No. 4
Elevated Railway carried on Bents under Columns. Temporary Shoring Girders removed and Permanent Bents resting on Girders *C* in place. Bents in place on Girders *C* carrying Surface Railway. East and West sides of Avenue excavated down to Sub-Grade and Five rows of Permanent Steel in place on each side. Bents erected on Permanent Steel to catch ends of Girders *C* while 2 outside Concrete Piers are removed and 6th row of Permanent Steel on each side is put in place

No. 5
Two outside Concrete Piers removed and 6th row of Permanent Steel in place. Girders *C* carrying all structures now resting on Bents on Permanent Steel. 48" C.I. Sewer carried on Brackets on Girders *C*.

No. 6
Excavation Completed

Fig. 2—Transverse Sections Showing Sequence of Operations in Excavating Under Elevated Railway Line.

carry the I beams under the surface railway structure, as shown on Fig. 3, and all temporary posts under these I beams were removed. The bents were framed with a jack, as tightly as possible, and very little settlement of the track occurred. A cradle was then built under the 24-in. water main and placed on girders C, and, as a temporay footwalk had been constructed on the west side of the avenue, it will be seen that all structures were thus carried on girders C.

All structures were put on the girders, C, before continuing the excavation on the sides of the avenue because, in case of a slide of rock, there would be less danger than to individual structures. The outside piers, on which the girders, C, rested, might even be lost, without affecting the stability of the structure, and posting could readily be done beneath these girders in case of necessity.

All structures then being supported on girders C, which were carried on four concrete piers resting on the central rock core, the excavation on the sides of the avenue was continued down to sub-grade and the east and west portions of the concrete north abutment were constructed. The central rock core was about 36 ft. wide on the top and 45 ft. wide on the rock core was being excavated. Four 80-ton jacks were used, and oak blocks were placed on the top of each jack to transmit pressure to a temporary oak cap under the girders, C, independent of the bents; all four of these jacks were operated simultaneously, and the girders, C, were lifted off the bents and clear of the concrete piers. Oak filling pieces were then inserted between the bents and the girders, C, so that when the jacks were released the girders, C, were clear of the concrete piers. Elevations were taken on each set of girders during each operation, and careful observations were made on the elevated railway columns. Where the rock was very close to these bents, the open space between the posts was filled with blocking so that there would be less danger of the bent shifting if struck by blasted materials.

All structures being carried on girders C, which, in turn, were carried on the sides of the permanent viaduct, the central core was excavated. Fig. 1 shows the work at this stage. The central portion of the viaduct was then erected, and using concrete piers and timber bents all structures were placed on its deck.

Work Between Ninth and Tenth Avenues.—until such time as it would interfere with the excavation, and then the tracks were abandoned. This was done on Nov. 11, 1908. On Aug. 30, 1908, a cut was made under 9th Ave. at sub-grade, and cars could then be run from 7th to 10th avenues at sub-grade. On Oct. 24, 1908, the connection with the disposal trestle east of 9th Ave. was abandoned, and all excavated material was hoisted from sub-grade at 10th Ave. by derricks.

Practically all the earth excavation, amounting to about 57,000 cu. yds., was done with steam shovels. The average quantity of earth excavated by a steam shovel per 10-hr. shift was 180 cu. yds. This material was loaded on side-dump cars and taken to the disposal pier, where it was dumped through chutes to the decks of scows. Inasmuch as the quantity of earth excavation was small, as compared with the rock, the earth was used principally for the first layer on the scows for padding, so that small stones might be dumped through the chutes without injuring the decks.

The rock broke better on the south than on the north side, where there were several slides, and considerable excavation had to be taken out beyond the neat line required in the specifications. The rock on the south side

broke very well, and there were no slides of any consequence.

The drill holes were laid out by the blaster and the general method of drilling for different classes of work was as follows: In breaking down, the holes were started about 8 ft. apart, on a slight batter, so that at the bottom they would be considerably less than 8 ft. apart. They were drilled about 10 ft. deep, and blasting logs were used, as it was necessary to load quite heavily in order to lift the material and start the cut. After the cut had been made, side holes were shot to widen out sufficiently to start another cut.

After a side cut about 20 ft. deep had been made, the side holes were drilled 20 ft. deep and the holes were loaded and tamped for the full 20-ft. cut. Under the terms of the specifications, the contractor was required to complete the excavation on the sides by drilling broaching holes.

The maximum length of drill steel was about 20 ft. and where the excavation plane of broaching was more than 20 ft. in depth the contractor was permitted to start the holes back of the broaching line, in order to allow for setting up the drills on the second lift. A distance of about 8 ins. was usually allowed for setting up a drill. The broaching line was painted on the surface of the rock in advance of the drilling, and the batter of the drill was tested with a specially designed hand level in which the bubble came to a central position when the face of the level was on the required batter. Holes were also drilled in front of this broaching line and when the excavation had been taken out to within about 6 ft. in front of it, the holes immediately in front were loaded, and also about every third one of the broaching holes, and unless the rock was very bad it usually broke sharply at the broaching line. Occasionally the broaching holes which were not loaded were filled with sand, which gave rather better results than leaving them open.

In the steam shovel work on the east side of 9th Ave. spring holes were used. They were formed by drilling a 20-ft. hole and exploding at the bottom of it, without tamping, two or three sticks of dynamite, and repeating this process with heavier charges until there had been formed at the bottom of the hole a large cavity which would hold from 100 to 200 lbs. of dynamite. Face holes and breast holes were also drilled, and it was possible by this method to drill and break up a cut 20 ft. deep and 15 ft. thick. The only place where spring holes were used on this work was on the east side of 9th Ave., where the heavy cutting was sometimes extended beyond the east house line.

From the best records obtainable, the average progress in drilling was about 33 lin. ft. per 8-hour shift. The average number of cubic yards of excavation per drill shift was 13.9, and the average amount of drilling per cubic yard of excavation was 2.4 ft.; this covered more than 27,000 drill shifts.

The dynamite was practically all 60 per cent and the average excavation per pound of dynamite was 2.2 cu. yds. The contractor employed an inspector of batteries and fuses, who, using an instrument for that purpose, tested the wiring of each blast prior to firing, in order to discover any short circuits, and thus prevent the danger of leaving unexploded dynamite in the holes.

The average quantity of excavation per derrick shift of 10 hours, covering 7,400 shifts, 87 per cent of the excavation being rock, was 50 cu. yds., and the average force per shift, including only foreman and laborers, was 13 men. It was found that a derrick operating at the top of a 20-ft. cut would handle about 40 cu. yds. per shift, whereas if operating at the bottom of the cut, it would handle about 60 cu. yds. per shift. The elevator derricks at 10th Ave. were very efficient, and each could take care of the material from four derricks at the bottom, hoisting 250 cu. yds. per shift a height of 60 ft.

The Portland R. R. Co. of Portland, Me., will commence work in April laying new loop tracks in Portland.

Roads and Streets Section

Note: This section is devoted to methods and costs of road and street construction. It will cover road building in all its details, the construction of pavements, sidewalks and gutters, the testing and use of paving materials and the machinery and tools used in road building and paving.

Method and Cost of Constructing a Shell-Macadam Pavement at Annapolis, Md.

Southgate Ave. and Franklin St. extended, at Annapolis, Md., are paved with a combination of oyster shells and broken stone, the shells being used as the bottom course of the pavement. The work was done late in the fall of 1908 under the direction of Mr. J. C. Little, city engineer, to whom we are indebted for the following information. The grading and tarring of the street was done by the contract, the remainder of the work being accomplished by day labor.

The contract price for the grading was 50 cts. per cu. yd. and the contract price for the tarring was 12 cts. per sq. yd. The street bed was graded very carefully so as to conform to the finished surface of the street, the sub-grade being 6½ ins. below the finished grade. The sub-grade was thoroughly rolled with a 10-ton roller and depressions that appeared were filled up with clay, sand, or cinders that had been thrown to the site for that purpose while the street was being graded or rerolled. After the sub-grade was completed the oyster shells were spread from a dumping board to a depth of about 6 ins., great care being taken to see that they were spread uniformly. These shells were then rolled with the 10-ton roller until they were thoroughly compacted. In some places where they did not readily compact, a little sand or cinder was spread over the shells and rolled again, no water being used. The shells after being rolled were 3½ ins. thick and this composed the first course of the macadam. The No. 2 broken limestone was then spread over the shells to a depth of about 4 ins. and rolled thoroughly so that the stone would be 3 ins. thick before the third course, composed of tarvia and screenings, was added. The screenings were spread and rolled as in the construction of any other class of macadam. This macadam was completed late in the fall and opened to travel all winter. It was not covered with the tarvia "A" until the following August. As a result of the traffic on the street, there was considerable clay and dirt that accumulated on the macadam from the unpaved streets adjoining. Hence the tarring of the street cost 12 cts., which is more than it would have cost under ordinary circumstances.

The detailed cost of the work was as follows:

	Total.	Per sq. yd. Pavement.
Oyster shells, 16,125 bu. at 3½ cts., including hauling	$ 564.38	$0.1096
Oyster shells, 3,875 bu. at 3¼ cts., including hauling	125.94	.0245
Stones and screenings, 1,016.05 tons	493.64	.0959
Freight on stone	812.72	.1579
Unloading and hauling stone	406.42	.0789
Spreading and rolling shells and stone	386.00	.0750
Hauling screenings, watering, etc.	47.52	.0092
Cleaning up streets and incidental work	25.00	.0046
Total	$2,861.62	$0.556

The total amount of pavement was 5,146.7 sq. yds. There was 689 cu. yds. of grading, which at the contract price of 50 cts. per cu. yd. cost $344.50, or about 6.7 cts. per sq. yd. of pavement. The tarring with tarvia A cost 12 cts. per sq. yd., making the total cost of the completed pavement 74.3 cts. per sq. yd.

Common labor was paid $1.25 for an 8-hour day and a team and driver cost $2.50 per day. The pavement has given good satisfaction and Mr. Little considers it an excellent type for a residential district.

Work of the Municipal Asphalt Repair Plant of Brooklyn, N. Y., in 1909 with Detailed Costs of the Repair and Maintenance of Asphalt Pavements.

The municipal asphalt repair plant of the borough of Brooklyn, New York city, is located on the 7th St. basin of the Gowanus Canal near 2d Ave. It has a capacity of 270 cu. ft. of wearing surface and 100 cu. ft. of binder per hour, and is equipped with self contained rotary driers, two of which are used for heating sand and one for binder stone. The cylinders of these driers are 40 ins. in diameter, 19 ft. 5 ins. long, with longitudinal vanes. Each set is so arranged that they may be driven independently or at the same time. The driers discharge into an elevator, fitted with 10x6-in. buckets, which convey the material to the respective storage bins above the mixing boxes, from whence the material is drawn by gravity into the weighing boxes, which rest on platform scales, so that each batch of material can be accurately weighed. These scales are fitted with double beams, so that the amount of dust used in each batch of wearing surface may also be accurately weighed with the sand. The weighing boxes discharge into the mixers, which have a capacity of 9 cu. ft. of wearing surface mixture and 10½ cu. ft. binder. The mixers discharge by gravity into trucks driven directly underneath, and are so arranged as to permit of running out both top and binder simultaneously.

There are three melting tanks of 1,500 gals. each, inclosed, and capable of withstanding 15 lbs. pressure, and equipped with mechanical agitators. These tanks are so arranged that any of the three or all of them may be used for the asphaltic cement supply to either one or both of the mixers. The asphaltic cement is fed into the weighing buckets by air pressure through standpipes from the bottom of each tank, rising above the level of the mixing floor, so as properly to discharge into the weighing buckets, which run on overhead trolleys and are equipped with double beam scales.

The power plant has a 60 h. p. Babcock & Wilcox water tube boiler. The plant is driven by a 10x12-in. automatic cut-off center crank engine, manufactured by the Erie Engine Works, Erie, Pa. Since it is desirable to have the power for agitating the tanks independent from the main engine, so that the tanks may be charged and agitated without running the rest of the plant, there is also a 5-in. by 5-in. vertical automatic cut-off engine of 9 h. p.

The plant value on Jan. 1, 1909, was $41,016.10, and during 1909 the following betterments were made:

Manganese link chain	$ 127.00
Skylight over engine room	42.00
Tools and gang equipment	634.32
Miscellaneous	21.50
Total	$ 824.82

This makes the total plant value $41,840.92.

The plant was placed in operation on June 13, 1907, and data on the cost of its operations for that year, together with a description of the plant, were given in our issue of May 27, 1908.

The plant is operated under the general direction of Mr. John C. Sheridan, chief engineer, Bureau of Highways, of the borough of Brooklyn, and we are indebted to him for the following data on the work of the plant for the year ending Dec. 31, 1909.

The fixed charges for the plant for 1909 were as follows:

Interest on payments on betterments at 5 per cent	$ 9.32
Interest at 5 per cent and depreciation on plant at 10 per cent for 1 yr. on $41,016.10	6,152.41
Rent on plant and grounds	1,440.00
Taxes for 1909	608.23
Total fixed charges	$8,209.96

During 1909 the plant turned out 23,113 boxes of wearing surface mixture and binder, the total plant product in cubic feet being 203,496.5. Of the above amount 158,217.5 cu. ft. was wearing surface mixture and 45,279 cu. ft. was binder. A total of 18,082 boxes of wearing surface mixture, 8.75 cu. ft. to the box, was turned out. The binder amounted to 5,031 boxes of 9 cu. ft. each. The wearing surface and binder were used for maintenance repairs to pavements and for restoring openings in pavements, the amount of each kind of work done during the year being as follows:

	Wearing Surface boxes.	Wearing Surface cu. ft.	Binder boxes.	Cu. ft.
Maintenance	13,078	114,432.5	3,163.5	28,471.5
Restoring openings	5,004	43,785	1,867.5	16,807.5
Totals	18,082	158,217.5	5,031	45,279

In addition the street gang constructed 1,704.23 sq. yds. of concrete in connection with the maintenance work and 13,380.32 sq. yds. in connection with restoring openings in pavements. The cost of the concrete material was as follows:

774 cu. yds. stone at $1.00	$ 774.00
1,372 bbls. cement at $1.25	1,715.00
77 cu. yds. sand at $0.75	57.75
501 cu. yds. sand at $0.45	225.45
23 cu. yds. sand at $1.00	23.00
Total cost concrete materials	$2,795.20

The quantities and cost of the materials used for the 18,082 boxes (158,217.5 cu. ft. loose measurement) of wearing surface were as follows:

Refined asphalt, 1,420.854 lbs., at $23.50 per ton	$16,695.03
Refined asphalt, 154,586 lbs., at $25 per ton	1,932.32
Residuum oil, 525 gals., at $0.07⅜	38.68
Residuum oil, 18,609.08 gals., at $0.09	1,674.82
Stone dust, 264.925 tons, at $2.84	752.38
Stone dust, 192.20 tons, at $3.15	605.42
Labor unloading stone dust	50.53
Sand, 1,015 cu. yds. at $0.85	862.75
Sand, 6,166 cu. yds., at $0.87	5,364.42
Total cost wearing surface materials	$27,976.35
Deduct credit on 444 empty oil barrels returned, at 50 cts. each	222.00
Total actual cost	$27,754.35

TABLE I.—SUMMARY OF COSTS OF MAINTENANCE WORK.

	Wearing Surface.	Binder.	Concrete—Total.	Concrete—Per sq. yd.	Concrete—Total.
Supervision and fixed charges	$ 5,872.02	$ 1,420.41	$ 22.58	$0.013	$ 7,315.01
Supplies, repairs, etc.	6,112.56	1,477.35	16.81	.009	7,606.72
Materials	20,073.21	2,792.75	315.28	.185	23,181.24
Plant labor	10,583.65	2,559.27	.....	....	13,142.92
Street labor	28,292.79	6,842.65	737.44	.433	35,872.88
Trucking	7,270.33	1,758.91	165.00	.097	9,194.24
Grand total	$78,204.56	$16,851.34	$1,257.11	$0.737	$96,313.01

From the above figures it will be seen that the unit cost of the materials in the wearing surface mixture per cubic foot loose was as follows:

	Per cu. ft. Loose.
10 lbs. asphalt at 1.18* cts.	$0.117
.12 gal. oil at 7.79* cts.	.009
5.9 lbs. stone dust at .15* cts.	.009
.045 cu. yds. sand at 86.7 cts.	.039
Total wearing surface per cu. ft., loose	$0.175

*Average unit price.

The quantities and cost of the materials used for the 5,031 boxes (45,279 cu. ft. loose) binder mixture were as follows:

Refined asphalt, 144,484 lbs., at $23.50 per ton	$1,697.69
Refined asphalt, 16,000 lbs., at $25 per ton	200.00
Flux (residuum oil), 1,850 gals., at $0.09	175.50
Binder stone, 601.5 cu. yds., at $1.40	842.10
Binder stone, 1,339 cu. yds., at $1.14	1,526.46
Total cost binder materials	$4,441.75

The unit cost of the binder materials per cubic foot, loose, figures out as follows:

	Per cu. ft. Loose.
3.54 lbs. asphalt at 1.18* cts.	$0.042
.043 gal. flux at 9 cts.	.004
.043 cu. yds. binder at $1.22*	.052
Total cost material per cu. ft., loose	$0.098

The cost of labor at the plant was as follows:

	Total.
Foremen 300.25 days at $6	$ 1,801.50
Foremen 69.25 days at $4	277.00
Engineers 461.59 days at $4.50	2,077.17
Stokers 966.86 days at $3	2,900.58
Asphalt workers 4,100.89 days at $2.50	10,252.23
Laborers 689.25 days at $2.50	1,723.12
Clerk 6.00 days at $2.100 per year	40.38
Total for the year	$19,071.98

The cost of the street labor for the maintenance repairs, restoring openings, concrete work and filling and repairing trenches was as follows:

Foremen 2,341.04 days at $4	$ 9,364.17
Engineers 1,587.30 days at $4.50	7,142.84
Asphalt workers 13,678.05 days at $2.50	34,144.60
Asphalt workers 5,699 days at $2	11,398.00
Laborers 68.50 days at $2	137.00
Total for the year	$62,186.61

This street labor cost was distributed as follows:

Maintenance work	$35,135.44
Restoring openings	14,098.28
Vacations	1,791.49
Filling and preparing trenches	1,290.15
Concrete work in maintenance	737.44
Concrete work in restoring openings	9,133.81
Total	$62,186.61

The cost of trucking for the year was $17,308.48, teams and trucks being employed for 2,884.747 days at $6 per day.

The following is a general summary of the expenditures for the year, including fixed charges, supervision, labor, materials and supplies:

TABLE III.—SUMMARY OF THE COSTS OF RESTORING PAVEMENT OPENINGS.

	Wearing Surface.	Binder.	Concrete—Total.	Concrete—Per sq. yd.	Concrete—Total.
Supervision and fixed charges	$ 2,246.80	$ 837.60	$ 316.18	$0.024	$ 3,400.58
Supplies, repairs, etc.	2,336.87	872.12	223.31	0.017	3,432.30
Materials	7,681.14	1,649.00	2,479.92	0.185	11,810.06
Plant labor	4,048.24	1,510.81	.....	.....	5,559.05
Street labor	10,266.17	3,832.11	9,133.81	0.683	23,232.09
Trucking	3,551.32	1,325.93	3,085.49	0.231	7,962.74
Grand total	$30,130.54	$10,027.57	$15,238.71	$1.140	$55,396.82

TABLE IV.—ANALYSIS OF THE COSTS OF RESTORING PAVEMENT OPENINGS.

	Wearing surface per box.	Wearing surface per cu. ft.	Binder per box.	Binder per cu. ft.
General costs:				
Superintendence	$0.094	$0.011	$0.094	$0.011
Superintendent's automobile	0.067	0.008	0.067	0.007
Repairs to plant	0.090	0.010	0.090	0.010
Repairs to tools	0.049	0.006	0.049	0.005
Dumping privilege	0.059	0.007	0.059	0.007
Coal	0.113	0.013	0.113	0.013
Wood	0.058	0.007	0.058	0.006
Miscellaneous supplies	0.031	0.003	0.031	0.003
Depreciation	0.178	0.020	0.178	0.020
Rent	0.062	0.007	0.062	0.007
Interest	0.089	0.010	0.089	0.010
Taxes	0.026	0.003	0.026	0.003
Total general costs	$0.916	$0.105	$0.916	$0.102
Material costs:				
Asphalt	$1.030	$0.118	$0.377	$0.042
Residuum oil	0.083	0.009	0.035	0.004
Sand	0.344	0.039	.....	.....
Stone dust	0.078	0.009	.....	.....
Binder stone	.....	.....	0.471	0.052
Total material costs	$1.535	$0.175	$0.883	$0.098
Labor and trucking costs:				
Plant labor including foreman	$0.809	$0.092	$0.809	$0.090
Street labor including foreman	2.051	0.235	2.051	0.228
Trucking	0.710	0.081	0.710	0.079
Total labor and trucking costs	$3.570	$0.408	$3.570	$0.397
Summary of total costs:				
General costs	$0.916	$0.105	$0.916	$0.102
Material costs	1.535	0.175	0.883	0.098
Labor and trucking costs	3.570	0.408	3.570	0.397
Grand total costs	$6.021	$0.688	$5.369	$0.597

TABLE II.—ANALYSIS OF COSTS OF MAINTENANCE WORK.

	Wearing surface per box.	Wearing surface per cu. ft.	Binder per box.	Binder per cu. ft.
General costs:				
Superintendence	$0.094	$0.011	$0.094	$0.011
Superintendent's automobile	0.067	0.008	0.067	0.007
Repairs to plant	0.090	0.010	0.090	0.010
Repairs to tools	0.049	0.006	0.049	0.005
Dumping privilege	0.059	0.007	0.059	0.007
Coal	0.113	0.013	0.113	0.013
Wood	0.058	0.007	0.058	0.006
Miscellaneous supplies	0.031	0.003	0.031	0.003
Depreciation	0.178	0.020	0.173	0.020
Rent	0.062	0.007	0.062	0.007
Interest	0.089	0.010	0.089	0.019
Taxes	0.026	0.003	0.026	0.003
Total general costs	$0.916	$0.105	$0.916	$0.102
Material costs:				
Asphalt	$1.030	$0.118	$0.377	$0.042
Residuum oil	0.083	0.009	0.035	0.004
Sand	0.344	0.039	.....	.....
Stone dust	0.078	0.009	.....	.....
Binder stone	.....	.....	0.471	0.052
Total material costs	$1.535	$0.175	$0.883	$0.098
Labor and trucking costs:				
Plant labor including foremen	$0.809	$0.092	$0.809	$0.090
Street labor including foremen	2.163	0.247	2.163	0.240
Trucking	0.556	0.064	0.556	0.062
Total labor and trucking costs	$3.528	$0.403	$3.528	$0.392
Summary of total costs:				
General costs	$0.916	$0.105	$0.916	$0.102
Material costs	1.535	0.175	0.883	0.098
Labor and trucking	3.528	0.403	3.528	0.392
Grand total of costs	$5.979	$0.683	$5.327	$0.592

TABLE V.—MONTHLY COSTS, PRODUCT AND BOX COSTS.

Month.	Plant labor.	Street labor.	Trucking.	Boxes of product.	Box cost	Plant.	Street.	Trucking.
January	$ 740.02	$ 414.00	.....	.....	.....	64	36	..
February	870.02	572.00	$ 22.50	.....	.....	61	39	2
March	1,762.71	3,609.22	994.50	1,788	$3.56	28	57	15
April	1,560.98	4,365.77	1,216.12	2,589	2.76	22	61	17
May	1,638.14	5,730.84	1,640.25	3,019	2.68	18	64	18
June	2,162.22	7,768.93	2,185.50	3,891	2.11	18	64	18
July	1,434.48	3,931.41	1,068.00	1,665	3.86	22	61	17
August	2,185.75	5,942.48	1,675.50	2,294	4.27	22	61	17
September	1,744.25	4,286.09	1,161.37	1,853	3.88	24	60	16
October	1,721.34	4,772.87	1,473.75	2,432	3.28	22	60	18
November	1,900.09	5,340.19	1,719.00	2,472	3.62	21	60	19
December	981.97	2,499.92	756.00	1,110	3.81	23	59	18
Totals	$18,701.97	$49,233.72	$13,906.49	23,113	$3.54	23	60	17

Labor:	
Superintendent asphalt repairs	$ 2,543.27
Superintendent's automobile (operation)	1,778.66
Plant labor, including foremen	19,071.98
Street labor, including foremen	62,186.61
Trucking	17,308.48
Repairs to plant	2,092.22
Repairs to tools	1,144.35
Materials:	
Wearing surface mixture	27,754.35
Binder materials	4,441.75
Concrete materials	2,795.20
Hardwood, 147.91 cords, at $8	1,183.28
Hardwood, 14.98 cords, at $10	149.80
Pea coal, 211.5 tons, at $3.79	801.58
Pea coal, 328 tons, at $3.98	1,305.44
Egg coal, 77.25 tons, at $6.49	501.35
Rosendale cement, 99.33 bbls., at $1.10 less cr. on 242 bags returned, at .07½ cts	91.11
Kerosene oil, 1,540 gals., at $0.09½	146.30
Machine oil, 565 gals., at $0.18	101.70
Cylinder oil, 234 gals., at $0.30	70.20
Waste, colored, 360 lbs., at $0.05	18.00
Waste, white, 560 lbs., at $0.06½	36.40
Albany grease, 370 lbs., at $0.07	25.90
Miscellaneous supplies	237.08
Dumping privilege, 2,337½ loads, at $0.58	1,355.65
Total expenditures	$147,140.66
Total fixed charges	8,209.96
Grand total	$155,350.62

For restoring openings in pavements 5,004 boxes of wearing surface and 1,867.5 boxes of binder were used. The cost of trucking for restoring openings was $4,877.25, and the cost of street labor was $14,098.28. In addition 13,380.32 sq. yds. of concrete was constructed.

A summary of the costs of restoring openings is shown in Table III, and a further analysis of the costs is shown in Table IV.

TABLE IX.—COMPARATIVE COSTS OF MAINTENANCE OF ASPHALT PAVEMENTS PER SQ YD. OF TOTAL YARDAGE OUT OF GUARANTEE, TOGETHER WITH UNIT PRICES FOR WORK.

	Municipal Asphalt Plant.			Contract System.					
	1909.	1908.	1907. July 1 to Dec. 31.	1907. Jan. 1 to July 1.	1906.	1905.	1904.	1903.	1902.
Unit prices	$0.608	$0.544	$0.552	$0.81½	$0.56	$0.67	$0.87	$0.95	$0.90
Prices, binder	0.597	0.737	0.745	0.35½	0.25	0.30	0.40	0.40	0.50
All streets	0.028	0.0384		0.0559	0.0350	0.0345	0.0422	0.0732	0.0579
Railroad streets only	0.089	0.0637		0.1390	0.0630	0.0720	0.0681	0.1435	0.1780
Non-railroad streets	0.021	0.0353		0.0481	0.0321	0.0314	0.0392	0.0644	0.0418

The following is a summary of costs of maintenance for the year 1909 of all the asphalt pavement in the borough of Brooklyn out of guarantee:

	Yardage.	Total cost.	Cost per sq. yd.
All streets	3,227,929	$91,386.21	$0.028
R. R. streets	348,240	30,877.10	0.089
Not R. R. streets	2,879,689	60,509.11	0.021

The accompanying table, Table V, shows the monthly costs, product and box costs for the year. Table VI shows the comparative unit costs of asphalt repairs in connection with maintenance work for three years and Table VII shows the comparative unit costs of asphalt repairs in connection with restoring pavement openings. Table VIII shows the cost of maintenance of asphalt pavement in 1909 and Table IX shows the comparative costs of maintenance of asphalt pavement per square yard of total yardage out of guarantee, together with unit prices for the work. The unit prices are per cubic foot of material measured in trucks, delivered on streets. The costs of maintenance are given per square yard, and are the total cost divided by the total yardage in the respective classes.

TABLE VI.—COMPARATIVE UNIT COSTS OF ASPHALT REPAIRS FOR MAINTENANCE WORK.

	Wear Surface per Box.			Binder per Box.			Wear Surface per cu. ft.			Binder per cu. ft.		
	1907.	1908.	1909.	1907.	1908.	1909.	1907.	1908.	1909.	1907.	1908.	1909.
Supervision and fixed charges	$0.608	$0.544	$0.449	$0.608	$0.544	$0.449	$0.070	$0.062	$0.051	$0.068	$0.060	$0.050
Supplies, repairs, etc	0.462	0.516	0.467	0.462	0.516	0.467	0.052	0.050	0.053	0.051	0.057	0.052
Materials	1.657	1.695	1.535	0.904	0.944	0.883	0.189	0.194	0.175	0.101	0.105	0.098
Plant labor	1.438	1.032	0.809	1.438	1.032	0.809	0.164	0.118	0.092	0.160	0.115	0.090
Street labor	2.356	2.264	2.162	2.356	2.264	2.163	0.270	0.258	0.247	0.262	0.252	0.240
Trucking	0.933	0.579	0.556	0.934	0.579	0.556	0.107	0.066	0.064	0.103	0.064	0.062
Grand total	$7.454	$6.630	$5.979	$6.701	$5.879	$5.327	$0.852	$0.758	$0.683	$0.745	$0.653	$0.592

TABLE VII.—COMPARATIVE UNIT COSTS OF ASPHALT REPAIRS FOR RESTORING PAVEMENT OPENINGS.

Supervision and fixed charges	$0.608	$0.544	$0.449	$0.608	$0.544	$0.449	$0.070	$0.062	$0.051	$0.068	$0.060	$0.050
Supplies, repairs, etc	0.462	0.516	0.467	0.462	0.516	0.467	0.052	0.059	0.053	0.051	0.057	0.052
Materials	1.657	1.695	1.535	0.904	0.944	0.883	0.189	0.194	0.175	0.101	0.105	0.098
Plant labor	1.438	1.032	0.809	1.438	1.032	0.809	0.164	0.118	0.092	0.160	0.115	0.090
Street labor	2.356	2.699	2.051	2.356	2.699	2.052	0.270	0.309	0.235	0.262	0.300	0.228
Trucking	0.933	0.896	0.710	0.934	0.896	0.710	0.107	0.102	0.081	0.103	0.100	0.079
Grand total	$7.454	$7.382	$6.021	$6.701	$6.631	$5.370	$0.852	$0.844	$0.688	$0.745	$0.737	$0.597

As previously stated, 13,078 boxes of wearing surface and 3,163 boxes of binder were used in connection with the maintenance repairs to pavements. The cost of trucking in connection with surfaces and binders for the work was $9,029.24, and the cost of street labor was $35,135.44. In addition 1,704.23 sq. yds. of concrete were laid in connection with the maintenance work. A summary of the costs of the maintenance work is shown in Table I.

A further analysis of the costs for this maintenance work is shown in Table II.

TABLE VIII.—COST OF MAINTENANCE OF ASPHALT PAVEMENT, YEAR 1909.

Year laid.	Material used in repairs, 1909. Cubic feet wear surface.	Cubic feet binder.	Total cost.	Yardage.	Years out of guarantee.	Cost of maintenance per sq. yd.
1886	.....	.....	.....	235	18	.....
1887	991.46	193.50	$ 791.71	4,763	17	$0.166
1888	5,796.80	763.50	4,411.22	44,141	16	0.10
1889	5,524.40	899.00	4,305.37	43,162	15	0.10
1890	962.48	193.50	771.92	16,647	14	0.046
1891	5,902.54	2,055.50	5,248.30	25,124	13	0.209
1892	2,408.67	561.50	1,977.53	33,313	12	0.059
1893	1,021.47	221.50	828.79	20,359	11	0.041
1894	5,208.10	1,249.50	4,296.84	59,496	10	0.072
1895	13,594.12	2,825.00	10,957.20	164,203	9	0.067
1896	8,899.23	1,868.00	7,184.04	189,349	8	0.038
1897	32,445.00	6,622.75	26,080.62	425,442	7	0.061
1898	1,807.14	500.50	1,530.56	51,826	6	0.295
1899	426.55	90.00	344.61	51,923	5	0.007
1900	2,825.89	576.75	2,271.51	124,603	4	0.018
1901	2,118.91	816.50	1,930.58	74,651	3	0.026
1902	3,381.75	769.50	2,765.26	336,754	2	0.008
1903	17,416.82	6,280.50	15,613.76	877,803	1	0.018
1904	96.25	18.00	76.39	684,135	..	0.000
Totals	110,827.58	26,505.00	$91,386.21	3,227,929	..	$0.028

Suggested Standard Specifications for Macadam, Brick, and Granite Block Pavement, Creosoted Wooden Block Pavement and Concrete Pavement.

(Continued from March 9 issue.)

GRANITE BLOCK AND SIMILAR STONE BLOCK PAVEMENTS.

The committee in considering this question decided at this time to only recommend certain dimensions and features in regard to the blocks themselves, rather than a complete set of specifications for this form of pavement. It is believed that the adoption of certain standard dimensions for the blocks will result in having the several quarries improve the output of paving blocks and enable them to furnish a standard block more expeditiously, and it is hoped that not to exceed the cost which now maintains.

Dimensions of Blocks.—1st. It is recommended that the depth of block be 5 ins., with an allowable variation of ¼ in. greater or less in said depth.

2d. The blocks shall be so dressed that they can be laid with ½-in. joint for a distance of 1 in. down from the head, the individual joints to be measured, the joint not to exceed ½ in. at the top nor to be more than 1 in. in any part of the joint.

3d. The block to be from 8 ins. to 12 ins. in length.

4th. The block to be from 3½ ins. to 4½ ins. in width for ordinary conditions, with a suggestion of greater width to be allowed for streets of flat grades, said width to be specified in each individual contract.

5th. The head of the block shall be so dressed that it shall not have more than ⅜ in. depression from a straight edge laid in any direction across the head and held parallel to the general surface of the block.

CREOSOTED WOODEN BLOCK PAVEMENT.

The committee appointed for the purpose of

drafting standard specifications for creosoted wooden block pavement consisted of George W. Tillson, chief engineer, Bureau of Highways, Manhattan, New York city; Andrew Rinker, chief engineer, Minneapolis, Minn.; George S. Smith, commissioner of public works, New Orleans, La.; N. S. Sprague, superintendent Bureau of Construction, Pittsburg, Pa.; James C. Travilla, member Board of Public Improvements and street commissioner, St. Louis, Mo.; Thos. F. McGilvray, city engineer, Duluth, Minn.; William F. Harvey, assistant engineer, Board of Local Improvements, Chicago, Ill.; H. L. Conway, engineer in charge Street and Sewer Repair Department, Cincinnati, Ohio; J. K. Mitchell, general assistant city engineer, Detroit, Mich.; Albert F. Keeney, president, Board of Local Improvements, Chicago, Ill.

The committee recommended the following as the principles upon which specifications shall be drafted, the idea being that these principles would be sufficient to enable any manufacturer to make a block that would conform to the specifications and at the same time permit the local engineer to adapt same to conditions in his particular city.

Timber.—The wood to be treated shall consist of long leaf yellow pine, Norway pine, black gum and tamarack, only one kind of wood, however, to be used in any one contract.

Yellow pine blocks shall be cut from what is known as prime timber, namely, all timber must be sound commercial long leaf yellow pine, well manufactured, full size, saw butted, all square edge, and shall be free from the following defects: unsound, loose and hollow knots, worm holes and knot holes, through shakes and round shakes that show on the surface. In yellow pine timber the annual rings shall average not less than six to the inch measured radially from the center of the heart.

Norway pine block, gum and tamarack blocks shall be cut from timber that is first class in every respect, and shall be of the same grade as that defined for the yellow pine.

Size of Blocks.—The blocks shall be from 5 to 10 ins. long, but shall average 8 ins.; they shall be 3½ and 4 ins. in depth according to traffic; they shall be from 3 to 4 ins. in width, but all blocks in one street or improvement shall be of uniform width, provided that blocks 3 ins. in depth can be used on residential streets and in alleys; provided further that in no case shall the width and depth of the blocks be equal.

A variation of 1/16 in. shall be allowed in the depth, ⅛ in. in the width of the blocks.

Treatment.—The blocks shall be treated with a preservative oil elsewhere described, so that the pine and tamarack blocks shall contain not less than 20 and the gum blocks not less than 22 lbs. per cubic foot.

The oil used shall be a coal tar product, free from adulteration of any kind whatever, and shall comply with the following requirements:

1. The specific gravity shall be at least 1.10 at a temperature of 38 degrees C.

2. Not more than 3 per cent of the oil shall be insoluble by hot continuous extraction with benzol and chloroform.

3. On distillation, which shall be made exactly as described in Bulletin No. 65 of the American Railway Engineering and Maintenance of Way Association, the distillate shall not exceed 2 per cent up to 150 degrees C. and 35 per cent up to 315 degrees C. The mean of three determinations to be taken.

The manufacturer of the oil shall permit full and complete inspection and sampling at the factory at which the oil is produced, of all materials either crude or refined entering into the manufacture of the finished product, as well as the finished product itself, in order that the materials used can be determined to be in accordance with the foregoing requirements. He shall also submit satisfactory proof of the origin of all materials entering into the composition of the finished product.

Oil samples taken by the inspector from the treating tank during progress of the work shall at no time be allowed to show an accumulation of more than 2 per cent of foreign matter, such as sawdust and dirt.

Due allowance shall be made for such accumulation of foreign matter by injecting an additional quantity of oil into the blocks.

Cushion.—The blocks shall be laid on a sand cushion 1 in. in thickness placed upon the concrete foundation.

Filler.—The joints between the blocks shall be filled with pitch or fine sand, the particular kind to be determined by the local authorities as conditions may demand.

Expansion Joints.—An expansion joint shall be laid along the curb and transverse joints ½ in. in width every 50 ft. along the street, these joints to be filled with a bituminous composition, the necessity of the transverse joints to be determined by the local authorities, according to climatic conditions.

Inspection.—The party manufacturing the blocks shall equip his plant with all the necessary gauges, appliances and facilities to enable the inspector to satisfy himself that the requirements of the specifications are fulfilled.

CEMENT, CONCRETE AND CONCRETE PAVEMENTS.

The committee appointed for the purpose of drafting standard specifications for cement, concrete and concrete pavements was made up of the following members: J. H. Weatherford, chairman, city engineer, Memphis, Tenn.; Abram Swan, Jr., city engineer, Trenton, N. J.; Nicholas E. Murray, superintendent of sidewalks, Chicago, Ill.; D. C. Washburn, city engineer, Aberdeen, S. D.; L. A. Jansen, commissioner of public works, Milwaukee, Wis.; C. D. Hill, engineer, Board of Local Improvements, Chicago; Otto H. Klein, chief engineer, commissioner of accounts, New York; Mont. Schuyler, engineer, City Testing Laboratory, St. Louis, Mo.; W. W. Reed, city engineer, Green Bay, Wis.

The committee discussed specifications for cement, concrete sidewalks, concrete curbs and combined curb and gutter, concrete base for pavements and concrete pavements, and reported specifications for each. We have, however, only reprinted the suggested specifications for cement, concrete base and concrete pavements.

CEMENT.

The report of the committee on cement was as follows:

The cement shall meet the requirements of the standard specifications for Portland cement of the American Society for Testing Materials, adopted Aug. 16, 1909, with section 21 of said specifications amended to read as follows:

The minimum requirements for tensile strength for briquettes 1 sq. in. in cross-section shall be as follows, and the cement shall show no retrogression in strength within the periods specified:

Provided, however, if the cement fails to meet the requirements of the 24-hour neat test, it may, at the discretion of the engineer, be held for further tests before being rejected.

One Part Cement, Three Parts Standard Ottawa Sand.

	Lbs.
7 days (1 day in moist air, 6 days in water)	200
28 days (1 day in moist air, 27 days in water)	275

but in no case shall the increase in strength at 28 days be less than 20% over the strength shown at 7 days.

Age. Neat Cement.	Strength, lbs.
24 hours in moist air	175
7 days (1 day in moist air, 6 days in water)	500
28 days (1 day in moist air, 27 days in water)	600

CONCRETE FOR PAVEMENT FOUNDATIONS.

Cement.—The cement shall meet the requirements of the standard specifications for Portland cement of the American Society for Testing Materials, adopted Aug. 16, 1909, with section 21 of said specifications amended as shown above.

Fine Aggregate.—The fine aggregate shall consist of any material of siliceous, granitic or igneous origin, free from mica in excess of 5 per cent, and other impurities, uniformly graded, the particles ranging in size from ¼ in. to that which will pass a No. 100 standard sieve.

Coarse Aggregate.—The coarse aggregate shall be sound gravel, broken stone or slag, having a specific gravity of not less than 2.6. It shall be free from all foreign matter, uniformly graded, and shall range in size from ¼ in. up, the largest particles not to exceed in any dimension one-half the thickness of the concrete in place.

Proportions.—In preparing the concrete, the cement and aggregate shall be measured separately and then mixed in such proportions that the resulting concrete shall contain fine aggregate amounting to one-half of the volume of the coarse aggregate, and that 7 cu. ft. of concrete in place will contain 94 lbs. of cement.

Mixing.—The ingredients of the concrete shall be thoroughly mixed, sufficient water being added to obtain the desired consistency, and the mixing continued until the materials are uniformly distributed, and each particle of fine aggregate is thoroughly coated with cement and each particle of the coarse aggregate is thoroughly coated with mortar.

Where a mechanical concrete mixer is used, the materials must be proportioned dry and then deposited in the mixture all at the same time. The mixer must produce a concrete of uniform consistency and color, with the stones thoroughly mixed with the water, sand and cement.

Consistency.—The materials shall be mixed wet enough to produce a concrete of a consistency that will flush readily under light tamping, but which can be handled without causing a separation of the coarse aggregate from the mortar.

Retempering—that is, remixing with additional water, mortar or concrete that has partially hardened—will not be permitted.

Placing Concrete.—The concrete shall be deposited in a layer on the sub-grade in such quantities that, after being thoroughly rammed in place, it will be of the required thickness and the upper surface shall be true, uniform and parallel with the surface of the finished pavement.

In conveying the concrete from the place of mixing to the place of deposit, the operation must be conducted in such a manner that no mortar will be lost and the concrete must be so handled that the foundation will be of uniform composition throughout, showing no excess nor lack of mortar in any place.

When completed the foundation shall be kept moist for four days, and it shall be protected from traffic until the concrete has thoroughly set before the wearing surface is put on.

CONCRETE PAVEMENT.

Because of lack of experience with this form of pavement, the committee hesitated to recommend unreservedly the adoption of any specifications for concrete pavement. The committee reported that it believed that there are conditions where traffic is light and economy and cost are essential, where a concrete pavement may be used to advantage, and in such cases is recommended the following specifications:

Cement.—The cement shall meet the requirements of the standard specifications for Portland cement of the American Society for Testing Materials adopted Aug. 16, 1909, with section 21 of said specification amended as shown above.

Fine Aggregate.—The fine aggregate shall consist of any material of siliceous, granitic or igneous origin, free from mica in excess of 5 per cent, and other impurities, uniformly graded, the particles ranging in size from ¼ in. down to that which will pass a No. 100 standard sieve.

Coarse Aggregate.—The coarse aggregate shall be sound, broken stone, trap rock or granite having a specific gravity of not less than 2.6. It shall be free from all foreign matter, uniformly graded, and shall range in size from ¼ in. up, the largest particles not to exceed in any dimension one-half the thickness of the concrete in place.

Proportions.—In preparing the concrete the cement and aggregate shall be measured separately, and then mixed in such proportions that the resulting concrete shall contain fine aggregate amounting to one-half of the volume of the coarse aggregate, and that 5 cu. ft. of concrete in place will contain 94 lbs. of cement.

Mixing.—The ingredients of the concrete shall be thoroughly mixed, sufficient water being added to obtain the desired consistency, and the mixing continued until the materials

are uniformly distributed and each particle of the fine aggregate is thoroughly coated with cement and each particle of the coarse aggregate is thoroughly coated with mortar.

Where a mechanical concrete mixer is used, the materials must be proportioned dry and then deposited in the mixer all at the same time. The mixer must produce a concrete of uniform consistency and color, with the stones thoroughly mixed with the water, sand and cement.

Consistency.—The materials shall be mixed wet enough to produce a concrete of a consistency that will flush readily under light tamping, but which can be handled without causing a separation of the coarse aggregate from the mortar.

Retempering.—Retempering—that is, remixing with additional water, mortar or concrete that has partially hardened—will not be permitted.

Placing Concrete.—The concrete shall be deposited in a layer on the sub-grade in such quantities that, after being thoroughly rammed in place, it will be of the required thickness and the upper surface shall be true and uniform.

In conveying the concrete from the place of mixing to the place of deposit, the operation must be conducted in such a manner that no mortar will be lost and the concrete must be so handled that it will be of uniform composition throughout, showing no excess nor lack of mortar in any place.

Finishing.—The pavement shall be finished by thorough hand tamping, until the mortar flushes freely to the surface, then lightly tamped with a templet made of 2-in. plank shaped to conform to the curvature of the surface of the finished pavement, and having a length of not less than one-half the width of the roadway, to give a uniform surface with the slight markings thus made transverse to the street.

Expansion Joints.—Expansion joints shall be placed at right angles to the curb line at intervals of 50 ft. These joints shall be not less than 1 in. wide and shall be filled with creosoted soft wood timber with the grain vertical and extending the full depth of the pavement.

Protection to Work.—During the first four days after placing, the pavement shall be kept moist and it shall be protected against traffic until the concrete has thoroughly set. In no event shall the pavement be used within ten days after being laid.

The Canal Zone Highway.—Two of the three sections necessary to complete the Canal Zone highway from Panama to Gorgona are well under way. The subgrade of the section between Las Cascadas and Gorgona was finished in September, 1909, and crushed rock has since been placed for a distance of about 4,000 ft. out of Gorgona. The rock is quarried in the vicinity and crushed in a portable machine. Between Gorgona and Bas Obispo, the road will be surfaced with rock, but between Bas Obispo and Las Cascadas, gravel, obtained from the deposits at Santa Cruz, will be used. Gravel, which has only recently been used in roadmaking in the Zone, is expected to prove a fairly good substitute, and costs about one-quarter as much a cubic yard as broken stone. Municipal prisoners have been employed on the work of metaling the Las Cascadas-Gorgona extension, which, up to now, has been confined to the Gorgona end. Graveling, however, will be started on the Las Cascadas end within a few days, with contract laborers, and it is expected that the entire section will be about completed by the end of the dry season.

The status of the work on the Canal Zone highway at the present time is shown by the following table:

Section.	Condition.	Length, miles.
Panama to Corozal	Completed	3.30
Corozal to Paraiso	Work temporarily suspended	5.45
Paraiso to Empire	Building	4.82
Empire to Las Cascadas	Completed	2.30
LasC'scadas to Gorgona	Building	4.34
Gatun to Colon	Completed	8.50

Railway Section

Note: This section is devoted to methods and costs of constructing railways. It will cover road-bed and track construction, contractor's plant and organization, surveying methods and permanent way structures.

Method of Constructing Concrete Lining for Bergen Hill Tunnels; Pennsylvania R. R. Tunnel Extension to New York City.*

Preliminary Considerations.—For the placing of the concrete lining, a sub-contract was given to Messrs. King, Rice & Ganey, by Mr. Bradley, which provided substantially that all materials should be supplied by him, and delivered to the sub-contractors at track level, at or near the point in the tunnel at which they were to be placed, and that he would supply light and power; the sub-contractors were to supply the plant, forms, and labor necessary for placing the concrete and water-proofing, building the conduit lines, manholes, etc., etc., to complete the lining, the general form of which is shown in Fig. 1. The latter illustration shows the different sections into which the lining was divided for purposes of construction, and the nomenclature adopted for each. It may be noted, incidentally, that the cubic contents of the lining per linear foot of tunnel is almost exactly half the quantity excavated, out to the standard section lines, and as there was some excavation outside of these lines, all of which had to be replaced, the actual quantity of material which had to be brought back into the tunnel was quite a little more than half the quantity taken out. It will be evident, therefore, that the question of transportation was an important one.

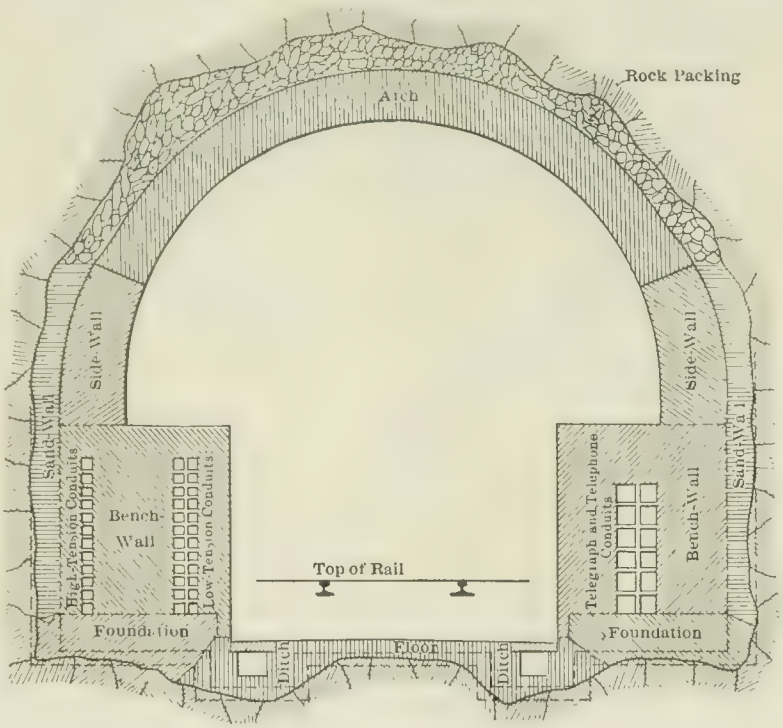


Fig. 1—Sketch Showing Division of Lining for Purposes of Construction and Names of Sections.

An essential part of the agreement with the sub-contractors provided that the operations incident to the placing of the lining should be carried on so as to provide at all times space for a single track of 3-ft. gage, running through the work, and the necessary clearance for the locomotives and cars used in hauling out the muck. A clearance diagram of one of the dinkys used in the tunnels, and its relation to the forms used, is shown by Fig. 00 and also by Fig. 00, the 4-yd. Allison cars, used for handling the muck, taking practically the same width, although they were not quite as high. This requirement and the limited space available must be kept in mind in considering the design finally adopted for the forms and plant required in placing the lining. It should also be kept in mind that, with the rolling stock used, there was only room for a single track through that part of the tunnel where any concrete had been built. As the concrete progressed, therefore, the length of single track was necessarily lengthened, and the problem of transportation was made increasingly difficult.

In working out a design for the bench-wall forms, another highly important and controlling factor, which had to be considered, was the arrangement of the conduit lines, as shown in the general cross-section.

The quantities of the various materials in the lining, per linear foot of tunnel, were as follows:

Concrete		7.64 cu. yd.
Rock packing: Paid for	1.48 cu. yd.	
Outside standard section line	1.74 cu. yd.	
		3.22 cu. yd.
Iron and steel		44.2 lbs.
Vitrified conduits		84.0 duct ft.
Waterproofing		13.0 sq. ft.
Flags		3.3 sq. ft.

General Methods.—The lining was started at both ends of the tunnels before the headings were finally holed through, so that there was practically a separate organization at each end, each in charge of one of the members of the firm. The work at the Weehawken end was started first, and the plant and scheme of working adopted there was thoroughly tried out before the plant for the western end was built, consequently, the latter was somewhat more efficient, being designed in the light of the experience gained at the Weehawken end.

The general sequence of the plan first

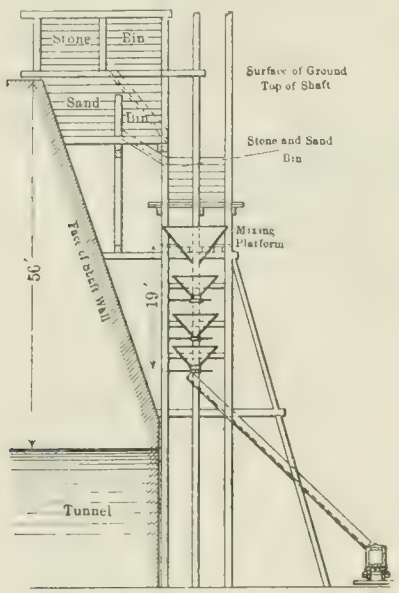
*Condensed from a paper by F. Lavis in Proceedings American Society of Civil Engineers, Vol. XXXI, p. 262.

adopted in placing the concrete is shown by Fig. 1. The concrete was first placed in the foundations up to the elevation of the bottom of the conduit lines, this work, of course, being kept well in advance; next followed, in the order named, the sand-walls, waterproofing, conduits, bench-walls, and finally the arch. The foundation was built in any convenient lengths, multiples of 16 ft., the length of one section of form, the sand-walls in lengths of from 25 to 35 ft., the bench-walls in 25-ft. lengths, and the arch in 10-ft. lengths. Concrete was placed during the day shift only, the forms being moved partly at night, and partly on the alternate days when concrete was not being placed in them.

Five gangs were organized at each end, the first placed concrete in the foundations in both tunnels, as the excavation was ready. In each tunnel there was a gang which built sand-wall one day and bench-wall the next, the two tunnels alternating so that only one bench-wall was built each day, and finally a gang in each tunnel building arches, a 10-ft. section being completed each day. During the night shift, the arch froms and travelers were moved, and all other forms, etc., were by a derrick having a clam-shell bucket, the other two with stone directly from the screen above.

This type of mixer proved very efficient on this work. The largest number of full batches (0.8 cu. yd.) mixed in one plant per hour was about 35; the largest number per day of 10 hrs. was about 240; but the apparatus was never worked to its full capacity, the quantity of concrete which it was possible to use being limited by other considerations.

The concrete for the foundations was hauled in steel, V-shaped, dumping cars holding about 1-cu. yd., and the concrete for the bench-walls and arches in Stuebner, 1-yd., bottom-dumping buckets placed on small flat cars. Rock packing was handled in Allison 4-yd. cars and also in the muck cars as well as in the Stuebner buckets, the latter, however, being most generally used. Mules were used for a short time at the Weehawken end to haul the concrete in, but proved entirely inadequate to haul the loaded cars up the 1.3 per cent. grade, and locomotives were substituted after the headings were holed through. At the western end the cars were allowed to coast in, and, up to the time the headings were holed



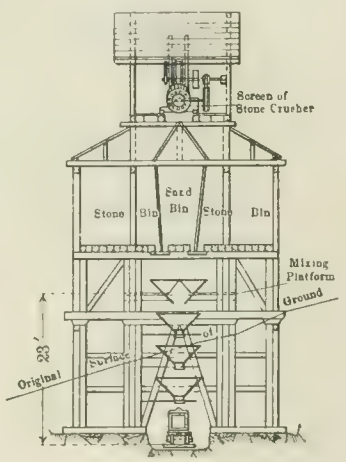


Fig. 2—Diagram Showing Arrangement of Mixers and Material Bins at Hackensack, Portal.

made ready for the concrete to be placed the following day. Some of the conduit laying was done by the night shift, but part of it was necessarily done during the day, as the concrete was built up. A small gang was kept busy in both tunnels, during the day shift, laying conduits and waterproofing. The latter two operations were generally performed by the same gang.

This organization, of course, required considerable regularity in the work, and this was finally attained, but at the beginning many sections were often not finished on time, thus creating considerable confusion. The progress possible with this organization (finally maintained with great regularity) was 75 ft. of bench-wall and 60 ft. of arch per week at each of the two working faces in each tunnel. This allowed the bench-wall to gain considerably on the arch, and therefore at a suitable point, a third pair of arches was started, one in each tunnel, increasing the progress on the arches to 180 ft. per week in each tunnel.

Mixing and Transportation.—All the concrete used on this section was mixed in Hains mixers, one being at each end. At the Weehawken shaft the mixer was installed in the framework supporting the head-house and elevators; and storage bins were arranged above, as shown by Fig. 2, *A*, the whole structure being somewhat strengthened to allow this to be done. At the western end the mixer was placed immediately under the bins of the stone crusher, as shown by Fig. 2, *B*, the track below being connected directly with the tunnels. The stone bin under the screen of the crusher plant at the Hackensack end was divided into three parts, the center being filled with sand through, were hauled back by mules; after that they were pushed out by a locomotive which had gone in ahead of them. As a rule, from 8 to 10 cars of concrete and rock packing were sent in, one after the other, in proper order, a boy riding on each car and stopping it at the proper place; all these cars were pushed out together when empty.

During the time the excavation was being carried on simultaneously with the lining at the Weehawken end, the rock packing was loaded at the working face and sent out to the point where it was to be used; after that the rock packing was sent in from outside from the reserve pile.

At the western end the larger part of the rock packing was sent in from outside, but occasionally, during the time the excavation was going on, the cars from the heading were stopped at convenient points, generally under the gantries, where the lining was being placed, and whatever stone could be utilized was sorted from the top and passed up to the platforms above.

After the headings were holed through, there was considerable difficulty at times in getting a sufficient supply of concrete and rock packing into the tunnel at the time it was required, and while undoubtedly the transportation facilities may have had some influence in this, the principal trouble lay in the difficulty of securing a sufficient supply of proper stone for rock packing, and for the crusher.

While the excavation was progressing, the cars of muck, as they came from the headings, were taken directly to the crusher and dumped into it, the proportion of fine material being fairly constant and the supply regular. At this time, also, a portion of the rock not required at the crusher was dumped along the edge of the bank on the south side of the approach, the larger stones rolling to the bottom where they were easily available to be loaded into cars for rock packing, being entirely free from the fine material; as this stone at the bottom of the bank was used up, the supply was renewed, the rock suitable for rock packing being automatically separated from the fine material as it rolled to the foot of the slope.

After the excavation was completed, however, it was necessary to go into the bulk of the storage piles to get material for the crusher and for rock packing, and then the difficulties were materially increased by the large quantity of fine material encountered, the proportion remaining after the rock packing had been sorted out being too large to send through the crusher. It was not only the handling over of this fine material which caused delay, but the difficulty of disposing of it. On rainy days the trouble was increased by the difficulty of getting men to work in the open.

The delays due to transportation were usually caused by derailments, which were more numerous than they should have been, and were due to the condition of the rolling stock rather than to that of the track. These delays, especially when they occurred in the early part of the day, greatly increased the cost, by necessitating over-time work; a delay of 1 hr. in the forenoon generally meant 2 hrs.' work after 6 o'clock to finish the day's work.

The average number of cars handled (round trips of 1 car) during a day (two 10-hr. shifts) at the Hackensack end during January, 1908, when the excavation and lining were in full swing, was about 125 cars of muck and 200 cars of lining material, the former being hauled by locomotives and the latter by mules.

Methods of Handling Concrete in the Tunnels.—The concrete for the floor, ditches, and foundations, was brought into the tunnel in V-shaped steel, dumping cars, and dumped as near as possible to the place it was to occupy.

The concrete for the arches and bench-walls was loaded at the mixers into 1-yd., Stuebner, bottom-dumping buckets which just held a 4-bag batch. These buckets were placed on small flat cars, hauled into the tunnel, placed beneath the traveling gantry, and hoisted to the platform above.

These traveling gantries, the details of which are shown by Fig. 3, consisted essentially of platforms at each end of which an A-frame was erected; the latter supported at their apexes two I-beams, from the lower flanges of which was suspended a traveling block, shown at *A*, Fig. 3, and through which the hoisting rope was rigged. The buckets were hoisted through an opening in the platform and then moved along to where they could be dumped. The platforms were supported on wheels traveling on rails laid on the concrete of the foundation (for the bench-wall gantries) or on top of the bench-wall (for the arch gantries).

Each of the first two of these traveling gantries used was equipped with a belt conveyor working on a cantilever arm. In using these belt conveyors, the concrete was dumped from the Stuebner bucket into a hopper, with an adjustable slot in the bottom, under which the belt ran.

It was the original intention, in designing the conveyor, that the end of the cantilever arm should be swung from one side of the tunnel to the other, and that the traveler should be moved backward or forward, as might be required, and thus deliver the concrete from the end of the belt directly over the place in which it was to be deposited in the bench-walls. As a matter of fact, it was found impractical in operation to move the gantry readily, owing to its great weight, which was supported on only four ordinary car wheels and their bearings, and it was found more convenient to leave the arm in one position near the center, letting the concrete drop on the platform above the bench- or sand-wall forms, whence it could be shov-

eled into place, than to attempt to move it as had been intended. Both of these difficulties might possibly have been overcome by modifications in the design of the gantry and conveyor, had this method of handling the concrete seemed otherwise desirable.

The principal difficulty with its use, however, was the inability to take care of more than one batch of concrete at a time. When one batch had been dumped into the hopper, a second could not be disposed of until the first had nearly all run through on the belt, and this took from 7 to 20 mins., varying with the consistency of the concrete, etc. In a few instances, where there happened to be some fairly dry batches, the concrete could not be started through the slot at all, and had to be shoveled out of the hopper. On the other hand, it is stated that some batches, under favorable conditions, passed through in about

platform by a rope running to the winch on the hoisting engine on the traveling gantry.

Aside from the fact that neither type was a success, neither of these schemes was much improvement over the belt, inasmuch as only one batch could be handled at a time, owing to the necessity of using the engine to haul the cars back and forth on the platform. The final solution was found in the use of the traveling gantry, shown by Fig. 3. The gantry used for the bench and sand walls was supported on framed bents on wheels running on rails laid on the foundation; that for the arch was the same, except that the high-framed bent was dispensed with, the side-sills resting directly on the journals of wheels traveling on rails on top of the finished bench-wall.

These gantries were used only as a means of hoisting the buckets and moving them along

Mundys, operated by compressed air.

Ditches, Floor and Foundations.—The first method of building the foundation was that shown by Fig. 4, *A*; no attempt was then made to build the ditch, or floor, the intention being to leave these until the completion of the remainder of the lining. In building the bench-wall on this foundation, however, it was found difficult to secure the bottom of the forms properly so as to prevent any give, as the material under the track was not solid enough to brace against. It was decided, therefore, to build the whole of the ditch (see Fig. 4, *B*) so that the bottom of the forms could be braced against the solid concrete. At the beginning of the work, the face of the bench-wall was built up to the level of the bottom of the conduits with the foundation; if, therefore, in placing the concrete above this level, extreme care were not taken to get a

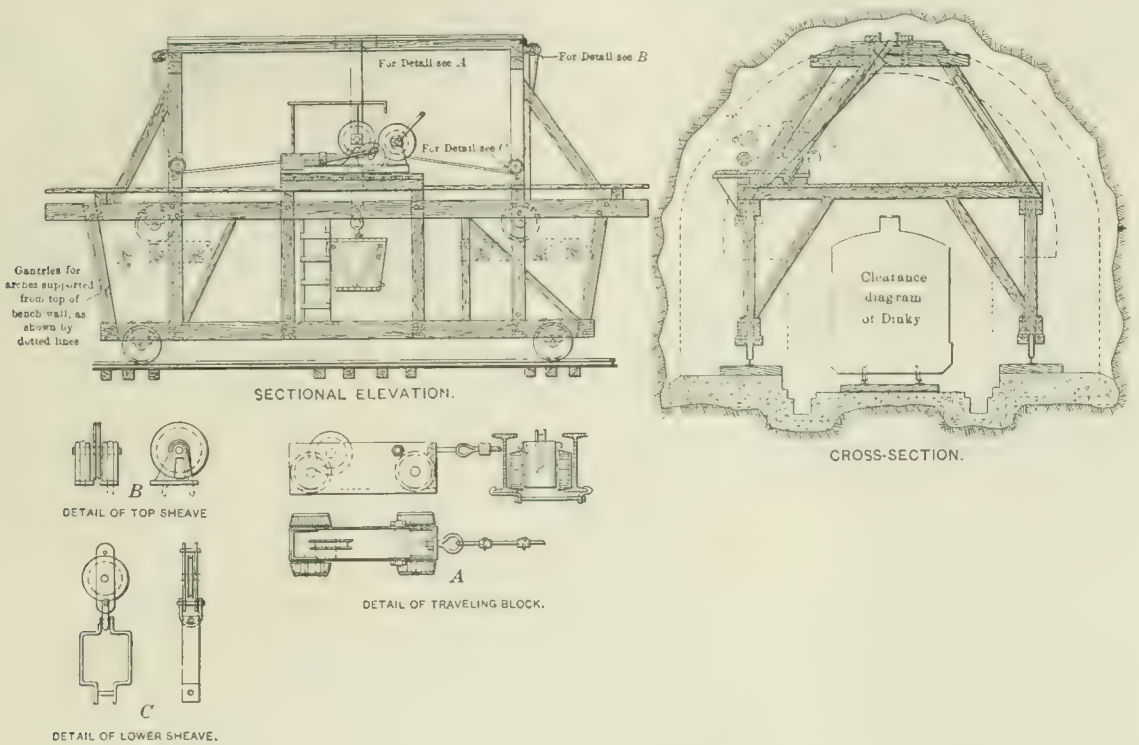


Fig. 3—Details of Traveling Gantry Used in the Construction of the Tunnel Lining.

2 mins., but this was quite exceptional, and the operation was irregular and uncertain.

Before the final method of handling the concrete was adopted, a trial was made of two forms of cars and buckets, to be used on the top platform. In one method the concrete was hoisted in the regular Stuebner buckets, and dumped into the car shown, which was mounted so that it could be revolved in a horizontal plane. It was intended to move this car on the tracks to the point at which the concrete was required, and dump it directly through a chute into the bench-walls. This car was abandoned, as there was a great deal of difficulty in turning it when it was loaded, and in several instances it had to be dumped straight ahead in the middle of the platform and the concrete shoveled into the forms. This method was also objectionable when the bucket was dumped, inasmuch as the force of the impact of a whole batch of concrete dumped from such a height into the forms, not only tended to throw the conduits out of line, and to break them, but also caused considerable strain on the forms.

A different form of bucket was next tried. It had a slanting bottom and a door opening at the side. It was filled at the mixer, came into the tunnel on a small flat car, and was hoisted and placed on a similar car on top. This bucket was not successful, as its great weight made it difficult to handle, and it generally required a man to shovel the concrete out, which latter, of course, had been pretty well compacted in the bottom of the bucket by its trip from the mixer. All these cars were hauled backward and forward on the top

to where they could be dumped directly on the platform, whence the concrete was shoveled into wheelbarrows, which could be dumped directly into the bench-walls; or, in the case of the arches, shoveled from the platform of the gantry to the intermediate platform on the arch ribs, and thence directly into the arch. This use of wheelbarrows, though apparently a somewhat crude method and a retrogression from the use of the belt conveyor, proved very successful, and really involved no more labor than did the conveyors, although this might not have been the case had these latter worked as they were originally designed to.

The method finally adopted allowed as many as four buckets to be dumped on the platform on one end of the arch gantry at one time, and eight on one end of that used for the bench-walls, the workmen handling about three of these latter into the forms by the time the last of the eight was dumped. It required 1½ mins. to place a car under the gantry, hoist the bucket, dump, close it, and return it to the car below.

Rock packing was stored at the other end of the platform, for use as required, when it was not handled directly from the end nearest the work. This method allowed the concrete and other materials to be brought in in trains at infrequent intervals, and provided a sufficient supply of material on hand so that the men handling it on top could be kept steadily at work.

Each hoisting engine on these gantries had 7 by 10-in. cylinders, and a double drum; some of them were Lamberts and some

tight fit between the bench-wall form and the lower face, and then to hold it rigidly in place, the result was a rather unsightly horizontal joint high enough to be plainly visible. Several subsequent sections showed an overhang above this joint, amounting in one or two cases to as much as ½ in., due to the fact that the bench-wall form moved or did not fit tightly. This defect was obviated by building the foundations with an offset on the face, shown by Fig. 4, *B*, so that the joint came at the level of the top of the flagging over the ditches, and therefore was almost entirely concealed; at the same time this allowed a sufficient surface, on the plane of the face of the bench-wall, against which the bench-wall forms could be braced and lined up.

The ditch forms were set very carefully to line and grade by the alignment corps, as this formed the starting point of all the rest of the work, the only other thing which was necessary was to give a level at the front end of the bench-wall form, after it was set, for the elevation of the top of the bench, and to check up the stations of the ends of the sections occasionally to see that they were at the even 25-ft. points (that is +08, +33, +58, and +83).

After a short length had been built with the ditches only, it was thought desirable to try and put in the floor as well, so that the whole of the concrete would be put in place as the lining advanced, and leave less cleaning up to be done over the end of a single track, in the restricted spaces between the bench-walls. Figure 4, *C*, shows the method finally adopted. In this may be seen the three stages

in which it was put in, the details of the ditch forms being shown by Fig. 4, *D*.

In that part of the tunnel where sand walls were built, a hollow tile drain was built into the foundation, as shown in Fig. 4, *A* and *B*, along the foot of the waterproofing and connected at intervals with the drains by 4-in. cast-iron pipes. When the sand-walls and

ment, therefore, for placing the concrete was found to be impractical, if the proposed schedule of a section of bench-wall and a section of sand-wall to be built on alternate days, was to be carried out. In a few instances, where the sand-wall was finished fairly early in the afternoon, the forms were released next morning, and the conveyor was moved back,

lagging was placed in separate pieces and held against the uprights by lightly nailing every third or fourth piece; the whole was removed each time the form was moved, and built up again as the concrete was placed.

Considerable care was taken to slope the top of the sand-wall back toward the rock, as shown by Fig. 5, and to allow free drainage

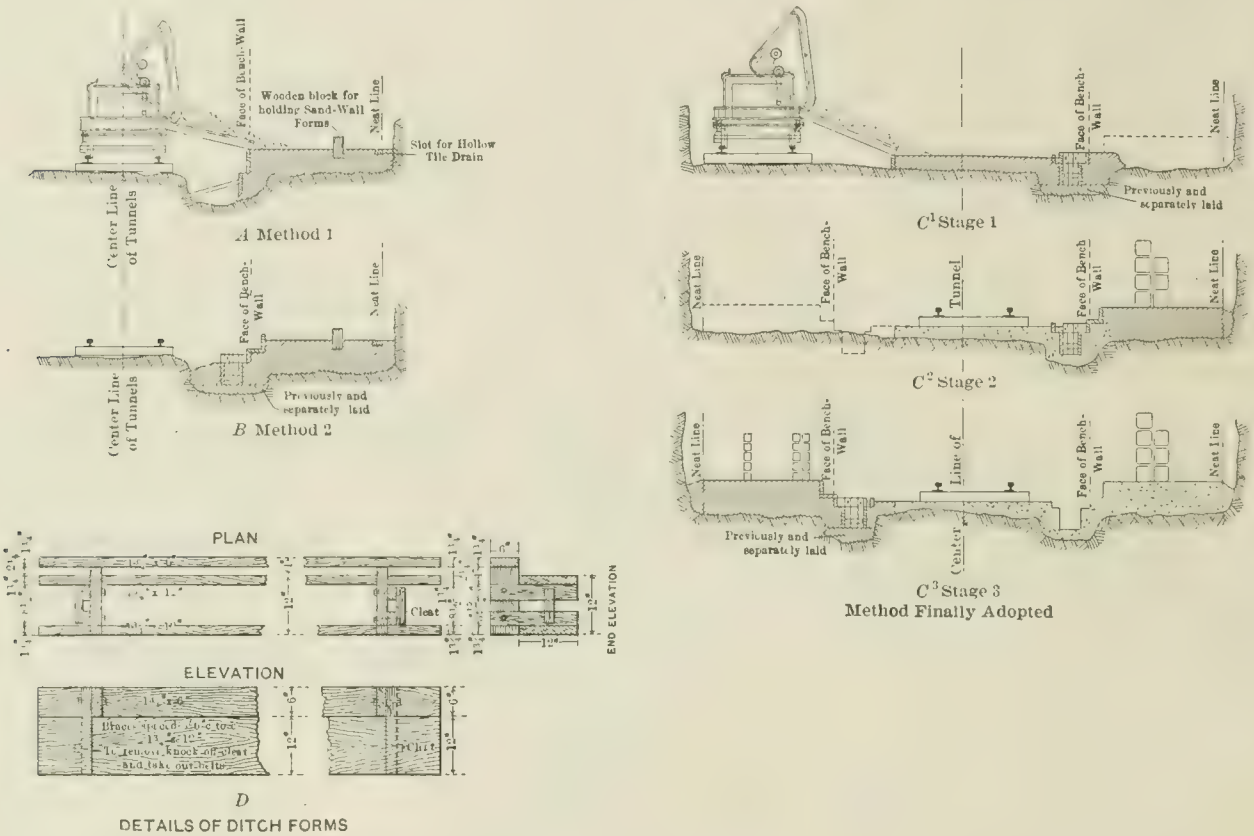


Fig. 4—Plan Showing Various Methods of Building Floor and Foundation and Details of Forms.

waterproofing were not built, however, the concrete of the foundations was sloped from the neat line back to the rock, as shown by Fig. 4, C^3, so that in case any water found its way down through the rock packing, its tendency would be to flow back against the rock, or to follow the low part of this concrete to 4-in. cast-iron pipes leading to the side ditches, rather than to find its way through the joint between the foundation and the bench-wall and so into the lower duct lines.

Sand walls.—As the work was only intended to give a comparatively smooth surface against which to place the waterproofing, no particular care was taken with the surface, except to avoid sharp projections which might cut through the felt and pitch used for this purpose. A rather porous concrete (with all the rock which could be safely embedded in it and have the wall stand) was used, so that it would not act as a dam, but rather tend to allow the water to find its way to the bottom of the tunnel, and so into the drains.

The traveling gantry for placing the concrete in the sand-walls, as first designed, with the belt conveyor, could of course only deliver the concrete at one end. Before setting the forms for a new section, it was necessary, therefore, to move the gantry ahead, before the cross-bracing between the tops of the forms, which also held the top platform, could be placed in position. In order to hold the bottom of these forms, small wooden blocks were embedded in the foundation concrete, against which they could be wedged, as shown by Fig. 4 *A*; these blocks were cut out after the sand-wall had been built.

After the forms had been filled, the conveyor could not be moved back to the bench-wall until the concrete had set sufficiently so that these cross-braces could be removed, and, on account of the overhang at the top, the set had to be fairly good in order to prevent this overhang from breaking off. This arrange-

but, even then, 2 or 3 hours at least were lost at the beginning of the shift. The conveyor, however, was abandoned, for the reasons previously given, and the traveling gantry was rearranged to allow concrete to be delivered at either end; it was then only necessary to move it backward and forward between the bench- and sand-wall forms instead of through these forms. This permitted the con-

along the top (which ran parallel to the grade of the tunnel) to the 4-in, cast-iron drain pipes which carried the water from the rock packing above the arch to the drains beneath the track.

Sand-walls were built for a length of about 1,100 ft. in each tunnel at the Weehawken end, and about 700 ft. in each tunnel at the western end, the remainder of the work, with the

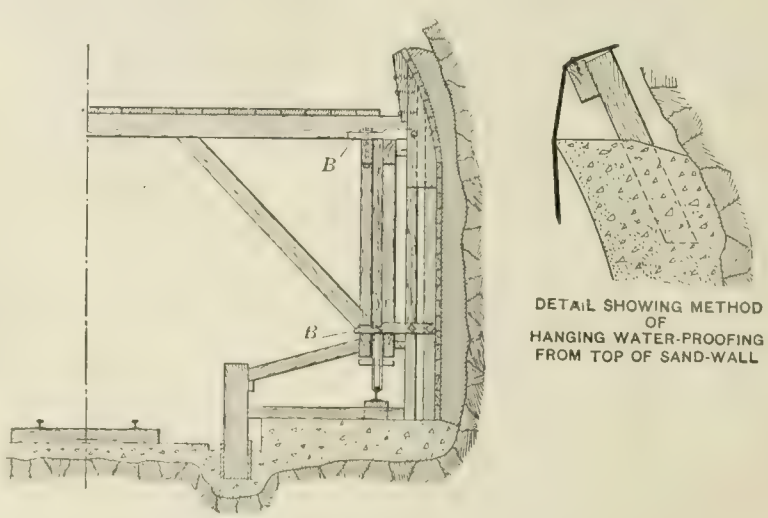


Fig. 5—Traveling Form for Building Sand Wall.

struction of the much more substantial type of forms shown by Fig. 5.

After being moved ahead on the track on top of the foundation, the form was first blocked up to grade, and then adjusted to line by the screws and slotted cleats shown at *B*, Fig. 5, after which it was secured by the braces from the ditches, as shown. The face

exception of a few short stretches, not being considered wet enough to require waterproofing.

Conduits.—On the core-wall side there are 48 lines for telegraph and telephone cables, built of 4-way multiple conduit, each piece of which is 3 ft. long and about 10 in. square outside. On the other side there are the high-

and low-tension lines, built of single conduit 18 ins. long and a little more than 5 ins. square outside. Man-holes or splicing chambers are built over every 400 ft., and are about 8 ft. long and 4 ft. wide.

In attempting to plan the work of placing the lining, two methods of building the bench-wall were considered. One was to build the wall in longitudinal sections, each section separated by a line of ducts; and the other was to attempt to build the wall in the manner called for by the specifications, which required the concrete to be carried up in layers as the conduits were laid. In this latter method, it was proposed to bond the concrete together with the forked bonds, the details of which are shown by Fig. 6, *A*, but, as it might have been impractical to use these if the wall had been built in sections, provision was made in the contract to place expanded metal, as shown by Fig. 6, *B*, if this was thought advisable. The method of construction necessary, if the wall had been built in sections, is shown graphically by the five sketches, Fig. 6, *B*, 1 2, 3, 4, and 5.

The form and details of the expanding mandrel which was finally designed to meet the conditions, and proved so satisfactory in that the wraps could be placed around the joints. The 4-way conduits were generally laid in the ordinary way, except that no laying mandrel was necessary. One dowel was used between each of the pieces of conduit, at the center, and the joints were wrapped. When a line was finished, two mandrels were placed diagonally in each line and expanded simultaneously, so that any inequalities in the ducts themselves were divided as far as possible. In connection with the use of these mandrels, one of the points which was most carefully watched was that they projected back into the last completed section, thus insuring the continuity of the alinement.

It was originally intended to wrap the joints of the 4-way ducts only, but it was found to be impractical to keep the grout from the wet concrete entirely out of the single ducts, and, after a short trial, it was decided to wrap these also. The expanding mandrel kept out a great deal of the cement, and in the sections laid without wraps, the only difficulty from this cause seemed to be that a slight film of grout, from 1-16 to ⅛ in. thick, was deposited on the bottom of the inside of the ducts at some places, and although this was not considered a serious defect, it was furnished by the Great Eastern Clay Co., and were made at its factory at South River, N. J., where they were inspected before shipment.

The mandrel used in the final rodding was made as shown at *G*, Fig. 6, the larger size being used for all lines. The rods for pushing it through the conduit lines were made of 6½-ft. lengths of ordinary 1-in. wrought-iron pipe with extra long (3-in.) couplings. The lines were rodded in both directions from alternate manholes, thus avoiding uncoupling the rods and allowing every pull to be effective in pushing the mandrel through the ducts.

Wooden rods were used at first, but proved entirely too light, as the mandrels used were a close fit, and it required considerable effort to push them through 400 ft. of conduit. Iron pipe with ordinary couplings was next tried, but the couplings broke quite often as the threads became worn in uncoupling the sections to move the rods from one line to another, and the break was generally inside a duct line. The long couplings were finally adopted, and a set of rods was put in each line, that is, six sets in all, so that when coupled up they remained in the line until it was finished. The expense of the extra

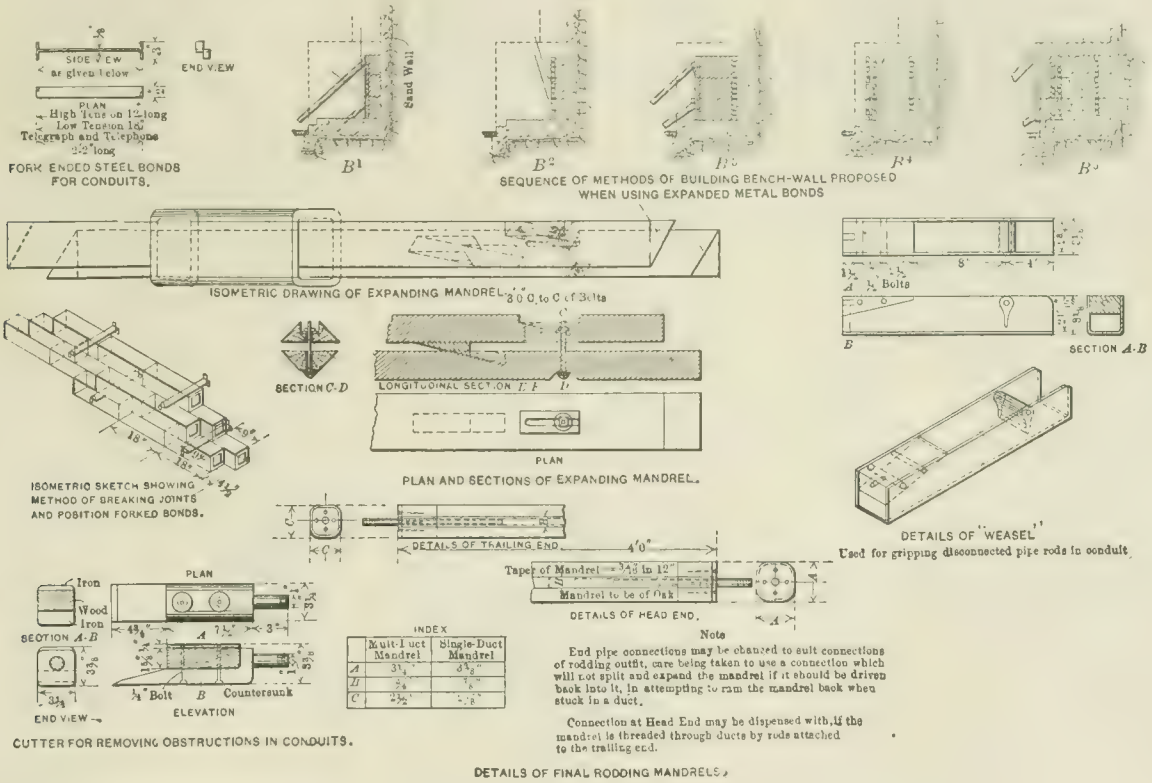

FORK ENDED STEEL BONDS FOR CONDUITS.
SEQUENCE OF METHODS OF BUILDING BENCH-WALL PROPOSED WHEN USING EXPANDED METAL BONDS
ISOMETRIC DRAWING OF EXPANDING MANDREL
ISOMETRIC SKETCH SHOWING METHOD OF BREAKING JOINTS AND POSITION FORKED BONDS.
PLAN AND SECTIONS OF EXPANDING MANDREL.
DETAILS OF "WEASEL"
Used for gripping disconnected pipe rods in conduit
DETAILS OF TRAILING END.
DETAILS OF HEAD END.
Taper of Mandrel = 3/16 in 12"
Mandrel to be of Oak
INDEX
Note
End pipe connections may be changed to suit connections of rodding outfit, care being taken to use a connection which will not split and expand the mandrel if it should be driven back into it, in attempting to ram the mandrel back when stuck in a duct.
Connection at Head End may be dispensed with, if the mandrel is threaded through ducts by rods attached to the trailing end.
CUTTER FOR REMOVING OBSTRUCTIONS IN CONDUITS.
DETAILS OF FINAL RODDING MANDRELS.

Fig. 6—Sketches of Method of Laying and Rodding Electrical Conduits.

every way, are shown by Fig. 6, *C*. The mandrel consisted of two triangular pieces of hard pine, separated by wedges attached to one piece which fitted into slots in the other; these, when expanded, practically filled the whole of the inside of the ducts. One of these mandrels was placed in each line of single ducts and two in each 4-way duct, placed diagonally. This required 60 mandrels at each working point, or 240 for the whole work. The mandrels were 35 ft. long, so that they easily covered the whole of a 25-ft. section, projected sufficiently far back into the previously finished work to assure the continuity of the alinement, and allowed the ends to be racked out at the forward end to secure proper breaks between the joints.

In laying the single conduits, as a rule, the (collapsed) mandrels were pulled ahead from the previous section as each line was laid, and the conduits were strung on it until the whole length was completed; the conduits were then pushed up tight together, so as to close the joints as tightly as possible, and then the mandrel was expanded. The conduits were thus held firmly in position, and the forward end of the line was lifted slightly so thought that the slight extra cost of placing the wraps would undoubtedly be justified by the practically perfect results obtained by using them.

Considerable attention was given to breaking the joints of the ducts properly, so as to maintain throughout the conduit lines the greatest breaks possible. The joints in each superimposed line were broken at half the length of the individual pieces of conduit, the joints in lines in the same horizontal plane being broken at one-quarter the length, thus preventing any joints from touching one another at the sides or corners, which tended to prevent a burn-out on one line from being communicated to another. There was some little difficulty at first in maintaining the breaks, owing to slight variations in the lengths of the conduit, but after a very short time both the workmen and the inspectors became very expert at this and in the proper use of short lengths to maintain the spacing; after the first few weeks there was little difficulty in attaining at all times almost perfect results. The method of making the breaks is by the isometric sketch at *F*, Fig. 6.

All the conduits used on this work were quantity of pipe thus required was more than offset by the decreased labor cost.

It was thought necessary at first to run a cutter, Fig. 6, *E*, through the conduits ahead of the final rodding mandrel, but this was soon found to be unnecessary except in a very few instances, and, after a short experience, the cutter was only used at places where an obstruction was encountered by the mandrel.

At such times as the pipe became uncoupled inside the duct line, the part remaining inside was recovered by the use of the tool shown at *D*, Fig. 6, called a "weasel." In two instances, the mandrel became stuck in such a manner that the duct line had to be cut into in order to take it out.

The best day's work of the rodding gang (1 foreman and 4 men) was 20,400 duct ft. of the 4-way conduit in the telegraph and telephone line, and 19,200 duct ft. of single conduit on the low-tension line, an average day's work under ordinary conditions being about 10,000 duct ft. The cost, including labor, material, and all tools, for rodding for the whole work was slightly less than 0.2 ct. per duct ft. The average cost of the single conduit was about 0.25 cts. per ft., and of the 4-way,

0.15 cts. per ft. About 10 per cent of the conduit lines were rodded twice, owing to partial sections having been rodded once before completion. The best continuous work on rodding was done between October 22d and 29th, 1908, when in 7 working days, 105,600 duct ft. were rodded, an average of a little more than 15,000 ft. per day.

Bench-walls.—The original design for the tunnels provided for the construction of a brick arch above a point 22 deg. above the springing line, that is, the part above the side walls (Fig. 1.). It was thought desirable, therefore, in designing the bench-wall forms, to provide for placing the concrete in the side-walls and bench-walls at one operation. These forms, as first designed, are shown by Fig. 7, *A* and *A'*; they were built of steel, the facing plates being 5-16 in. thick, in pieces 4 ft. 6 ins. wide, and in length about 6 ins. more than the height of bench-wall.

The design was controlled very largely by the necessity of providing the requisite clearance for the locomotives and muck cars, and the principal feature was the support of the forms on two trusses, one at either side, the front ends of which were supported from the foundation on a long leg, and the rear ends directly on the journal-boxes of wheels traveling on a rail on the top of the finished bench.

Although it had been decided to substitute concrete for brick in the arch before any of the lining was actually placed, two sets of forms for the Weehawken end had already been ordered and delivered, so it was decided to use them as designed, and place the side-wall with the bench.

The forms were designed so that 30-ft. lengths could be built, and this was done at the start, but owing to the occurrence of the refuge niches, ladders, etc., at 25-ft. intervals, it was soon seen that it would be advisable to build the bench wall in sections of that length (25 ft.), or multiples of it, and as the clearance conditions seemed to preclude the possibility of making the forms 50 ft. long, 25 ft. was adopted. This permitted the removal of one of the panels, 4 ft. 6 ins. wide, and at the same time it was decided to remove the side wall forms. This decreased the load on the trusses considerably, but being still a trifle weak, they were strengthened by the substitution of 1¼-in. truss rods instead of the ¾-in. rods used originally. The top platform and the cross bracing were also stiffened a little and tightened up to prevent racking.

The construction of the side walls in conjunction with the bench wall was abandoned for three reasons: First, it was found that there would be a much more even distribution of the work by including the side wall with the arch rather than with the bench; second, there was difficulty in getting a good finish for the top of the bench wall, as of course a top form for the latter had to be placed to prevent the concrete from squeezing up when the side wall was built above it, which prevented troweling; the third reason was the weakness of the whole form as designed, and the increasing difficulty of adjusting it to line as the work progressed, the principal difficulty being with the curved side-wall forms.

The bench wall forms were set in position, after they had been moved ahead, by first blocking the bottom against the face of the foundation, as shown by Fig. 4. As previously noted, this foundation face had been built very carefully to line. The back end of the form, of course, was blocked tightly against the end of the previously finished section, and the top was made plumb by the adjusting screwjacks shown in Fig. 7, *B*. At first these screws were ¾-in., but they were afterward changed to 1¼-in. The only points which it was necessary for the alinement corps to give in setting these forms was a grade at each of the front ends for the top of the finished bench.

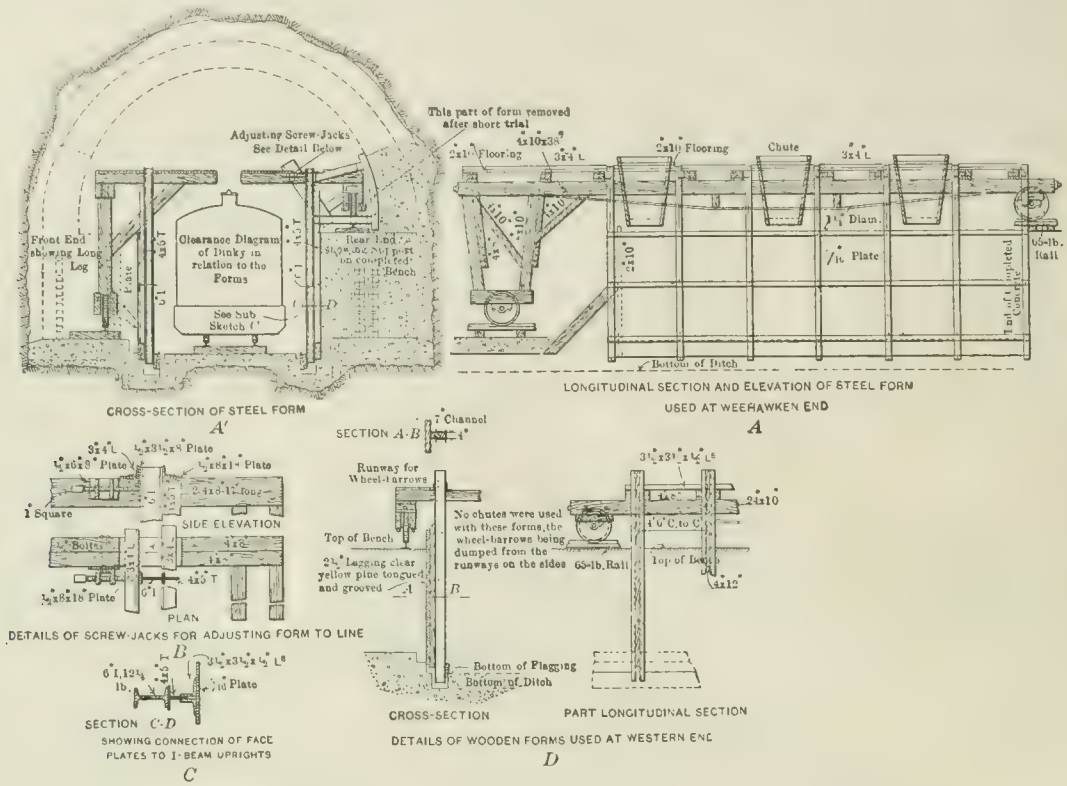

This part of form removed after short trial
Adjusting Screw-Jacks See Detail Below
Clearance Diagram of Dinky in relation to the Forms
See Sub Sketch C
Front End showing Long Leg
Rear End
2x10 Flooring
Chute
Bottom of Ditch
LONGITUDINAL SECTION AND ELEVATION OF STEEL FORM USED AT WEEHAWKEN END
A
CROSS-SECTION OF STEEL FORM
A'
SIDE ELEVATION
PLAN
DETAILS OF SCREW-JACKS FOR ADJUSTING FORM TO LINE
SECTION C-D
SHOWING CONNECTION OF FACE PLATES TO I-BEAM UPRIGHTS
C
SECTION A-B
Runway for Wheel-barrows
No chutes were used with these forms, the wheel-barrows being dumped from the runways on the sides
Top of Bench
Bottom of Flagging
Bottom of Ditch
65-lb. Rail
CROSS-SECTION
PART LONGITUDINAL SECTION
DETAILS OF WOODEN FORMS USED AT WESTERN END
D

Fig. 7—Details of Traveling Forms Used in the Construction of Bench Walls.

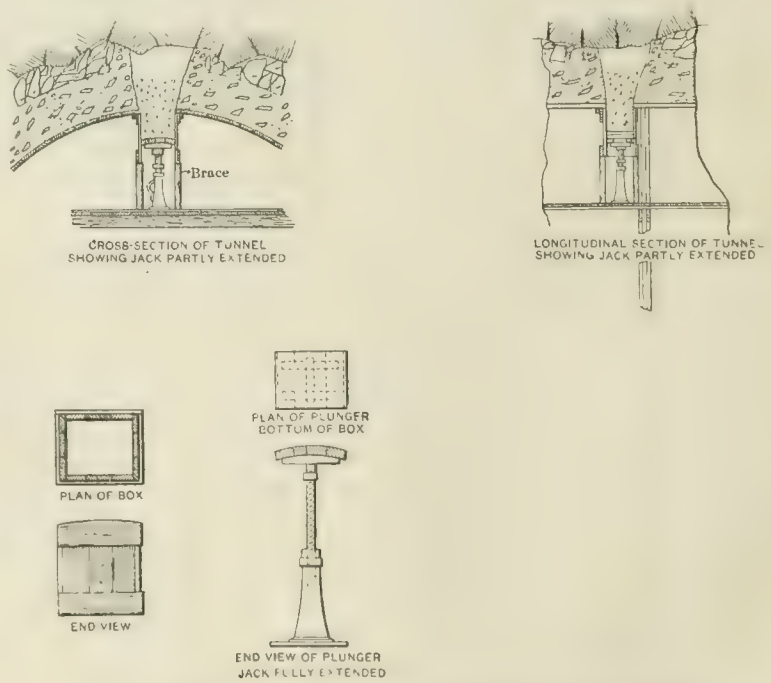

Brace
CROSS-SECTION OF TUNNEL SHOWING JACK PARTLY EXTENDED
LONGITUDINAL SECTION OF TUNNEL SHOWING JACK PARTLY EXTENDED
PLAN OF BOX
END VIEW
PLAN OF PLUNGER BOTTOM OF BOX
END VIEW OF PLUNGER JACK FULLY EXTENDED

Fig. 8—Sketch Showing Method of Making Arch Closure.

The steel face forms in both tunnels gave excellent results, as far as smoothness of finish was concerned, but, owing to the imperviousness of the steel, small air holes were

formed in the surface, though not in sufficient numbers or size to cause trouble or disfigure the work in any way.

The design of the bench wall forms used at the western end, where this differs from the steel form, is shown by Fig. 7, *D*. The principal features in which they differed from those used at the Weehawken end was in the substitution of 2½-in. tongued and grooved hard pine for the face. This timber was of the very best quality obtainable, each piece being especially selected and as nearly clear and free from knots or other defects as it was possible to get it. The edges of each piece were planed at the back so as to insure a tight joint on the face, and all joints were shellacked. These forms were used without renewal of the face timber and with only two planings, for a length of 2,500 ft., or 100 separate sections, and gave good satisfaction.

In order to obtain a surface to which the face lagging could be fastened, wooden uprights were used and were reinforced on either side by light channels bolted together through the timber, in place of the I-beams used on the steel forms. The lagging was nailed to these uprights by 6-in. wire nails driven through the top edges of each piece as it was placed in position, thus leaving the surface entirely clear and free from any marks or nail holes, and in condition for planing when this became necessary. Runways for wheeling the concrete were built on either side over the bench walls instead of having a center platform with chutes, as was used at Weehawken.

When the original lagging had become too much worn for further use, it was resurfaced with strips of ⅞ x 2½-in., clear, tongued and grooved, hard pine, placed vertically, which did fairly well and lasted to the end (about 1,000 ft.), although it was not altogether satisfactory, and the last eight or ten sections built had to be rubbed down with a wooden float in order to obtain a suitable finish.

In designing the forms for all exposed surfaces in the tunnels, it was the desire of the contractors to obtain directly from them a surface which would be satisfactory to the engineers without further finishing than the patching of minor defects. In this they were generally quite successful, and excellent results were obtained. The surface of the bench walls was obtained solely by spading the face with a flat spade as the work progressed. No after treatment was resorted to, except for the few sections where the forms became worn. The top of the bench wall was finished with a float about 2 or 3 hrs. after the concrete was placed.

When the work was well organized, a bench wall was built at each end each day, one day in the North Tunnel, and the following day in the South. During the time sand walls were being built, a sand wall and bench wall were built on alternate days in each tunnel, care being taken that when a bench wall was being built in one tunnel, the sand wall was being built in the other, this being necessary in order to equalize the work of the night gang and the conduit layers as well as the transportation.

The conduit layers on the day shift, two or three men and a foreman, required about 2 hrs. in the forenoon and 1 hr. in the afternoon to lay their portion of the conduits, and usually finished this work by 3 p. m. At other times during the shift they were utilized at those points where rock packing was heaviest, and when the packing was brought in in the large cars, these men helped unload it so that the track could be cleared as soon as possible.

When waterproofing was to be done, the number of men in this gang was increased, so as to enable them to do that work also.

A gang of four rough carpenters and a foreman was employed on the day shift; they moved and set the bench wall forms or sand wall forms, as the case might be, and moved the traveling gantry into position. This was done in the afternoon, and required about 3 hrs. They also took out, cleaned, repaired, and set all ditch forms, all passenger forms, circuit breaker forms, and did all other repair work. The ladder forms, the refuge-niche forms, and overhead conductor pocket forms were attended to by one man, who set, removed, cleaned, and repaired them. The carpenters on the night shift set the arch centers and gantries, also the manhole forms when needed. The conduit layers on the night shift laid up half the 4-way conduits (3-high) and one-third of the single ducts (4-high). This one gang laid the conduits in two sections of bench wall each night, that is, one section at Weehawken and the other at the western end.

In concreting the bench walls, the concrete was first placed on the side containing the single conduit until it reached the top of the four tiers laid, then the concrete gang was turned over to the side with the 4-way conduits while four more tires of single conduits were laid, the work thus progressing, the conduits being laid on one side while concrete was placed on the other. On the side of the 4-way conduits the concrete was built in two layers while that on the side of the single ducts was built in three; the interval between the different layers was not sufficiently long to prevent a complete bond being obtained, and there were only one or two instances where there was any mark on the face to indicate a break.

After the work had been in progress some time, it was found to be quite feasible to build all the 4-way conduits at night and half the single conduits, that is, 6 ducts high, as the mandrels proved amply sufficient to hold them in place; in fact, had it been necessary, the writer has no doubt that all the ducts might have been laid and held in place with very little extra precaution, by the use of the expanding mandrels, as described under the head of conduit laying. A V-shaped joint about ½ in. deep was made between each section of bench wall so that the expansion cracks would follow this joint rather than show irregularly on the face. These joints divided the face into the even 25-ft. panels, and were very effectual in concealing what few cracks there were.

After the construction of the sand walls was discontinued, the space behind the bench walls, between the neat line and the rock, was filled with rock packing, which was generally built, part way up at least, as a dry wall ahead of the construction of the bench wall, or it was put in place simultaneously with the concrete, care being taken to keep it as free as possible for the drainage of any water there might be. Toward the latter part of the work, owing to the difficulty of getting sufficient rock packing during the day, a rough back form for the bench wall was built at the neat line, in places where the section was at all large, and the space was filled with rock afterward, generally at night or on Sundays.

In the sections where waterproofing was required, where no sand wall was built, the rock was taken out for 2 ft. outside the neat line, if the excavation was not already that far out (at the expense of the contractors, who preferred to do this rather than build the sand walls for the short sections required), so that there would be sufficient room for placing the waterproofing on the back of the bench walls, as shown by Fig. 9, *E*. The waterproofing of these sections was left until just before the

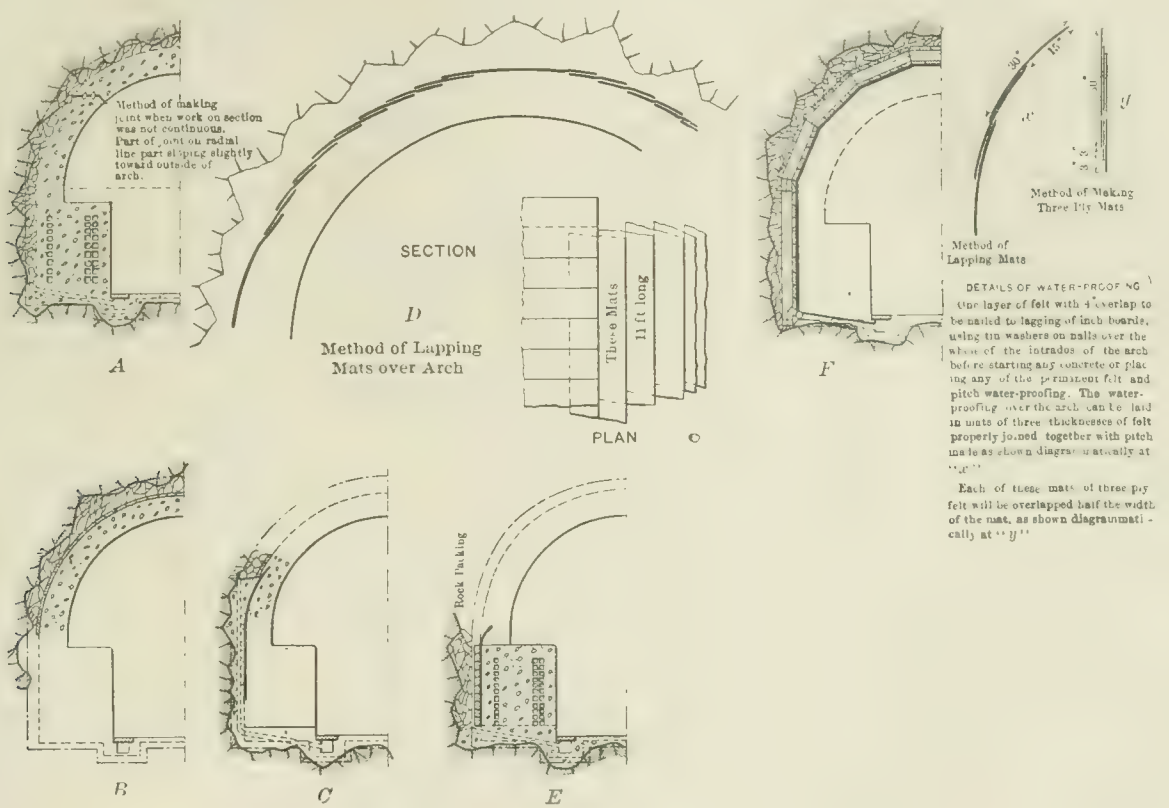

Method of making joint when work on section was not continuous. Part of joint on radial line part sloping slightly toward outside of arch.
A
SECTION
D
Method of Lapping Mats over Arch
Three Mats 11 ft long
PLAN
C
F
Method of Making Three Ply Mats
Method of Lapping Mats
DETAILS OF WATER-PROOFING
One layer of felt with 4" overlap to be nailed to lagging of inch boards, using tin washers on nails over the whole of the intrados of the arch before starting any concrete or placing any of the permanent felt and pitch water-proofing. The water-proofing over the arch can be laid in mats of three thicknesses of felt properly joined together with pitch mastic as shown diagrammatically at "x"
Each of these mats of three ply felt will be overlapped half the width of the mat, as shown diagrammatically at "y"
B
C
Rock Packing
E

Fig. 9—Various Types of Arches and Water Proofing Used.

arch was to be built, and after being placed it was protected by a single row of brick laid on edge before the rock packing was filled in.

Arches.—In Weehawken section of the tunnel, the lower part of the arch, about 5 ft. above the bench wall, was built first, as previously referred to, but the centers, as will be seen, were built so that they could be used for the whole of the arch.

The front bulkheads used were made in nine sections, bolted to a 2½ x 2½-in. angle bent to the radius of the arch, and fitting on the end of the lagging; when set they were braced partly against the rock of the roof and partly against the gantry. After the ribs and part of the lagging had been set by the night gang for a fresh section of arch, the braces holding the bulkheads were knocked out, the concrete placed during the day having set sufficiently by this time; the whole of the bulkhead was then easily moved ahead, sliding along the lagging to the forward end, and made ready for the next day's work. The middle section at the top was taken out temporarily, to faciliate working at the sides, until it was needed.

The arches were built in 10-ft. sections, the ribs being spaced 5 ft. apart, the end ribs of each section supporting the end of the lagging on two adjoining sections. Five sets of lagging and ten ribs were used at each place where the arch was being built, thus giving each section practically 4 days' set before removing the centers. Probably in the greater part of the work the centers could have been removed in from 40 to 48 hrs. after the concrete had been placed, but 3 days was considered the least time which would certainly be safe at all times, and the contractors thought that the very slight additional expense involved in leaving the centers up 4 days was more than warranted by the additional feeling of security.

The lagging was made from 3 to 6-ins. clear, hard pine, 10 ft. long, dressed to about 2½ ins. in thickness, about 5½ ins. in width, and the sides to radial lines. As it was placed, every third or fourth piece was lightly nailed to the ribs; when the latter were released and taken down, the nails pulled out, and the lagging was left in place until one piece was pried out, allowing the others to fall. A light A-frame, about 8 ft. long, spanning the bench walls, was placed below, in order to break the fall and allow the lagging to slide to the top of the bench walls rather than to the track beneath.

Cross passages between the two tunnels were built every 300 ft. There were two circuit breaker chambers, one at Station 286 and the other at Station 310. Steel doors are provided so that all the openings between the two tunnels can be closed. At Station 294+24, the core wall broke through for a length of about 40 ft., and instead of filling this in, a storage chamber 34 ft. long and 11 ft. wide, inside, was built there.

During construction the arches in each tunnel were kept even with each other, so that when the cross passages were reached, they, and the section of arch which they joined, could be completed at one operation.

By the methods used on this work, one section of arch was easily built in a shift, so that the monolithic construction of each section was easily secured, and concrete, as wet as it was possible to handle with shovels, could be used for all except the last 5 ft. or so at the top, thus getting a structure which was as nearly impervious as possible under the circumstances.

The gangs placing the arches were paid overtime when they were required to work after 6 o'clock to finsh their section, which was generally only necessary when the quantity of rock packing to be placed was very large. If they finished their section before 6 o'clock, however, they were allowed to quit when this was done, and were given a full day's pay. The difference in time, when there was any, was usually due to the greater or less quantity of rock packing, as the excavation varied from the standard section line.

In building the arches, the night gang set the two ribs (one at the center and one at the forward end of the section to be built), placed the lagging on the sides, 4 or 5 ft. high, built the shoveling platform on the horizontal cross braces of the ribs, and placed the traveling gantry in position for use. The forward end of the gantry (that is, the end farthest from the arch being built), was loaded with rock packing to be used as required. As the concrete was brought into the tunnel it was hoisted and dumped on the end of the gantry next the arch, and shoveled from there to the platform on the ribs and from there into place. The rock packing brought in during the day was dumped on the front or back end of the gantry, as was most convenient, and handled into the work in the intervals between batches of concrete. The concrete and rock packing, with the backlagging and waterproofing, where these were used, were placed simultaneously, or nearly so, and brought up the sides together until the key was reached; the latter was then worked from the back toward the front. The key was usually made about 5 ft. wide, the lagging for this width was made 5 ft. long and put up in two sections. It was found to be more convenient to have the key of this width than narrower.

The method used in making the closures where two sections of the arch came together is shown by Fig. 8.

Waterproofing.—The original design for the lining of these tunnels provided for a brick arch. It was intended to cover this arch with waterproofing, this latter extending over the whole of the roof and down the sides as far as the bottom of the conduit lines. The waterproofing was to be placed against the sand walls on the sides, up to the top of the side walls, Figs. 1 and 5. Over the arch, after being placed, it was to be protected by an armor course of brick, laid flat, the space between the brick and the excavation, which was required to be not less than 4 in. (and, as a matter of fact, was actually a great deal more), being filled with rock packing. Besides filling the space, this latter was designed to allow any water from the roof of the tunnel to find its way easily to the top of the sand wall, from there being carried through the 4-in. castiron pipes, to the side ditches in the floor of the tunnel.

All the waterproofing placed in these tunnels was of felt and pitch, sixply felt and seven layers of pitch. The felt was required to be Hydrex, or of equal quality, and the pitch, "Straight run coal-tar pitch which will soften at 60 deg. F., of a grade in which the distillate oils will have a specific gravity of 1.05."

In addition to tests as to the above qualities, the pitch was analyzed to determine the amount of free carbon it contained, and was not accepted if this fell below 20 per cent.

It was considered quite important that there should be absolutely free drainage on the outer side of the lining, so that there would be no chance for any water to acquire a head. More than three-quarters of the length of these tunnels is below the level of mean high water, and while it was hardly expected that there would be any direct connection between the water in the Hudson River and the ground-water of the section penetrated, it was thought wise to provide ample drainage.

Before the lining was started, however, the excavation had progressed sufficiently to show that the tunnels, while very wet in places, and varying from that to quite damp, would be, on the whole, much dryer than had been anticipated. It was then decided to substitute concrete for the brick in the arch and omit the waterproofing over the top, except at places where water came into the tunnels in sufficiently large quantities to form practically a continuous stream. Three general types of construction for the arch were decided on, as shown in Fig. 9. The first, as shown at *A*, was to be used where the tunnel was quite dry. In this type, the sand wall was omitted entirely, and the concrete and rock packing were built up together, the rock packing impinging to a certain extent on the concrete, and the concrete squeezing somewhat into the rock packing. The section shown at *B* was used where the tunnels were damp, or where there were slight droppers not forming a continuous stream. The back lagging, of 1-in. boards, which was left in place, provided a practically smooth outer surface on the concrete arch, and allowing the concrete and rock packing to be built almost simultaneously. It was considered that the free drainage through the rock packing, the surface of the boards, and the smooth outer surface of the concrete in the arch would allow the comparatively small quantity of water in these parts of the tunnel to find its way to the sides, and thence to the ditches at the bottom, rather than to percolate through the concrete, and this proved to be very generally the case, as is shown by the dry condition of the tunnel as built. The back lagging was used over the arch both, where the sand wall was built and where it was omitted, as well as being placed over the waterproofing of the arch as an armor course where waterproofing was required. Where the sand walls were built and waterproofed, and where the waterproofing was not carried over the arch, the waterproofing was turned in at the top, as shown at *C*, Fig. 9.

The third method provided for water-proofing the whole of the arch, and was the same as *B* except for the addition of the waterproofing inside the back lagging. In placing this water-proofing, the felt was cut in strips about 11 ft. long (about 1 ft longer than the length of a section of arch), and six thicknesses were cemented together with hot pitch. These mats were then laid shingle-fashion, as shown at *D*, Fig. 9, up the sides of the arch until a space about 5 ft. wide remained at the crown; shorter mats were then brought out over this, laying them perpendicular to the axis of the tunnel. Care was taken in making all laps, irrespective of the direction in which the arch was built, so that they would lay with the grade, that is, so that the water would tend to flow over the edges of the laps rather than against them.

Most of the wet sections of the tunnel were at the ends, where sand-walls had been built for the purpose of providing a smooth surface against which the water-proofing was to be placed; there were several wet places at isolated points in the tunnels, however, and, in order to avoid building sand-walls at these points, the method shown at *E*, Fig. 9, was adopted. This involved a slightly larger excavation, 2 ft., outside of the neat line up to the height of the top of the bench, where there was not already that much room. The bench-wall was built with a back form on the neat line, the waterproofing was placed as shown, protected by an armor course of brick, and then continued over the arch when this latter was built. The excavation and refilling with rock packing were done at the contractor's expense, which he was willing to assume rather than build these short sections of sand-wall.

The method of waterproofing that part of the timbered section which was very wet, is shown at *F*. Fig. 9. A lagging of 1-in. boards was nailed up the sides and to the soffit of the segmental timbering, all the spaces outside of this lagging being carefully filled with rock packing. Before starting any concrete work, a single thickness of waterproofing felt was nailed to the inner side of the lagging, which not only served to protect the finished surfaces of the concrete from the water which fell copiously from the roof, but also provided a comparatively dry surface to which the regular six-ply waterproofing could be cemented with pitch and held in position, while the concrete was placed against it.

In placing the water-proofing in this section on the sides, the strips of felt were placed vertically, nailed at the top to the wall-plate, to support their weight, and lapped and cemented with pitch to the sides as on the sand-walls, except that there was no trouble from the overhang. After the bench-wall had been built, the felt was cut just below the nails and about 2 ft. above the top of the bench, so that the mats which were placed over the arch could be inserted behind it. The roof was covered with three-ply mats and lapped over a little more than half, as shown diagrammatically on the drawing.

When the upper part of the arch was reached, where the cementing strength of the pitch was not sufficient to hold the felt in place, the mats were braced temporarily from the center-

TABLE I.

Title.	Day. No.	Day. Rate.	Day. Amount.	Night. No.	Night. Rate.	Night. Amount.
Walking bosses	2	$5.00	$10.00	..	.....	.....
Timekeeper	2	3.00	6.00	..	.....	.....
Watchmen	..	....	....	5	$2.00	$10.00
Waterboys	1	1.50	1.50	..	.....	.....
Carpenter foremen	2	3.50	7.00	1	4.00	4.00
Carpenters	14	2.50	35.00	8	2.50	20.00
Pipe-fitters	1	3.00	3.00	..	.....	.....
Pipe-fitter's helper	1	1.75	1.75	..	.....	.....
Wheelwright	1	2.75	2.75	..	.....	.....
Wheelwright's helper	1	1.75	1.75	..	.....	.....
Blacksmith	1	3.00	3.00	..	.....	.....
Blacksmith's helper	1	1.75	1.75	..	.....	.....
Foremen riggers	1	3.00	3.00	..	.....	.....
Riggers	6	1.75	10.50	..	.....	.....
Foremen trackmen	1	3.00	3.00	..	.....	.....
Trackmen	6	1.50	9.00	..	.....	.....
Machinist	2	3.00	6.00	..	.....	.....
Machinist's helper	1	1.75	1.75	..	.....	.....
Electrician	2	3.00	6.00	1	2.50	2.50
Electrician's helper	1	1.75	1.75	..	.....	.....
Lampman	1	1.50	1.50	..	.....	.....
Pumpman	1	1.50	1.50	..	.....	.....
Finishers	3	2.50	7.50	..	.....	.....
Hoist engineers	12	3.00	36.00	..	.....	.....
Dinky engineers	5	2.75	13.75	1	2.75	2.75
Brakemen	5	1.75	8.75	1	1.75	1.75
Switchmen	1	1.50	1.50	..	.....	.....
Barnmen	1	2.00	2.00	1	2.50	2.50
Drivers	9	1.50	13.50	..	.....	.....
Foremen ductmen	..	.....	.....	2	2.50	5.00
Ductmen	..	.....	.....	5	2.00	10.00
Foremen laborers	13	3.50	45.50	2	3.50	7.00
Laborers	120	1.75	210.00	20	1.75	35.00
Compressor engineer	1	3.50	3.50	1	3.50	3.50
Firemen	2	2.50	5.00	1	2.50	2.50
Oiler	1	1.75	1.75	..	.....	.....
Coal passers	2	1.75	3.50	1	1.75	1.75
Totals	324	....	$469.75	50	....	$108.25
Total daily labor expense						$578.00

ing, until the concrete could be packed against it.

Where the water-proofing was placed against the sand-wall, the method of securing the sheets at the top is shown in the small sketch on Fig 15. At the start an attempt was made to stick the water-proofing to the sand-wall, but this could not be done on account of its dampness and the overhang at the top.

The sand-wall water-proofing was kept about 35 ft. ahead of the finished bench-wall. As the bench-wall form was moved ahead and set, the mat was braced back against the sand-wall from the forms at a point just above the top of the finished bench, care being taken to avoid wrinkles, as, if these were once formed, it was practically impossible to straighten them out.

The completion of the bench-wall left the upper part of this water-proofing stretched taut across the curved top of the sand wall, forming a chord of the arc. As the arch was built up, the top was gradually slackened so as to allow the concrete to press the mat back into place until the top of the sand wall was reached, when the end was turned in, as shown at *C*, Fig. 9, or the waterproofing was continued over the arch, if that was necessary.

The desire to obtain a dry tunnel, and the methods adopted to secure it, were responsible in a great measure for the decision to build the arch in short lengths, as well as the reasons given under the head of arches. Had the tunnels been dry throughout, the method shown at *A*, Fig. 9, could have been used exclusively, and, except for the fact that monolithic concrete might not have been obtained, there would have been no objection to building longer lengths.

The quantity of water reaching the tunnel drains and flowing out of their lower ends after the completion of the lining was about 100,000 gals. per day, or 75 gals. per min.; of this it is estimated that considerably less thaan 1 per cent comes through the lining in the form of leaks. The very general distribution of this water over the roof is indicated by the fact that, during the excavation of the first 1,000 ft. of both tunnels from the Weehawken end, oilskins had to be provided for the laborers to induce them to work at all. The success, therefore, of the rock packing as a means of diverting this water to the side drains, is shown, especially in view of the fact that, excluding the cut-and-cover section, only 10 per cent of the length of the arch, 1,189 ft., was waterproofed.

Considerable care was taken to make all joints in the concrete which were in such a position that water might follow through them to the inside of the tunnel lining, in such a manner that they would slope outward toward the rock. The top of the sand wall is shown by Figs. 5 and 9. The slope of the back of the foundation may be noted in Fig. 9, and the method of making the joint in the arch, in the few instances where a section was not completed at one operation, is shown at *A*, Fig. 9. These joints in the arch were not allowed to be made above a point 60 degrees above the springing line.

Table I shows approximately the number of men employed daily on the tunnel lining, by both the contractor and the sub-contractors, their occupation, the average rate of wages and the total daily expense for labor when the work was in full swing.

Some Notes on Cost of Treating Ties with Preservatives.*

Comparative Cost of Treating Seasoned and Unseasoned Ties.—With some process, air seasoned ties only can be treated, while with others either seasoned or unseasoned ties may be treated, the latter being artificially seasoned in the retorts by steaming. The question is often asked whether it is more economical first to season the ties in the yard, or artificially to season them in the retorts, and thereby treat them immediately as delivered to the plant.

This is a somewhat difficult question to answer, as there are so many factors to be taken into consideration, and what will apply to one locality may not necessarily apply to another. First, we would have to decide what is a seasoned tie. In the South a pine tie may be seasoned thoroughly in two months. In the Northern states it may require three to six months, and even longer. For an illustration, let us take a plant situated in one of the northern states, say Illinois, for I am better acquainted with that climate. We will assume that we have a plant with a capacity of treating 1,800,000 season ties annually, and that it will require an average of six months to air season the ties for treatment, necessitating the storing of 900,000 ties continually. Of course, ties will season more rapidly in warm weather than in cold weather, and some kinds of wood more rapidly than others, but the average may not be far from six months. We must further assume that we are using a process which can be adapted to either seasoned or unseasoned timber. We will also say that thoroughly seasoned ties can be treated in six hours, and that unseasoned ties will require nine hours, or in other words it will require one-half longer time to treat unseasoned timber. Of course this will vary one way or the other but this is no doubt a fair average.

*Extracts from a paper by F. J. Angier, Superintendent of Tie Preservation, Chicago, Burlington & Quincy R. R., read at the February meeting of the New York Railroad Club.

Seasoned Ties.

Capacity of Plant, 1,800,000 Per Year.

Unloading from cars to ground to season at 0.0070 each	$ 12,600.00
Loading from ground to trams after seasoning at 0.0055 each	9,900.00
Switching trams from yard to retorts at 0.0020 per tie	3,600.00
Loading treated ties out at 0.0065 each	11,700.00
Fixed expenses	28,800.00
Preservatives at 0.150 per tie	270,000.00
Fuel (assume ⅓ less for seasoned over unseasoned ties)	6,000.00
Insurance on 900,000 ties (estimated)	3,000.00
Interest on 900,000 ties, or say 5 per cent on $450,000	22,500.00
	$368,100.00
600,000 more seasoned ties treated than unseasoned, worth 0.0451 each. (See part 12)	27,060.00
Total	$341,040.00

This gives a cost of $0.1895 per tie.

Unseasoned Ties.

Capacity of Plant, 1,200,000 Per Year.

Unloading one-sixth from cars to ground to enable prompt releasing of cars, and to insure a continuous supply so as not to delay plant at 0.0070 each	$ 1,400.00
Loading 1,000,000 ties from cars to trams for treatment, and 200,000 ties from ground to trams at 0.0055 each	6,600.00
Switching 200,000 ties from yard to retorts at 0.0020	400.00
Loading treated ties out at 0.0065	7,800.00
Fixed expenses	28,800.00
Preservatives at 0.150 per tie	180,000.00
Fuel (estimated)	9,000.00
Insurance on 200,000 ties (estimated)	665.00
Interest on 200,000 ties, or say 5 per cent on $100,000.00	5,000.00
Total	$239,665.00

This gives a cost of $0.1997 per tie.

From the above statement results show that to treat thoroughly seasoned ties, the cost is $0.1895 per tie; whereas, the unseasoned ties cost $0.1997 each, or a difference of $0.0102 in favor of seasoning. This multiplied by 1,800,000, the capacity of the plant, represents a saving of $18,360 per year.

In addition to this saving there would no doubt be other advantages, such as a better penetration by the preservatives, thereby getting a greater life out of the ties, and reducing the liability of weakening the timber from excessive steaming. Another important factor is that in steaming there is always a large amount of sewage to dispose of, while in non-steaming there is practically none. The disposition of sewage is always a difficult problem at any plant, because no matter how you handle it, it will eventually get into the rivers or creeks and pollute the water supply to such an extent that damage suits may result sooner or later.

Cost of Treatment and Returns on Investment.—A plant consisting of three treating cylinders, each 6 ft. in diameter and 132 ft. long, will have a capacity of about 1,500,000 ties annually. The estimated cost of the plant is $175,000. The life of such a plant is estimated to be at least 15 years. To arrive at the cost of treating ties the following items are considered:

First—Interest on $175,000 invested at 5 per cent compound interest for 15 years represents an annual charge of $12,587.

Second—Depreciation. Estimating the life of the plant at 15 years, we will charge off 6⅔ per cent or $11,666 annually.

Third—Insurance. The stock of ties, as well as the buildings should be insured and a reasonable estimate may place the annual premium at $5,000.

Fourth—Freight on Ties to Plant. It would not be right to charge all freight on ties to the treatment, but it may be reasonable to assume that every car of ties for treatment is hauled on an average of 100 miles, and we can base the freight haul on a rate of ½ ct. per ton per mile. Also estimate that cars will hold an average of 390 ties each, and that the ties will average 135 lbs. in weight. Thus, 1,500,000 ties will require 3,846 cars to haul them to the plant, and these ties weigh 101,-

250 cars. This represents an annual expenditure of $50,625.

Fifth—Switching. To switch 3,846 cars of ties, plus approximately 500 more containing preservatives, fuel, etc., or say a total of 4,346, in and out of plant at 50 cts. per car, will cost $2,173.

Sixth—Per diem on Cars. It is not always possible to unload ties the same day that they are received; in fact it often happens that they are delayed a week or more from one cause or another, in which case we are called upon to pay a per diem charge of 25 or 50 cts. For our present purpose it may be reasonable to estimate $1 per car, or an annual cost of $3,846.

Seventh—Operating the Plant. This will include all labor and material other than itemized above, estimated $300,000.

These expenses are summarized as follows:

	Total Cost Per Year.	Cost Per Tie.
First—Interest	$ 12,587.00	$0.0084
Second—Depreciation	11,666.00	.0078
Third—Insurance	5,000.00	.0033
Fourth—Freight on Ties	50,625.00	.0337
Fifth—Switching	2,173.00	.0014
Sixth—Per Diem on Cars	3,846.00	.0026
Seventh—Operating Plant	300,000.00	.2000
Total	$385,897.00	$0.2572

We do not know just what lift these ties will give, but it may be fair to assume twelve years for treated ties, and six years for untreated ties, or in other words, treating will double their life. For our purpose of comparison we will not consider tie plates in either case.

Untreated Ties.
(Life assumed as 6 years.)

First cost of tie (estimated)	$0.500
Insurance, interest, freight, etc. (as per statement "A")	.0435
Cost of putting in track	.150
Cost of tie in track	$0.693
5% compound interest on investment for six years	0.2320
Second renewal end of six years	0.6935
5% compound interest on 1st investment for six years and 5% on 2d investment for six years	0.5503
	$1.4758
Total cost of tie for period of 12 years	$2.1693
Average cost per tie per year	0.1808

Treated Ties.
(Life assumed as 12 years.)

First cost of tie (estimated)	$0.7572
Cost of putting in track	0.15
Cost of tie in track	$0.9072
5% on $0.9072 for 12 years	.7220
Total cost of tie for 12 years	$1.6292
Average cost per tie per year	.1357
Saving per tie per year	0.0451

Taking capacity of plant at 1,500,000 ties, this would show an annual saving of $67,650, which is nearly 39 per cent on the original investment of $175,000.

(Statement "A").
Untreated Ties.

	Total.	Per tie.
Insurance (assumed to be the same as with treated ties)	$ 5,000.00	$0.0033
Freight (assumed to be one-half as much as with treated ties)	25,312.50	0.0169
Switching 3,846 cars of ties in and out of storage yards at 50 cts. per car	1,923.00	0.0012
Per diem on cars (assumed to be the same as with treated ties)	3,846.00	0.0026
Handling ties in storage yard (unloading 1,500,000 ties from cars to ground at $0.007 each, and loading from ground to cars at same rate)	21,000.00	0.0070
Interest on 750,000 ties, or 5% on $375,000 (assuming that one-half the ties are in the storage yard constantly)	18,750.00	0.0125
	$75,831.50	$0.0435

During the month of February the contractors for the Roosevelt Dam of the Salt Lake project of the U. S. reclamation service have placed 8,000 cu. yds. of masonry, bringing the elevation of the lowest point to 180 ft. above stream bed and of the highest point to 235 ft. above stream bed. At the end of the mouth the dam was 93 per cent completed.

Unclassified and General Articles

Note: This section is devoted to methods and cost articles on construction work not properly coming under any of the preceding classifications.

New Formulas for Base and Bearing Plates.

Professor N. Clifford Ricker, professor of architecture, University of Illinois, has been making experiments having in view the production of accurate formulas for base and bearing plates. The results are given in Bulletin No. 35, University of Illinois Experiment Station, from which the following data are taken.

Complete formulas for plates of uniform thickness:

Let A = total area of plate in square inches.
P = total load in pounds transmitted by it.

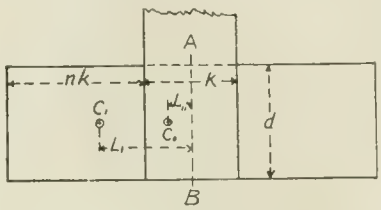


Fig. 1.

k = width of beam or girder resting on plate.
nk = distance from edge of beam or girder to edge of plate.
d = width in inches of the plate, usually equal to the thickness of the wall.
t = thickness of the plate in inches.

According to usual formulas for moment of resistance,

$$\frac{Pnk}{4} = \frac{fdt^2}{6}$$

Hence $t = \sqrt{\frac{3Pnk}{2fd}}$ for any material

with f = maximum safe fiber stress in pounds per square inch.

and $t = \frac{1}{103.3}\sqrt{\frac{Pnk}{d}}$ for steel plate $f = 16{,}000$ pounds.

$t = \frac{1}{44.7}\sqrt{\frac{Pnk}{d}}$ for cast iron $f = 3{,}000$ pounds.

$t = \frac{1}{40.8}\sqrt{\frac{Pnk}{d}}$ for cast iron $f = 2{,}500$ pounds.

The foregoing formulas refer to Fig. 1. If a square or cylindrical column stands on the bearing plate instead of the end of a beam resting thereon, the general formulas become:

$t = \frac{1}{103.3}\sqrt{\frac{P}{d}\left(\frac{nk}{2} + \frac{k}{4} - L''\right)}$ for steel plate. $f = 16{,}000$ lbs.

$t = \frac{1}{44.7}\sqrt{\frac{P}{d}\left(\frac{nk}{2} + \frac{k}{4} - L''\right)}$ for cast iron. $f = 3{,}000$ lbs

$t = \frac{1}{40.8}\sqrt{\frac{P}{d}\left(\frac{nk}{2} + \frac{k}{4} - L''\right)}$ for cast iron. $f = 2{,}500$ lbs.

in which L'' = perpendicular distance in inches from fracture line to center of downward pressures on one-half the area of the plate.

$L'' = 0.25 \times$ width of beam or girder on a bearing plate.

$L'' = 0.25 \times$ side of a solid square post or column.

$L'' = 0.2187 \times$ diameter of solid octagonal post or column.

$L'' = 0.2122 \times$ diameter of solid cylindrical post or column.

For hollow posts or columns L'' is found as follows:

Let R = radius of outer circle inscribed in cross section of hollow square or cylindrical column.

r = radius of inner circle inscribed in hollow square or round column.

Then $L'' = 0.500 \frac{R^2 - r^2}{R^2 - r^2}$ for a hollow square column.

Limiting values are $\begin{cases} 0.500\ R \text{ for a solid column.} \\ 0.750\ R \text{ for a very thin shell column.} \end{cases}$

Also $L'' = 0.424 \frac{R^2 - r^2}{R^2 - r^2}$ for a hollow cylindrical column.

Limiting values are $\begin{cases} 0.424\ R \text{ for a solid column.} \\ 0.637\ R \text{ for a very thin shell column.} \end{cases}$

These values of L'' may readily be found by calculation, but much more easily by the aid of the diagram, Fig. 2.

Example in use of Fig. 2: Assume a hollow cylindrical column, 12 ins. external and 9 ins. internal diameter.

Then $\frac{r}{R} = \frac{4.5}{6.0} = 0.75$.

By the diagram $L'' = 0.56\ R = 3.36$ ins.

In the experiments made at the University of Illinois by Mr. C. R. Dick, as thesis work under the direction of Professor Ricker, plates were designed by older formulas and tested to destruction. The fracture line was under the load and was in all cases a diameter of the plate, a shorter diameter when such was possible.

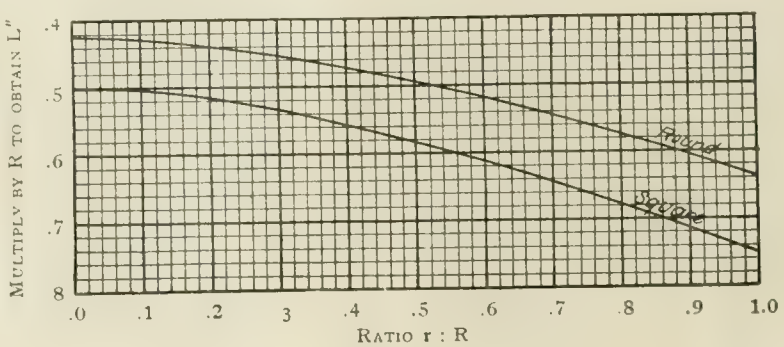


Fig. 2.

The formulas above given for cast iron bearing plates are also applicable to plates of the same material tapered in thickness from beam or column to each end, since the fracture section always remains rectangular in form. With tapered plates, nk = length in

inches of each tapered portion of the fracture section.

SQUARE PLATE (FIG. 3).

Let S = side of square plate in inches.

then $t = \sqrt{\frac{3P}{fS}\left(\frac{S}{4} - L''\right)}$

$t = \frac{1}{73}\sqrt{\frac{P}{S}\left(\frac{S}{4} - L''\right)}$ for steel f = 16,000 lbs.

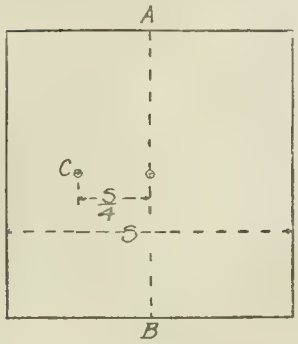


Fig. 3.

$t = \frac{1}{31.6}\sqrt{\frac{P}{S}\left(\frac{S}{4} - L''\right)}$ for cast iron f = 3,000 lbs.

$t = \frac{1}{28.9}\sqrt{\frac{P}{S}\left(\frac{S}{4} - L''\right)}$ for cast iron f = 2,500 lbs.

OCTAGONAL PLATE (FIG. 4).

Let D = inscribed diameter of polygon.

$L' = 0.2187\ D$.

then $t = \sqrt{\frac{3P}{fD}}\ (0.2187\ D - L'')$

$t = \frac{1}{73}\sqrt{\frac{P}{D}}\ (0.2187\ D - L'')$ for steel. f = 16,000 lbs.

$t = \frac{1}{31.6}\sqrt{\frac{P}{D}}\ (0.2187\ D - L'')$ for cast iron f = 3,000 lbs.

$t = \frac{1}{28.9}\sqrt{\frac{P}{D}}\ (0.2187\ D - L'')$ for cast iron. f = 2,500 lbs.

L' = perpendicular distance in inches from fracture line to center of upward pressures on one-half the area of the plate.

Then $L' = 0.25 \times$ length in inches of a wall or bearing plate.

$L' = 0.25 \times$ side of a square plate.

$L' = 0.2187 \times$ inscribed diameter of octagonal plate.

$L' = 0.2122 \times$ diameter of a circular plate.

CIRCULAR PLATE (FIG. 5).

Let D = diameter of the plate in inches.

$L' = 0.2122\ D$.

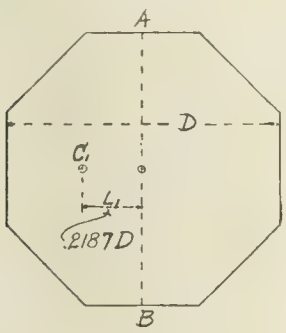


Fig. 4.

then $t = \sqrt{\frac{3P}{fD}}\ (0.2122\ D - L'')$

$t = \frac{1}{73}\sqrt{\frac{P}{D}}\ (0.2122\ D - L'')$, for steel. f = 16,000 lbs.

$t = \frac{1}{31.6}\sqrt{\frac{P}{D}}\ (0.2122\ D - L'')$ for cast iron. f = 3,000 lbs.

$t = \frac{1}{28.9}\sqrt{\frac{P}{D}}\ (0.2122\ D - L'')$ for cast iron. f = 2,500 lbs.

PLATES OF TAPERED THICKNESS.

These comprise all cast iron base plates, which are always made thinner at their edges for the sake of economy. Bearing plates of cast iron set on walls, however, have a rectangular fracture section, for which direct formulas have already been given. When the plates are tapered the formulas become somewhat complicated and the work is simplified by the use of the diagram given in Fig. 6.

Let t = thickness in inches at middle.

t' = thickness in inches at edge.

n = ratio between k and length in inches of each tapered portion.

1. Assume n.

2. Compute the thickness for a rectangular fracture section.

3. Assume the desired ratio $\frac{t'}{t}$ of thickness at edge and middle.

4. On the right of Fig. 6 the ratio $\frac{t'}{t}$ is found and along the top are values of n. With the assumed values determine the per cent, @, of the resistance of the plate in comparison with a plate of rectangular section of equal width and thickness.

5. By the following formula compute the required actual thickness t at the middle of the plate. Then t' is easily found.

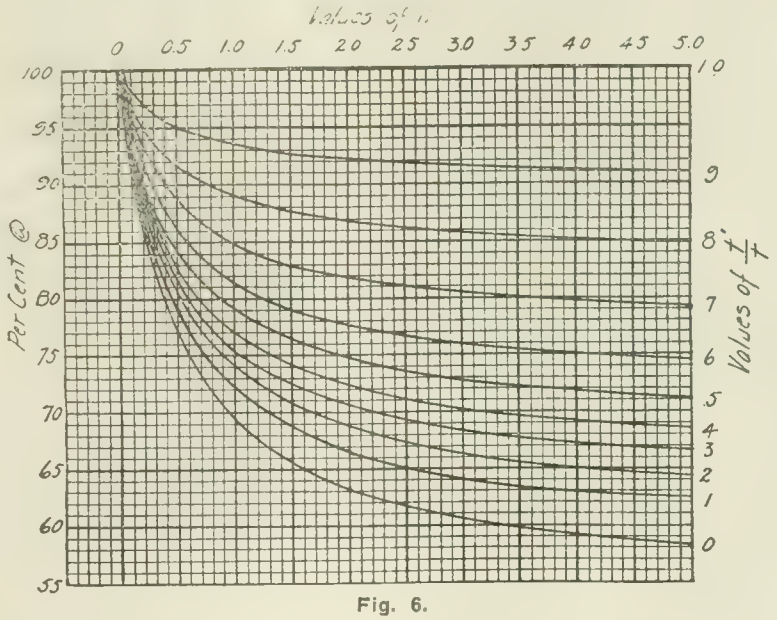


Fig. 6.

$t = \sqrt{\frac{100}{@}} \times \frac{1}{50}\sqrt{\frac{3P}{B}}\ (L' - L'')$ for cast iron.

in which $B = k\ (2n + 1)$ = length in inches of fracture section.

The bulletin contains a full account of the experiments and a study of the results whereby the formulas were obtained. The examples worked out by the author show that simple formulas and diagrams have been devised, making the design of safe bearing and base plates a very simple matter. Diagrams are given showing ratio of r/R, values of ratio n, values of strength per cent @, dimensions of plates, relations of $\sqrt{\frac{3P}{B}}$, $L' - L''$, and t, with typical examples worked out.

Boyes, Hulshizer & Co., Seward, Nebr., owners of the Seward flouring mill, have made a proposition to the city of Seward to rebuild their dam on the Blue River and put in a power plant to furnish electricity to the city, providing the city will enter into a ten-year contract for the electricity.

LETTERS TO THE EDITOR.

Hydraulic Filling Using Long Pipe Lines and Relay Pumps.

Sirs:—Referring to Mr. Allan's description on method and cost of hydraulic filling at Cairo, Ill., in your issue of Feb. 16, I beg to call attention

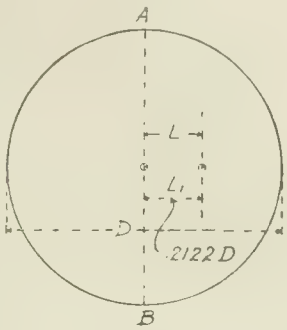


Fig. 5.

to more ambitious and successful delivery through long pipes at Galveston, Tex., by the North American Dredging Co., of which I was then engineer and New York agent. I do not claim to have designed the installation, as it was in operation before I joined the company.

While the outfit could have been improved by purchasing new machinery in general harmony of proportion and style, it was nevertheless as successful as could be expected and using a large proportion of second-hand material for the relay stations. As the whole matter is a world's record as far as is known, it may be of interest to your readers, and I present the data in tabular form:

Diameter of pipe	20 ins.
Maximum pipe length	11,000 ft.
Maximum vertical lift	17 ft.
First pump, 20-in. regular suction dredge.	
Dredge location on inside marsh.	
Material 10 ft. top mud and 20 ft. sand below.	
Dredge pump engine 500 H. P.	
First relay plant, fixed steam engine boiler and pump, and also an electric generator for second relay.	
Second relay, semi-portable.	
Second relay machinery, electric motor and pump.	
Material handled per month	120,000 cu. yds.
Engine hours per month	600 to 630
Contract price per cu. yd. of filling	about 21 cts.

It will be noted that the material was pumped twice as far as at Cairo, with about half the Cairo lift and the friction head made the total resistance fully up to the Cairo total.

All records were broken for continuous engine hours per month, and as many as five days in one month showed 24 hours continuous opera-

tion without a single minute lost by stoppage from engine and pump.

It is obvious that if the Cairo people had possessed the experience of the old hydraulic dredging companies, they would have avoided many of the troubles which required re-arrangement of their plant, and they would not have needed to use a double suction pump to avoid thrust at the sacrifice of simplicity and convenient access. The fact remains, however, that it is a bold undertaking to pump coarse sand through such small pipe for such great distances and the pumps would have lasted much longer, and the delivery would have been considerably higher if two relays had been used instead of one, and especially if both could have been electrically driven.

Yours very truly,

H. S. Wood.

New York, N. Y., Feb. 24, 1910.

What Caused the Failure of the Dansville Dam?

Sirs. In your issue of March 2, 1910, Mr. R. C. Beardsley criticises very severely my letter in the issue of Feb. 2 commenting on the failure of the Dansville dam. He jumps to the conclusion that I advocated a certain method of design, whereas in the second paragraph of my letter appears the following sentence: "I do not blame poor workmanship, except as a contributing cause, for the design in my opinion is poor."

My letter was written in defense of the contractor. Several accounts of the failure of this dam had appeared in leading technical papers. In all accounts the failure was blamed on the contractor, whereas in my opinion the failure of the dam was due to faulty design. I did suggest that if the designer had computed the forces acting against the face he might have reinforced the bottom slab, but that was not an approval of his work, which I had already condemned.

There are plenty of standard texts on the building of dams, not the least of which must be ranked the excellent book by Mr. Beardsley, so it is not difficult for designers to secure safe guidance. The discussion so far elicited, and which Mr. Beardsley wonders at, seems to be unanimous on one point, which is that the design was faulty.

Chicago, March 8, 1910. Q. E. F.

A Method of Determining Relative Economy.

Sirs: I am in receipt of Engineering-Contracting of Jan. 19 which contained an article by me on "A Method of Determining Relative Economy, With Rules and Tables for Practical Computation." In looking this over I note that the bracket has been omitted at the end of equation (5); also notice that an error has been made in print by the omission of the prime sign (′) for the N of the denominator of the second fraction of the first term of the seventh equation. Equation (7) should be written as follows:

$$\left[\frac{(1+K)^N}{(1+K)^N-1} - \frac{1+K)^{N'}-1}{(1+K)^{N'}}\right] C$$

Very truly yours,

SHELBY S. ROBERTS.

1018 West Nevada St., Urbana, Ill., Feb. 18, 1910.

Technical Society Meetings.

The list following names those technical societies in which engineers and contractors are most interested, whose meetings are to be held within three months of the date of this issue. There are given for each society listed the date and place of meeting and the name and address of the secretary, to whom all communications and inquiries should be addressed.

American Institute of Mining Engineers.
March 1-5. Annual meeting at Pittsburg, Pa. Secy., R. W. Raymond, 29 West 39th St., New York City.

American Railway Engineering and Maintenance of Way Association.
March 15-17, 1910. Annual convention at Chicago, Ill. Secy., E. H. Fritch, 962 Monadnock Block, Chicago, Ill.

American Water Works Association.—April 26-30, 1910. Annual convention at New Orleans, La. Headquarters, Gruenwald Hotel. Secy., J. M. Diven, Charleston, S. C.

Notes from Technical Societies.

Annuel meeting of the Iowa Engineering Society.—The twenty-second annual meeting of the Iowa Engineering Society was held at Cedar Rapids, Iowa, Feb. 16 and 17. An enthusiastic meeting was reported, about thirty members being present. The welcoming address was made by Mr. Matt J. Mile, Mayor of Cedar Rapids. A paper on "Concrete Construction in Cold Weather" was read by Mr. J. H. Chubb. Mr. A. H. Ford spoke on "Rates for Electric Service." The "Direct Method in Illuminating Engineering" was discussed by Mr. L. B. Spinney.

Monthly Meeting of the Engineers' Society of Western Pennsylvania.—The monthly meeting of the Engineers' Society of Western Pennsylvania was held Feb. 15 at Pittsburg, Pa. Mr. Elmer K. Hiles was re-elected secretary for the ensuing year. A feature of the programme was a paper presented by Mr. J. C. Roberts, Assistant Chief Engineer Technologic Branch, U. S. Geological Survey, on "The Government Testing Station in Pittsburg." An exhaustive description of the work accomplished, as well as that taken up in connection with the testing of structural materials and the causes and prevention of mine accidents, was given. The saving of waste coal, the testing of explosives and safety lamps, and the provision of rescue stations and rescue apparatus were among the topics enlarged upon. The society made arrangements for an inspection trip to the testing station in Pittsburg on Feb. 26. Tests of explosives found in coal dust, safety lamp tests, tests of fire brick, etc., will be made. In addition a practical demonstration of rescue work as carried out in the mines will be given.

Canadian Cement and Concrete Association Exhibition.—The annual exhibition and convention of the Canadian Cement and Concrete Association will be held at London, Ont., March 29-April 1. Particulars in regard to special railroad rates, admissions, etc., will be supplied by Mr. R. E. W. Hogarty, secretary of the association, 662 Euclid avenue, Toronto. The convention will be held in London, Ont., during the exhibition. Arrangements are being made for a programme, with addresses by representatives of cement and concrete engineering, manufacturing and contracting firms from various parts of Canada and the United States. A complete programme will be printed later.

Catalogs Worth Having.

Engineers and contractors should have on file the latest catalogs of machines, tools and supplies that they use. In sending for catalogs reviewed or advertised in this paper, you will confer a favor on us if you will write directly to the advertisers and state that you saw the catalog mentioned in ENGINEERING-CONTRACTING. If you are in the market for tools, machinery or supplies, tell us and we will notify promptly the leading manufacturers.

Cement.—Paper 10x13½ ins. 6 pp. Ash Grove Lime & Portland Cement Co., R. A. Long Bldg., Kansas City, Mo.

Shows the cement dealer how this company advertises their product for the benefit of the dealer. Contains a number of sample advertisements to be run in the dealers' local paper, also tells of the arguments advanced to the prospective user for the products manufactured by this company.

Uses of Mineral Oil Mixed Concrete.—Paper 6x9 ins. 8 pp. Vulcanite Portland Cement Co., Philadelphia, Pa.

This pamphlet contains an able discussion on concrete mixed with mineral oil, with test records and other valuable information, as well as a few remarks on the methods used in the manufacture of this company's product.

Dump Wagons and Dump Boxes.—Troy Wagon Works Co., Troy, O.

Two little folders sent by this company describe in a concise manner a dump wagon and a portable dump box made by them. The use of the dump box in converting an ordinary teaming or farm wagon into a dump wagon for sand, gravel, crushed stone, etc., is explained.

Steel-Bound Concrete Curb.—Paper 4¾x7 ins. 16 pp. Steel Protected Concrete Co., Real Estate Trust Bldg., Philadelphia, Pa.

Contains directions for laying steel-bound concrete curbs. Explains with the aid of diagrams, the methods of excavating trenches, building forms, laying the concrete and setting the corner bar. Also shows how to set forms having curves, giving process of finding length and location of any desired curve.

Concrete Construction.—Paper 6x9 ins. 8 pp. Aberthaw Construction Co., Boston, Mass.

Contains a number of handsome photographs of buildings erected by this company.

Pile Driving Hammer.—Paper. 4x7½ ins. 12 pp. Aug. A. Goubert, 90 West St., New York, N. Y.

This pamphlet describes the Goubert steam pile driving hammer. The principles of pile driving and the essentials of a steam hammer are discussed.

Aggregate.—Paper. 6x9 ins. 15 pp. Edison Portland Cement Co., New Village, N. J.

This booklet tells about the $10,000,000 Chelsea dock improvement of the city of New York. A number of views of the elaborate ornamental concrete work on the dock front are shown.

Track Devices.—Paper. 6x9 ins. 55 pp. Q. & C. Co., Old Colony Bldg., Chicago, Ill.

A well prepared catalogue of rail joints, anti-rail creepers, guard rail clamps, braces, portable saws, rail benders, and other rail devices. Also describes, a deformed bar, a metal and cement tie and a surfacing and rail lining block sold by this company. In addition, contains dimension sheet on Am. Soc. C. E. and Am. Ry. Assoc. rail sections, with some useful information on weights and measurements, together with some handy tables on railway construction work.

Fabricated Reinforcement.—Paper. 6x9 ins. 16 pp. Corrugated Bar Co., Bank of Commerce Bldg., St. Louis, Mo.

A detailed description of the fabricated concrete reinforcing products of this company with some well chosen arguments on the advantages of the design used by them.

Core Drills.—Paper. 6x9 ins. 60 pp. Terry Core Drill Co., 50 Church St., New York, N. Y.

This book gives full information on core drills for prospecting, testing, blasting, etc., made by this company. Also contains instructions for setting up and operating core drills, with lists of appliances needed for equipping different classes of drills.

Draughting Specialties.—Paper. 3¼x5¼ ins. 8 pp. Henry V. St. George, Inc., 10-14 Grand St., New York, N. Y.

Describes the heliographic process of outlining tracing sheets and printing titles, comparing the cost of doing this work by hand with that of the above mentioned process.

Expansion Bolts.—Paper. 6x9 ins. 17 pp. A. C. Seaman, 1638 Hutchinson St., Philadelphia, Pa.

This is the revised 1910 price list on expansion bolts made by this firm. A description of the different kinds of bolts with illustrations is given.

Hoisting Machinery.—Paper. 5x6¾ ins. 110 pp. S. E. Parker, Chicago, Ill.

A complete catalogue of derricks, drums, cranes, elevators, barrows and carts, and hoisting equipment. Fully illustrated with cuts showing details of all machines and method of setting up and operating.

Contractors, Engineers and Railroad Supplies.—Paper. 9¾x12 ins. 12 pp. G. W. Cole, 50 Church St., New York, N. Y.

An illustrated catalogue of dump wagons, plows, scrapers, barrows, pumps, etc., and contractors' hand tools with price lists on each.

Smith Mixer.—Paper, 6x9 ins., 36 pp. The T. L. Smith Co., Old Colony Bldg., Chicago, Ill.

This catalog anticipates and answers every question a prospective purchaser might ask. Line drawings are given of different sizes for the assistance of draftsmen in designing installations.

Rubber Belt Conveyors.—Paper, 3½x6 ins., 24 pp. The Jeffrey Mfg. Co., Columbus, O.

Contains much useful information on the subject of rubber belt conveyors and belts for power transmission.

Reinforced Concrete Design. — Trussed Concrete Steel Co., Detroit, Mich.

For the quick and accurate design of slabs this company has issued a pocket circular slide rule. With one setting, knowing the span and load, is found the thickness of slab and amount of steel. On the back is a table of beams and girders with reinforcement required. Full directions accompany this rule.

Acme Wagons.—Acme Wagon Co., Emigsville, Pa.

This company sends in several envelope size folders describing dump wagons and stone spreader wagons for the use of contractors and municipalities.

The York Gas Engine.—Catalog 9-B. Paper, 6 x9 ins., 48 pp. Flinchbaugh Mfg. Co., York, Pa.

This is a very complete catalog of engines operating by use of standard gas, producer gas, gasoline, kerosene and alcohol. Stationary and portable outfits are illustrated, together with a traction engine propelled by an internal combustion engine.

Farquhar Machinery.—Paper, 9x12 ins., 70 pp. A. B. Farquhar Co., Ltd., York, Pa.

This catalog illustrates road engines, portable engines, boilers, sawmills, horse powers, crushing plants, etc.

Reinforced Concrete Design, No. 1.—Paper, 3½x6 ins., 70 pp. Northwestern Expanded Metal Co., Chicago, Ill.

This company about two years ago commenced issuing a series of booklets on reinforced concrete design. The present booklet is a consolidation of the first five and parts of two more, with additional matter. It is a useful pocket book on design of beams, slabs, columns and sidewalks, containing also data on stucco for houses. Tables and diagrams are given, the intention being to make it of use to architects, contractors and engineers.

Contract News Section

of

ENGINEERING-CONTRACTING

A Consolidation of ENGINEERING-CONTRACTING—CONTRACT NEWS—ENGINEERING WORLD—THE DIRT MOVER.

Containing Items of Interest to Railroad, Public Works and Other Contractors.

The Doings of the Week. Several fairly large railroad construction contracts have been let since our last issue among them being the following: The Texas Co., Fort Worth, Tex., for constructing the first 20 miles of grade for the Brownwood North & South Ry., from Brownwood, Tex., to May, Tex.; the Hauser Construction Co., Los Angeles, Cal., for constructing the Fullerton-Richfield cut off, five miles, for the Santa Fe.; Robert Grace, 830 Schofield Bldg., Cleveland, O., for excavation work on the new yards of the B. & O. R. R., at Chicago Junction, the contract amounting to something like $1,500,000; the Jennings Construction Co., Joplin, Mo., for constructing the first section of the Arkansas Valley Interurban Ry., between Wichita, Kan., and Valley Center, Kan.; Theodore Lutguerding, Wichita, Kan., for constructing the Wichita, Kinsley, Scott City & Denver Air Line Ry.; Smith & Scott, Garden City, Kan., for constructing a section on the Nebraska, Kansas & Southern Ry.—One feature of the week worthy of note is the large number of electric railways which have advanced preliminary arrangements so far that they will shortly let contracts for construction work. Among these companies are the following: The Houston-Galveston interurban line to connect the two cities named; the Slippery Rock & Grove City Traction Co., for a 9 mile line from Slippery Rock, Pa.; the Niagara Frontier Traction Co., for an 8 mile line from Niagara on the Lake, Ont.; the Aberdeen Ry. Co., for six miles of street railway in Aberdeen, S. Dak., and the Cherryvale, Oklahoma & Texas Ry., for a 62 mile line from Caney, Kan., to Nowata, Okla.—The contract for the construction of one of the largest private irrigation systems in the west was let during the past week. This contract calls for the construction of the irrigation systems of the Colorado Southern Irrigation Co., and the Canon City, Florence & Pueblo Water Co., in Colorado. The contract amounts to $12,987,000, and was secured by Kenefick, Quigley & Russell, Denver, Colo., and Kansas City, Mo.—Two large municipal contracts have also been let recently. The first of these calls for the construction of the dam, spillway, etc., at the White Rock reservoir site for the city of Dallas, Tex. The other contract calls for the construction of the headworks and tunnel for the power plant on the Nisqually River for the city of Tacoma, Wash. The contract price was $655,255, and the contract was secured by Wright & Sweeney Co., Pacific Ave., Tacoma. The work includes a tunnel 8 ft. in diameter and 100,000 ft. long.

Battleships. Our little friend the Argentine Republic seem to have slipped one over on the English and other foreign ship builders in the recent award of contracts for two battleships. In the beginning Argentina issued a request to the warship builders of the world for the submission of battleship designs fulfilling stated conditions. Some 20 firms replied to the request and prepared at least 60 designs and specifications the preparation of which probably cost at least $100. These didn't seem to be satisfactory to Argentina and another set of designs was asked. The ship builders complied and again prepared which probably cost at least $100,000. These also were not satisfactory and the government went through the process for the third time, and then to the ire of our British cousins especially awarded the $22,000,000 contract to an American firm, the Fore River Ship Building Co., of Massachusetts. And now the British ship building interests are claiming that Argentina by its cleverness in asking for the many designs, has obtained a host of secrets relative to British battleship constructions.

Levee Work in Missouri. The State Labor Bureau of Missouri is doing good work in its efforts to convince the land owners of that state that a concerted effort should be made to protect their lands from floods. Figures issued recently by the Bureau show that the damage to crops alone in the 53 counties of the state from the floods of July 1909 amounted to $18,896,340. In one county alone crops valued at $1,500,000 were destroyed, and 1909 was an off year for floods in Missouri. In the counties along the Missouri River the flood damage to crops in 1909 was $8,629,750. As the channel of the Missouri River from the Iowa line to the river's mouth north of St. Louis is about 575 miles long the crop loss per mile of river channel in 1909 was over $15,000. The Bureau estimates that the average cost of constructing new channels for small rivers and building levees will not exceed $15 per acre of land benefited; whereas the average loss of crops in one flood year is now from $18 to $25 per acre. The report of the State Labor Bureau from which the above figures are taken concludes as follows: It is not wisdom or economy for our property owners to longer neglect their land and leave it at the mercy of the floods. Land owners are committing an unpardonable sin by not conserving the land which our Creator placed here for the use and support of not only the present owners, but future generations. They should not feel as did the profligate French king who often declared: "Things will outlast our time." The Lord no longer speaks to the people by word of mouth and warns them of the deluges that are coming, as did he to the Patriarch of old, but he has taught us by example that floods will visit our low lands, and we should prepare for their coming, not as did Noah, by building an ark, but by constructing levees and other forms of protection to keep back the water. If the farmers persist in ignoring these warnings they should not murmur when their crops are swept away.

The Discoverer of the Water Jet. The water jet has been used for so many years both in putting down and pulling piling that its original discoverer has long since been lost sight of. It was used during the civil war and for many years previous by government engineers. Tradition has it that the discoverer of the advantages of the water jet was a government engineer, and that his discovery was made in the following manner. It seems that along in the forties this engineer was building a wharf, and was having unusual difficulty in putting down his piling. One day in wading around his boots became stuck in a tenacious mud and he found it impossible to pull them out. There happened to be a hose nearby and one of the men handed it to the officer, the idea being that he could wash the mud away from his boots. The water was turned on and the officer applied a stream to his feet. To his surprise he sank deeper. He tried it again and went down still further in the mud. By this time he was in up to his waist and still going down. Surprised by his discovery he continued to apply the stream to his feet and he might be going down yet had not his men came to the rescue and pulled him out by means of a small hand derrick. Once on shore he began to think. If a stream of water applied to a man's feet will cause him to sink deeper in the mud, why won't it have the same effect if applied to the base of a pile. He tried it and the pile which had obstinately refused to go down before sunk easily to place, and in that way states tradition was discovered the use of the water jet for putting down piling.

Confirmed Reports by Engineers and Contractors

RAILROADS, POWER DEVELOPMENTS, LEVEES, DRAINAGE AND IRRIGATION WORKS.

Railroads—Steam and Electric.

ARKANSAS.

F. C. Kyte, Carlisle, Ark., chief engineer Meto Valley R. R., has finished final survey of 40 miles for the Stuttgart Rice Belt R. R., from Devalls Bluff south through Stuttgart to Cummins Crossing on the Arkansas River, Construction work is to start this spring.

Contracts will be let by the County Court of Clay County, at 9 a. m., March 26, at the court house in Piggott, Ark., for the construction of main ditch and laterals in Drainage district No. 9. The work is located 5 miles east of Piggott at the upper end and the outlet is in the St. Francis River, 10 miles southeast of Rector, Ark. The total yardage is 470,927, and it is all dredge work. At the same time contracts will also be let for constructing four laterals requiring the removal of 19,350 cu. yards by team work. J. D. Mitchell, Rector, Ark., is the engineer.

CALIFORNIA.

The Atchison, Topeka & Santa Fe Ry. Coast Lines is about to put into execution a plan that has long been contemplated for the time when its overland freight business to and from Los Angeles should become heavy enough to warrant the outlay; that is, the building a line in Southern California, from Fullerton to Richfield. A great deal of the freight business between Los Angeles and San Bernardino is handled by way of Orange because of the low grades, and by the construction of this cut-off the mileage is diminished between these points eight miles, the new line being five miles in length. The cut-off will be constructed under the name of the Fullerton-Richfield R. R., and the contract has been let to the Hauser Construction Co., Los Angeles, Cal.

GEORGIA.

A company will be organized during this month to build a steam railroad from Toccoa to Carnesville, Ga., a distance of 20 miles. The required amount of money has been subscribed, the survey made and the contract will be let in the next few days. Contractors and dealers in supplies and machinery can address W. S. Erwin at Clarksville, Ga.

The Rome & Northern R. R. now has surveys under way for an extension from Gore to Tunnel Hill, Ga., a distance of 33 miles. Construction contracts will be let in about 30 days. H. M. Smith, Rome, Ga., is chief engineer.

IDAHO.

The Payette Valley Extension R. R. Co. (Payette Valley R. R.) has completed surveys and has secured the capital for the construction of a 19-mile extension to the Payette Valley Ry. Construction contracts will be let in about 30 days. C. W. Nibley, 14 North Main St., Salt Lake City, Utah, is president, C. P. Lattig, Payette, Idaho, is chief engineer, and H. E. Dunn, Payette, Idaho, is vice president and general manager.

IOWA.

Surveys are now being made for the projected 20 mile line of the recently incorporated Charles City Western Ry. Co. About $300,000 capital has been secured for the construction of this line, which is to extend from Charles City in a Southwesterly direction. No definite date has been set for awarding contracts. C. W. Hart, Charles City, Ia., is President. A. W. Dennis, Charles City, is also interested.

KANSAS.

Smith & Scott, Garden City, Kan., have been awarded the contract for constructing a portion of the Nebraska, Kansas & Southern R. R. The projected length of this road is 162 miles, and it is to extend from Omaha to El Paso. Surveys have been made and construction capital has been secured. Baxter Brown, St. Louis, Mo., is Chief Engineer, and J. C. Hopper, Ness City, Kan., is President.

Surveys have been started for the projected 62-mile line of the Cherryville, Oklahoma & Texas Ry. The capital for construction has been secured and construction contracts will be let as soon as locations are completed. The route is from Caney, Kan., to Nowata, Okla. and Vinita, Okla., S. M. Porter, Caney, Kan., is president and B. J. Dalton, Lawrence, Kan., is chief engineer.

MICHIGAN.

W. E. Tench & Co., 210 John R. St., Detroit, Mich., has been awarded the contract for constructing the Lansing & Owosso Electric Ry. between Lansing, Mich., and Owosso, a distance of 30 miles. The contract includes 250,000 cu. yds of earth excavation. Practically all of the work has been sublet, the subconstractors being Myron Warkley, Shaftsburg, Mich.; C. J. Snyder & Son, Perry, C. E. Swain, Owosso, Mich.; E. E. Thomas, Perry, Mich., and John Evans, Morrice, Mich. Tench & Co. are also working two steam shovel outfits. The Northern Construction Co., Morrice, Mich., will build all of the bridges, etc. All work is to be completed by Aug. 1, 1910. The headquarters of Tench & Co., on this work are at Morrice.

NEBRASKA.

Bids are asked until 10 a. m., April 4, by the Commissioners of Drainage District No. 2, C. M. Linn, secretary, Humboldt, Neb., for the construction of about 11 miles of new channel for the Nemaha River, requiring the moving of about 810,000 cu. yards, about 14,000 cu. yards of Long Branch Channel, about 6,320 cu. yards of Long Branch levee, about 2,640 squares of river cleaning and the furnishing and construction of three steel bridges over the new channel of the Nemaha River. All work is to be completed by April 1, 1911. Plans, etc., are let at office of Frank Snethen, Humboldt, Neb. The official advertisement will be found elsewhere in this issue.

NEW JERSEY.

Surveys have been made and practically all of the capital has been secured for the construction of the proposed line of the Wildwood & Delaware Bay Short Line R. R. The projected length of this line is seven miles and it is to extend from Wildwood, N. J., to the Reading R. R. at Rio Grande and then on to Delaware Bay. Construction contracts will be let in one to three months. Curtis Baker, Wildwood, N. J., is President; Harry C. Wier, Wildwood, is Chief Engineer.

OHIO.

The matter of beginning construction work on the proposed Ohio & Pennsylvania Belt Line R. R. has been postponed until fall or later. As stated in our March 2 issue, this is to be an independent belt line railroad to extend from Youngstown, O., to Lawrence Junction. Robert Bentley, Lowellville, O., is interested.

PENNSYLVANIA.

Contracts will probably be let by April 15 for the construction of the projected 9-mile line of the Slippery Rock & Grove City Traction Co. The route of this road is north along the east side of Wolfe Creek from Slippery Rock to Armstrong, Barmon Lake and Grove City. John P. Barr, Grove City, Pa., is president and H. B. Graves, Butler, Pa., is engineer.

Surveys have been made and capital has been secured for the construction of the projected 40 mile line of the Johnstown & Altoona Ry. Co. Construction contracts will be let June, 1910. This road is to extend from Johnstown to Altoona, passing through South Fork, Cresson, Gallitzen and eight other towns. George Holman, 302 Suppes Bldg., Johnstown, Pa., is Chief Engineer.

SOUTH DAKOTA.

The Aberdeen Ry Co. has surveys underway for 6 miles of street railway in Aberdeen, S. D., and will let construction contracts in about three weeks. F. D. Brown, Aberdeen, S. Dak., is chief engineer and Charles N. Herreid, Aberdeen, is president.

TEXAS.

The Morey-Faulhaber Construction Co., Lometa, Tex., will sublet part of 30 miles of grading in quantities to suit outfits at good prices.

D. J. Grigsby, Dallas, Tex., has been awarded the contract for constructing the Temple & Northwestern Ry., as stated in our last issue. The projected length of this road is 210 miles and it is to extend from Temple via Galesville., Hamilton, Comanche, Gorman and Eastland. Surveys have been made for 75 miles of the road and the capitol for construction has been partially secured. W. J. McDaniel, Temple, is president, W. E. Dozier, Temple, is chief engineer, and E. L. Trimble, Temple, is secretary.

The contract for the first 20 miles of grade work, including grading, cleaning and grubbing on the Brownwood North & South Ry., from Brownwood to May, was let to the Texas Co., of Fort Worth, Texas, on March 10th. John Meade, Brownwood, Tex., is Chief Engineer.

Col. R. A. Love, who will build a railway from Brownwood to Rockwood, a distance of 30 miles, has employed A. B. Carson as Chief Engineer, and has placed a party in the field. He will be in position to let the contract and begin actual construction inside of 30 days. The road is to be known as the Brownwood Southwestern, as mentioned in our last issue.

Montgomery Bros., Marshall, Tex., have started work on their grading in eastern Texas on the Western Colonial R. R. The contract includes 75,000 cu. yds. earth excavation, 45,000 cu. yds. rock excavation and 115,000 cu. yds. of embankment. Montgomery Bros. have about 75,000 cu. yds. of the work which they will sublet at once. The subcontractors already on the line are Jno. L. Williams and Frank Madlock. It is expected that the work will be finished by July 1, 1910.

WASHINGTON.

Wright & Sweeney Co. Pacific avenue, Tacoma, Wash., have been awarded the contract for constructing the headworks and tunnel for the power plant on the Nisquelly River for the city of Tacoma. Bids for this week were opened Feb. 21, and the contract price was $655,225. The work includes the construction of a tunnel 8-foot in diameter and 10,000 feet long.

CANADA.

The Niagara Frontier Traction Co. has been formed and proposes the construction of an 8-mile electric railway from Niagara on the Lake, Ontario to Queenstown. Contracts are to be let as soon as the company secures its charter. E. Garrett, Niagara Falls, Ont., is president and general manager.

ONTARIO.

Bids are asked by P. E. Ryan, Secretary the Commission of the Transcontinental Ry.,

Over 40 years building Contractors' Tents, Tarpaulins and Canvas Goods of Every Kind

Stable Tent 30 x 49 10 oz. army duck, roped on ridge, eaves, across bottom of gables and every seven feet over top with 6 foot detachable 10 oz. S. F. walls and poles for **$160.00** net. First-class in every respect. Other sizes and weights in same proportion. *Write for Catalogue.*

MORRISON TENT & AWNING CO., 115-117 OLIVE STREET ST. LOUIS, MO.

Ottawa, Ont., until noon, March 23, for furnishing 24,733 gross tons of open hearth or Bessemer steel rails and necessary splice bars, track spikes, bolts and nuts, nut locks and tie plates. Specifications can be obtained from Gordon Grant, Chief Engineer, Ottawa, Ont.

Power Developments, Levees, Drainage and Irrigition Works.

CALIFORNIA.

There are no new developments as yet regarding construction work in the South San Joaquin Irrigation District. The bond issue of $1,875,000 voted on Dec. 30th, 1909, is now being reported upon by a New York firm of bond lawyers. If all proceedings are found to be correct, the bonds will then be printed—but it is not likely that the printed bonds will be received complete for a month or two yet. Then an effort will be made to sell them for *cash*—and it will not be until they are so sold that the contractors will be asked to bid on the work. Edwin Duryea, Jr., 1314 Humboldt Bank Bldg., San Francisco, is engineer for the district.

MAINE.

Bids are asked until April 14, by the Rumford Falls Power Co., Rumford, Me., Charles A. Mixer, Engineer, for the following work: For the ledge excavation and masonry cradles for 1,000 ft. of 14 ft. penstock, for the relief pipe concrete spillway, for machinery and building excavations and concrete foundations, for the brick and concrete station building, and for the cofferdam and ledge excavations of the tail race. The work is to be done for an addition to the present power station. The work includes 4,000 cu. yds. ledge excavation, 500 cu. yds. ruffle masonry, 1,200 cu. yds. concrete and 112 M. brick work. The official advertisement will be found elsewhere in this issue.

MONTANA.

Contracts will be let soon for more than 40 miles of canals for the Glen Lake Irrigation project. A considerable amount of reinforced concrete will be used in headgates, dams and pipes. F. E. March, Kalispell, Mont., is engineer.

NEW JERSEY.

Bids are asked until noon, April 1, by Col. Wm. T. Rossell, U. S. engineer, 39 Whitehall St., New York City, for dredging in Passaic River and Shrewsbury River, N. J. About $4,000 is available for the Shrewsbury River work and $12,000 for the Passaic River work. The latter work consists in removal of shoals, maintaining, continuing or enlarging the channels in the vicinity, of Belleville, Indian Reef, and Rutherford Park Bars, in the channel between Rutherford and Passaic, and in any part of the river between the Montclair and Greenwood Lake Railroad bridge and the City of Passaic. The low water depth ot be made will be 6 feet.

NEW YORK.

Bids are asked until noon March 29, by Col. W. M. Black, U. S. engineer, 39 Whitehall St., New York City, for dredging in Patchogue River, Great South Bay, N. Y., and Brown's Creek, N. Y. The work is to be done in connection with the preservation and maintenance of river and harbor waters for Great South Bay. About $5,500 is available for the Patchogue River work and $4,000 for the Brown's Creek work.

NORTH CAROLINA.

Bids are asked by the Commissioners of Bear Swamp Drainage District, W. J. Berryman, Secretary, Edenton, N. C., until March 26, for construction of canals, including one main canal and five branches, amounting to 145,000 cu. yds. Plans, profiles, specifications and other information may be had of Patrick Matthews, Chief Engineer, Superintendent of Construction, Edenton. Two other large districts are to be opened right away in adjacent terrjtory.

OHIO.

T. Brindle, county surveyor Ashland County, will sell at public outcry, at the Commissioner's office, Ashland, at 1 p. m., March 18, the contract for straightening, widening and deepening the Jerome Fork branch of the Mohican River in Orange, Montgomery, Perry and Mohican counties. The work will include 9⅝ miles of dredge work in the channel or about 285,000 cu. yds. estimated to cost $28,500, and about 28,000 cu. yds. of dredge work in three laterals; also about 11,530 cu. yds. of hand and team work.

TEXAS.

The Fred A. Jones Co., Dallas, Tex., has been awarded the contract for constructing the dam, spillway, etc., at the White Rock reservoir site for the city of Dallas. The dam is to have a clay-filled trench from end to end. Before the filling with clay sheet piling of pine is to be driven in the bottom of trench to hard pan, or white rock. The earthen dam is to be 2,100 ft. long and about 42 ft. high at is greatest height. It is to be 211 ft. wide at the base and 16 ft. wide at the top. From the top to a line about half way to the bottom of the upstream side there is to be a concrete apron from end to end of the dam. The spillway of concrete at the western end of the dam will be 450 ft. wide. The spillway will have over it a reinforced concrete walkway and the upstream end of the piers of this walk will be furnished with cast iron guides for flash boards. Bids for the work were opened Feb. 16.

UTAH.

Bids are asked by the Upper Blue Bench Irrigation District, Jackman Herrick, Secretary, Theodore, Utah, until noon April 9, for materials and constructing a main irrigating canal from Rock Creek to the eastern edge of the Blue Bench, a distance of 13.56 miles. Plans, etc., may be seen at the office of Ed. F. Harmston, Chief Engineer, Roosevelt, Utah. The official advertisement will be found elsewhere in this issue. The Upper Blue Bench Irrigation District includes 8,400 acres of land, and is bonded for $150,000. Immediately to the South is the Blue Bench Irrigation District No. 1, embracing 7,300 acres bonded for $125,000, whose notice to contractors will probably be published in a few weeks, as Engineer Ed. F. Harmston (who is also engineer for the upper district) commenced the cross-section survey about March 10. The expected building this summer of the Moffat railroad into the Uintah basin on its way to Salt Lake Clty has set in motion the construction of many irrigation systems in Northeastern Utah. Directly across the Duchesne river from the two Blue Bench districts the West Bench Irrigation District has voted $50,000 bonds and plans to dig canal some time this summer, while 15 miles farther west the Fruitland Irrigation District, to irrigate over 20,000 acres, has been formed, and already has the survey of its 26 mile ditch nearly completed. Neighboring the Blue Bench on the southeast the South Myton Bench Irrigation District, bonded for $300,000, hopes to begin canal construction in April in conjunction with an adjoining Carey Act proposition of over 30,000, acres promoted by Frank H. Lott of Denver. The Uintah basin of 8,000 square miles, as yet unpierced by a railroad, included more than one-third of all the irrigable land in the State of Utah. To hasten the reclamation of several large areas Senator Smoot has pending in Congress a bill to extend the provisions of the Carey Act to all lands in the former Uintah Indian Reservation not homesteaded within five years from the opening to settlement of the reservation, August 28, 1905.

The Spokane, Wallace & Interstate R. R. Co. which received a franchise in Coeur d'Alene, Idaho, recently has about concluded the purchasing of the right of way between there and Wallace.

Advices from Sandpoint, Idaho, state that the necessary capital has been secured to assure the commencement of construction work this spring on the proposed Idaho & Swatiska Ry. from Lakeview to the Swatiska Mine, J. W. Ferguson, manager of the Swatiska mine is interested.

The construction of an electric railway from Naper, Neb., to Valentine, Neb., is being promoted by Mr. Carnell of Valentine. Arrangements are said to have been made with Eastern capitalists to finance the project.

At a meeting recently held in Buffalo, Wyo., a bonus of $35,000 was raised to assist the construction of the proposed railroad from Clearmont to Buffalo. The Wyoming Construction Co. will have charge of the work and will commence work about April 1.

The Sioux Falls & Western Ry. has been incorporated with a capital stock of $1,000,000 and proposes the construction of a line from Sioux Falls to Wheeler, S. Dak., a distance of 126 miles.

Reports from the vicinity of Wallace, Idaho, are to the effect that surveyors running a line from Pine Creek to Wallace are making preliminary surveys for the proposed line connecting Wallace with the Chicago, Milwaukee & St. Paul Ry., at St. Maries.

Town Council of Harrison has granted the Hyatt Roller Bearing Co., of Harrison, N. J. permission to construct a railroad spur from the Center street branch of the Pennsylvania R. R., across the New Jersey Railroad avenue, to their factory.

Surveys for the projected railroad from Tonopah Junction, Nev., to Mona Lake, Nev., have been completed. The road will be constructed for the Tonopah & Goldfield R. R., of which F. T. Armistead, Tonopah, Nev., is engineer.

The Chicago, Milwaukee & St. Paul Ry. is said to be planning to purchase the Rapid City, Black Hills & Western R. R., which has 34 miles of line extending from Rapid City, S. D., to Mystic.

It is reported that a contract has been let for the grading of 45 miles of the projected railroad from Goldfield north to Ely, Nev. The line has already been located from Goldfield to Tybo and a new survey will be made from Tybo through Hamilton, Cherry Creek and Deep Creek into Salt Lake.

Items Concerning Contractors and Their Work

RAILROADS, POWER DEVELOPMENTS, LEVEES, DRAINAGE AND IRRIGATION WORKS.

California Notes.

FROM CORRESPONDENTS AND OTHER SOURCES.

The Oakland Traction Co., W. F. Kelly general manager, Oakland, has announced that as soon as the city council establishes the grades in the northern section of the annexed district, the company will extend its lines to give the residents of that section street railway facilities.

The Los Angeles Dock & Terminal Co. is to extend the east jetty at Long Beach in the harbor 300 ft. further into the ocean, in order to make the east jetty conform in length with the west jetty. The Mercerau Construction Co. will do the work.

The city of Los Angeles will vote next month on the issuance of $6,500,000 of harbor improvement and power bonds. Of the $6,500,000 bond issue the city intends to spend $3,000,000 in improving both the outer and inner harbors. One million dollars is to be spent in the construction of the wharves and warehouses, and the acquisition of all necessary land, besides establishing connecting roadways in that portion of the inner harbor north of the turning basin. The sum of $2,000,000 will be spent on similar improvements to be made in that portion of the inner harbor and outer harbor south of the turning basin.

The Edward C. Cribb Construction Co., of Los Angeles, has been incorporated with a capital stock of $200,000, the incorporators being Stanley M. McKee, Edward C. Cribb, H. W. Reynolds, W. W. Butler and J. H. Smith.

The Bear Valley Mutual Water Co., H. H. Garstin, president, of San Bernardino, is planning to build a new dam this summer which will greatly increase the capacity of Bear Valley lake. The supplies will have to be taken into the valley by way of Victorville as the Santa Ana canyon road will not be in shape until late in the summer.

The Hauser Construction Co., Los Angeles, Cal., has been awarded the contract for constructing the Fullerton, Richfield cutoff for the Santa Fe. The cutoff will be about five miles long. The cutoff will be constructed under the name of the Fullerton-Richfield R. R. as mentioned in our last issue.

The Cabazon Land & Water Co., of San Francisco, has been organized with a capital stock of $128,000, and proposes to reclaim and improve a tract of land on the Southern Pacific at Cabazon, a few miles east of Banning. George C. Boardman, and George W. Spencer, San Francisco, are interested.

The Southern Pacific Ry. Co. has started work building a second track on its Sierra Nevada Mountain District from Sacramento, Cal., east to Colfax. The work which will involve an expenditure of several hundred thousand dollars includes double-tracking in both directions from Truckee and Reno. William Hood is chief engineer, San Francisco, Cal.

Engineers of the Western Pacific Ry. Co. are going over the proposed site of the big railroad shops to be erected at Sacramento, Cal. The plant is to cost about $750,000 and is to handle all repairs, rebuilding and overhauling for the division west of Salt Lake. C. H. Ketcham, Sacramento, Cal., is division superintendent.

The San Diego, El Cajon & Escondido Ry. Co. is stated to have ordered the necessary materials for the construction of its projected electric railway from San Diego to Escondido. Engineers are shortly to make final surveys in Escondido preliminary to beginning grading work.

The Southern Pacific Co. has a crew of 250 men at work on the electrizing of its system in Alameda and it is expected to have electric cars in operation there by July 1.

Work on the turning basin in the Long Beach harbor at Long Beach has been started under the direction of Cady Markley, superintendent of the dredging operations for the Western Marine Navigation Co. About 400,000 cu. yards of dirt will have to be dredged.

The Southern Pacific Ry. is to expend about $500,000 in repairs to tunnel No. 10, near San Luis Obispo. The work will include lining the tunnel throughout its entire length with reinforced concrete.

Colorado Notes.

FROM CORRESPONDENTS AND OTHER SOURCES.

The Denver, Laramie & Northwestern R. R. Co. has filed its incorporation papers with the secretary of state. The capitalization is given as $30,000,000. The company is a Wyoming corporation and the filing of its papers in Colorado gives it a right to do business in that state.

C. S. Barnes, Monte Vista, is promoting a project for the establishment of a reservoir 33 miles northwest of Antonito on the Conejos River. The project proposes the use of the water for power purposes as well as for irrigation.

Plats for the Brookcliff Reservoir & Ditch Co. have been filed at Grand Junction by J. F. Hartley, of Denver. The company will irrigate 640 acres of fruit land on Red Mesa, several miles northwest of Grand Junction. The dam will be 70 ft. high and the reservoir will impound 34,344,000 cu. ft. of water.

Atchison & Daly, Fort Morgan, began work March 10 on their contract for constructing the San Arroya reservoir. The irrigation system will water about 15,000 acres. The dam will require 15 cars of steel and cement.

The Granada and Holly Irrigation District will issue $250,000 of bonds to build its proposed irrigation system, water for which will be taken from the Picket Wire river, the Arkansas and Rule creek. The storage reservoir will be located on Rule creek and will have a storage capacity of 33,000 acre feet. Contracts will be let by the board of directors within 60 days and actual construction work will commence within 90 days. W. A. Menil, Lamar, S. G. Higbee, Carlton, and W. J. House, Holly, are the directors of the district.

Construction work will probably be started in July on the Stone Prairie reservoir projects and also on the hydro-electric developments on the Poudre river near Fort Collins. Plats for the reservoir project were filed on Jan. 24, 1909, with the state engineers at Denver. The reservoir sites filed on in the Poudre canon provide a total capacity of 11,212,063,146 cu. ft. They are known as the Stove Prairie, Elkhorn and Roosevelt reservoirs. The project is backed by the Moffatts, the Cheesman estate and William G. Evans of Denver. George B. McFadden, Denver, is engineer.

The Union Pacific has secured the right of way for its Fort Collins branch from that city to the Weld county line, and has opened engineering offices in the Stover Drug Store at Fort Collins for the building of the branch.

Promoters of the Pueblo & San Luis Valley Ry., are looking over the proposed route of the line. A. B. Hulit, Pueblo, Colo., is interested.

Harry House, of Pueblo, has filed maps at Aspen for the reservoir site of the Colorado Power Co., on the Roaring Fork. It will be 350 feet wide, 100 feet long, will back up the water for three-quarters of a mile, and contain 34,000,000 cu. ft. of water, which will be used for power and irrigating. The total cost will be $250,000.

Kenefick, Quigley & Russell, Denver Colo., and Kansas City, Mo., have been awarded the contract at $12,987,000 for the construction of their irrigation system of the Colorado Southern Irrigation Co. and the Canon City, Florence and Pueblo Water Co. The project is one of the biggest irrigation enterprises ever attempted and the contract calls for its completion by April 1, 1912. Active work will be commenced within 60 days and 3,000 men will be employed in constructing the twelve reservoirs, 160 miles of main canals and 30 miles of diversion canals. The largest reservoir will have a dam of 197 feet high. The system will extend from Salida through the Wet mountain valley within a few miles of Pueblo.

Georgia Notes.

FROM CORRESPONDENTS AND OTHER SOURCES.

The Rome Railway & Light Co. of Rome, Ga., will at once begin work on a 900-ft. extension of its tracks in north Rome. The tracks will be extended from the present terminus at the north Rome depot of the Southern to the Southern Cooperative foundry.

It is stated here in Macon that work will be begun within the next 60 days on the Macon-Atlanta-Albany interurban trolley line, a charter for which was granted several months ago. Macon capital is said to own a majority of the stock. The material, it is stated, has been purchased for the construction of the line from Macon to Atlanta, a distance of 87 miles. The line will be completed within 12 months. The line to Albany from Macon will be 100 miles in length.

Powell & Sneed of Vidalia are projecting the construction of an eight mile interurban line from Vidalia to Gillis Spring in Emanuel county. Electric power for the road will be secured from the Penhoopee River, which has a good fall at the Gillis Spring end of the lines, and power will be furnished to plants in Vidalia from the power plant of the road.

The Augusta Railway & Electric Co. of Augusta is contemplating belting the Durpin Hill line with the Monte Sano line.

The construction of a railroad from Irwinville to Ashburn is proposed and W. A. Shingler, president of the Board of Trade of Ashburn, has appointed a committee to take steps to secure the construction of the road. It is proposed to later extend the line west to Albany or Americus.

James White, owner of the Star Thread Mills at Athens, has formed the James White Power Co. and will expend $250,000 or more for the construction of a hydro-electric plant at Barnett Shoals. About 4,000 h. p. will be developed and transmitted by electricity for manufacturing and lighting.

Work has been started on broad gaging the Lawrenceville Branch R. R., a 10 mile line running from Lawrenceville to Suwanee, where connection is made with the Atlanta-Charlotte line of the Southern Ry. J. R. McKelvey, Lawrenceville, is general manager.

Grading has been started at Fitzgerald for the Fitzgerald & Ocilla Electric Ry. and it is said will be pushed to early completion. The enterprise includes a complete street railway system in Fitzgerald, a suburban line to the A., B. & A. shops, besides a line to Ocilla. Two ship loads of rails have arrived at Savannah, while large quantities of ties have been contracted for locally.

The permanent organization of the Jacksonville & Atlanta Short Line Ry. Co., was effected at Fitzgerald, on March 10. This road projects a trunk line from Atlanta to Jackville, Fla., and for that purpose will absorb a number of short lines along the route. At a recent meeting the following temporary officers were elected: Col. J. E. Mercer, president, Fitzgerald, Ga.; B. B. Gray, first vice president, Pinebloom, Ga.; T. B. Ragan, second vice president, Hawkinsville, Ga.; T. W. Garbutt, third vice president, Fitzgerald, Ga.; Dr. J. C. Luke, fourth vice president, Ocilla, Ga.; Dr. C. A. Holtzendorf, treasurer, Fitzgerald, Ga.; W. A. Heller, secretary, New York; J. W. King, assistant secretary, Rochelle, Ga.; H. B. Coates, assistant secretary, Hawkinsville, Ga.; R. G. Dickerson, assistant secretary, Emmerville, Ga. The road, if con-

structed, will be 40 miles shorter than present routes, and will require much construction work.

The Albany & Northern Ry. has been formally transferred to the Georgia Southwestern & Gulf Ry. The latter road is planning to build a line southward from Albany to St. Andrews Bay on the Gulf of Mexico.

Advices from Jackson state that Capt. W. F. Smith and associates in connection with the building of the Middle Georgia Interurban Railway Co. from Griffin through Indian Spring and Jackson to Social Circle, will build a power plant at Smith's mills, on the Ocmulgee river, about four miles below the site of the Central Georgia Power company's plant.

The Albany Power & Manufacturing Co., of Albany, Louis Jverissen, general manager, will expend $50,000 for an auxiliary steam plant.

The Southern Ry., W. H. Wells, engineer of construction, Washington, D. C., has placed an order with the Tennessee Coal & Iron Co. for 30,000 tons of 85-pound steel, to be delivered from its Birmingham plant between June 1 and December 1, 1910, at the rate of 5,000 tons per month. The rails will be used in the work of improving and double-tracking the main stem between Washington and Atlanta. A large part will be used in replacing steel now in the track, which will, in turn, be used to better the tracks of some of the secondary lines.

The Savannah, Augusta & Northern R. R. which has 25 miles of line in operation, is planning to build an extension through to Gainesville. E. M. Rice, Statesboro, Ga., is general manager.

The Atlantic & West Point R. R. has an amended petition before the State Railroad Commission, asking for authority to increase its bond issue by $1,286,000. It is stated that the increased issue will be for the purpose of taking up outstanding debentures of that amount against the railroad.

Illinois Notes.

FROM CORRESPONDENTS AND OTHER SOURCES.

Contracts have been let at Beecher for digging the Exline Creek drainage ditch. William Brown, Crown Point, Ind., secured the contract at 5.48 cts. per cubic yard. The creek runs through Will and Summer townships and is 8½ miles long. The width is from 10 to 12 ft. bottom and 25 ft. from bank to bank. Work will begin as soon as possible.

It is now said that the Burns Construction Co., Isabella Bldg., Chicago, Ill., will commence work in April on the construction of the projected line of the Northern Illinois Electric Ry. Co. The charter of the railway has been amended to permit of extending the road from Steward to DeKalb and Aurora and southwest from Amboy to Princeton, Kewanee, Rock Island and Peoria.

The Elgin-Belvidere Traction Co., according to an announcement of its president, J. Hamilton Browne, will soon have a new line in operation from Marengo north that will connect with a line to Elkhorn, Wis. Later a line will be constructed that will connect Aurora and northern Illinois with Milwaukee and the lakes and summer resorts of northern Illinois and southern Wisconsin.

The Peoria Ry. Terminal Co., E. A. Burrill, general manager, Peoria, has begun work on the preparation of plans for new terminal yards in South Bartonville, Peoria, which will contain between 25 and 30 miles of track, and will afford storage capacity for from 3,000 to 3,500 cars. In addition to building the yards the Terminal Co. will also construct yard offices, superintendent's offices, water tanks, coal chutes, round houses and other necessary buildings.

The S. & H. R. Robinson & Son Constructing Co., of St. Louis, Mo., and Thebes, has begun work on its contract for grading on the Cairo & Thebes R. R. The company has about 80 teams at work on the contract, which amounts to about $100,000. Work on the embankment begins at Thebes and will connect with the work already completed southeast of there. There is to be a deep cut made near Thebes, said to be about 63 ft. Contractor Wolf will in a few days begin grading on the road near Fayville, about three miles from Thebes.

Robert Grace, 830 Schofield Bldg., Cleveland, O., has been awarded the contract for the excavation work for the new yards of the Baltimore & Ohio R. R., to be constructed at Chicago Junction. The yards will have a capacity of 4,000 cars and will contain nearly 65 miles of track. The Grace contract is said to amount to $1,500,000 and will take six months to complete. Mr. Grace has already started work with three steam shovels, six locomotives, about 100 cars and about 250 men.

The Chicago, Burlington & Quincy Ry., T. E. Calvert, chief engineer, Chicago, will have work started early in the spring on double tracking between St. Paul and Savanna, Ill. All reverse curves and unnecessary trackage will be eliminated.

The Chicago & Alton Ry. and the Santa Fe have decided to start work at once on filling in along the right of way at Joliet, Ill., for track elevation in that city. As soon as the frost is out of the ground other steps will be taken toward the completion of the work.

The Eastern Illinois Ry. Co. has been incorporated with a capital stock of $1,000,000 and headquarters at Chicago and proposes to construct a road from West Hammond by way of Harvey to Riverside, all in Cook county. The incorporators and first board of directors are Willbur E. Snyder, Warner H. Robinson, Edgar H. Fank, and Sam Blumenthal, all of Chicago, and John Cox, of Joliet.

Indiana Notes.

FROM CORRESPONDENTS AND OTHER SOURCES.

It is stated here in Gary that if the Gary & Interurban continues to refuse to make terms and refuses to extend its tracks to the river so that the Gary & Southern cars can enter the city over the tracks, the latter railway will ask for a franchise across the river to 25th Ave. and north on Washington St. to the northern limits of the city.

Announcement has been made that the Evansville Ry. Co. of Evansville will begin at once the work of building its extension from Rockport to Grandview. Later the road will be built to Cannelton and Tell City, and it is hoped to eventually build to Louisville.

A movement has been started at Washington by local business men to form a company for the purpose of constructing a new line through the town.

It is proposed to extend the Muncie & Portland traction line to Celina, O., from Portland, passing through Fort Recovery.

Morton S. Hawkins, Indianapolis, has applied to the Board of Public Works of that city for the right to occupy Le Grande Ave. with the tracks of the Beech Grove Traction Co., which is to build a line from Indianapolis to the suburbs.

The Wabash R. R. has broken ground at Fort Wayne for the preliminary work for track elevation.

Iowa Notes.

FROM CORRESPONDENTS AND OTHER SOURCES.

The city council of Monticello has been petitioned to call a special election for the purpose of voting upon a 5 per cent tax in aid of the Manchester & Davenport interurban railway. A contract for constructing the first 30 miles of the line has already been let. Lafe Matthews of Manchester, Father M. C. Murphy of Argand, J. A. Voorhees of Monticello and W. T. Baker of Davenport are the promoters. The road is to begin at Manchester and end at Davenport and be constructed either by way of Tipton or Bennett.

The Centerville Light & Traction Co. of Centerville has been incorporated under the laws of the state of Maine with a capital stock of $500,000, the incorporators being M. W. Baldwin, H. E. Mason, J. R. Griffith, J. J. Herman and A. S. Conant.

The Iowa & Illinois Railway Terminal Co. of Clinton has been organized with a capital stock of $25,000. F. W. Ellis is president and P. P. Crafts is secretary.

The Chicago, Milwaukee & St. Paul Ry. is said to be contemplating constructing a 22-mile loop connecting Dubuque, Ia., and Shullsburg, thus making a direct route from Janesville, Wis., to Kansas City.

Kansas Notes.

FROM CORRESPONDENTS AND OTHER SOURCES.

Orders for 14 miles of rails have been placed by the Wichita Street Ry. Co. of Wichita for track reconstruction purposes. The steel will be shipped about March 15. Most of the steel will be used to replace the present tracks, but there will also be about 1½ miles of new track laid.

The Oklahoma & Kansas Ry. Co., which projects an electric railway between Hattonville, Okla., and Galena, Kan., a distance of 23 miles, has preliminary arangements well under way. Arrangements have already been made with the Baxter Light & Power Co. at Baxter Springs for operating the six cars which will be used when the road is completed. Mayor Charles Jones of Baxter Springs and John M. Cooper of Baxter Springs are directors of the traction company.

Petitions have been circulated in Wichita asking the mayor and city commissioners to call an election for the purpose of voting $30,000 of terminal bonds for the Arkansas Valley Interurban Ry. Surveys for the road were made some time ago and the company will soon be ready to begin the work of building its line between Wichita, Hutchinson and intermediate points. Practically all preliminary work has been accomplished, such as securing right of way, etc.

D. Siggins of Independence, owner of the interurban line recently placed in operation between Cherryvale and Independence, is to apply for franchises for a street car line in the latter city. It is also probable that the interurban line will be extended on to Columbus.

The Jennings Construction Co. has started work at a point midway between Valley Center and Wichita on the projected line of the Arkansas Valley Interurban Ry. It is expected that cars will be running over the first ten mile stretch between Wichita and Valley Center by July 1. All of the material for the line except the cars has been ordered and a part of it is now here. The interurban will parallel the Santa Fe most of the distance north from Wichita to Valley Center. The ultimate terminus of the road will be Hutchinson and it will pass through Sedgwick, Halstead and Burrton. This same company has secured the right of way for an interurban line south from Wichita, going down the west side of the Arkansas valley, through Oxford to Arkansas City. This part of the road will not be built until the line north is completed.

Theodore Lutguerding, Wichita, has been awarded the contract for constructing the Wichita, Kinsley, Scott City & Denver Air Line Ry. Mr. Lutguerding has organized the Air Line Construction Co. and, according to the contract, will begin to grade for the new road May 1. The first actual work will begin at Turon and will progress east toward Wichita and west toward Kinsley. This portion of the line will be completed first, although the Air Line Construction Co. was given the contract for the entire road from Wichita to Denver, a distance of 500 miles. W. F. Brown, Naron, is president of the railway.

A mass meeting was held recently at Clay Center by residents of Abilene, Washington and Industry to make preliminary arrangements for an electrical interurban railroad through that section. A preliminary organization was perfected. The plan is to build an electric line from Beatrice or Fairbury, Neb., down through Washington, Clay Center, Industry, Abilene, Newton and to Wichita.

The St. Joseph & Grand Island Ry., W. A. Parker, chief engineer, St. Joseph, Mo., is shortly to let contracts for bettering its roadbed between Marysville and Garden. Several contractors were over the work recently.

The Mexican, Oaxaca & Yucatan R. R. Co. has filed articles of incorporation with a capi-

tal stock of $1,000,000, with general offices at Omaha, Neb., Joplin, Mo., and Topeka, Kan. The company proposes the construction of a line from Omaha, Neb., through Nebraska by way of Douglas, Sarpy, Cass, Otoe, Johnson and Pawnee counties, thence through Kansas, Missouri and western Arkansas, the system being 1,314 miles in length.

Voters of Cheyenne county, Kan., are soon to vote on a proposition to issue bonds for the purpose of raising money to secure the construction of the Gulf & Northern line through that county. St. Francis, Kan., is the county seat.

The Missouri Pacific Ry. Co. is said to have completed all financial arrangements preparatory to following the plans laid for the construction of the cutoff from Sterling, Kan., on the Hutchinson-Geneseo line to Great Bend, the terminus of the Hutchinson line. The line will be 33 miles in length and would change the route from St. Louis to Colorado, which is by way of Osawatomie, Council Grove and Salina, to that by way of Fort Scott, Yates Center, Wichita and Hutchinson, thus shortening the distance and running time and traversing a more thickly populated country. E. F. Mitchell, St. Louis, Mo., is engineer of construction.

The Western Kansas, Gulf & Northern Ry. Co. of Goodland, Kans., has applied to the State Board of Railroad Commissioners for the right to issue stock and bonds for the construction of the line. The road will run from Oklahoma City Okla., through the western tier of Kansas counties to Northern Colorado. It will be the first north and south line to traverse Kansas and will pass through three Kansas counties without railroads. Every county through which the road passes with the exception of one has voted bonds for it, the bonds thus voted amounting to $695,000. The company asks permission to issue $20,000 in stocks and $20,000 in bonds per mile, the bond and stock only to be issued as work proceeds. Construction is expected to begin next April.

Michigan Notes.

FROM CORRESPONDENTS AND OTHER SOURCES.

The Grand Trunk R. R. has applied to the city council of Bay City for a franchise in Saginaw St. The company plans to construct an east side terminal in the city, which will involve the expenditure of $1,000,000, it is said, and will require the construction of a long bridge over the Saginaw River.

Alderman Charles E. Fish of Petoskey is advocating the construction of a municipal dock.

Surveys have been under way for some time for the proposed Detroit, Lansing and Grand Rapids interurban line and it is expected that plans will be ready shortly for submission to the capitalists who are to finance the road. Of the 53 councils controlling the territory through which the road will pass, 45 have agreed to submit the question of granting franchise rights either March 14, when the village elections will be held, or April 4, when the cities and townships will vote. Former State Senator Andrew Fyfe of Grand Rapids and Dr. Oliver H. Lau and H. M. Wallace of Detroit are the promoters.

Minnesota Notes.

FROM CORRESPONDENTS AND OTHER SOURCES.

The American Bridge Co. has been awarded the contract for furnishing the steel for the new steel ore dock to be constructed at Allouez for the Great Northern Ry. Bids for the construction contracts have already been received. About 3,000,000 ft. of lumber will be required for the cribbing alone and there will be about 25,000 cu. ft. of concrete work. A total of 12,000 piles will be required in putting in this concrete foundation for the heavy superstructure and over 60,000 cu. yds. of gravel filling will be used for sinking the cribbing. A. H. Hogeland, St. Paul, Minn., is chief engineer, Great Northern Ry.

The Interstate Dredge & Dock Co. of Duluth has been awarded the contract for building the cribbing for the 360,000 sq. ft. of floor space to be added to No. 1 dock of the Northwestern Fuel Co. at Duluth. The contract for the dredging in connection with the addition was let to the Great Lakes Dredge & Dock Co. of Duluth. About 200,000 yds. of material must be moved. The Interstate Dredge & Dock Co. contract calls for furnishing and placing 1,200 ft. of cribbing, to inclose the two 600-ft. sides of the corner of the dock site not already occupied. The cribbing on the slip side will be 20 ft. wide by 33 ft. deep and on the channel side 18 ft. wide and 29 ft. deep.

The Walsh Construction Co., Davenport, Ia., has eight miles of grading for the Soo and is preparing to begin work. The work extends from Withrow to the St. Croix river, a mile north of the present Wisconsin Central bridge and four miles from Stillwater.

The Ambursen Hydraulic Construction Co. of Boston, Mass., has begun preliminary work on the construction of the dam at Rapidan for the Consumers Power Co. The dam is to be of reinforced concrete and will be 60 ft. high. Work is to be completed by Dec. 1. J. M. Smith is superintendent of construction.

The Minnesota River Improvement & Power Co. of St. Paul has filed its articles of incorporation in the office of the register of deeds of Ramsey county. The company has a capital stock of $1,000,000 and was formed for the improvement of navigation of the Minnesota River, its tributaries and Big Stone and Traverse lakes, for the development and improvement of the water powers of these streams and lakes for public use, and for the reclamation and cultivation of the low, marshy and swampy lands bordering on these waters. The incorporators include E. S. Warner, St. Paul; William F. Nelson and Loren W. Collins, Minneapolis, and William H. Gold, Redwood Falls.

The Great Northern Ry. is, it is said, seriously considering the construction of a branch line from the Mississippi in Aitkin county, Minn., through Aitkin, Mille Lacs, Kanabec and part of Isanti counties to a connection with its line at Mora. As projected the line will be about 80 miles in length. J. C. Patterson, St. Paul, Minn., is assistant chief engineer of the Great Northern Ry. Co.

The Northern Pacific Ry. is planning extensive improvements to its terminal facilities at Minneapolis. It is said that the capacity of the existing yards in Northeast Minneapolis will be more than doubled and that new yards will be established in South Minneapolis.

Duluth and the Ranges.

BY PETER E. MEAGHER.

Andrew Perrin of the contracting firm of Carl Hall & Co. came in to see us the other day. He just returned from a month's visit to Southern California. He had a very enjoyable trip out there, and the way he described some of the pleasures he had, we got the idea that he was trying to make us envious because we were not so fortunate as to be there to participate in all of the good things he told us about. His firm has just been awarded a contract by the Duluth & Iron Range Ry. Co. to construct a spur track about 7 miles long into one of the iron mines near Ely, Minn. They will start on the same at once.

The Roberts-Kingston Contracting Co. of Duluth has already started on their new contract of iron mine stripping that they were awarded recently on the Mesaba Range.

The Winston-Dear Co. has already started on their 6,000,000 yard contract of stripping the Buffalo & Susquehanna Mine near Hibbing, Minn. They are going to start this job temporarily with a narrow gauge outfit, and just as soon as they can purchase a standard gauge plant, will start the same on this work.

Denis Madden, general superintendent, and C. E. Sloan, chief engineer, for the MacArthur Brothers Co., were visitors at this office a few days ago. They were accompanied by Arthur Mitchell, an old friend of the writer, who has been appointed general superintendent, in charge of MacArthur Brothers Co.'s operations in the northwest. They have, at the present time, two large stripping operations on the Mesaba Range, and are working night and day shifts on both of them.

The Interstate Dredge & Dock Co. of Duluth was awarded a large timber contract for the erection of a new coal dock at Superior, Wis., and have already started to work on the same.

J. A. Higgins, railroad contractor, was a caller at this office recently. He has at present, about 300 men working on the Thief River Falls branch of the Soo Line, a contract he subbed from Foley, Welch & Stewart.

C. E. Jamieson, contractor on the Soo line, was a caller at this office. He has about 15 miles of work under way at the present time.

O. A. Lewellen, general agent for the northwest for the J. I. Case Machine Co., was a visitor with us a couple of days this week. He reported that their business was opening up very fine, and was far ahead of what it was this time last year.

John R. Davis, contractor, was a caller a few days ago. He is not doing anything at the present time, but is looking for a contract to get busy on the coming season.

John Runquist, the Duluth railroad contractor, has got a great many men working at the present time, and has about 8 different jobs under way for the Duluth & Iron Range railway, the Duluth, Mesabe Northern, and Great Northern Railways.

C. J. A. Morris of Morris & Shepard, was a caller here the other day. He reported nothing new at the present time.

Robert Patterson, well known to the contractors in this section of the country, was recently appointed president of the Board of Public Works of the city of Duluth.

Patrick McDonnell, the Duluth contractor, is at the present time in Grand Forks, N. Dak. He is figuring on a very large paving job, and, from last reports, we understand that the probabilities are, he will be awarded the same.

The Drake & Stratton Co., Hibbing, Minn., was awarded a large stripping contract by the Oliver Iron Mining Co. last week to strip the Dale-Uno Mine. I do not know the exact yardage in this job, but know that it is at least a couple of million yards.

Peter E. Meagher's Employment and Labor Offices and Warehouses, are at the present time in the hands of the carpenters and painters, and being enlarged considerably, and improvements are being made. We extend invitations to all of our old friends, and to those interested in the contracting line, to pay us a visit and inspect our new quarters. We will be ready for business March 15.

At present in Duluth and vicinity, there are quite a few laboring men idle, but not from choice. There is a great deal of work going on now, and more opening up every day. The surplus of laborers is caused by a great many of the logging camps closing down on account of the soft weather, and the men returning from them all have money, and the majority of them will not go to work until they have the same spent.

Missouri Notes.

FROM CORRESPONDENTS AND OTHER SOURCES.

Track construction work was started at Mexico, Mo., on March 3 on the projected line of the Mexico, Santa Fe & Perry Traction Co. The line will be 40 miles long and is expected to be in operation from Santa Fe to Hereford in eight months. Later the road will be extended to Hannibal and to Fulton and Columbia. The Burns Construction Co., Isabella Bldg., Chicago, Ill., has the contract.

The Commercial Club of Unionville has taken up the matter of securing the extension of the interurban railway from Kirksville to that city and possibly north to Seymour.

The directors of the Manufacturers Ry. Co. of St. Louis have voted to increase the capital stock from $250,000 to $5,000,000 and to issue $5,000,000 in bonds. The line is 21 miles long. J. J. Baulch, St. Louis, Mo., is superintendent.

Business men of Bethel, Mo., have completed arrangements for the construction of

an extension of the Shelby County railroad from Shelbyville, Mo., to Bethel. L. B. Houck, Shelbina, Mo., is president of the railroad.

Farmers along the proposed route from Columbia to Jefferson City, Mo., have signed up for the right of way for the proposed North Missouri Central Ry. Co. Contracts for the necessary ties are now being let and as soon as bonds are sold construction work will start in earnest.

Practically 75 per cent of the necessary capital is reported to have been received for the projected new railroad from St. Louis to Fort Smith, Ark. The road will be known as the St. Louis & Pacific, and is being projected by Joseph Ramsey, Jr., formerly president of the Wabash, and Malcolm Niven, of New York City. The new road will be 310 miles in length, with as low a maximum grade as one-half or one per cent and a maximum curvature of 5 per cent. The cost of the enterprise is estimated at $75,000 a mile.

St. Louis Items.

BY A. B. KOENIG.

The L. J. Smith Construction Co. of Kansas City has started work on the Santa Fe R. R. near Winslow, Ariz. Scott Mitchell, vice president of the company, is going to be in charge of this. They have also started several more camps on the Missouri Pacific R. R.

The construction of a new southwestern trunk line with independent terminals at St. Louis is assured, and the project will be realized by Jos. Ramsey, Jr., former president of the Wabash, or by the Manufacturers' Railway., George F. Moore, president. Malcom Niven of New York is associated with Mr. Ramsey in exploiting the St. Louis & Pacific, which will be built from St. Louis to Fort Smith, Ark. The new road will be 310 miles long, with as low a maximum grade as one-half of 1 per cent, and a maximum curvature of 5 per cent. The cost of the enterprise is estimated at $70,000 a mile, and Mr. Niven says that more than 75 per cent of the necessary capital has been obtained. The line will entail an investment of approximately $21,000,000. This undertaking of Mr. Ramsey's is in addition to that of the Manufacturers' Railway. If Mr. Ramsey decided to carry out his project, the Manufacturers' Railway will cooperate with him, but should Mr. Ramsey conclude, for any reason, not to go ahead, then the Manufacturers' Railway will provide the contemplated line. The St. Louis & Pacific proposes entering St. Louis over the rails of the Manufacturers' Railway and using this company's terminal facilities. Mr. Moore also announced that one important railroad in the southwest has signified its willingness to enter into an arrangement with the Manufacturers' Railway to form a new southwestern line. The Manufacturers' Railway is determined to establish a new route from St. Louis to the southwest. The Manufacturers' Railway recently increased the capital stock from $250,000 to $5,000,000 and authorized an issue of $5,000,000 of bonds. Although the Manufacturers' Railway has had a capital of only $250,000, it has approximately $1,500,000 invested. This amount is represented by notes to Adolphus Busch and the St. Louis Union Trust Co. About $500,000 of land has been purchased by Mr. Busch and it probably will be transferred to the railway. The company has a large tract in St. Louis county at the southwestern city limits for immense yards, terminal yards in the vicinity of the Anheuser-Busch Brewing Association, and adequate area for yard purposes on the Illinois shore immediately opposite the brewery. It also has land along its right of way in St. Louis for factory and warehouse purposes. Through the issuance of stock the company will have $3,250,000 and through the bond sale approximately $5,000,000, or a total of about $8,250,000, for developing the property. Aug. A. Busch was re-elected chairman of the board, George F. Moore president, Adolphus Busch vice president and Otto H. Rassfeld secretary and treasurer. The officers and E. A. Faust, George F. Meyer and W. D. Orthwein constitute the board. Negotiations are pending between the Manufacturers' Railway and the St. Louis & Illinois Belt, controlled by Donk Bros. Coal and Coke Co., looking to a merger. It is considered probable that this east side line will unite with the Manufacturers'. Through an arrangement with the St. Louis & Illinois Belt the Manufacturers' Railway will establish a belt line from Alton to its yards south of East St. Louis.

The Cooney Construction Co. of St. Louis, Mo., and Fort Smith, Ark., got in on an $80,000 paving contract at Oklahoma City, Okla. This is not the only good thing that happened last week. R. E. Cooney, general manager of this company, when he returned home from Oklahoma City, found a big, bouncing boy there to greet him. The new arrival came Sunday night.

The St. Louis & San Francisco is perfecting a financial scheme to cover the Colorado Southern, New Orleans & Pacific and allied lines and the St. Louis, Brownsville & Mexico, and the progress of the adjustment is such as to warrant an official announcement from the company's fiscal agents in a few days. The transaction will approximate $30,000,000. The St. Louis, Brownsville & Mexico was acquired recently by the Frisco from the St. Louis syndicate which constructed and operated it, and the members of the syndicate became powerful factors in the group which obtained control of the Frisco. It runs from Houston to Brownsville on the Rio Grande, paralleling the gulf coast. The Colorado Southern, New Orleans & Pacific was built by the Frisco and always was part of the system. It extends from New Orleans to Houston and with the Brownsville line forms a gull coast route from New Orleans to the Mexican boundary at Brownsville. The St. Louis, Brownsville & Mexico and the Colorado Southern, New Orleans & Pacific will become part of the Frisco system proper and they will constitute the New Orleans, Texas and Mexico division. The bonds of these properties will be guaranteed by the Frisco. Negotiations are pending with the Mexican government and the National Railways of Mexico for the construction of a new line, paralleling the coast of the gulf of Mexico, from Matamoras, opposite Brownsville, to Tampico and Mexico City. The road will be constructed either by the National Railways of Mexico or the Frisco, or by the Frisco and the Mexican government, or by the National Railways of Mexico and the Frisco. The undeveloped territory in Mexico along the projected line will be opened to settlement and cultivation. With the Matamoras-Tampico line completed, there will be a continuous gulf coast route from New Orleans via Houston and Brownsville to Tampico. By the Brownsville route the distance from St. Louis to Mexico City will be reduced about 200 miles. Through trains will be operated from New Orleans to Brownsville, carrying through cars from St. Louis and other cities, and ultimately through trains will be run from New Orleans to Mexico City via Brownsville. Plans are being made already for double tracking part of the Brownsville line.

R. M. Quigley of the Kenefick-Quigley-Hoffman Construction Co., 229 Century Bldg., Denver, Colo., stopped off here for a couple of days on his way west. The Kenefick-Quigley-Hoffman Construction Co. just landed an $8,000,000 irrigation job near Canyon City, Colo. It has 6,000,000 yards of rock, 12,000,000 yards of earth, 2½ miles of tunnels and 250,000 yards of concrete work to sublet on this work. Will open an office in Canyon City next week, where profiles can be seen and all other information obtained.

M. C. Connors, 14 S. Canal St., Chicago, Ill., has 4,000 yards of bridge filling on the Burlington R. R. north of Barrow, Ill., to sublet. This work is suitable for a 6 or 7 team wheeler outfit.

Mulville Bros., Alton, Ill., have 200,000 yards of team work in quantities to suit outfit to sublet. Free transportation over the C. & A. R. R.

Labor is thinning out very fast here. Every road in the country has been putting on extra gang and section men in the past two weeks and there is a good demand for labor of all kinds in this neighborhood.

Montana Notes.

FROM CORRESPONDENTS AND OTHER SOURCES.

The construction of an electric railway through the Madison valley is under consideration and P. A. Morrison of McAllister, Mont., is securing tonnage data for submission to eastern capitalists.

Boynton, Church & McCoy, Billings, are making good progress with their contract for double tracking the Northern Pacific between Billings and Huntley, a distance of 10 miles, and it is believed that entire contract will be completed by June 1. The camps on this work are as follows: Camp No. 1 is the steam shovel camp and is operated by Boynton, Church & McCoy, the contractors. Their territory extends to a distance of about a half mile the other side of the Yellowstone river bridge. Camp No. 2 is next, operated by A. J. Sullivan. He has some six miles of track under a sub-contract. Camp No. 3 comes next, that of James Ryan, with a sub-contract of about 1½ miles. Camp No. 4, operated by Fred Johnson, who has about two miles of the road under a sub-contract.

The Big Horn Water, Light & Power Co. is being formed at Billings for the purpose of furnishing water, light and power to the towns of Byron, Cowley and Lovell in the Big Horn Basin. The plant will be established at Byron and it is probable that natural gas will be utilized by the company for fuel, as there is sufficient gas now obtainable in that field to supply the plant. The water will be obtained from large springs located at Byron. Norman S. Poole, Billings, is promoting the project.

New York Notes.

FROM CORRESPONDENTS AND OTHER SOURCES.

Matters are shaping up so that it is now practically assured that the Public Service Commission will ask for bids for the construction of the Broadway-Lexington Ave. subway route at New York city by April 1, and that ground for the line will be broken about two months later. Construction work on the Broadway-Lafayette Ave. subway route in Brooklyn will be started about the same time.

The Schenectady Ry. Co. of Schenectady has applied to the Public Service Commission for permission to lay tracks on Edison Ave. in Schenectady.

The Mohawk Engineering & Construction Co. of Highland has been incorporated with a capital stock of $10,000 and will engage in a general contracting business, including construction of railways. The incorporators are Harry A. Sylvester, 132 Clinton St., Schenectady, N. Y.; Andrew W. Lent, 60 Second St., Newburgh, N. Y., and Harold A. Lent, Highland, Ulster Co., N. Y.

The Board of Estimate of New York city has voted to grant a franchise to the Manhattan Bridge Three-Cent Line, which desires to operate trolley cars between Desbrosses St. ferry, Manhattan, and the Fulton St. shopping district in Brooklyn.

The State Public Service Commission is considering the application of the Frontier & Western R. R. Co. for permission to build a line from the western end of the Buffalo Frontier Terminal R. R. to the International bridge.

A bill has been introduced in the state legislature of New Jersey for the appointment of a Hudson County, New Jersey, rapid transit commission, which shall have power to expend not more than $15,000,000 to build at the county's expense a subway from one end of the county to the other. The bill provides that if the Board of Freeholders adopts a resolution saying that rapid transit railways are necessary in any county of the first class that a rapid transit commission shall be created. The commission shall be appointed by a supreme court justice sitting in the special county. The commission is to consist of three members appointed by the court and the fourth shall be the director of the Board of Freeholders. The term of office is six years, with a salary of $10 a day for each day in which the commissioners actually work. A

chief engineer, who shall be appointed by the court, also is provided.

Articles of incorporation have been filed by the Schein Construction Co., Brooklyn, N. Y., with the state department. The company is capitalized with $5,000, consisting of $100 shares. The first board of directors are Louis P. Schein, Isidor Meyer and Charles V. Lewis, Brooklyn, N. Y.

The Catskill Traction Co. of Catskill, which succeeded to the property and franchises of the Catskill Electric railroad, sold at foreclosure on January 12, has applied to the State Public Service Commission, asking for consent to mortgage its property and franchise securing a bond issue to the amount of $200,000, and for permission to issue presently $60,000 in bonds in part payment of the purchase price of the property of the Catskill Electric railroad, also for leave to issue $12,000 capital stock to the incorporators, which has been paid for in cash, and $48,000 par value capital stock to W. C. Wood in payment of the balance of the purchase price of the Catskill Electric railroad property.

Ohio Notes.

FROM CORRESPONDENTS AND OTHER SOURCES.

The Chesapeake & Ohio Ry., H. Pierce, engineer of construction, Richmond, Va., is said to be about to award contracts for double tracking its line from South Portsmouth to Maysville, Ky., a distance of about 20 miles.

The commissioners of Marion county, Marion, have taken definite steps for having work started on the improvement of the Little Scioto River. The work will cost over $65,000 and will include widening and straightening the course of the river.

Estimates have been made showing that it will cost the city of Elyria $3,900 for ripraping the shore line at the water works pumping station to prevent erosion.

The stockholders of the proposed Cleveland, Norwalk, Van Wert and Indianapolis electric line will hold a meeting in Van Wert May 31, when the proposition of a construction company will be heard.

The Toledo Rail & Light Co., Toledo, will erect a new power house, to cost, with equipment, $300,000.

Oklahoma Notes.

FROM CORRESPONDENTS AND OTHER SOURCES.

The Eastern Oklahoma Traction Co. has been chartered with a capital stock of $100,000 and headquarters at Muskogee. The company proposes to build electric lines from Muskogee to Tulsa, 48 miles; a branch to Wagoner, 9 miles; from Wagoner to the Grand river, 10 miles; Tulsa to Sapulpa, 14 miles; Muskogee to Webber's Falls, 23 miles; Muskogee to Checotah, 21 miles; Muskogee to Okmulgee, 39 miles; Okmulgee to Oklahoma City, 87 miles. In all it is proposed to build 251 miles of line at an estimated cost of $26,000 per mile. The directors are H. B. Spaulding, R. N. Eggleston, J. W. Mattox, L. R. Kershaw, W. L. Tull, J. B. Furry and Guy Bowman, all of Muskogee. An auxiliary company, to be known as the Railway Construction Co., with $50,000 capital and headquarters at Muskogee, has also been chartered. The directors are R. N. Eggleston, W. R. Robison, L. R. Kershaw and J. B. Furry of Muskogee and W. P. Keegan of Tulsa.

J. B. Moore, Tahlequah, is promoting a project for an interurban line between Muskogee and Tahlequah.

J. W. Griesel, surveyor for Pawnee county, Pawnee, Okla., has completed the survey to the Osage county line for the Missouri, Golden City & Oklahoma railroad, which was chartered three years ago to build southwest from Jefferson City, Mo., through Carthage and Joplin to Bartlesville, and Pawhuska in Oklahoma.

The Choctaw Railway & Lighting Co. of McAlester has secured a franchise from the city council of Haileyville, which insures the construction of the interurban from McAlester to Haileyville, two of the most important towns in the Oklahoma coal belt.

The Oklahoma City & Panhandle Ry. Co. recently chartered to build westward from Oklahoma City across the Texas Panhandle, has elected the following officers and directors: A. Rey of Oklahoma City, president; Eugene S. Sullivan, Boston, vice president; H. E. Chapman, Altus, secretary; E. J. Dupree, Oklahoma City, treasurer. Directors: A. Key, Eugene S. Sullivan, H. E. Chapman, E. J. Dupree, T. R. Anderson, Oklahoma City. The estimated cost of the proposed line is $3,000,000.

R. W. Raymond, civil engineer of Philadelphia, has completed his investigation and will make his report to the banking interests he represents on the construction of the proposed Mid-Continent Traction Co. from Sapulpa to Tulsa. This is a link in the interurban system to connect the principal cities in the mid-continent oil and gas field.

The Enid, Ochiltree & Western Ry. Co., which already has a line under construction from towns in the Texas Panhandle east to Enid, has taken out an Oklahoma charter. The company proposes to build from Beaver City and from a point near the southeast corner of Beaver county to Enid and Oklahoma City, 500 miles, traversing Beaver, Harper, Ellis, Woodward, Dewey, Major, Woods, Alfalfa, Grand, Garfield, Kingfisher, Logan, Canadian and Oklahoma counties. The capital stock is $500,000 and the principal place of business at Enid. The directors are Benjamin H. Tallmadge, LeRoy W. Layons, William H. Greer, Hamlin Palmer, Ernest W. Waite, all of Enid.

It has been announced that the Oklahoma & Golden City Ry. Co. has secured financial aid and the construction of the proposed system is assured. The company was organized in July, 1907, and projected the construction of a line from Jefferson City, Mo., southwest to Fairview, Okla., a distance of 340 miles. As planned the line will pass through Eldon, Climax Springs, Preston, Pittsburg, Humansville, Stockton, Golden City, Carthage, Joplin, Mo., Miami, Centralia, Bartelville, Pawhuska, Fairfax, Enid, Okla., and branches from Climax Springs to Springfield and from Linn to Sylvania, making the total length of the system 425 miles. Edward Griesel and W. S. Hawkins, Muskogee, Okla., are interested in the work.

Oregon Notes.

FROM CORRESPONDENTS AND OTHER SOURCES

The Albany & Interurban Ry. Co. recently incorporated by citizens of Albany, has asked a franchise for a city system. The company also proposes to build a number of interurban lines from Albany as a center.

The Hood Valley Electric R. R. has filed deeds for part of its right-of-way with the county clerk at Hood River. The plans include a complete system of transportation for the west side of the valley in addition to a main line into the Mount Hood country.

The Portland Railway, Light & Power Co. of Portland will lay double tracks from the intersection of East 28th street and Sandy road on the Sandy road to East 16th and East Davis street and East 10th to East Burnside, as soon as the city council authorizes the work.

The dam of the Prineville Flouring Mills on Crook River above Prineville was washed out for the second time this year as the result of floods, entailing a loss of more than $6,000.

The Gold Hill Railroad & Lumber Co. of Gold Hill has begun construction work on a railroad to extend from Gold Hill to the lime deposits four miles west and thence to the timber belt in the upper Foots creek country.

The Celilo Milling & Power Co. has purchased 80 acres of land from I. H. Taffe at Celilo Falls on the Columbia, and announcement has been made that a power plant will be installed this summer.

The Hurley-Mason Co., Portland, has been awarded the contract for all of the masonry work in connection with the regrading and double-tracking of the Northern Pacific from Tenino to Vancouver. The contract involves about 40,000 yards of concrete. The work consists of all of the masonry work from the small culverts up to the large bridges crossing the Lewis River, Kalama River, Cowlitz River, Toutle River and numerous smaller streams.

Southern Pacific surveyors are working on the new route for the line through the Big Elk Creek district, Oregon, which will shorten the distance between Corvallis and Yaquina by 12 miles and also reduce the grade to 1 per cent.

Surveys are now being made by the Oregon Railway and Navigation Co. engineers for the construction of the yards at Hood River, Ore. The work will also include the construction of a $25,000 station. G. W. Boschke, Portland, Ore., is chief engineer of the company.

Pennsylvania Notes.

FROM CORRESPONDENTS AND OTHER SOURCES.

The Fairmont & Pittsburg Ry. Co. of Fairmont, W. Va., has been chartered with a capital stock of $1,000,000 and proposes to construct an electric railway from Fairmont to Blacksville, thence to Waynesburg, and on to Pittsburgh. The company also proposes an electric railway from Fairmont to Mannington, thence to Blacksville, thence to Morgantown, thence along the Monongahela River to Fairmont. The incorporators are: William M. Laws of Jersey City, N. J.; H. F. Smith, J. R. Linn, S. E. Miller of Fairmont, and J. F. Beatty of Mannington.

Construction work has been started under the contract recently let by the Buffalo, Rochester & Pittsburg R. R., for the double-tracking and straightening of about ten miles of road between Newton and Mount Jewett, in McKean county, Pa. The cost of this construction will be $625,000.

Contractors have been going over the route of the projected extension of the Western Maryland R. R. to Connellsville, Pa., and it is more than likely that construction work will be started this spring.

The Bessemer & Lake Erie R. R., G. M. Gray, mechanical engineer, Greenville, will expend $200,000 in the Greenville shops this year. The new buildings will include an office building for the superintendent of motive power, a modern seventeen-stall roundhouse, to replace the one destroyed by fire, a forge building 400 feet long, an addition to the power plant 50 by 101 feet in size, a 2-story fireproof pattern shop 40 by 40 feet in size; a new coaling station, and several smaller structures. Work on the forge building and power plant addition has been started.

Announcement has been made by officials of the West Penn R. R. Co. that plans have been completed for the building of a branch line from Greensburg to the Jamison coke works, and thence to Latrobe, a distance of 10 miles. The West Newton and Hunter line will be built during the coming summer. Nearly all the rights of way have been secured. The line will be 20 miles long and will pass through the Yukon valley.

The Pottstown & Reading Electric Ry. Co., of Pottstown, will shortly commence work on the construction of its extension from Sanatoga to Royersford, via Linfield.

The Schuylkill and Dauphin Traction Co., has been asked to extend its lines eastward from Reinerton to the Keystone hotel, thence south and west to Orwin and north to Reinerton.

Advices from Somerset state that construction work on the Indian Creek Valley R. R. has been completed to Indian Head and that it is expected to have the new line open to traffic by May 1. With the line now under construction the company will operate 22 miles of track on its main road and about 10 miles of branch track in addition. It is reported that yards will be constructed at Indian Creek.

The Quaker City Construction Co. has been incorporated with capital stock of $10,000 and principal offices at Philadelphia, Pa., and will engage in the construction of roads, railways and public works. Sydney Kenney, F. H. Hickock and Harry J. Crossan, Philadelphia, Pa., are the incorporators.

Advices from Allentown, Pa., state that active construction work is now under way on

the double tracking of the East Penn R. R. between Allentown and Reading.

The Chambersburg, Greencastle & Waynesboro Traction Co. of Chambersburg, has commenced work on its extension in that city. Work will also be started shortly on the extension to Red Bridge and Blue Ridge Summit.

An ordinance has been before the city council of Wilkesbarre to give the Wilkesbarre Traction Co. permission to extend its Grove and Brown street line so that the route will extend over Blackman street to South Main, thence to Horton and down South Franklin to the city line, completing the circuit and returning by way of Carey.

Tennessee Notes.

FROM CORRESPONDENTS AND OTHER SOURCES.

The Virginia-Carolina Ry., W. E. Mingea, president, Abingdon, Va., has about secured the necessary capital for the construction of an extension from Bristol to Charlotte, N. C. The road at present extends from Abingdon, Va., to the Virginia coal fields and towards the timber belt of North Carolina. A cut-off will be constructed from Bristol, connecting with the line now built, and the road will be extended to Charlotte, N. C. It is thought that the work will begin in the near future.

Surveys have been made for the projected line of the Tennessee, Alabama & Kentucky Ry., and the promoters hope to have construction work started in the near future. The line proposed will extend from Chattanooga, Tenn., to Louisville, Ky. The route in Tennessee passes through Hamilton, Sequatchie, Bledsoe, Van Buren, White, Jackson and Putnam Counties, Rutledge Smith, Cookeville, Tenn., is interested.

Texas Notes.

FROM CORRESPONDENTS AND OTHER SOURCES.

The Houston Electric Co., David Daly, manager, Houston, has plans well under way for the extension of the south end street car line out Fannin street beyond the city limits, to connect with the electric line recently completed by the Westmoreland Farms Co., beyond the Rice Institute site.

Austin Electric Ry. Co., Wm. J. Jones, president, Austin, is considering making a number of extensions and other improvements to its lines in Austin.

The construction of a pleasure pier at Port Arthur to cost $100,000 is proposed. C. E. Smith, Port Arthur, is interested.

The Commissioners' Court at Cameron has made an order approving the estimate of the levee for the Hefley improvement district and directing that bonds may be issued. As soon as the bonds are approved by the attorney general the commissioners will advertise for bids for the building of the levee.

Surveys are being made for a 12-mile extension on the Sugarland Ry., from Juliff to the State farm road. W. C. Yearger, Sugarland, Tex., is chief engineer.

Surveys have been made and a good part of the right-of-way secured for the construction of a standard-gage railroad from Houston to Penn City. The road will be constructed by a Pennsylvania syndicate which is interested in the development of Penn City. C. L. Walther, Pittsburg, Pa., is the representative of the syndicate.

The railroad committee of the town of West, J. H. Chambliss, chairman, is seeking to have the Houston & Texas Central R. R., extend its line from Ross to West, a distance of six miles. I. A. Cottingham, Houston, is engineer. H. & T. C. R. R.

Track laying on the Sterling City extension of the Santa Fe was to have been commenced about the middle of the month and rushed forward so that trains could be in operation by July 1.

Good progress is being made with the plans for building a railroad from Waco to Georgetown by way of Belton. Surveys for such a road were made a few months ago. George Tyler and G. M. Felts, Belton, are interested.

The Seguin Water Power Co. of Seguin has been organized with a capital stock of $100,000 and proposes to develop power in the falls in the Guadalupe River, about two miles above the city. There is a natural rock dam at this spot giving a fall of 7 ft.

We are in receipt of advices from El Paso, Tex., that the El Paso & Southwestern Ry. Co. is considering the construction of a line to Tucson, Ariz., a temporary terminal. Later the line will be constructed by way of Phœnix, thence to Yuma, to connect with the San Diego Southern Ry., thus giving the new line direct connection with San Diego, Cal. As projected the main line will form a junction with the Red Rock & Silverbell R. R. of the Imperial Copper Co. at Red Rock; a branch will then be constructed from Port Lobos, Mex., to tap the Red Rock & Silverbell line at Sasco. H. J. Simmons, El Paso, Tex., is general manager of the E. P. & S. W. Ry.

The Texas North & South R. R., of Coleman, Tex., has filed articles of incorporation with a capital stock of $360,000 and proposes the construction of a railroad from Coleman to New Braunfels, which will pass through Baylor, Throckmorton, Shackleford, Callahan, McCullough, San Saba, Mason, Llano, Gillespie, Kendall and Comal Counties. The incorporators are all of Coleman, Tex., L. E. Collins being among the number.

The Missouri, Kansas & Texas Ry., has completed surveys for three different routes for a connecting line from its Trinity & Colmesneil Branch to either Waco, Granger or Temple, Tex. A. M. Acheson, Dallas, Tex., is Acting Chief Engineer of the company in Texas.

The Stone & Webster Engineering Corporation of Boston, Mass., has begun to let contracts for the construction of the Houston-Galveston interurban line. The North American Dredging Co., Galveston, has been awarded the first contract, which calls for filling in on Galveston Island for a distance of 2½ miles and requires the sluicing in of 100,000 cu. yards of material. Bids for grading the 16-mile section from a point about 2 miles above the Galveston causeway to Clear Creek, are to be in by March 18. Mark Lowd, Houston, is southwestern superintendent for Stone & Webster. Shortly after that bids are to be in for the grading of the second section, 19 miles in distance, from Clear Creek to Brays Bayou, and shortly thereafter the final section to the city limits of Houston, a distance of 2½ miles. Bids have also been asked on 130,000 ties and for the timber necessary to construct some 3,000 feet of trestles. There will be some 30 odd trestles constructed on the entire road varying in length from 30 to 660 feet, the longer distances being necessary where bayous are struck at an angle, such as that of Clear Creek, where a considerable stretch of low land on one side of the bayou must be bridged. The longest trestles are those at Clear Creek, 660 feet; Dickinson Bayou, 500 feet, and Brays Bayou, about 300 feet. The tracklaying etc., will be done by the Stone & Wekton corporation, under the direction of J. B. Townsend, chief engineer, First National bank building, Houston.

Crosby County is raising a bonus of $150,000 to secure the construction of a railroad into Crosbyton. Julian M. Bassett, Crosbyton, is interested.

The city of Weatherford has accepted the proposition of the Mitchell & Pigg Construction Co., to build the Chicago, Weatherford & Brazos Valley R. R. Weatherford will give a bonus of $60,000 for the line to go north to a connection with the Rock Island, probably at Bridgeport.

Citizens of Canyon City are advocating the construction of an interurban line between Amarillo and Canyon City.

Utah Notes.

FROM CORRESPONDENTS AND OTHER SOURCES.

William H. King, Salt Lake City, acting as local representative of a syndicate of eastern capitalists, is to apply to the city and county for franchises for an electric railroad from Salt Lake to Wasatch, in Little Cottonwood canyon, where a summer resort is to be built by the builders of the interurban line.

The Provo Reservoir Co., of Provo, which is to build a canal from the mouth of Provo canyon northward to irrigate the high lands of Utah county as far north as American Fork, has let contracts to build 2½ miles of the canal. Contracts for additional work will be let shortly.

The Joseph and Cove Highland Canal Co. of Joseph, Sevier county, has filed articles of incorporation with the secretary of state yesterday, taking over a ditch and water right at Joseph. The capital is $8,000. The officers are W. J. Carter, president; J. E. Leavitt, vice-president; Ed. Rose, secretary and treasurer.

City Council of Brigham City and the County Commissioners have been considering application of the Ogden Rapid Transit Co., for franchises for the extension of lines from Hot Springs to Brigham City and along the streets of the latter town. If granted, the final difficulty in the way of the interurban line will be removed and active operations will commence. The line would probably be opened next fall in time for the beet hauling season.

The Belknap Power Co. of Richfield, has been reorganized and its reported that eastern capital has been secured to carry out the proposed power development. The company now has a small force of men at work in the approach to the proposed tunnel. J. B. Weimer is manager.

Virginia Notes.

FROM CORRESPONDENTS AND OTHER SOURCES.

The city council of Richmond, Va., is to appropriate $20,000 for building a city wharf.

Surveys are being made from the eastern terminus of the Chesapeake Western Ry. from Elkton, Md., Rockingham County, through Madison, Greene and Orange counties. The Chesapeake Western, it is reported, has recently been acquired by the Pennsylvania. W. E. D. Stokes, 73rd St. and Broadway, New York City, is president and general manager of the C. W. Ry.

Surveys for the extension of the Richmond, Chesapeake Bay Ry. to Washington have been completed between Ashland and Fredericksburg. The route crosses the Chesapeake and Ohio just west of Doswell. William Northrop, Richmond, Va., General Manager.

The stockholders of the proposed Roanoke & Bent Mountain Ry. Co., at a meeting held at Roanoke, Va., recently elected the following officers: A. L. Sibert, president; R. H. Angell, vice-president; C. M. Armes, secretary and treasurer; C. G. Ogden, general manager.

St. Albans, Johnson & Briggs, of Richmond, Va., have secured a contract from the Chesapeake & Ohio Ry, for building 5 miles of line on Horse Creek, in West Virginia for the Coal River Ry.

Washington Notes.

FROM CORRESPONDENTS AND OTHER SOURCES.

The Commercial Club of Bellingham has secured the subscriptions for $400,000 worth of stock in the Whatcom County Railway & Light Co., asked for by Stone & Webster Engineering Corporation, Boston, Mass., preliminary to construction of an interurban line between Bellingham and Skagit county points or Burlington, Mount Vernon and Sedro-Woolley Construction work on the 30 miles of road is to be started on April 1. R. T. Laffin, Seattle, Wash., is district manager for Stone & Webster.

Residents of Chesaw, under the leadership of the Commercial Club, are going to build three miles of railroad to connect the town with the V., Y. & E. branch of the Great Northern.

Watson & Snow, railroad contractors, have sailed from Seattle to Alaska to complete their contract on the Alaska Northern R. R. Watson & Snow have the contract to complete the road to Mile 72.

Plans have been announced for an interurban railway between Aberdeen and Seattle.

The company will probably be known as the Western Washington Railway & Navigation Co., and will have its headquarters in Aberdeen. Surveys are to be started shortly. C. C. Quackenbush, Aberdeen, is interested.

The Chewach Canal Co., of Winthrop, has been incorporated with a capital stock of $12,000. the incorporators being W. C. Hanks, C. E. Cotton and H. E. Seniff.

The Great Northern Ry. is stated to have been making surveys with a view to building a cut off from Harrington to a point in the main line below Wilson Creek, to avoid the inconveniences caused by the high waters from Lamono to Wilson Creek.

H. L. Mardy, of Spokane, and J. L. Leeper, of Orient, have filed on power sites in the Kettle River at a point a little below the town of Orient and will develop power for that place.

Bids are to be asked this month by the city of Seattle for filling in Westlake avenue. The work will cost about $300,000 and will involve the moving of several hundred thousand cubic yards of dirt, R. H. Thomas, Seattle, is city engineer.

According to advices from Tacoma, Wash., work will be started soon on the water grade line of the Northern Pacific Ry., from Tacoma northwest via Point Defiance and the Narrows. The plans call for the construction of a 900-ft tunnel at Point Defiance. Peter Sims, Spokane, Wash., is contractor.

The North Coast R. R. has filed amended articles of incorporations, announcing its purpose to build and operate the following lines of railway. From Seattle to Spokane, 350 miles, through the counties of King, Pierce, Lewis, Yakima, Benton, Franklin, Adams, Whitman and Spokane, with a branch from the line in either Benton or Franklin county, 75 miles to Walla Walla; branches from points on the line in Adams County respectively to Eureka Junction, Davenport and Wilson Creek, and from Spokane southeasterly to Tekoa and thence to Lewiston, Idaho. Work on this road has been underway for some time. F. L. Pitman, Spokane, Wash, is chief engineer.

The Seattle-Snohomish Electric Ry. Co. has applied for a 50-year franchise for an electric street railway over the streets and avenues of Snohomish. This company recently purchased the Snohomish electric light system. According to its representative C. W. Kimball, of Seattle, the company will build an interurban line from Seattle to Snohomish, via Bothell.

The Chicago, Milwaukee & St. Paul Ry. is said to intend to relay its tracks between Madison and Portage.

A. E. Rau, engineer, St. Paul, Minn., has completed preliminary surveys for the proposed railroad from Gilmanton to Fountain City. A feasible route from the Waumandee Valley is said to have been found.

Wisconsin Notes.

FROM CORRESPONDENTS AND OTHER SOURCES.

The city council of Portage has granted a franchise to the Chicago & Wisconsin Valley R. R. Co. to pass through the city and to install a local street car line within the city. The company will begin the work of construction at Portage just as soon as the frost is out of the ground and the material to commence the work has been ordered to Portage. This new railroad is an electric line and will be built from Janesville to Merrill. The survey has been made from Stevens Point to Madison, the line passing the entire length of Adams county north and south, touching Friendship, Easton, Briggsville, Portage, Lodi, Middleton and Madison. Work will commence at three points on the line, Portage, Madison and Stevens Point. The survey will be completed from Stevens Point to Merrill and Madison to Portage as soon as the permanent lines are completed from Madison to Stevens Point.

W. F. King, Duluth, Minn., has begun work on the section on the Interstate railroad which will connect Pokegama Junction, and present terminus with dock sites on Wisconsin Point Work was started at Saunders, where a subway is being constructed under the Great Northern ore yards and works. The excavation will be continued eastward from the subway to the Nemadji River bank where a steel bridge is to be erected at a cost of $250,000. There is considerable grading and filling to be done between the Nemadji and the Wisconsin plant and as a result may not be laid on that section of the line until late next fall. across the Big Pokegama river to the west Either a fill or trestle will have to be built of Saunders. The entire force of men employed by Contractor King on the concrete work of the St. Louis River bridge will be taken to Saunders as soon as the work at the present location is finished. There are about 400 men working for Mr. King at the St. Louis River bridge now.

E. E. and Gail Woodworth, Eugene Willard, Edward Norton, John K. Land, John Rowe, George Dennison and William I. Barrager, mill wrights of Stevens Point, have gone to canal zone in Panama, where they will erect a lumber mill for the Panama-American Land & Lumber Co., a corporation with headquarters at Peoria, Ill. They expect to be gone a year.

As soon as weather conditions will permit work is to be started on extensive improvements to the plant of the General Electric Co. at St. Croix Falls. The cost of improvements and extensions will approximate $750,000, the estimated cost of the addition to the power plant being nearly $500,000. An itemized statement of the estimated cost is as follows:

Addition to St. Croix Falls station and lines from St. C. F. to Minneapolis	$400,000
So-called short extension in Minneapolis	150,000
Underground work in Minneapolis	70,000
Remodeling substation "A"	56,000
Rebuilding Garfield avenue substation and cable line to substation "A"	25,000
Tie lines from Main street station to substation A	30,000
Additional feeder lines in center of city	30,000
Total	$755,000

The Chicago & Northwestern Ry. Co. has purchased all right of way for the proposed extension to Friendship, Wis., and also a tract of land for the construction of station, roundhouse, shops and division headquarters. S. S. Long, Antigo, Wis., is acting division engineer.

According to advices from Barberton, O., Paul & Henry Coal & Ice Co., Barberton, which is also interested in railroad construction have closed a contract for building a railroad in the central part of Wisconsin and work will be commenced in about two months.

It is reported in Janesville, Wis., that the Chicago Milwaukee & St. Paul Ry. Co. is planning the construction of large sorting yards near Janesville.

Canadian Notes.

FROM CORRESPONDENTS AND OTHER SOURCES.

The Toronto Ry. Co., R. J. Fleming, manager, Toronto, Ont., is planning to begin work shortly on the construction of an extension of its street railway to the North Rosedale district.

The Dominion Legislature has empowered the Temiskaming & Northern Ontario Ry. Commission to extend its lines from a point just above Matheson in a southwesterly direction into the Township of Tisdale and Whitney. The building of the branch to Elk Lake and Gowganda will depend upon the developments in the Porcupine fields. S. B. Clement, North Bay, Ont., is chief engineer.

Property owners in Elbow Park have asked that the city of Calgary, Alberta, extend the street car system from its present terminal, to a point on Elbow River. City Engineer Childs, of Calgary estimates that extension would cost $12,000.

In order to be in a position to compete with the Great Northern Ry. for traffic between Vancouver and the Kootenays via the rich Similkameen and Okanagon districts, the Canadian Pacific Ry. will build a line this spring over the Hope Mountain. Surveys have been completed by both companies across the mountains, and it would appear that the Canadian road has been able to secure a lower gradient across the summit than its American rival. It is understood that a maximum gradient of 2.2 per cent going west has been secured, which is lower than anything as yet secured by the engineers of the Great Northern. Two years will see the completion of a direct C. P. R. line between Hope and the Kootenays. At or below Hope, a bridge will be built across the Fraser. The C. P. R. route from Hope, a point in Fraser River valley, is across the mountains to Coquehalla summit, thence down to Coldwater River, a distance of 13 miles, then over a low divide to Otter Creek and on into the fertile Similkameen district. From Penticton the line will cross a summitt, and proceeding via the west fork of Kettle River reach the C. P. R. branch line now in operation as far west as Midway.

The Canadian Pacific Ry. Co. has appropriated $2,000,000 for the construction of terminals on Island No. 1, near Fort William, Ont., and work will be started as soon as weather permits. The above appropriation does not include the cost of constructing the Kam bridge or new freight sheds. F. S. Darling, Toronto, Ont., is engineer.

The Government of Saskatchewan has guaranteed the bonds on a line of the railway to be built by the Grand Trunk Pacific Ry. Co., from Regina Sask., to Sherwood, N. Dak. As projected the line will run between the Arcola and Soo lines from Regina to the Estevan branch of the Canadian Pacific Ry., crossing it near Hirsch, east of Estevan, and continuing in a southeasterly direction through Bow district south of Oxbow and thence through Workman and across the international boundary line into Sherwood. H. G. Kelly, Montreal, Que., is chief engineer.

Mexico Notes.

FROM CORRESPONDENTS AND OTHER SOURCES.

Mexican Pacific R. R. Co. recently incorporated under the laws of Delaware with a capital stock of $40,000,000, has secured a number of concessions from the Mexican government. They propose the construction of a 350-mile railroad along the west coast of Mexico beginning at Salina Cruz, Oaxaca, and extending to the port of Manzanillo. Judge G. W. Baitch, Salt Lake City, Uutah, is legal representative of the company. Harold G. Villard, New York City, is president.

A concession has been granted by the federal government of Mexico to William P. Wood for the construction of a 650 mile railroad forming the connecting link between Mexico City and Merida, Yucatan. The line as projected will start at Santa Lucrecia in the state of Vera Cruz, traversing portions of the states of Vera Cruz, Chiapas, Tabasca, Campeche and Yucatan. United States capitalists will finance the project.

The Chicago & Northwestern Ry. is to have work resumed on its Hitchcock-Onida branch as soon as weather will permit. A large amount of material has already been transferred to Onida, N. Dak., preparatory to beginning work.

A bill is before the Maryland legislature to incorporate a company to build an electric railway between Silver Springs and Damascus, Md. The company is to have a capital stock of $250,000, Charles F. Neswitt and Lee L. Latimer, Washington D. C. are interested.

Officials of the Fernwood & Gulf R. R. Co., are considering bids for the construction of a 5-mile stretch of the proposed line toward Columbia, Miss. The Worthington Construction Co., which has a contract with the railroad is making rapid progress. I. C. Enochs, Fernwood, Miss., is president of the railroad company.

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CHAS. S. HILL
C. T. MURRAY
F. A. SMITH
} EDITORS

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CONTENTS.

EDITORIAL: Page

Ballinger's Criticism of the U. S. Reclamation Service....257
How to Increase the Efficiency of the Civil Service....257

CONCRETE SECTION:

A Simple Method of Computing the Strength of Flat Reinforced Concrete Plates....258
Structural Features of New Concrete Recreation Pier at Albany, N. Y....263

EARTH AND ROCK SECTION:

Some Records of Work with a Scraper Bucket Excavator on the New York Barge Canal....265
Shapes of Drill Bits in Use with Comments on Efficiency and on Sharpening and Tempering....266

ROADS AND STREETS SECTION:

Some Methods and Costs of Oiling Roads in St. Louis with a Description of a New Construction Employing Molded Slabs of Bitumen and Aggregate....268
Suggested Standard Practice for Pavement Bonds and Suggested Specifications for Asphalt and Bituminous Pavements....270

WATER-WORKS AND SEWERS SECTION:

The Sanitary Examination of Water....274
Sugar Beet Cultivation on Sewage Farms..275
Method and Cost of Reforesting the Marginal Lands of the Wachusett Reservoir, Metropolitan Water-Works, Boston, Mass.275
Method of Recording Test Borings for Sewer Construction at Louisville, Ky....277
Cost of Cleaning Catch Basins, Borough of Brooklyn, New York City....278

GENERAL SECTION:

The Preservation of Timber Used in Mines.278
LETTERS TO THE EDITOR....278
TECHNICAL SOCIETY MEETINGS....280
PERSONALS....280
CATALOGS WORTH HAVING....280

Ballinger's Criticism of the U. S. Reclamation Service, and a Suggestion That One of the Cabinet Should Be an Engineer.

Most of our readers will have seen the daily press reports of the testimony of Mr. Arthur P. Davis, Chief Engineer of the U. S. Reclamation Service, as given before the Ballinger investigating committee. It is made clear from this testimony that Secretary Ballinger is not well qualified to judge of the work done by the U. S. Reclamation Service or of the engineering organization that has had charge of it. For example, Mr. Ballinger believes that the engineers are receiving salaries that are too high! He believes that Director Newell is incompetent. He intimates that the Reclamation Service has not been fair to contractors! He questions the high cost of the work, and yet is unquestionably incompetent himself to judge unit costs.

While ENGINEERING-CONTRACTING has criticised the high cost of some of the work done by day labor by the Reclamation Service, it has realized that high unit costs were to be expected on much of the work, due to local conditions. It has also realized that the Reclamation Service felt impelled to do some of the work by day labor, because of high prices bid by contractors. Yet ENGINEERING-CONTRACTING has never made its criticisms in an unfriendly spirit, or because it lacked appreciation of the excellent work done by the Reclamation Service, taking their performances as a whole, but rather because it regretted seeing their splendid work marred by even the slightest departure from the sound economic policy of doing all construction by contract.

In Secretary Ballinger's blunders we have again an illustration of the danger that civilians run when they attempt to criticise the work of engineers.

Vast as are the engineering undertakings of the federal government, why is it that not a member of the President's cabinet is an engineer? It would seem that at least one of his "official family" should be an engineer of national standing. Surely the time has come when some professional men other than lawyers should share the responsibilities that rest upon a presidential cabinet.

How to Increase the Efficiency of the Civil Service.

Among the letters to the editor which we publish this week will be found two relating to our editorial remarks under the above caption in Engineering-Contracting for Feb. 2, 1910. It will be noted that these letters both were from civil service employers, one from New York and one from Chicago, the largest two cities in the United States and the two cities carrying the largest number of civil service employes on their pay rolls. These letters are so instructive, each in a different way, that we shall comment on them at length.

The Chicago man somehow cannot get away from the meaning now attached to the words "Civil Service." To him it is still a method for appointment. As explained in our editorial all men employed in the civil service departments are designated thus as distinguishing them from men in the military and naval establishments. Owing to the way examinations have been conducted and appointments made, the average man no longer looks upon the civil service idea as one that attempts to secure fit men—and fit men only—for the public service, but it refers to public servants who have been appointed after due compliance with certain rules and regulations to a life position. The question of good service and fitness and ability are not thought of but the machine like rules and regulations are always uppermost. We would suggest to those interested a re-reading of the editorial referred to by our correspondents.

Taking up the Chicago case first. There is a senseless rule that the names of eligibles will be retained on an eligible list for two years only. Can any mortal man of common sense give a good reason for this? Take a case that actually occurred in Chicago. Four years ago a man passed an examination for a position paying $175 per month, but not passing close enough to the head of the list, he did not secure a position. He did secure a position as a designer with a firm for a short time and made $200 per month, going from that to the superintendence of two pieces of work at a combined salary of $250 and then as chief engineer of another company at a salary of $300 per month. In two years his name was dropped from the eligible list, just as his last job was completed. That man was more competent on the day his name was dropped from the eligible list than the day it was first put there. Why was it dropped? Merely because that was the rule and rigid adherence to rules marks the mind of the average present day Civil Service administrator. The rule as to eligible lists should be changed to require every person on any eligible list to file a sworn statement at least once each year to the effect that his, or her, employment in the interim had been substantially in the kind of employment for which the eligible list was created. This then would tend to keep a man ready just as long as he wanted to be kept on the list. The man of whom we wrote was dropped from the list because the two years had elapsed and he would not have been able to get again on an eligible list without passing another examination. If he had received the position for which he had taken the examination most of his time would have been put in setting grade stakes for sewers and streets. The work he actually did was to design structures costing many thousands of dollars and to look after their construction. Yet after two years of this class of work he was not considered fit to work in the city hall until he passed another examination, merely because the two years his name was kept on the list had expired.

No examination has since been held to create another eligible list in that grade but it has been said that within the past two years some more "60 day" men have been certified. The Civil Service Commission is not honest if it does not maintain an eligible list for every department and grade. The plea has been made that frequent examinations cost money but that is because of the senseless two year rule for eligibles. There is no reason why "60 day" men should ever be on any list. To see so many on the list is bound to give color to charges that the Civil Service Commissioners stand in with the politicians to negative the efforts of men who had the law put on the statute books in order that all appointments to the public service should be based on fitness. Charges are made that after a certain number of "60 day" men have served long enough to get a good experience rating that an examination is ordered to create an eligible list, and it is noticeable that these "60 day" men generally pass highest and secure their jobs for life. These may be rumors but the fact that they are persistent indicates that something is out of joint in the administration of the civil service laws in the city of Chicago. Our Chicago correspondent speaks dispassionately of a matter that is in need of attention.

The New York letter is remarkable. In our editorial we said nothing whatever about men having to pass examinations at intervals in order to retain their positions. We stated that after a man had passed he was supposed to be eligible and that the entrance examination was to determine fitness and should not be competitive. Therefore all men who passed should be eligible for selection, not merely those who had the highest marks. After appointment the efficiency rating given each month should settle whether a man should remain in the service, or not. We suggested an appointment for one year and if the efficiency was good then a reappointment for five years and if the efficiency rating was good during that term, then a life appointment. The appointee would be subject always to automatic removal for lack of efficiency and attention to business, during the first six years. After that removal only after trial.

The remainder of the letter makes us ashamed to know that the writer is an engineer. The engineer who is not employed in a city job for life as the result of a few days' strenuous review of text books and a written examination, has to take what pay he can get when he gets it. He is never secure in any position. Taken on today, laid off tomorrow, his pay fixed by the laws of supply and demand, he has to do as much work as the man at his elbow or be discharged ahead of time from what is at best a position of uncertain tenure. Under such circumstances he has lifted his profession to a plane where hon-

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esty is the ruling guide of an engineer's conduct. Lapses there are occasionally but they are often through stress of circumstances beyond the control of the man. The profession itself is judged by the honesty of the men who follow it.

What term can be applied to a man who holds on to a position and gives as little as he can simply because he feels he is not appreciated? He seeks the position voluntarily. No one compels him to accept it. He can quit any time he likes and resume again the wandering life of his brother "job chaser." We notice he intends hanging on but thinks he is an object of pity, which, verily, we think he is; not, however, for the reasons he would assign. If he wants (to quote his letter) "a cause for hope, antidote for discouragement, a financial reward for proven merit," let him throw up his civil service job and join the crowd of men not so fortunate as to have a life job and compete with them in the fight for a livelihood. There is a tremendous difference between the ambition of the large-minded man and the desire of the small-minded man, although the latter always mistakes desire for ambition. Our correspondent is not ambitious and it is the curse of the present civil service organization that so few ambitious met get an opportunity, simply because of the men whose only desire is to do as little as they can for their money and who watch the clock. The transitman on a railroad gets from $75 to $90 per month and expenses. A leveller gets from $50 to $80 per month and expenses. A chief of party gets from $125 to $175 and expenses per month. An engineer on construction work seldom gets more than $125 per month and expenses, and the editors know able men getting only $75 to $100 per month and expenses in charge of quite important work. As a rule the men in the engineering departments of the cities under civil service regulations get slightly better pay, considering the class of work they do, than the men working for railroads and other corporations. Yet the civil service employee has a life job and the other men are never sure when theirs will end.

We believe in engineers getting all the pay they are worth and believe also that the pay in transient employment is generally too low. No good reason exists, however, for paying city hall employes more than their less fortunate professional brethren when the city hall man is secure in his position for life or during moderately good behavior. There should be a minimum entrance pay rising by very slow and moderate annual increases to a maximum and this maximum should be what commercial corporations pay for similar work. A dissatisfied employe may resign or he may take a promotional examination when opportunity offers. To encourage the men permission should be given them to take one promotional examination each year without loss of time, being docked for time if other examinations are taken. At present, we are informed, the practice in Chicago is to dock a man for time spent in taking examinations. The custom has arisen because many of the employes made a practice of taking every examination offered. While some safeguard was necessary, the present rule is calculated to discourage ambitious men. Much of the dissatisfaction at present existing is caused by the lack of control department heads have over their subordinates. This leads to an over-manning of many departments so that promotion is slow and the atmosphere is deadening to ambition. In the summer months when construction work is rushing, a large number of men must be employed and they have to be carried through the winter. Large corporations do not carry the men through the winter, but we do not advocate such heartlessness in public offices. Engineers in private practice generally try to secure as assistants men who can work in the office and in the field, thus employing the men when practicable on office work and designing when field work is stopped. By co-operation between and a proper co-ordination of, the various departments much could be done by following the practice of trying to do nearly all office work at the time of year when field work is impossible.

Concrete and Reinforced Concrete Section

Note: This section is devoted to methods and cost of constructing concrete and reinforced concrete structures. It will cover the selection, testing and proportioning of concrete materials; laboratory tests of concrete; concrete mixing, transportation and placing; fabrication and placing of reinforcement, and form construction and erection. It will also contain articles on new and interesting developments in the design of reinforced concrete.

A Simple Method of Computing the Strength of Flat Reinforced Concrete Plates.

One of the most recent developments of reinforced concrete is the type of floor originating with Mr. C. A. P. Turner and known as the "mushroom floor." While this system is in its infancy as yet, examples of it are nevertheless sufficiently numerous to be more or less familiar to all building designers. The absence of beams, the increase of head room resulting therefrom, the low cost of centering, and the comparatively small amount and simplicity of the steel reinforcement unite to make this system desirable for many buildings and relatively low in cost. With its advantages, however, it has some disadvantages, perhaps the most important of which is a lack of detailed analysis of the internal stress occurring in a slab of this kind. It may be mentioned that this analysis is not necessary for safe construction, for as the more or less empirical formulas we have seem to give results sufficiently strong, enough confidence can certainly be placed in the formulas to enable the designer to guarantee a test load of twice the designed live load over an entire bay without harm to the construction and with a very insignificant amount of deflection.

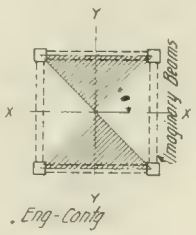

Fig. 1.

About two years ago the writer had occasion to design floors of this kind for an office building in Portland, Me. At that time the amount of information concerning the stresses in the concrete plate was very limited, and the writer had some difficulty in finding a satisfactory solution.

A good deal of study of buildings designed by the inventor gave the impression that Mr. Turner used a formula equivalent to about $M = \frac{WL}{48}$ to get a bending moment, and that he then solved for an area of steel and distributed the resulting amount uniformly or nearly so, in the different directions. This seemed so extreme, however, that no confidence was placed in the result and various other ways of solving the problem were tried.

For purposes of comparison the writer proposes to give a description of the different methods then used or that have since come to his knowledge, together with the solution of each of a typical floor panel. They are as follows:

(1) To consider the slab around the head of the column out to the point of inflection as a cantilever supporting a uniform load over its surface and a concentrated load consisting of the rest of the slab hung from its periphery. This will be called the "Cantilever System."

(2) To consider the slab around the head of the column out to the point of inflection as a flat, circular plate supporting a uniform load over its surface and a concentrated load consisting of the rest of the slab with its superimposed load hung from the perimeter of the plate. Diagrams for the analysis of this method are given in Turneaure and Maurer's "Principles of Reinforced Concrete," pp. 272 and 328.

The first impression of these two methods is that they are almost identical, but the solution and final results are quite different.

(3) Grashof: In Green's "Structural Mechanics," on p. 255, are given the formulas for deflection and bending moments in a plate supported on rows of points forming squares whose side is L. A direct application of this to the typical case will be tried. Two other methods result from different application of these formulas, Mensch and the writer's.

(4) Mensch: A more or less incomplete description of this method is given by Mensch in his Pocket Book on p. 81 as follows:

> The problem of calculating the stresses in a plate supported at four points was first thoroughly investigated by Grashof in connection with the strength of end plates in steam boilers. He gives the greatest bending moment per lin. ft. in such a plate as $\frac{WL^2}{26.5}$, which formula he derived more by an elimination process than by exact science.
>
> By similar reasoning we lay down the following rule for the computation of girderless floor construction:
>
> Divide the panels in strips of a width equal to 0.35L when L is the distance in feet from center to center of support; two strips run diagonally, while the others run in the line of the columns. The greatest bending moment of such a strip we assume to be $\frac{WL^2}{20}$ when the size of the capital is at least 0.23L.
>
> From this bending moment we easily obtain the required thickness and reinforcement given in the slab tables on pages 16 to 20.

In the solution of the typical case the writer has simply copied the slab thickness and amount of steel directly from the tables mentioned, and has not endeavored to perform the actual necessary operations.

(5) Turner's: Turner confidently recommends and uses a formula that requires considerably less steel than any other method given here. He refers to Grashof's analysis of the stresses in plates given in Lanza's "Applied Mechanics," and to Professor H. T. Eddy's "Theory of the Flexure of a Thin Flat Circular Plate or Ring Loaded Symmetrically

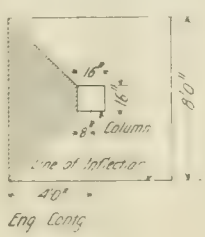

Fig. 2.

Above Its Center," Engineering Year Book, University of Minnesota, 1899.

In his book recently published on the subject he states that the bending moment $M = \frac{WL}{50}$, where W is the total load on the slab

*A paper by Angus B. MacMillan, Engineer Aberthaw Construction Co., read at the 1910 Convention of the National Association of Cement Users.

and L is the span in feet or inches according as the result is desired in foot or inch pounds. Having obtained the bending moment and assumed a depth for the slab, the area of steel is found. This area is divided in the different directions and placed in bands about 7/16 of the span in width. The method of getting the stress in the radial bars and circular rings is left in doubt. The writer has assumed that they have no function other than to keep the slab steel up near the top of the slab where it belongs when crossing the columns, and to a very limited extent to give a larger bearing for the concrete plate. What fixes the size of the column heads is not stated to the writer's knowledge. Turner supports his conclusions with the records of many slabs tested with loads largely in excess of the regular working loads.

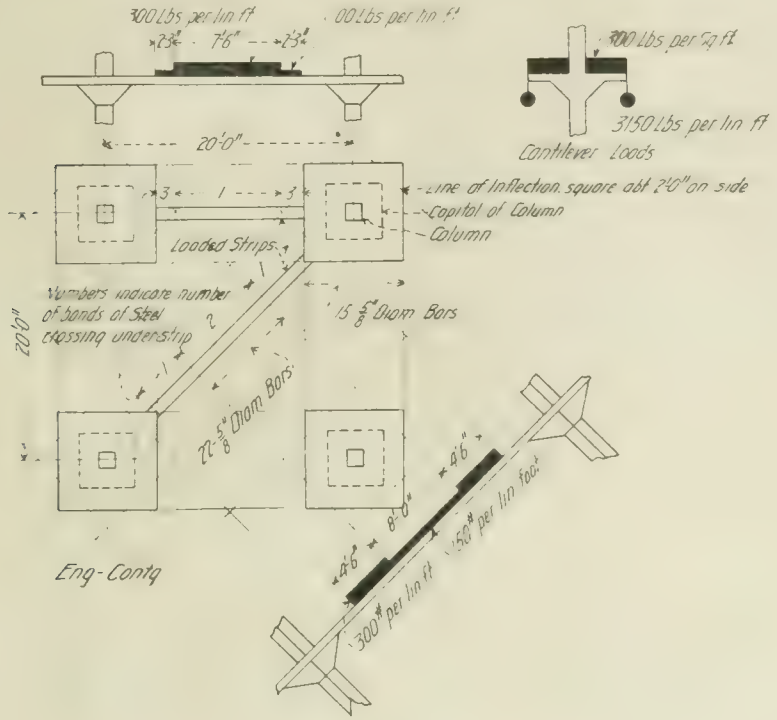

Fig. 3.

(6) MacMillan: This method is based on general deductions made from Grashof's analysis of the stresses in a plate supported at rows of points forming squares, whose side $= L$. Before taking up a typical case it might be well to indicate what these deductions were. Attention is called to the following formulas giving the maximum fibre stress in square plates uniformly loaded, but with different methods of support.

(a) For a square plate supported on two edges, $f = \frac{3WL^2}{4T^2}$

(b) For a square plate fixed on two edges, $f = \frac{WL^2}{2T^2}$

(c) For a square plate fixed on four edges, $f = -\frac{WL^2}{4T^2}$,

(d) For a square plate fixed on four points, $f = \frac{WL^2}{1.27T^2}$,

It is interesting to note that a plate fixed at four points is stronger than one fixed on four sides, and is 3.2 times as strong as one supported on two edges.

Now in the first formula the moment of resistance can be expressed by $M_r = \frac{WBL^2}{8}$

Therefore for a plate fixed at four points and the same unit load, the bending moment would be $\frac{1}{3.2}$ times this amount, or

$$M_r = \frac{WBL^2}{8\times 3.2} = \frac{WBL^2}{25.6}$$

Using 25 instead of 25.6 for a denominator, the result will be $M_r = \frac{WBL^2}{25}$, a formula that expresses the maximum stress over the head of the column.

Out in the center of the slab, the stress would actually be about one-half of this, or $\frac{WBL^2}{50}$. However, while in continuous slabs supported on beams making the different spans equal, the bending moment at the center of the span, $M_r = \frac{WL^2}{24}$, the different city building laws only allow the use of $M_r = \frac{WL^2}{10}$ or at most $M_r = \frac{WL^2}{12}$.

So in this type of floor the writer sees no good reason for departing from a standard practice and has used the maximum moment and neglected the lesser one. Actually, as all bars are lapped over the columns, there is a large excess of steel at this point, but as the extra strength developed by the lapped bars is to some extent uncertain, it is probably better to get an excess than otherwise. Having determined the bending moment, it is a simple matter to get a steel area. This steel area is divided up into a number of small bars and distributed in uniform bands in the different directions.

It might be well to say at this point that two other distinct methods were tried without satisfactory results. One depended on considering the amount of load each separate bar should carry, allowing a certain amount of sag in the bar and figuring the stresses in the rod as a catenary. The other was to replace the straight bars from column to column by an imaginary beam on all sides of the panel as per sketch, Fig. 1, and to consider that the bending moment in plane $X - X$ was caused by the loading indicated by the shaded portions of slab, and that it was equal to $\frac{W}{2} L$, $\frac{}{12}$ where W equals total load on panel and L equals span. The steel to take up this stress was then obtained in the ordinary way except that the diagonal bars were considered to take a stress equal to 16,000 × sin. ϕ and to be equally effective in resisting stresses in a plane $Y - Y$. If the beams had really existed, this might have been permissible, but as they did not, it seemed that two other types of loading were possible, one giving $M = \frac{\frac{W}{2} L}{8}$ and the other $M = \frac{\frac{W}{2}}{6} L$, just double that originally considered.

Of course if the slab was considered continuous, these moments would in every case be cut down. However, the conditions were not satisfactory, and taking the most unfavorable method of loading, the amount of steel necessary was excessive.

The symbols that will be used in analyzing the different cases are as follows:

L = the span.
B = breadth of panel.
w = live load.
w_1 = dead load.
$W = w + w_1$ = combined load.
M = Bending moment.
R = Reaction at end of strip.
I = Moment of inertia.
ϕ = Angle.
Δ = Deflection.
T = Total thickness of slab.
$c = \frac{1}{2}T$.
E_s = Modulus of elasticity of steel in tension.
E_c = Modulus of elasticity of concrete in compression.
f_s = Unit fibre stress in steel in tension.
f_c = Unit fibre stress in concrete in compression.
d = Depth from top of slab to center of steel.
jd = Arm from center of compression to center of tension = 86d.
b = Width of strip considered.
A_s = Area of steel.
Σ = Summation.
V = Fibre stress in concrete in shear.
a = Span in inches in "Grashof" method.
r = Radius of column head.*
r_o = Radius of point of inflection.*
*Turneaure and Maurer method.

In working out the amount of steel in the different designs, the same unit stress—i. e., 16,000 lbs. per sq. in.—has been used in every case, and in Turner's method the slab has also been worked out for the regular working stress of 13,000 lbs. per sq. in. used by Turner.

In Turner's, Grashof's, and the writer's methods the unit stress will be less than that adopted for the "Cantilever" and "Turneaure and Maurer," as it was not considered advisable to make the slab less than 8 ins. thick, owing to difficulties arising in covering up the steel at the columns in thinner slabs.

In getting the deflection in the method called "Grashof" the deflection was assumed to depend directly on the modulus of elasticity of the concrete, which for stresses up to about

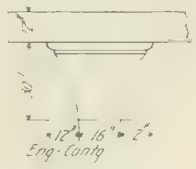

Fig. 4.

600 lbs. per sq. in. has been taken at 3,000,000 as recommended by Turneaure and Maurer in their article on deflections.

For a typical case to be solved by each method, let the span equal 20 ft., the live load equal 200 lbs. per sq. in., and the panel to be square.

(1) Cantilever method:
Let L = span = 20 ft.
Let w = live load = 200 lbs. per sq. ft.
Let w_1 = dead load.

Assume slab 8 ins. thick = 100 lbs. per sq. ft.

Assume columns 16 ins. square.

$W = w + w_1 = 200 + 100 = 300$ lbs per sq. ft.

Point of inflection of slab for uniform load $= \frac{L}{5} = \frac{20}{5} = 4.$

Lay out square with half diameter of 4' around column as per diagram, Fig. 2.

To get moments at side of column, let ab = one side of square = 8 ins.

Let uniform load on one side be as indicated by shaded portion $= \frac{(8 + 1\frac{1}{3}) \times (4 - \frac{2}{3})}{2} \times 300 = 4{,}667$ lbs.

Center of gravity of area $= \left(\frac{4 - \frac{2}{3}}{3} \times \frac{2 \times 8 + 1\frac{1}{3}}{8 + 1\frac{1}{3}} \right) \times 12 = 24\frac{3}{4}$ ins.

$M = 4{,}667 \times 24\frac{3}{4} = 115{,}500$ in. lbs.

We must add to this the amount of the concentrated load hung from the perimeter of the square. This is equal to the load on the entire bay minus the load on the square under consideration divided by the number of sides of the square equals $\frac{(20 \times 20) - (8 \times 8) \times 300}{4}$ = 25,200 lbs.

Lever arm = (4 ft. — ⅔ ft.) × 12 = 40 ins.

$M_2 = 25{,}200 \times 40 = 1{,}008{,}000$ in. lbs.

$M_1 + M_2 = 115{,}500 + 1{,}008{,}000 = 1{,}123{,}500$ in. lbs.

For maximum compression in concrete = 750 lbs. per sq. in.

For maximum tension in steel = 16,000 lbs. per sq. in.

$\frac{E_s}{E_c} = 15$ $M = 133\ bd^2$ and $A_s = .0097 \times b \times d$ taking b = 16 ins. = width of column side.

$d = \sqrt{\frac{1{,}123{,}500}{133 \times 16}} = 23.0$ ins., say 27 ins. from top of slab to point where column head starts to flare out.

Area of steel at this point = 23.0 ins. × 16 ins. × .0097 = 3.56 sq. ins.

It is advisable to obtain the moments and thickness of concrete required to resist the stresses found at several points between the side of the column and the line of inflection of the slab. With these additional points it will be quite easy to plot a curve for the column head. If these intermediate points are not located, it will be quite safe to carry the column head up at an angle of 45° with the horizontal, as in this instance. Later, when the amount of steel in the slab is obtained, see if it equals the area needed. If not, it will be necessary to add some extra bars over the column head.

Now consider the stresses in the diagonal bands. Take a strip, Fig. 3, 12 ins. wide between the points of inflection. As the bars cross in the center assume that each band of steel taken one-half the full load where they cross and the entire load where they do not cross. See diagram, Fig. 3.

The reactions at each end are equal as the load is uniform, and

$$\frac{4\frac{1}{2} \text{ ft.} \times 300 \text{ lbs.} \times 2 \div 8 \text{ ft.} \times 150 \text{ lbs.}}{2}$$

= 1,950 lbs.

$M = 1{,}950$ lbs. × 8.5 ft. − 4 ft. × 150 lbs. × 2 − 4½ ft. × 300 lbs. × 6¼ ft. = 6,938 ft. lbs.

6,938 ft. lbs. × 12 ins. = 83,256 in. lbs.

$d = \sqrt{\frac{83{,}256}{133 \times 12}} = 7.21$ ins.

Area of steel = 7.21 × 12 × .0097 = .8392 sq. ins.

If ⅝-in. round bars are used, the number of bars required will equal $\frac{.8392}{.3068} = 2.73$ in strip 1 ft. wide.

Then the spacing of bars in the diagonal bands will equal $\frac{12}{2.4} = 4.4$ ins. on centers.

Bands to be made 8 ft. wide, as this fills the area.

Next the stresses in the straight bands between lines of inflection will be obtained. These may be arrived at in a similar way. Take a strip 12 ins. wide. Over a portion of the length there is but one line of bars, so it may be considered that the whole load is acting here. Near the points of inflection, however, the diagonal bars cross and as there are three layers of bars, we assume that each line takes but one-third of the load at these points.

On this basis, the placing of the steel being symmetrical and the loads uniform, the reactions of the slab at each end are the same and

$$R = \frac{2\frac{1}{4} \text{ ft.} \times 2 \times 100 \text{ lbs.} + 7\frac{1}{2} \text{ ft.} \times 300 \text{ lbs.}}{2}$$

= 1,350 lbs.

M = (1,350 lbs. × 6 ft.) − (3¾ ft. × 300 lbs. × 1⅞ ft.) − (2¼ ft. × 100 lbs. × 4⅞ ft. = 4,904 ft. lbs.

4,904 ft. lbs. × 12 ins. = 58,848 in. lbs.

Using d same as obtained for diagonal strip = 7.21, and $jd = .86d$.

$$A_s = \frac{58{,}848 \text{ in. lbs.}}{.86 \times 7.21 \text{ ins.} \times 16{,}000 \text{ lbs.}} = 0.594 \text{ sq. in.}$$

= ⅝-in. round bars, 6.4 ins. on centers. Bands to be 8 ft. wide as before.

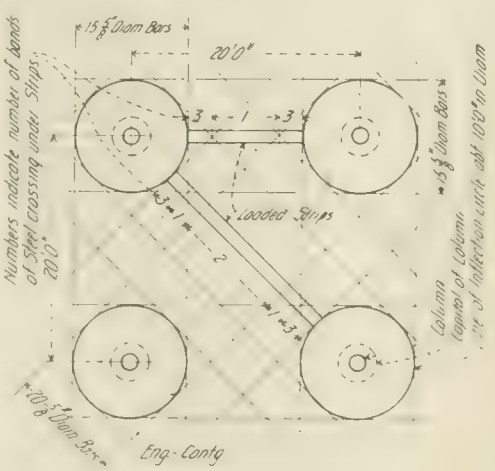

Fig. 6.

The total area of bars then that cross the column cap is equal to .594 sq. in. × 8 ft. × 2 ÷ .839 sq. in. × 8 ft. × 2 = 22.9 sq. ins.

As the bars if continuous would resist stresses in opposite sides of column head, take one-half the total area as effective for taking care of the stresses in any one side of the head.

Now $\frac{22.9}{2} = 11.45$ sq. ins., but from the previous calculations only 3.56 sq. ins. were found necessary, so there is a large excess of steel.

Actually this excess would be still greater, as in practice the bars seldom come long enough to be carried continuously over more than one span, especially in the diagonal direction, so a lap is necessary at the columns. The usual method is to schedule the bars long enough to extend 2 ft. beyond the center of the column at each end, making a lap of 4 ft.

(2) Turneaure and Maurer: A careful study of the diagrams given in the "Principles of Reinforced Concrete Construction," pp. 290 and 291, would indicate that as the ratio of r to r_0 decreases, the bending moments in the circular plate decrease. This being the case, it would seem to be an advantage to have a fairly large and very stiff column head. This is readily obtained with the common form of capital used in this type of floor. For instance, assume a circular column 16 ins. diameter. The column head has a flare of about 12 ins. and a depth of about 30 ins., as per diagram, Fig. 4, making a total diameter of about 40 ins. at the top. The ratio of depth to flare is 2½ to 1, which should insure ample stiffness. (Fig. 4.)

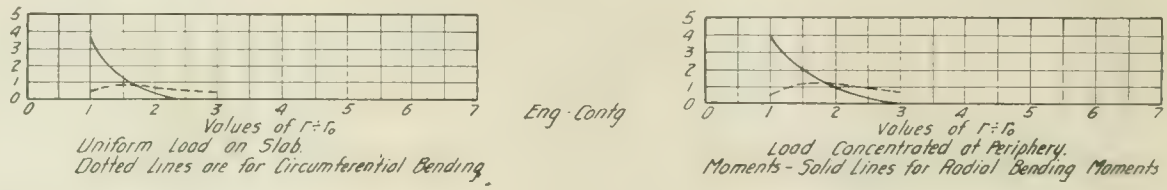
Values of r÷r₀
Uniform Load on Slab.
Dotted Lines are for Circumferential Bending.
Eng. Contg
Values of r÷r₀
Load Concentrated at Periphery.
Moments - Solid Lines for Radial Bending Moments

Fig. 5.

To take the case used in the preceding examples: Span 20 ft. and live load of 200 lbs. per sq. ft. It will be necessary to assume the slab somewhat thicker than in the other cases in order to get enough material to resist the apparent bending moments. It might perhaps be admissible to thicken the slab gradually near the columns, but Turneaure and Maurer do not state this, and further it might complicate the centering to an extent that would not be economical.

Assume the slab 12 ins. thick. Taking concrete at 150 lbs. per cu. ft., the slab weighs 150 lbs. per sq. ft. of area. This added to the live load makes a total of 350 lbs. per sq. ft. With column spacing 20 ft. apart, the diagonals will be 28.28 ft. c. to c. As the point of inflection of the beam fixed at the ends and continuously loaded is about one-fifth of the span length from the end, take the mean for the straight length and diagonal. This will equal approximately $\frac{\frac{20}{5} + \frac{28.28}{5}}{2} = 4.83$, say about 5 ft.

Having assumed a line of inflection, the area inclosed may be treated as a circular plate having a uniform load over its area and a concentrated load hung from its periphery equal to the remainder of the panel load. This will equal

$$\frac{(20 \text{ ft.} \times 20 \text{ ft.}) - (5 \text{ ft.} \times 5 \text{ ft.} \times 3.1416) \times 350 \text{ lbs.}}{10 \text{ ft.} \times 3.1416}$$

= 3,580 lbs. per lin. ft.

The ratio of the column head to the diameter of circle assumed is as 1 to 3.

Referring to the diagrams, see Fig. 5 (pages 290 and 291), it is found that the moments caused by the uniform load on circular plate are:

(1) Circumferential at column = .4 × 350 × r^2 = 140 ft. lbs. per ft. width.

(2) Radial at column = 3.5 × 350 × r^2 = 1,225 ft. lbs. per ft. width. And for the concentrated load at the edge are

(3) Circumferential at column = .5 × 3,580 × 1 = 1,790 ft. lbs. per ft. width.

(4) Radial at column = 4 × 3,580 × 1 =

14,320 ft. lbs. per ft. width. Adding the moments together, we have 140 + 1,225 + 1,790 + 14,320 = 17,475 ft. lbs. = 209,700 in. lbs. per ft. width.

Under the same stresses, etc., used in the Cantilever system, $d = \sqrt{\frac{209,700}{133 \times 12}} = 11.4$ ins., a depth that does not allow very much room to cover up the steel with the thickness of slab assumed.

Assume that this stress is constant for every linear foot of circumference of cap. The circumference of the capital being equal to 40 ×

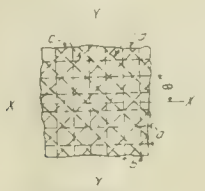

Fig. 7.

3.1416 = 125.66 ins., the area of steel needed around the column head = 125.66 × 11.4 × .0097 = 13.90 sq. ins.; but as the bars are continous, only one-half of this amount is needed: $\frac{13.90}{2} = 6.95$ sq. ins.

These bars are to be arranged in four bands over the head of the column, and the results will probably be near enough if the amount of steel (6.95 sq. ins.) is divided by 4 = $\frac{6.96 \text{ sq. ins.}}{4}$ = 1.74 sq. ins. in band the width of the column head:

$\frac{1.74}{40} = .0435$ sq. ins. per inch width.

Using ⅝-in. round bars with an area of .3068 sq. in., the spacing will be $\frac{.3068}{.0435} = 7.07$ ins. on centers. This spacing had better be continued out to the point of inflection in each case, making the bands 10 ft. wide. $\frac{10 \text{ ft.} \times 12 \text{ ins.}}{7.07 \text{ ins.}}$ = 17 ⅝-in. round bars per band. It may be that some of these bands can be omitted in the slab between the points of inflection.

Consider a diagonal strip first: Referring to the diagram, Fig. 6, noting the small figures that indicate the numbers of bars crossing, and assuming that each set of bars takes its proportion of the load, the loads are, scaling the distances:

$\frac{2 \times 2 \times 350}{3} + \frac{2 \times 2 \times 350}{1} + \frac{10 \times 350}{2} =$ 3,616 lbs.

The reaction at either end = $\frac{3616}{2} = 1,808$ lbs.

$M = 1808 \times 9 - 875 \times 2.5 - 700 \times 6 - 233 \times 8 = 8,020$ ft. lbs.

8,020 × 12 ins. = 96,240 in. lbs.

Taking depth to center of steel area as 10½ ins., it will be found that $\frac{96,240 \text{ in. lbs.}}{.86 \times 10.5 \text{ ins.} \times 16,000 \text{ lbs.}}$ = .667 sq. in. is needed and $\frac{.3068 \times 12}{.667} = 5.52$ ins. on centers, against the 7.07 in. previously found. It would seem advisable to space the bars somewhat close together in the diagonal directions, say 6 ins. on centers, making 20 bars in a 10-ft. band. This ought to allow of spacing the remaining bars somewhat farther apart.

The load in the straight direction on a unit strip equals $\frac{2 \times 2 \times 350}{3} + 6 \times 350 = 2,566$ lbs.

The reaction at each end equals $\frac{2566}{2} = 1,283$ lbs.

$M = 1283 \times 5 - 1050 \times 1.5 - 2.33 \times 4 = 3,908$ ft. lbs.

3908 × 12 = 46,896 in. lbs.

$\frac{46896}{.86 \times 10.5 \times 16000} = .325$ sq. ins.

$\frac{.3068 \times 12}{.325} = 11.35$ ins. on centers for spacing of ⅝-in. round bar.

As the stresses in the bars increase toward the edges of the bands, a spacing of about 8 ins. on centers is perhaps all that is advisable. That is equal to 15 bars in a band.

(3) Grashof's analysis of the stresses in a plate supported at rows of points making squares whose side is "a"

$$f = \frac{15 W a^2}{64 T^2}; \text{ and } \Delta = \frac{15}{512} \frac{W a^4}{E T^3}$$

As these formulas are worked out for steel plates, for which Poissom's ratio is somewhat different than that for concrete, the results obtained may not be accurate, but it will be interesting to make the comparison.

Let L = the span = 20 ft.

Let total thickness of slab = 8 ins.; dead load = 100 lbs. per sq. ft.

Let live load = 200 lbs. per sq. ft.

Let W = total load per sq. in. = $\frac{200 + 100}{144}$ = 2.08 lbs. per sq. in.

Let a = length of side in inches = 20 × 12 = 240 ins.

Let T = effective thickness of slab = 7 ins.

$f = \frac{15 \times 2.08 \times 240 \times 240}{64 \times 7 \times 7} = 573$, maximum fibre stress.

However, this fibre stress is based on the moment of inertia of a homogeneous material like steel, whose center of gravity is one-half T from the bottom. As this does not hold for concrete, the bending moment per unit width may be determined by the formula:

$M = \frac{fI}{c} - \frac{573 \times 7 \times 7 \times 7}{3.5} = 56,162$ in. lbs. per ft. width.

A somewhat lower stress on the concrete than in the previous example will be used. In this instance f_c = 650 lbs. per sq. in.

f_s = 16,000 lbs. per sq. in.

$d = \frac{M}{108b}$ and $A_s = .0077\ bd$.

From these formulas we get

$d = \frac{56162}{108 \times 12} = 6.59$ ins., which is fairly near the 7 ins. we assumed for d, and

$A_s = .0077 \times 6.59 \times 12 = .608$ sq. ins. per foot width.

From a comparison with the position and magnitude of stresses in continuous beams, it will be safe to consider the maximum stress in the present case is the negative stress at the column in the direction of the diagonals, and that the positive stress half way between the columns diagonally is but one-half this amount or less.

Also assume that the concrete plate will get the full stress indicated at the column and must be able to resist this stress from any direction, so that instead of one set of reinforcing bars, there must be at least two sets crossing at right angles to each other. Actually in this system there are four sets, which will be lettered a, b, c, and d, crossing as shown in the diagram, Fig. 7. It will now be apparent that any stress tending to rupture the slab in the vertical plane X—X will be resisted by bars b directly up to their area bA_s, and that bars c and d will assist in the ratio of $A_s \cos \phi$. Then to resist the stress in plane $X - X$,

$f_s (bA_s + cA_s \cos \phi + dA_s \cos \phi)$

$\phi = 45°$, so cosine $\phi = .707$

Now as the component forces of bars c and d for resisting stresses in the vertical plane $Y - Y$ are the same as for $X - X$, we may write $fs\ (aA_s + cA_s \cos \phi + dA_s \cos \phi)$ for the area of steel needed to resist stresses in $Y - Y$.

But it was previously found that .608 sq. ins. of steel was needed to resist M in any one

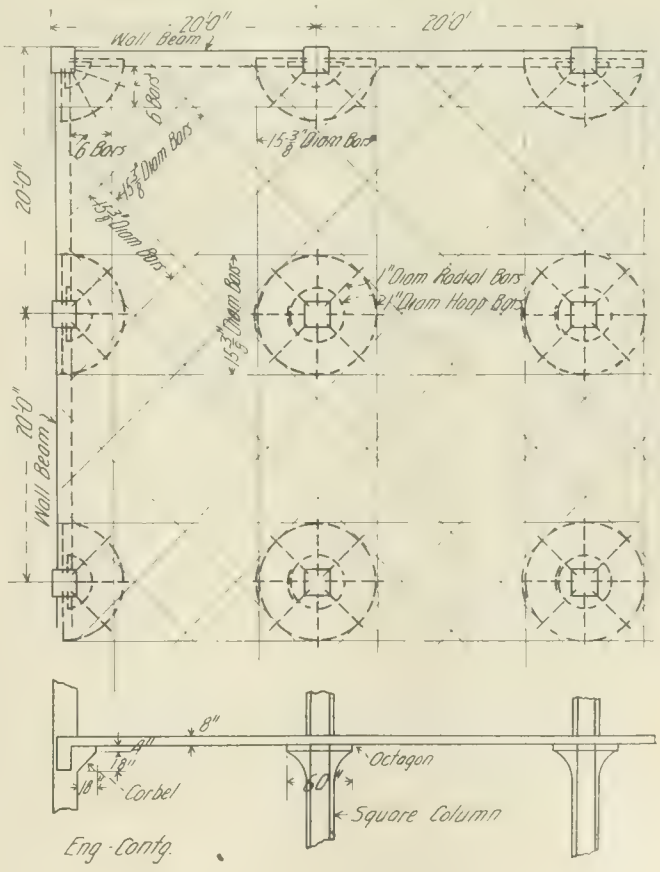

Fig. 8.

plane, say $X - X$, therefore the same amount will be needed for the equal stress in $Y - Y$; $2a.f_s + b.f_s + 2c.f_s \cos\phi + 2d.f_s \cos\phi = f_s\ (2 \times .608)$ for an area 1 ft. square.

As f_s is constant and bands a, b, c, and d are equal, $A_s = \frac{2 \times .608}{2 + 4 \times .707} = .252$ sq. in. per ft.

If the area of a ⅜-in. bar = .1104, the spacing of the bars equals $\frac{.1104}{.252} \times 12 = 5.25$ ins. c. to c.

Now if bands are made the width Mr. Turner recommends—i. e., $7/16L$— the number of bars in a band will equal $\frac{20 \text{ ft.} \times 12 \text{ ins.} \times 7}{16 \times 5.25} =$ 20 ⅜-in. round bars per band.

If it is assumed that the stresses in the center of the slab are approximately but one-half of those at the column, but one-half the amount of steel will be needed. There actually is .252 and $\frac{.608}{2} = .304$ are needed; but as the bars are crossing each other in the center of the span and as tests of expanded metal seem to prove that the concrete develops higher resisting powers when reinforced with metal in the form of a mesh, this may perhaps stand as it is.

The deflection by this method, using $E_c = 3{,}000{,}000$ equals $\frac{15 \ 2.08 \text{ lbs.} \times 240^4}{512 \ 3{,}000{,}000 \times 7^3} = .196$ in.— a little more than 3/16 in.

The size of the column head of course will serve to modify more or less the results obtained by any method, and the writer can think of no better way than to make the diameter of the cap of such a size that the vertical sheer per square inch at its perimeter will not exceed 80 lbs. per sq. in.

(4) Mensch: The writer has not attempted to analyze this method and is simply going to copy the results given in the tables on page 56 without demonstration.

Thickness of slab = 8 ins.

Area of steel in strip per foot of width, 0.75 sq. in.

Width of strip, 7 ft.

Size of column capital, 4 ft. 6 ins.

Weight of steel per sq. ft., 5.3 lbs.

Total weight in panel = 20 ft. × 20 ft. × 5.3 lbs. = 2,120 lbs.

The percentage of steel per ft. width = 0.89 of 1 per cent.

Mensch states that the rods running in the direction of the columns should extend into the adjoining panel $0.12L$, and those running diagonally should extend $0.16L$ beyond the column center.

(5) Turner's Method: Let $M = \frac{W\,L}{50}$ and f_s = 13,000 lbs. per sq. in.

All other quantities to have the same index as in previous cases.

$L = 20$ ft.

w = live load = 200 lbs. per sq. ft.

w_1 = dead load = 8-in. slab = 100 lbs. per sq. ft.

(1) $W = (200 + 100) \times 20^2 = 120{,}000$ lbs.

(2) $M = \frac{120{,}000 \times 20 \times 12}{50} = 576{,}000$ in. lbs.

(3) $\Sigma A_s = \frac{576{,}000}{.86 \times 7 \times 13000} = 7.38$ sq. ins.

The area of a ⅜-in. round bar = .1106.

(4) $\frac{7.38}{.1106} = 66.7$ ⅜-in. round bars, say 68.

(5) Number of bars in band $= \frac{68}{4} = 17.$

If $f_s = 16{,}000$ lbs.

$A_s = \frac{576{,}000}{.86 \times 7 \times 16000} = 6$ sq. ins. nearly.

$\frac{6}{.1106} = 54.2$ bars ⅜ in. diameter.

$\frac{54.2}{4} = 13.55$ bars, say 14 bars in each band

(6) Width of band $y = \frac{7 \times 20}{16} = 8$ ft. 9 ins.

Mr. Turner does not state what rule he uses to obtain the size of his column capitals.

The deflection of the slab by Turner's method $\Delta = \frac{1}{7000} \times \frac{(60) \times (20)^3}{(4 \times 17 \times .1106)\ (7)^2} =$ .19, about 3/16 in.

(6) MacMillan Method: Let w = live load per sq. ft.

Let w_1 = dead load per sq. ft.

Let $w + w_1 \times L \times B = W$ = total load on pier.

Let L and B = length and breadth of panel respectively in feet.

When panel is square, $L = B$.

When panel is rectangular, L is greater than B and must be used in getting the bending moment.

Let f_s = tension in steel = 16,000 lbs. per sq. in.

Let d = effective depth of slab.

Let jd = arm of forces = .86.

Let A_s = area steel = total number of bars in panel × area of single bar.

Let y = width of bands of steel = $7/16L$ approximately.

Let v = fibre stress of concrete in shear = 80 lbs.

Let T = total thickness of slab.

Then (1) $W = (w + w_1) \times L \times B.$

(2) $M = \frac{W \times L \times 12}{25}$

(3) $\Sigma A_s = \frac{M}{jd \times f_s}$

(4) Number of bars $= \frac{\Sigma A_s}{\text{Area of bar used.}}$

(5) Number of bars in band $= \frac{\text{total number}}{4}$

(6) Diameter of cap $= \frac{W}{\pi \times T \times V}$

(7) $y = \frac{7L}{16}$

jd will vary according to $\frac{E_s}{E_c}$ and to the percentage of steel used, but .86 is a good average. It will not be found advisable to make T less than 7 ins. regardless of load on account of the difficulty found in embedding the bars in concrete.

To illustrate the case we have been using,

Let $L = 20$ ft.

Let $W = 200$ lbs.

Let $w_1 = 100$ lbs. for 8-in. concrete slab.

Let $d = 7$ ins.

Let $T = 8$ ins.

(1) $W = (200 + 100) \times 20 \times 20 = 120{,}000$ lbs.

(2) $M = \frac{120{,}000 \times 20 \text{ ft.} \times 12 \text{ ins.}}{25} = 1{,}152{,}000$ in. lbs.

(3) $\Sigma A_s = \frac{1{,}152{,}000}{.86 \times 7 \times 16{,}000} = 11.95$ sq. ins.

The area of a ½-in. round bar = .196.

(4) $\frac{11.96}{.196} = 61$ bars.

(5) Number of bars in band $= \frac{61}{4} = 15.25,$ say 16 each way diagonally and 15 each way straight.

(6) Diameter of column cap $= \frac{120{,}000}{3.1416 \times 8 \times 80} = 59.6$ ins.

(7) Width of band $y = \frac{7 \times 20}{15} = 8$ ft. 9 ins.

It will be desirable to get the depth of cap at the junction with column by solving for depth at that point, having shear and diameter of column fixed.

The radial bars and rings have generally been made of 1-in. round rods, the rings being lapped at the ends about 2 ft. and U-bolted together or else welded. These rings are placed so that they bring the slab bars up near the top of the slab at the column.

In general $f_s = 16{,}000$ has been used for stress in tension with plain round bars. The percentage of steel has been kept below .5 per cent for a single layer of bars. The wall beams are designed to carry ¼ of the panel loads and if necessary the columns are calculated for stresses caused by eccentric loading. The wall panels are made the same as the interior panels, and where the holes of a reasonable size occur, they have been made in the slab without hesitation.

The deflections occurring have never been calculated, but the tests made indicate that they are quite insignificant. This method has been used by the writer in connection with the following work by various engineers and architects: In designing the floors and roof for the Congress Building at Portland, Me.; for a fire station at Weston, Mass.; for the floors of the East Boston Terminal Refrigerating Co.; for a storage building for the Pierce Arrow Motor Car Co. at Buffalo, N. Y.; for a storage building for the Hood Rubber Co. at Watertown, Mass.; and with a slight modification for the Winchester Repeating Arms Co.'s new loading buildings at New Haven, Conn. With the exception of the East Boston Terminal Refrigerating Co.'s floors, all of these buildings were built by the Aberthaw Construction Co.

It would seem that if the writer's interpretation of Turneaure and Nauer's diagrams and descriptions are correct, the results are extremely heavy—much more so than any existing work would lead one to believe necessary.

Only recently in fact the writer agreed to test a slab in the Refining Building for the Hood Rubber Co. with a live load of 450 lbs. per sq. ft. This slab was 9 ins. thick and the reinforcement consisted of ½-in. round bars 7 ins. on centers. Columns were spaced 20 ft. on centers. The slab was cast 8 ins. thick, and later an inch of finish was put on. A box without a bottom whose sides were long enough to span from column center to center and 5 ft. high was built, resting on the concrete slab and inclosing one bay. On the center of this bay a target was attached to the under side of the slab so that readings for deflections might be taken. The box was then filled with sand. At a load of 200 lbs. per sq. ft. no deflection of the slab could be measured. At this point, as the slab was cast in cold weather and was quite green, it was decided to put some shores under the panel and then continue the loading to the required amount. Later, when the concrete had a little more chance to season—that is, in February, 88 days after casting—the shores were taken out and the whole load was allowed to come on the slab.

The deflection under the total load was 5/64 in. This is about 1/3000 of the span with over twice the figured live load superimposed. This certainly does not seem to indicate that as thick a slab or as much steel as this method seems to demand was necessary.

A table giving the weights of steel required by the different methods may be of interest and will be given here:

Method.	Thickness of slab. ins.	Fiber stress lbs. per sq. in. in steel.	Lbs. steel in panel.	Deflection. in.
1. Cantilever	8	16,000	2,189	.
2. Turneaure and Nauer	12	16,000	1,931	.
3. Grashof	8	16,000	784	.195
4. Mensch	8	16,000	2,120	.
5. Turner, a	8	16,000	549	....
5. Turner, b	8	13,000	718	.19
6. MacMillan	8	16,000	1,084	.
Average (Not including 5b.)	8.66	16,000	1,463	.

A few points worth mention are noticeable in this summary: First, the similarity of methods 1, 2, and 4 in regard to amount of steel. This holds true of methods 3 and 5*b* also. Secondly, the marked difference in thickness of slab required by the second method. Thirdly, the remarkable closeness in deflections obtained in 3 and 5*b*.

Regarding the merits or demerits of the different methods, the writer can say little except that the floors designed by his method have been low in cost, have shown remarkable

powers of resisting abuse, have stood tests of twice the live load over an entire bay not only without signs of failure but with such trivial deflection that one is led to believe that the constituent materials are far from being stressed inordinately.

It may be well to call attention to one other point that may give trouble to the designer of this system; that is the ratio of length to breadth of panel. It will be apparent that as the greatest length is used in getting the bending moment, the depth of the slab and the amount of steel increase rapidly with the increase of length and the variation of stresses will become very uncertain. In consequence it would seem that nearly square slabs were desirable and that an increase of length over breadth of more than 25 per cent was perhaps not economical practice.

The most economical spans would seem to be from 16 ft. to 24 ft. For shorter spans the cost of columns runs up pretty fast. A heavy floor load seems to show greater relative economy than a light one. Where speed of erection is a desideratum, the flat floor slab with its absence of beams is far ahead of any other method.

The wood forms can be built into panels and laid in place by rough form builders, carpenters being used only for shoring and leveling; and there being no beams to be taken care of, little if any of the sawing and fitting necessary when they are part of the design has to be done. The bent steel is reduced to a minimum, being confined almost entirely to the columns, distributing rings and wall beams. The bars themselves, while fairly long, are generally quite small in section and easily handled, and will readily sag of their own weight to the required position at the center of the span without having to be held down.

The joints where the day's concreting is stopped are infrequent, and the danger of temperature or shrinkage cracks with such a net work of steel is minimized.

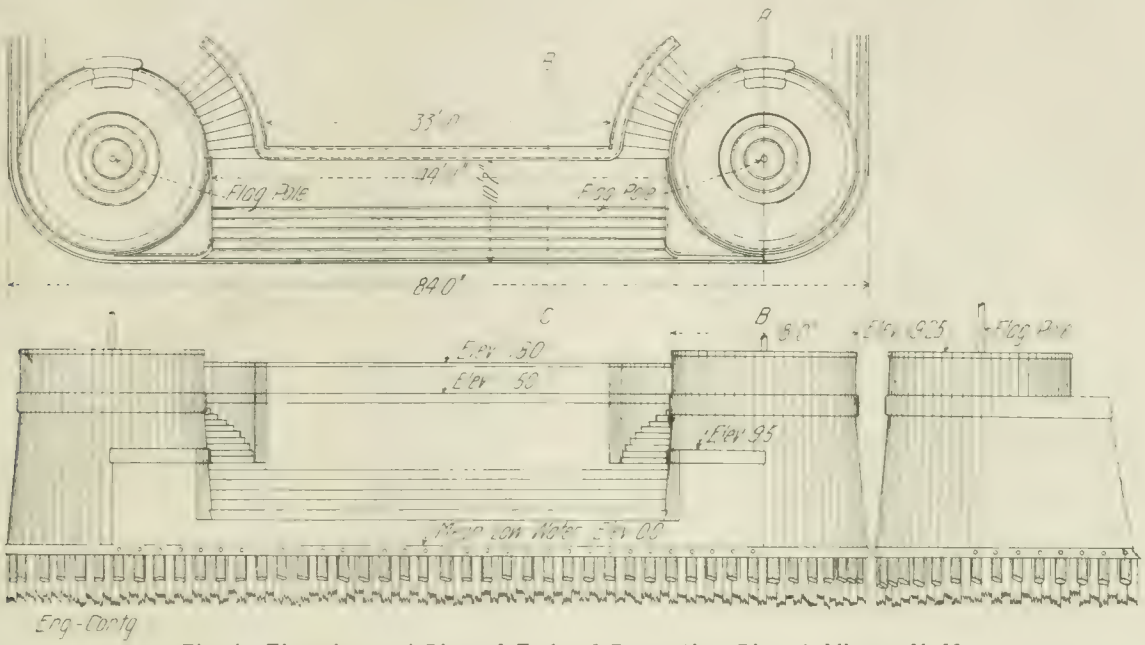

Fig. 1—Elevation and Plan of Ends of Recreation Pier at Albany, N. Y.

Structural Features of New Concrete Recreation Pier at Albany, N. Y.

Attention to water front improvements of exceptionally attractive character is being given by a number of cities located on inland rivers. This is an opportunity which American cities have quite generally neglected in the past and interest naturally attaches to the designs and details of specific examples. The accompanying illustrations show such an example. This is the new recreation and boat pier being constructed at Albany, N. Y., after designs by Mr. Walter Melius, City Engineer.

The new pier replaces an old pier and is located parallel with the city's water front and separated from the shore by a stretch of water known as Albany Basin. State Street, of the city, extended, would intersect the pier about midway of its length and the pier is connected with the shore by a bridge on the line of that street. In plan the new pier is a rectangle 898 ft. long and 84 ft. wide; its length is 100 ft. less than that of the old pier and this 100 ft. of old pier will be removed. The pier runs north and south and there are boat landings at both ends, and four others on the river side of the pier. The tops of the pier will be concrete pavement with grass plats, shelters and drinking fountains at intervals and a lavatory, all of concrete. An idea of the character of the ornamental design throughout is given by Figs. 1, 2 and 3, which show plans and sections of the boat-landings at the ends of the pier. The boat-landings on the river side of the pier are generally similar in design.

Aside from the boat-landings the pier construction consists of a plain concrete bulkhead wall supported on piles and filled behind with earth. Figure 4 is a plan and Figs. 5, 6 and 7 are sections of the bulkhead wall, showing different features of the construction. As will be seen the toe of the wall is supported on a row of round piles cut off at mean low water level and having waling on both sides. Back of the inside waling and close

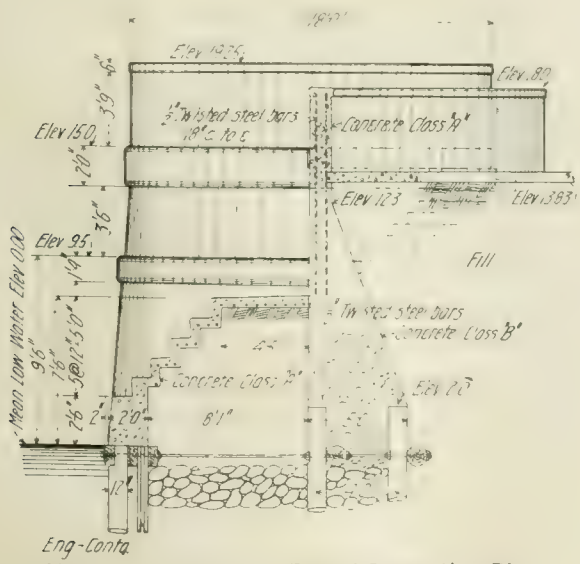

Fig. 2—Section B C of End of Recreation Pier.

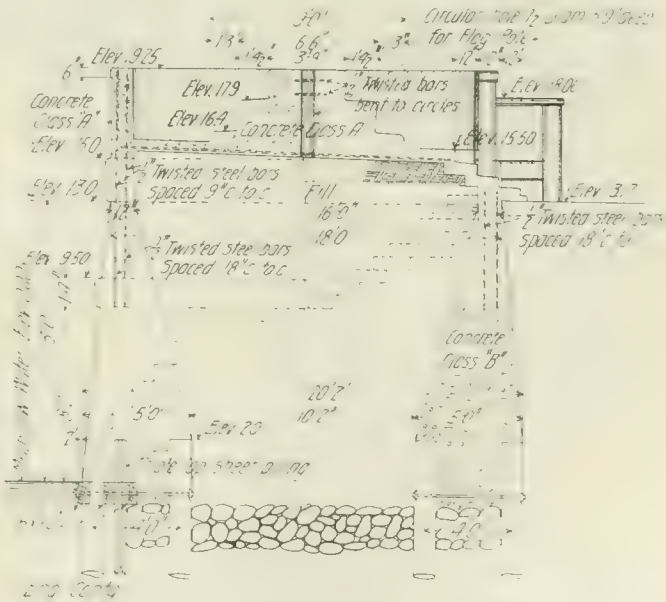

Fig. 3—Section A B of End of Recreation Pier.

against it is a row of sheet piling driven to a depth of 22 ft. below mean low water level. Each sheet pile consists of three 2-in. planks not less than 8 ins. wide, nailed together to form a tongue and groove. A waling timber extends along the top of the sheeting at the back, and, as will be noted, the sheeting, waling timbers and front bearing piles are drawn up tight at the top by a 1-in. bolt at every bearing pile. It will also be noted that every other front bearing pile is tied back to its opposite bearing pile under the heel of the wall. The system of further anchorage of the wall bearing piling consists of a row of anchor piles and waling and of a series of concrete anchor blocks; these are shown clearly by Figs. 4, 5 and 6.

The wall construction pr per is also shown by Figs. 4 to 7. As will be seen, the wall is of gravity section with both front and rear face battered and having at the back buttresses every 15 ft. The toes of these buttresses embrace the tops of the anchor piles. Structurally, the wall is divided into sections 40 ft. long, separated by expansion joints. An interesting detail is the provision of a ladder recess at each expansion joint which effectually conceals the joint. Figure 7 shows the construction of this joint. The coping as shown by Figs. 5 and 6 is separately molded and placed, being anchored to the wall proper by twisted burs 18 ins. apart. The illustrations also show the location of and manner of attaching ring bolts and snubbing posts.

Two grades of concrete will be used: Class A for steps, coping on pier walls and other places where the sections are small, and, Class B for the main body of the work. The proportions are the same for both classes, viz. 1 bag of cement, 3 cu. ft. of sand and 5 cu. ft. of broken limestone, but 1-in. stone will be the maximum size for Class A concrete while 1½-in. stone may be used for Class B, and in addition it may contain embedded rubble stone if they are not larger than 1 cu. ft. and are not placed closer than 4 ins. to each other or than 9 ins. to faces of work. It is interesting to note that the engineer specifies that a "bag of cement shall contain 94 lbs. net of cement," that "1 cu. ft. of cement shall be assumed to weigh 100 lbs.," and makes the bag the unit of measurement in proportioning. According to the specifications, then, a bag of cement is 0.94 cu. ft. of cement and the proportions as given above are by volume 0.94 : 3 : 5, not 1 : 3 : 5. In this same connection the specifications state: "For each batch the cement shall be weighed and the sand, crushed limestone and water separately measured before placing in the mixer."

The specifications require the concrete to be deposited in 6-in. layers and compacted by spading and ramming until the water comes to the surface. The finishing will consist in spading and in drawing back the stone from the forms so as to give a surface of fine material.

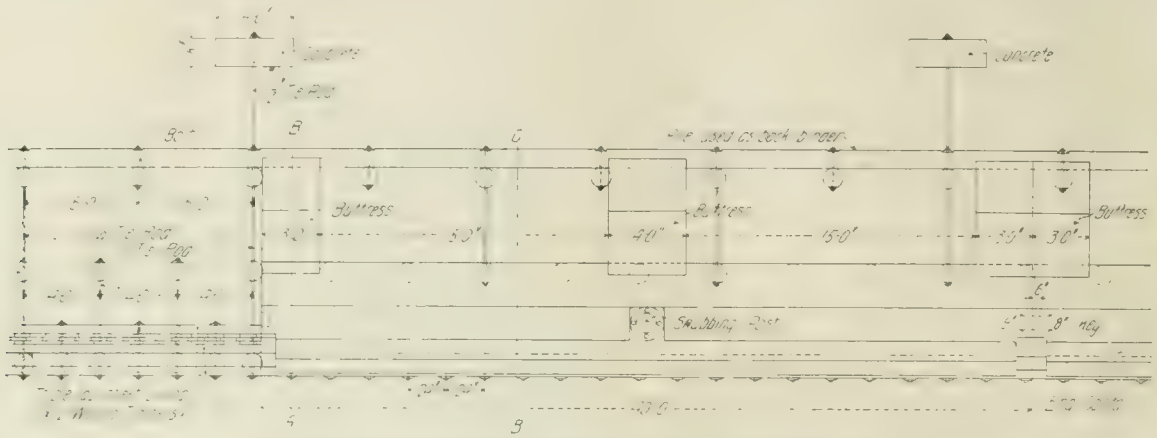

Fig. 4—Plan of Wall Construction for Recreation Pier.

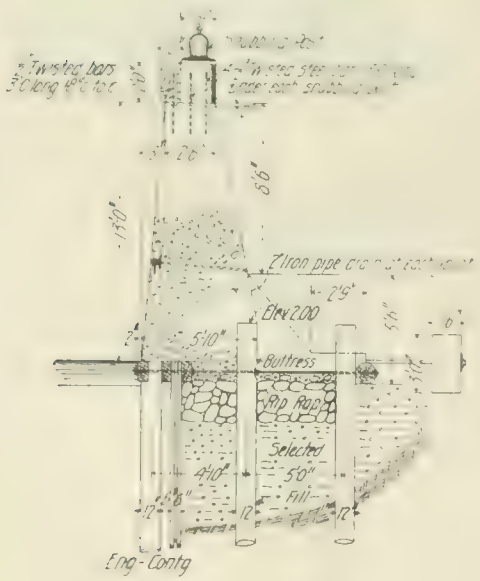

Fig. 5—Section B C of Recreation Pier Wall.

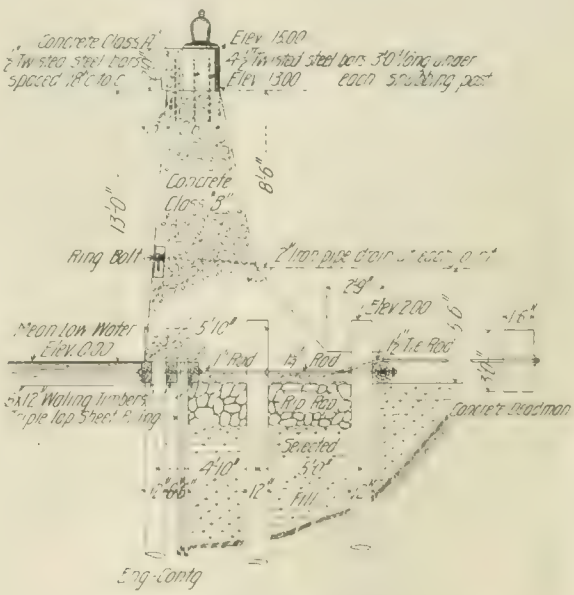

Fig. 6—Section A B of Recreation Pier Wall.

Cornelius Vanderbilt was elected to the board of directors of the Missouri Pacific, and Kingdon Gould to the board of the St. Louis, Iron Mountain & Southern, at the annual stockholders' meeting in St. Louis. Mr. Vanderbilt succeeds H. B. Henson of New York and Mr. Gould takes the place of A. G. Cochran of St. Louis. The Missouri Pacific board is constituted as follows: Geo. J. Gould, Edw. T. Jeffery, Fred T. Gates, Kingdon Gould, Cornelius Vanderbilt, R. M. Gallaway, C. S. Clarke, O. L. Garrison, W. K. Bixby, M. C. Markham, C. H. Middleton, S. B. Pryor and S. H. Kilgore. Eighty-five per cent of the stock was voted. The Iron Mountain board is constituted as follows: Geo. J. Gould, Kingdon Gould, Edw. T. Jeffery, J. J. Slocum, Benj. Nicoll, John T. Terry, C. S. Clarke, B. F. Edwards, C. A. Pratt, M. C. Markham, C. H. Middleton, G. A. A. Deane and J. G. Hollenbeck. Ninety per cent of the stock was voted. Both boards adjourned to meet Friday in New York. No changes will be made among the active executive officers.

The directors of the Gould lines, Missouri Pacific and St. Louis, Iron Mountain & Southern met last Friday at the New York offices and elected officers for the ensuing year. Vice President C. S. Clarke, M. C. Markham and C. H. Middleton, assistants to the vice president, and General Purchasing Agent S. F. Pryor were present at the meeting from St. Louis. E. C. Simmons of St. Louis was elected a member of the Iron Mountain board and Kingdon Gould, son of President George Gould, was likewise elected a member of the board and the executive committee. Cornelius Vanderbilt, who was elected a director of the Missouri Pacific at the St. Louis meeting of stockholders on Tuesday, was placed on the executive committee of that company. Fred T. Gates represents the Rockefeller interests on that committee. General Purchasing Agent Pryor of St. Louis was elected on Tuesday a member of the Missouri Pacific board. Vice President Clarke was elected a member of the executive committee. B. F. Edwards of the Bank of Commerce and C. S. Clarke were elected members of the Iron Mountain board. The organization was perfected as follows:

Missouri Pacific—Directors: George J. Gould, E. T. Jeffery, Fred T. Gates, Kingdon Gould, Cornelius Vanderbilt, R. M. Gallaway, Edwin Gould, C. S. Clarke, O. L. Garrison, W. K. Bixby, J. J. Slocum, Howard Gould, S. F. Pryor; executive committee: George J. Gould, E. T. Jeffery, Fred T. Gates, Cornelius Vanderbilt, Kingdon Gould, C. S. Clarke J. J. Slocum. St. Louis, Iron Mountain & Southern—Directors: George J. Gould, E. T. Jeffery, J. J. Slocum, Kingdon Gould, Benjamin Nicoll, John T. Terry, C. S. Clarke, B. F. Edwards, C. S. Whelen, Jay Gould, H. B. Henson, E. C. Simmons, Howard Gould; executive committee: George J. Gould, E. T. Jeffery, Kingdon Gould, J. J. Slocum, Jay Gould, John Terry. Officers for both companies were selected as follows: George J. Gould, president, New York; C. S. Clarke, first vice president, St. Louis; Martin L. Clardy, vice president, and general solicitor, St. Louis; J. M. Johnson, vice president in charge of traffic, St. Louis; Kingdon Gould, vice president, New York; O. B. Huntsman, vice president, New York; Frank Jay Gould, vice president, New York; A. H. Calef, secretary and treasurer, New York; F. M. Hickman, local treasurer, St. Louis; F. W. Irland, assistant secretary, St. Louis.

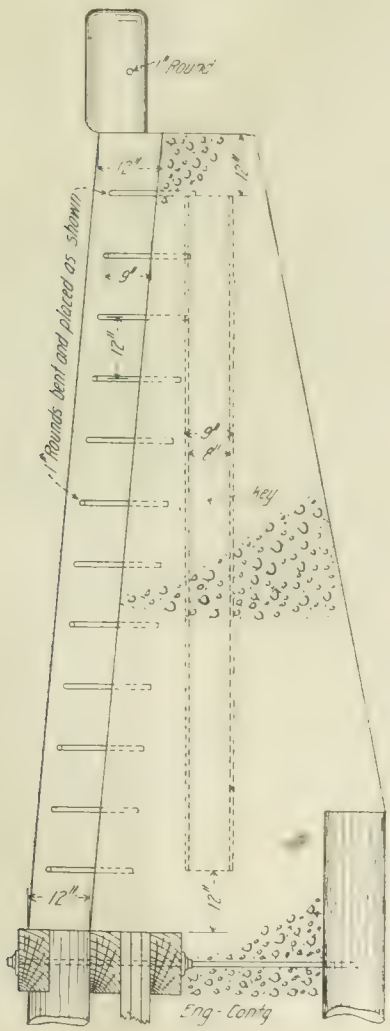

Fig. 7—Section of Pier Wall at Expansion Joint.

An investigation regarding the use of granolithic and other floors in manufacturing plants has been recently undertaken by the Aberthaw Construction Co., Boston, Mass. The results will be embodied in a special report which is now in process of preparation. It is understood that the above named company will be very glad to receive information from various sources regarding experience with granolithic floors as to cost, durability, hygienic effect, and general convenience.

Earth and Rock Section

Note: This section is devoted to methods and costs of excavating earth and rock and building embankments. It will cover the grading of roads and railroads, diking and canal work, dredging, building reservoirs and earth dams, sewer and water pipe trenching, quarrying, etc.

Some Records of Work With a Scraper Bucket Excavator On the New York Barge Canal.

The following records relate to scraper bucket excavation work on the New York Barge Canal contract of the Thomas Crimmins Contracting Co. of New York, N. Y. The section of the canal on which the work recorded is located is in that part of New York state so famous for Medina sandstone and this sandstone is covered with a very hard material composed of sand, loam and clay which is widely known as "red horse." This "red horse" is so tightly compacted that it can be picked only with the greatest difficulty. Specifically the material excavated in the work recorded consists of about 1 ft. of silt over the whole prism of the canal and of "red horse" underneath or, say, of about 10 per cent mud and 90 per cent hard material.

The excavator used is shown by the accompanying illustration. It is a Class C, Lidgerwood-Crawford scraper bucket excavator built by the Lidgerwood Manufacturing Co., Chicago, Ill. Briefly, the excavator consists of an upper frame mounted on a turntable which rides on a lower frame carried on trucks. From the upper frame there rises an A-frame thoroughly guyed, and to its front end is hinged a boom, the outer end of which is rigged with topping lines to the A-frame. The upper frame carries the power plant which consists of a double-cylinder, double-friction drum main engine, a 90 hp. Scotch boiler, swinging engine, boom winch, water tanks, pump and accessories. A notable feature of this plant is the convenience and ease of its operation. The steam, reverse and brakes are all controlled by one lever. The frictions on main engine and the swinging engine are operated from the front of the engine platform by the "Crawford" pneumatic control. The exertion required to handle the frictions and swinging engine by this compressed air control is confined to moving a lever 8 ins. long, forward and back, a total distance of 8 ins. When this 8-in. lever is thrown forward the bucket is filling and when thrown back the bucket is hoisting. The moving of a lever on another similar controller starts the swinging engine the moment the bucket is clear of the ground. It is then conveyed to a point where the dumping is performed by the operator removing his foot from the brake of the lower drum. Another convenient feature is the connection of the pump with a suction pipe which runs down through the center spider of the turn table and which has a ball and socket joint. The boom in the machine illustrated is 85 ft. long; the bucket is a 2-cu. yd. Page bucket. The total weight of the machine is 110 tons.

The excavator is operated on a steel rail and timber track built in 15 ft. sections. The excavator grades its own roadbed and shifts the 15 ft. sections of track from rear to front as needed.

Table I is a record of work with the machine illustrated which covers the period from March 25 to April 14, 1909, inclusive. The excavator was operated three 8-hour shifts per day as follows: Shift 1, 4 a. m. to 12 noon; shift 2, 12 noon to 8 p. m.; shift 3, 8 p. m. to 4 p. m. On each shift there was the following gang: 1 operator, 1 fireman, 1 foreman and 4 pit laborers, or 7 men in all on the excavator proper. The duties of the several men were as follows: The operator had the entire operation of the excavator; the fireman tended the fire, oiled the working parts and kept an eye on the machinery for his operator. The foreman had complete charge and directed the movements of the machine. His most important function, however, was to direct the bucket. This he did by standing in the cut and signalling the runner when and how deep to dig. It was found that directing the work in this manner saved much time and expense; there was no excavation below grade nor was material above grade left on the banks and bottom. The 4 laborers attended to setting the track, put on coal and kept the lights in shape.

Fig. 1—View of Lidgerwood-Crawford Scraper Bucket Excavator at Work on New York Barge Canal.

TABLE V.—RECORD OF '21 DAYS' OPERATION OF A SCRAPER BUCKET EXCAVATOR ON THE NEW YORK BARGE CANAL.

	Distance moved, ft.	Yardage handled, cu. yds.	Hours time lost out of 24 hrs.
March 25	60	817.5	2 (delay)
March 26	90	1,179	.....
March 27	60	786	11 "
March 28	75	982.5	4 "
March 29	90	1,179	1 "
March 30	95	1,252.36	1½ "
March 31	75	982.5	1 "
April 1	75	982.5	3½ "
April 2	110	1,467.2	.....
April 3	90	1,179	.....
April 4	45	589.5	9½ "
April 5	80	1,048	4 "
April 6	105	1,260	.....
April 7	75	900	.....
April 8	105	1,260	.....
April 9	90	1,080	1½ "
April 10	30	360	14 "
April 11	15	180	16 "
April 12	120	1,440	.....
April 13	90	1,080	.....
April 14	60	720	.....

The 7 men mentioned were all the men em-

ployed with the exception of two "dinkey" runners who brought up coal and water to the machine. They worked from 4 o'clock in the morning till 8 o'clock at night. Each shift took water three times, stopping 20 mins. each time for this purpose and while the machine was standing idle for water the coal was put on. The machine operated when there was no break-down, 20 hrs. out of the 24-hrs. The coal used was a medium class bituminous, and the machine required about 1 ton per shift.

Referring to the table it will be seen that the machine worked 21 days, advanced 1,635 ft. and excavated 19,725 cu. yds. Of the third column, recording delays, it may be noted that all repairs which could be postponed till then were made during the shift from 8 p. m. to 4 a. m. Out of the 69 hrs. lost time, 46 hrs. were for broken shafts. These were broken on the drag line drum and were chiefly the fault of the operators. The remaining 23 hrs. lost time were because of cable and bucket breaks.

The information contained in the table and most of the other data given have been sent us by Geo. S. Taylor, The Crimmins Contracting Co., Knowlesville, N. Y., who also writes as follows concerning the excavator:

The great advantage of these machines rests in their flexibility. They revolve upon a track set upon dolly wheels making a complete revolution from right to left. In addition to this their power is increased by their great reach. Their boom, which is a firmly constructed framework, can be lowered to give a radius of 89 ft. The saving is at once seen. Material can be picked up out of a cut and dumped 89 ft. on either side of the machine, which makes a total distance of 178 ft. This often does away with the handling of material twice as by dump cars or conveyors. However, if it is necessary to haul material from her it is as readily loaded into cars as by a steam shovel. Furthermore, from this advantageous reach the hauling track may be either on a level or higher or may be kept close or at a distance from the machine according to whatever conditions require.

These powers give the machine great advances over other shovels. For example, in all drainage work, such as canal digging, the machine can be placed in the bottom of the cut and excavating the material, deposit it on either side. Likewise if it is undesirable to set the excavator in the cut, when there is quicksand or water to contend with she may be kept up on dry land and be worked to almost as great an advantage.

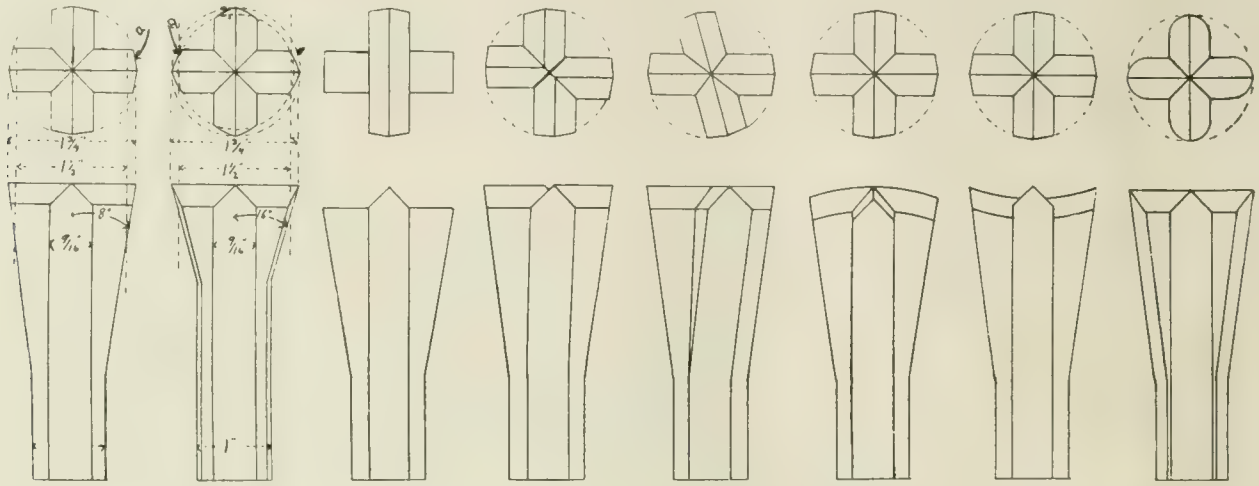

Fig. 1. Fig. 2. Fig. 3. Fig. 4. Fig. 5. Fig. 6. Fig. 7. Fig. 8.

Shapes of Drill Bits in Use with Comments on Efficiency and on Sharpening and Tempering.*

The success of almost every drilling operation depends on the selection and treatment of the bits. Too much attention cannot be given this important part of the work. If the bits have been properly formed, sharpened, and tempered for the work, and if they are changed just as soon as their edges and gauges are worn, the result will be found to be most economical. The power-drill sharpener has removed many of the shortcomings attendant upon the hand-sharpening process, with the result that where these machines are used it is possible to accomplish from 25 to 100% more drilling than under the old methods. The reasons for this are that the power sharpener turns out a much better bit. The saving in the blacksmith's wages should be a secondary consideration. The superior quality of the bits made in a machine will increase the capacity of the drilling machines sufficient to pay handsome dividends on the cost of the power sharpener.

For the guidance of those unfamiliar with the forms of drill-bits used in the different sections, I have prepared a few drawings of those in use. Fig. 1 represents the square cross-bit adopted as the standard for American mining practice. It is made from either round, octagon, or cruciform steel. In the copper mines of Michigan, it is usually made of a round steel. In the iron mines of Michigan and Minnesota and wherever this form of bit is used east of the Rocky Mountains, octagon steel is preferred, but in the Rocky Mountain and Pacific States cruciform steel is used. The reason for the adoption of this form of bit as a standard will be appreciated when the three requirements of a rock-drill bit are recalled. These are, "to chisel out a hole in the rock," "to keep this hole round and free from rifles," and "to mud freely." There is really a fourth requirement, which is "to do as much drilling as possible before being resharpened."

The different kinds of rock to be drilled affect the wear of the bit. Very hard rock will blunt the chisel and reaming edges. The softer rocks do not blunt these edges, but wear the outer sides so that it loses its gauge and size, still appearing to be quite sharp. For this reason a bit that is made with a square edge and a clearance angle of 8 deg. will drill about four times as long in soft rock as a bit with round edges and a clearance angle of 16 deg., before being reduced to the size of the next bit that is to follow. Referring to Fig. 1 and Fig. 2, the latter being a round-edge bit with a clearance angle of 16 deg., it will be seen that in Fig. 1 the corners of the bit at the

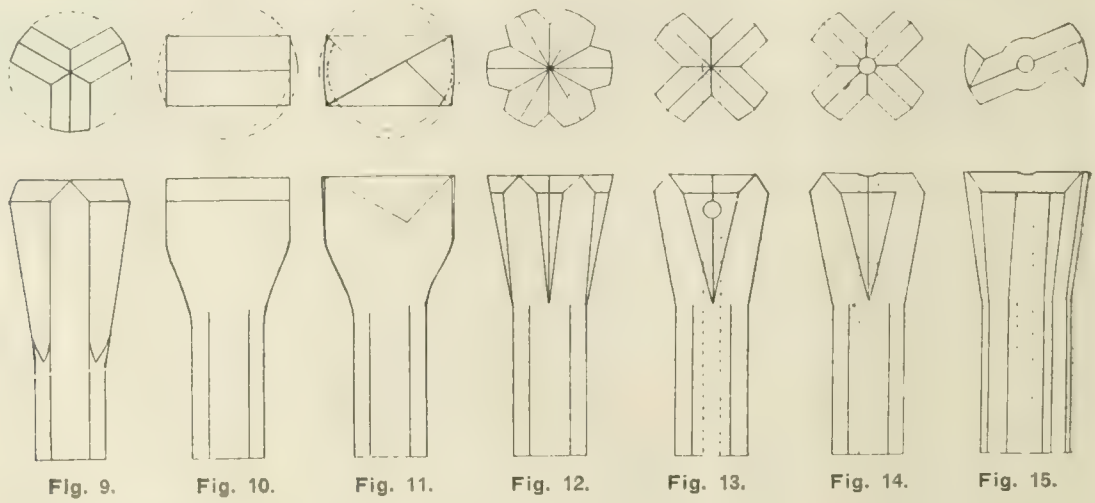

Fig. 9. Fig. 10. Fig. 11. Fig. 12. Fig. 13. Fig. 14. Fig. 15.

*From an article by T. H. Proske in "Mining and Scientific Press" for March 5, 1910.

base of the bevel describe a circle that is equal to the circle that the chisel edges describe. This is as it should be, as it is impossible for the chisel edge to cut out all of the rock. The reaming edge, which is that part of the bit extending from the chisel edge to the base of the bevel, marked "A" in both Fig. 1 and Fig. 2, must ream the outer edge of the hole and keep it round and free from rifles. In Fig. 2 it will be noted that the circle described by the corners of the bit at the base of the bevel is much smaller than the circle described by the chisel edges. This causes an excess of wear on the corners of the chisel edges, the bit rapidly loses its guage, as well as it efficiency, and it is almost impossible to keep the hole round. Rifles form, and these cause the rotation parts of the drilling machine to break, often resulting in the loss of the hole.

Fig. 16. Fig. 17. Fig. 18. Fig. 19. Fig. 20.

The angle of the bevel of the face of the bit has to do with its life as well as with the property of "mudding" freely. It is generally accepted that if this angle be 90 deg. it gives strength and permits the bit to "mud" or throw back the cuttings from the face of the bit when the drill is pointed downward. Bits made like Fig. 19 and Fig. 20 will not "mud" freely. Another reason why bits such as is shown in Fig. 1 are preferable to those illustrated by Fig. 2, is that having a long wing they are stronger and will not break so readily as does a short bit.

The Simmons bit, used at the Champion mine at Beacon, Mich., is shown in Fig. 3. In it two of the wings are devoted entirely to reaming and keeping the hole round and free from rifles. Some tests made several years ago in jasper, the hardest rock found in the Champion mine, using a 2¾-in. Rand drill with 60-lb. air pressure at the compressor, showed an average speed per minute of 0.28 in. for the ordinary cross-bit, and 0.659 in. for the Simmons bit. Both forms were hand-sharpened.

The Brunton bit, the invention of the well known mining engineer, D. W. Brunton, is extensively used in Idaho and Montana. It is shown in Fig. 4. The object of this bit is to obtain the advantages of the X-bit without the attendant difficulties of re-sharpening. With this bit, as in the case of the X-bit, the piston must revolve a half turn before the cutting edges will strike in the same place a second time. It is as easily re-sharpened as the regular square cross-bit. The X-bit itself is shown in Fig. 5. Since the invention of power-drill sharpening machines, this bit is fast disappearing. The reason will be understood when a comparison is made with the regular square cross-bit, as made with the power-sharpener, and the cross-bits as they are re-sharpened by hand, shown in Fig. 18, Fig. 19, and Fig. 20. The X-bit is designed to prevent rifles. This the hand-sharpened cross-bit would not do, but the machine-sharpened cross-bit effectually accomplishes. Figure 6 shows what is commonly termed the high-centre bit. This was for many years accepted as the proper form. It is still used in the mines of Cornwall and where Cornish customs prevail. Since the introduction of hammer-drills this bit is again finding favor. It is of especial advantage in starting a hole, the high centre immediately making an impression on the rock, whereas the square-faced bit requires a flat face for ready starting. For a starting bit in hammer machines it has no equal. Here, however, its advantages over the square bit end. Used as a bit to follow the starter, it is liable to follow slips and seams in the rock, causing crooked holes, which are sometimes lost before being finished. This the square bit will not do. Figure 7 shows a bit where the corners are in advance of the centre. This is a fast cutting bit. The corners break up the rock in advance of the centre and leave little for the centre to do; this causes the corners to wear fast, but still not to excess when it is considered that they do most of the work. This drill will not follow slips and seams, will drill a round hole, and is easy on the drilling machine. The weak point of this form is that the leverage is so great on the corners that they are liable to break off if tempered too hard. Figure 8 shows the round-edge bit, which is a favorite with some. In soft rock this is good, but in hard rock it permits rifles to form in the hole because there are no reaming edges.

The Y-bit shown in Fig. 9 gives the advantage of plenty of room for the cuttings to essape. It is, however, quite difficult to make and re-sharpen by hand. With the power-sharpener it can be made as easily as any other form. Figure 10 shows the 'bull' bit in use in the lead and zinc mines of the Joplin, Missouri, district, before the introduction of the power-sharpener. The extreme hardness of the limestone and flint in the sheet-ground of that district, caused the ordinary cross-bit as made by hand to wear too fast. This dull bull-bit therefore had to be adopted. Drilling here was not a matter of cutting the rock, but of shattering it by impact. The power-sharpener has changed all this, and the American standard cross-bit as made in these machines is now used. As a result the capacity of the drills has been materially increased. In mines where hand-sharpening is still done the bull-bit is yet in use. Figure 11 shows the Z-bit used in hand-sharpening in the south-east Missouri lead district. This bit is also used quite extensively in Germany. In both places, however, the advantage of the standard square-cross-bit as made with the power-sharpener is fast causing it to be displaced.

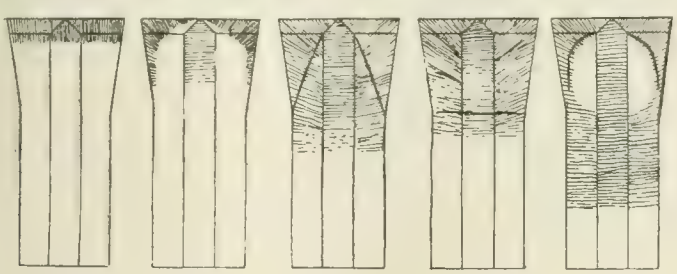

Fig. 21. Fig. 22. Fig. 23. Fig. 24. Fig. 25.

Figure 12 shows the 'six-wing rosette' bit as made in the power-sharpener in use at the Penarroya mines in Spain. It is used in hammer drills only. Of all the rosette forms of bit this has been found to be the most satisfactory. Figure 13 shows the square cross-bits when made up for hammer drills where a hole for the introduction of air or water to remove the cuttings apexes at a point back from the bevel of the bit in one of the recesses between the wings. Figure 14 shows the same form where the hole ends in the centre of the cross of the cutting edges. This form of bit is extensively used. Its faults are that a core is formed by this hole; this core fills the hole, and causes a stoppage of air or water. These cores have been known to become as much as 8 in. long, and are quite difficult to remove. To clear them away the core must be burned out by heating the steel the full length of the core in a slow fire; a sometimes slow and tedious process. This difficulty is entirely overcome by the use of the bit shown in Fig. 13, The Z-bit, Fig. 15, is extensively used in Germany. In hammer drilling machines, the steel is formed in bars having a Z shape. While I show this bar straight, it is usually twisted to form a spiral. It is an easy matter to form a Z-bit on the end of such a bar. The results obtained are excellent. Holes to a depth of 16 ft. horizontal have been drilled with this form of steel. The spiral draws out the cuttings much the same as an auger. Figure 16 to Fig. 20 are given to show the evolution of the cross-bit where hand-sharpening is employed. There are two system of hand-sharpening. One is known as the set-hammer system. In it the steel is hammered by placing a set-hammer on the bevels and driving the steel back. The results of this method are illustrated in Fig. 16 to Fig. 19. Fig. 16 shows a bit made by cutting the bevels with a chisel and is as it should be in form. Figure 17 shows this bit after about the third sharpening. Figure 18 is the same bit after about the sixth sharpening, and Fig. 19 is the same bit at about the time that the original cross that was formed on the bar of octagon steel has become exhausted. The other system of hand-sharpening is known as the fuller and dollie system. By this system the stock is first drawn sharp at the corners as shown in Fig. 20 with the fuller, after which it should be set back in the centre with the dollie. Unfortunately the man swinging the sledge hammer gets tired before the bit is set back enough, the result is that the bit, partly finished, is left as shown in Fig. 20. It is because the power-sharpener has the staying power, and because it readily finishes a bit perfectly, that inferior bits like these are not to be found where machine sharpening is employed.

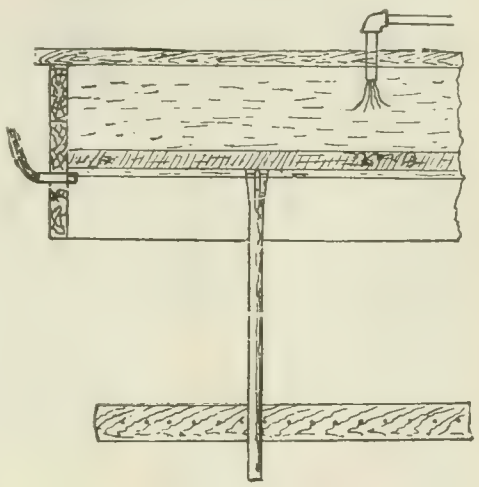

Fig. 26.

After a bit has been forged, it should be properly tempered as in Fig. 21. Figure 22 shows the result of the common method of tempering. The centre of the bit is soft, while the corners are hard. When the bit is immersed in the water about an inch the large mass of metal in the centre cools more slowly than the corners since the corners have three sides exposed to the water. Perhaps the centre had not chilled at all when the bit is withdrawn for annealing, and the final result is a soft-centre bit, which will flatten and retard the work of drilling. Figure 23 and Fig. 24 show the result of trying to temper the bit with the forging heat, by plunging the

whole bit into the water as soon as it is sharpened. The line of tension induced by cooling is indicated. At this place the drill will break. Figure 25 shows the checking caused by first chilling the steel back of the bit and then plunging with the forging heat.

For the purpose of tempering a bit as shown in Fig. 21 a tank should be provided, such as shown in section in Fig. 26. This should be about 12 in. deep by 12 wide, and of sufficient length to accommodate whatever number of drills are to be sharpened in a day with the machine. The water inlet should be at the bottom, and the outlet should be placed about ¾ in. above a grate which itself should be about 8 in. above the bottom. This permits the bit to be immersed to a depth of about ¾ in. With a temperating tank of this construction the bit can be hardened to any desired degree. This depends on the temperature of the bit when placed on the grate. It is essential that the drill stand in a vertical position. To lean either way would cause it to harden to a greater depth on one side than on the other, causing a tension that might lead to breaking of the wings. It is best to provide a rail around the tank about the distance above required to hold the shortest drill, and to drive pins about 3 in. apart in this rail. By placing the drills between these pegs they can be kept in a vertical position. When using this tank a small flow sufficient to displace the water heated by the cooling of the bits should be turned on to keep the supply always cool.

Best Woods for Piling.—At the Oct. 1909, Convention of the American Railway Bridge and Building Association the following facts were brought out on the subject of wood for piling. Mr. W. T. Powell, Colorado & Southern Ry., Denver, Colo., reported that untreated long leaf yellow pine had a life of about six years and the use of this material was abandoned in favor of oak about two years ago. The oak procurable by his road is small and crooked so the use of treated short leaf yellow pine will be resorted to although the life of good oak piles is placed at approximately sixteen years. Mr. J. T. Parker, Santa Fe Coast Lines, San Bernardino, Calif., stated that his line use mainly Oregon pine for piles but in recent years this is inferior in quality to that received ten to fifteen years ago. White cedar has given the best service, lasting from eight to fifteen years, depending upon soil and other conditions. Second cuts do not last so long. Good Oregon pine has given nearly the same length of service under like conditions. Mr. L. D. Smith Southern Pacific Co., San Francisco, reported the use of Oregon pine and Washington fir treated with ten pounds of creosote per cubic foot at the company's plant. In Texas on the El Paso & Northeastern R. R., Mr. B. J. Mustin, said Texas pine creosoted is used in all pile bridgework. Mr. A. H. King, Oregon Short Line R. R. reports success with saltwater, the piles of Oregon fir being submerged a year or longer in the waters of the Great Salt Lake. As long as the saline coating remains on the timber the crust proves a very valuable preservative, and piles driven 25 to 30 years ago in the lake are in perfect condition, but as yet he is unable to say what the results may be with piles thus treated, and used in other places, remote from the lake.

A national convention of inventors is to be held at Rochester, N. Y., June 13 to 18, 1910, under the auspices of the International Congress of Inventors, an organization established four years ago to work for the reform of patent law and procedure and the better protection of inventors' rights. Arrangements for the convention are in the hands of Alexander B. Lamberton, president of the Board of Park Commissioners of Rochester.

The Louisville & Nashville R. R. has bought the 25-mile line belonging to the Cullman Coal & Coke Co., of Cullman, Ala., and will complete it and operate it.

Roads and Streets Section

Note: This section is devoted to methods and costs of road and street construction. It will cover road building in all its details, the construction of pavements, sidewalks and gutters, the testing and use of paving materials and the machinery and tools used in road building and paving.

Some Methods and Costs of Oiling Roads in St. Louis with a Description of a New Construction Employing Molded Slabs of Bitumen and Aggregate.

In St. Louis Mr. Jas. C. Travilla, Street Commissioner, ably assisted by Mr. W. L. Hempelman, chemist for the Department, has been doing much advanced work along experimental lines, in the use of oils and bitumens for the preservation of road surfaces. A careful study has been made of all current literature on the subject and of experiments being conducted elsewhere so that each experiment made in St. Louis is rather in advance of previous work instead of a duplication.

Fig. 1—Tank Wagon for Heating and Mixing Oil-Asphalt Compounds.

The following specifications for residuum oils for road treatment have been in use the past season. The use of No. 1 oil will be abandoned this season since this oil is too light, its use producing but temporary results at best. Specifications for No. 2 and No. 3 oil will be slightly modified for the coming season and a new grade introduced between them.

NO. 1 OIL.

The specific gravity of the oil shall be not less than 0.075 (30° Be) at 60° F. (15.5° C.). Evaporation loss upon heating a 20 gr. sample in a vessel 2¼ ins. in diameter and 1½ ins. high, with vertical sides, for six hours:

At 212° F. (100°.C.) not to exceed five per cent (5%).

At 325° F. (163° C.) not to exceed fifteen per cent (15%).

At 400° F. (205° C.) shall not exceed twenty-eight per cent (28%).

The oil shall be steam refined, and shall be free from insoluble or suspended matter. Information in writing concerning the source of the oil, with a ½ gal. sample of same, must be submitted with each bid.

NO. 2 OIL.

The specific gravity of the oil shall be not less than 0.931 (20.4° Be.) at 60° F. (15.5° C.). Evaporation loss upon heating a 20-gr. sample in a vessel 2¼ ins. in diameter and 1½ ins. high, with vertical sides, for five hours at 325° F. (163° C.) shall not exceed 4 per cent. The oil shall be steam refined and when evaporated at a temperature not to exceed 500° F. (260° C.) it must give a residue of not less than 60 per cent, having a penetration of 10 millimeters at 77° F. in 5 seconds, under a weight of 100 grs. using a No. 2 needle. The oil shall be free from insoluble or suspended matter. Information in writing concerning the source of the oil, with a ½ gal. sample of same must be submitted with each bid.

NO. 3 OIL.

The asphaltum oil shall have the following characteristics: It shall have a density of not less than 0.982 (12.6° Be.) at 15.5° C. (60° F.). It shall be free from water and the evaporation loss upon heating a 20-gram sample in a vessel 2¼ ins. in diameter and 1½ ins. high, with vertical sides for five hours at 400° F. (204.5° C.) shall not exceed 2½ per cent. It shall not yield more than 6 per cent fixed carbon on ignition. It shall be of such a consistency that it will pour at 95° F. It shall be steam refined and free from insoluble or suspended matter. It shall not flash below 400° F., closed oil-tester, when temperature is raised at rate of 20° F. per minute. It shall be delivered in barrels of about 400 lbs. capacity. Information in writing concerning the source of the oil, with a ½

STREET DEPARTMENT.
St. Louis, ...191....
Switch No. .....
Load No. ..... Wagon No. .... Contains . . . . . Gals.
Car .....
Oil Temperature (leaving) ....Deg. F.
Oil Temperature (on road).....Deg. F.
Time leaving ..... A. M. .....P. M. Time received ..... A. M. ..... P. M.
Air Temperature ..... Deg. F.
Remarks .....
.....
Heating Engineer.

Fig. 2.

gal. sample of same must be submitted with each bid.

For mixing and heating the oil-asphalt compounds the machine shown in Fig 1 has been used by Mr. Travilla.

Card Fig 2 is used where the oil, heated in the tank car, is pumped directly into the distribution wagon; card Fig 3 is used in connection with the oil-asphalt heater. These two cards are furnished in block form, while that represented by Fig 4 is a postal-card. Figure 5 is a 4x6 in. permanent laboratory record card, of good quality. Cards Figs. 2 and 3 make it possible to allow for the expansion of the oils, due to the high temperature to which they are heated before distribution on the road. It will be seen from card Fig. 4 that the cost per yard per day for all roads oiled can be easily determined.

STREET DEPARTMENT.
St. Louis, ...191....
Switch No. .....
OIL ASPHALT HEATER.
Load No. .... Wagon N . .. . Contains ....Gals.
Proportions ..... Oil No. ..... Asphalt No. ..... Tar No. ....
Car.....Oil Temperature (leaving) .....Deg. F.
Oil Temperature (on road) .....Deg. F.
Time of leaving ..... A. M. ..... P. M. Time received ..... A. M. ..... P. M.
Air Temperature ..... Deg. F.
.....
Heating Engineer.

Fig. 3.

The plant consists of a melting and agitation kettle, a storage compartment, air-pump for furnishing compressed air for agitating the oil-asphalt mixture and for forcing the same from the pressure or storage compartment to the distribution wagon, also a steam pump as an auxiliary for pumping heavy oil from the tank car to the melting kettle, and a steam boiler for the operation of the air-pressure and steam pumps.

The heater has a capacity of 1,350 gals. and is divided transversely into two equal parts. Both sections are provided with air-agitation pipes the open compartment being used for melting and thoroughly agitating the oil-asphalt mixture, the other closed compartment for receiving the mixture previous to forcing it into the distribution wagon.

The method of operation is as follows: The oil-asphalt compound, in the kettle or open compartment, is melted and is agitated by means of air pressure. When the desired temperature and consistency of the mixture has been obtained, it is drawn into the closed compartment and then by air-pressure is delivered to the distribution wagon. In the mean time another charge is being heated and mixed in the open compartment.

The cards shown by Figs 2 to 5 have been devised for keeping track of the oil used. In all places heretofore giving accounts of work done the records have not been very exact but by using cards, Fig 2 and Fig 3, for each load, all necessary information will be obtained. One feature worthy of notice is that the exact number of gallons used and the area covered per day is recorded.

STREET DEPARTMENT.
St. Louis, ...191..
To-day ..... gals. of oil were used on.....
.....from .....
.....to .....
.....
Car .....
Distance ..... ft. Aver. width..... ft.
Loads sand spread.....
Loads screenings spread.....
Cubic feet sand spread.....
Cubic feet screenings spread.....
... Foreman @ .... per day .....
... Men prep. rdwy. @ .... per day .....
... Men prep. oil @ .... per day .....
... Men hauling oil @ .... per day .....
... Men spreading oil @ .... per day .....
... Men hauling sand @ .... per day .....
... Men spreading sand @ .... per day .....
... Additional men @ .... per day .....
Total cost per day.....$.....
Av. oil Temp. arriv.....Deg. F.
Av. air Temp.....Deg. F.
Grade of Oil No. .....
Mixture .....
Weather: Clear, Cloudy, Windy, Calm.
Roadway oiled before—Yes, No.
.....
Foreman in Charge.

Fig. 4.

STREET DEPARTMENT.
St Louis, ... 191....
To-day ..... gallons of oil were used on.....
..... from .....
..... to .....
.....
Car .....
Distance, ... feet. Average width, ... feet.
Loads of sand spread. ..... Loads screenings spread, ...
Cubic feet sand spread, ... Cubic feet screenings spread, ...
..... Foreman .....@..... per day .....$.....
..... Men preparing roadway.....@..... per day .....
..... Men preparing oil.....@..... per day .....
..... Men hauling oil.....@..... per day .....
..... Men spreading oil.....@..... per day .....
..... Men hauling sand.....@..... per day .....
..... Men spreading sand.....@..... per day .....
..... Additional men .....@..... per day .....
Total Cost per day.....$.....
Av. Oil Temp. arriv..... Deg. F. Av. Air Temp.....Deg. F.
Grade of Oil No..... Mixture .....
Weather: Cloudy, Clear, Windy, Calm.
Roadway oiled before—Yes, No.
Oil per gal. ..... cts. Sand per sq. yd., ... cu. ft. Oil per sq. yd., ... gals.
Sand per cu. yd..... ..... cts.
Cost per sq. yd..... ..... cts.
Heating, cost per sq. yd..... ..... cts.
Hauling, cost per sq. yd..... ..... cts.
Supervision and application, cost per sq. yd..... ..... cts.
Total cost per sq. yd.....cts.
.....
Foreman in Charge.

Fig. 5.

Sunday in good weather from 1,500 to 2,000 automobiles pass over this section which is 1,840 ft. long and 25 ft. wide, a total of 5,110 sq. yrs. The Good Roads convention in November, 1910, it is expected will be much interested in this work. The following data were obtained on cost of labor and material, exclusive of preparation of base.

Section A: 975 sq. yds.; old park road broomed clean, oiled with No. 3 oil and covered with gravel and sand; 14c per sq. yd.

Section B: 400 sq. yds.; new macadam rolled, voids partly sand-filled, then No. 3 oil, sand and limestone dust; 28c per sq. yd.

Section C: 136 sq. yds.; new macadam, voids partly sand-filled, tar painted, sanded, coating A. C. and sand. The A. C. mixture—2 parts No. 3 oil and 1 part asphalt; 30c per sq. yd.

Section D: 400 sq. yds.; new macadam rolled, tar painted, slabs, flush coat, sand or torpedo gravel; 32c per sq. yd.

Section E: 533 sq. yds.; new macadam with limestone screening broomed in, No. 3 oil, light coat screenings, flush coat No. 3 oil, then ½ in. screenings rolled. Dust to take up excess of oil; 28c per sq. yd.

Section F: 140 sq. yds.; new macadam covered with asphaltic concrete 1 in. thick. Prepared at plant; 30c per sq. yd.

Section G: 420 sq. yds.; park road resurfaced, covered with No. 2 oil and coating of screenings and sand; 8c per sq. yd.

Section H: 550 sq. yds.; new macadam. Tarvia treatment.

Section I: Old park road oiled in 1908 and again treated with No. 2 oil in 1909, covered with sand; 5c per sq. yd.

These tests give valuable information. Particular interest attaches to Section D of malleable slabs because of the ingenuity displayed in overcoming the accidents of exposure, frost, moisture, excess of bitumen, etc., and dispensing with a portable plant for mixing the aggregate and cement.

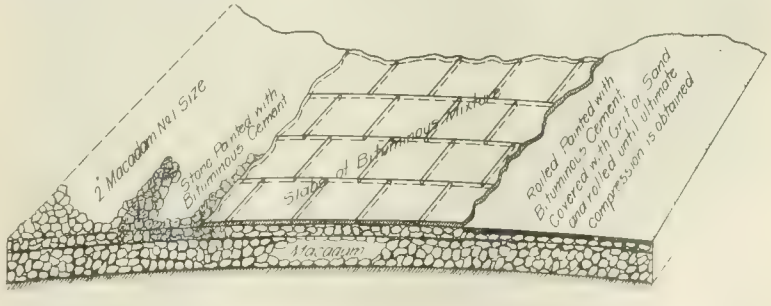
2 Macadam No. 1 Size
Stone Pointed with Bituminous Cement
Slabs of Bituminous Mixture
Roller Pointed with Bituminous Cement, Covered with Grit or Sand and rolled until Ultimate Compression is obtained
Macadam

Fig. 6—Isometric View of Special Road Construction, St. Louis, Mo.

In Forest Park last August, with the permission of Mr. Philip Scanlan, Park Commissioner, a stretch of experimental road was constructed and is now under test. On each Sunday in good weather from 1,500 to 2,000 automobiles pass over this section which is 1,840 ft. long and 25 ft. wide, a total of 5,110 sq. yrs. The Good Roads convention in November, 1910, it is expected will be much interested in this work. The following data were obtained on cost of labor and material, exclusive of preparation of base.

Figure 6 is an isometric view of the struc-

Fig. 7—View Showing Application of Bitumen to Broken Stone Foundation.

ture of the road and Figures 7, 8 and 9 are views showing different stages in the process of applying the wearing surface.

In applying a bituminous sand or gravel wearing surface possessing the necessary cementing properties, it has been considered essential to haul the "hot stuff" from the plant, to rake it to a uniform depth and to roll it while hot to obtain good results.

Mr. Travilla has used slabs made of a lightly compacted mixture, consisting of a selected sand or Torpedo gravel and bitumen, in such proportions that the slabs will maintain their shape while being handled and transported, but will be sufficiently plastic under ordinary atmospheric temperatures that it is unnecessary to heat them on the road.

The slabs are 12 in. square and 1 in. thick, containing about 10 per cent of bitumen. Before piling them up, the slabs are dusted with limestone dust, to keep them from sticking together.

The base for the roadway is rolled macadam, upon which was spread about 3 in. of clean stone, ranging in size from 1½ in. to 2½ in., lightly rolled into position. The surface of the stone, when perfectly dry, was painted with bituminous cement and the slabs laid thereon and given preliminary compression sufficient to force the bituminous mixture of the lower portion of the slabs into the interstices of the sub-structure. A flush coat of bituminous cement was then applied to more effectually waterproof the surface and to co-operate in the welding of the slabs, after which the surface was covered with grit and thoroughly rolled, until ultimate compression was obtained; thus providing a firm wearing surface of from ¼ in. to ¾ in. in thickness.

The coating of the macadam with bituminous cement, protects the slab surface from moisture from below; the impervious top with the proper crown to the roadway, insures proper surface drainage and a lasting roadway.

It is considered that this method does away with all the difficulties heretofore experienced in building roads with a bituminous wearing surface and is patented, Mr. Travilla believing that the supervision by men interested in the process, rather than in the job, will insure good work.

In commenting on road construction, Mr. Travilla claims that the life of a macadam pavement depends largely on the hardness of the stone in the 1 in. wearing surface and that by this method of road construction, a selected material may be used and since the slabs are of uniform size and thickness, the application thereof, is rapid and without the need of any particular skill. The slabs also form a mechanical interlock with the macadam, which prevents the creeping of the surface layer and binds the stone together. The bituminous mixture which originally consisted of a multiplicity of slabs, becomes ultimately a continuous, hard and smooth layer of substantially uniform thickness and makes a comparatively inexpensive pavement, which is resilient, durable, water-proof and dustless.

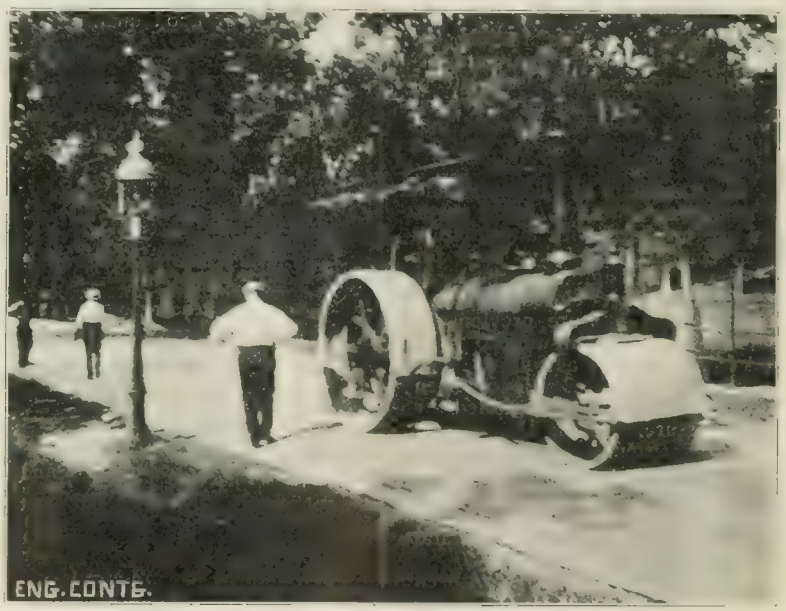

Fig. 9—View Showing Bituminous Slabs Being Rolled into Continuous Sheets.

Fig. 8—View Showing Placing of Bituminous Slabs on Foundaton Stone.

The United States Civil Service Commission announces an examination on April 20, 1910, to secure eligibles from which to make certification to fill a vacancy in the position of engineer in wood preservation. District No. 2, Forest Service, at $1,300 per annum, and vacancies requiring similar qualifications as they may occur.

Suggested Standard Practice for Pavement Bonds and Guarantees and Suggested Specifications for Asphalt and Bituminous Pavements.

In addition to the subjects mentioned in our issues of March 9 and 16, the Organization of City Officials for Standardizing Paving Specifications at its first convention at Chicago, Febraury 21 to 26, also considered the questions of securing a uniform practice in regard to pavement bonds and guarantees and the securing of standard specifications for asphalt and bituminous pavement.

The committee on uniform practice on pavement bonds and guarantee consisted of the following: W. J. Hardee, Chairman, City Engineer, New Orleans, La.; Henry C. Allen, City Engineer, Syracuse, N. Y.; George H. Norton, Deputy Engineer Commissioner, Department Public Works, Buffalo, N. Y.; Chas. A. V. Standish, Secretary Board of Local Improvements, Chicago; A. C. Kugel, Chairman

Paving Committee, Omaha, Neb.; Chas. E. Norton, Member Board Public Works, Grand Rapids, Mich., and Robt. W. Goodnow, Secretary Board of Public Works, Kansas City, Mo. This committee found that the practice of providing for the maintenance of pavements upon completion and requiring a guarantee to insure the faithful execution of the obligation is common to all cities The committee further found that the period of such maintenance and the methods of guarantee are widely different. Ten years of maintenance are still insisted upon in some cities for all classes of pavements, five years for soft pavements and three years and one year for the hard pavements are required in others, and in one city, Baltimore, City Engineer B. T. Fendall has recommended to his City Council, without the prospects of adoption, that maintenance periods be eliminated altogether from their contracts, because he believes that unnecessary amounts are being paid out for maintenance and that it is practicable to establish and operate a system of inspection that will afford every reasonable and necessary assurance that the contract in all respects, both as to materials and labor, has been properly executed.

The usual practice to insure the faithful performance of the contract to maintain the pavement for a given period is to resort to a guarantee bond. In the majority of cases this bond is required to be that of a bonding company, although since the bonding companies have declined to write ten-year risks, those cities asking for ten-year guarantees have been obliged to accept personal bonds for five years of the period.

Until recently this practice was general, but experiences related by several of the cities have led to the adoption in some cases of a further safeguard to insure the maintenance of the pavements. This further safe-guard is the requirement that at the close of the construction work there shall be left with the city a cash deposit or its equivalent, which may be used for the purpose of making repairs, in case the contractor fails from any cause to meet his obligation during the life of his contract. The money is to be returned during or at the expiration of the period, provided the contract has been fulfilled.

In some cases, in fact in the majority of cases brought to the committee's attention, both the cash reserve and the guarantee bond are required to be given, with the object of doubly insuring the proper maintenance. In New Orleans alone for the past year and a half the use of maintenance bonds has been abandoned because in every case of default it was not possible to recover on the bond, and instead a cash reservation, equal to 15 cts. per square yard in the residential districts and 25 cts. per square yard in the business districts, has been made to guarantee the maintenance. Taking into consideration all the facts brought to its attention, the committee concluded to make the following recommendations: (Suggested Standard Practice for Pavement Bonds and Guarantees.)

(1). That all pavements, any portion of which is constructed of materials of a perishable nature, among which we would include asphalt, bitulithic or bituminous macadam and wood block, or other pavement requiring special equipment to lay and maintain, and also such pavements as are of a patent or proprietary nature, new or more or less experimental in character, shall be required to be maintained for a period of five years from the first day of July next following completion.

(2). That all pavements composed of materials more durable in character, among which we would include stone block, vitrified brick, and well-established Portland cement concrete pavements, shall be required to be maintained for a period of one year from the first day of July next following the completion.

(3). That in the case of all pavements, a cash deposit, or its equivalent, of 10 per cent of the contract price per square yard for each square yard of pavement be retained for the whole of the maintenance period, said sum with its accumulations, if any, to be paid in full to the contractor if he fulfills the terms of his guarantee. The reservation is to be subject, however, during the maintenance period, for use by the city in making such repairs as are necessary and have been neglected or ignored by the contractor. In the latter case the balance of the fund, if any, shall be returned to the contractor at the end of the maintenance period.

(4). We further recommend that if the bonding companies will offer a uniform and standard form of guarantee, satisfactory in form and cost to the cities, members of this Association, which will protect the cities as amply and accomplish the purpose of keeping the pavements in repair as fully as may be done by the cash reserve plan, a guarantee bond in twice the amount of the established cash reserve be accepted in lieu thereof.

(5). In case of the satisfactory adjustment in the guarantee bond plan, and its adoption by this Association, it is further recommended that any default on the part of any bonding company in any of the cities of this Association shall be reported to its Secretary, and it shall be his duty to report to each of the said cities on account of such default.

Our conclusions with respect to the period of maintenance for pavements like asphalt are based on the theory of the execution of the construction under specifications permitting the contractor to use his own judgment between certain limits in manufacturing the pavement, thus assuming to himself the responsibility and risk of its success, and relieving the city therefrom.

If it is the determination of the Convention to adopt close drawn specifications for asphalt and similar pavements, taking over to the city the full responsibility for the manufacture and construction of the pavement, our views upon this subject will have to be modified.

ASPHALT AND BITUMINOUS PAVEMENTS.

The committee on standard specifications for asphalt and bituminous pavements consisted of Geo. W. Craig, Chairman, City Engineer, Omaha, Neb.; Linn White, Chief Engineer, South Park Board, Chicago, Ill.; Geo. W. Tonson, Chief Engineer Department Public Works, Toledo, O.; W. R. Benson, Chief Bureau of Highways, Philadelphia, Pa.; J. M. Burrows, Assistant City Engineer, Des Moines, Ia.; E. P. Babcock, First Assistant Engineer, Buffalo, N. Y.; L. W. Rundlett, Commissioner of Public Works, St. Paul, Minn.; L. Kirachbraun, Asphalt Chemist, Chicago; Geo. F. McGonagle, City Engineer, Salt Lake City, Utah, and L. W. Anderson, City Engineer, Grand Rapids, Mich. In its report the committee stated "in preparation of specifications such as these, where there is such a rapid progress being made in the use of asphalt and kindred pavements, it is impossible to make a general specification that will answer all of the requirements for a length of time. A specification that might be made today, could be revised tomorrow, due to the rapid progress that is being made along these lines should be so considered. In preparation of the specifications we had this one thought in mind, realizing in any way discourage the use of the materials that we term as experimental, for what might be an experimental pavement today might be considered in the other class a year hence and that this committee or any other committee that may be selected by your honorable body for the preparation of specifications would be glad to admit of them. They are therefore of necessity more or less tentative and some materials are excluded until such times as further developments in the sciences and technology of their manipulations make their use safe. They are open enough to admit of the use of such range of materials as have proven to be beyond the experimental stage, yet they are sufficiently conservative to insure with skilled supervision and expert direction the laying of a durable pavement. Reiterating again, we are cognizant of the rapid development of the paving industry and we anticipate that in the near future that it may be advisable to extend the range of these specifications.

"In the preparation of the specifications for Bituminous Concrete the committee do not assume to pass on the validity of the patents that may have been issued for certain paving mixtures and methods, and the various municipalities that may adopt these specifications are advised by the committee to determine their own policies as to the recognition of these patents."

SPECIFICATIONS FOR SHEET ASPHALT PAVEMENT.

Sub-drainage—When the soil is of such a character that it retains an excessive amount of moisture, such as clays subject to swelling or heaving under the action of frost, or sands similar to quick sand that do not afford a ready natural drainage, subdrains should be provided.

Subdrains may be of two general kinds, first, tile drains of open porous material or vitrified tile laid with open joints, second, trenches filled with broken stone, gravel, cinders or other similar material.

In some cases it may be sufficient to construct a line of tile or a trench filled with broken stone, cinders or gravel, on each side of the roadway at or near the lines of the gutters, but when the soil is of a very wet nature, it may be advisable to lay additional lines of drains which may be in or near the middle of the roadway. This system of drains may be varied by diagonal lines of drains running from near the crown of the roadway to the gutters.

In all cases the drains should have connections with the existing sewers, catch basins or inlets.

Foundations of an Asphalt Pavement—The contractor will be required to do all of the grading necessary to bring the surface to the proper sub-grade as determined by the lines and grades given by the engineer. If the material at sub-grade shall be of an unstable character and unfit for foundation the contractors will make such additional excavation as may be determined by the engineer and refill with suitable material approved by the engineer. Should the sub-grade require draining, such provision shall be made as the local conditions will require, as determined by the engineer and provided for in the specifications for that particular locality. After all necessary grading has been done to bring the surface to sub-grade, the street shall be thoroughly rolled with a steam roller weighing not less than ten tons. If settlement occur the depression shall be filled and then rolled until the surface is solid and uniform. All filling shall be free from animal or vegetable matter and of a character approved by the engineer. Should the foundation be of sand, which would be impracticable to roll, the entire roadway from curb to curb shall be thoroughly puddled by flooding with water one or more times if found to be necessary. The contractor shall furnish all water and hose for puddling and all necessary labor to properly perform the work.

Asphalt Surfacing Mixture; Refined Asphalt—The refined asphalts to be used for paving mixtures herein required shall be derived in the following manner:

(1). By heating, if requiring refinement, crude, natural solid asphalt, to a temperature of not over 400° F. until all the water has been driven off. Crude, natural, solid asphalt shall be construed to mean any natural mineral bitumen either pure or mixed with foreign matter, from which, through natural causes in the process of time the light oils have been driven off until it has a consistency harder than 100 penetration at 77° F. At least 98½ per cent. of the contained bitumen in the refined asphalt which is soluble in cold carbon disulphide, shall be soluble in cold carbon tetra chloride. Such asphalt must melt readily upon the application of heat. In no case shall it be prepared at the refinery with any product not hereinafter provided for.

(2). By the careful distillation of asphaltic petroleum until the resulting residue has a consistency not harder than 40 penetration at 77° F.

(a). The solid residue so obtained shall be soluble in carbon tetra chloride to the extent of 98½ per cent.

(b). Its bitumen shall yield upon ignition not more than 15 per cent. of fixed carbon.

(c). When 20 grams of the material are

heated for five hours at a temperature of 325° F. in a tin box 2½ ins. in diameter, after the manner officially prescribed, it shall not lose over 5 per cent. by weight nor shall the penetration at 77° F. after such heating be less than one-half of the original penetration.

(d). A briquette of the solid residue having a cross section of one square centimeter shall have a ductility of not less than 30 centimeters at 77° F.

NOTE:—Combinations of asphaltic and semi-asphaltic residues having the ductility and other characteristics above named are admitted under Section 2.

(3). By combining at the paving plant in uniform and fixed proportions which shall be satisfactory to (proper city official) solid, natural asphalt and solid asphaltic residue as hereinbefore described. The refined natural asphalt shall be derived from the crude natural asphalt of the quality and in the manner specified before, except that the crude natural asphalt may have added to it, if desired, at the refinery, as a partial fluxing, an amount of asphaltic or semi-asphaltic flux of the character and within the limit specified elsewhere herein, such fluxing to be conducted under the supervision of (proper city official) when desired. In the use of these mixtures of refined asphalts or asphaltic cements, only asphaltic or semi-asphaltic fluxes shall be used, except in those cases where the solid natural asphalt is of such character that when mixed with parafine flux without the further addition of any other material, it will produce an asphaltic cement complying with the requirements hereinafter set forth under that head. In such cases any of the fluxes elsewhere herein specified may be used.

The preparation and refining of all asphalts admitted under these specifications shall be subject to such inspection at the paving plants and refineries as the (proper city official) may direct.

Flux—The fluxing material may be a parafine, a semi-asphaltic, or an asphaltic residue which shall be tested with and found suitable to the asphalt to be used. It shall be free from water or other impurities.

The residuums must have a penetration greater than 350 hundredths centimeters, with a number 2 needle at 77° F. under 50 grams weight for one second.

A natural Maltha may be used if it passes the heat and flash tests specified under "a" and all fluxes must furthermore remain soft after heating for five hours at 400° F.

All residuums shall be soluble in cold carbon tetra chloride to the extent of 99 per cent.

(a). The parafine residuum shall have a specific gravity of .92 to .94 at 77° F. It shall not flash below 350° F. when tested in the New York State closed oil tester, and shall not volatilize more than 5 per cent. of material when heated five hours at 325° F. in a tin box 2½ ins. in diameter as officially prescribed. The residue after heating shall flow at 77° F. and shall be homogeneous and shall show no coarse crystals.

(b). Semi-asphaltic residuum shall have the same general characteristics as parafine residuum except that it shall have a specific gravity of .94 to .98 at 77° F.

(c). Asphaltic residuum shall have the same general characteristics as parafine residuum except that the specific gravity shall be not less than .98 nor more than 1.04 at 77° F. The asphaltic residuum after evaporation at 500° F. to a solid of 50 penetration shall have a ductility of not less than 30 cm.

Asphaltic Cement—The asphaltic cement prepared from materials above designated shall be made up from the refined asphalt or asphalts, and the flux where flux must be used, in such proportions as to produce an asphaltic cement of a suitable degree of penetration. The proportion of the refined asphalts comprising the cement shall in no case be less than 40 per cent by weight.

When weight of flux in the asphaltic cement prepared from solid natural asphalts exceeds 25 per cent thereof, asphaltic or semi-asphaltic flux shall be used. Semi-asphaltic flux in such case, must have a gravity of not less than .95 at 77° F.

Refined asphalts and flux comprising the asphaltic cement shall, when required, be weighed separately in the presence of the authorized inspectors or agents of (proper city official).

Refined asphalt and flux used in preparing the cement shall be heated together in a kettle at tempertures ranging from 250° to not over 375° F., and be thoroughly agitated when hot by air, steam or mechanical appliances, until the resulting cement has become thoroughly mixed into a homogeneous mass. The agitation must be continued during the entire period of preparing the mixtures. Cement shall always be of uniform consistency, and if any portion should settle in the kettles between intervals of using the same, it must be thoroughly agitated before being drawn for use.

The asphaltic cement shall have a penetration of from 30 to 100 which shall be varied within these limits to adapt it to the particular asphalt used in the paving mixture and to the traffic and other conditions of the street.

(a). When 20 grams of the asphaltic cement of the penetration to be used in the paving mixture shall be heated for five hours at a temperature of 325° F., in an oven as officially specified, there must not be volatilized more than 5 per cent. of the bitumen present, nor shall the penetration at 77° F. after such heating be less than one-half of the original penetration.

(b). The bitumen of the asphaltic cement shall give upon ignition, not more than 15 per cent. of fixed carbon.

(c). A briquette of the pure bitumen of the asphaltic cement of the penetration to be used in the paving mixture, having a cross section of one square centimeter, shall elongate to the extent of not less than ten centimeters nor more than one hundred centimeters at 77° F.

Sand—The sand shall be hard-grained and moderately sharp. It shall be free from loam or any other foreign material, and shall be so graded as to produce, in the finished surface mixture, the mesh requirements elsewhere herein specified. It shall contain not to exceed 6 per cent of sand that will pass a No. 200-mesh sieve.

Binder Stone—Stone or gravel to be used for asphaltic concrete binder shall be hard and durable, free from all foreign substances, and of varying sizes, from one inch down.

Preparation of Asphaltic Concrete Binder—Asphaltic concrete binder shall be made as follows:

The binder stone and sand as above specified shall be heated to from 200° to 325° F. in suitable appliances. Stone and sand shall be measured off separately and then be mixed with sufficient asphaltic cement prepared as heretofore specified, in such proportions that the resulting aggregate will contain by weight material passing a No. 10 mesh screen, between 30 and 40 per cent, and bitumen in quantity from 5 to 8 per cent. of the entire mixture. Concrete thus prepared shall be a compact mass containing a minimum of voids. If the permission of (proper city official) were available, old asphaltic surface paving mixtures may be used in combination with the binder stone, such mixtures having been previously crushed or disintegrated and augmented with at least 1 per cent. of fresh asphaltic cement, so that when combined the resulting concrete shall form an equally compact mass and correspond as to aggregate passing a No. 10 mesh screen and it contained percentages of bitumen with the requirements for the mixture previously specified.

NOTE: Inasmuch as the percentage of bitumen in the binder will depend upon the grading of the aggregate, the proportions of the materials used in the above may be varied by (authorized city official), but only within the limits designated.

Laying Asphaltic Concrete Binder—The asphaltic concrete binder shall be brought to the work in wagons, covered with canvas or other suitable material, and upon reaching the street shall have a temperature of 200° to 325° F. It shall be placed upon the street and raked to a uniform surface to such depth that, after being rolled and thoroughly compacted, it shall have a thickness of ... ins. The surface, after compression, shall show at no place an excess of asphaltic cement, and any spot covering an area of 1 sq. ft. or more showing an excess of asphaltic cement, shall be cut out and replaced with other material. Smaller spots may be dried by the use of stone dust and smoothers. Any asphaltic concrete binder broken up during the process of laying must be removed and replaced with new material. Asphaltic concrete binder shall be followed and covered with wearing surface as soon as is practicable in order to effect the most thorough bond between the binder and the wearing course.

Asphaltic Surface Mixture or Wearing Course—The committee in presenting two kinds of mixtures for wearing surface, one having as filler Portland cement and one with a stone dust filler, considers that the adopton or application of either would be a matter of local conditions and accordingly should be left to the discretion of the engineer in charge of such paving construction.

The surface mixture shall consist of asphaltic cement, Portland cement, (stone dust) and sand proportioned by weight so that the resulting mixture will contain average proportions of the whole mixture as follows:

	Mixture A. Per Cent.
Bitumen soluble in cold carbon disulphide	11.0 to 13.5
Portland cement passing a No. 200 sieve	10.0 to 15.0
Sand passing a No. 80 sieve	18.0 to 36.0
Sand passing a No. 40 sieve	20.0 to 50.0
Sand passing a No. 10 sieve	8.0 to 20.0
Sand passing a No. 4 sieve	up to 10.0

	Mixture B. Per Cent.
Bitumen soluble in cold carbon disulphide	10.5 to 13.5
Stone dust passing a No. 200 sieve	10.0 to 15.0
Sand passing a No. 80 sieve	18.0 to 36.0
Sand passing a No. 40 sieve	20.0 to 50.0
Sand passing a No. 10 sieve	8.0 to 20.0
Sand passing a No. 4 sieve	up to 10.0

The item designated as "Portland cement (stone dust) passing a No. 200 sieve" within the limits named herein, includes in addition to the Portland cement (stone dust) fine sand passing a No. 200 sieve not exceeeding 4½ per cent of the total mixture, and such 200-mesh mineral dust naturally self-contained in the refined asphalt.

Sand and asphaltic cement shall be heated separately to about 300° F. The maximum temperature of the sand at the mixers shall in no case be in excess of 375° F. and the maximum temperature of the asphaltic cement shall not exceed 325° F. at the discharge pipe. The Portland cement (stone dust) shall be mixed with the hot sand in the required proportions, and then these shall be mixed for at least one minute with the asphaltic cement at the required temperature, and in the proper proportions in a suitable apparatus so as to effect a thoroughly homogeneous mixture.

The proportion of asphaltic cement shall at all times be determined by actual weighing with scales attached to the asphaltic cement bucket.

The Portland cement (stone dust) and sand must also be weighed unless a method of gauging approved by the (authorized city official) shall be used.

The contractor shall furnish every facility for the verification of all scales or measures.

The sand gradings and bitumen may be varied within the limits designated in the discretion of (proper city official).

Laying the Wearing Surface—The asphalt wearing surface shall be hauled to the work in wagons provided with a canvas or other suitable cover. It shall leave the plant at a temperature between 250° and 325° F. as suitable for the asphalt used. Upon arrival at the street it shall be dumped at such distance from the work that all of the mixture must be turned and distributed to the place where it is to be raked. It shall be spread, while hot, to such depth upon the Asphaltic Concrete Binder, which must be thoroughly dry, free from leaves or other foreign matter, that after receiving its ultimate compression by rolling, it shall have a thickness of ... ins. The initial compression may be effected by means of a small roller, after which a small amount of mineral dust shall be swept over the surface. The final compression shall be

effected by a 10-ton roller, or the equivalent of not less than 250 lbs. per running inch width. Rolling must be steadily kept up and continued until all roller marks shall disappear and the surface shall give indication of no further compressibility.

NOTE: All tests herein provided must be conducted according to official methods on file in the office of (proper official).

All penetrations indicated herein, unless otherwise specified refer to the depth of penetration in hundredths centimeters of a No. 2 needle weighted with 100 grams at 77° F. acting for five seconds.

SPECIFICATIONS FOR BITUMINOUS CONCRETE PAVEMENT.

Foundation—The foundation upon which the pavement is laid may be either concrete or macadam. If of concrete it may be laid according to the standard specifications for concrete foundation, the surface being made rough and grainy so the paving material may get a proper bond or grip on the concrete. If the pavement is to be laid on a new macadam foundation the macadam shall be built according to the standard specifications except the upper ½ in. shall not be completely filled and bonded, the intention being the same as with the concrete foundation, viz.: to produce a somewhat rough, grainy surface into which some of the paving mixture will be forced by the roller. For heavy traffic 8 ins. of well-compacted macadam may be considered equal to 6 ins. of concrete, and for light or ordinary traffic 6 ins. of macadam equal to 4 or 5 ins. of concrete. If the pavement is to be laid on an old macadam base, the surface shall be thoroughly swept and cleaned of all fine material that may be either caked upon the surface of the stone or lying loose as dust, thereby exposing the clean stone in the surface for the reception of the paving material. If the old macadam is not in suitable condition or proper grade after cleaning it shall be spiked up and redressed to the proper crown and grade, the coarse stone being left at the top, or new stone added when, in the opinion of the engineer, it is needed to give the desired grainy surface or thickness of foundation. It shall then be thoroughly rolled with the use of as little water as possible so the macadam does not finish smooth.

When it is not practicable to secure a foundation, either macadam or concrete, with sufficient grain in the surface to give the desired bond or key between the foundation and the paving material, the adhesion between the two may be increased by sprinkling the foundation with the bituminous cement before the paving mixture is spread, using not exceeeding ¼ gal. per square yard.

An old brick or granite block pavement, if in the opinion of the engineer it is well supported and stable, may be used as a base for the bituminous concrete pavement by thorougly cleaning the old pavement and sprinkling its surface with the bituminous cement.

Wearing Surface—On the foundation as heretofore specified shall be laid the bituminous concrete wearing surface, which shall be composed of carefully selected, sound, hard, crushed stone and sand mixed with bituminous cement and laid as hereinafter specified. This wearing surface shall have a thickness of ... inches after thorough compression with a 5-ton tandem roller.

Mineral Aggregate—The mineral aggregate shall consist of broken stone or broken stone and sand of a fairly uniform grading from the largest to the smallest particles in such proportions as to give the mixture a maximum degree of density and low percentage of voids. The maximum size of stone used may range from that passing a screen having circular openings ¾ in. in diameter up to 1¼ in. in diameter. Crusher run of stone between 1 in. and screenings passing a ¼-in. mesh screen may be used if found to be fairly evenly graded. Coarser stone when used shall be graded and remixed in proper proportion. (The screenings passing the ¼-in. mesh screen may be used when the bitumen is refined coal tar or an asphalt not having a less ductility.) Coarse and fine sand having proper grading shall be added in such proportions as necessary to secure the dense aggregate specified above. Stone dust or hydraulic cement may be added as needed when the character of the bitumen used requires it.

Bituminous Cement—The bituminous cement may be either refined coal tar or asphaltic cement.

Coal Tar—The coal tar must be the residue of the distillation of coal tar only and be specially refined for the purpose. No admixture of hard pitch with the lighter oils of coal tar will be permitted. The cement shall conform to such physical and chemical tests necessary to satisfy the (local officials) as to its suitability.

(The committee does not find available sufficient data enabling the preparation of more detailed specifications at this time. We recommend careful experiments and collection of data for future consideration.)

Asphaltic Cement—The asphaltic cement may be prepared: (1) from refined natural asphalt; (2) from the residue obtained in the oxidation or distillation of asphaltic or semi-asphaltic petroleum; (3) from any uniform combination of the preceding materials together with a suitable flux, if flux be necessary, such combination being subject to the approval of the engineer.

Each bidder must state the nature and origin of the bitumen to be used by him, and further, shall submit samples of the bitumen with his proposal.

The asphaltic cement shall pass the requirements designated below:

(1). The asphaltic cement shall have a penetration of 30 to 100 hundredths centimeter at 77° F. Dow Standard, which shall be suitable to the nature of the material used and to the traffic and other conditions of the street.

(2). When 20 grams of the cement are maintained at a temperature of 325° F. for five hours in a tin box 2½ in. in diameter, there must not be volatilization more than 3 per cent by weight of the bitumen present, nor shall the original penetration be reduced thereby over one-half.

(3). The bitumen of the asphaltic cement shall give upon ignition not more than 15 per cent of fixed carbon.

(4). Ninety-eight and one-half per cent of the bitumen of the asphaltic cement which is soluble in carbon disulphide, shall be soluble in carbon tetra chloride.

(5). At 32° F. the bitumen of the cement shall have a penetration of not less than 10 when tested one minute with the needle weighted to 200 grams, and at 115° F. when weighted to 50 grams for five seconds, shall have a penetration of not more than 280.

(6). The cement shall not flash at a less temperature than 350° F., New York state closed oil tester.

Method of Mixing—The aggregate shall be thoroughly dried in properly designed driers before mixing with the bitumen. The driers shall be of the revolving type, thoroughly agitating and turning the materials during the process of drying. When the aggregate is thoroughly dried and heated to a temperature of from 200 to 350° F. depending on the bituminous cement used it shall be immediately, before cooling or exposing to moisture, mixed with the hot bituminous cement as hereinafter specified.

The bituminous cement shall be melted in a tank arranged so the heat can be properly and easily controlled and regulated. When melted and raised to a temperature of from 200 to 350° F. depending upon the bituminous cement used, it shall be combined in proper proportions with the hot aggregate and immediately mixed in a properly designed mixer with revolving blades until a thorough and intimate mixture of the ingredients has been accomplished, and the particles composing the aggregate evenly and thoroughly coated with the bituminous cement. The mixer shall not be exposed directly to the action of the fire.

Laying—While still hot from the mixer, the paving mixture shall be spread evenly on the foundation with hot iron takes or shovels or both, so that when compressed with the roller it shall have the thickness specified above, with the surface even and true to grade. Along the curb and around manholes, catch basins and other obstructions in the street where the roller cannot reach, the compression shall be secured by the use of hot iron tampers. The tamping shall be done as quickly as possible after the material is spread, while still hot and pliable. When the paving mixture is hauled on the street in dump wagons it shall be kept covered with canvas to retain heat, dumped on platforms and shoveled into place and raked to secure the proper grade. As soon as the temperature will permit, the paving mixture shall be rolled with a tandem steam roller weighing at least five tons and the rolling continued, working lengthwise and diagonally of the street. Rolling must be steadily kept up and continued until all roller marks shall disappear, and the surface gives indications of no further compressibility.

The paving shall be done continuously, so the number of joints between the hot and cold material shall be reduced to the minimum. When it is not practicable to lay it continuously and a joint is unavoidable the edge of the cold material shall be trimmed down to a rough feather edge, and the surface, where the joint is to be made, painted over with bituminous cement, the hot material raked over the feathered edge and thoroughly rolled. Instead of trimming the cold material joint strips may be used consisting of strips of canvas about 18 ins. wide with three parallel lines of ¾ in. ropes sewed on the under side about 3 ins. apart. The joint strips shall be laid on the feather edge of the freshly raked material with the upper rope at the line where the thickness begins to decrease and the rolling completed on top of the canvas as for finished pavement. The faces of the curb and gutter, iron castings, etc., shall be painted with the bituminous cement before the paving mixture is laid.

Surface Finish—As soon as possible after the rolling of the mixture is finished, and while the surface is still fresh and clean, and if possible while warm, a skin coat of bituminous cement of proper consistency to be flexible when cold shall be spread over the surface. It shall be spread on while at a temperature of from 200 to 350° depending on the bituminous cement used, and evenly spread with rubber squeegees. Only a sufficient coat shall be spread to flush the surface voids without leaving an excess. Immediately over this a top dressing of torpedo sand, fine gravel or stone, chips free from dust, which must be thoroughly dry and heated in cold weather, shall be spread and thoroughly rolled into the surface. A small surplus shall be left to be worn in or worn away by the traffic.

After the sand or stone chips have worn in to the surface the street shall be swept, all excess of surfacing material removed and the street left clean.

Water Power Plant.—The Keokuk & Hamilton Power Co., of Quincy, Ill., has perfected a plan for water improvements of considerable magnitude. The company intends to develop the power of the Des Moines rapids of the Mississippi river at Keokuk, Ia., and Hamilton, Ill. It will construct a dam across the river at the foot of the rapids, and a powerhouse immediately below the dam and parallel with the stream on the Keokuk side. The dam, including abutments, will be 4,700 ft. long. On top of the spillway will be placed 116-ft. flood gates, supported by concrete piers. These piers will be built integral with the dam, being carried down to bedrock. The piers will support an arched bridge, from which the gates will be operated by electric hoists. The dam will be constructed entirely of concrete and locked firmly into the rockbed of the river. The powerhouse will be 1,400 ft. long and 123 ft. wide. The substructure will be concrete, in which will be molded the water passages and waterwheel chambers. On top of this will be built the superstructure—a house of concrete, brick and steel 133 ft. high. The machinery will be capable of developing 250,000 H. P.

Water-works and Sewer Section

Note: This section is devoted to methods and costs of constructing sewers and water-works. It will cover the construction work for all details of water supply and sewerage, including sewage purification and water filtration.

The Sanitary Examination of Water.*

That pure water is one of the factors making for good health, few deny; but in a strict sense the mention of pure water is speaking of something that rarely exists, for even the distilled water of our laboratories is not pure in the chemist's sense; that is, it does not consist entirely of the elements, hydrogen and oxygen, chemically combined. Water is so readily a solvent of all kinds of matter, gaseous as well as solid, that unless extreme caution is taken, it is never chemically pure. When so prepared, as it may be occasionally, for experimental purposes it is to the scientist worth any price.

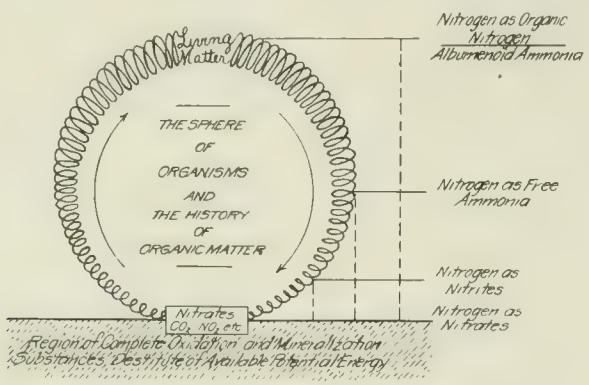
Nitrogen as Organic Nitrogen Albuminoid Ammonia
Gamma Matter
THE SPHERE OF ORGANISMS AND THE HISTORY OF ORGANIC MATTER
Nitrogen as Free Ammonia
Nitrogen as Nitrites
Nitrogen as Nitrates
Nitrates CO2 NO3 etc
Region of Complete Oxidation and Mineralization Substances Destitute of Available Potential Energy

Fig. 1—Diagram Illustrating the Sphere of Organisms and the History of Organic Matter.

But what we intend to say, and what we desire is not a pure water but a safe water,—one not likely to injure health. Such water we can find quite readily; and it is with this object in view, to prove the safety and guard against its pollution, that examination of water is made. The examination of water is made generally for two purposes: to determine its fitness as a potable water, i. e., for use for household or domestic needs; and its use for industrial purposes.

The Examination of Water.—The examination of water for the first class is called the sanitary water analysis; and of the second class, industrial water analysis.

The examination of these two classes is not distinct. The sanitary analysis includes the total amount of mineral matter held in solution, and the amount of that matter which causes "hardness," i. e., the precipitation of soap preventing formation of a lather. Industrial analysis includes this, but it determines also the particular substances which cause scale or corrosion.

The specific mineral contents are often determined in so called mineral waters, but rarely with the exception of "hardness," in sanitary analysis.

The sanitary examination of water includes the physical, chemical, and microscopical analysis, and the bacteriological examination. The object, as stated before, is to find out the quality of the water. Is the water at present receiving pollution of any kind? To what extent? Has the water at any time somewhat remote received pollution; if so, what is the origin of this pollution, animal or vegetable? Is the water hard or soft? Are there any vegetable organisms which by growth and decay are likely to cause nuisances due to odors? All these questions and others, the chemist has to answer from his sanitary examination.

In our laboratory work we shall devote the time to physical and chemical examination, and shall only learn of the methods of the microscopic and bacteriological.

Sources of Water.—The sources of our water are the dew, rain and snow which fall upon the earth's surface. The process by which this takes place is exactly similar to that of distillation and condensation, as conducted in the laboratory. The evaporation takes place from the ocean and larger lakes aided by the sun's rays and the winds. This moisture carried into the atmosphere remains until, by a change of temperature, condensation occurs and the moisture is precipitated, as rain or snow, depending upon the temperature. This precipitation is at first practically distilled water, but even in its passage through the atmosphere it absorbs gases, as carbon dioxide, ammonia, oxygen, and in the neighborhood of towns and cities sulphur dioxide, soot, and dust particles, both mineral and organic. It is quite high in ammonia.

Rain water is a "soft" water, and contains little mineral matter in solution; but when it reaches the earth it begins at once to dissolve the mineral salts, carbon dioxide, and "albuminoid" ammonia, of which latter we shall have much to say. The water thus enriched is capable of greater solvent action on rocks and soils. The water collects and may form rivulets and brooks, enlarging later into ponds and rivers, or it may sink deeper into the ground and then emerge as springs or become our wells. The rivers and ponds,—so-called surface waters, pass through the fields and forests where they take up considerable vegetable matter, such as leaves and peaty material. The color of the water is changed by this; and from the colorless water of the rain (that away from towns, at least) as viewed by looking through a considerable layer upon a white surface, as in Nessler tubes, it changes to a yellow or a brown color. This depends upon the amount dissolved, the color deepening with increasing amounts, similar to the steeping of tea. This vegetable coloring is organic matter. It is a highly complex molecule containing the elements carbon, nitrogen, oxygen, hydrogen, and is called by the name of "albuminoid ammonia." The estimation of the amount of albuminoid ammonia is important, but we must take into consideration its origin. If this be leaf or peaty matter, it is harmless, but if it be household and city wastes, which we may designate by the term sewage, it is objectionable and likely to be highly injurious. Our analysis of albuminoid ammonia does not point out its source.

The water which sinks into the earth will take up a large amount of mineral matter, but there is much less organic matter, peat or leaves. This water should be practically colorless. In distinction from the water which flows over the surface of the earth, surface waters, we designate wells and springs, as ground waters.

Water Pollution.—Up to the present we have assumed that the rain fall which we have followed in its collecting together, either as a surface or ground water, has not come in contact with the "wastes of human life." Such a condition could not long be maintained except in the virgin forests far away from habitation of man. Far up on the hillside it may be, a lonely farm house has diverted a little stream for drinking purposes. It flows through a sunken trough, where it may be dipped up both for family and barnyard use. A little way below this trough the flow from the kitchen sink finds its way into the brook. This it may do by directly flowing along the surface or sinking into the ground, emerging again into the brook, with less turbidity and other changes not so apparent to the eye. Again, the family cesspool, the barnyard with its manure heap, and the fertilized fields all have drainage outlets into the brook. This process of adding to the brook the "wastes of civilization" is repeated over and over again as the brook, increasing in size to the river, continues on its way. What the changes are which take place under the circumstances described, we will relate further on, but what we must remember is that along with the "household wastes" there may be disease germs, as typhoid. Of course, there are chances of purification. Seeds of tiny plants sprout and grow in the water, feeding upon the products of organic decay which have entered the water.

A part of the water sinks into the sand, and by this filtration becomes freed from suspended matter and disease germs. By running over rocks and minute waterfalls oxidation by the oxygen of the air takes place. Another purifying process is its storage by which suspended matter settles, and oxidation slowly goes on.

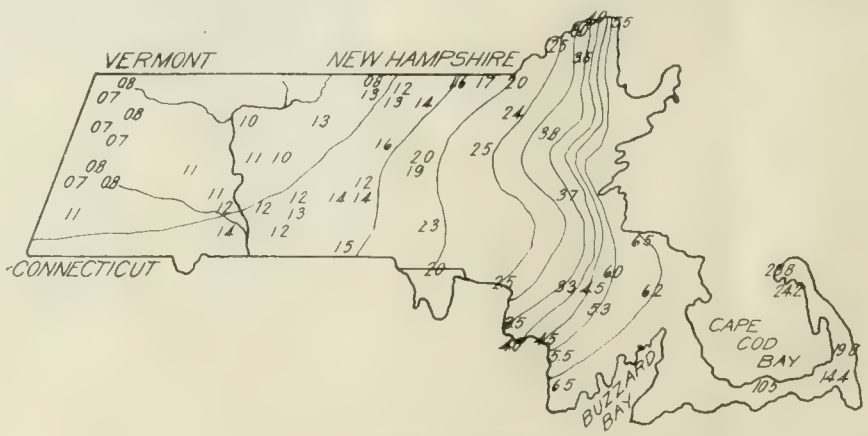

Fig. 2—Diagram Showing Normal Chlorine in Parts per Million in Surface Water in Massachusetts.

Organic Matter in Water.—We have named the elements of organic matter as carbon, hydrogen, oxygen, and nitrogen, the latter being

*A paper by L. K. Russell in the "Clarkson Bulletin" for January, 1910.

the essential element of animal life, and by its quantitative estimation we may judge the pollution of the water. This may be present in at least four combinations, and our sanitary examination includes these four determinations, viz: albuminoid ammonia, free ammonia, nitrates and nitrites.

The term albuminoid ammonia includes all the highly organized, complex forms in which the nitrogen may exist as organic matter, and is the form in which the latter enters into the water. As previously explained, we cannot distinguish by this fact alone, the source of the nitrogeneous matter, whether harmless vegetable matter, or the extremely harmful animal refuse. But once in the water, decomposition sets in, aided if not caused by the minute organisms, known as bacteria; and organized nitrogen passes from the form of albuminoid ammonia to free ammonia, remaining in this form in solution. In passing, we may remark that the animal refuse will more quickly pass through the change noted than vegetable matter. Nitrogen as free ammonia next passes by bacterial action to form of nitrites, and finally into form of nitrates. Our surface waters are high in albuminoid and free ammonia, and the ground waters in nitrates and nitrites, especially the former. In fact, the forms of free ammonia and nitrites are transition forms, while the nitrates are a permanent form, and are not decomposed by bacteria, but only by chlorophyll or green-growing plants. We judge of the nearness or of the remoteness of the pollution by the form in which we find the nitrogen present. A water high in albuminoid with some free ammonia, and nitrites, but low in nitrates, has received pollution within a short time. If these are low and nitrates high, pollution took place at a period somewhat remote. If all are present, the water has received pollution not only at a remote stage but is also receiving it at present.

Changes in Water.—If what has been said about the changes of the nitrogeneous matter entering into the water, and the part played by the bacteria and green growing plants in these changes is carefully considered, we see we have a never-ending cycle. This cycle is best illustrated by a diagram devised by Prof. Sedgewick, of the Massachusetts Institute of Technology. Fig. 1, is the diagram, as published in "Elements of Water Bacteriology," by Prescott and Winslow.

The left hand side of the diagram indicates the complex organic matter built up by the chlorophyll bodies of green plants in the sunlight from the mineral matter, i. e., nitrates, and the other half of the tearing down process carried out by the bacteria, with the accompanying changes, evidenced in our chemical examination. It is well to note that the change indicated by the left hand side of the diagram, viz: the building up of the nitrates into complex organic compound, does not take place in the case of well waters, since they are not reached by sunlight. Hence nitrates are high in ground waters.

Chlorine in Water.—Another accompaniment of animal refuse pollution is chlorine which enters the water as sodium chloride, or common salt. We must, however, take into consideration that all water has present in it some chlorides which it dissolves from the soil or which has blown into it from ocean fogs. So in our final decision of the quality of the water we must take into consideration its source and locality. Distance from the ocean, the existence of mountains between the water and the sea will regulate the amount of sodium chloride carried along by the winds and deposited in the surface waters. One very important point must be noticed in regard to chlorine, once in the water it remains as it enters. There are no such transformations as is the case with nitrogen compounds. For this reason and the fact that it is present in sewage it is looked upon as helpful determination especially in surface waters, where any considerable amount over the normal for the region leads one to view the water with suspicion. So important have the Boards of Health in some states, notably in Massachusetts, New York, and Connecticut, considered the determination of normal chlorine present in surface waters, that they have been to considerable expense to determine the amount of chlorine present in surface waters known to be unpolluted, and have published maps showing this. By comparison with the normal chlorine map of the region we may obtain an idea of the pollution of the surface water we are examining.

The Total Solids Present.—The "total solid residue on evaporation," or as it is more often called "total solids" is determined. This gives a measure of the solid matter held either in suspension or solution; and when this residue is gently ignited, (heating the outside of the dish containing the residue with the flame of the Bunsen lamp) by which means the organic matter is charred and oxidized, and thus removed, we get a measure of the carbonaceous matter present; for a second weighing will detect this removal. This is reported as "loss on ignition," or volatile matter. The difference between the weight of total residue and loss on ignition is considered to be the mineral matter.

Another method which gives a measure of the carbonaceous matter present is that of "oxygen consumed." The water is heated with a known amount of oxidizing agent, as potassium permanganate, this giving up its oxygen in proportion to the amount of carbonaceous or easily oxidizable matter present. By analytical methods we can determine the amount of our reagent so decomposed.

WATER FROM POTSDAM WELLS.
In Parts Per Million.

	Total Solids.	Nitrogen as Albuminoid Ammonia.	Nitrogen as Free Ammonia.	Nitrites.	Nitrates	Chlorine.	Oxygen Consumed	Total Hardness.
I.	370.0	.012	.008	0.0	1.5	7.0	0.0	249.0
II.	900.0	.16	.076	.002	36.0	24.12	33.17	533.8

I—Does not indicate pollution. II—Indicates pollution.

Summary of Results to Be Obtained by Analyses.—The "hardness" of water determines its fitness for domestic purposes, especially for washing, as very hard water increases soap bills and is rough on hands and clothes.

In addition to the chemical tests given, a physical examination is made to note odor, hot and cold, turbidity, sediment, and color.

Under the microscope an examination is made to detect such micro-organisms as would by their growth and decay cause unpleasantness to sight, smell or taste. In some cases special samples are taken to find out the number of bacteria per cubic centimeter.

In the ways mentioned by chemical, physical, microscopical, and bacteriological tests an accumulation of evidence is obtained, from which the water analyst passes judgment upon the desirability and safety of the water for potable purposes. This is not a simple task, as there is no hard and fast line up to which the amount of a substance may go and be safe, and above which the water is to be condemned.

The task before the water analyst is not like that of the assayer who reports definitely that the ore submitted to him contains a certain number of ounces of gold per ton, but rather it is that of the physician making his diagnosis from observed symptoms. The data we have collected tells us the past and present history of the water, and with a knowledge, if possible, of its surroundings we must advise whether or not it is best to use it.

Sugar Beet Cultivation on Sewage Farms.

Mr. J. Ashton at a recent meeting of the Association of Managers of Sewage Disposal Works of Great Britain suggested the cultivation of sugar beets and the erection of small beet sugar factories on sewage farms where a porous, well drained soil can be obtained. He stated that he had grown beets in such locations as an experiment and found he could grow from 12 to 20 tons per acre on heavy soil, and from 18 to 30 tons on lighter soil; the difference comes in the suitability of the soil and its richness—the richer the soil and the more porous it is, the greater will be the crop of beet. He stated that a crop of 43 tons to the acre has been registered on the Liverpool sewage farm. Mr. Stein, a Liverpool sugar expert, believed the idea of thus utilizing sewage farms was good, but stated that a small factory was too costly. He cited an instance of work done in Belgium, where beet roots were pulped and the juice was piped to a central factory, where it was worked up into sugar. Among the 4,000 sugar beet growing experiments he had conducted in the United Kingdom in every county, the most successful were those on the sewage farms, where the yield of roots per acre varied from 18 to 41 tons. The sugar in the roots averaged 16 per cent. Germany is the premier beet growing country in the world and the yield of roots per acre is 12 tons, with from 15 to 16 per cent of sugar in the roots. In regard to this subject we note that Mr. W. C. Easdale has written to the *Surveyor* calling attention to the fact that sewage farms are not all adapted to beet growing. In addition he was afraid that wherever the sewage works manager was very successful in his farming operations he would degenerate into a poor sewage works manager and the quality of the effluent is what he should look after. Mr. Easdale believes plants for making alcohol from the beets will be cheaper than sugar factories.

Method and Cost of Reforesting the Marginal Lands of the Wachusett Reservoir Metropolitan Water Works, Boston, Mass.*

In the early development of the plans for building on the south branch of the Nashua River, at Clinton, Mass., what is now known as the Wachusett Reservoir, in which to store water for the supply of Greater Boston, the Metropolitan Water Board, largely through the efforts of one of its members, Dr. Henry P. Walcott, appreciated the fact that, unless systematically and scientifically studied and developed, the marginal lands of this great inland lake, which aggregate 3,380 acres, and in places extend back for half a mile, would become waste and valueless, a detriment to the purity of the water supply and a menace to the life of the soil. A small part of this large tract was made up of arable and pasture land which could be used for farming and grazing purposes, but on account of the fact that manurial matters would result from such utilization, all idea of allowing cultivation and pasturage was abandoned as being even more of an injury to the purity of the water supply than the non-use of the land would be. There remained but one alternative—to reforest in some way the whole or a part of this reservation. To determine the kinds of trees to be used, methods of treatment and the various other questions of policy in this reforestation, the board secured the services of Prof. J. G. Jack of the Harvard Agricultural School, a recognized authority on sylviculture.

An outline of the general policy adopted in the reforestation of the marginal lands of the Wachusett Reservoir, comprising as they did 1,090 acres of arable, pasture and light sprout land, 280 acres of thick sprouts and young, thin timber land and 1,475 acres of heavy timber or forest land, was as follows: 1st, to establish two forest nurseries, one on each side of the reservoir, for the raising from seed of coniferous trees, mostly native white pines, to form the ultimate or final forest, and of deciduous trees to act as fillers and aid in the final development of the conifers; 2d, to plant all of the first mentioned class of land with a mixture of white pines and hardwoods; 3d, to underplant the second class with white pines, making what are hereafter termed "Improvement Thinnings in Young Pine Stands," as the growth of the pines demanded; 4th, to make "Improvement Thinnings in Original Timber Stands," as opportunity permitted; 5th, to clear and maintain a fire guard 40 ft. wide around the outside limit of the reservation, to serve as a protection against fires having their origin on abutting land; 6th, to

*Condensed from a paper by E. R. B. Allardice read before the Boston Society of Civil Engineers and printed in the Journal of the Association of Engineering Societies for January, 1910.

maintain some of the present and build necessary additional internal forest roads 15 ft. wide, making accessible all areas and acting as secondary fire lines, dividing the entire reservation into lots containing from 15 to 30 acres; and 7th, to clear and maintain a 50-ft. margin along the forested portion of the flow line of the reservoir, and to plant the inside half of it with white pine and arbor vitæ closely spaced, forming an effectual screen or hedge to keep the greater part of the foliage from adjoining forests from being blown into the reservoir.

NURSERIES AND CARE OF SEEDLINGS.

Early in 1898, or about eight years previous to the completion of the reservoir, work was begun upon the preparation of the nursery on the north shore, containing 4.3 acres, and about two years later upon the one on the south shore, containing 3.7 acres. In selecting the sites, attention was given to securing land comparatively level and well drained, composed of moderately fertile, sandy loam, free from weeds and stones. The nursery on the north shore was located on land formerly used for agricultural purposes and contained couch grass in large quantities, making it very expensive to prepare for and maintain as a nursery. The one on the south shore was located within the limits of a large area covered with a stand of fifteen year old white oaks and chestnuts in a rather backward state, due to the ravages of forest fires. To prepare this area for nursery purposes, it was necessary to clear, grub, plow and harrow at a cost of approximately $200 per acre.

Seed Planting.—As the methods adopted in the raising of coniferous and deciduous trees varied somewhat, they will be described here separately, first dealing with the white pines and other varieties of conifers.

During the month of May the area to be used was plowed to a depth of about 15 ins. and then leveled up by raking with heavy iron rakes. Beds were laid out 4 ft. wide by 40 ft. long, separated by paths 1½ ft. wide. The seed was prepared by soaking in warm water for about 48 hrs. and then covering with red lead to keep off birds and rodents. A "drill board" was used for shaping the drills in which the seeds were placed, consisting of a 1-in. board, 6 ins. wide and 4 ft. long (the same as the width of a bed), fitted with a handle on the upper side for convenience in handling, and with two grooved strips about 1 in. square running lengthwise of the under side of the board at each edge, the centers being 5 ins. apart and the groove about ⅝ in. deep. For convenience in spacing the drills, this tool had at each end an outrigger or gage, consisting of a short piece of lathe, through which was driven a small nail 5 ins. distant from the center of one of the grooves.

The seed-planting gang consisted of a foreman and four laborers, divided as follows: one drillman, two sowers, two coverers. The drillman formed the drills by forcing the molds or grooves of the drill board down into the soil and rubbing it endwise. The two sowers, one of whom was the foreman, worked from opposite sides of the bed. The seed was placed in bottles fitted with wooden stoppers having a hole of the proper size to permit of one seed passing out at a time. The seeds were dropped on the edge of the drill and fell into either channel. It was necessary to go over the same length three or four times in order to get a single continuous line of seeds. This method was found to be more economical than that of allowing the seeds to run freely from the bottle, which method sows too thickly. The sowers were followed by one of the coverers, who sifted loam over the seed through a common ash sieve of ⅜-in. mesh until the drills were filled to the general level of the bed. The other coverer completed the planting by consolidating the loam with a board which he laid over the drills and pressed firmly into the ground.

It requires from two to three weeks before the sprouts appear above the ground and during this time great care has to be exercised to give the seed the proper amount of moisture. No particular rule can be laid down for this treatment, as it of necessity varies with the climatic conditions. During particularly dry seasons it was found necessary to cover the seed beds with a mulching of leaves and to water this mulch in the late afternoon about every second day. When the beds are mulched, daily examinations are necessary after the first ten days to ascertain when the sprouts have been broken through, at which time the mulching should be removed. The ideal condition is that in which nature meets all the requirements and the beds or seeds demand no artificial treatment. Unfortunately, this condition rarely if ever continues for any length of time and it therefore becomes necessary to give almost constant attention to the beds from the time the seeds are planted until the sprouts break through the ground.

During the life of the seedlings in the seed beds (one year) they had to be given considerable care to prevent "damping off." This care consisted principally of screening and watering. Light lath screens about 4 ft. square supported on stakes about 1½ ft. above the surface of the ground were used, being manipulated as the weather conditions demanded. If the season was excessively dry, it was necessary to mulch the seedlings with dead leaves and water about three times a week.

Transplanting.—The seedlings having been in the seed beds one year, the next step was to transplant them into "transplant beds," where they were spaced about 4 ins. apart in rows 6 ins. apart and left from one to three years. In doing this work a gang composed of a foreman, one lifter, three sorters and counters, one pruner, one helper and eight planters was found convenient.

With a common garden spade the lifter removed the seed beds and they were sorted, counted, pruned and puddled. When the seedlings were taken from the seed beds they were first sorted, separating the strong and weak specimens. Then the long, fine, feathery roots were cut off at the bottom of the stocky part with a butcher's cleaver. The next step was to cover the pruned roots with a thick puddle, prepared by thinning heavy swamp muck to the consistency of thick gruel, after which they were immediately heeled into the ground ready for the planters.

The transplant beds were prepared in the same manner as the seed beds, and the plants or trees were placed in them by means of a common mason's trowel. A good planter should plant about 3,000 trees per 8-hr. day. While in the transplant rows the only care necessary in the summer time was to keep the beds free from weeds, which was done with small hand cultivators. During our treacherous New England winters we are very liable to experience short, heavy thaws, which penetrate the ground to a depth of 3 or 4 ins. and heave the young transplants out, especially if they were transplanted the previous fall, as the roots do not have time to become well established before being exposed to this severe treatment. When this happens, they must be immediately pushed back into the ground or they will be frozen to death. This work should be done as rapidly as possible because of the liability of a freeze setting in at any time. Very little attention is given while pushing the seedlings back into the ground to keep from bending or crooking the small stems, as the seedlings are being raised for our own use and their value does not in any way depend upon their appearance. So long as nothing is done to injure the growth of the tree, our requirements are met. Caring for the seedlings at such times is given much more attention, however, by nurserymen, as their appearance is quite a factor to their value.

Field Planting.—Our practice has been to divide the work about equally into spring and fall plantings, and time fails to show any difference in the results obtained. Most of our plans have called for the planting of from 50 to 100 acres of ground in both spring and fall, the former taking place immediately after the frost left the ground and before the trees began to grow, while the fall plantings have generally been made after the fall buds had set, depending largely upon the season. One planting, however, was made in August, and that, although experimental, proved a decided success, in spite of the fact that the trees were four years old and the season immediately following extremely dry. During the following fall these trees suffered some kind of a shock which apparently killed them, the needles all turning brown, but they have since recovered and are now among the finest stands we have.

Planting gangs are composed of a foreman and about thirty men, five of whom are engaged in the nursery preparing the trees for the field in the same manner as for transplanting. The field part of the gang is divided into pairs, one man making the hole for the tree with a common mattock, the other placing the tree and compacting the earth firmly about it. The work is very interesting because of its simplicity and rapidity. The men are lined up in pairs in a diagonal position on the field, the leader with a mattock and the planter with a pail filled with about 100 trees. The first pair are shown a previously established line, stone wall or fence to guide them, while the others in succession, with the aid of one man especially assigned to the duty, plant parallel to and at a given distance from the preceding pair. The spacing in the rows is done by pacing. In the easiest plantings, such as open pasture or light grass land, the leader opens the ground with two strokes of the mattock, the first one being made with the axe blade and the second with the grub blade, cutting the ground just below the top of the first cut. With the grub blade of the mattock in its position at the end of the last stroke, the ground is pulled up and back while the planter places the tree in the hole. While the leader is pacing the distance to and preparing the next hole, the planter compacts the earth about the tree by forcing his heel into the sod. With a well-organized and experienced gang, a pair of men will plant about 2,000 trees in a 9-hr. day, or 1,000 trees per man, at a cost, including the nursery work, of about $3.25 per 1,000 trees.

Great care has to be given during this work to see that the roots of the seedings are not "root bound" when placed in the ground. The covering of the roots with thick puddle naturally binds them together and, unless they are shaken out before being planted, the growth of the tree will be greatly retarded.

The above description and rate are applicable only to first-class planting areas, the methods varying and the cost increasing according to the nature of the ground. For instance, in heavy grass land it is necessary to remove the sod from an area about 6 ins. square, requiring three or four strokes of the mattock, before making the final hole as described above. In sprout land or grown-up pasture the speed is necessarily slower because of the interference of the trees. The maximum cost per 1,000 trees was $7.87.

Thus far we have considered and described the methods adopted in the raising of white pine and other varieties of coniferous trees from the time the seed was sown until they were placed in their final location in the field. Remarkably successful results with these varieties have been obtained, 90 per cent of the trees placed in the field having lived, and great credit is due the men who outlined and instituted the system. We, as engineers, are frank in admitting that at times we learn fully as much from our unsuccessful ventures as we do from the successful ones.

Composition of Plantings.—Thus far we have considered and explained the work so far as the methods of raising forest trees from seed and planting them into the field are concerned. Now let us deal with the make-up or composition of the seeding stands.

The original condition of the area to be treated being so varied, it was necessary to vary the composition of the artificial stand to meet the requirements of the individual lot. In the main, the plantings comprised white pines planted 10 ft. by 10 ft. apart, using oaks, chestnuts and maples as fillers, making the final stand with trees 5 ft. by 5 ft. apart, the theory of this composition being that the hardwoods, growing so much faster than the pines, would thrash their young, tender limbs, thereby forcing them to grow upwards and develop a long, straight,

clear log. This type of planting required 435 pines and 1,307 hardwood trees per acre and was used in arable, open pasture and light sprout land.

In the thick sprout and young, thinly grown timber land, the pine seedlings were used to underplant the sprouts and interplant the open areas of the timber land. No set rule could be established for the spacing in this type of planting, as it varied with the existing growth. It would be safe to estimate from 500 to 800 trees per acre.

The first plantings were made during 1902, and from then up to the time that the failure of the hardwoods (1906) was discovered, the mixed type of planting was used. Since that time no hardwoods have been planted and the pine seedlings have been spaced 6 ft. by 6 ft. apart in the field, this close spacing being adopted so that the limbs might thrash and kill each other, thereby obtaining the same results as with the mixed stands. This spacing required 1,210 trees per acre.

Improvement Thinning.—We are told by forestal experts and advocates that the pines need no attention after planting in the field until such time (about 15 yrs. afterwards) that the first thinning is necessary. This is true only so far as it deals with the planting of arable and open pasture land. One of the main arguments in favor of reforestation is that sprout and scrub lands may be converted into paying timber land by simply raising and planting the young trees. While I would not go on record as making any statements detrimental to the growth and advancement of this great industry of forestry, which is one of the foremost questions before our country to-day, yet I believe that, for the good of its development, it is necessary that this article contain all the facts as we have found them.

A large part of our reservation was covered with sprout and scrub growth, which has been and was originally intended to be underplanted with pines. About the only requirements for a vigorous growth are plenty of light and fresh air, and we all know, if only from occasional observation, that neither of them is found under such a ground cover. When planted in this kind of land, the pines grow up in a rather delicate condition, until their tops encounter the low-lying limbs of the surrounding growth. At this stage it is absolutely necessary to give them assistance if they are to survive. This we have found can be done for about $6 per acre, the method being to cut out all growth which is in any way, at this time or within the next few years, liable to stunt or kill the trees. The wood cut at this time has very little value as cord wood on account of its small size, so it has been piled in windrows between the pines and left to rot, or deposed of for pea brush.

In doing this work due care is taken to preserve all valuable specimens of trees and to leave sufficient fillers of any nature whatever which will act as crowders to the pines.

Our aim in all branches of the work thus far described has been to secure ultimately a sound, healthy stand of pure white pines, having from 250 to 350 trees per acre.

As considerable of the reservation was originally covered with timber stands varying from 15 to 50 yrs. of age, which had been left to take care of themselves for years past, it has been our practice to make improvement thinnings in them by cutting out the poor, weak specimens, and such of the hardy ones that were overtopping or crowding the young vigorous growth. In a stand of 25-yr.-old maples and chestnuts intergrown with gray birch, a thinning such as described above, which included the cutting out of all the birches, was made at a cost of $28.50 per acre. There is considerable revenue derived from the sale of cordwood made at this time, which has, under the most favorable conditions, paid for the labor. Undoubtedly additional thinnings will have to be made from time to time, taking out the weak and overtopping specimens, which in all probability can be done at a profit. By this method the maximum returns per acre will ultimately be secured.

Fire Protection.—Among the greatest dangers to the forests are fires and, in order to prevent their spreading to or from abutting property, and to provide a line of defense on which to fight them, a "fire guard" 40 ft. wide has been cut around the entire outside limit of the marginal lands of the reservoir. There is also a network of "forest roads" 15 ft. wide throughout the reservation, which acts as supplementary fire protection. The brush and weeds are cut from these two protective systems once every year. A double furrow has been plowed along that portion of the fire guard where there was no stone wall to check the advance of creeping fires from neighboring property.

On holidays and Sundays, during the dangerous seasons of the year (early spring and late fall), men armed with fire extinguishers patrol the reservation to further protect it from the ravages of forest fires.

Thus far no serious fires have occurred, though several have started which would have caused great damage but for the effectual protection given.

Reservoir Marginal Screen.—In order to have an effectual screen along the forested portions of the shore of the reservoir, which would prevent the foliage from the deciduous trees from being blown into the reservoir, three rows of white pines spaced 6 ft. apart each way, and two rows of arbor vitæ 2 ft. apart, trees 3 ft. apart in the rows, have been planted on the back half of the 50-ft. reservoir margin. The greater proportions of the arbor vitæ have failed, probably because of having been planted in the field when too young (two or three years old) to endure the severe exposure which prevails along the shores of the reservoir.

At the time of sowing the arbor-vitæ seed, a much larger quantity was used than was needed for this purpose, so the seedlings which remained after the planting was done have been transplanted into transplant beds in rows 12 ins. apart with the trees 6 ins. apart in the rows. These trees have now been in the transplant beds two years, during which time they have been pruned once, with the result that we now have available a sufficient number of strong hardy specimens with which to replant the entire 32 miles of flow line. This will require about 113,000 trees, spaced 3 ft. apart in rows 2 ft. apart, breaking joints, so to speak.

The Tables I, II and III show that it costs about $15.40 per 1,000 trees, or $19.20 per acre (1,390 trees per acre), to raise the trees from seed, prepare, plant and protect the lands planted, through the time of the final planting in the field; that it costs about 22 cts. and 31 cts. per year respectively to maintain efficient fire protection; that in sprout and scrub land it costs about $4.25 and $6 respectively for an improvement thinning, which will probably have to be made twice during the first ten years, after which time the trees should care for themselves.

TABLE I.—WORK ACCOMPLISHED TO DECEMBER 31, 1908.

Total area of nurseries	8.0 acres
Total area planted	1 330 acres
Total number of trees planted:	
Coniferous	948,000
Deciduous	902,000
Total length of reservoir margin planted	32.0 miles
Total length of fire guard cleared and maintained	20.8 miles
Total length of forest roads cleared and maintained	30.0 miles
Planted area thinned	488 acres
Original timber stands thinned	209.0 acres

TABLE II.—COSTS OF WORK. WAGE RATE, $1.75 PER 8-HOUR DAY.

Nurseries:	
Clearing nursery on south shore	$200 per acre
Maintenance of nursery, first year seedlings	$1.50 per 1,000 trees
Maintenance of nursery, second and third year seedlings	$1.75 per 1,000 trees per year
Plantings:	
Clearing areas preparatory to planting	$4 per acre
Transplanting seedlings from nursery to field	$5.25 per 1,000 trees
Transplanting seedlings from nursery to field	$5.50 per acre (6x6 ft. planting)
Improvement thinnings:	
Among planted trees	$6 per acre
In original timber stands	$20 per acre
Fire Protection:	
Clearing marginal fire guard (40 ft. wide)	$150 per mile
Maintaining marginal fire guard	$27 per mile per year
Clearing and grading forest roads 15 ft. wide	$120 per mile
Maintaining forest roads	$8 per mile per year
Maintaining fire patrol	$100 per year

TABLE III. — REFORESTATION: SUMMARY OF COSTS ON PLANTED PINE STANDS; WAGE RATE, $1.75 PER 8-HOUR DAY.

Item.	Per 1,000 trees planted.	Per acre planted.
Preparing nurseries	$0.40	$0.60
Seedlings (1 year)	1.50	2.25
Transplants (2 years)	3.50	4.50
Preparatory clearing	3.00	4.00
Field planting	5.25	5.50
Clearing 40-ft. fire guard	0.75	1.00
Clearing 15-ft. forest roads	1.00	1.35
Maintaining 40-ft. fire guard (per year)	0.14	0.19
Maintaining 15-ft. forest roads (per year)	0.06	0.09
Maintaining fire patrol	0.02	0.03
Improvement clearing	4.25	6.00

The credit for the marked success of this work is here given to Dr. Henry P. Walcott, of the Metropolitan Water and Sewerage Board, and president of the Massachusetts Forestry Association; Frederic P. Stearns, chief engineer of the Metropolitan Water Works during its conception and the greater part of its development; and Hiram A. Miller, who, while engineer of the reservoir department of the Metropolitan Water Works, had charge of the planning and beginning of this work.

Method of Recording Test Borings for Sewer Construction at Louisville, Ky.

By Roger DeL. French.

The city of Louisville, Ky., is at present engaged in making extensive additions to its sewerage system, funds for which are provided by a bond issue of $4,000,000. The work is in charge of a commission of five members, appointed under special legislative authority by the mayor. All sewers over 24 ins. diameter, are constructed of concrete, plain or reinforced; sewers less than 24 ins. diameter are of vitrified pipe. Practically all construction work has been carried on by contract; two or three small jobs only having been constructed by day labor under direction of the commission.

Form No. 1

COMMISSIONERS OF SEWERAGE
OF LOUISVILLE, KY.
ENGINEERING DEPARTMENT

RECORD OF BORINGS

Location of Hole.....

Date	No. of hole	Station No.	Elevation of hole

Kind of drill	Cost of hole	Time of boring

Surface of ground

Total depth of hole — Details of material penetrated

Remarks:

Observer

Wash borings are taken on the line of proposed sewers by a superintendent and (usual-

ly) four men. Oftentimes a bore hole can be put down to its full depth with a post-hole auger, but small holes require to be cased with 4-in. pipe, and sunk with a sand pump. Results of borings are reported on a blank like Fig. 1. This is self-explanatory, and on the back are kept rates relating to the details of equipment used, time spent in boring, time spent in moving from hole to hole, etc. The cost of these holes has run from 2 cts. to as high as 20 cts. per foot, according to location, material penetrated, and number in one group. Four men and a superintendent can put down an average of 180 lin. ft. per day of 8 hrs., in the clay, sand and gravel underlying Louisville.

Construction work is divided into three districts, each in charge of a Resident Engineer, assisted by as many inspectors, field parties, etc., as occasion demands. In addition there is the Headquarters Division in charge of a Designing Engineer, assisted by draftsmen, laboratory force, cash keeper, etc. All employers are required to keep time sheets, on which their time is charged to the various contracts, or if not chargeable to a contract, then to the particular work in hand. The series of blanks used in keeping records of cost were illustrated and described in ENGINEERING-CONTRACTING for Nov. 17, 1909.

Cost of Cleaning Catch Basins, Borough of Brooklyn, New York City.

The following costs of cleaning catch basins in the Borough of Brooklyn, N. Y., are taken from the annual report for the year ending Dec. 1, 1909, of Edwin J. Tart, Chief Engineer of Sewers for that borough:

Year.	Number of Basins.	Number Examined.	Number Cleaned.	Soil Removed Cu. Yds.	Cost per Basin.	Cost per Cu. Yd.	Number Cleaned of Snow.
1905	9,257	40,242	17,254	25,512	$1.79	$1.23	14,375
1906	9,537	19,768	25,386	33,423	1.65	1.25	5,999
1907	9,979	42,327	24,389	35,272	1.63	1.12	9,674
1908	10,127	47,933	30,693	44,476	1.60	1.10	5,423
1909 (11 mos.)	10,285	54,530	30,619	36,699	1.54¾	1.35	5,615

The foregoing figures indicate a cleaning about three times each year; a better record than many cities make. Considerably more than one cubic yard was removed at each cleaning. The method of measuring is not stated.

A resolution was recently passed by the Engineers' Club of St. Louis urging the passage of such laws by congress as would provide for a Department or Bureau of Public Works, to include Coast and Geodetic Survey, Geological Survey, Reclamation Service, River and Harbor Improvement and such other branches as may be rationally classed under one general department. This department is to include all competent engineers who may be in the employ of the Government at the time the department is organized. The following plan is advised when additional employes are to be appointed. They shall be men of suitable age, experience and education, selected in accordance with the U. S. Civil Service Commission regulations without regard to the school or college, whether civil or military, from which they came. The compensation shall be commensurate with the importance of the work and the degree of experience and ability required, promotion to be based on merit and seniority in service. In case congress shall decide to postpone the organization of such a department, it is urged that the pending bill be modified and appended as far as practical in accordance with the resolutions, to the end that civilian engineers may be entitled to the same emoluments, rank and tenure of office as Engineer Officers in the Army occupying similar positions.

Excavation On the Panama Canal in January.—The total amount of excavation on the Panama canal during the month of January was 2,831,929 cu. yds., 20,248 cu. yds. more than during December. Of this amount 1,728,755 cu. yds. was dry excavation removed principally by steam shovels. The dredges removed 1,103,174 cu. yds., in addition to the large amount pumped into the Gatun dam by the suction dredges.

Unclassified and General Articles

Note: This section is devoted to methods and cost articles on construction work not properly coming under any of the preceding classifications.

The Preservation of Timber Used in Mines.

Mr. John Macoun in a paper read recently before the Canadian Mining Institute stated that protection of underground timbers by creosoting was too expensive and had not always proved a sure preventive of what is generally termed "dry rot." Apart entirely from the great expense usual preservative methods entail, the conditions are so vastly different that it is more than doubtful whether the results of open air experiments are of much value when applied to deep mines. He recommended the Henry Aiken method for preserving timber in mines and gave the following data:

In this process the timber is soaked in water, raised to a temperature of from 190° to 200° F., and contains enough common salt to form a thoroughly saturated solution. The timber should be free from bark, fairly well seasoned and thoroughly dry. Tests made in many British collieries have proved conclusively that this treatment is in every way a satisfactory one. In one mine the timbers, after being in place five years, were perfectly sound and in another they had shown no sign of rot at the end of six years. What is even more noteworthy is an experiment made in Fifeshire. Two pieces of ordinary fir, 3½ ins. in diameter and 3 ft. long, both weighing 10 lbs., before being treated, were selected. One of the pieces was treated by the salt process and the other not. After being treated it weighed 12 lbs. Both were taken underground and placed in a return air course and after 11 months were examined and reweighed. The untreated timber then weighed only 5 lbs., whereas the treated wood weighed 12 lbs., or exactly the same weight as when it was put in. They were replaced in the mine and allowed to remain 11 months longer, with the result that the untreated timber weighed 6 lbs. and the treated timber weighed 11¾ lbs. They were again replaced in the mine, and after an exposure of three years they were examined and while the treated piece was sound the untreated one was decayed. Such evidence as this must be considered as conclusive, and as the salt water treatment is inexpensive, there seems to be no good reason why all mine timbers should not in future be treated in this way. Timbers already in place might from time to time be sprayed with salt water, for while such treatment could not be expected to prove as efficacious as if the wood were treated, fungus spores could not develop on wood that was so treated. In coal mines where spraying is systematically done for the purpose of preventing coal dust explosions the addition of salt to the water used would entail very little extra expense. What is certain is, that when the greatly enhanced price of timber in recent years is taken into consideration, the cost of treating mine timbers with salt is insignificant as compared with the money that would be saved.

All timber used in mines is not subject to dry rot and the amount of timber used depends largely upon the system and upon the character of the walls. The *Mining and Scientific Press* is authority for the statement that timber to the amount of 4.5 cu. ft. per ton of ore is used at the Bodie mine, while at the Ontario 100 tons may be produced using only 6.25 cu. ft.

LETTERS TO THE EDITOR.

Suggestions Wanted for a Cost Keeping System for a Large Earth Dam Job.

Sirs: I have been placed in charge of construction of the Patillas Dam of the Porto Rico Irrigation Service as described in your issue of Jan. 19, 1910. I would like very much to get a very close cost account on same and wish that you and the readers of Engineering-Contracting would offer suggestions as to the best methods of keeping the data obtained. The contract was signed up on Jan. 18, 1910, for $468,150, and the contractors are actively engaged in preparing for work, getting machinery, etc. The dam proper will be built by excavation of material with steam shovels and hauled with locomotives and the material sluiced in place.

As I am sure the readers of your paper will be interested in this class of construction, would like to get close cost data and afterwards publish same in your paper.

Yours,
FULTON PACE,
Assoc. Mem. Am. Soc. C. E., Division Eng.
Patillas, Porto Rico, Feb. 21, 1910.

(Suggestions from our readers are invited. The new book by Gillette & Dana entitled "Cost Keeping and Management Engineering," published by the Myron C. Clark Publishing Company, Chicago and New York ($3.00), we believe should be of considerable assistance in devising a cost keeping system for this dam.—Editors.)

Information Wanted About Automatic Regulating Dams.

Sirs: Will you kindly advise me whether you know of any form of sluice gate or flood gate in general use, for carrying off the surface water that collects above the gate and is closed by the tide on the lower side. I have been informed that the British Government has adopted a general plan for sluice gate, which is also extensively used in Canada. The gate swings on an axle placed about ⅓ of the distance from its top to its bottom, the top portion swinging up stream between the walls when the gate is opened, thereby giving it a horizontal position with the water. The advantages claimed for it are that drift wood has no chance to stop the gate from closing. "SUBSCRIBER."

(If any readers of this paper know of dams of this type being in use full information will be appreciated. A number of types of movable dams are described in the standard works of Frizell, Mead, Beardsley & Wilson. —Editors.)

How to Increase the Efficiency of the Civil Service.

Sirs:—In reading over your editorial on the administration of Civil Service as applied in Chicago (although the city was not mentioned), I wish to make a few remarks based on personal experience and observation.

The great trouble in administering the present Civil Service law is the presence, or rather the dominance, of politics. The Civil Service Commission is appointed by the Mayor and frequently attempts to justify its existence by catering to his party's political needs and desires. Many department heads are also appointive. Naturally they seek to oust the present incumbents and install their friends. Despite the apparent present rigid law they often succeed in doing it.

What happens then? The eligible list (being of two years' duration) has expired. Does the Commission hold an examination at once? No. The political department head fills the place with a "60 day" appointee. There are cases where the "60 day" man has been kept in office by repeated certification for years. This is demoralizing to real civil service men. Under such ad-

ministration they dare not protest. Few men now-a-days care to sacrifice a good job for principle.

As to probation. At the present time all appointees are certified subject to a six months' probation. That is, the head of a department can discharge an incompetent party without filing charges against him within this period.

As to conduct of examinations apparently there are no fair rules governing the rating of experience. Recent examinations show this. Where the commissioners or their hired examiners exercise discretionary powers they fail miserably. Since experience is judged from a written personal record the candidate is known to the examiner. Naturally a political "friend" will stand high in such an "experience" test. No. It is hard enough for a man to get into the service nowadays without lifting the bars that keep him employed as long as his work is satisfactory.

The trouble with the rank and file is due to the department heads when they in turn must do the bidding of the political party in power. It might be mentioned that the tendency of the times is for more, or rather complete, Civil Service selection of city employes. What is the Commission form of government but the selection of the most fit of the candidates presented? Members of such a commission have been subjected to a public civil service examination. They can be recalled if need be and this is a form of trial. We want complete civil service from the Mayor down. Until that time you will have waste, scandal and graft.

Respectfully yours,
"A Civil Service Man."

Chicago, Ill., Feb. 4, 1910.

Sirs:—Apropos of your editorial on civil service, I desire to state the cause of the deadening of interest among civil service employes, causing them to work with a lack of that snap and vim which is supposed to characterize the work of engineers employed in private enterprises.

In assuming that there is something wrong in engineering civil service you are entirely right; but the remedies you suggest are negative and insufficient. Your suggestion of dropping from the service men who fail after one year's service, or after five years' service, to measure up to a required standard to be determined by examination, would drive men to work harder at times immediately preceding examination, but it would not inspire any engineer to work at his daily task with a joyful snap and energy.

What is needed is a cause for hope, an antidote for discouragement, a financial reward for proven merit.

The writer has been employed for a number of years as a transitman and assistant engineer under New York City civil service, in one of the largest engineering departments under the city government. My deductions as to what is wrong with engineering civil service are intended to apply in particular to New York City conditions. Here since the panic of 1907 not more than 10 per cent of all the transitmen, draftsmen and assistant engineers have received any increase in salary. The result is natural. The men are discouraged, and the work drags.

On one hand are the wide-awake civic associations bent upon securing economy in government. In the eyes of these people all salary increases are detrimental to the public welfare. The newspapers toady to these societies and emphasize their views. Finally the political head of department is now, after numerous "investigations," afraid of the criticism of civic associations and dares not raise salaries for fear that it will react against him on election day. Is it strange that even engineers do not put spirit into their work under these present-day conditions? What draftsman who has not had an increase in salary for three years, will get out a drawing as quickly as he would if his efficiency were being rated to estimate his claims for an increase in salary at a definite set time?

A well regulated business concern announces a list of promotions and increase in salary at a definite date each year, generally on Jan. 1. Much has been said and printed of late concerning the need for application of business principles in municipal administration. Here, then is a true business principle—reward merit by increase of salary at a definite date yearly. In the haste to secure economy, this principle has been all but forgotten. Is there need to inquire further as to why employees are not working with vigor?

Now attack the problem in a practical manner. Transitmen and draftsmen should be appointed to the city service at the present minimum salary of $1,200 per annum. Of these men, those who measure up to a required standard of efficiency, should be advanced yearly, on a definite date, a minimum of $150 or a maximum of $300. For efficient employees, these advances should continue with regularity until draftsmen and transitmen receive the maximum salary of $1,800 a year. Then these men should be permitted to try a promotion examination for assistant engineer, and when vacancies occur in the department, those men on the list who possess the essential character for the positions should be promoted to assistant engineer, and the minimum salary for this position should be $1,950 per annum. Assistant engineers who prove efficient, should be advanced in salary, yearly, on a definite date, either $150 or $300 until a maximum salary of $3,000 per year is reached.

There is an old adage which relates that more flies can be caught by molasses than by vinegar; in the civil service among engineering employees, more efficiency can be secured by a system of rewards than by a policy of cutting.

Respectfully yours,
"Civil Service Engineer."

New York, N. Y., Feb. 7, 1910.

Power Required to Hoist a Car Up an Inclined Plane.

Sirs: I am unable to find a formula for calculating power required to hoist a car (rolling load) up an inclined plane.

M. G. GUSTIN.

Manhattan, Kas., Feb. 28, 1910.

(On page 244, 26th edition of *Molesworth's Pocket Book* the following formulas are given for rope inclines. The ton in all English books is the long ton of 2,240 lbs.:

W = weight of one train in tons (vehicles only).
w = weight of the load (passengers or goods) in tons.
y = weight of the cable in tons.
r = resistance on the level = say 0.006 at slow speeds.
$\frac{1}{x}$ = rate of inclination.
V = velocity in miles per hour.
$H.P.$ = actual horsepower required, to which should be added 25 or 30 per cent. for contingencies, friction of rope, etc.

$$H.P. = 6V\left[\frac{W+w+y}{x} + r(W+w+2y)\right]$$ for single ropes.

$$H.P. = 6V\left[\frac{w+y}{x} + 2r(W+w+y)\right]$$ for double rope.

"TAIL-END" SYSTEM.

This formula is based on the assumption that the vehicles of the ascending train are balanced by those of the descending train.

$$H.P. = 6V\left[\frac{W+w+\frac{y}{2}}{x} + r(W+w+4y)\right]$$ for endless rope.

EDITORS.]

Is the Present Method of Design of Concrete Bridges Unduly Wasteful?

Sirs: In the light of my own experience the question sometimes occurs to me: Is our accepted method of design for reinforced concrete structures, especially bridges and culverts wasteful of material and founded on an incorrect application of the principles involved, or wrong assumptions of the behavior of the materials in question, under stress? A few years ago while acting at County Surveyor I sent out a number of circular letters to road officials—not forgetting the County Commissioners—regarding the adoption of concrete as a material for bridge and culvert purposes. This vaccination process "took," and our Board of Commissioners at once got busy investigating the concrete bridge. At length they asked me to accompany them to look at some small bridges that had been built in a neighboring county and which they had been asked to examine by the construction company that had erected the same.

These were ordinary highway bridges, designed by "rule of thumb" and were the first product of the newly organized company that was trying to push the concrete bridge business in that territory. The bridges were in use at the time of our visit, having only been opened for traffic a short time. To the eye of the engineer they were rather crude in design, and the construction was not of the best, and the finished product did not present a very flattering appearance, but my board took to them wonderfully, and decided on the spot that they would submit alternative propositions to bidders and in that way find just what the difference in cost would be between the combination steel and wood, and tne reinforced concrete bridge for several structures for which they were soon to advertise for bids.

Knowing that the cost of the concrete bridge would be considerably more than the steel and wood bridge, especially as the bridge company who held this territory was bound to make a strong fight to keep out the interloper, and hold their grip on the territory, it was necessary that the cost of the concrete be held down to the lowest possible limit in order that it might receive consideration in the competition. With this end in view the standard plans of the concrete bridge company were overhauled and changed in some respects, not only to cheapen the work, but to secure a better distribution of the material, to make a better appearing job when finished, and to add to the factor of safety—if it could be said that their designs possessed that factor.

We were so far successful that concrete was awarded the place for six bridges, of from 35 to 50 ft. span, although the cost was still considerably above that of the steel people. These six bridges were built under my supervision, and at the end of 28 and in some instances of 30 days were tested with a very heavy traction outfit—which in this locality represents the maximum loading for highway bridges—and in every instance they passed the test successfully, and I may say that after three years of constant use they are still answering all demands upon them. One 50 ft. span tested at 28 days, showed a deflection of 3/16 in. under a center load of 14 tons on four wheels with axles 8 ft. apart, and as the load was removed the bridge recovered its normal position. All these six bridges were subjected to the same test, and all gave equally good results.

Now these bridges were constructed by a company new in the business—not yet having passed beyond the experimental stage—and their entire equipment was crude and inefficient, their workmen inexperienced, and with the exception of one man who had served on the Government work on the Hennepin Canal, were all having their first taste of concrete construction. Under these conditions it may be considered not strange that as the time approached for the testing of each bridge I had some uneasy feelings.

Coming to the design of these bridges, I will say that they were all of the girder type, there being four girders under each span and the outside girders being carried up to a point 12 ins. above the floor line to form a parapet wall, which was surmounted by a gas pipe railing. These girders run in depth from 12 ins. to 16 ins. owing to the length of span, the 50 ft. spans having the 16-in. girders. The floor slabs which were built continuous with the beams were 6 ins. in thickness at the outer edges and crowned to 9 ins. at the center. The lower side of the slab was arched between the girders—slightly. The reinforcement of the girders consisted of five corrugated bars, in size from ¾ in. for the shorter spans to 1¼ ins. for the 50-ft. spans. The floor slabs were reinforced with a single layer of expanded metal, placed near the bottom of the slab, and a narrow strip of the same was run in the parapet walls. A comparison of these bridges with the standard plans as sent out and recommended by different makers of

reinforcing material will show their great deficiency in depth of girder and also in some cases in the quantity of reinforcement used, yet these bridges are in constant use and there has not a single crack developed in any girder.

These bridges are freaks possibly in design, but if so, must certainly be regarded as such in point of behavior. Whether the extreme care used to secure a perfect concrete, and a correct placing of the reinforcement, or the providence that overlooks fools is to be regarded as the solution, I leave to others. Certainly in the light of this experience I may be pardoned if I sometimes think that in our desire for safety we permit ourselves to go to unwarranted extremes. Certainly it will not be denied that if concrete is to come quickly into its own as a bridge material, we cannot afford to sacrifice a due regard for economy to an undue desire to secure unwarranted and unnecessary strength.

In this connection it may occur to others as it did to me, Are we ever justified in adopting doubtful expedients to overcome obstacles to the advancement of the common good? My defense must be that as the contractor was under heavy bonds and the specifications called for the test on the bridges that I have named, that if the bridges were to fail under the test he would be the loser and the public was amply protected. And as I had materially strengthened his bridge plans before these were constructed, it must be argued that he was now building a better bridge than those that he had already built, and which were in successful use.

I might say in conclusion that this same construction company now has a very large number of such bridges in this section of the state and in Oklahoma, and Colorado, and so far have not a single failure to its discredit.

Hence again the question, "Is our present method of design unwarrantedly wasteful?"

Yours truly,

O. T. REECE.

Wellington, Kan., March 17, 1910.

Technical Society Meetings.

The list following names those technical societies in which engineers and contractors are most interested, whose meetings are to be held within three months of the date of this issue. There are given for each society listed the date and place of meeting and the name and address of the secretary, to whom all communications and inquiries should be addressed.

American Water Works Association.—April 26-30, 1910. Annual convention at New Orleans, La. Headquarters, Gruenwald Hotel. Secy., J. M. Diven, Charleston, S. C.

Notes from Technical Societies.

Engineers' Society of Western Pennsylvania.—At the regular monthly meeting, Mar. 15, President E. K. Morse, in response to a request made by the Pittsburg Chamber of Commerce, appointed the following committee to report on the question of raising the bridges over the Allegheny River at Pittsburg: Geo. S. Davison, Julian Kennedy, F. L. O. Wadsworth, John N. Chester and Emil Gerber. The importance of the questions involved, both engineering and financial, may be realized from the fact that there are eight bridges affected, over a river averaging 1,000 ft. in width, the majority of which would be replaced in toto. A paper on the "Floods in the River Seine" was read by Thomas P. Roberts of the U. S. Engineer's Office, Pittsburg.

Canadian Cement and Concrete Association.—Among the papers to be presented at the annual convention to be held at London, Ont., March 29 to April 1 will be the following: Richard L. Humphrey, Director of United States Structural Materials Testing Laboratories, Philadelphia, "Concrete in Europe"; Cecil B. Smith, of Smith, Kerry & Chace, Toronto, "Concrete Construction"; F. S. Baker, President Royal Architectural Institute of Canada, "The Use of Cement in Architecture"; A. W. Campbell, Deputy Minister of Public Works, Ottawa, "The Engineer and the Finished Work"; Professor W. H. Day, Ontario Agricultural College, Guelph, "Cement Tiles"; A. W. Connor, of Bowman & Connor, Toronto, "Municipal Concrete Bridges"; Gustave Kahn, Toronto, "The Commercial Aspect of Reinforced Concrete Work in Canada"; C. R. Young, of Barber & Young, Toronto. "An Analysis of Concrete Bridge Failures"; M. D. Morrill, Architect, Washington, D. C., "Inexpensive Homes of Concrete"; D. C. Raymond, Vice-President Bishop Construction Co., Montreal and Toronto, "Concrete from the Contractor's Standpoint"; Charles Talbot, London, Ont., "Highway Bridge Construction"; Philip Wormeley, United States Department of Agriculture, Washington, D. C., "The Uses of Concrete on the Farm"; James Pearson, Contractor, Toronto, "Concrete Pavements"; C. W. Boynton, Chief Inspecting Engineer, Universal Portland Cement Co., "Concrete Sidewalks"; R. A. Plumb, Detroit, Mich., "Waterproofing." In addition to the list of speakers given, a very important feature of the convention will be the discussion and subsequent designing of Standard Specifications for Cement and Concrete Work with special reference to the adaptation to Canadian business and climatic conditions.

Personals.

Mr. Hudson F. Layton, Civil and Consulting Engineer, Pittsburg, Pa., will on April 1 move his offices to Suite 2501 Henry W. Oliver Bldg., Pittsburg, Pa.

Mr. S. D. Newton, who recently retired as City Engineer of Knoxville, Tenn., has opened offices in that city as a civil and consulting engineer. Mr. Newton will make a specialty of municipal work.

Mr. R. L. Murphy has resigned as District Sales Manager for the Corrugated Bar Co., at St. Louis, and has been elected treasurer of the Murphy Construction Co., General Contractors, E. St. Louis, Ill.

Mr. John M. Price of Atchison, Kansas, noted as a pioneer railroad contractor, and who built the Rule Branch of the Chicago, Burlington and Quincy R. R. from Atchison to Falls City in 1869, died March 10.

Mr. Walter B. Snow, publicity engineer, 170 Summer street, Boston, Mass., has added to his staff Mr. Benjamin Baker, formerly of the "Boston Transcript," and late editor of "The Navy," and Mr. Herbert M. Wilcox, a chemical engineer with a varied industrial experience.

Mr. Ernest McCullough, who since July 1, 1909, has been a member of the editorial staff of Engineering-Contracting, has resigned to accept a position on the editorial staff of the Railroad Age-Gazette. Mr. McCullough's headquarters will be at the Chicago offices of the last named paper, 305 Dearborn street, Chicago, Ill.

Mr. C. A. Greenidge, late general manager Electric Department Utica Gas & Electric Co., and for a number of years engaged in a varied mechanical and electrical engineering practice, has been engaged by J. G. White & Co., Inc., as engineer in charge of the operating department. Mr. Greenidge is a graduate of Stephens Institute of Technology.

Mr. H. B. Kamschutle, for many years chief engineer of the T. M. E. R. & L. Co., and the T. M. L. H. & T. Co., and Mr. G. Pickhardt, formerly with the Milwaukee Western R. R., have formed a copartnership for engaging in large building and railroad contracting. They will work under the firm name of Kamschulte-Pickhardt Engineering & Contracting Company with offices at 711 Majestic Building, Milwaukee, Wis.

Catalogs Worth Having.

Engineers and contractors should have on file the latest catalogs of machines, tools and supplies that they use. In sending for catalogs reviewed or advertised in this paper, you will confer a favor on us if you will write directly to the advertisers and state that you saw the catalog mentioned in ENGINEERING-CONTRACTING. If you are in the market for tools, machinery or supplies, tell us and we will notify promptly the leading manufacturers.

Nazareth Portfolio.—Charles Warner Co., Wilmington, Del.

The Nazareth Portfolio is a heavy envelope containing loose sheets 7½x9 ins., each sheet giving information on the use and abuse of cement.

Tools for Draftsmen and Artists.—Paper, 6x9 ins., 72 pp. The Lutz Co., Guttenberg, N. J.

While this catalog contains the usual things seen in catalogs of office tools, it shows on page 50 a convertible scale for draftsmen that is new and good.

Nestable Corrugated Metal Culverts.—Paper, 6x9 ins., 24 pp. The Canton Culvert Co., Canton, O.

This is the 1910 edition of a catalog describing culverts made of a rust resisting iron having the trade name of No-Co-Ro metal. The book contains useful data.

The Mason Builder.—Paper, 6x9 ins. Charles Warner Co., New York City.

This is a new monthly publication by a cement company, devoted to the uses of cement and lime. It is well illustrated and the three numbers thus far received are very good.

Fine Steel for Heavy Work.—Paper, 7x10 ins., 83 pp. Penn. Steel Casting & Machine Co., Chester, Pa.

This catalog is a splendid pictorial history of work done by this old and well known company. There is a great deal in the book to interest contractors.

Conduit Construction.—The Safety Insulated Wire & Cable Co., Chicago, Ill.

A small envelope folder advertising a construction company making a specialty of underground electrical installations.

Heavy Wagons.—Paper, 8x8½ ins., 68 pp. Columbia Wagon Co., Columbia, Pa.

This catalog describes a full line of heavy carts and wagons for contractors and other wagon users. Some very good specialties are illustrated.

Generators and Producer Gas Plants.—Paper, 8x11 ins. Hill-Hupfel Engineering Co., New York, N. Y.

This company publishes 8-page illustrated bulletins of a convenient size to file in letter files. Each bulletin describes some special machine and valuable data are given with costs when same may be had.

Cast Iron Pipe.—Cloth, 9x11 ins., 156 pp. United States Cast Iron Pipe & Foundry Co., New York, N. Y.

This book is handsomely illustrated and printed on heavy coated paper. It contains line cuts of standards with tables of sizes and a number of useful tables relating to pressure and flow of water, friction, etc.

Interlocking That Locks.—Paper, 6x9 ins., 25 pp. The Interlocking Tube Co., 79 Dearborn St., Chicago, Ill.

Interlocking tubes are made of steel and are tongue and groove construction of various diameters. They are driven like piles and when filled with concrete make a strong wall. This wall may be reinforced and is excellent for foundations, wharves, piers, etc.

Electrical Instrument Bulletins.—8x10½ ins. Fort Wayne Electric Works, Fort Wayne, Ind.

Bulletin 1118 of 12 pages describes the Type A Transformer, and Bulletin 1119 describes "Northern" Type B, Direct Current Motors. A number of smaller pamphlets sent describe a handy electrical pump and the Atwood Vacuum Cleaner.

Austin Drainage Excavators.—Paper, 7x10 ins. 112 pp. F. C. Austin Drainage Excavator Co., Railway Exchange Building, Chicago, Ill.

This catalogue should be in the hands of every engineer and contractor having anything to do with the excavation of ditches and canals for either irrigation or drainage. It describes a number of styles of a type of excavator that cuts sloping banks at one operation to any depth. A number of useful earthwork tables are given. The catalogue is well written, well printed and voluminously illustrated.

Construction Methods on a Concrete Dam.—Paper. 3½x6 ins. 8pp. Ernst Wiener Co., 50 Church street, New York, N. Y.

In building a concrete dam at Bellows Falls, Vt., industrial cars were used to great advantage as described in this booklet.

Eclipse Machinery.—Frick Company, Waynesboro, Pa. Paper. 7½x9 ins. 60 pp.

Traction engines, portable sawmills, threshers, etc., are illustrated in this book.

Emerson Pumps.—Paper. 6x9 ins. The Emerson Steam Pump Co., Alexandria, Va.

The 1910 catalogue contains 52 pages and is handsomely illustrated. Accompanying it is a 19-page illustrated catalogue of parts for this extremely handy and valuable contractor's pump.

Flexible Metallic Tubing.—Paper. 6x9 ins. 15 pp. Schoen-Jackson Co., Media, Pa.

Describes flexible metallic tubing and connections in all sizes for pressures up to 4,000 pounds from either steel, copper or brass, for steam, water, air, gas, oil and conduits, or for any other purpose for which hose is used.

Standard Specifications for Hard Drawn Copper-Clad Steel Wire.—Paper. 5x8 ins. 8 pp. Duplex Metals Company, Singer Building, New York, N. Y.

The subject matter of this book is sufficiently indicated in the title.

The Sharon Silo.—Paper folder. 5½x7⅛ ins. 8 pp. Sharon Steel Hoop Co., Commercial National Bank Building, Chicago, Ill.

This circular describes a silo having a steel frame of Collins united studding covered with metal lath and plastered, thus forming an air space in the walls.

Steel Fabric.—Paper. 7x10 ins. 22 pp. Clinton Wire Cloth Co., Clinton, Mass.

This is No. 1, Volume 1, of a publication to be published at frequent intervals in the interest of Clinton Wire Lath and Clinton Electrically Welded Wire. This issue contains a description of the work done in covering the unsightly steel work of the Boston Elevated Railway structures with reinforced concrete, Clinton products being used.

Marine Oil and Gasoline Engines.—Paper. 6x9 ins. Fairbanks, Morse & Co., Chicago, Ill.

Catalogue 112-B contains 17 pages and describes four cycle heavy duty marine engines. Catalogue 113 contains 32 pages and describes two cycle marine engines. These catalogues are printed on heavy coated paper and are handsomely illustrated.

Peerless Hauling Engines.—Paper. 6x19 ins. 64 pp. Geiser The Manufacturing Company, Inc., Waynesboro, Pa.

This is a general catalogue of "Peerless" machinery comprising hauling engines for all uses, threshers, saw mills, gasoline engines, plows, wagons, etc.

Contract News Section

of

ENGINEERING-CONTRACTING

A Consolidation of ENGINEERING-CONTRACTING—CONTRACT NEWS—ENGINEERING WORLD—THE DIRT MOVER.

Containing Items of Interest to Railroad, Public Works and Other Contractors.

The Doings of the Week.

The largest municipal contract to be let the past week was probably the one awarded by the City of Portland, Ore. This contract called for the construction of Bull Run Conduit No. 2, and was secured by the Shaw-Batcher Co. Pipe Works, Sacramento, Cal., at $1,259,782.—Several fairly large railroad construction contracts were let during the past week, chief of these being the contract for constructing the Evansville-Mt. Carmel line for the Big Four Ry. This contract was secured by the Walsh Construction Co., Davenport, Ia. Among the other railroad contracts were the following: Guilford Co., Kansas City, Mo., for constructing six miles of line from Shawnee, Kan., to Zarah, for the Kansas City, Lawrence & Topeka Electric R. R.; W. O. Robertson, San Antonio, Tex., grading contracts for the first 90 miles of the San Antonio, Rio Grande & Tampico R. R.; and Peter Simms, Tacoma, Wash., for constructing the Point Defiance-Narrows line for the Northern Pacific, a total distance of about 42 miles.—The New York State Highway Commission is now calling for bids for over 200 miles of state highway construction. Bids for the work are to be opened April 4, 6 and 8.—The Kenefick-Quigley-Hoffman Construction Co., of Kansas City, Mo., and Denver, Colo., contractors for the irrigation system for the Colorado Southern Irrigation Co., are to sublet over $2,000,000 worth of the work on April 5, from their offices at Canon City, Colo. —Announcement has been made that the new Western Pacific line from Salt Lake City to San Francisco will be open to passenger traffic by June 1.—The Canadian Pacific Ry. is now calling for bids for completing the canal system in the eastern section of its irrigation branch in Alberta. The contract involves about 25,000,000 cu. yd. of excavation.

The Commission Form of City Government.

The great tidal wave of 1900 which fell upon the city of Galveston, Tex., not only washed out a greater part of the city but it also washed in a new form of city government which seems to have gained a firm foothold in many cities of this country. Following the great flood chaotic conditions prevailed in Galveston, but with characteristic courage the citizens set about rebuilding their city. The City Council was found wanting under the abnormal conditions that prevailed: Inefficiency was seen on every side and charges of graft abounded. Finally the citizens decided that in order to carry out their plans, to make the new Galveston a stronger and better city than the old, it was necessary to have a form of government strong enough to handle the situation. Accordingly a charter was obtained from the legislature and a form of city government new to America came into being. Under this new form of city government the City Council was abolished, and all authority was vested in five commissioners, who were at once the executive, legislative and all other branches of the municipal government. This was the start of the commission form of city government in this country. The Galveston plan proved so successful that it was soon adopted by Houston. Other cities in Texas followed suit and at the present time there are 15 cities in Texas which have the Galveston Commission plan. Other states soon took up the new form of municipal government. The legislature of South Dakota passed a law which, while retaining the essential features of the Galveston plan, was an improvement over it, inasmuch as it put all responsibility upon the people. The State of Iowa also adopted a similar law. At the present time there are about 60 cities having a combined population of something like 3,000,000 people which have adopted the essential features of commission government. Among the cities of over 100,000 population which have adopted this plan are Boston, Buffalo, Memphis, St. Joseph and Tacoma. Nine cities in Kansas are governed under the Des Moines plan, and in Iowa there are also a number of cities similarly governed. In Illinois and Michigan efforts are being made to secure an enabling act from the State legislature. In the former state 20 of the larger cities have formed an organization to secure this act.

Some Reminiscences of an Old Timer.

The Hoosac Tunnel was the first railroad tunnel of any great length to be constructed in this country. The contract for its construction was let in 1868, but, it was not until Feb. 9, 1875, that the first locomotive passed through the tunnel. The party making the first trip consisted of Thomas Doane, State Engineer; M. T. Munson, Superintendent of Construction for the contractor; N. C. Munson, Contractor for the Grenfield & Troy R. R., owned by the State; C. D. Munson, a contractor on the tunnel, two other men, and a number of laborers. Of this party the engine driver and C. D. Munson, as far as known, are the only persons living. Mr. Munson now lives in Florida, where, notwithstanding he is 83 years old, he is engaged in extensive orange and pineapple culture. In a recent interview Mr. Munson told of the completion of the tunnel and the memorable first trip. Speaking of this he said: "There was attached to the locomotive a boxcar in which were 8 or 10 laborers. The day was severely cold. The start was made about noon, and we went safely through to North Adams, remaining there about an hour, then returning to the east end of the tunnel.

"The reconstruction of the state railroad and the construction of the tunnel were in charge of a state commission of three men. It was desired to forward the construction by sinking a central shaft, from which two faces could be worked and debris hoisted out. The Hoosac mountain has two summits, one on the east and one on the west, leaving a valley between. The central shaft was started at the lowest place in the valley between the two summits. It was 1,600 ft. from the surface of the ground to the tunnel grade. Hoisting apparatus and a building of wood were erected. When the central shaft had been sunk about a thousand feet a fire consumed the hoisting apparatus and building, with its contents. There were at the bottom of the shaft 11 men at work. Their bones were taken out several months later, and if any inquest was ever held I never heard of it. The hoisting building was rebuilt of brick and stone. Near the east end of the tunnel can be seen a round hole about 25 ft. across, where someone undertook to bore the tunnel with a machine, but after getting about 15 ft. into the solid rock stopped."

Old Mexican or Spanish Land Measures.

The following notes on old Mexican or Spanish land measures originally appeared in the Galveston News in 1859 in the form of a letter from Col. F. W. Johnson. This letter was recently reprinted in the Houston Post. Col. Johnson, by the way, was one of the earliest surveyors in Texas, and he, with Col. Ben Milam, was in command of the Texans who stormed Bexar (San Antonio) in December, 1835. His original letter to the Galveston News was as follows:

Editors Galveston News:

Industry, Texas, September 3, 1859.—I find in the Texas Almanac of 1857-8 tables showing the difference between English and Mexican long and land measure. The second seems a correction of the first. Although correct as to results, it furnished no rule by which its equivalents are obtained. Believing a brief history of the ten-vara chain used by the Mexican and Texas government will be of interest to many, I send you the following, with the rule by which the equivalents may be obtained: From 1821-2 to 1830 there was no uniform measure in laying out lands. Chains used were from 29 ft. to 28½ and 27 ft. 9⅔ ins. Each surveyor regulated his chain by what he believed the colonization laws required. Hence the difference in old surveys. In 1830 the two-pole chain of 50 links, reduced to 10 varas of 33⅓ ins., making the length 27 ft. 9⅓ ins., was established in Austin's colony, every five links of which equals 1 vara and every link equals 2/10 of a vara. The long and land measure established by the government of Mexico, compared with that of the United States, is found to be less by a discount of 8 per cent. Hence 1 yd. equals 1.08 varas and 100 yds. 108 varas. Hence, also, yards × 1.08 equals 108 yds. and 1.08 yds. × 1.08 equals 100 yds. There is perhaps no land measure less simple than that of Mexico. The vara is the unit; 5,000 varas the side of the league, 1,000 varas the side of a labor. The labor being the least subdivision of the league, may be regarded as the unit in quantity, and is the 1/25 part. An area 25,000,000 square varas equals 1 league or 4428.4 acres. An area of 1,000,000 square varas equals 1 labor or 177.136 acres; 5654.3797 square varas equals 1 acre.

The State Legislature of Rhode Island is now considering the application of the Southern New England Ry. for a charter. This is a Grand Trunk Ry. project and by means of this line the latter would secure an entrance to Providence, R. I. In a statement before the legislature, committee vice president E. H. Fitzburgh of the Grand Trunk said that the road would surely be built if the charter was granted.

The Alaska Petroleum & Coal Co., T. S. Lippy, president, Seattle, Wash., is stated to have had surveys made and to have let the contracts for building a railroad from Controller Bay in Alaska to the coal mines in the Katallas field. The proposed railroad will be 24 miles long, extending from the harbor east of Katalla to Carbon creek, in the coal fields.

According to an estimate furnished by Engineer J. B. Ferguson, the elevation of the Western Maryland R. R. tracks through the city of Hagerstown, Md., will require an expenditure of $200,000.

Confirmed Reports by Engineers and Contractors

RAILROADS, POWER DEVELOPMENTS, LEVEES, DRAINAGE AND IRRIGATION WORKS.

Railroads—Steam and Electric.

ALABAMA.

J. M. Kinney and C. W. Merritt, Pensacola, Fla., have the contract for grading 12 miles of line for the Pensacola, Mobile & Tennessee Ry. from Sticks River to Loxley, Ala. The work includes about 30,000 cu. yds. of earth excavation and about 35,000 cu. yds. of embankment.

CONNECTICUT.

Plans are being prepared by the engineering department of the New York, New Haven & Hartford R. R., for double track work on the Berkshire division from Hawleyville, Conn., to Botsford.

IDAHO.

The Central Idaho R. R. Co. has been incorporated and surveys have been made from Owinza to Payette. Nothing further has been done about this matter and construction or any further expenditures, is not yet authorized. This is an Oregon Short Line R. R. project.

ILLINOIS

As stated in our last issue the S. R. H. Robinson & Son Contracting Co., 915 Chemical Bldg., St. Louis, Mo., has the grading contract for constructing the Cairo & Thebes R. R. between Cairo and Thebes, Ill. The contract includes 350,000 cu. yds. of earth excavation, 50,000 cu. yds. of rock excavation and 300 cu. yds. of concrete masonry. The excavation is principally side borrow work the material being sandy loam with very little clearing. The work is principally through cultivated fields and covers 11½ miles of line. With the exception of one heavy mile, it is entirely a scraper proposition. Some of the work has been let to J. M. Wolfe, Thebes, Ill., but the contractors still have about 100,000 cu. yds. of side borrow work which they will sublet.

INDIANA.

The Walsh Construction Co., Davenport, Ia., has been awarded the contract for the construction of the Evansville-Mt. Carmel line for the Cleveland, Cincinnati, Chicago & St. Louis Ry.

IOWA.

The Iowa City, Ottumwa Southwestern R. R., which projects a 75 mile line between Ottumwa and Iowa City, has completed surveys and has about secured the capital for the construction of its line. The line is to pass through Sharon Center, Frytown, Amish, Wellman, Krota and Ollie. Frank Tanner, Iowa City, Ia., is vice president.

LOUISIANA

The Alexandria & Western Ry. has secured the capital for the construction of its projected 50 mile line traversing the Bayou Rapides territory in Louisiana. The company will do its own work. I. W. Sylvester, Alexandria, La., is chief engineer; G. F. Cotton, Alexandria, is president and W. H. Larsen, Alexandria is secretary and treasurer.

MICHIGAN.

Bids will be requested in 10 days on 10 miles of new single track railroad grading near Kalamazoo, Mich. Responsible contractors owning suitable team outfits immediately available for such work may receive invitations to bid by applying to H. P. Robinson, 703 Plymouth Bldg., Chicago, Ill., and giving particulars as to size and kind of output. The work is to be paid for in cash. Official advertisement will be found elsewhere in this issue.

MISSOURI.

The Chicago, Rock Island & Pacific Ry. Co. is doing a large amount of ballasting and rail renewal on its line between St. Louis and Kansas City, Mo. It is not, however, intended to make any changes in the line.

The Kansas City, Lawrence & Topeka Electric R. R. Co. of Kansas City, Mo., has awarded a contract to Guilford Co., Kansas City, Mo., for the construction of 6 miles of line from the present terminus at Shawnee to Zarah.

MONTANA.

The Eastern Montana Electric Ry. Co. has surveys under way for its projected 80 mile line from Red Lodge via Clarks Fork and Bear Creek and the capital for the constructing of the line has been promised. F. A. Kesselkuth, Billings, Mont., is chief engineer, and A. C. Logan, Billings, is president.

NEVADA.

The San Pedro, Los Angeles & Salt Lake R. R., E. G. Tilton, chief engineer, Los Angeles, Cal., has begun temporary repairs on its line in Meadow Valley, Nevada, which was badly injured by recent floods.

OKLAHOMA.

The Enid, Ochiltree & Western R. R., recently chartered in Oklahoma, has had preliminary surveys made for its Oklahoma lines. The capital for construction, however, has not been secured as yet. The total projected length of the lines in Oklahoma is 500 miles and they are to traverse Beaver, Harper, Ellis, Woodward, Dewey, Major Woods, Alfalfa, Grand, Garfield, Kingfisher, Logan, Canadian and Oklahoma counties. This company already has its line in the Texas Panhandle under construction. B. H. Tallmadge, Enid, Okla., is president.

NORTH CAROLINA.

The Isothermal Traction Co. of Rutherfordton, N. C., has surveys under way for its projected 98-mile line from Gastonia via Shelby and Rutherfordton to Asheville, N. C. Negotiations are under way for securing the necessary capital for the construction of the line, and construction contracts will be let in six months. K. S. Finch, Charlotte, N. C., is president.

WEST VIRGINIA.

Johnson & Briggs, 216 Mutual Bldg., Richmond, Va., as previously noted, have five miles of work on Horse Creek in West Virginia. The work is on a branch line of the Chesapeake & Ohio R. R. from Julian. It is light work, not suitable for machinery, and is already covered with the usual cart and scraper force. Work is well under way.

VIRGINIA.

The contract recently awarded to the Joseph H. Sands Contracting Co., Roanoke, Va., for constructing the Petersburg low grade connecting line for the Norfolk & Western Ry. at Petersburg, includes 600,000 cu. yds. of earth excavation, 18,000 cu. yds. of concrete masonry and 64,000 lin. ft. of piling. Wright & Dickey, Petersburg, Va., have been awarded the subcontract for the concrete and piling.

TEXAS

Preliminary surveys have been made and the capital has been partly secured for the construction of the proposed line of the Nueces River Valley R. R. As projected this road is to be 175 miles long, extending from Beeville, Tex., to Eagle Pass, passing through Oakville, Tilden, Cotulla and Carizzo Springs. Construction contracts are to be let between April 1 and May 1, 1910. John Andrewartha is chief engineer, Wm. A. Frisby, Beeville, Tex., is president, and Lee Frisby, Beeville, Tex., is vice president and general manager.

The Texas Building Co., F. & M. Bank Bldg., Fort Worth, Tex., has been awarded the contract for the grade work for the Brownwood North & South R. R., from Brownwood to May, Tex., a distance of 20 miles, as stated in our last issue. The contract includes approximately 200,000 cu. yds. of earth excavation, 5,000 cu. yds. rock excavation, 800 lin. ft. of pile trestle and approximately 7,000 lin. ft. of piling. Probably one-half of the grading will be sublet immediately. The railway of which John Meade, Brownwood is chief engineer, is in the market for bridge and track material.

WASHINGTON.

The Hurley-Mason Co., Tacoma, Wash., and Portland, Ore., as stated in our March 16 issue, has a contract for a considerable amount of masonry work on the line of the Northern Pacific. The work extends from Tenino to Vancouver, Wash., and covers the building of abutments and piers for several river crossings. The work is for the second track of the Northern Pacific, the line of which has been changed in several places. The contract includes 40,000 cu. yds. concrete masonry and 100,000 lin. ft. of piling.

WISCONSIN.

The Prairie Farm & Southwestern Ry., which projects a 25-mile line from Prairie Farm, Wis., is now having surveys made. The company has partly secured the necessary capital for the construction of the line and plans to begin construction work April 15. The company will do its own work. J. H. Thomas, Prairie Farm, Wis., is chief engineer, and G. E. Scott, Prairie Farm, is president.

WYOMING.

MacArthur Brothers Co., Thermopolis, Wyo., or Walton, Wyo., have 450,000 yds. of exceptionally fine machine and fresno work to sublet in Wyoming; Burlington transportation. Official advertisement will be found elsewhere in this issue.

Power Developments, Levees, Drainage and Irrigition Works.

ARKANSAS.

County Judge of Ashley County Arkansas, has contracted with G. A. McWilliams, 702 Royal Insurance Bldg., Chicago, Ill., for the construction of a system of Drainage Ditches in Hamburg Drainage District No. 1 of Ashley County. The amount of contract is $80,000. McWilliams also contracted to take the Bonds of said District, at par, in payment of construction work.

CALIFORNIA.

Plans are being made for the proposed reservoir scheme of the Calaveras Development Co. of Stockton. The dam is to be of concrete with under sluices and spillway. Eventually flumes and ditches for irrigation will be installed. Contracts for construction work will probably be let in 1911. The estimated cost of the project is $600,000. W. G. Hunter, 219 East Flora St., Stockton, Cal., is engineer.

The Rubio Canon Land & Water Association, J. B. Coulston, secretary, Pasadena, Cal.,

will construct a 3,000,000 gallon storage reservoir in Rubio Canon; however, only the excavating for this reservoir will be done this year. It is likely that a contract for the excavating will be let within the next 30 days. The contract for the concrete work will not be let until next year.

COLORADO.

The Kenefick-Quigley-Hoffman Construction Co., Kansas City, Mo., as mentioned in our last issue, has been awarded the contract at $12,987,000 for constructing one of the largest irrigation projects yet undertaken. The contract was let March 8 by the Colorado Southern Irrigation Co. of Canon City, Colo., and A. L. Register & Co. of Philadelphia. The lands to be irrigated lie on both sides of the Arkansas River, beginning at Canon City and extending down to Pueblo, covering 400,000 acres. The contract includes the building of twelve dams, ranging in height from 112 ft. to 200 ft., excavating 160 miles of main canals and several hundred miles of laterals. Fourteen tunnels will be driven, the longest of which is to be one-half mile long and is located near Canon City. Four of the dams will be located in the mountains, three on Grape Creek and one near Salida on the Arkansas River. They will be built of concrete and of the most improved design of construction. The other eight dams will be located below Canon City; they will be built of earth with concrete face and core walls. All construction has been designed by Mr. W. H. Rosecrans of the Arnold Co. of Chicago, under whose supervision as engineer the construction will be done. The Kenefick-Quigley-Hoffman Construction Co., whose present western office is in the Century Bldg., Denver, Colo., will soon establish a local office in Canon City and will commence the actual construction as rapidly as machinery and forces can be shipped in. The work is to be sublet and further information will be found in our proposal advertising columns in this issue.

GEORGIA.

Following bids were received March 9 by Col. Dan C. Kingman, U. S. Engineers, Savannah, Ga., for improving Club and Plantation creeks, Georgia, by dredging 111,000 cu. yds.: Simons-Mayrant Co., Charleston, S. C., 17.3 cts. per cu. yd.; P. Sanford Ross, Inc., Jersey City, N. J., 24½ cts. per cu. yd.; Paschal N. Strong, Savannah, Ga., 15½ cts. per cu. yd.; Savannah Dredging Co., Savannah, Ga., 17.8 cts. per cu. yd. All bids were rejected and it was deemed to be to the advantage of the United States to let the whole work at one time, when the additional funds required for the completion of the project became available, which amount is provided for in the pending river and harbor bill. When the work is readvertised, the amount to be expended will be approximately $40,000. Under the present specifications it was intended to expend only $20,000.

IOWA.

The contract for constructing a ditch in Drainage District No. 10, bids for which were received March 9 by the County Auditor at Sibley, Ia., has been let to the Standard Drainage Co., Windom, Minn., at 10.9 cts. per cu. yd., for the main ditch, and 14 cts. per cu. yd. for the lateral. The main ditch will be 30,045 long, the cut averaging 6.94 ft. and the lateral will be 2,666 ft. long, thus averaging 6.25 ft.

The contract for constructing Drainage District No. 12 in Louisa County, Iowa, has been let to Chapman Bros., Muscatine, Ia., at 7.9 cts. per cu. yd. The work, bids for which were opened March 16, includes the following: Section 1, 111,000 cu. yds. of excavation, 6 acres of clearing; Sec. 2, 154,000 cu. yds. excavation, 3 acres of clearing; 127,000 cu. yds. of excavation, 12 acres of clearing; 87,000 cu. yds. of excavation, 30 acres of clearing.

John McAndrews, Kankakee, Ill., has been awarded the contract for constructing the Ocheyedan River improvement, District No. 6, for Clay County, Ia. The contract price was 5.97 cts. per cu. yds. The ditch is 11.55 miles long with side slopes 1 to 1 and 6-ft. berm. The soil is black dirt and gravel. The work includes the following:

		Width.	
Sec. Y'dage.	Max. Cut.	Av. Cut.	Bottom.	Top.
1... 69,301.1	11.95	5.65	8 ft.	20 ft.
2...227,233.9	11.75	...	...	...
3... 83,058.3	11.20	8.20	25 ft.	41 ft.
4... 74,189.8	11.70	9.20	23 ft.	41 ft.
5...100,985.0	11.40	8.45	22 ft.	39 ft.
6... 55,685.7	12.05	8.50	21 ft.	39 ft.
... .	...	9.55	20 ft.	39 ft.
7... 11,167.2	6.90	8.60	18 ft.	35 ft.

OREGON.

The contract for constructing Bull Run conduit No. 2, for the city of Portland, Ore., has been awarded to the Schaw Batcher Co. Pipe Works, Sacramento, Cal., at $1,259,782. The itemized bids for this work will be found elsewhere in this issue.

MINNESOTA.

Jenniges & Zubroegel, Wanda, Minn., were awarded the contract March 19 for constructing Judicial Ditch No. 1 at Redwood Falls. The contract price was $4,115 and the work is all tile work.

MISSISSIPPI.

Bids are asked by J. D. Laughlin, Chancery Clerk of Warren County, Vicksburg, Miss., until Monday, April 6, for building a canal in Sandy Bottom.

OHIO.

J. A. Roberts, Ashland, O., has been awarded the contract for straightening, widening and deepening the Jerome Fork branch of the Mohican River for Ashland County. The contract price was 9.7 cts. per cu. yd. and the work includes 313,000 cu. yds. of dredge work. Bids were opened March 18.

WYOMING.

Bids are asked until about April 15 for the construction of the Coney Canal near Cokerville, Wyo., the approximate quantities being as follows. Earth excavation, 75,000 cu. yds.; loose and solid rock, 2,000 cu. yds. Information can be obtained from W. Newbrough, M. Am. Soc., C. E., chief engineer, Evanston, Wyo., or from S. M. Covey, 933 E. 1st South street, Salt Lake City, Utah.

CANADA.

Bids are asked by J. S. Dennis, assistant to 2nd vice president Canadian Pacific Ry., Calgary, Alberta, until Monday, April 1, for the labor required to complete the timber construction in the Western Section of the Irrigation Block, Alberta, amounting to upwards of 1,250,000 ft. B. M. of timber. Plans, specifications, and any other information may be obtained at the Office of the Assistant Chief Engineer, Calgary.

Bids are asked by J. S. Dennis, assistant to the second vice president, Canadian Pacific Ry., Calgary, Alberta, until noon, May 1, for all excavation required to complete the canal system in the eastern section of the Canadian Pacific Railway Co.'s irrigation block, Alberta, amounting to upward of 25,000,000 cu. yds. of material. Plans, specifications and all other information may be seen at the office of the assistant chief engineer, Calgary, Alberta. Official advertisement will be found elsewhere in this issue.

A bill is before the U. S. House of Representatives to incorporate the East Washington Suburban Ry. Co., which proposes to construct an electric road from near the intersection of Nichols Av. and Good Hope road, at Washington, D. C.; thence along or near the Good Hope road to the Bowen road, and following the Bowen and Suitland roads to the District line. The incorporators named in the bill are Samuel E. Cox, William A. Harrison and A. W. Thomas of Maryland; Albert Carry, O. A. Emmons, John Kuhn, Maurice Otterback, Robert Bradbury and George E. Emmons of the District of Columbia; Reese Carpenter of New York and R. H. Phillips and J. S. Sims of Virginia.

The Louisiana Investment & Development Co., of which E. J. Larkin, 225 Dauphine St., New Orleans, La., is local representative, is considering a project that contemplates the purchase of the Barataria and Lafourche canal and the establishment on that waterway of a million-dollar barge line, thus connecting New Orleans with Morgan City and the Teche district.

The Honduras Transportation Co., of Detroit, Mich., has been chartered under the laws of the State of West Virginia. The company proposes constructing railroads and providing other means of transportation in Honduras and will operate under Decree No. 62 of the Honduran government granting franchises to Thomas W. Troy. The company has a capital stock of $1,000,000 and the incorporators are Harry E. Simons, Frank A. Gordon, Leopold Freud, John H. Bissell, of Detroit; Lewis H. Kirby, of Kalamazoo.

Surveys have been completed for an extension of the Tennesse & North Carolina R. R. from Mt. Sterling, N. C., to Canton, N. C., and it is said that construction work will be started at once. A. J. McMahon, Newport. Tenn., is superintendent.

J. B. Daniel of Wonder, Nev., has secured from the government a lease on the power site on the Truckee-Carson Irrigation Canal, 16 miles west of Fallon, Nev. There is sufficient water and sufficient drop to generate at least 2,000 hp. and Mr. Daniel expects to build a plant that will cost in the neighborhood of $50,000, and to supply Wonder and Fairview with light and power.

Preliminary surveys have been made for an extension of the Coal & Coke Ry., R. H. Pemboke, chief engineer, Elkins, W. Va., from Roaring Creek Junction to Elkins, a distance of eight miles. It is planned to have construction work completed this year. Later the line will be extended from Elkins to Parsons and Rowlesburg.

The Nebraska Traction & Power Co., W. D. Crist, Omaha, Neb., is planning to begin work this spring on an extension of its interurban line from Ralston to Springfield via Papillion.

Announcement has been made that construction work will soon be commenced on the proposed extension of the Louisiana & Pine Bluff R. R. from Dollar Junction to a point near Champagnolle, Ark., a distance of about 22 miles. The line will pass through several small towns and open up a rich virgin timber section in Union County. W. H. Lee, Huttig, Ark., is chief engineer of the company.

The Trenton Power Co. of Trenton, N. J., has been incorporated with a capital stock of $310,000, the incorporators being D. W. Duncan, H. F. Price and James Fry.

Construction work is to be started in the early spring on the new proposed 20-mile railroad of the Lee Land & Lumber Co. As projected, the line will start at Winn, Me., and pass through Lee and on to No. 3. All right of way has been secured. Amos F. Gerald, Fairfield, Me., will construct the line. A. A. Stebbins, Lee, Me., is president of the company.

The Harrison Southern R. R. Co. has filed articles of incorporation with principal offices at Harrison, Idaho, and capital stock of $100,000, $51,000 of which has been subscribed. The company proposes the construction of a line from Harrison, Idaho, to Bell Creek, along that stream to the Chicago, Milwaukee & Puget Sound R. R. The stockholders are as follows: P. H. Wall, $16,000; M. K. Wall, $16,000; A. A. Crane, $16,000.

Items Concerning Contractors and Their Work

RAILROADS, POWER DEVELOPMENTS, LEVEES, DRAINAGE AND IRRIGATION WORKS.

Arkansas Notes.

FROM CORRESPONDENTS AND OTHER SOURCES.

The Citizens Light & Traction Co., Pine Bluff, Ark., is planning to make extensive improvements to its street car lines in Pine Bluff. Several important extensions are also to be made. F. E. Cherot is General Manager.

Larry Boshears, and W. R. Brown, of Corning have bought out the Cole Dredging Co., a former Jonesboro concern, and the firm will soon inaugurate a new system of drainage west of Corning, as an auxiliary to those already in operation.

John A. Purdue & Co., Pine Bluff, have been awarded the contract for constructing five miles of grade towards Columbia, Miss., for the Fernwood & Gulf R. R. The contract amounts to about $38,000.

California Notes.

FROM CORRESPONDENTS AND OTHER SOURCES.

The Town Council of Coalinga has granted a franchise to C. L. Morrill for an electric railway through the town. The County Supervisors have also granted him a franchise over six miles of county roads. The Morrill proposition is for the building of an electric railroad of 15 miles out of the town of Coalinga north and east to the oil field and as far as the California Limited holdings.

Preliminary surveys have been made and practically all right of way secured for the proposed branch of the Northern Electric Ry., E. R. Lilenthal, President, Sacramento, from Fair Oaks, through the Carmichael Colony. The road will tap a rich fuel belt and will probably later be extended to Orangevale.

An application has been filed with Lieut. Charles T. Leeds, U. S. Engineer, 723 Central Building, Sixth and Main Streets, Los Angeles, for permission to build a pier 1,800 feet long between India and Kinney streets, in front of the Lindsay property at Santa Monica.

Durst Brothers, hop growers of Wheatland, have made a proposition to the Western Pacific Ry. to build a branch line to that city. Durst Brothers offer to give the company a place to build a depot and they will also build a large depot at their own expense. They will also help the company build the line to Wheatland from some point near Plumas Lake, it is reported.

Citizens of Red Bluff have raised $21,000 for stock subscriptions for the Eureka Electric R. R. This company is backed by Eastern capitalists who will build the line if Tehama County citizens will raise $100,000 for subscriptions to the stock.

The Sacramento Electric, Gas and Ry. Co. of Sacramento has been petitioned by by owners of property south of that city to extend a loop line from the Riverside road to connect with 21st street at Bonita avenue, in Highland Park.

The Southern Pacific Co. is said to have expressed a willingness to build a railway between Santa Ana and Tustin, if given the right of way, and operate a system of gasoline motor cars around a loop through Santa Ana, Tustin, McPherson, Villa Park, Anaheim, Westminster, Smeltzer, Huntington Beach and Newport Beach.

The city trustees of Vallejo have granted a permit to the newly organized Vallejo Traction Co. the use of certain streets of Vallejo for its electric line to White Sulphur Springs.

The Edison Electric Co., R. H. Ballard, manager, Los Angeles, is planning the erection of $2,000,000 power plant at Long Beach or some other beach city in the vicinity of Los Angeles.

The San Diego Consolidated Gas & Electric Co., C. E. Groesbech, president, San Diego, is to expend about $1,000,000 for improvements. It is stated that without any delay the system is to be extended to Ocean Beach, Pacific Beach, La Jolla, La Mesa, La Mesa Springs, Chula Vista, Otay, El Cajon Valley and Lakeside. All the electric wires in the business section of San Diego are to be placed underground.

Board of Supervisors of San Francisco, Cal., have voted to grant A. J. Pons a franchise to operate a railroad over Gough street, between Market and McAllister, connecting thereby two branches of the United Railroads.

Colorado Notes.

FROM CORRESPONDENTS AND OTHER SOURCES.

It is now announced that the Grand Junction & Grand River Ry. will have its electric railway completed from Grand Junction to Fruita, 14 miles, by June 15. Work on the terminal yards at Grand Junction is to be commenced at once.

The Green Lawn Reservoir Co., of Denver, has been incorporated with a capital stock of $32,000, the incorporators being Frank P. Head, George H. Read and George L. Horton.

Good progress is being made on the dam and reservoir of the Park Center Land & Irrigation Co. on Upper Four Mile Creek, ten miles west of Cripple Creek, and it is expected to have the work completed by June 1. The reservoir will be 1¼ miles long, ½ mile wide, with an average depth of 35 ft., impounding over 4,000 acre feet of water for the irrigation of a large tract of land. The dam will be 75 ft. high, 400 ft. in length.

Permanent surveys are to be started soon on the right of way for the proposed line of the Montrose & Paradox Railroad Co. The road will have a water grade, from Montrose, Colo.

Work on the Union Pacific line between Dent and Fort Collins has been commenced. Two camps have been established and subcontracts let.

The Denver & Rio Grande R. R. is to make several improvements in the yards and traffic facilities at Montrose. A subway will be built under the tracks crossing main streets and addition sidetrack facilities will be added.

The Dennis Gibbons Construction Co., of Denver, has been incorporated with a capital stock of $100,000, the incorporators being Dennis Gibbons, E. T. Gibbons and W. T. Huffman.

It is stated here in Denver that the Rock Island system has officially announced that it will not buy the Denver, Northwestern & Pacific R. R., according to a statement of David H. Moffatt, president of the latter road, other plans for building the line to Salt Lake City are being worked out, but construction work west of Steamboat Springs will not be commenced until funds have been provided for the completion of the entire line.

Georgia Notes.

FROM CORRESPONDENTS AND OTHER SOURCES.

W. J. Oliver, of Knoxville, Tenn., has bought the partially completed Savannah, Augusta & Northern Ry., at a master in chancery sale, paying $250,000 for it. Mr. Oliver built the road, which at present is graded to Louisville. It is said that the road will be continued to that place and later on may be extended on from Garfield.

The Southern Ry., W. H. Wells, engineer of construction, Washington, D. C., will at once double track its line from Atlanta Junction to North Rome, a distance of five miles.

Engineers are now at work on a plan to construct a large dam across the Chattahoochee river at the falls opposite Mechanicsville, in Lee County, Alabama, and about 20 miles above Columbus, Ga., for the purpose of generating electricity to operate cotton mills and to furnish Opelika, Ala. city with power and electric lights. The promoters of the project are Columbus, Ga., and Eastern capitalists, among whom is B. H. Hardaway, of Columbus, who has already secured titles and options to property at the point on the river where it is proposed to build the dam. It is proposed to either construct a short railroad line from the river to a point on the Central of Georgia R. R. near Motts Mill, or extend the Chattahoochee Valley R. R. down the river to the site selected.

The Albany, Ashburn & Atlantic Ry. Co., has been organized to construct a railway from Albany, Ga., to the Coast by way of Ashburn. The company will take over the Fitzgerald Ocilla & Broxton Ry., now under construction from the coast to a point near Broxton. A charter for the new company will be applied for at once.

Idaho Notes.

FROM CORRESPONDENTS AND OTHER SOURCES.

The Southern Idaho Reclamation Co., S. G. Yerkes, President, Boise, Idaho, has filed plats in the U. S. Land Office for right of way for the pipe line and reservoir of its irrigation system. The reservoir is designated as the Long Tom and when completed under the new plans will be one of the largest in the state. The right of way for this basin is for 3,133.32 acres and according to the estimates of the promoters it will contain 313,332 acre feet of water and have an average depth of 100 ft. Under the old plats for right of way for this reservoir there was but 119,500 acre feet of water in it so that the new plats indicate the company will double its capacity. The plats for the right of way of the pipe line show that the water for the reservoir will be taken from the south fork of the Boise river and carried many miles, crossing Lime, Deer and other creeks, from which water will also be diverted. From the reservoir a main canal will conduct the water to the Sunnyside tract. It is the intention of the company to start active work enlarging the big reservoir just as soon as the plats are accepted.

The U. S. government has accepted the official surveys of the Brunleau-Twin Falls irrigation project and it is believed that immediate work will be started on the project. The Twin Falls Land & Water Co., of Twin Falls, Idaho, is back of the project, which calls for an extension of the canal of the South Side Twin Falls project a distance of over 85 miles west over the new tract. It will be necessary to raise the Milner dam in order to secure the proper volume of water and divert it into the canal, which will be widened and deepened. A chain of reservoirs about four or five, are to be installed, and these will be used for storage purposes, guaranteeing the project water during the entire irrigation season.

Illinois Notes.

FROM CORRESPONDENTS AND OTHER SOURCES.

The Rock River Traction Co., incorporated about a year ago, has practically completed its surveys, and is considering making Princeton a terminal point instead of Sterling as originally planned. As now proposed the line would extend from Princeton to Rock Island by Way of Wyanet, Sheffield, Mineral, Annawan, Geneseo and other towns. H. W. Cole, Geneseo, is President.

Final construction work on the Rock Island Southerns' interurban line between Maple City and Rock Island has been resumed. The team grading work will be finished shortly and there will only remain a small amount of steam shovel work, the laying of some nine

miles of steel, the installation of the overhead electrical equipment and the ballasting of the road. Work was started at several points. Petersons' men went to work with their team outfits at a point north of Middle Henderson, while Grant Brothers started operations at Main Henderson. Marble & Grier put their men at work on the north approach of the Cedar Creek bridge. Reports from the camps of the several contractors are to the effect that with a continuation of the present weather they will make short work of finishing the job. The frost is well out of the ground save in the cornfields, where there still remains a little of the frozen dirt.

The Interurban Construction Co. of Chicago has been incorporated with a capital stock of $60,000 and proposes to construct interurban lines and electric railways. The incorporators are Irving D. Stevens, Charles A. Spenny and Edward B. Harrang.

Surveys have been started at McLeansboro for the projected line of the Illinois Oil and Coal Belt Ry. from Terre Haute, Ind., to Cairo, Ill. The proposed road is an electric interurban line that will cross every railroad in the state running east and west. As stated in our February 9 issue, the Western Indiana Construction Co., Room 12, 6 Sherman St., Chicago, Ill., has the contract for the engineering and construction work. Allen G. Russell, Chicago, Ill., is Chief Engineer.

The street railway company at Springfield is to expend $65,000 for rebuilding its tracks and double tracking in that city.

The Newkirk-Powers Construction Co., of Joliet, have resumed work on their track elevation contract at Joliet for the Chicago, Rock Island & Pacific Ry.

The receivers of the Illinois Tunnel Co. of Chicago, have been granted authority to borrow $3,500,000 to complete and extend the telephone system in Chicago. Under the ordinance the company must have 20,000 telephones in operation by June, 1911. It has at present 3,500 telephones.

The Drainage Commissioners of Harvel and King Union Drainage District No. 2, have awarded the contract for widening and deepening the ditch to A. J. Klentchy at 15.90 cts. a cu. yard. He is to begin work on the ditch as soon as he can move his dredging machinery from the Horse Creek ditch which he is just finishing. Work will begin on the Bentley farm, near Harvel.

The Commonwealth Edison Co. of Chicago, has plans underway for the construction of a turbine generating electric light and power plant on the North branch of the Chicago River at Chicago, which will cost when completed between $15,000,000 and $20,000,000. The plant will consist of two stations for the generation of power with six turbine engines each. One station will be installed at once with 160,000 hp. capacity. When both have been built they will have a capacity of 350,000 hp. Holabird & Roche, architects, Monadnock Building, Chicago, are the architects, and will also superintend the construction work.

Frank Moody, representing Bradner, Smith & Co. paper makers, Chicago, has been in Rockton, securing options on land for a power development of 5,000 hp.. It is proposed to build a concrete dam about one half a mile long and 18 ft. high, giving a head of 15 to 19 ft., capable of developing about 5,000 hp. for industrial uses. O. M. Glass, Rockton, is interested.

The Stoddard Construction Co., has been incorporated with a capital stock of $10,000 and principal offices at Chicago, Ill., and proposes to engage in general contracting business. Edward B. Stoddard, Thomas J. Peden and Roy C. Merrick are the incorporators.

Grading work on the Rock Island Southern Ry. has been resumed at a point seven miles above Monmouth and also at a point three miles south of that city. It is expected that the grading work would be finished by April 15, when track laying will be started. A portion of the line is already in operation. The grading now being done is under the direction of F. J. Peterson.

Iowa Notes.

FROM CORRESPONDENTS AND OTHER SOURCES.

The Cedar Rapids & Marion City Ry. Co. will expend $45,000 in improvements at its power house in Cedar Rapids, comprising a one-story brick addition 70x15, a 1,500-hp. engine, 500-hp. boiler, modern stokers, condensers, air and circulating pumps, etc.

The Centerville Light & Traction Co. of Centerville has purchased a site, 500x100, for car barns and repair shops and freight yards.

A petition has been submitted to the Muscatine County Commissioners, at Muscatine, for the extension of Drainage District No. 3. The improvement, if ordered, will touch 28 sections of land in Louisa county and 38 sections in Muscatine county. No estimate of the probable cost has been made, but it is believed that it will cost not less than $100,000.

Proposition has been laid before the Commercial Club of Iowa City asking that subscriptions of $100,000 be raised in that city for a proposed interurban line to connect Iowa City and Williamsburg. The proposition is being promoted by George W. Rhine, Des Moines.

The franchise for a gas plant at Ames has been secured by Tenney Bros., of Newton, and they will start work at once on the erection of a plant.

The Sioux City Crystal Lake & Homer Ry. Co., Joseph Foye, president, Sioux City, is planning to electrify its roads this spring. The company at present operates gasoline motor cars between Sioux City and Crystal Lake.

It is rumored in the vicinity of Waterloo, Ia. that the Waterloo, Cedar Falls & Northern R. R. is to change its name to the Cedar Valley Railroad and extend the line to Cedar Rapids to make connections with the Cedar Rapids and Iowa line. L. S. Cass, Waterloo, Ia., is president of the W. C. F. & N. R. R.

Work is to be started as soon as the frost leaves the ground on the ballasting and improving of the Great Northern between Sioux City and Perkins, Ia., a distance of 51 miles. W. D. Scott, St. Paul, Minn., general superintendent, has made an inspection of the line and will report to the officials of the road at Sioux City. The line will be relaid with 88 lb. rails and the road bed will be raised in the low places and small grades will be lowered.

The Hawarden cut-off which will be constructed this year by the Chicago & Northwestern Ry., will, it is said necessitate an expenditure of $1,000,000.

The Waterloo, Cedar Falls & Northern Ry. Co., of Waterloo, has arranged for the flotation of a large bond issue and many miles of interurban extensions will be built. One of these is projected from Denver Junction to Waverly, and it is possible a line will be built to the south with Belle Plaine as the terminus.

Kansas Notes.

FROM CORRESPONDENTS AND OTHER SOURCES.

The Motor Grand Traction Co., of Belleville, has engineers in the field locating its line between Concordia and Belleville. The greater part of the right of way between these two points has been secured, and it is believed that grading work will be started early in April. The company projects an interurban line from Chester, Neb., to Concordia and Wichita, Kan. Gasoline motors and gasoline locomotives are to be used. The company is said to have already placed an order with the Buda Co., Chicago, Ill., for a portion of its equipment.

A special election is to be held at Oswego on April 5 to vote on a proposition to issue bonds in the sum of $5,000 to aid the Oswego, Columbus & Cherryvale Interurban.

The State Railroad Board has granted authority for a merger of the Joplin & Pittsburg, the Girard Coal Belt and the Pittsburg & Kansas City electric lines in Southeastern Kansas. The first named has 72 miles of line and the two latter combined have 28 miles. The merger company will be known as the Joplin & Pittsburg Electric R. R. Co. It will take up all the outstanding obligations of all three companies and issue enough new securities to build a system of 250 miles, which eventually will extend from Joplin to Kansas City.

Sam Steele and Nick Delaney, Larned, have been awarded the contract for constructing a 40 ft. regulation half-mile race track at Larned for the Pawnee County Agricultural Association. The track is to be completed by June 1, and will be built under the direction of engineer Fred Eckert.

The city of Liberal has voted a $25,000 bonus for the Garden City, Gulf & Northern Ry., thus completing the list of subsidies for this road between Liberal and Garden City, a distance of 75 miles. Construction work has been started at a number of places along the line.

The Gulf & Northwestern Ry. Co., with headquarters at Goodland, Kan., and a capital stock of $1,500,000 has been granted the right by the state railroad commission to issue stock and bonds to construct the proposed line from Oklahoma City, Okla., through western Kansas Counties to Northern Colorado. The incorporators of this company are J. B. Dyatt, John A. Keeran, C. C. Evans and J. F. Kimmel, Goodland, Kan., J. W. Tibbles, Dresden; James A. Sprague, Seldon; R. B. Ketchum, Canon City, Colo.

Louisiana Notes.

FROM CORRESPONDENTS AND OTHER SOURCES.

Advices from New Orleans, La., state that the Gulf, Delta & Northwestern R. R. Co. has filed a charter in that city. It is to build from Cottonport, in Avoyelles Parish, to a connection with the Colorado Southern Road, and to extend north and south from Cottonport. The incorporators are O. H. Williams, William T. McElroy, E. E. Overstreet, W. B. Tscharner, J. C. Lachlin.

Surveys have been made and practically all right of way secured for the projected line of the Avoyelles, Palmetto & Gulf R. R. An excellent route has been found, practically free from swamps. Elections are now being held to vote financial aid to the route. Hollier & Neff, Opelousas, La., are the engineers.

It is reported here in New Orleans that the Frost-Johnson Co. has purchased the timber holdings of the W. T. Joyce Co. in Catahoula and Winn Parishes, in this state, involving a stumpage of about 1,500,000,000 feet and including the purchase of 80 miles of railroad. The company will cut the timber and probably build more railroad.

The Progressive Union of Hammond has again taken up the matter of a motor line between that place, Natalbany and Genesee. Steps will be immediately taken to secure a right of way for such a line, and an effort made to interest outside capital in the building of the road.

Plans are reported to be under preparation for the construction of a railroad from Kinder, La., to timber land, a distance of 15 miles. The work as proposed will include the construction of a bridge over the Calcasieu River. Frank Shutts, Lake Charles, La., is engineer in charge of the work.

The joint committee of the Lafourche Basin and Atchafalaya Levee Board has awarded the contract for a steel hull for a dredgeboat now lying in the Bayou Lafourche to the Johnson Iron Works of New Orleans, at $15,300.

The United Irrigation & Rice Milling Co., Crowley, La., is reported to have 50,000 yds. of levee work which it wants to let at once.

Michigan Notes.

FROM CORRESPONDENTS AND OTHER SOURCES.

George W. Burhans, Portland, Mich., is promoting a project for the construction of an electric road from Portland to Westphalia and Forest Hill in Riley Township.

Five townships, four in Berrien County and one in Cass County, have voted favorably on

the question of giving franchises to the Southern Michigan Ry. Co. to cross highways in the respective townships with an electric railroad.

It is reported in Houghton that the Stone & Webster Engineering Corporation, 147 Milk St., Boston, Mass., owner of the Houghton County Traction Co. and the Houghton County Electric Light Co., is to go ahead at once with its proposed Painesdale-Houghton railway line. It is also reported that the corporation is to take over the Sturgeon River water power proposition which was incorporated some time ago.

The Mullen Coal Co., Amherstburg, Ont., recently incorporated with a capital stock of $100,000, has awarded a contract to the Campbell Dock Co. of Detroit, for the construction of a 550-ft. dock.

The State Railroad Commission has authorized the proposed issue of $800,000 in bonds by the Lansing & Northeastern Construction Co., of Lansing, with which to build the electric line from Lansing. It has been announced that the builders expect to have the line in operation by next October. The company has already expended over $100,000 in work on the line and has the grading well under way. Arrangements have been perfected for financing the proposition, it is stated, and the construction will be pushed from now on. The company acquires the Owosso city railway and will rebuild that line as well as install new rolling stock there. The interurban roads runs on private right of way most of the distance between Lansing and Owosso, and a third rail will be used.

L. O. Peppard & Co., Minneapolis, Minn., have been awarded the contract to rebuild the dock recently damaged by fire at Escanaba.

The Southern Michigan R. R. Co. has been granted permission to construct the projected railroad through Niles from Dowagiac, Mich., to Buchanan.

Minnesota Notes.

FROM CORRESPONDENTS AND OTHER SOURCES.

Construction work is to be started this spring on the Great Northern cutoff from Swan River Junction to Milaca, 75 miles. This line when completed will give a direct line from Minneapolis to the iron range. The sections and mileage will be: Minneapolis to Milaca, already built, 64 miles; Milaca to Swan River, to be constructed, approximately 75 miles; Swan River to Hibbing, already built, 30 miles. A. H. Hogeland, St. Paul, Minn., is Chief Engineer.

The Minneapolis, St. Paul & Sault Ste. Marie Ry. is to lay additional tracks near Shoreham, at Minneapolis, and build a 4-story concrete building and an addition to its roundhouse.

The Minneapolis & St. Louis Ry., W. D. Taylor, Chief Engineer, Chicago, Ill., has purchased land at Hopkins, and will, it is said, establish new freight terminals there. According to the report the shops now at Kenwood will not be moved, but the yards now lying between the hills and the shore of Cedar Lake will be discontinued as freight terminals and trains will be made up in the new terminal yards to be established at Hopkins.

A. E. Bennett has shipped his dredging outfit from Randolph, Wis, to Badger, Minn., where he has secured a big contract to dredge about 46 miles of marsh land for the state. The contract amounts to about $65,000.

According to an announcement by M. D. Stoner, city engineer of Bemidji, Minn., work will be completed by June 1, on the railroad from Nakoda Junction to the Black River County of which he is in charge. As projected, the line will connect with the M. & I. Ry. at Nakoda Junction about 7 miles south of International Falls and extend westward to the Black River.

The Canadian Northern R. R. Co. has filed notice that the franchise offered for the construction of its line into Duluth, Minn., will be accepted. Under the provisions of the franchise the line must be constructed from Virginia to Duluth within three years.

Missouri Notes.

FROM CORRESPONDENTS AND OTHER SOURCES.

Surveys have been finished for the interurban line to Savannah, projected by the St. Joseph Street Ry. Co. of St. Joseph, and the route has been inspected by C. M. Clark, chairman of the executive committee, and G. L. Estabrook, secretary of N. W. Clark & Co., of Philadelphia, owner of the St. Joseph Street Ry. Co., and J. H. Van Brunt, general manager. It is understood that all of the right of way has not been secured as yet.

The Kansas City-St. Louis Electric R. R. Co., D. C. Nevins, President, Kansas City, is said to have made arrangements in London for the disposal of $15,000,000 in 30-year 5 per cent mortgage bonds of the road. The construction work will be begun in about 60 days, as soon as the second survey is completed. The work probably will be started in Howard County, where the company has 10,000 acres of coal land and it is believed cars will be in operation there in the fall.

The Busch-Everett-Walkers syndicate of St. Louis has surveyors in the field running lines for a pipe line to convey natural gas from the Caddo, La., field to St. Louis.

The Chicago, Burlington & Quincy, R. R. is said to be having preliminary surveys made between Mexico, Mo., and Kansas City. Two other surveys were made about three years ago. It has been unofficially understood for some time that the Burlington expected to extend the cutoff from Old Monroe to Mexico city on to Kansas City.

According to reports in Rich Hill, Mo., the Missouri Pacific Ry. Co. has under consideration, the construction of a cutoff from that city to Bagnell, Sedalia or Jefferson City.

As noted several times in these columns, the Missouri Pacific and the St. Louis, Iron Mountain & Southern are planning extensive improvement work for this year. The improvements will involve the expenditure of $15,000,000 and will have largely to do with reconstruction operations between St. Louis and Pueblo and between St. Louis and Texarkana. One of the most important of the new plans is the construction of a four-track line in Illinois from St. Louis to Thebes, 15 miles. Large gravity yards, located opposite South St. Louis, are being enlarged steadily in advance of the double-tracking, and, when completed will be adequate for handling the traffic.

St. Louis Items.

BY A. E. KOENIG.

Pat Walsh, President of the Walsh Construction Co., was tendered a banquet by the business men and his associates in Davenport, Ia. on St. Patrick's Day, his fifty-fifth birthday. From the looks of the menu card we are sure they did not overlook anything, even a Blarney stone. Many happy returns of the day, Walsh.

East St. Louis soon is to have one of the finest boulevards in the United States. It will be practically fourteen miles long and at least half of it will be ninety-six feet wide. It will extend in almost a straight line from the junction of Tenth and State streets and Illinois avenue in East St. Louis, to the public square in Belleville. Aside from being of immense commercial advantage to East St. Louis and Belleville, it is believed that it also will do more than any other one thing toward bringing about the long-talked-of consolidation of all the cities adjacent to East St. Louis. The cities of Belleville, Granite City, Madison, Venice, National City and Brooklyn, are within a few miles, Bellevue fourteen miles away, being farther than any of the others. Although it was believed that Belleville would be the last of these cities to agree to consolidate and to surrender its individuality, East St. Louisians believe that this new boulevard will be the means of showing Belleville why it should join the proposed combination. The plans for the new thoroughfare are being worked out as rapidly as possible by City Engineer Wm. J. Cocken of East St. Louis, his chief assistant, Wilford A. Thompson, and practically their entire office force. These plans should be ready for the Board of Local Improvements within a week. These plans provide for the widening of State street for more than half its length from 66 to 96 feet. From Thirty-eighth to Ninetieth streets, which is a distance of nearly four miles, the boulevard will be paved with brick. On each side of the thoroughfare will be 12 ft. sidewalks. There will be two driveways, one on each side of the street car tracks. Each of these driveways will be 24 ft. wide. The entire cost of the boulevard will be approximately $250,000, and the street car company will be asked to pay at least $50,000.

The Walsh Construction Co., of Davenport, Ia., was awarded the contract for the Big Four Railroad extension in Southern Illinois. They also secured the contract for raising the grade of the Missouri Pacific yards in the east bottoms and the Kaw River bridge at Kansas City, Mo.

Mulvill Bros., Alton, Ill., have a lot of nice team work on the Chicago & Alton R. R. to let.

Gifford & Hogan of the Walsh Construction Co., were in town the other day. Too busy to stay long.

The McIntire-Tese Construction Co. are getting along nicely with their sewer and street work in Wichita, Kansas.

Will Dankleff is working at Edwardsville, Ill., at the present time. Will finish shortly.

A deed of trust amounting to $1,500,000 was filed in Audrain County, Mo., to secure the bonds for the construction of the entire line of the Mexico, Santa Fe & Perry Traction Co. It calls for bonds similar to those already signed for by the subscribers to the lines and states $60,000 may be certified by the trustees as soon as recorded in all counties the road passes through for the construction of the first four miles of the road. After these four miles are constructed the trustees can certify $15,000 and more a mile if called on with proof of additional mile being constructed. The bonds are for the 100 miles of road to run from Mexico to Hannibal and from Mexico to Columbia and Fulton. The deed of trust will be filed in every county through which the line runs. The first mile of the line is almost completed.

Montana Notes.

FROM CORRESPONDENTS AND OTHER SOURCES.

Engineers are in the field between Billings Mont., and Bear Creek working on the survey of the proposed Eastern Montana Electric Ry. Co. It is expected that surveys will be completed and a report ready for the directors by May 1. The line may be extended to Red Lodge.

The Northern Pacific Ry. has purchased land at Missoula and will almost double the capacity of its yards at that city. The line between Missoula and DeSmet will also be double tracked this summer.

Preliminary reports on the Butte & Boise R. R. have been made by R. H. Tingley, C. E., of New York, and representatives of French capitalists are now in Montana looking over the project. As projected this road will be 400 miles long, and the cost of construction is estimated at about $20,000,000. The project is being promoted by S. H. Bracey, of New York and Chicago. T. F. Halveston, Boise, Ida., is also interested.

Mass meetings have been held at Wisdom to consider the proposition of A. L. Wright and R. H. Jones, for building a railroad to traverse the southern section of the Big Hole River and to extend to Anaconda and Butte. Ranch owners and business men of the section have practically agreed to give $200,000 for the project, and a free right of way. Surveys are now being made by Thomas M. Ward.

The Chicago, Milwaukee & Puget Sound Ry. has engineers in the field working east from Lewiston through the Forest Grove and Grass Range County. Surveys are also underway in the vicinity of Kendall, two parties have gone to Melston to work north and west to meet the Lewiston party.

New York Notes.

FROM CORRESPONDENTS AND OTHER SOURCES.

Residents of Lincoln Park and vicinity in Rochester are asking that the present West Av. line be extended through the park. At present the line terminates at Lincoln Av., which is the boundary between the city and Lincoln Park, which is situated immediately to the west.

The Internationlal Waterways Commission, with offices at Albany, will shortly take action on the applications of the St. Lawrance Power Co., Ltd., a Canadian corporation, and the Long Sault Development Co., a New York corporation. The proposition of the companies is to dam part of the Long Sault Rapids in the St. Lawrence River and develop 800,000 HP. It is understood that the action will be favorable. The American section of the International Waterways Commission has in its possession amendments to a bill which is now before the United States Congress at Washington, granting rights to the American company to erect its dam, and copies of the amendments have gone to the River and Harbor Committee at Washington, which body will make them public soon. The action of the Canadian section of the International Waterways Commission will probably come after the action of the American section is made definitely public.

The Westchester Northern R. R. Co., recently incorporated, has applied to the State Public Service Commission for authority to construct and operate a steam railroad, connecting the New York, Westchester & Boston Ry. and the New York, New Haven & Hartford road in Westchester and Putnam counties. The company also proposes to construct an extension across the state boundary into Danbury, Conn. The company has a capital of $1,000,000. The estimated cost of the proposed road is $6,766,769, and it is to be a part of the New York, Westchester & Boston company's system, and the stocks and bonds are to be taken up by the New York, New Haven & Hartford Ry. at par.

The city of Batavia has voted to expend $8,000 for a new dam.

The New York Central & Hudson River R. R. has had surveys made and will have work started in the early summer on a spur from Watertown to Sanfords. It will be used for freight purposes, doing away with the long Factory street grade in Watertown.

The Manhattan Bridge Three-Cent Car Line Co. which now has an application before the State Public Service Commission for permission to construct its proposed line in New York City, will use the regulation overhead trolley wire with electric motor power for its Brooklyn service, with underground wires in Manhattan. The total cost of equipping the road will be about $617,000. according to John C. Breckenridge, 95 Liberty street, New York, chief engineer of the company.

The Cliff Electrical Distributing Co., John Harper, engineer, Niagara Falls, has applied to the State Public Service Commission for permission to issue $400,000 additional mortgage secured coupon bonds. This bond issue would be for additions to the generating plant amounting to approximately $96,000; additions to the distributing lines amounting to approximately $126,000; and other improvements involving an expenditure of about $147,000.

North Dakota Notes.

FROM CORRESPONDENTS AND OTHER SOURCES.

The City Council of Valley City, N. Dak., has granted a franchise to the Valley City St. & Interurban Ry. Co., to lay track and run cars on Fourth, Fifth, Sixth, Seventh and Eighth Avs., and also to cross the N. P. tracks and run over into Normal Park addition.

The Chicago, Milwaukee & St. Paul Ry. Co. is said to have secured a right-of-way through North Dakota as far as Neche.

The Wahpeton-Breckenridge Street Ry. Co., F. L. Strum, Manager, Wahpeton, N. Dak., is reported to have placed orders for materials and supplies and it is said that construction work will be started at once. The eastern terminal of the company's line has been purchased in Breckinridge near the First National Bank building, and the erection of car barns will be started shortly.

The Commercial Club of Fargo, J. E. Weiser, president, is taking steps to secure the construction of a line of railroad to connect Fargo with Chaffee. The line would be about 32 miles long and, if some of the present roads will not build it, it will be built by Chaffee parties. James G. Brown, Chaffee, is interested.

According to reports from Ray, N. Dak., the surveyors of the Minneapolis St. Paul & Saulte Ste. Marie Ry. are working from Plaza, west toward Williston passing through a rich farming country.

Ohio Notes.

FROM CORRESPONDENTS AND OTHER SOURCES.

The street railway lines at Lima are to be extended in a loop for more than two miles, encircling the new industrial section of the city to the southward.

The Baltimore & Ohio Southwestern R. R., has plans under way for extensive improvements between Cincinnati and St. Louis, which will be made this summer. The work will include some double tracking and the installing of block signals and will involve the expenditure of several hundred thousand dollars.

An election will probably be held in Hamilton on April 16 to vote on an appropriation of $400,000 bonds to construct a levee and other improvements, including parks.

The city council of Cleveland has appropriated $199,000 for the dredging of the Cuyahoga River and bids will be received at once by A. B. Lea, director of Pueblo Service.

Construction work is to be started this spring on the projected line of the Fostoria, Napoleon & Defiance Ry. Co. The road is to extend from Fostoria to Defiance and is to be operated with gasoline motor cars. Charles A. Bliss, Toledo, O., is president and Rufus T. Betts, Toledo, is secretary.

Contractors for work for the Lake Shore, Pennsylvania and other companies for improvements on the new lake front harbor at Ashtabula have resumed the work which has been suspended all winter because of severe weather.

The Wellman-Seaver-Morgan Co., Cleveland, is making good progress on construction of the new battery of Huletts and accessories at Ashtabula and the machines, power house and bridge are well under way. The plant is to be a duplicate of the one erected last year on the Lake Shore side, with 15-ton grabs for ore. It will be in commission late in the coming navigation season.

Plans have been prepared at the office of U. S. Engineer, E. W. Moeser, Zanesville, for the construction of a new levee on Linden avenue, in that city.

The executive committee of the Hocking Valley Ry. has authorized M. S. Connors, Columbus, O., general superintendent of the company, to install 8 additional passing tracks on the line between Columbus, O., and Toledo and to make other necessary improvements.

According to information received from Youngstown, O., work will be started shortly on the proposed line of the Lake Erie & Eastern R. R. Co.

Grading is already under way for the construction of two additional tracks for the Erie & Ashtabula R. R. from Lawrence, Junction to Wampum, O., a distance of 8 miles. The work will require the entire rearrangement of the interlocking system.

The Baltimore & Ohio Southwestern R. R. has begun the construction of a new double track between Loveland and Blanchester, O. E. Stimson Cincinnati, O., is engineer Maintenance of way.

Oklahoma Notes.

FROM CORRESPONDENTS AND OTHER SOURCES.

The Citizens' Street Railway Co., of Wilburton, has been chartered and proposes to build an interurban line connecting Wilburton, Patterson and Lutie, a distance of ten miles. The capital stock is $100,000, and the directors are James McConnell, Richard Howard, Benjamin Mills, Elias M. Cooper and William H. Powers, all of Wilburton.

Ground was broken at Lawton on March 7 for the construction of the Lawton & Fort Sill Electric Ry. It is planned to have the line completed between Fort Sill and Lawton by May 1.

The Muskogee Traction Co., of Muskogee, has applied to the City Council of that city for franchises for a number of extensions.

The city of Sulphur has raised a bonus of $70,000 to be given to the first interurban to build to this resort. The holders of the trust bonds are negotiating with several sets of capitalists, each set promoting a different road. One proposes to build from Oklahoma City, one from Shawnee, one from McAlister and one from Denison.

Plans are under way for the construction of an interurban line to connect Dewey and Bartlesville. As proposed the line will connect with a projected interurban from Coffeyville, Kan., to Nowata. Alfred Etchen, South Coffeyville, Okla., is interested.

Track laying on the Alton, Wichita Falls & Hollis Ry. has been started and the work will be pushed to Hollis as rapidly as possible. The offices and shops of the railway are to be at Altus.

J. W. Maxcy Co., Engineers, Houston, Tex., have engineers in the field between Ardmore and Chickasha making surveys for a railway from Sherman, Tex., by way of Ardmore to Chickasha.

The contract is said to have been let for constructing the interurban road from Ardmore to Chickasha. According to the plans, the line is to be built from Ardmore to Milo and from Milo the road will be extended to Chickasha and also to Lawton which will give this city connection by interurban with both Lawton and Chickasha. Construction work is to be started early in April. Oscar O. Ayers, Olathe, Kan., is president.

Conference of city officials of Oklahoma City and various railroads interested, was held on March 12, regarding the proposed Union Depot plan for that city.

Plans have been designed by City Engineer Burke of Oklahoma City, which will eliminate all grade crossing and bring the freight all into one general yard and the passenger trains into the union station which is to be located near enough to the business section of the city to make it thoroughly practical from every standpoint. Should the plans carry, it will necessitate the expenditure of approximately $3,000,000 by the various roads.

The Oklahoma Electric Power Co. of Oklahoma City, has been incorporated with a capital stock of $250,000, the incorporators being E. J. Deupree, W. T. Croslen, E. S. Sullivan, R. R. Bell, Charles B. Caldwell and R. B. Howeth, Oklahoma City.

Plans are now under way for the consolidation of the Kansas Northwestern Ry., now under construction, and the railroad controlled by B. C. Mason, Kansas City, Mo., which is being constructed from Elk City, Okla., to Aransas Pass, a distance of 650 miles. The combination of these lines will give a through route from Great Bend, Kan., to the Gulf of Mexico.

Citizens of Walter, Okla, have organized a stock company to finance a proposition to construct a railroad line from that city to Oklahoma City. Thus with the connection of the Wichita Falls & Northeastern line under construction to Walter a through route from Wichita Falls to Oklahoma City will be obtained.

Oscar Parish, a railroad contractor of Madill, Okla., is said to have a contract for grading 10 miles of Rock Island extension from Ardmore to Waurika.

S. Axtell, the engineer of Quanah, Tex., who made surveys for the proposed railroad from Eldorado to Hollis, Okla., has taken up the matter with the capitalists who project the construction of the line from Woodward, Okla, to Quanah, Tex., a distance of 115 miles.

A. C. Robertson, chief engineer of the Mountain, Valley & Plains R. R., has opened

offices in the Beadles Bldg., Oklahoma Ave. and 2nd St., Guthrie, and all work at that end of the line will be directed from Guthrie. Construction work at the western terminus of the line is being directed from Cimarron, N. Mex.

Oregon Notes.

FROM CORRESPONDENTS AND OTHER SOURCES.

The Boise-Western Ry. Co. has completed the securing of its right of way through the Malheur Canyon. As projected this road is to extend from Boise, Idaho, to Vale.

The Oregon Railroad & Navigation Co. has notified the State Railroad Commission of its intention to begin the building of the Stanfield-Coyotte cutoff.

The Oregon Trunk Line, F. Stevens, president, Portland, will, it is said, at once let contracts for the construction of that portion of its line from Madras to Bend, a distance of 40 miles.

On account of flood troubles, the officials of the Oregon Railway & Navigation Co. deem it best to construct three miles of the main line on the Washington Division in Hay Canyon along the Snake River. The new route will be located on rock foundation. It is planned to eliminate 1,000 ft, bridge and 160 degrees of curvatures. The work is estimated to cost $100,000. G. W. Boschke, Portland, Ore., is chief engineer of the company.

All grading has been completed for the new 24-mile line from Vale to Brogan, Ore. and ties are on the ground for laying the steel.

E. W. Thomas has applied to the City Council of The Dalles for a franchise to build a street car line in that city.

Pennsylvania Notes.

FROM CORRESPONDENTS AND OTHER SOURCES.

The following bids were received March 9 by the Department of Docks of Philadelphia, for the construction of the new bulkheads at South St. Pier, preparatory to the erection of a ferry house by the Gloucester Ferry Co. Latta & Terry Construction Co., for $8,441; Filbert Paving & Construction Co., $9,300; B. F. Sweeton & Son, $9,807.53, and the American Paving Co., $9,925. The new ferry house will cost the ferry company $40,000. The bulkhead will extend 140 ft.

Construction work is to be started shortly on the proposed electric railway from New Castle to Sharon by way of New Wilmington. In Sharon alone, over $130,000 has been subscribed for the road. The project is being financed by J. G. White & Co., New York. Among those interested in the line are: George Dresch of Sharon; State Senator James M. Campbell, of Mercer; Frank P. Filer and Lyle W. Orr, Mercer; S. D. Downs, Greenville, and J. H. Veazy, registrar of Westminster College and Dr. Robert M. Russen, president of Westminster college of New Wilmington.

The Pittsburg & Susquehanna R. R. Co. of Pennsylvania has been chartered with a capital stock of $100,000 and will construct a line from Eutahville, Clearfield County to Dean, Cambria County, a distance of 10 miles. The incorporators are Thomas F. Barrett, Philadelphia, President, 992 shares; R. K. Klack, F. J. Salade, J. H. Smeltzer, A. E. Doremus, C. D. Bruce, H. G. Vancourt, all of Philadelphia, Pa., each holding one share.

Surveys have been completed for the projected electric railway of the Altoona & Bedford County R. R. Co. As projected, the road is to extend from Altoona to Bedford City, a distance of 45 miles. It is said that arrangements have been perfected so that construction contracts may be let this month. Charles G. Tate, Altoona, Pa., is chief engineer.

South Carolina Notes.

FROM CORRESPONDENTS AND OTHER SOURCES.

The Greenville, Spartanburg & Anderson Ry. Co. has been chartered with an initial capital stock of $300,000 and an ultimate capital stock of $2,000,000, and purposes to extend the Anderson-Belton electric line to Greenville, S. C., and Spartanburg, S. C. This is the project backed by the Duke interests, J. B. Duke, B. N. Duke and George W. Watts of New York having subscribed for $180,000 of the capital stock. W. J. Thackston, Greenville, S. C., is President and T. F. Mills, Anderson, S. C., is Secretary.

The Orangeburg Ry. Co., of Orangeburg, S. C., with a nominal capital stock of $50,000 and a maximum of $500,000, has been chartered and proposes to build an electric railway from Orangeburg to Springfield, a distance of 30 miles. The incorporators are W. C. Wolfe, J. A. Berry and Lawrence Manning. It is proposed at some future date to extend the line to Columbia, Charleston and Augusta. The road at present will be built entirely within the county of Orangeburg, and will pass through the townships of Livingston, Elizabeth City, Rock Grove, Goodland, Liberty, Hebron, Zion, and Williams. The Edisto Power Co., with a capital of $10,000, was also chartered, the incorporators being the same as for the Orangeburg railway. This company is given the right to develop waterpowers and manufacture light and electrical power.

Tennessee Notes.

FROM CORRESPONDENTS AND OTHER SOURCES.

The Memphis, Pensacola & Northwestern R. R. Co., recently incorporated, is said to have secured the necessary capital for construction, with the intention of beginning work at once. The road is to extend from Memphis to Pensacola, Fla., the route being from a point near Plum Point, De Soto County, on the boundary line between Mississippi and Tennessee in a southeasterly direction, through Meridian to a point on the boundary line between Mississippi and Alabama, leaving the state at or near Pine Ridge, Clarke County, and running in the general direction of Pensacola, Fla. The incorporators are: J. M. Dockery, George E. Newhardt, H. T. Bruce, Dr. B. G. Henning, A. Goodman, S. W. Jones, J. H. Scaife and D. S. Rice of Memphis, Tenn.; Will Dockery of Dockery, Miss.; R. Craig of Chicago and M. J. Roach of Memphis.

The Tennessee Traction Co., according to General Manager Bushnell, Memphis, will be engaged for the next two months in completing surveys for its projected line between Memphis and Jackson. As soon as the route is definitely decided on it is said that grading contracts will be let. Gasoline motor cars are to be used at first.

The Louisville & Nashville R. R. has bought the Jellico R. R. extending from Athens to Jellico Plains, 24 miles in length and it is believed that the road will be extended to Harriman.

Grading is stated to have been started on the first ten miles of the extension of the Chicago, Memphis & Gulf R. R. from Tiptonville, Tenn., to Hickman, Ky.

Texas Notes.

FROM CORRESPONDENTS AND OTHER SOURCES.

The Eastern Texas Traction Co. of Greenville, has been chartered with a capital stock of $12,000, the incorporators being J. H. Blocker, J. B. Murphy, H. E. Vaughan, W. M. McBride, H. C. Tittsworth, Glen A. Coulson, J. Riley Green, S. B. Perkins, J. H. Myrick, R. N. White, L. N. Byrd and Joseph F. Nichols. The company proposes to build an interurban line projected from Greenville to Wolfe City, in Hunt county, and provides for further extensions to Bonham, Denison, Honey Grove, Paris, Cooper, Clarksville, Dallas, Plano, Chisholm, Rockwall County, and Forney, Kaufman County. Those interested in the road all live in Hunt County.

Location surveys are under way for the proposed Fort Worth-Mineral Wells Interurban line and it is thought that actual construction work will be started in May. Paul Hurley, Fort Worth, is Secretary and Treasurer.

Good progress has been made with grading work on the Bryan-College trolley line and it is over two-thirds completed. A great many ties have arrived and are being distributed along the track. The first shipment of rails has also arrived. The order has been placed for the motor cars and they will be at Bryan by April 20.

The Colorado River Power Co. of Marble Falls has filed its charter at Austin. The company has a capital stock of $1,000,000 and is to construct a reinforced concrete sluice dam with chambers in the interior across the Colorado River at Marble Falls. This dam, which is about 75 per cent completed, will be 750 ft. long and 50 ft. high, with an 80-ft. base and a 16-ft. crown. A railroad and driveway will be laid on the crest and the water will flow through openings instead of over the top. A lake ten miles long will be formed, submerging the falls in the Colorado River above the site of the dam, and a reservoir for the storage of surplus water will be established six miles above Marble Falls. Light will be furnished by the city of Marble Falls and power will be furnished by a saw mill and a cotton mill, the machinery for which is being installed. It is proposed to lay copper cables to Austin and San Antonio to convey electric power to those cities. E. C. Alexander, Marble Falls, and C. H. Alexander and J. O. Wiley, Dallas, are interested.

The Quanah, Acme & Pacific Ry., C. E. Ensminger, General Manager, Quanah, has advised the State Railroad Commission that financial arrangements have been made for the extension of that line southwest from Paducah to El Paso, a distance of about 375 miles. It is stated that the money for building the line is being furnished by one of the large trust companies of St. Louis. The road is already in operation from Quanah to Paducah, about 50 miles, and application will be made to the Railroad Commission for authority to issue bonds to the amount of $30,000 per mile upon the completed track. The route from Paducah to the Texas-New Mexico line has been surveyed. It runs through a part of Western Texas that is settling up rapidly with farmers. It connects with the Frisco and the Fort Worth and Denver City at Quanah. About 175 miles of the road yet to be built will be in Texas and the remaining 200 miles will be in New Mexico.

The St. Louis, Brownsville & Mexico R. R., E. C. Burgess, Engineer of Construction, Kingsville, Tex., is to extend what is now known as the Buckeye switch to Collegeport, a distance of seven miles from the present terminus at the Simpson warehouse on the Texas rice plantation.

The Gulf Texas & Western Ry., Ben B. Cain, Manager, Dallas, Tex., has made preliminary surveys on a short spur from Jermyn toward the Stewart coal mine, 4½ miles distant.

The Bowers Southern Dredging Co., of Galveston has filed an amendment to its charter, increasing its capital stock from $600,000 to $750,000.

Capitalists of Hereford are forming a company to build a railroad from that city to a connection with the Rock Island in Oldham County. It is proposed to raise $150,000 locally.

A bonus of $75,000 has been raised at Gainesville for the construction of a railroad from there to Decatur and on to Bridgeport. The road is to be built by Gainesville capital, twelve local citizens contracting to build the road, which will cost about $500,000, if the bonus above stated is given them. The promoters guarantee to begin work in 60 days and have cars running as far as the county line, a distance of 18 miles, in 18 months, when the bonus shall be paid. M. P. Kelley, Gainesville, is interested.

The North American Dredging Co., of Texas, has been chartered with a capital stock of $600,000, and headquarters at Galveston, the incorporators being Elliott M. Maple, Charles Guthridge of Los Angeles, Cal., Morgan A. Adams of San Francisco, R. A. Percy of Oakland, Cal., and C. A. Houkins of Galveston.

Grading work was started at Temple on March 17 on the construction of the Temple Northwestern Ry.; the contract for which has been let to D. J. Grigsby, Dallas, as stated in our last issue. At a meeting of the stockholders of the railway at Temple on March 14

the following officers were elected W. J. McDaniel, Dallas, president and general manager; H. W. Peck, of Dallas, first vice president and general attorney; J. B. Grigsby, of Dallas, second vice president; P. L. Downs, of Temple, treasurer. In addition to the above, the directors are S. P. Sadler of Gatesville, W. B. Ferguson of Waxahachie and J. V. Bird of Dallas. The above named, together with A. F. Bentley, John Cole, George E. Wilcox of Temple and D. J. Grigsby of Dallas are the incorporators. The company is incorporated for $100,000 to build a line of 100 miles in length from Temple to a western terminus at Comanche.

The Little River Improvement District has issued $18,500 of bonds for building a levee along the Little River to reclaim about 4,000 acres of land. D. A. Morrison, Cameron, is interested.

The City Council of Houston has granted the Houston Electric Co. the right to rebuild some of its lines in this city with T rails.

The Aransas Terminal R. R. Co., of Aransas Pass, has been organized with a capital stock of $7,000 and proposes to build a 7-mile line from Aransas Pass at a connection with the San Antonio & Aransas Pass Ry. Co., southeast across Red Fish Bay to a point near Steadman Island and Hog Island, thence southeast across Harbor Island to Deep Water east of Harbor Island at a point about 1,000 ft. southeast, or at right angles to the line of the north jetty extended. The incorporators are E. O. Burton, A. H. Danforth, A. J. Bell, A. I. Matlock, San Antonio; J. J. Welder, Victoria; J. F. Green, Gregory; D. M. Picton, Rockport; R. P. Clark, Galveston; F. L. Alvord, T. P. Boyd, Fort Worth.

Karner Brothers have begun work on their grading contract for the Texas Central branch road from DeLeon to Cross Plains.

Two complete surveys have been made for the proposed Terrell-Dallas Interurban R. R. By one of these, the road will be 30.1 miles long and by the other, it will be 31.6 miles. The citizens of Terrell are to raise $50,000 and $50,000 is to be raised in Dallas. Over 23 miles of right of way has already been secured. William Cook, Dallas, Tex., is chief engineer.

W. O. Robertson, San Antonio, has been awarded the grading contracts for the first 90 miles of the San Antonio, Rio Grande & Tampico R. R. According to a statement of B. S. Harrison of New York of the Harrison Engineering Co., a director of the San Antonio, Rio Grande and Tampico railroad, the railway will be built directly to the Rio Grande. When the contract just let nears completion, the remainder of the road will be located and constructed. Surveyors are now in the field and several lines are being projected.

Citizens of the city of Wellington, Tex. have offered a bonus of $40,000 to the Wichita Falls & Northwestern R. R., in order to obtain the extension of the line from Altus to Wellington. A charter has already been filed at Austin, Tex., for the extension.

Officials of the Hearne & Brazos Valley R. R. are considering the construction of an extension into the Levy District of Bryan, Tex. J. W. Green, Hearne, Tex., is vice president and general manager of the company.

According to advices from Georgetown, Tex., engineers have completed preliminary surveys for the construction of the proposed Waco-Belton & Georgetown R. R. An executive committee will meet at Waco to consider ways and means for the promotion of the project.

It is stated that L. E. Walker, Quanah, Tex., president of the Quanah & Gulf Ry., has announced that all bonuses necessary for the construction of the proposed line had been obtained and that surveys for the projected route would be made at once.

Citizens of Canadian, Tex., are in receipt of reports stating that the Atchison, Topeka & Santa Fe is considering the construction of a line from Englewood, Kan., to that city.

The officials of the Fort Worth & Denver R. R. and Wichita Falls & Northwestern R. R. have decided upon the construction of a new modern depot at Wichita Falls, Tex., to cost $200,000. The structure will be two blocks in length and will front on 8th and 9th streets.

The Sioux Falls & Western Ry Co. has been incorporated with a capital stock of $1,000,000 and headquarters of Sioux Falls, S. Dak., and proposes the construction of a line from Sioux Falls to Wheeler, a distance of 162 miles. The work is estimated to cost $3,000,000. The incorporators of the company are R. F. Brown, Sam Fantle, George B. Tuthill, Fred H. Hollister and George T. Blackman, all of Sioux Falls, S. Dak.

The Wichita Falls & Northwestern Ry. has purchased land at Wichita Falls and will erect machine shops to cost $200,000.

Tracklaying on the Llano Estacado branch of the Santa Fe has been completed to Floydada and as soon as the depot is completed the branch will be opened to passenger traffic.

The citizens of Hereford are planning to secure the incorporation of a company to be known as the Hereford North & South R. R. Co., for the purpose of building a railroad from Hereford south to a connection with the Rock Island in Oldham county. This line would be 35 miles long, and it is also planned to later build a line south. The company is to have a capital stock and is to begin actual operations within 90 days after May 1. Over $30,000 was subscribed at the first mass meeting called by the Hereford Commercial Club, of which L. Gough is president.

Plans are well underway for the construction of the pleasure pier at Port Arthur, mentioned in our last issue. As proposed, the pier is to be built of concrete and will cost about $100,000. Plans are also under way for further improvements to include the construction of a large artificial island and the erection of several large concrete buildings which may bring the cost of the project up to $500,000. C. A. Logan is architect. John W. Gates, Port Arthur, is back of the project.

It is believed that the Naples & Sulphur River R. R. will shortly be built from Jefferson to Clarksville. Eighteen miles have already been built from Jefferson to Linden, owned by the Clark & Boyce Lumber Co., of Jefferson, and 20 miles have already been built from Naples up the Sulphur, owned by the Sullivan-Calhoun Lumber Co., of Naples. A gap of 11 miles is to be filled up between Linden and Naples, and an extension of 20 miles from the end of the Naples and Sulphur to Clarksville. The Sullivan-Sanford Lumber Co. has bought 23,000 acres of timber in Red River county from Clarksville and Annona parties, and when the road is built it is claimed that it will have timber enough to last it ten years. The road, it is said, is to be built during the summer.

Virginia Notes.

FROM CORRESPONDENTS AND OTHER SOURCES.

The Virginia-Carolina Ry., Wilton E. Mingea, president, Abingdon, Va., is stated to have awarded contracts for part of the work for the proposed extension from Konnarock, in Washington county, Virginia, across the mountain in the direction of Charlotte, N. C. It is expected that the road will be extended to make connection with the Seaboard Air Line. There is also talk of extending it northward to the lakes, in which event it would become an important trunk line. At present the road is only about 30 miles in length, extending from Abingdon, on the N. & W. to Konnarock, Va.

The Lynchburg, Amherst & Northern Ry. Co., of Lynchburg, Va., has preliminary surveys under way for a 30-mile line from Lynchburg to either Sandidges or Louisville, by way of Amherst Courthouse.

Washington Notes.

FROM CORRESPONDENTS AND OTHER SOURCES.

The Valley Railway & Power Co., of Kent, has secured franchise in Renton and Kent for its proposed electric railway.

J. T. Heffernan, President of the Heffernan Dry Dock Co., of Seattle, has secured 18 acres of the Seattle tide lands on the east waterway fronting on Spokane Av. He proposes to improve this property by building additional dry docks and a ship repair plant. Work will begin within a few months.

According to an announcement made by W. T. Beck, president of the Spokane & British Columbia Ry. Co., surveys have been completed into Spokane, Wash., and a franchise will soon be asked. The company has been incorporated with a capital stock of $1,000,000 and at a meeting of the stockholders Feb. 24, the following officers were elected. W. E. Beck, Spokane, president and general counsel; James J. Warren, Toronto, Ontario, vice president; F. M. Adlyn, Republic, Wash., secretary; F. M. Holland, Toronto, Ontario, general manager; O. E. Fisher, Republic, Wash., treasurer and general freight and passenger agent; Fred Demuth, Grand Forks, B. C. general superintendent.

The Northern Pacific Ry has notified the Secretary of State of its intention to extend its Sunnyside branch line to tap principal points in Yakima and Benton counties which at present have no railroad facilities. The line now runs as far as Grandview. The extension will be eastward into Benton county.

Riparian rights and land deals have finally been closed by George S. Canfield, of Spokane, representing the Ham, Yearsley & Ryrie Co. of that city, on Klickitat River for the development of the water-power near Lyle. The last deal closed was the Indian Emma Dave land on which is located the Klickitat gorge, two miles from Lyle. At this point in the gorge alone 6,000 hp. can be developed, but by extending two miles farther up the stream 12,000 hp. is available. Further extension to a total of 11½ miles from the foot of the gorge gives 30,000 hp. Water rights covering each and all these developments were located some time ago and each of the projects has been definitely surveyed and located. It is stated to be the purpose of the capitalists behind the project to commence the development this present season and that the longest line of development to contain all three sites, has been decided upon. This contemplates a long transmission line up the Columbia River to pump water for irrigation and also, it is said, a power line into Portland.

The Spokane, Portland & Seattle Ry. T. H. Croswell, chief engineer, Portland, Ore., has made an appropriation of $300,000 for 1910 to fill in trestles near Vancouver. They will be filled with what is termed "cliff droppings," and gravel from the company's pits. Work will begin soon and four or five crews will be employed. Two steam shovels will be used.

The Inland Electric Ry Co. is to at once rebuild its washed out lines at Colfax and is also planning to raise the ground for its terminal in that city.

Peter Simms, of Simms & Shields, Tacoma, is reported to have been awarded the contract for the construction of the Northern Pacific four-track railroad line from Tacoma to Tenino, known as the Point Defiance-Narrows line. The line cut off from the present Tacoma-Portland line at Tenino, in Thurston county, and runs to the Sound at the mouth of the Nisqually River, crossing the tideflats there and running along the beach through Steilacoom, Chambers creek, Lemons beach, Belmarlow and by a tunnel through the ridge at Point Defiance, coming out on the bay shore at the Tacoma smelter and thence along the bay shore, inside of the supplemental terminal yards of the Milwaukee between the smelter and Old Town, to the Oriental docks, and along under the edge of the bluffs below the Tacoma hotel and into the new union passenger station yards at 15th St., Tacoma. The total length of the line is about 42 miles.

Plans are reported to have been announced by Robert E. Strahorn, Spokane, who recently secured control of the Hanford interests at Priest Rapids, for a canal 100 ft. wide at the bottom, with a minimum depth of 20 ft., to be built from Priest Rapids to Pasco, carrying water to 150,000 acres of fertile land. About 7 miles down the river from Priest Rapids the canal will have a fall of 72 ft. and electrical horsepower will be generated. The

canal will also be used in transporting boats around Priest Rapids.

Wisconsin Notes.

FROM CORRESPONDENTS AND OTHER SOURCES.

The State Railroad Commission has authorized the Milwaukee Electric Railway & Light Co. to issue another $1,000,000 of 4½ per cent bonds. The new financing will make a total of $7,728,000 of these bonds outstanding and is to be consummated to provide for extensions.

The Milwaukee Light, Heat & Traction Co. has an application before the city council of Oconomowoc for a franchise in Oconomowoc, and the right to operate a street railway in the city.

The contract for the new coal shed to be erected by the Northwestern Fuel Co. at its dock No. 1 in Superior has been let to the Heyl-Patterson Co. of Pittsburg, Pa. The company will extend the western side of the dock 600 ft., giving 350,000 more sq. ft.

Canadian Notes.

FROM CORRESPONDENTS AND OTHER SOURCES.

The Niagara Falls, Welland & Dunnville Electric Ry. Co. has been incorporated with headquarters at Welland, Ont. The capital stock is $200,000, and the provisional directors are J. G. Gardner, Geo. Arnold, F. E. Misener, G. H. Burgar, H. A. Rose. The road will run from Niagara Falls through the townships of Stamford, Thorold, Crowland, town of Welland and Townships of Haldimand, Wainfleet, Moulton and Sherbrooke, to Dunnville, passing through a number of villages on the way and probably a branch line through Pelham.

A bill is before the House of Commons to incorporate the Ottawa, Montreal & Eastern Ry. Co., which proposes to construct and operate a railway from a point in the vicinity of Lake Megantic, near St. Agnes, thence through the counties of Wolfe, Arthabaska, Richmond, Drummond, Yamaska, Bagot, Richelieu, St. Hyacinthe, Vercheres and Chambly, crossing the St. Lawrence at or near Longueuil to Montreal, and thence in a westerly direction through the counties of Hochelega, Jacques Cartier, Laval, Terrebonne, Two Mountains, and Argenteuil, and thence crossing the Ottawa River into the Province of Ontario. William I. Bishop, Arthur Jarvis, Charles E. Cutler, Victor Cusson and Maurice Tetreau, of Montreal, Que., are interested.

City Engineer Rust, of Toronto, Ont., has been authorized by the Board of Control of that city to open negotiations with Bion T. Arnold of Chicago, Ill., with a view to securing his services in preparing a report on a tube railway system for Toronto. The proposed tube system would consist only of two or three trunk lines from the congested downtown districts. A report as to cost is needed, to present to the rate payers before they vote on the scheme.

Tracklaying out of Prince Rupert, B. C., on the Grand Trunk Pacific Ry., is to be started about April 1, and it is expected to have the line finished and in operation to a point 100 miles inland before the end of the summer. W. C. C. Mehan, General Superintendent Mountain Division, G. T. P. Ry., Prince Rupert, will be in charge.

The Railway Committee of the House of Commons has passed the bill incorporating the Northern Quebec Colonization Ry. with a line from Tadousac to Lake St. John, thence to Chibougaman, and thence to Hannan Bay, Ontario. From Chibougaman it is intended also to build to Weymoutache, on the Transcontinental.

The city engineer of Ottawa, Ont., estimates that it will cost between $75,000 and $80,000 to extend the city street car lines to Ottawa East.

The Canadian Stewart Co. of Montreal, Que., has been awarded the contract to build the new drydocks at Port Arthur, Ont. The Dominion Government has guaranteed the bonds to the extent of $1,200,000.

Extensive harbor improvements are proposed for Montreal. The harbor commission of that city have decided to spend part of its new $6,000,000 Government loan in building a mammoth elevator, with a capacity of over 2,000,000 bushels. New piers, docks, improved sheds, and the raising of railway tracks are other improvements to be caried out.

Construction work, it is said, will be started on the Prince Albert & Hudson Bay Ry. as soon as a small section of the final survey is completed. Engineers are now on their way to Prince Albert to complete their surveys. It is intended to finish the first 1,000 miles of the Hudson Bay railway in two years. This completes the section from Edmonton to Prince Albert and Prince Albert to Churchill. The road then goes from Churchill to Athabasca.

Reports in Antler, N. Dak., are to the effect that the Grand Trunk Pacific is considering the extension of its line from Regina, Sask., to the boundary line, running to the north of Estevan and crossing the Souris branch about 5 miles east of Bienfait, from which point it will take an easterly course and make a connection with the Great Northern at Antler.

The Canadian Legislature has given the city of Guelph, Ont., authority to extend its street railway line to the New Central prison grounds, near that city.

The Simcoe Railway & Power Co., of Simcoe, Ont., has been given a two years' extension of time in which to begin delivering power.

Advices from St. John, N. B., state that it is reported there that the Canadian Pacific R. R. is planning a new line of railway from that city to Montreal. It is common belief that the C. P. R. owns the shore line from St. John to St. Stephen, N. B., just across the St. Croix River from Calais, Me. The rumored project is to straighten the shore line and build a new road from Calais to Mattawamakeag, Me., connect them at Calais, and use this line to Montreal. It would be much shorter than the present route via McAdam.

A bill has been introduced in the New Brunswick Legislature to aid in the construction of a railway down the St. John River Valley to St. John. The first part of the bill guarantees the bonds of $25,000 a mile, providing the federal government will operate and equip it as part of the Intercolonial, giving the Province 40 per cent of the gross receipts in lieu of interest. The second part of the bill provides the same guarantee for the steam or electric road from St. John to Quebec, via Andover, and across the state of Maine. A proposal has been made to the government by the Aroostook Falls Development Co. to construct and operate the road, using power developed at the falls for the whole line.

The Grand Trunk Pacific Transcontinental R. R. has acquired title to a large tract on the shores of Courtenay Bay, St. John harbor, St. John, N. B. This tract will be utilized for the Atlantic terminal of the new road.

Mexico Notes.

FROM CORRESPONDENTS AND OTHER SOURCES.

The Mexican Northern Ry., V. P. Safford, Escalon, Chihuahua, Mexico, has taken over the concession held by the Cananea Consolidated Copper Co. to build a railroad from Cananea, Sonora, to a connection with the National Railways of Mexico, between El Paso and Chihuahua. The Mexican Northern Ry. Co. owns the old Rio Grande, Sierra Madre & Pacific road, and it is stated that the line to be built under the concession will connect with that road, instead of with the National Railways of Mexico, as originally planned. The proposed road will parallel the International border for about 200 miles.

Grant Bros. Construction Co., of Los Angeles, has completed its contract on the Guaymas-Guadalajara R. R. and has moved its outfit to the United States. It is understood that the construction force is to be moved to the Southern Pacific line at Winkelman, Ariz.

Colonel Antonio Ramos Cadena and Severiano Caldereon have been granted a 40-year concession by the state of Chihuahua to build a street railway from Ortiz station, that state, to the little town of Meoqui, on the Conchos River. According to the terms of the concession, the road may be operated by horses, steam or electricity. The line will be about 3 miles long.

The Mexico Pacific R. R. Co. mentioned in our last issue, composed of Seattle and Victoria capitalists, has arranged for a State subsidy for the railroad it will build between the Pacific ports of Acapulco and Zihuatanejo, in the state of Guerrero, a distance of about 100 miles. The government will pay the company 4000 pesos a kilometer for the line between Acapulco and Cuesta, and 1000 pesos a kilometer for the line from Cuesta to Zihuatanejo. Construction is in progress. The company owns a great tract of land between the two ports, and will colonize a portion of it. Moritz Thomson, a prominent grain man of Seattle, is at the head of the enterprise.

Track laying on the San Diego & Arizona R. R. has been completed for a distance of several miles beyond Tia Juana and grading is completed for a distance of 10 miles or 12 miles below that point. Approaches to tunnel No. 1 in Carriso Canyon have been completed and the tunnel work proper has been started. Robert Sherer & Co., Los Angeles, Cal., have the contract.

Grading work is stated to have been resumed on the Fort Wayne-Bryan electric line work, which was suspended with the coming of cold weather. Grading gangs were started from Maysville, Hicksville and Farmer, O.

The Fall River Electric Light Co. of Fall River, Mass., has petitioned the State Gas Commissioners for authority to issue $200,000 additional capital stock at $140 per share for the purpose of making additions to the plant and for enlarging the property.

The Chicago, Milwaukee & St. Paul R. R. is to expend about $1,250,000 for improvements to the Kansas City division, comprising the main southwest line from Kansas City to Davenport. The work will include the expenditure of $525,000 for replacing trestle and iron bridges with concrete structures. In addition some new track will be laid and a considerable amount of reballasting done.

Northern Pacific Ry. engineers are taking advantage of the cold weather to run surveys for the construction of the proposed line from Edgeley, N. Dak., across frozens sloughs and creeks, westward through Burnstad and Linton, N. Dak. Contracts for the work will probably be let in the early Spring. S. J. Bratager, St. Paul, Minn., is principal assistant engineer of the Northern Pacific.

Business men along the Dallas line of the Chicago & Northwestern Ry. have started an agitation for an extension from New Castle, S. Dak., to Niobrara, Neb. The extension will be about 40 miles long. A. F. Wilcox, Gregory, S. Dak., is interested.

The board of trade of Phoenix, Ariz., has appointed committees to secure right of way and a bonus for the projected line of the Phoenix & Buckeye R. R. According to a proposition of L. H. Landis, general manager of the railroad, if a bonus of $50,000 is raised and right of way secured, the road will be constructed and in operation as far as the Hassayampa River by July 1, 1910.

Surveys are being made for the construction of the spur line from Bayard Station on the Santa Rita Branch of the Atchison, Topeka & Santa Fe Ry., to the government hospital at Fort Bayard, New Mexico.

Options on land are being secured for a power project which contemplates the construction of one or more large dams across the Deerfield River, between Wilmington and Reedsboro, Vt., Martin A. Brown, North Adams, Mass., is interested.

BIDS ASKED.

Bridges.

Bids are asked on following work, the notes being arranged alphabetically by states:

San Jose, Cal.—Until 11 a. m., April 5, by Board of Supervisors for the construction of a reinforced concrete bridge over the Coyote River at San Jose and Oakland Road. Henry A. Pfister is Clerk.

Clinton, Ia.—Until noon, April 4, by Board of County Supervisors, for the construction of steel bridges, concrete bridges, concrete arches, concrete culverts and building and repairing of wooden bridges required by the county for one year. Frank W. Leedham is County Auditor.

Gretna, La.—Until June 1, by E. M. Hubert, Secretary Police Jury, Gretna, La., for the construction of a steel bridge across Harvey Canal in Jefferson Parish.

Harrisonburg, La.—Until April 4, by Police Jury, for the construction of Bayou Louis bridge. W. Bethard is Secretary of the Jury.

Sidney, O.—Until noon, Mar. 26, by County Commissioners, for the construction of superstructure of a 50-ft. highway swing bridge over the Miami Canal near Dawson, O.

Antlers, Okla.—Until March 31, by W. D. Parks, County Clerk, for the construction of a bridge over Anderson Creek at a point 200 yds. west of the quarter corner on line between Sec. 1 and Sec. 12.

Minitonas, Man. Until March 30, by E. Widmeyer, Secretary-Treasurer, for the construction of a 90-ft. steel Pratt truss bridge.

Calgary, Alta.—Until noon, Mar. 31, by N. E. Brooks, Division Engineer, Canadian Pacific Ry., Calgary, Alta., for the construction of the following: Concrete subway at Albert St., Regina. Sedimentation basins at Drinkwater, Rouleau and Milestone. Double 10-ft. concrete arch culvert; mileage 25.5 Laggan section. Concrete abutment for steel span; mileage 117.6 Laggan section. Concrete abutments for steel span; mileage 19.2 Red Deer section. Edmonton section—Concrete abutments for steel span; mileage 65.7 and 87.2. Concrete for subway First street east, Calgary. Concrete abutments and pier for overhead bridge E. Calgary, with pile approaches and dock. Cranbrook section—Concrete abutments for steel span, mileage 8.2 and 9.2. Sirdar section—Concrete abutments for steel span, mileage 11.0 and 62.8.

Buildings.

Bids are asked on following work, the notes being arranged alphabetically by states:

Clearfield, Ia.—Until 3 p. m., March 24, by Building Committee, for the erection of a brick and stone church building. O. A. Houghland, Chariton, Ia., is Architect.

Greencastle, Ind. Until 3 p. m., April 20, by James Knox Taylor, Supervising Architect, Treasury Department, Washington, D. C., for the construction including plumbing, gas piping, heating apparatus, electric conduits and wiring, of the United States Post Office at Greencastle, Ind.

Monticello, Ind.—Until noon, April 5, by County Commissioner for the repairing of the Court House.

Fort Leavenworth, Kan.—Until 11 a. m., April 12, by Capt. William D. Davis, Constructing Quartermaster, Fort Leavenworth, Kan., for the construction of a guard house at the post including plumbing, heating, fixtures for electric lights and wiring.

Kansas City, Kan.—Until 3 p. m., April 25, by James Knox Taylor, Supervising Architect, Treasury Department, Washington, D. C., for the extension, etc., except elevator, including plumbing, gas piping, heating apparatus, electric conduits and wiring, of the United States postoffice at Kansas City, Kan.

Boston, Mass.—Until 10 a. m., April 18, by Capt. A. M. Miller, Constructing Quartermaster, 263 Summer St., Boston, Mass., for the construction of plumbing, heating, electric wiring and fixtures of one double set Officers' Quarters; one double set of Non-Commissioned Officers' Quarters; one Quartermasters' Storehouse.

Lansing, Mich.—Until noon, March 28, by the Board of Education, E. A. Gilkey, Clerk, for the erection of an addition to the Moores Park School building.

Lansing, Mich.—Until noon, April 11, by Gordon Plumbing & Heating Co., 122 Ionia St. W., for the construction and completion of a church of Christ, Scientist, Lansing, Mich.

St. Ignace, Mich.—Until 3 p. m., March 31, by P. W. Murray, Secy. St. Ignace, Mich., for the construction of a heating and ventilating system in LaSalle School at St. Ignace.

West Point, N. Y.—Until noon, April 15, by Quartermaster, West Point, N. Y., for the construction of a crematory building and garbage crematory complete at West Point.

Concord, N. C.—Until 3 p. m., April 19, by James Knox Taylor, Supervising Architect, Treasury Department, Washington, D. C., for the construction, including plumbing, heating apparatus, electric conduits and wiring of the U. S. Post Office at Concord, N. C.

Chicago Junction, O.—Until noon, April 15, by Chicago Ohio Temple Co., for the construction of a 4-story Masonic Temple and Theater at Chicago Junction, O.

Columbus Barracks, O. Until 11 a. m., April 1, by Capt. H. J. Hirsch, Constructing Quartermaster, for installing plumbing and heating two extensions to administration buildings and mess hall at this post.

East Cleveland, Cleveland, O.—Until noon, April 14, by H. F. Jordan, 605 Euclid Ave., Clerk Board of Education, for labor and material necessary for the construction and erection of two 2-story brick school buildings and one 2-story brick addition to the Prospect St. School in the Village of East Cleveland.

McDade, Tex.—Until 2 p. m., April 1, by J. B. Watson, President of the School Board, for the construction of a two-story brick school building.

Richmond, Va.—At once by the Building Committee of New Roanoke College, for the construction of the building which is estimated to cost about $50,000.

Puget Sound, Wash.—Until 11 a. m., April 23, by Bureau of Yards and Docks, Navy Department, Washington, D. C., for the construction of a general storehouse at the U. S. Navy Yard, Puget Sound, Wash.

Fort William H. Seward, Alaska.—Until 11 a. m., April 8, by Capt. E. C. Long, Constructing Quartermaster, 482 Arcade Annex, Seattle, Wash., for the construction of an addition to post exchange and gymnasium at Fort William H. Seward, Alaska.

Calgary, Alta.—Until noon, March 31, by N. E. Brooks, Division Engineer, Calgary, Alta., for the construction of the following: Regina, brick freight shed; Moose Jaw, extension to present frame freight shed; Weyburn, frame freight shed; Medicine Hat, brick machine shop; Coleridge, frame locomotive foreman's cottage; Coleridge, six stall addition to brick engine house; Lethbridge, extension to brick station; Calgary, 18 stall brick engine house and attached machine shop; Calgary, addition to present brick machine shop; Calgary, addition to station; Calgary, standard stores building; Red Deer, brick station; Banff, station building; Laggan, station building; Macleod and Crow's Nest, six stall addition to brick engine houses; Cranbrook, Y. M. C. A. frame building; Granum and High River, frame freight sheds; C. P. R. Class "A" stations at Morse, Rush Lake, Marquis, Keeler, Loreburn, Strongfield, Glenside, St. Aldyne, Tyvan, Erskine, Strome, Brocket, Cowley, Lundbreck, C. P. R. Standard No. 5 stations at Welsh, Shepard, Hillcrest, Blairmore, McGillivray, Natal; C. P. R. Standard No. 4 section houses at Weyburn, Stoughton, Pitman, Froude, Beverley, Tompkins, Cardell, MacKid, Cummings, Larmour, Carlstadt, Stobart, Cassils, Bow Island, Banwil, Lethbridge Junction, Mitford, Keith, Yoho, Carstairs, Didsbury, Red Deer, Rosebud, Netook, Tuttle, Nisku, Lougheed, Woodhouse, Clareholm, Nanton, Aldersyde, Midnapore, Burmis, Kingsgate.

Minnedosa, Man.—Until noon, March 28, by Frank Lee, Division Engineer, Canadian Pacific Ry., Winnipeg, Man., for the construction of a station at Minnedosa, Man.

Leamington, Ont. Until 5 p. m., April 4, by Napoleon Tessier, Secy. Department of Public Works, Ottawa, Ont., for the construction of Post Office Customs and Inland Revenue Fittings, Leamington, Ont.

Roads and Streets.

Bids are asked on following work, the notes being arranged alphabetically by states:

Jonesboro, Ark.—Until 2 p. m., April 5, by Board of Improvement of Street Improvement District No. 4, for grading, surfacing and paving with vitrified brick block pavement on gravel foundation about 23,000 sq. yds. of street. The work also includes 10,000 lin. ft. of curbing and 105,000 sq. ft. of concrete sidewalks. B. H. Berger is Chairman of the Board.

Atlanta, Ga.—Until 3 p. m., April 4, by Mayor and General Council for paving North Boulevard from Ponce de Leon Ave. to North Avenue, with creosoted wooden blocks, including about 3,500 sq. yds. B. M. Clayton is City Engineer.

Normal, Ill. Until 3 p. m., March 26, by Board of Local Improvements for the construction of vitrified brick block pavement on concrete foundation with concrete curb and a central parking on Broadway. O. L. Manchester is a member of the Board.

Kokomo, Ind.—Until 2 p. m., April 15, by County Commissioners, for the construction of a gravel or stone road in Center Township. A. B. Easterling is Auditor of Howard County.

Monticello, Ind.—Until noon, April 5, by County Commissioners for the construction of a gravel road in Liberty Township. A. G. Fisher is Auditor of White County.

Muncie, Ind.—Until 10 a. m., April 8, by County Commissioners for the improving of a public highway in Harrison Township. Joseph E. Davis is Auditor of Delaware County.

Petersburg, Ind.—Until 2 p. m., April 5, by County Commissioners for the construction of two roads in Logan Township. F. R. Bilderback is Auditor of Pike County.

Sullivan, Ind.—Until noon, April 5, by County Commissioners for the construction of a stone road in Hamilton Township, also a gravel road in Gill Township. B. C. Crowder is Auditor of Sullivan County.

Tipton, Ind.—Until 10 a. m., April 4, by County Commissioners for the construction of two stone roads. J. F. Barlow is Auditor of Tipton County.

Williamsport, Ind.—Until 1 p. m., April 8, by County Commissioners for the construction of a gravel road in Stonlon Township. Robert L. Winks is Auditor of Warren County.

Clarinda, Ia.—Until 7.30 p. m., April 12, by C. W. Stuart, City Clerk, for the construction of about 20,500 sq. yds. of concrete paving of 5-in. Portland cement concrete. Official advertisement of the work will be found elsewhere in this issue.

Fort Leavenworth, Kan.—Until 11 a. m., April 6, by Capt. William D. Davis, Constructing Quartermaster, for the construction of concrete walks, curbs and gutters at Fort Leavenworth, Kan.

New Castle, Ky.—Until April 12, by S. Bruce, Judge Henry County Court, for the construction of about 41 miles of turnpike roads. The work includes furnishing, hauling, breaking and spreading rock.

Lake Charles, La.—Until 8 p. m., March 28, by C. H. Burton, City Engineer, for the construction of 7 miles of cement sidewalk and curb.

Harrisonburg, La.—Until noon, April 4, by Police Jury, for improving 25 miles of the road in Catahoula Parish, La. The Parish will furnish grader and road machine.

Albany, N. Y.—Until 1 p. m., April 8, by State Highway Commission, Albany, N. Y., for the improvement of the following roads:

County.	Road No.	Approx. miles.
Tompkins	5043	2.59
Otsego	5037	3.50
Monroe	492	5.75
Genesee	853	4.07
Livingston	856	1.32
Cayuga	686	8.72
Ontario	5015	1.19
Oswego	46	1.12
Chenango	598-A	0.22
Oneida	761	6.32
Lewis	5036	2.61
Hamilton	5038	3.00
Fulton	542	2.69
Albany-Schoharie	5039	4.01
Nassau	5051	1.97
Sullivan	823	4.82
Suffolk	846	5.30
Dutchess	5050	2.14
Warren	5055	1.63

Albany, N. Y. Until 1 p. m., April 4, by State Highway Commission, Albany, N. Y., for the improvement of the following highways:

County.	Road No.	Approx. miles.
Tompkins	683	3.57
Allegany	801	4.68
Otsego	787	0.47
Tioga	845	4.05
Steuben	850	6.14
Schuyler	5047	1.64
Chemung	5048	2.50
Broome	834	7.50
Delaware	5045	3.04
Monroe	5046	5.77
Wyoming	874	4.50
Niagara	740	2.75
Livingston	715	4.54
Erie	5054	2.00
Chautauqua	857	1.62
Cayuga	852	0.81
Chenango	664	4.53
Madison	811	2.39
Ontario	5041	2.41
Oswego	5044	3.50

Albany, N. Y.—Until 1 p. m., April 6, by State Highway Commission, Albany, N. Y., for the improvement of the following highways:

County.	Road No.	Approx. miles.
Tompkins	682	3.95
Tioga	5049	2.58
Otsego	786	3.76
Monroe	851	1.11
Niagara	729	3.20
Livingston	855	0.47
Chautauqua	5053	2.54
Seneca-Cayuga	5042	3.33
Chenango	665	5.18
Madison	812	4.81
Monroe	494	4.43
Oswego	661	3.58
Suffolk	5008	3.56
Lewis	847	5.74
Oneida	5052	0.65
Hamilton	848	3.76
Chenango	596-A	0.34
Albany	755	4.25
Rensselaer	5040	1.56
Onondaga	555	7.79
Dutchess	628	4.66

Amsterdam, N. Y.—Until 8 p. m., April 5, by F. E. Crane, City Engineer, for the necessary labor and material for the construction of 4,500 sq. yds. of fire clay brick pavement on East Main St. and about 3,600 sq. yds. of fire clay brick pavement on Spring St.

Cleveland, O.—Until 11 a. m., March 30, by Board of County Commissioners for grading, draining, improving Depot Road from Wooster Pike at Strongsville Center to Prospect Rd. at Vigil in Strongsville Township. John F. Goldenbogen is Clerk of the Board.

Cleveland, O.—Until noon, March 23, by Director of Public Service for paving a number of streets throughout the city with brick, dressed block medina stone and asphalt. A. B. Lee is Director of Public Service.

Yeadon, Pa.—Until March 24, by Borough Council, for laying sidewalks and constructing

curbs and gutters in the borough. T. H. Dan is Secretary of the Council.

Staunton, Va.—Until 10 a. m., March 24, by County Clerk, for the construction of 3½ miles of macadam road at Craigsville, Va.

Aberdeen, Wash.—Until 5 p. m., April 6, by P. F. Clark, City Clerk, for the construction of pavement, curb and sidewalks and gutters on portions of Market and K Sts. The work is estimated to cost $45,000.

Aberdeen, Wash.—Until 5 p. m., April 6, by P. F. Clark, City Clerk, for the construction of sidewalks, curbs and gutters on portions of Market and K Sts., estimated at $45,000. Official advertisement of the work will be found elsewhere in this issue.

Olympia, Wash.—Until March 26 (readvertisement of bids), by State Highway Board, for improving the road between Orillia Bridge and Kent in King County.

Olympia, Wash.—Until 2 p. m., March 28 (readvertisement of bids called for March 8), by H. L. Bowlby, State Highway Commissioner, for clearing, grading, curbing, drainage, bridging and macadamizing State Aid Road No. 65 in King County from Orilla bridge to the town of Kent, forming part of the big trunk road planned from Blaine to Vancouver. The work is now estimated at $64,000 instead of $58,000.

Platteville, Wis.—Until 7:30 p. m., April 14, by P. D. Hendershott, City Clerk, for the construction of 6,560 sq. yds. of brick paving on Main and Second Sts. The work will include 340 lin. ft. of curb and gutter, 490 lin. ft. of marginal curb, and 320 lin. ft. of plain curb. W. G. Kirchoffer is Engineer. Official advertisement will be found elsewhere in this issue. Plans and specifications are on file at the office of Engineering-Contracting, 355 Dearborn St., Chicago, Ill.

Moose Jaw, Sask.—Until 8:30, April 11, by W. F. Heal, City Clerk, for the following contracts: Contract "A"—Furnishing material for and constructing 33,300 sq. yds. of pavement. Contract "B"—Furnishing material and constructing 13,500 lineal ft. of combined curb and gutter. Contract "C"—Furnishing material for and constructing 116,500 sq. ft. of concrete sidewalks.

Sewers.

Bids are asked on following work, the notes being arranged alphabetically by states:

Washington, D. C.—Until 2 p. m., March 28, by District Commissioners, for the construction of sewers in the District of Columbia.

Michigan City, Ind.—Until March 29th, by City, for the construction of a reinforced concrete sewer in Willard Ave., estimated to cost $40,000, and a vitrified pipe sewer in Myrn St., to cost $6,000. Harry M. Miles, Michigan City, Ind., is Engineer.

Peabody, Kan.—Until 7:30 p. m., April 5, by City Clerk, for furnishing necessary materials and labor for the construction of 4 miles of sanitary sewers from 8 to 12 in. in diameter, with manholes, lampholes, flush tanks, etc. Also a reinforced concrete septic tank. J. W. Mavity, Lyndon, Kan., is Engineer.

Peabody, Kan.—Until April 5, by Ray. B. Roberts, City Clerk, for the construction of a sewer system. J. W. Mavity, Marion, Kan., is Engineer. Official advertisement of the work will be found elsewhere in this issue.

Louisville, Ky.—Until noon, April 1, by Commissioners of Sewerage, for the construction of sewer known as Section "A" of the Frankfort Ave., Sewer, Contract 63. The work will include 2,337 ft. of combination sewer and drain 8 to 18-in. in diameter and from 8.5 to 18 ft. in depth. The work will involve 50 cu. yds. of concrete and 4,674 ft. of vitrified pipe from 8 to 18 in. in diameter. P. L. Atherton is Chairman.

Louisville, Ky.—Until noon, April 8, by Commissioners of Sewerage, for the construction of the Brook St. sewer, Contract No. 62. The work includes 5,198 ft. concrete sewer, 7 ft. 6 in. by 10 ft. in diameter. Consisting of 5,000 cu. yds. of concrete; 495,000 lbs. of steel.

Louisville, Ky.—Until noon, April 1, by Commissioners of Sewerage, for the construction of the Third St. sewer, Contract No. 64. The work includes 1,435 ft. of 51-in. reinforced concrete sewer; 2,645 ft. of 33 and 24-in. unreinforced concrete sewer; 670 ft. of 18-in. vitrified pipe, including 4,750 ft. of earth excavation from 6 to 22 ft. deep; about 575 cu. yds. of reinforced concrete; 515 cu. yds. of unreinforced concrete and 43,000 lbs. of steel reinforcement. P. L. Atherton is Chairman of the Commission. J. B. F. Breed is Chief Engineer.

Comstock, N. Y.—Until noon, April 5, by C. V. Collins, Superintendent State Prisons, Albany, N. Y., for the construction of a sewage disposal system at Great Meadow Prison, Comstock, N. Y.

Fargo, N. Dak.—Until 5 p. m., April 28, N. C. Morgan, City Auditor, for furnishing all necessary labor and material for the construction of a 12-in. lateral sewer on 13th St. north, extending from Alley between 1st and 2d Aves., north to 3d Ave.

Lima, O.—Until noon, March 24, by S. S. Wheeler, Secy. Board of Trustees, Holland Bldg., Lima, O., for the necessary labor and material for the construction of a 10-in. vitrified pipe sewer with catch basin and outfall wall for the District Tuberculosis Hospital.

Newburgh, O.—Until noon, March 26, by J. W. Shimek, Clerk Board of Control, for the necessary labor and material for the construction of improvements on Hulda Ave., from the easterly city limits to East 109th St., including sewer and concrete culvert.

Youngstown, O.—Until noon, March 28, by Director of Public Service, for furnishing the necessary labor and materials for sewering Fairview Ave. and Hoffman St. W. H. McMillen is Clerk of the Director.

Enid, Okla.—Until noon, April 21, by E. R. Lee, City Clerk, for the construction of a lateral sewer in the Garland Addition of the city.

Muskogee, Okla.—Until 5 p. m., March 28, by Charles Wheeler, Jr., City Clerk, for the construction of sanitary sewers in Districts Nos. 20, 24 and 21.

Milwaukee, Wis.—Until March 28, by Board of Public Works, for the construction of sewers in West and South Sewerage Districts. Charles J. Poetsch is Chairman of the Board.

Mimico, Ont.—Until noon, April 4, by Industrial School Association, Toronto, Ont., for the construction and completion of a pipe sewer and appurtenances from a point on the premises of the Victoria Industrial School, Mimico, to the head of Seventh St., New Toronto, to connect with the New Toronto sewer system.

Water Supply.

Bids are asked on following work, the notes being arranged alphabetically by states:

Savannah, Ga.—Boiler.—Until 4 p. m., March 30, by Board of Aldermen, Savannah, Ga., for the furnishing of one 150-hp. boiler for the water works system at this city.

Meridian, Miss.—Until April 5, by Water Commission, for the construction of 8,500 ft. of 24-in. reinforced concrete conduit. William F. Wilcox, C. E. is General Manager.

Fort Bayard, N. Mex.—Until 11 a. m., April 12, by Capt. S. P. Vestal, Constructing Quartermaster, for the complete construction of an extension of post water main from the hay barn to the dairy barn with installation of a fire plug

Fort Sill, Okla.—Until 10 a. m., April 1, by Capt. David L. Stone, Constructing Quartermaster, for the extension of the water works system at Fort Sill.

Marietta, Pa.—Until noon, April 20, by Marietta Gravity Water Co., Marietta, Pa., for laying a submarine line of about 2,200 ft. of 10-in. universal cast iron pipe.

Milwaukee, Wis.—Until 10:30 a. m., March 24, by Board of Public Works, for necessary labor and materials required for the construction of house drains and water service connections on streets in First Ward, Fifth Ward, Seventh Ward, Twelfth Ward, Twelfth and Seventeenth Ward, Fifteenth Ward, Seventeenth and Eighteenth Wards.

Weyburn, Sask.—Until 8 p. m., April 27, by George Ross, Esq., Secretary and Treasurer, for the following work: Contract "A"—Pipe laying on the sewerage system. Contract "B1"—Water works pump house. Contract "B2"—Power house. Contract "F"—Mechanical water filters. Contract "G"—Water works pumping machinery. Contract "S"—Sewer pipes. Contract "W"—Furnishing wooden stave pipes. Contract "X"—Sewage disposal works. Willis Chapman, Winnipeg and Toronto, is Chief Engineer.

Miscellaneous.

Bids are asked on following work, the notes being arranged alphabetically by states:

Fort Logan H. Root, Ark.—Plumbing.—Until April 13, by Quartermaster, for remodeling plumbing in Lavatory No. 3.

Washington, D. C.—Rock and Sand Barges.—Until 10:30 a. m., April 18, by Capt. F. C. Boggs, General Purchasing Officer, Isthmian Canal Commission, Washington, D. C., for furnishing steel rock and sand barges.

Baltimore, Md.—Bulkhead.—Until 11 a. m., March 30, by O. F. Lackey, Harbor Engineer, for constructing a timber bulkhead at the old Marine Hospital property. Certified check for $300 required with bid.

Baltimore, Md.—Fire Boat.—Until 11 a. m., Mar. 30, by Board of Fire Commissioners, O. W. Wilkinson, Secretary, for furnishing and delivering one fire boat.

Cincinnati, O.—Hire of Boats.—Until 2 p. m., April 11, by Lieut. Col. J. H. Warren, U. S. Engineers, Cincinnati, O., for hire of three tow boats to serve as tenders for the Ohio River dredges during the present season.

Cleveland, O.—Vacuum Cleaning System.—Until 2 p. m., March 23, by County Building Commission, John J. Boyle, Secretary, for installing a complete vacuum cleaning plant for the Cuyahoga County Court House.

Fort Sill, Okla.—Electric System.—Until 10 a. m., April 13, by Capt. David L. Stone, Constructing Quartermaster, for the installation of an electric light and power plant and electric lighting system at Fort Sill.

Philadelphia, Pa.—Dredge Plant.—Until March 28, by City Department of Wharves, Docks and Ferries, for a municipal dredging plant, including hydraulic dredge, combination dredge boat and tug not less than 80 ft. over all, one or three dump scows.

Excavation, Earth and Rock.

Bids are asked on following work, the notes being arranged alphabetically by states:

Calgary, Alta.—Timber Work. — Until noon, April 1, by J. S. Dennis, Assistant to 2d Vice President Canadian Pacific Ry. Co., for the completion of the timber construction in the Western Section of the Irrigation Block.

Canon City, Colo.—Irrigation System.—Until April 5, by Kenefick-Quigley-Hoffman Construction Co., Canon City, Colo., for the grading, tunneling and masonry work included in the construction of an irrigation system. Work is also noted under Confirmed Reports in this issue and Official Advertisement.

Miller, Ind.—Drainage Work.—Until 7 p. m., April 1, by M. J. Zelibor, Town Clerk, for the construction of a drainage system consisting of 15,000 cu. yds. excavation, open ditch work and 2,100 lin. ft. of 36-in. reinforced concrete pipe. Official Advertisement will be found elsewhere in this issue.

Boston, Mass.—Dredging.—Until 11 a. m., April 2, by Bureau of Yards and Docks, Navy Department, Washington, D. C., for dredging at the navy yard, Boston, Mass.

Vicksburg, Miss.—Canal.—Until noon, April 6, by J. D. Laughlin, Chancery Clerk, for the construction of a canal in Sandy Bottom. Work is also noted under Confirmed Reports.

Bellefourche, S. Dak.—Earth Work.—Until April 7, by City Council for the excavation of a cutoff channel 30 ft. wide and filling of Poplar St., at the crossing of Hay Creek and for the construction of a 2-span pile bent bridge across said channel.

Evanston, Wyo.—Canal.—Until April 15, by W. Newbrough, M. Am. Soc. C. E., Chief Engineer, for the construction of the Covey Canal, near Cokeville, Wyo., including approximately 75,000 cu. yds. of earth and 2,000 cu. yds. of loose and solid rock. Noted also under Confirmed Reports in this issue.

Calgary, Alta.—Canals and Dams.—Until noon, May 1, by J. S. Dennis, Asst. 2d Vice-Pres., Canadian Pacific Ry. Co., for the construction of a complete canal system in the eastern section of the Canadian Pacific Ry. Co.'s irrigation block. Work includes about 25,000,000 cu. yds. of material. Noted also under Confirmed Reports. Official Advertisement will be found elsewhere in this issue.

Materials, Machines, Supplies, Etc.

Bids are asked on following work, the notes being arranged alphabetically by states:

Washington, D. C.—Wire.—Until March 24, by Chief Signal Officer, Washington, D. C., for furnishing 10,000 ft. of wire, messenger strand 3-in.; 2,000 ft. of wire cross connecting No. 19 B. & S.; 25,000 ft. of wire inside twisted pair No. 18; 2 miles wire, copper, hard drawn, bare, No. 12, 10,560 ft. of rubber insulated lead covered multiple conductor cable; 200 ft. of wire green instructment; 200 ft. of wire red; 200 ft. do black; 1 lb. magnet wire, triple cotton covered.

Washington, D. C.—Lining for Gun.—Until March 24, by William Crozier, Chief of Ordinance, Washington, D. C., for furnishing one lining tube for 10-in. wire wrapped gun.

Washington, D. C.—Launches, Pumps, Steel, Etc.—Until 10:30, April 5, by Capt. F. C. Boggs, General Purchasing Officer, Isthmian Canal Commission, Washington, D. C., for furnishing: Gasoline launches, boiler feed pumps, steel, boiler tubes, chain, bolts, rivets, screws, copper, Muntz metal, sheet zinc, sheet lead, lead pipe, bits, twist drills, taps, dies, pipe cutters, tube expanders, boilermaker's clamps, fusible plugs, cellar bolt keys, saws, timber carriers, files, jacks, pulleys, tallow pots, valves, vacuum gauges, cylinder cocks, paint and scrubbing brushes, water coolers, life preservers, hose, packing, gaskets, leather belting, chalk line, creosote oil, metallic brown, coach varnish, Aqua ammonia, paper, etc.

Washington, D. C.—Screens.—Until noon, April 1, by Capt. H. L. Pettus, Constructing Quartermaster, Walter Reed General Hospital, Washington, D. C. (Takoma Sub-station), for furnishing and installing door and window screens in hospital corps barracks, two single sets of officers quarters, one storehouse at the Walter Reed General Hospital.

Detroit, Mich.—Lumber.—Until 2 p. m., April 14, by Col. C. McD. Townsend, U. S. Engineer, Jones Bldg., Detroit, Mich., for furnishing and delivering at St. Mary's Falls Canal, Mich., about 2,630,000 ft. B. M. of timber.

Mt. Pleasant, Mich.—C. I. Water Pipe.—Until 7 p. m., April 1, by H. H. Hunter, City Clerk, for furnishing 6 to 12 in. water pipe and fittings weighing approximately 50 tons.

Madison, Nebr.—Pump, Etc.—Until April 6, by City Council for furnishing one motor, one pump and one horizontal tubular steam boiler. F. J. Dakners is City Clerk.

Fort Hamilton, N. Y.—Screens.—Until 11 a. m., April 1, by Lieut. Lawrence T. Walker, Constructing Quartermaster, for furnishing and installing door transom and window screens in new double barrack building at this post.

Governors Island, N. Y. H.—Lumber.—Until 1 p. m., April 16, by Col. O. B. Mitcham, Commanding Officer New York Arsenal, Governors Island, N. Y. H., for furnishing during the fiscal year ending June 30, 1911, burlap, cotton, cloth

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HALBERT P. GILLETTE
CHAS. S. HILL
C. T. MURRAY
F. A. SMITH
} EDITORS

MYRON C. CLARK . . . PUBLISHER
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CONTENTS.

Results of Percentage System of Bidding in Brooklyn, N. Y. . . . 281
Methods and Cost of Constructing a Reinforced Concrete Fence Around a Shaft Top . . . 282
A New Floor Construction of Separately Molded Reinforced Concrete Hollow Beams . . . 283
Methods and Cost of Steam Curing Concrete Blocks . . . 284
A Method of Depositing Concrete by Chutes in Building Construction With Costs of Actual Work . . . 286
Method and Cost of Snow Removal in St. Louis, Mo., by Flushing It Through City Sewers . . . 288
Effect of Motor and Horse Traffic on Macadam Roads . . . 288
Cost Data on Macadam and Gravel Road Construction in Peel County, Ont. . . . 290
A Road Roller with New Front Truck Arrangement and Improved Details. . . . 291
Some Methods and Cost of Building Reinforced Concrete Cisterns. . . . 292
Detail of Wood Insulating Joint Used in Mains of Hartford, Conn., Water-works. 293
Special Pipe Joint Used in the Baltimore, Md., High Pressure Fire System. . . . 294
Some Costs of Construction of the Cincinnati, Ohio, Filtration Plant. . . . 294
Representative Concrete Structures on the New York Barge Canal and Methods of Inspecting, Mixing and Handling Concrete . . . 295
Protection of Cross-ties From Mechanical Wear by Means of Plugs and Tie-plates and Estimates on Cost and Savings. . . . 297
A Collapsible Steel Horse and Trestle. . . . 299
Specifications for Erection of Railroad Bridges . . . 299
Cost of Patching Asphalt Pavement at St. Augustine, Fla., Using a Portable Repair Plant . . . 301

Results of the Percentage System of Bidding in Brooklyn, N. Y.

The Bureau of Sewers of Brooklyn Borough is unique among all the bureaus of public works in New York city in its practice of requiring the percentage system of bidding on practically all construction work. This practice has incurred the protest of the General Contractors' Association of New York as being unfair to contractors and unwise as public policy. In our issue of Jan. 12, 1910, we quoted from an open letter sent out by this association its objections to percentage bidding, and raised the question as to their sufficiency. We may say here that our purpose in making the remarks we did was largely to bring out discussion. Such discussion was presented in our issue of Feb. 9, 1910, in letters from the Aberthaw Construction Co., and from the General Contractors' Association. Both letters criticized the percentage system of bidding and both represented the contractors' side of the argument. No comment was had from engineers who practice or approve the percentage system and we again editorially presented their side of the case. A further reply to our remarks from the General Contractors' Association was published in our issue of March 2, 1910. To secure if possible the engineers' arguments so far lacking in this discussion except as stated by us, we requested a statement of their case from the engineers of the Bureau of Sewers of Brooklyn Borough and were forwarded in answer the 1909 annual report of Mr. Edwin J. Fort, Chief Engineer of Sewers. We quote from this report as follows:

The results obtained have been generally satisfactory so far as the city's interest is concerned in broadening competition, in maintaining prices at a reasonable or low figure, and in avoiding unbalanced bids, and the consequent use of outside influence in overruling the engineer in his plain duty in carrying out contracts according to their letter and spirit. I do not mean to assert that the system is without fault, for it undoubtedly has a number of faults, and from the contractor's point of view sometimes seems to be unfair. The arguments advanced against its use by contractors (who are quite generally opposed to it) and which undoubtedly have some foundation in fact, are as follows:

(1) That it is too easy for those not familiar with this class of work and the particular conditions in each case, to submit bids. The detailed estimate of cost given makes public certain information which is a part of the experienced contractor's stock in trade, which it has taken time and money to acquire, and which in all fairness he is entitled to the benefits of. The best of reasons must be advanced for not awarding contracts to the lowest bidders. It is a popular notion that there is a large profit in any kind of municipal contracts. The result is that many contracts under this system of bidding are awarded to incapable men; that the quality of the work is not the best, and that profits are a minus quantity. In many cases complications and delays which arise leave the city a loser even though prices bid are very low.

(2) An incompetent engineer is not capable of preparing sufficiently correct estimates, and the way is open for an unprincipled or dishonest one to enter into collusion with contractors to defraud the city by the preparation of unbalanced estimates.

(3) That as a general thing engineers are not as capable of estimating accurately the cost of a piece of work as contractors.

The report then gives the history of the conference held to discuss uniform specifications in all the boroughs of New York, nothing having been settled. The arguments made by the General Contractors' Association (printed in ENGINEERING-CONTRACTING, Jan. 12, 1910) are given and the following reply made:

While this is perhaps not the most appropriate place to discuss at length the points raised above, it may be said they are not unanswerable. Any new system of this kind must be judged by the results. If an engineer is incompetent or corrupt there would seem to be little justification for retaining him in the employ of the city, and if he were so retained the opportunities offered under this system of bidding are perhaps no greater than under the ordinary one. I venture the assertion that the standard of honesty among engineers is fully as high as among any other class of city employes, contractors or people of other occupations or professions.

Bids submitted during the past season varied among themselves from 10 per cent to 40 per cent, while the average of all bids submitted varied from the estimates of the engineer only 2.2 per cent. This would not tend to show any superior ability on the part of contractors in general to estimate accurately the cost of such work. There is much to be said in favor of uniform specifications throughout the different boroughs of the city, yet it is not at all essential that they should be uniform. Conditions vary greatly, and if any material advantage can be gained in one borough by a particular form of specification, it would seem as if as yet no sufficient reason has been advanced why the city should not have that advantage.

It is true that the field of competition has been considerably broadened by the percentage system of bidding and inevitably new and more or less inexperienced men have entered it. This has necessitated increased labor and vigilance on the part of the engineer to get satisfactory results. It has also materially increased the labor of preparing estimates. Some complications have also arisen with contractors that would not have arisen with men old and experienced in business, but on the whole the benefits have far outweighed these disadvantages. If uniform specifications are insisted upon, however, it seems as if this system of bidding must be abandoned, because there does not seem to be a disposition to undertake it in the other boroughs, and it is doubtful whether the necessary information has been collected in every borough to enable accurate estimates to be made.

During the first eleven months of 1909, bids were received upon 131 contracts for sewer improvements in which an engineer's estimate was presented with the invitation and upon which the contractors submitted percentage bids.

The average of the lowest bids upon the 131 contracts was 91.1 per cent.

The average of the averages of each set of bids was 102.2 per cent.

The lowest bid made was 76.9 per cent and the highest bid made was 200 per cent.

The prices given in the engineer's estimates were based upon the market prices of the materials and labor entering into the construction of the work. The cost of the transportation of the materials to the site of the work was taken into account and also the local conditions at the site of the work.

The cost of excavation in the trenches has varied from 30 cts. to $1.50 per cu. yd. The cost of pumping to keep trenches clear of water is an item that influences the cost of excavation greatly.

The cost data being collected by this bureau is admirable, and so far as it goes, is of great importance. It is, however, up to the present time too incomplete and special in character to be of use except as a check on our computations. This may be readily understood when it is considered that it goes back only about two years, and covers only a few special kinds of work; and it has been largely compiled during the carrying out of contracts for which this bureau did not have this data when preparing estimates.

It must be years before sufficient data of this nature can be obtained and digested in the form that is required for general use and application. Moreover, the use of cost data obtained upon work under construction is not without risk of error, especially as there is no means of determining from a record of actual cost of work, no matter how perfect it may be, whether the contractor directed his work wisely, and employed the most economical number of men for performing the various items of work, and whether the character of labor that he was obliged, on account of the labor market, to employ, was the best and cheapest for the purpose. Again, it is always doubtful, and cannot be otherwise, what accidents may occur on a job to incidentally delay the work, and make the cost of labor unduly high. In short, it must be acknowledged that cost data in the hands of an inexperienced man are always misleading and unusually dangerous. There is but one royal road to success in estimating the cost of a projected engineering project, and that is long professional experience in the construction of such work on the part of the engineers. This experience is usually a history of successes and failures in estimating correctly, and must be assisted by all available cost data, selected with discriminating knowledge as to what of it is, and what is not useful.

It cannot be too seriously urged that the cost of a sewer constructed under certain unknown labor conditions and financial exigencies, by a contractor, who may, or may not, have had the highest capacity or skill, is no actual criteria

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as to what a different kind of sewer (and no two are ever alike), will cost when built by a different contractor under different labor and financial conditions in a different location. Such cost data is of value only for use as a check on figures and financial conditions, and average weather conditions.

So far, it may truly be said that our cost data has only been available in a very few instances, and that for checking conclusions arrived at by our engineers from their long experience in anticipating average conditions and average expenses.

Bidders vary their bids for three main reasons, not to mention minor reasons. The first of these main reasons, is an assumption of average conditions surrounding the work to be done; the second is the probable cost of labor and materials, etc., under the assumed average conditions; and the third, is a spirit of competition purely. The ordinary contractor loves a gamble, "to take a chance and beat the other fellow," and this feeling sometimes overcomes a proper caution. The facility with which percentage bids may be put in furthers the gambling spirit, and makes for competition; at the same time it makes bidding by incompetent persons much easier than was the case under the old method of bidding. If the method is to be continued the interests of the city would be much served by the rigid enforcement of a rule that no bid would be received from a bidder who has not had sufficient experience in the kind of work proposed to know what it should cost, or how to perform it in the best manner.

The advocates of the percentage system of bidding certainly cannot get much encouragement from this record of experience. Indeed it disproves its own assertions of merit. There are several points that might be discussed in proof of this but we shall consider only one and that very briefly.

The percentage system of bidding encourages and develops a gambling instinct which has been hurtful to the calling of the contractor from time immemorial. At the present time the contractor and his business have a standing never before accorded and as the class improves the work improves and costs become more settled. Long training and experience develop the gambler into a quasi-manufacturer but whatever tends to keep the ranks recruited with irresponsible men and gamblers is not conducive to good work. It is opposed to public policy and should be discredited.

Whatever might be said in favor of the percentage system of bidding is nullified by this report from the city in which it has been given a thorough trial. The engineer recommends a rule to prevent any but experienced men being awarded contracts. City fathers are notoriously fond of a gamble and it is impossible to convince all the people that everything is all right if a man with a low bid is not permitted to take a contract. The courts when appealed to, as they often are, compel awards to inexperienced men who can show financial responsibility. A great defect then of the percentage system of bidding is that inexperienced, and, oftimes irresponsible, men will make no investigations for themselves but relying upon the judgment of the engineer will bid close to his figures.

Low costs and good methods must go together or some one will lose. Good methods come with experience and no collection of cost data, no matter how reliable, will make up for inexperience. Any system of bidding that encourages looseness in awarding contracts and runs the labor and cost of supervision up to an unduly high per cent cannot be perfect. The evils it brings may be worse than those it is meant to overcome.

The obvious thing to do is to employ competent engineers and keep them as long as they continue to develop. Encourage systems of cost keeping and study of work management so these men will each year be better fitted to control the spending of the public funds. Treat contracting as a serious business and not as a gamble so that ultimately a proper spirit of harmony will be developed and even the dread subject of unbalancing bids will be understood and it may be done at times openly when financial considerations warrant.

Concrete and Reinforced Concrete Section

Note: This section is devoted to methods and cost of constructing concrete and reinforced concrete structures. It will cover the selection, testing and proportioning of concrete materials; laboratory tests of concrete; concrete mixing, transportation and placing; fabrication and placing of reinforcement, and form construction and erection. It will also contain articles on new and interesting developments in the design of reinforced concrete.

Cost of Constructing a Reinforced Concrete Fence Around a Shaft Top.

BY F. LAVIS, M. AM. S. C. E.*

The following article describes the design and construction of a concrete wall or fence around the top of the shaft of the Pennsylvania R. R.'s New York tunnels at Weehawken, N. J. It was desired to build a fence which would not only be a protection against accidents by reason of persons falling into the shaft, but which would also be discouraging to the efforts of the small boy to climb on or over it and throw things down on passing trains. It was decided that the fence should be 8 ft. high and, of course, necessarily tight.

For about two-thirds of its length the space available on which it could be built was the width of the top of the shaft wall, 2 ft. 4 ins., one side of this being on the line of the property, the other having a shear drop of about 80 ft. to the track level. The rest of the fence at the ends of the shaft was on the property line with space to work on both sides, but the design was necessarily controlled by the conditions on the long sides, which are shown by Figs. 1 and 2, the former showing the outside and the latter the inside, during construction.

The land surrounding the shaft was held temporarily under lease from the Erie R. R., and was available for purposes of construction; this ground was approximately level with the top of the shaft wall.

In attempting to design a structure for the purpose indicated, both concrete and brick were considered, but concrete was preferred, as it would harmonize better with the concrete walls of the shaft. In the case of the plan to use reinforced concrete, which was finally adopted, it was also considered that should the fence be damaged in any way (it was situated in the yards of the Erie R. R.) there would be less liability of portions of it falling to the tunnel tracks below than would be the case if brick were used.

In designing a concrete structure, consideration was necessarily given to possible methods of construction. It was seen at once that a wall 5 or 6 ins. thick, with posts at certain intervals, would be sufficient to meet the requirements, but the principal difficulty seemed to be in devising some method of removing the forms from the inside of the wall; that is, the side next the shaft after the concrete had been placed and had set.

Fig. 1—Outside Face of Reinforced Concrete Fence.

The design finally adopted was made with the idea that the panels could be cast on the ground, face down, opposite where they were to be located and then up-ended into place. With this idea the side of the panels facing the shaft was made a plane surface, the outer side having the recessed panel and projecting coping. It was intended to cast and place the panels first and build the posts afterwards. The panel was 5 ins. thick through the recessed part, 6 ins. around the edge, and the coping 7 ins. It was realized that the panels would be heavy (with the form about 4 tons each) and difficult to raise, but it was thought that this could be done and by removing the sides and leaving the face form on during the raising, without injury to the concrete. By this method the inner face would of course have been finished before the panel was set up, thus avoiding working on the narrow ledge outside the panel, and no bolt holes through the concrete would have been necessary, as would be the case were the panels cast in place.

On starting construction, however, it was found that owing to numerous obstructions near the shaft, which had not been cleared

*50 Church St., New York, N. Y.

away as anticipated, the method outlined above would have to be modified. It was decided to cast the panels upright in place and it was thought at first that a derrick would be necessary with which to handle the forms. This would have been quite feasible of course, but expensive, especially as it would have required either two derricks or double the number of panel forms actually used.

Fig. 2—Inside Face of Reinforced Concrete Fence.

As there were two different panel lengths, it was possible to make part of the forms of one length and part of the other and have sufficient forms to keep them all in use with one gang and keep that gang continuously at work. This necessarily involved working at two different points, but there was no objection to this, especially as it was proposed to mix all concrete by hand on account of the small quantity involved and the limited amount which it was possible to place in one day; 4 panel forms were used and 4 forms for the posts.

The idea of using derricks was discarded on account of expense, especially as they would each have had to be shifted more than once; the use of a small gin pole or a small builder's derrick with a hand winch was proposed, but the method finally adopted for removing the back forms, as shown by Figs. 3 and 4, proved entirely successful and involved hardly any expense for plant beyond the purchase of a couple of single blocks, a few feet of rope and a very little extra lumber.

Each of the back panel forms was built in one piece and then cut into four parts, as is shown by Fig. 4; these four parts were bolted together, as may be seen in the complete form.

A double deck platform for getting the concrete into the top of the forms was built as shown by Fig. 3 and attached to this two slanting posts framed together at the top overhanging the form, from the cross bar of which was suspended the block and fall for hoisting the back forms.

The face forms for the front or paneled side were built up of three thicknesses of 1-in. boards, arranged so as to make the projections shown, the surface coming in contact with the concrete being of tongued and grooved clear hard pine. The surface of the back forms was made of one thickness of 1-in. hemlock plank covered with a layer of ⅞x4-in. tongued and grooved hard pine laid with vertical joints. The facing of the forms was fastened to a framework of 2x4-in. spruce. An attempt was made to build the panels without bolting through, except at the bottom, but it was found impossible to keep the forms from warping. Some additional bracing was added and three 2x4s were placed longitudinally on both sides, the whole length of the forms, and bolted through, the bolts being easily pulled through the concrete before the forms were removed. No further difficulty was experienced after this was done.

The panels were reinforced by one thickness of expanded metal, 3-in. mesh, No. 10 heavy. The ends of the panels projected 4 ins. into the posts and a layer of wool felt was placed on the ends of the panels to allow for expansion and contraction.

The posts were anchored to the foundations by two 1¼-in. corrugated bars, extending 18 ins. into the foundations, and for convenience of construction four or five small ½-in. bars 12 ins. long were placed in holes drilled in the wall under each panel, which helped to hold the panel in place until the posts were built. There were four ½-in. rods in each post, wired together diagonally every 12 ins., each rod extending 6 ins. into the foundation.

The concrete was 1:2½:5 mixture, stone screenings being used in place of sand; the stone was ¾-in. and was trap rock from the tunnels. In the panels a slight excess of fine material and equal decrease in the amount of stone was used. Very little difficulty was experienced in getting a good surface on the concrete in spite of the fact that the forms were 8 ft. deep and only 5 ins. wide, and part of this space was taken up by the expanded metal which was used for reinforcement. Expanded metal was preferred for reinforcement, as there was no difficulty in keeping it flat.

After removing the forms, the surface was slightly sprinkled by using a brush dipped in water, and after being thoroughly dampened was lightly rubbed with canvas or cement bags. This was found to give a much better surface than the use of a wooden float or cement block, as these tended to expose the stone in places. After the concrete had thoroughly hardened—that is, in about two weeks—it was given a second rubbing, which gave a very uniform texture and color to the surface.

The following table gives the unit costs per cubic yard of concrete and per lineal foot of fence and does not include any profit, the foundation concrete not being included in either case.

Item	Per cu. yd.	Per lin. ft.
Superintendence	$4.21	$0.82
Labor drilling holes for anchor bolts	1.28	.25
Materials drilling holes for anchor bolts	.19	.04
	$1.47	$0.29
Labor building forms	$2.06	$0.40
Materials building forms	2.34	.46
	$4.40	$0.86
Labor setting forms	$4.04	$0.79
Materials setting forms	1.02	.20
	$5.06	$0.99
Material reinforcement	$2.28	$0.44
Concrete materials	3.74	.73
Labor placing concrete	5.21	1.02
Materials placing concrete	.55	.11
	$5.76	$1.13
Miscellaneous	$0.44	$0.09
Interest	.23	.05
Totals	$27.59	$5.40

This fence was designed and built by the writer. Mr. C. A. Case superintended the construction.

A New Floor Construction of Separately Molded Reinforced Concrete Hollow Beams.*

During the past ten years a vast amount of concrete construction work has been done (designed on various principles by different engineers) in the United States and abroad, and it has stood up with a comparatively small percentage of failures. The systems mostly employed in the United States are of the solid slab type. This also was the case in Europe at the time reinforced concrete was introduced, but owing to the increase in the cost of lumber and labor, a cheaper method was sought and certain constructors designed a fireproof building system on entirely new lines. Instead of erecting falsework and pouring the concrete in place, it occurred to these constructors that it would take less work if beams were molded on the ground and hoisted to their respective places, forming the floor. This method, having at first been contested

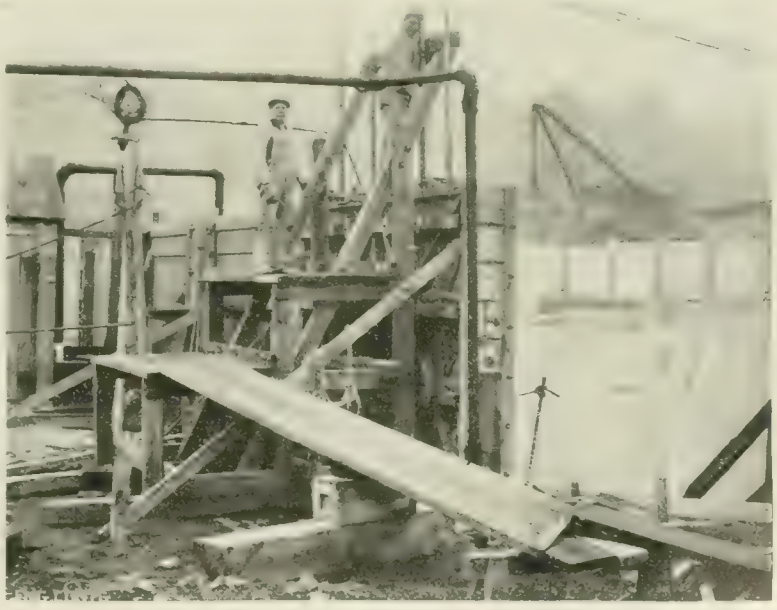


Fig. 3—View of Platform for Handling Concrete Into Forms.

*Condensed from an article furnished us by Theodore Ahlborn, Waterloo, Ia.

vigorously by the solid slab constructors, found its way to the public but slowly; but time has proved that buildings constructed on this system are quite as strong and far more economical than the solid slab types. Today it is safe to say that one-half of all the reinforced concrete buildings in Europe are constructed on what might be called the floor beam system.

Some constructors employed beams in the shape of a box, while others imitated the I beam. The first design has proved to be more economical than the latter. Recently the writer, who has had extensive experience in both the solid slab and hollow floor beam methods, has designed a novel section which he considers renders his system more economical than any of the floor beams designed heretofore. A description of this system follows:

It is known that the shape of a T used in the construction of a concrete beam is the most economical, but it has the fault that the flange does not always fulfill its duty, perhaps due to the lack of adhesion to the web, and also because it is difficult properly to place T beams without impairing their strength.

The reader will observe, Fig. 1, that the floor beam system devised by the writer is a series of T-shaped beams parted through the center line of the web and bound together where the flanges meet and having a thin slab connecting the adjacent web, thereby forming a hollow space and a smooth ceiling. The writer uses the parabola to form the air space, as he has found this to be the most economical way to secure the maximum strength with the minimum amount of material, and therefore the cheapest yet stronger construction. This also does away with the sharp corners in former T shapes where the web and flange meet.

After all the beams have been hoisted in place the small grooves, the shape of which, as can be seen in Fig. 1, is that of an I, are filled with cement grout, bonding the adjacent beams together and making the floor monolithic. Wire stirrups are also employed to aid in taking care of the shearing forces. These stirrups, the shape of which can be seen in Fig. 1, also have a hooping effect on the concrete. The writer also uses expanded metal bent to conform to the shape of the air space with a concrete margin to protect it from rust, acting in this case as a truss, therefore assisting materially to produce the claimed strength above earlier designs.

The beams are anchored to the walls and girders by means of iron anchors placed at certain intervals so that no lateral movements are possible. A floor beam system so constructed acts as a beam in one direction and as an arch in the other and tests have shown that a floor is considerably stronger than as calculated.

Fig. 4—View Showing Method of Handling Inside Panels of Forms.

The contract for the construction of the large-dry-dock and plant of the Western Dry Dock & Shipbuilding Co., at Port Arthur, Ont., has been awarded to the Canadian Stewart Co. at a figure in the neighborhood of $1,000,000. The Dry Dock Co. is assured of steady work for some time as soon as it is ready to begin operations, as it has orders for the construction of two big steel freighters. It is hoped that the keels can be laid next year.

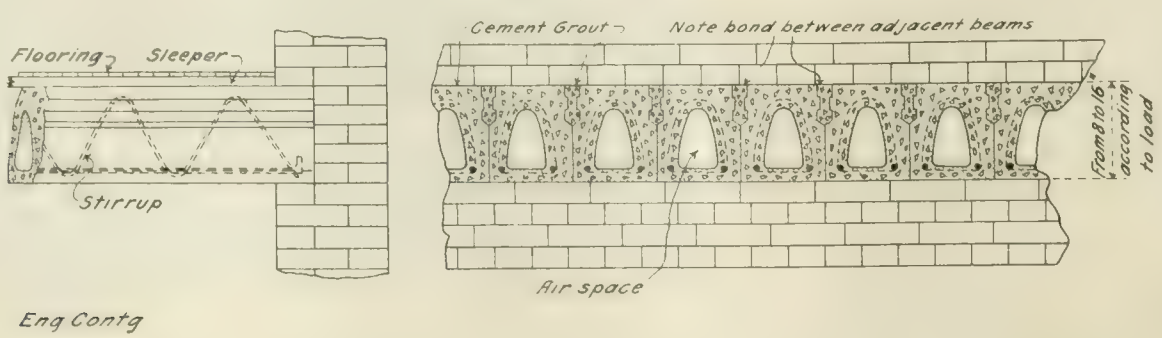


Fig. 1—Detail of Ahlborn Separately Molded Reinforced Concrete Hollow Beam Floor Construction.

Construction and Cost of an Inexpensive Steam Curing Oven for Concrete Block Plants With Some Notes on Operation.

The oven which I will describe to you is one which I highly recommend, and which has in my experience in the steam curing business proved satisfactory in every way. It is built 15 ft. long, 6½ ft. wide, and 45 ins. to the starting of the arch in height. The walls of the sides and the rear of these ovens are built of 12-in. smooth blocks. The arch is a true arch, giving you in the center of the oven about 7 ft. 3 ins. in height. These ovens allow us to use four three-deck cars, which allow about 100 to 125 blocks to the oven. The pallets we use are 32-in. pallets and we make blocks 4, 6, 8, 10 and 12 ins. in width. They are all 9 ins. high. Your pallets, if made properly, can be made of wood. The cleats must be well nailed and in using wide boards they will have to be ripped half way through on the under side to allow them to expand with the dampness and not to warp out of shape. This class of pallets has been used very satisfactorily and can be made out of any ordinary pine lumber, although white pine is better, but is very expensive. If pallets are made of the hard pine and properly cleated and nailed and when not in use piled in straight piles, you will find very little trouble in using the same with the steam curing. The iron pallets can be used very satisfactorily, but I would recommend that they be galvanized on account of there being some little danger of rust. While on this point of galvanizing I will speak of the cars. Any class of block cars is used very satisfactorily, but the iron of these cars above the wheels should be galvanized. This will do away with all trouble of rust. Although we are using some cars which are not galvanized, we do not have any trouble with the rust. Once in a while, however, and it seems to always happen when you make some special blocks, these cars cause trouble with rust.

Now to return to the description of the ovens; the arches to these ovens are 6 ins. thick, made of sand, gravel and cement, and reinforced with ½-in. corrugated bars, which are laid in 1 ft. apart running over the arch and running lengthwise of the arch. Your division wall answers for both arches, your arch being 6 ins. thick, wall being 12 ins., allowing two arches to rest upon one wall. By this method, when you are in need of a new oven, you only have to build one side wall, the rear wall and the arch. We use for laying our track in the oven old railroad ties, which we were able to buy second hand, sawing them off and using the best of them. Laying them about 2 ft. apart gives a very solid and substantial track. We have concreted in the bottom of our ovens so that they are very easy to be kept clean. We find that it is better to cement our floors around our tracks and around our block machine, giving you a chance to clean up and use all of the material and not having any waste like you do on the ordinary ground or cinder floor. The front of these ovens is entirely open and is covered

*Extracts from a paper by F. S. Phipps read at the 1910 convention of the National Association of Cement Users.

with the heaviest canvas that we were able to buy. In building our arch and side walls we use some ½-in. bolts, allowing them to project out 2 ins. and let them project into the concrete a sufficient distance to hold. Around the end of the ovens we bolted a 2-in. plank 12 ins. wide, covering the end of the arch with a 2-in. plank 6 ins. wide. The nuts of the bolts are sunken into the boards, giving a particularly smooth surface. We cut our canvas on a circle with the arch, and tack it fast with s ome strips of boards over the top, allowing it to roll up sufficiently high to allow the cars loaded with the blocks to be rolled in. When we have an oven full of blocks we roll the curtain down and have two or three laths and tack the edges fast. The weight of the roller at the bottom will hold it snugly to the floor, giving us the desired effect, as the curtain is used as a condenser and holds the temperature down in the oven. There should be directly over the front of the oven a ventilator of some sort to carry the steam that comes through the curtain out through the room of your building. This can be arranged as to the best advantage to the builder, but it is necessary, especially in winter time, for if you do not have an opening to carry the steam out it will collect on the ceiling of your shop and cause it to be damp and drip down on your work.

As to the steam pipes for the oven, we will start from the boiler with a 3-in. lead pipe, the pipe running about 18 ins. above the top of the arch. At each side of the oven we have a T on our lead pipe, reduced from the 3-in. pipe down to 1-in. pipe. This pipe runs directly down to within 1 ft. of the floor of the oven and about 3 ft. down on said pipe a valve where we turn the steam on or shut it off as wanted. At the end of the pipe, about 1 ft. from the floor, an elbow is attached and the same size pipe running along the side of the oven to the rear. At the rear end there is a cap placed on the pipe, closing it up. On the upper side of this pipe, that runs along the side of the oven every 15 ins. there is a ¼-in. hole drilled for the steam to escape. The steam comes out of these holes and passes up over the blocks; the blocks being cold causes the steam to condense on them very fast and fills the blocks with moisture.

The boiler that we are using is a 25-h. p. boiler, which is sufficient for twelve ovens the size we are using. It is a horizontal boiler, installed the same as any steam boiler would be for inside purposes, equipped with all the necessary fixtures, and is tested to carry 80 lbs. of steam. My advice is in all cases to have a good boiler, have it tested and carry your equipment the same as if you would carry 60 to 80 lbs. of steam. Twice a week we run the steam up to 15 to 20 lbs., blow out boiler and flues with the steam. By doing this you need never be afraid of the accidents that often happen to old boilers. You may be able to buy an old upright boiler or an old threshing machine boiler, but neither one will give you the desired effect that you need in this business. A good boiler installed properly and covered over with asbestos and the proper care taken of it will save you one-half in your fuel. You do not necessarily need to buy an absolutely new boiler, but buy a good second-hand boiler which can be bought very reasonably, have it overhauled and put in properly and have all new fittings and new pipe used, so that your joints are all tight and will not leak.

The tracks in your oven will depend upon the size of the cars you use. We use a 24-in. gage and a 7-ft. car, which allows us to put in four cars to the oven. We have expected to build some more ovens, but have not done so. I am going to build one oven a little wider than the rest of them so that our two tracks will set apart far enough to allow the car to be run in the center of the oven. By doing this way, when you have heavy material to steam cure you can handle it to a greater advantage by using cars where otherwise you will be compelled sometimes to carry it in and set it on the floor. The transfer track should be immediately in front of the oven. I have not seen any advantage in having doors in the rear of your oven. If you use the transfer car it is very easy to take the cars out and transfer them anywhere in the shop or yard.

The point I wish to impress upon you is that you must have your machinery for making the blocks as near the entrance of your ovens as possible, so it will not be necessary to transfer the blocks any great distance while they are green.

The Cost of Installing a Steam Curing Plant.—The cost of installing a steam curing oven will vary with the size of same. The size of oven that I have described, with an arch ceiling, will cost the ordinary block maker from $50 to $60, without the cost of the forms. The arch forms will cost for the making and lumber about $20 to $25, but it can be used to build as many arches as you wish. After having built one oven you have one side of the next oven. If you should build as many as four ovens you could safely say that you could build the ovens, including the arch form, for $40 apiece. Of course if you were building this for some one else you would have to charge more to receive a profit out of it, but these figures are a cost to the man who is in the cement block business.

The piping of the ovens, including the overhead pipe, will run about $12 per oven.

The boiler, the smoke stack, 25 h. p. in size, the fitting and the setting up ready for use ought not to exceed $225. You can make your own cement brick for bricking up your boiler or you can use blocks as you prefer. This can all be done by the block manufacturer himself; at least I have always been able to install the boilers and ovens without hiring any expensive labor. So that the cost of $250 for boiler complete and $40 apiece for four ovens, which is $160, and $15 for piping same, making a cost of $470, less than $75 per oven for four ovens, including everything except the track and cars that is used in same. With this class of curing ovens you will save one-half of the fuel over the ordinary upright exposed boiler and galvanized iron or plaster or tar paper oven. You would soon save the difference in the price between the cheap open and the concrete oven.

The small amount of coal that it will take to run a boiler under normal conditions will surprise you very greatly. A thousand pounds of coal will cure three to five ovens of blocks and at the price that we pay for coal, $2.25 per ton, or even figure it at $2.50 per ton, $1.25 will cure five ovens of blocks, making a cost of 25 cents per oven. You cannot hardly pay a man for sprinkling and taking care of your blocks for that amount of money. Of course your boiler has to be fired, it has to be filled with water, but you do not need a fireman all the time. He can do other work, and if you can keep a man in your factory at night he can unload the blocks that are cured and have your cars ready for you in the morning. Thereby the expense for firing your boiler and the cost of the coal will not exceed the expense of paying a man to take care of the blocks under the sprinkling or spraying process, so with the steam cure you will have the advantage of turning out the blocks in thirty to forty-eight hours and which I absolutely know is a better block than you can turn out in seven to fourteen days under the old process at no greater cost than it would to cure them under the old way, letting you use your material ten to twelve days sooner than you could use it otherwise and giving you a greater capacity for your plant, for when you have to pile the blocks out in the yard or in the shop it takes up a great deal of space.

Operation of a Steam Curing Plant.—A cement block to be good must have the proper amount of cement and the proper amount of moisture and must be tamped well to make a good product, whether you use the steam cure, sprinkle, spray or immerse. Do not think that the steam cure will make a good block out of a 1 to 6 proportion where you ought to use a 1 to 3 or 1 to 4. The sand and gravel differ as to the amount of cement that we should use and I am not discussing this point, but I want again to say that a poor proportioned block under the steam cure will make a poor block as well as under any other process of curing. In the extreme hot weather you should not let your blocks set more than two to two and one-half hours. Your ovens should be of such size and so arranged that they can be filled in this length of time. As soon as your car is loaded run it into the oven and in extremely hot weather close the curtain after each car is transferred in the oven. When you have the oven filled and the desired amount of blocks in the oven close your curtain and tack it at the sides. It depends greatly on the kind of weather and how quick the cement is setting that you are using as to how soon you must turn on the steam. This I cannot tell you. The only way is to use good judgment and the conditions that are around you. If the weather is hot and drying very fast and your cement is setting quick, you must turn the steam on immediately after closing your oven. You can turn that steam on so strong and wet your blocks so fast that they will become mushy and mash and ruin your product, but you must use judgment as to this; turn on a little steam and continue to do so until you have the capacity of your pipes. In some cases we have found it necessary to sprinkle in the ovens, but that is very seldom. We have a spraying process that we have used to some extent in reducing our heat and condensing our steam faster, but that you must learn from experience or from some one that is experienced and understands this class of work. In all cases carry your water high in your boiler. The one great point in the steam curing with my experience has been to carry the steam as moist as possible from the boiler to the ovens. Dry steam is not good for curing blocks; but do not give your blocks so much steam at the start that they will become mushy and will wash. We all well know that sprinkling will wash the cement from the outside and that there is a certain amount of the cement that is wasted, but with the steam the heat from the steam will start the block to setting and the moisture will sink into the block and you will not wash any of the cement from the block; therefore even if you could cure a block by sprinkling as good as you can with the steam you will not have as good a block for the reason that you have with the sprinkling process washed some of your cement from your block and with the steam you have not. In carrying the blocks immediately to the ovens after being made there is no chance for them to dry out as when you set them out of the building where the sun may strike them or even the current of air through the building will dry them out. When the steam is turned on you must turn it on gradually until you give the blocks the full capacity of the pipes. You must watch your boiler and not let your water get low and your steam become dry. The sound of the steam in the oven will tell you the amount of firing you need. We never allow our steam gage on our boiler to show any pressure above 3 lbs. and more often no pressure at all, and in most cases our blocks set 24 to 36 hours and are cured ready to be taken to the yard. Do not understand me that the block is as hard as it will get or as fully cured, but the point I am making is it is as good a block as you would have in 7 to 14 days under the old cure. It can either be taken to your yard or be loaded on your wagons and hauled to the jobs. We all know that blocks 24 hours old and cured by sprinkling cannot be handled with safety. The safer way is to cure your blocks from 36 to 48 hours. All of this refers to the semi-dry made block. The poured block or wet work, as we call it, does not need to be put in the ovens until it has been made from 12 to 20 hours. On this, 12 to 20 hours is sufficient to steam.

The poured work, if put into the oven immediately after making, especially if it has a troweled face and the steam turned on will scale, but if this class of work is left for 12 hours and then the steam turned on for 12 to 20 hours it will give you a product that is safe to handle and haul and to be put in a building. A great many times we have found it necessary to remove the poured work from the ovens after 6 to 12 hours of steaming and have found it very satisfactory. You can take poured work after being made 12 hours and turn the steam on full immediately after putting in the ovens without any bad effect.

A Method of Depositing Concrete by Chutes in Building Construction With Costs of Actual Work.

Depositing concrete by gravity through pipes or open troughs for considerable distances has been successfully practiced by a number of contractors during the past year or two. The most notable developments of the practice, however, have been made on the Pacific coast, where perhaps a score of important buildings have been concreted in this manner. While some notes of this work have been printed from time to time, no very clear account of the methods in detail or of its economy has appeared. The following description and notes are, therefore, of interest:

The "gravity system" of placing concrete as it is called, had its practical inception with F. O. Engstrum Co., contractors, of Los Angeles, Cal., and one of its more important early applications was in constructing the famous Christian Science Temple at Pasadena, Cal. It proved so successful in its earlier applications that this firm continued its use and gradually other contractors secured rights to employ it also. Recently all patents "pertaining to and embodying the principle of transporting concrete through a pipe or trough by "gravity" has been secured by the Concrete Appliances Co., of Los Angeles, Cal., and St. Louis, Mo., which proposes to dispose of to contractors by license the right to use the system.

The general practices of the gravity system will be best understood by referring first to the diagram plans of Fig. 1. The tower *A* carries at its top a concrete hopper *B* and a mast *C*, and at its bottom is a mixer *D* with material bins *E* and *F*. An elevator bucket *G* travels up and down the tower from the mixer *D* to the concrete hopper *B*; it receives the successive batches from the mixer, hoists them and deposits them in the feed hopper. Over one leg of the mixer in front of the hopper *B* is mounted on a step block a mast *C* which is guyed stable in the usual manner of a guy derrick. This mast revolves horizontally like a derrick mast. Just above the foot block the mast carriers an annular hopper *I* from which leads a pipe chute *J* in two parts connected by a horizontal swivel joint *K*. This pipe is supported by a boom *L* which is hinged and rigged to the mast as indicated.

In operation the concrete from the mixer is hoisted and deposited into the hopper *B*; thence it is discharged into the feed hopper *I* from which it flows through the chute pipe *J* and is run into the forms. The area "covered" by the mouth of the chute pipe is very wide. First the boom *L* has a swing of very nearly a full circle; second, the end section of the pipe beyond the swivel joint *K* has a horizontal swing of a full circle at any position of the boom and independent of the boom movement. The distribution of the concrete is, as will be observed, very flexible.

With the preceding general description, the application of the method may be more specifically illustrated by considering actual examples of work on which it has been employed. The first example selected is the Church of Christ Scientist at Pasadena, Cal. This structure is 120x120 ft. in plan and 120 ft. high with a central dome 60 ft. in diameter. The triangular tower shown by Fig. 2 was erected at the center of the building and all the concrete was poured with a single pipe line. One man handled the discharge. The cost of feeding the mixer, hoisting the concrete and delivering it in place was 12 cts. per cu. yd. The contractors were the F. O. Engstrum Co., Los Angeles, Cal. This same firm used the method in constructing the Majestic Theatre and Office Building in Los Angeles, Cal., and from a description of the work by Maybury & Parker, who designed and supervised the concrete construction, the following statement is taken:

A rather unique and uncommon method of handling concrete was employed on this building. In a convenient place, a tower was erected up one side of which the hoist track was placed and on a platform, some 30 ft. above the work on the building, was a hopper, with a capacity of two or three batches of concrete. This tower, track and hopper were elevated as the work progressed story by story. From the hopper, controlled by a gate, the concrete was run into a 7-in. galvanized iron pipe of movable sections and one or more ball-bearing joints, and delivered on the work where desired. Some difficulty was experienced at first by having either too small or too large a pipe, but it was found that a 7-in. pipe was about right, and by running a little water in the pipe before starting and afterwards to clean it out, little or no trouble was had. This gravity system was very satisfactory both to the contractor by reducing the labor force and to the engineer in charge, by doing away with the running over the form work and newly deposited concrete by a large force of laborers. It also gave a concrete of very uniform consistency in that if too dry it would choke up the pipe and if too wet the aggregate would separate. Properly handled it is very satisfactory.

Figures 3, 4 and 5 show the arrangement employed in constructing the pre-cooling ice plant for the Santa Fe railway at San Bernardino, Cal. This building is 1,212 ft. long, 132 ft. wide and 42 ft. high and contained 6,500 cu. yds. of concrete. The hoist tower was square and 172 ft. high, and concrete was passed from it to distributing towers. Figure 4 shows the method employed of supporting the pipe on top of the boom, and Fig. 5 shows the scheme of feeding two pipe lines reaching to two distributing towers. On this building a run of 253 cu. yds. of concrete in

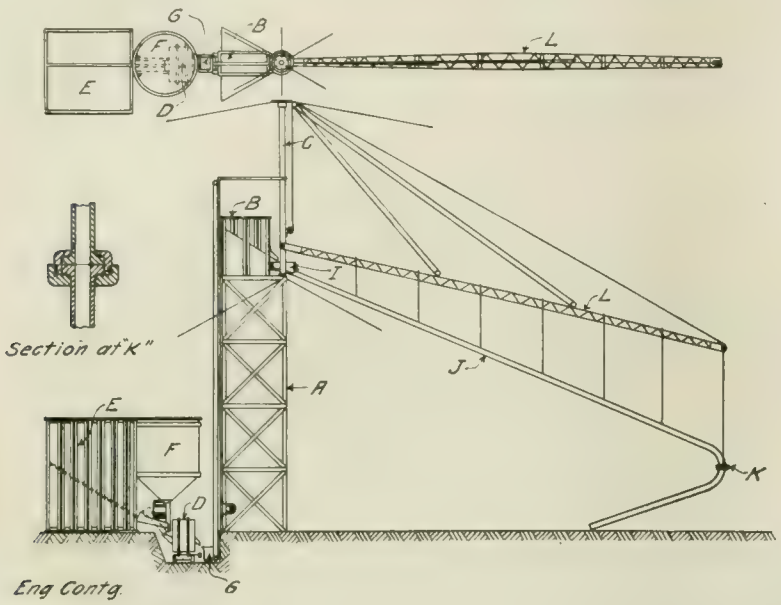


Fig. 1—Diagram Showing Arrangement of Mechanism for Depositing Concrete by Chutes.

Fig. 2—View of Triangular Tower and Chute Concreting Roof of Church Building.

9¼ hours was made. The cost of feeding the mixer, hoisting the concrete and distributing it in place was 21 cts. per cu. yd. The concrete was at times delivered 502 ft. from the mixing plant.

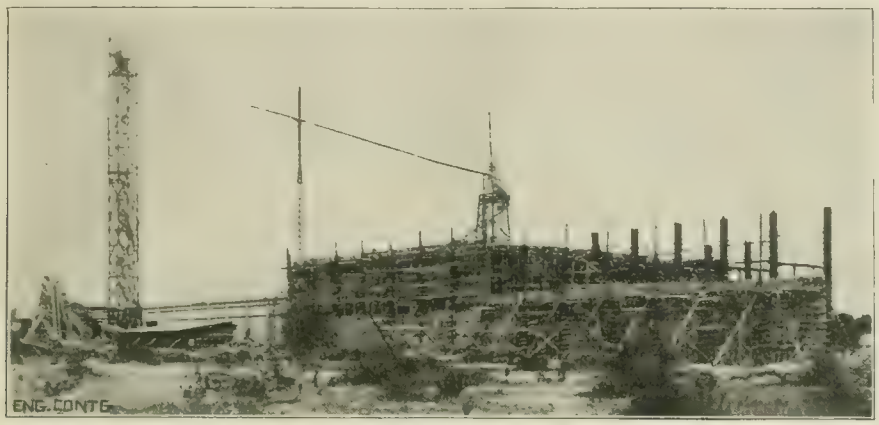


Fig. 3— Method of Chuting Concrete from Main Tower to Distributing Towers.

From a letter to us from H. W. Bryson, Manager, F. O. Engstrum Co., by whom the several buildings described were constructed, we quote the following:

Our firm, together with several other large contractors, have used the system for the last year during the issuance of the patents and they have found it successful, economical and practical from every standpoint. The photographs we are mailing you speak for themselves. They are among the largest buildings of the kind on the Pacific coast. I add without hesitancy the practical operation of the gravity system has excited keen interest among architects and engineers on the Pacific coast, and each is liberal in praises. The system has been tested and compared with the old wheelbarrow and cart deliveries of concrete from every standpoint by the highest authorities, and it excels in all points claimed. I write solely from the contractor's standpoint and not as one interested financially in getting an apparatus on the market for financial reasons. There is absolutely not a share of stock for sale.

The main points of superiority of this system over the wheelbarrow or cart method of distributing are as follows:

(1) The obtaining of the initial set of the concrete on account of the rapid handling of the mass and depositing the material into the forms in the shortest given time.

(2) A uniform homogeneous plastic mixture due to the large quantity which can be poured at one time.

(3) The unlimited variation of design of buildings to which it is adapted, from the simple foundation and dam work, to the most complicated dome, column and frieze work, such as found on tall buildings and overhanging cornices.

(4) The use at all times of a standard equipment for the entire process of mixing, transferring and pouring, and which can be executed at a minimum expense.

(5) The saving of breakage of hollow tile and displacement of steel on floor work, also saving of the spilling of concrete and cost of cleaning floors and beams afterward, which cannot be avoided when using the wheelbarrow or cart method. Also the cost of labor and material in building runways.

(6) The assurance of deep, narrow walls being perfectly filled.

(7) The handling of large quantities, the output being limited only by the mixing and hoisting capacity of the plant, thereby effecting a monolithic construction.

Quality is always to be considered first. This system absolutely assures the quality. Next in importance is that of cost. In this respect this system excels all others by comparison. The old wheelbarrow method of mixing and distributing costs per cubic yard from 60 cts. to $1; by the use of carts it runs from 40 cts. to 75 cts.; by the use of "gravity system" it costs from 15 cts. to 25 cts. This is the most apparent saving, but there are many others of vital importance, such as delay to work due to the shifting of planking or platforms and staging, the displacement of tile, steel, etc. The putting up and taking down of scaffolding is uncertain as to cost and very often a slow process. The patching and replacing of concrete which sets prematurely is avoided. The use of tampers is not required.

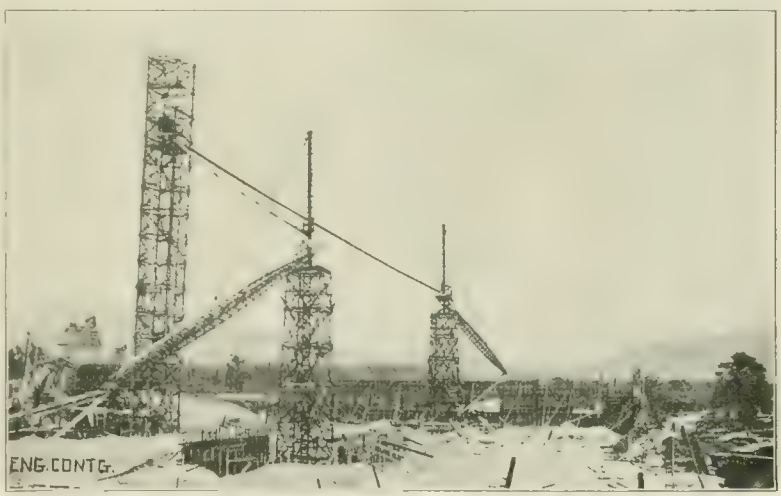


Fig. 5—View Showing Method of Chuting from Main Tower to Two Distributing Towers.

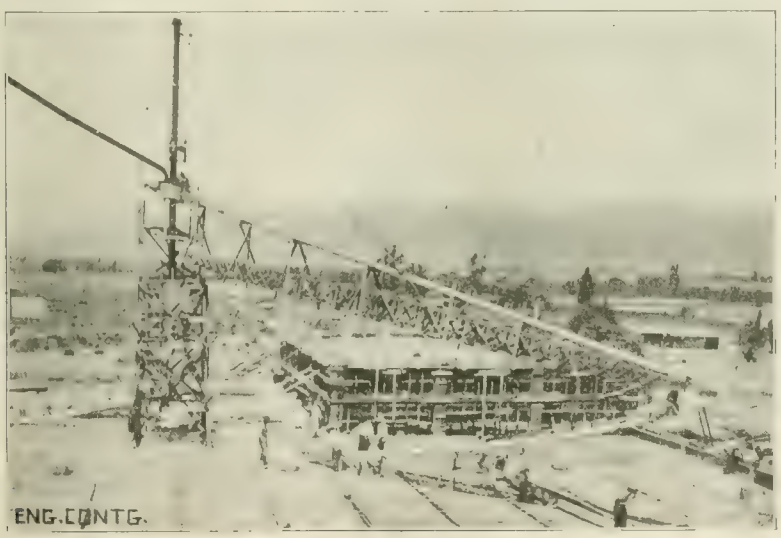


Fig. 4—View at Distributing Tower Shown by Fig. 3.

Shovel Record Broken on Panama Canal.—On Mar. 5, 1910, all records for daily excavation since the commencement of work on the Panama Canal were broken by steam shovel No. 213. During a working day of eight hours this shovel excavated 4,009 cu. yds. of rock and earth. It required 211 Lidgerwood flats to contain the material removed in loads. The shovel was under steam 8 hours, was actually digging 7 hours, and was waiting for cars, etc., 1 hour. Other high daily records were also made. During the same day 16 shovels working in the same district excavated a total of 26,152 cu. yds. of rock and earth. The shovels were under steam 128 hours, the actual time spent in digging being 83 hours and 50 minutes. On Feb. 26 16 shovels excavated 25,968 cu. yds. of rock and earth in actual working time of 93 hours. During the month of February the total amount of material excavated in the Central Division was 1,546,267 cu. yds, of which 413,131 cu. yds. was classified as earth and 1,133,136 cu. yds. as rock. Of this quantity 1,503,223 was removed by steam shovels. The high record for the month was made by shovel No. 214, working 23 days in the Culebra district, which excavated 50,677 cu. yds. of rock, approximately an average of 2,200 cu. yds. per day.

Cost of Cleaning Catch Basins.—At Cambridge, Mass., during the year ending March 31, 1909, 2,742 catch basins were cleaned, the average amount of material removed being 2.15 loads per basin. The cost of cleaning was $2.92 per basin and $1.81 per cu. yd. of material removed.

John Ferguson Co., of Paterson, N. J., have been awarded the contract for the buildings to be erected at Cape Charles, Va., for the New York, Philadelphia & Norfolk Ry. Co. The contract calls for a power plant, machine shop, erecting shop, blacksmith shop and a roundhouse. Work will begin within 30 days.

Roads and Streets Section

Note: This section is devoted to methods and costs of road and street construction. It will cover road building in all its details, the construction of pavements, sidewalks and gutters, the testing and use of paving materials and the machinery and tools used in road building and paving.

Method and Cost of Snow Removal in St. Louis, Mo., by Flushing It Through the City Sewers.

Snow removal from city streets is emergency work involving a sudden and large increase in the street cleaning forces. It cannot be foretold when the task will occur or what its magnitude will be. When it comes it has to be performed and performed with dispatch; cost is an almost negligible factor in comparison with these necessities. It thus comes about reasonably enough that few of the operations of keeping clean streets are ordinarily performed at such high cost and with such makeshift organization and apparatus. Recently, however, there has been more attention paid both to methods and facilities than formerly. Machinery has been introduced to a considerable extent in place of hand labor and systems of collection and disposal have been more carefully planned. It is a matter of interest then when an efficient and economic method comes to notice, such as has been worked out in the city of St. Louis, Mo., during the past winter.

St. Louis, like Boston and a good number of other large cities, cleans its streets from snow as it does its other street cleaning work by city forces. The department of streets handles the work with its own men and apparatus augmented when occasion demands by hand labor and machines. The special system described here is more particularly that employed in the retail business district shown by the sketch map, Fig. 1. It is one developed by Mr. James C. Travilla, commissioner of streets, and we are indebted to him for the information given here concerning it. Simply described it consists in collecting the snow by scrapers and by hand sweeping and hauling it to special snow traps built over the main sewers into which it is dumped and flushed away by hose streams.

Referring to Fig. 1, the solid black circles show the locations of the snow traps. The outline circles indicate the stations where the foremen are stationed to direct the work. The snow cleaning force comprises the regular street cleaning forces and apparatus, to which are added the men and teams of the garbage collection force and when necessary hired teams. Immediately after each fall of snow the inspectors, foremen, laborers and teams report to their assigned stations and the work is directed by the foremen and inspectors, who so distribute the force and arrange the hauling that there is a minimum of congestion.

In collecting the snow use is made of road machines to supplement hand labor wherever their use ensures economy. The hauling is done in wagons and carts. It is the experience of the department officials that the most convenient vehicles are the end dump carts belonging to the garbage collection service; these carts discharge conveniently and cleanly into the snow traps. Figure 2 shows one of these carts dumping its load. Next to these carts bottom dump wagons with straight sides dump with least trouble. Bottom dump wagons with enlarged tops and flaring sides cause trouble from the wedging and arching of the snow. Slat bottom wagons are most inefficient, the load having to be shoveled out.

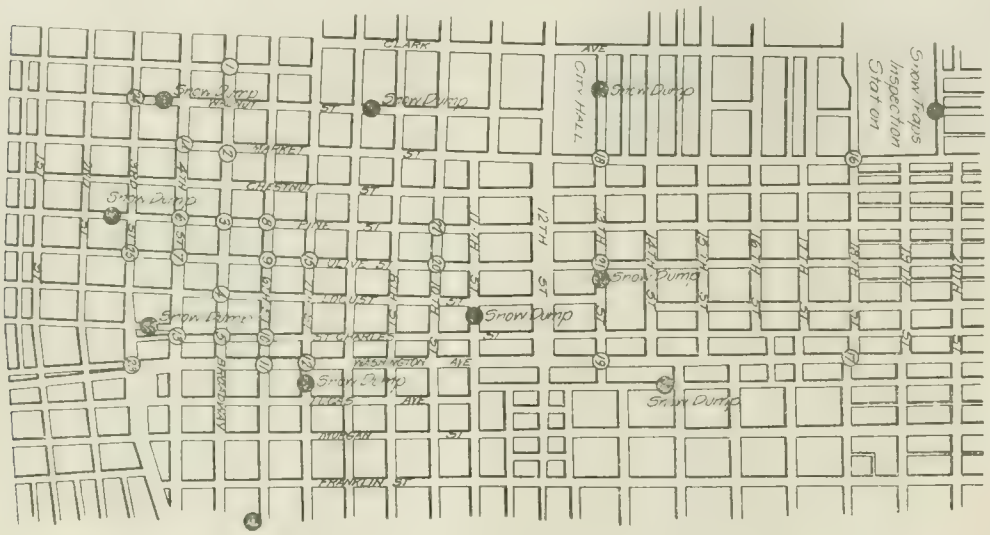


Fig. 1—Plan of Business District of St. Louis Showing Location of Snow Traps and Foremen's Stations.

A view of one of the snow traps is shown by Fig. 2. The actual construction of the trap is shown by Figs. 3 and 4. Fig. 3 shows a cross section, longitudinal section and top view of the trap. The covers are of iron plates, but these are placed next the curb during the time of snow removal, as shown by Fig. 2, and the wooden trap cover, shown by Fig. 4, is used. Men having hooks in their hands pull the cover over the hole so the team may walk across. When the wagon is in position the cover is hooked on to and slid endways until the hole is open enough to receive the load. The water is allowed to run all day and is turned on and off by means of the valve shown, this valve being operated by the hook used on the trap covers, a hole being made in the valve handle for this purpose. It should be noted that there is no heating of the snow. The water from the city mains impinging with great force on the snow quickly melts it and there has been no trouble at any time from clogging or freezing.

The snow traps as described above have cost on an average about $365 each. The cost of individual traps is governed both by the depth of the sewer and by the work required to connect the water pipe and trap nozzle. The cost of snow removal by this system obtained by dividing the quantities removed into the total cost figures out about 16 cts. per cu. yd. The wagons and carts used are figured carefully for volume and the yardage of snow is obtained by multiplying these volumes by the number of trips.

While owing to the fact that local conditions determine the cost of snow removal, a comparison of costs in different cities is not of great value, yet it is of interest to note the above costs in connection with the costs given in the report of Mr. Samuel Whinery, published in our issue of Dec. 22, 1909. Mr. Whinery gives the cost of removing snow per cubic yard in Boston and in New York as follows in 1906-7:

Boston	55 cts. per cu. yd.
Manhattan and Bronx	16½ cts. per cu. yd.
Brooklyn	21½ cts. per cu. yd.

In Boston the work was done by the street department forces and in New York it was done by contract.

Summarizing, the work in St. Louis is notable for the thoroughness of the organization which has been developed in the street department forces for this emergency work and for the means of disposal which has been devised.

Fig. 2—View Showing Snow Being Dumped into Traps.

Effect of Motor and Horse Traffic on Macadam Roads.*

Previous to the introduction of the motor vehicle, the broken stone or macadam road met the conditions of rural horse-drawn traffic better than any other type. Under fast motor traffic, the macadam road has proved to be quite unsatisfactory. Perhaps a clearer understanding can be had of the difference in effect between motor and horse traffic on road surfaces by a brief review of the development of the broken stone road.

*Paper read by Logan W. Page at the National Legislative Convention at Washington, D. C.

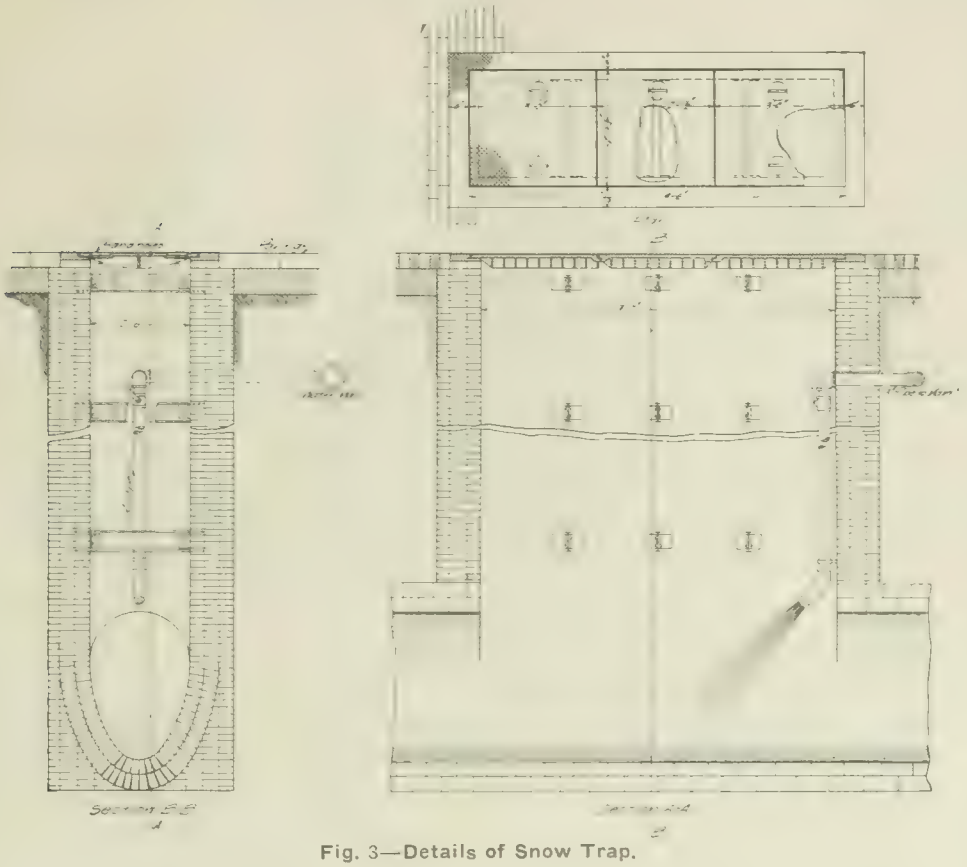


Fig. 3—Details of Snow Trap.

There is little doubt that the use of broken stone on roads antedates history. The first treatise written on the subject, however, was by a French engineer named Tresauget, in 1775; and the world is indebted to Tresauget for devising the first system of continuous road repair. This system is admirably exemplified by the French government in the maintenance of its splendid roads. Forty years later valuable contributions were made by MacAdam and Telford in England, and in comparatively recent years the introduction of time and labor saving machinery has done much to perfect and lessen the cost of construction.

The modern broken stone road is the result of a slow development and is designed to meet the requirements of horse drawn traffic. In this type the rock dust fills the voids between the stones and acts as a cement or binder. Under ideal conditions this road should be constructed of rock so suited to the volume and character of horse drawn traffic that only enough fine dust is worn from the stones of which it is composed to take the place of that carried off by wind and rain. When these conditions are met the fine dust resulting from the wear of traffic forms with the stone a smooth, impervious shell, shedding the surface water and protecting the foundations.

It was quite generally believed by engineers before the introduction of motor traffic that at least 60 per cent of the wear on roads was due to the action of horses' feet. Consequently when the motor vehicle was first introduced, engineers and others having charge of roads welcomed this new type of vehicles, believing the soft pneumatic tire would have rather a beneficial effect, if any at all, on the road surface. As the number and speed of motor vehicles increased, however, it was soon found that the cost of maintenance also increased, until at the present day most highway engineers consider the old method of constructing and maintaining broken stone road increasingly inadequate, and are experimenting with every known type of binding material other than rock dust to cement the stones together.

The first effect observed from fast motor traffic was an excessive amount of dust raised from the road surface, and many theories were advanced to account for this phenomenon, which is obviously injurious to the road. Aside from the minor effects of the motor vehicle on macadam roads, there are two very distinct ways in which the principal damage is done. The first is the tangential stress or the tendency of the rapidly moving car to leave the road at curves, which subjects the surface to great transverse strains where the ordinary crown or camber is used. This difficulty may be easily overcome by raising the outer side of the road. The other injurious effect is the shearing stress of the driving wheels on the road surface. This action is very similar to a circular saw going through a board, and it is a matter of common observation that the dust from a road surface is thrown up almost entirely by the rear or driving wheels. The effect on a road subjected to much fast motor traffic is to denude the surface to a great extent of the fine binding material, which results in the larger stones in the road becoming loose. It further results in greatly increased tractive resistance, and water makes its way freely to the foundation, and a general disintegration of the surface takes place.

As the pneumatic tire wears off no fine dust to replace that carried away by wind, rain and traffic, it can be seen that as motor traffic increases a point is reached where the type of road has to be changed. This point varies with the volume of horse traffic and the volume and speed of motor traffic. Although this seems a paradox, this condition may be said to be in part brought about by a failure of the motor vehicle to produce sufficient wear on the road surface. A great deal of work has been done in the past few years by engineers and chemists to meet this new condition, and I think it quite safe to say that it has been satisfactorily met as far as either type of traffic is concerned. We can build a road that will perfectly suit horse traffic, or we can build one that will perfectly suit motor traffic, but no type of construction has been devised for satisfactorily meeting both classes of traffic. Roads built of brick, concrete, bituminous materials and the various dust inhibitors are subjected to little or no wear from motor traffic, but are worn out by the action of horses' feet and narrow tired, overloaded horse vehicles. Besides, these types of hard pavements are quite injurious to horses.

In 1908 the republic of France held an International Road Congress at Paris for the purpose of considering the adaptation of highways to modern traffic. There were 27 nations officially represented, as well as many interested organizations and municipalities. It was decided at this congress that at low rates of speed the motor vehicle was "no more injurious to the road than ordinary traffic, but at high speeds the motor car causes the disintegration and destruction of the road." Experiments conducted by the U. S. Office of Public Roads seem to bear out this conclusion, as photographs taken of the motor cars moving at various rates of speed from 10 to 20 miles an hour show comparatively little dust, while at speeds of over 20 miles, the dust increased in proportion to the speed. Quite recently I addressed the following question to all of the state highway commissions and a number of highway engineers: "At what rate of speed do you consider motor vehicles to be more injurious to the ordinary macadam road than horse drawn vehicles?" Answers have been received from about one-half those addressed, and the majority of these experts state that at speeds not exceeding 20 miles an hour motor traffic is not more injurious to the ordinary macadam road than horse traffic. This comparison involves not merely speed as a factor, but also taken into consideration the destructive action of horses' hoofs, narrow tires and heavy loads.

Briefly, the situation as we find it today is that the automobile at the speeds at which it is generally run on the public highway is injurious to the ordinary macadam type of construction and the horse vehicle is injurious to the road surfaces treated for dust prevention.

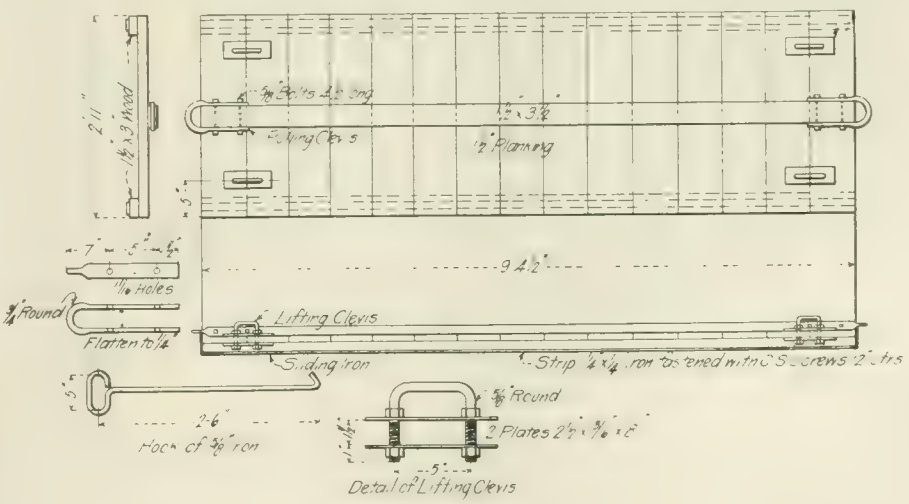


Fig. 4—Wooden Cover for Snow Trap.

The great problem confronting highway engineers is therefore to determine how this situation is to be met. There are laws in almost every locality in this country designed to limit

the speed of automobiles to a sufficient extent to prevent their seriously damaging the road, but nowhere that I know of are these laws enforced, nor do I believe it practicable to enforce them. If we cannot control the speed of motor traffic in the infancy of the motor era, how can we expect to cope with it in the future, when we consider that cars are being manufactured now at the rate of about 10,000 a month?

In my judgment the wisest traffic regulations are those enforced quite generally in France and England. They prescribe no arbitrary speed limit, but empower police officials to make arrests for reckless driving, whether the speed be high or low. It must be apparent that there are conditions under which a speed of 10 miles an hour is far more dangerous than 40 miles an hour under other conditions. These regulations take into consideration not only speed with reference to existing conditions, but the care and skill of the driver. I believe the automobile associations can render incalculable service by throwing the weight of their influence actively on the side of the safe and sane use of the public road. The great majority of automobile owners condemn the speed mania and reckless driving, and many associations have officially placed themselves on record for a conservative use of the road.

It was estimated that on November 1, 1908, there were in the United States about 150,000 automobiles with an original value of upwards of $250,000,000. The output in 1908 was 55,000 cars, for 1909 about 80,000, and preparations have been made for the manufacture of from 175,000 to 200,000 in 1910. This development is all the more remarkable for the reason that this industry was only begun a few years ago. Almost the entire output of cars has been for passenger transportation, but I believe the next ten years will witness a great development in freight transportation on public roads by motor vehicles. Last August the Massachusetts Highway Commission made a census covering a period of a week of all traffic passing over the state highways. There were over 200 stations where records were taken, and the results showed that 42 per cent of the entire traffic over these roads was motor traffic.

The horse is limited in power and speed, but so rapid has been the development of the country's agriculture and commerce that in spite of the advent of the motor vehicle the number of horses in the United States increased from 1900 to 1909 over 4,000,000, and their value has trebled. Wherever a road exists with a smooth, hard surface, the horse should be outclassed by the motor vehicle in the transportation of commodities to markets and shipping points. I do not believe it too prophetic to say that motor transportation from the farm to the market will contribute much to lessen the cost of food. Mr. Blackwall, an eminent English engineer, makes the following statement in regard to this point:

"It may be taken now as a fact, whether the majority of the public like it or not, that haulage by traction engine is cheaper and more reliable than horse traffic for all heavy work, provided the roads are fit to carry it. The use of the traction engine is therefore bound to increase, and highway authorities must make up their minds that the strength of the roads must be proportionately augmented to meet the requirements. A proof of this may be found in the growing difficulty experienced by highway authorities to prove a claim against traction engine owners for extraordinary traffic."

As an example of this, large supplies of food products from the territory surrounding London are transported to the city in trains of cars drawn by traction engines, and these trains return to the farms with manure and other necessary supplies. The value and economy of motor transportation in cities for freight has been demonstrated, and the economy of building roads over which it can travel in the country will become more and more evident to the tax payers in rural districts. Already the farmers are becoming owners of motor cars, and when this conservative element of our population utilizes to the fullest extent the advantages offered by the motor car for business purposes, much of the prejudice and many of the faults attendant upon the present opening automobile era will disappear.

In my judgment, much unwise legislation is being indulged in, both in relation to speed and taxation of the motor car, which will have to be repealed or ignored later on. Excessive taxation and unreasonable speed regulations will only retard the development of motor transportation along the more useful lines. Legislation now against a rich man's toy may later on be against a poor man's economy. The only points of superiority which this new means of transportation possesses over the horse drawn vehicle are power and speed, and it is only by the exercise of these agencies that it can be useful to man. The dust nuisance did not originate with the motor vehicle, but as a matter of fact the dustless road has been developed to meet this form of traffic.

A curious phase of this controversy was recently developed in London by some automobile enthusiasts, the automobilists claiming that the horse involves far more expense upon the maintenance and street cleaning department of the city government, and is a much more serious menace to health than the automobile, and in urban districts there is much truth in this assertion. If the street departments of our cities had only motor traffic to contend with, the scavenging bills would be very much lessened and dust reduced to a minimum. From this, together with the fact that about 99 per cent of all house flies are bred in manure, it can readily be seen that public health would be greatly benefited by the substitution of motor vehicles. This, however, is a phase of the subject beyond the province of the highway engineer, who for many years to come will be occupied in designing roads to meet both classes of traffic, and where motor traffic is sufficiently great, in constructing dustless roads.

Cost Data On Macadam and Gravel Roads Construction in Peel County, Ontario.

A considerable part of the road improvement work in the Province of Ontario, Canada, is done under the County System, according to the regulations of the Provincial Public Works Department. At the recent meeting of the Ontario Good Roads Association Mr. C. R. Wheelock, County Engineer of Peel, read a paper, giving some little cost data on several roads built in 1908 and 1909 on the County of Peel road system. The matter that follows has been actuated from Mr. Wheelock's paper.

The wages paid on the road construction work in 1908 and 1909 were as follows:

	Per day.
Ordinary laborers	$1.50 to $1.75
Road foremen	2.00 to 2.50
Machinery engineers	2.50
Teams	3.50 to 4.00

The cost of operating road machines was from $13.50 to $14.50. In some cases traction engines were used on the road machines instead of horses, with good results. The cost of operating was less, and it is estimated that on a clay road and in hot dry weather nearly twice as much work can be done.

The cost of operating the steam rollers was from $3.90 to $4.50. To this may be added the cost of sprinkling, $4 per day, making the total for rolling and sprinkling about $8 per day.

For the roads in the south part of the county crushed stone was brought in by rail, as satisfactory local material was not available. This added very much to the cost of these roads, as in some cases the freight was double the price of the stone, f. o. b. at the quarry.

The accompanying tabulation shows the actual cost of nine roads built in the county in 1908 and 1909.

Road No. 1 was surfaced with crushed stone. The road was well graded, knolls being cut down and hollows raised. The metal was consolidated into a steam roller. As no local material was available, crushed stone was brought in by rail. The freight on about one-half the stone was 65 cents per ton, and on the remainder, which was delivered at another station, it was $1 per ton. The price of the crushed stone f. o. b. at the quarry was 50 cents per ton.

Road No. 2 was surfaced with pit gravel. It was well graded. The gravel was spread evenly on the road early in the summer, without being rolled, and in the fall when the gravel was partly consolidated by the travel over it, it was gone over a second time, the ruts filled and the road recrowned.

Road No. 3 was surfaced with crushed stone and was similar to road No. 1, except that there was a greater depth of metal, and that the stone was all shipped to the same station, the freight being 65 cents per ton.

Road No. 4 was an old stone road, wide and flat on top. The grading consisted mainly of cutting off the shoulder, although in some places it had to be regraded and ditched. Crushed stone was placed in the center of the road for a width of 9 ft., and along each side of this was placed a strip of pit gravel about 3 ft. in width, forming a boxing for the stone and making the total width of metal about 15 ft. The metal was well consolidated with a steam roller.

Road No. 5 was surfaced with crushed stone. It was similar to road No. 1, except that the stone was all shipped to the same station, and that the freight was 60 cents per ton, and the stone f. o. b. at the quarry was 65 cents per ton.

Road No. 6 was surfaced with pit gravel. It was similar to road No. 2.

Road No. 7 was surfaced with crushed stone, and the construction details were similar to road No. 3.

Road No. 8 was surfaced with crushed stone and screened gravel. It was well graded, the knolls cut down and the hollows raised. The metal was well consolidated with a steam roller. The metal used was a coarse gravel mixed with stones, which was run through the crusher and revolving screen.

Road No. 9 was surfaced with gravel and clay. This was a short piece of road built as an experiment. The soil was very light sand.

TABLE SHOWING THE COST OF 9 ROADS IN PEEL COUNTY, ONTARIO.

Road No.	Width of grade. Feet.	Cost of grading per mile.	Class of metal.	Width of metal. Feet.	Depth of metal. (Consolidated). Inches.	Freight on metal.	Length of haul for teams for metal. Miles.	Cost per mile.	Total cost per mile.
1.	28	$126	Crushed stone.	[illegible]	[illegible]	$1,304	13¼	$3,145	$3,271.00
2.	24	195	Pit gravel.	[illegible]	[illegible]	Local	1	685	880.00
3.	24	175	Crushed stone.	[illegible]	[illegible]	1,005	3½	3,557	3,730.00
4.	27	145	Crushed stone & pit gravel	15	4	857	3½	2,170	2,315.00
5.	27	200	Crushed stone.	8	[illegible]	876	11¼	2,808	3,008.00
6.	24	272	Pit gravel.	[illegible]	[illegible]	Local	1	528	800.00
7.	32	190	Crushed stone.	9	[illegible]	940	2¼	3,214	3,404.00
8.	24	200	Crushed stone & screened gravel.	8	6	Local	2½	1,750	1,950.00
9.	26	85	Gravel.	8	9	Local	...	650	1,215.00
			Clay	9	5	.....	..	480	.....

The Gilmore & Pittsburg R. R., now under construction, has bought a 75 acre tract in Dillon, Mont., on which will be erected yards, roundhouses and shops. At present the headquarters of the surveying forces on the Salmon River for the Gilmore & Pittsburg are located at Lewistown, Idaho.

A Road Roller with New Front Truck Arrangement and Improved Details.

The accompanying engraving shows a road roller having a front truck construction essentially different from that usually employed. Figure 1 is a diagrammatic line drawing showing the arrangement more clearly. The front roller *A* is journaled into a cast ring or turntable *B*, and this turntable sets inside of and concentric with a circular ring *C*, which is connected by an A-frame *D* to the rear frame of the machine. The circular ring and connecting A-frame form the front truck frame of the machine from which the standard supporting the front end of the boiler rises as shown by the illustrations. The turntable *A* engages the circular ring *B* by means of a set of vertical rollers *E E* and another set of horizontal rollers *F F*, which permit it, with the front roll, to rotate horizontally within the circular ring *B*, which acts as a track. To actuate rotation there is a pinion *G* operating a sprocket chain, which connects with two pieces of wire rope encircling and fastened to semi-lunes *H H*, on the top of the turntable and on each side of the front roll. The shaft of pinion *G* rises out of a cast box and carries a pinion at its bottom within the box, which meshes with a worm actuated by a steering rod extending back and terminating in a hand wheel in the operator's cab. The cast box within which are the worm and lower pinion is filled with oil. It will be noted that the steering gear acts positively, with practically no slack.

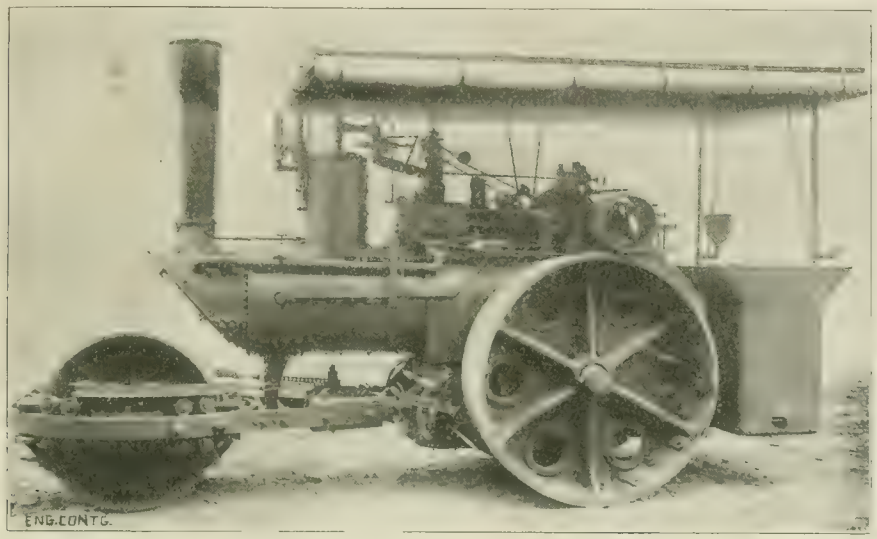


Fig. 1—View of Geiser Road Roller.

It will be noted that the A-frame *D* connects with the rear frame by a horizontal journal and that this journal is in the same horizontal plane as the axles of the front roll. This construction gives an oscillating front truck which can tip independently of the boiler and which is unusually stable because of its low center of gravity. Steering is also made easy because the front roller does not pinch or "bind" whatever its inclination may be. Also since the front truck tips independently there is reduced side sway to the front end of the boiler. Summarized the advantages claimed for this front truck construction are increased stability of the machine as a whole, increased stability of the front roll practically eliminating danger of upsetting, decreased side swing of the front end of the boiler, and a great gain in the ease of steering.

Other merits claimed for this roller are double cylinder engine, double drive and compensating gear, large front roller, short wheel base and arrangement of rear rollers to cover a minimum width of road bed of 8 ft. 8 ins.; free access to front end of boiler and particularly sturdy construction throughout. The following is a detailed description of the 12-ton roller illustrated:

The engines are double cylinder, each 6-in. bore by 7½-in. stroke; revolutions of engine shaft per minute, 280. The maximum indicated horse power for 160 lbs. boiler pressure, 280 revolutions, and 68.8 per cent cut off, is 72 H. P. The cut off is variable with the position of the reverse lever, and the latest possible cut off is 68.8 per cent of the length of the stroke of the piston. A piston valve 1¾ ins. in diameter is used. Open hearth steel gear is used and the gear is double drive. Springs are incorporated in the compensating gear arrangement to insure equal load distribution for the different pinions and to give it ability to absorb shocks without injury to the construction. All gearing is encased in practically dust proof casings. The countershaft is 4¼ ins. in diameter in boxes; the drive axle is 5 ins. in diameter in boxes; the front roller axle is 4½ ins. in diameter in hubs of rollers, and the steering hand wheel shaft is 19⅛ ins. in diameter. Each driving roller is 20-in. face and 64 ins. in diameter. The driving rollers are tapered, the inside edge having a diameter of 63 ins., while the outer edge is 64 ins. in diameter. Each driving roller is equipped with 24 tempered, removable steel spurs. The front rollers are two in number, each with a straight face of 20 ins. and a diameter of 44 ins. For all the scrapers the holding on power is transmitted through springs, thus producing the elasticity necessary to compensate for clearances caused by worn bearings. The scrapers for the driving rollers are operated by hand levers, each lever actuating two scrapers at a time.

The total coal capacity is 700 lbs. heaped and the total tank capacity is 247 gals. The total weight of the roller is 24,560 lbs. For working condition the weight on the driving rollers is 10,650 lbs. and on the front roller 6,700 lbs. The roller will make 2.178 miles per hour for governor speed.

The machine can be used to pull a road grader or rock crusher from place to place and for driving the rock crusher in stationary work. Stationary drive is accomplished by means of a leathered pulley 15 ins. in diameter and 9-in. face. This pulley is mounted on the overhanging end of engine shaft, and has a key integral with its hub, made to fit that key way in the engine shaft which served the engine shaft pinion. The pulley is pushed up against this pinion in its outer gear position and is kept from slipping endwise on the shaft by a set screw. In this position the inside edge of the pulley rim comes only 3½ ins. from the outer face of the engine shaft box and also in line with the inner edge of the left hand driving roller. The belt is run backward over the left hand coal box, which in order to allow proper room for the belt is made collapsible.

This road roller is made by the Geiser Manufacturing Co. of Waynesboro, Pa., to which we are indebted for the information from which the above description has been prepared.

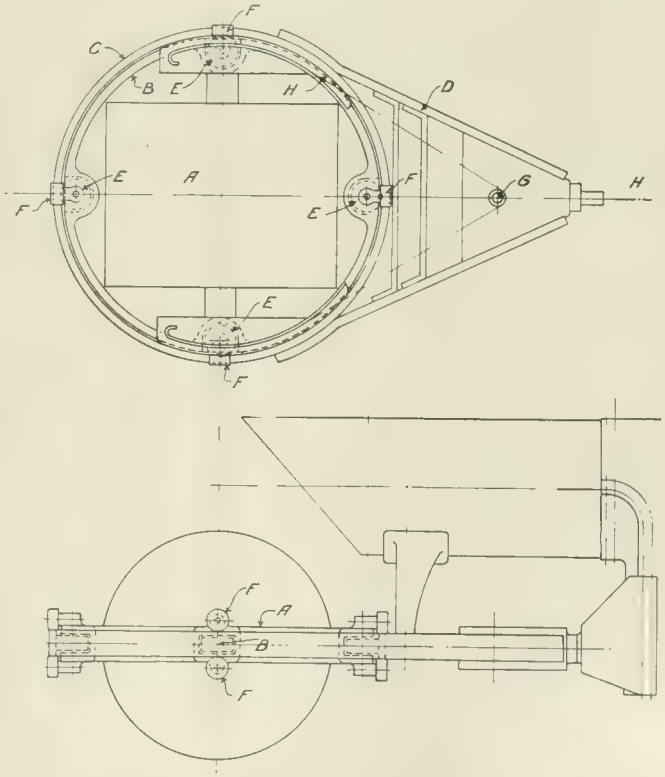


Fig. 2—Diagram Showing Front Truck Arrangement of Geiser Road Roller.

Road-Maintenance Competition.—In connection with the world's fair in Turin, Italy, in 1911, there will be held an international competition for machines and processes which shall represent improvements over systems and methods now employed for maintenance of common roads of crushed rock or gravel. Any machine for road building, maintenance or repair, or any process of road improvement may compete. About $17,000 will be awarded in prizes. Complete information concerning application to compete is furnished by the International Exposition Bureau, 41 Union Square, New York City, which officially represents the exhibition of 1911 in the United States.

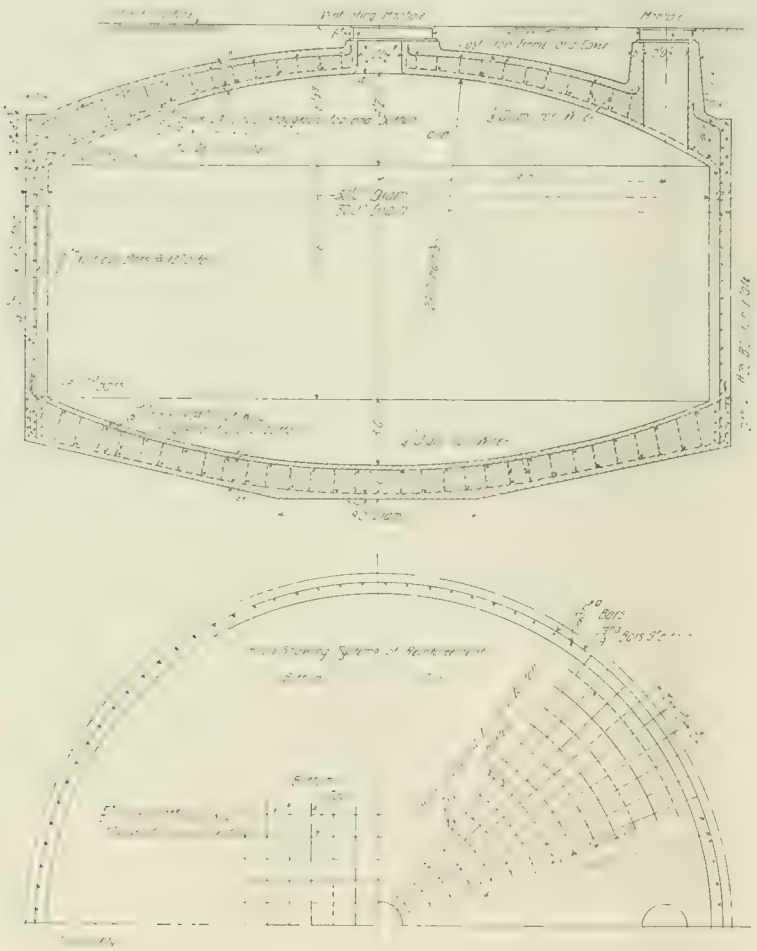
Water-works and Sewer Section

Note: This section is devoted to methods and costs of constructing sewers and water-works. It will cover the construction work for all details of water supply and sewerage, including sewage purification and water filtration.

Some Methods and Cost of Building Reinforced Concrete Cisterns.

BY BENJAMIN BROOKS.

The city of San Francisco has recently let the last of a series of contracts for the construction of a number of reinforced concrete cisterns to provide against future scarcity of water in time of severe earthquake. The work was divided into several contracts from 1 to 16 cisterns each, but although several contractors participated in the work, it is doubtful if any of them made money at it, for since no cost data were at hand for just this kind of job, the bids ran too low—between $4,000 and $5,000 per cistern.



Reinforced Concrete Cistern for Water Storage, San Francisco, Cal.

The cisterns were practically all alike—30 ft. in diameter, between 10 and 11 ft. high in the barrel, with domed bottom and top, and holding 75,000 gals. The top and bottom contained two layers of reinforcement, the sides one layer. Specifications called for sand of the following mesh composition:

At least 50% by weight to pass a 20-mesh screen.
Not more than 85% to pass a 50-mesh screen.
Not more than 15% to pass an 80-mesh screen.

and for rock:

⅓ between ¾ in. and 1¼ in.
⅔ between 1¼ in. and 2 in.

The mixture was 1 of cement to 5 of broken stone, with enough sand to fill the voids, which meant a 1:2½:5 or a 1:3:5 mixture, according to the run of materials and judgment of the engineers. Six pounds of some approved water-proof compound was to be mixed dry with each barrel of cement used in the sides and bottom (but not in the domes), and this necessitated at least one extra man to mix it with a hoe, measure it into boxes and pass it to the man on the mixer platform. On completion of the concrete the bottom received a regular sidewalk finish, and the sides and top a brush over with grout.

Several methods of excavation were employed. In rock or hard clay the contractor usually staged it out, two stages being sufficient for the deepest parts. In looser earth an ordinary concrete skip was used to advantage hoisted up a central tower by a donkey engine and discharged directly into wagons by a chute at 45°. In sand a bucket elevator worked very well, either chain or belt; cisterns in low, wet districts required a 4-in. motor-driven centrifugal pump to keep down the water, but a hand diaphragm pump usually sufficed, and in clay soil a bucket and a rope served the purpose. Some contractors built a pump sump outside the main excavation, but best results seemed to come by placing the sump in the middle of the excavation and leading the water to it by sub drains filled with crushed rock, the center well being formed by a large pipe which could finally be plugged below the line of the work and concreted over.

The only serious accidents that occurred as far as the writer is aware were from the collapsing or tipping over of the central towers for the hoisting skip. A man was always required on top to get the dirt out of the skip and if the tower fell he also fell, except in one instance where he had the presence of mind to slide down the chute into the wagon.

The lagging was almost universally made of 2x8-in. rough Oregon pine 20 ft. long, driven with mauls and held by circular girts made of bent car rails. The rails were in many cases too light to stand without a cross bracing of timber, but most satisfactory results were obtained with 70-lb. rails well coupled together and not otherwise braced. The original cost of these, however, was about $60 for bending plus the price of the old rails for each circle. Each cistern required from two to four circles. The contractors expected to be able to pull and redrive this lagging, but found it could not be pulled. All the contractors seemed to find great difficulty in keeping the lagging out to the proper diameter so as to give the full thickness of wall, and were obliged in some instances to draw and wedge it back plank by plank.

Forms for the side walls were usually made in three tiers, 12 or 16 sections to each tier. They were ordinary ⅞-in. T and G on 2-in. sawed ribs and were braced from a central frame or tower with 2x6-in. struts at each intersection top and bottom. Attempts to do without the central frame and to brace by polygons of 2x6 ins. around the cisterns usually resulted in the forms moving in. Dome forms were built on radial ribs of 2x16-in. stuff sawed to curve, each rib resting on a separate 3x4-in. post at the circumference and all resting on a cluster of 4x4s at the center. Over these ribs was nailed ⅞-in. T and G in about 6 pie-shaped segments. All the forms were used many times over, even being bought by one contractor from another.

The writer was employed by the city to inspect the work and keep cost data, and although he was not able to keep complete costs of any one cistern he had the advantage of obtaining them in part from several cisterns.

CISTERN A.

Located in filled ground, broken rock and clay saturated with water. Much delay on account of rain.

Excavation for First 6 Ft.—Five laborers loading by hand two 2-yd. dump wagons driven alternately by one driver to a dump 350 ft. distant on which one man did the spreading:

Item.	Per cu. yd.
Loading wagons, 1.25 man hrs. at 28c	$0.35
Teaming, .50 team hrs. at 75c	0.375
Spreading, .25 man hrs. at 28c	0.070
Total without superintendence	$0.795

Excavation for Remaining Depth.—Five to 8 laborers filling a 16 cu. ft. skip, 1 engineer hoisting, 1 laborer to dump, the bucket requiring two minutes for a round trip. One team took three buckets full in dry weather and one in very wet weather. Two men were sometimes required on the dump in very sloppy weather:

Item.	Per cu. yd.
Filling skip, 1.25 man hrs. at 28c	$0.035
Hoisting skip, .21 man hrs. at 75c	.157
Dumping skip, .20 man hrs. at 28c	.056
Teaming earth, .39 team hrs. at 75c	.292
Spreading, .23 man hrs. at 28c	.065
Total without superintendence	$0.92

This does not include the 60x5 ft. square hoisting tower built of 4x4s, which afterward fell and which cost as follows:

Item.	Per ft. height.
Man hrs. building, .48 at $.625+1.43 at $.28.	$0.70
Man hrs. rebuilding, .61 at $.625+.80 at $.28.	.60
Man hrs. dismantling, .60 at $.28	.17
Total without superintendence	$1.47

The cost of 147 pieces rough Oregon pine lagging 2x8 ins. by 20 ft. was as follows:

Heading and pointing, 0.23 man hrs. per pile at 28c = $0.06 per pile, or $2.43 per M.

Driving, 2.12 man hrs. per pile at 28c = $0.59 per pile, or $22.20 per M.

The cost of 3 rings of 70-lb. car rail rangers in 4 segments was as follows:

Man hrs. per ton placing, 17.4 at 28c, $4.87.

Forms cost as follows:

Man hrs. making per M lumber, 12.4; per sq. ft. surface, .03.

Man hrs. setting per M lumber, 47.4; per sq. ft. surface, .24.

Which at $.62½ per hour is equivalent to:

Making $7.75 per M, or $.02 per sq. ft. surface.
Setting, 29.62 per M, or $.15 per sq. ft. surface.

*572 Lombard St., San Francisco, Cal.

Reinforcing Bars.—To bend and place 1 in., ¾ in. and ⅝ in. twisted square bars required 38 man hours per ton, which at 62½ cts. = $23.75.

Concrete was mixed about 1:2½:5 in a Chicago Improved cube mixer, turning out about 7 cu. yds. per hour with a trained crew, and was wheeled and dumped in concrete "buggies." For the bottom of the cistern the man hours per yard required were:

Chutes and runways	.....
Measuring and wheeling materials	0.96
Mixing	.13
Wheeling and chuting concrete	.41
Placing and tamping	.27
Total	1.77

which at 50 cts. per hour = 88½ cts. per cu. yd.

Pumping during excavation, lagging, concreting, etc., cost as follows:

162 man hours (exclusive of night watchman), 0.27 man hours per yard of excavation at 28 cts. = 7½ cts. per cu. yd.

CISTERN B

Located in faulty serpentine rock which, though carrying much water, required little or no lagging and no drilling or shooting. Rock was staged out and conveyed in a single 2-yd. dump wagon to a dump two blocks away. The cost of excavation was as follows:

Average for the whole depth:	
Foreman days per yd. .06 at $3.00	$0.18
Team days per yd. .054 at $5 50	.30
Laborer days per yd. .442 at $2.25	.99
Pump days per yd. .05 at $2.25	.11
Total	$1.58
Average for the last 4 feet:	
Foreman days per yd. .088 at $3.00	$0.264
Team days per yd. .048 at $5.50	.264
Laborer days per yd. .674 at $2.25	1.516
Pump days per yd. .200 at $2.25	.450
Total	$2.494

The pump item is high on account of rain.

Reinforcing Bars.—Bending and placing 1 in., ¾ in. and ⅝ in. bars required 52 man hours per ton at 62½ cts. = $32.50 per ton.

Forms already made for another cistern were used and cost for placing and removing as follows:

	Per sq. ft.
Man hrs. at $.62½ placing 17.25 per M	.069
Man hrs. at $.28 placing 12.25 per M	.049
Man hrs. at $.28 removing 12.75 per M	.014

which is equal to:

Placing forms	$14.21 per M or $.057 per sq. ft.
Removing forms	3.57 per M or .014 per sq. ft.
Total	$17.78 per M or $.071 per sq. ft.

Concrete handled by same outfit and crew as for Cistern. A cost as follows:

For the bottom:	Man hrs. per yd.
Wheeling and measuring materials	1.16
Mixing materials	.17
Wheeling and chuting concrete	.45
Placing and tamping concrete	.35
Total counting delays*	2.13
Total actual running	1.80

which at $.50, $1.06 or $.90 per yd., not counting superintendence.

*Ran out of materials.

For the Walls:	Man hrs. per yd.
Wheeling and measuring materials	.82
Mixing concrete	.13
Wheeling and chuting concrete	.37
Placing and tamping	.37
Total	1.69

Which at $.50 per man hour equals $.95 per yd. exclusive of superintendence.

CISTERN C.

Located in mixed strata of sand, clay and soft rock. Work discontinued for some weeks waiting for rains to blow over.

The sheet piling having caved in out of plumb had to be drawn stave by stave for about one-third the circumference and jacked back a distance varying from 1 in. to 8 ins. This required 112 man hours at 25 cts. or, roughly speaking, 50 cts. a stave.

Reinforcing bars required 41⅓ man hours per ton to bend and place, which at 62½ cts. = $25.83.

Wall forms were already made for another cistern and required only a little patching.

Patching and placing required 44 man hours at 25 cts. plus 73 man hours at 62½ cts., which equals 4½ cts. per sq. ft., including the placing of chutes.

Removing forms and clearing cistern required 61 man hours at 25 cts. and 21 man hours at 62½ cts., which equals 2.8 cts. per sq. ft.

Concrete for the bottom and sides was mixed in a Smith mixer 2 cu. ft. of cement to the batch and run directly from mixer through portable chutes to the bottom, but wheeled in buggies to the side walls. The crew was untrained and poorly managed. The cost was as follows:

	Man hrs. per cu. yd.
Wheeling and measuring materials	1.55
Mixing materials	.30
Wheeling and chuting concrete	.42
Placing concrete	.60
Installing mixer	.74
Total	3.61

Which at 28c equals $1.01, including foreman.

Plastering bottom required 24.6 man hours at 75 cts., which gave a cost of 2 6/10 cts. per sq. ft.

Brushing the sides required 11 man hours at 25 cts., which gave a cost of 3/10 ct. per sq. ft.

CISTERN D.

Wall forms were already made and required for—

Placing (125 man hrs. at 62½c, 20 man hrs. at 25c) equals $22.46 per M, or 11 7/10c per sq. ft.

Removing (12 man hrs. at 62½c, 37 man hrs. at 25c) equals 1½c per sq. ft.

Reinforcing rods for dome required 131 man hours at 62½ cts., which gave a cost of $23.40 per ton.

Concrete for the bottom was handled as in Cistern C except that on account of a breakdown 44 cu. yds. were machine mixed and 8 cu. yds. were hand mixed, first the cement and sand dry and wet, then the grout and the rock being turned three times. For the machine mixing the costs were:

	Per cu. yd.
Wheeling and measuring materials, 1.50 man hrs. at 28c	$0.420
Mixing materials, .32 man hrs. at 28c	.089
Chuting and placing concrete, .74 man hrs. at 28c	.207
Building chutes, .55 man hrs. at 62½c	.344
Setting mixer, .34 man hrs. at 45c	.153
Total	$1.213

For the hand mixing the costs were:

	Per cu. yd.
Wheeling and measuring materials, 1.50 man hrs. at 28c	$0.42
Mixing materials, 5.12 man hrs. at 28c	1.43
Placing concrete, 1.25 man hrs. at 28c	0.35
Building chutes, 1.38 man hrs. at 45c	.62
Total	$2.82

Concrete for the walls cost as follows:

	Man hrs. per yd.
Wheeling and measuring materials	1.97
Mixing materials	.26
Wheeling and chuting concrete	.65
Placing concrete	.62
Setting mixer	.49
Total	4.00

This gives 4 hrs. × 28 cts. = $1.12 per cu. yd.

Concrete for the dome cost as follows:

	Man hrs. per yd.
Wheeling and measuring materials	1.02
Mixing materials	.23
Wheeling concrete	.47
Placing concrete	.32
*Setting mixer	1.02
Total	3.059

This gives 3,069 × 28 cts. = 80.85½ cts. per cu. yd.

Finishing the floor with ½ in. of sidewalk finish required 21 man hours at 75 cts. and 8 man hours at 25 cts. = $17.75, or 2½ cts. per sq. ft.

CISTERN E.

Located in clean, moist sand; fair weather; no pump. The excavation was done by small buckets on a rubber belt driven by an induction motor mounted on the conveyor beams so that the whole could be lowered together as the work progressed. Since the sand was valuable for construction work, the contractor had only to dump it from the elevator onto the street, where it was taken away gratis by other teams. The costs therefore are only those of getting the sand out of the excavation. They were as follows:

	Per cu. yd.
Shoveling into elevator	$0.171
Clearing sand from discharge end	0.139
	$0.310

A man hour cost 25 cts.

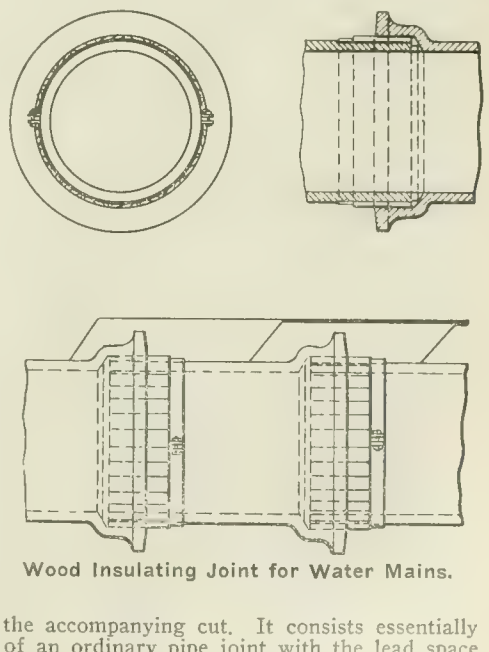
*This item seems very high, but often included carting the mixer back and forth from one cistern to another. It could have been reduced by better management.

It will readily be seen that no effort is made to account for all the costs of these cisterns, but simply to study the methods and the labor item. Costs of getting materials on the jobs are not considered nor is superintendence except in cases where it is specially mentioned.

In many cases the profits of the job were absorbed in trying to fix leaks in the concrete. This was in many cases due to hasty execution of the work, but was also largely due, in the writer's opinion, to the fact that not enough fine stuff was permitted in the concrete. In instances where the writer was able to allow the introduction of "crusher dust" running from the finest grit to gravel ⅛ in. in diameter, no leaks occurred. The costs of the several cisterns are tabulated in Table I.

Detail of Wood Insulating Joint Used in Mains of Hartford, Conn., Water-Works.

To reduce danger from electrolysis of water mains at Hartford, Conn., insulating joints have been introduced in a number of places. The construction of these joints is shown by



Wood Insulating Joint for Water Mains.

the accompanying cut. It consists essentially of an ordinary pipe joint with the lead space filled up with wooden wedges and a wooden

TABLE I.—SUMMARY OF COSTS.

	A	B	C	D	E
Excavation, per cu. yd.	$0.79-92	$1.58-2.49	....	....	$0.31
Hoisting tower, per foot	$1.47	.....	.....	.....	.....
Placing rangers, per ton	$4.87	.....	.....	.....	.....
Making logging, per M	$2.43	.....	.....	.....	.....
Placing logging, per M	22.20	.....	.....	.....	.....
Making forms, per sq. ft.	0.02	.....	.....	.....	.....
Placing forms, per sq. ft.	0.15	$0.057	$0.045	$0.117	.....
Removing forms, per sq. ft.	.....	0.014	0.028	0.015	.....
Reinforcing bars, per ton	23.75	32.50	25.830	$23.40	.....
Concrete in bottom, per yd.	0.885	$1.06-1.90		$1.21-2.80	.....
Concrete in sides, per yd.	.....	$0.95	$1.01	$1.12	.....
Concrete in dome, per yd.	.....	.....	.....	0.855	.....
Plastering bottom, per sq. ft.	.....	.....	$0.026	0.025	.....
Brushing walls, per sq. ft.	.....	.....	0.003	.....	.....

ring slipped inside of the bell end of pipe to keep the spigot end from "bottoming." If a sleeve is used instead of a bell end the wooden ring prevents the two pipe ends from touching inside the sleeve. A double joint of this kind is used for greater security, the two joints being made up in as small a length as convenient.

The wooden wedges are held in place by clamps around the pipe. This double insulating joint is installed by cutting out a piece of the main of the proper length and putting in the joint in place of it. A load of crushed stone is thrown in to keep moisture away from the joints as much as possible as damp earth around the joint would impair its efficiency. Three wires tapped onto each double joint as shown were brought up inside a service pipe box. Tests of these joints showed that they completely stopped the flow of current when first installed; further tests will be made this spring to determine their continued efficiency. The above information is taken from the report of Mr. H. E. Dart, assistant engineer, to the Board of Water Commissioners, Hartford, Conn.

Special Pipe Joint Used in the Baltimore, Md., High Pressure Fire System.

In constructing the new $600,000 high pressure fire system for the business district of Baltimore, Md., provision is made to supply a continuous pressure of 150 lbs. and an emergency pressure of 300 lbs. per sq. in. in the mains. All the pressure main, which varies from 24 ins. to 10 ins. with 8-in. hydrant connections, is open hearth steel lap welded pipe laid normally in 20-ft. lengths. The steel for pipe is required to show an ultimate tensile strength of 55,000-60,000 lbs., with an elastic limit of one-half the tensile strength. The thickness of shell required for the several sizes of pipe are ½ in. for the 24-in. and 7/16 in. for all smaller diameters. All pipe was coated with a composition of mineral rubber asphalt.

An interesting feature in connection with the construction of this line is the design adopted for the joints. Considerable trouble has been experienced with the effect of electrolysis upon underground pipes and in many instances the trouble has been directly traced to the pipe joint. By the use of the joint designed for this system provision is made to avoid the effect of electrolysis by making the electrical conductivity of the joint approximately equal to that of the body of the pipe. Figure 1 shows a section of this joint. The two ends of the pipes are expanded and accurately machined to the same radius as that of the separating ring. This ring which is made from the same grade of steel as that of the pipe is circular and has a cross-section as shown by the illustration. The flanges are made of medium steel, having a tensile strength a little greater than that of the steel used for the pipes, being about from 60,000 to 68,000 lbs. per sq. in. These flanges are accurately machined and the curved surface which is in contact with the pipe is made true, so that when the two adjacent pipes are deflected the contact between the pipe and the flange is fair and without strain. Preparatory to connecting these joints the rings are heated to a temperature sufficient just to melt the coating on the pipes and so secure a metal to metal contact in the joint. The ring is held in position by means of a rod screwed into a small tap hole provided at the peak of the ring, and the pipes brought together so as to bear firmly against the ring. The bolts are then put into the flanges and the final tightening of the joint is made by the tightening of these flange bolts. By this arrangement it is possible to secure a tight joint without the use of lead, gasket, cement or any other filler. Another marked advantage is its flexibility. Each joint permits a deflection of about 2 ins. for each linear foot of pipe so that by deflecting the pipe at the joint many obstructions in the ground are easily avoided.

This description has been extracted from an article by Raymond Schlegel in the *Cornell Civil Engineer* for March, 1910.

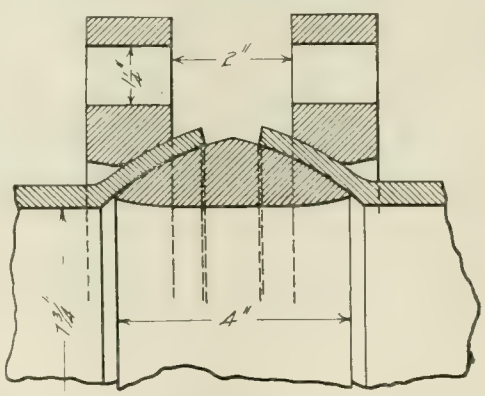
Some Costs of Construction of the Cincinnati, Ohio., Filtration Plant.*

Costs of construction of the water filtration plant at Columbus, O., were published in ENGINEERING-CONTRACTING for 1910, being taken from a paper presented by J. H. Gregory to the American Society of Civil Engineers. In discussion of this paper J. W. Ellms, Superintendent Cincinnati Filtration Plant presents comparative costs as follows:

Table I shows the costs of construction of the Cincinnati filtration plant.

TABLE I.—Total and Unit Costs of Main Features of Work Done in Construction of Water Purification Works at Cincinnati, Ohio.
(Capacity of Plant: 112,000,000 Gals. in 24 Hours.)

Work.	Total cost.	Cost per million gallons of capacity for 24 hours.
Preparation of grounds.	$ 33,359.67	$ 297.85
Pipe lines between settling reservoirs and head-house	55,354.77	494.24
Head and chemical house	144,989.85	1,267.77
Coagulation basins, gate houses and pipe lines	304,913.05	2,722.44
Filters, filter house, piping, sand and gravel	592,112.30	5,286.71
Piping, valves and gate-house between filters and clear-water reservoir	29,701.91	265.20
Clear-water reservoir	121,362.39	1,083.59
Total	$1,278,793.94	$11,417.80



Special Joint for High Pressure Fire Mains.

At Columbus, the unit costs per million gallons of capacity in 24 hours appear to be considerably greater for the settling basins and mixing tanks combined, than for the coagulation basins at Cincinnati. The figures for the Columbus tanks and basins are $7,100 per million gallons of capacity, as compared with $2,722 at Cincinnati. In a general way, these parts of the two plants correspond; but it should not be forgotten that at Columbus more elaborate baffling of tanks and basins, more divisions of the flow of the raw and treated waters, and more places for the primary and secondary applications of chemical solutions were needed and provided for, than were required at Cincinnati. The greater combined unit costs of the headhouse, lime-saturator house, storage-house, wash-water tank, offices and laboratories at Columbus, than for the corresponding head-house, chemical-house, wash-water tank, offices, and laboratories at Cincinnati, are similarly explained by the necessity for designing a plant for softening, as well as for clarifying and purifying the water. The combined unit costs for the items noted above for the Columbus plant amount to $3,784, as compared with $1,268 for the Cincinnati plant.

The filters and piping in the Cincinnati plant cost more per million gallons of capacity than did those at Columbus. The figures for Columbus, which include the air-washing equipment, are $3,540, as compared with $5,287 for Cincinnati. However, the filtered-water reservoir at Columbus cost more than that at Cincinnati. The figures for the Columbus plant are $3,280 per million gallons, and for the Cincinnati plant, $1,084. At the latter plant, the clear-water reservoir is a separate uncovered reservoir, while at Columbus, it is directly under the filter tanks, which latter form a protecting roof. Virtually, no great difference in costs exists, if the cost of the filters, piping, and clear-water reservoir of each plant be combined and then compared.

The cost per million gallons of capacity for the whole purification plant at Columbus is stated to be $17,750, which amount does not include engineering; the corresponding figure for the Cincinnati plant, as shown above, is $11,418, and this also excludes the cost of engineering. The difference of more than $6,000 per million gallons of capacity is doubtless due to the additional requirement demanded by the local conditions at Columbus, that is, for the softening of a very hard water, and one which is at times subject to rapid fluctuations in its physical characteristics.

*Proceedings American Society of Civil Engineers, Vol. XXXVI, p. 587.

Colon Breakwater.—A general scheme for constructing the west breakwater at the north entrance to the Canal has been approved and the preparatory work will be begun this month according to the Canal Record. The purpose of the breakwater is to protect shipping in the harbor of Colon, and vessels making the north entrance to the Canal, from the violent northers that are likely to prevail from October to January, and to reduce to a minimum the amount of silt that may be washed into the dredged channel. Preliminary plans provide for two jetties of rock, one extending from Toro Point, on the west shore of the bay and ending in 48 ft. of water, and the other extending from the east shore, near Manzanillo Point, to 44 ft. contour. An opening will be left between the outer ends of the jetties through which vessels may enter the Canal and habor.

In the construction of the west jetty, approximately 3,290,000 cu. yds. of rock will be required. A deposit of limestone suitable for the core of the jetty, which may also prove suitable for the armor, has been developed on Toro Point. It is proposed to build a double trestle from the shore line from which rock will be dumped, the construction of the trestles advancing with the progress of the field. Thus as the work advances the effect of wave action on the Toro Point rock can be watched and the question as to whether harder rock will be required for the armor of the breakwater may be determined.

A dredge will be set at work taking about 50,000 cu. yds. of coral from a small bay inside the line of the breakwater, known as Shelter Cove, thus making a harbor that can be entered in any ordinary weather, and which will be more protected as the breakwater advances. A wharf will be built along the north side of this harbor, with trestle connection with the mainland, at which plant and supplies may be unloaded.

Quarters for laborers, and other employes, will be built in proximity to the work, and the camp thus established will be connected with the regular telephone system by a line six miles long. A supply of water may be obtained from the Arenal River, a small stream about a mile and a quarter from Toro Point, and at a sufficient elevation, so that the quarters may be supplied by gravity. Preparatory work will also include the clearing of land, stripping of the quarry, and the assembling of equipment. A schedule of the plant required—buildings, steam shovels, locomotives, cars, barges, and other equipment—is under consideration. Fifty steel, 19-yd. air dump cars for this work are included in the order for three hundred cars recently placed in the States, and much of the other equipment required is already on the Isthmus.

The placing of rock in the jetty will probably not begin before July 1, and the construction will proceed at a rate to insure the completion of the entire breakwater in about three years.

Unclassified and General Articles

Note: This section is devoted to methods and cost articles on construction work not properly coming under any of the preceding classifications.

Representative Concrete Structures on the New York Barge Canal and Methods of Inspecting, Mixing and Handling Concrete.*

To provide for structures for different uses on the New York Barge Canal three grades of concrete are specified. First-class concrete calls for a mixture of 1 cement, 2 parts sand and 4 parts stone. The stone must be a hard trap-rock, granite or gneiss. This grade is only used in cases where an especially fine concrete is needed. Second-class concrete is a mixture of 1 cement, 2½ sand and 5 stone or gravel. By far the larger part of the concrete work is built of this grade and among the structures now being built of it are the locks, dams, bridge piers and abutments, breakwaters and retaining walls. The third-class concrete is 1 cement, 3 sand and 6 stone or gravel. This grade is not much used except in core walls and similar less important work.

Fig. 1—Dam at Vischer's Ferry, Showing Cyclopean Masonry.

STRUCTURES.

It depends on the viewpoint as to which is the most interesting class of concrete structures on the Barge Canal. Because of their large number, large dimensions and fine design and construction, the locks appeal to almost everyone. There are to be 53 lift locks. These locks have a minimum length of 328 ft. between hollow quoins; the width is 45 ft.; the lift varies from 6 to 40½ ft. This latter lift is at Little Falls and at the time of completion undoubtedly will be the highest lift of any mitered-gate lock in operation. The locks are built of second-class concrete and are constructed in sections of approximately 40 ft. in length. Each section is carefully keyed into the adjacent sections.

In constructing the locks all kinds of difficulties have been met. In some places piling is necessary to support the foundation; in other cases the locks are constructed in rock—notably so at the high lift at Little Falls, where the lock is constructed entirely in rock; and at Fulton, on the Oswego River section, the locks are constructed so close to the buildings that they almost become a unit. At Lockport the drop is so sudden that a double lift of a total 49 ft. is provided by a double lock. At Waterford five locks overcome the drop of 170 ft., which is now taken care of by 17 locks.

Adjacent to the locks are necessary approach walls, cut-off walls in earth dams forming pools, and in some cases where the locks are close together there are series of piers for forming docking to keep the barges in the channel. The estimated cost of these locks with the smaller immediately adjacent structures is $16,000,000. In addition several guard locks are to be provided at various points to prevent loss of a large amount of water in case of accident.

To canalize the rivers it will require 22 fixed dams and 14 movable dams. The fixed dams are of particular interest to those interested in concrete. They are all to be built of concrete and their construction is worthy of special consideration. For purpose of illustration the straight dam at Vischer's Ferry (Fig. 1) and the curved dam at Crescent (Fig. 2) will be taken. The dam at Vischer's Ferry is built in two river sections, these being separated by a rocky island in the middle of the river. The river sections are built on rock bottom while across the island a lighter dam connects the two with a straight crest line 700 ft. long. The concrete in the river sections is massive and it has been advantageous for the contractor to build it of cyclopean masonry. Into this second-class concrete are embedded huge stone, averaging several tons in weight. About 30,000 tons of these large blocks of stone—which were originally quarried for bridge work—were used in this masonry. The dam is built in sections of 36 ft. in length by 10 ft. high at any one time. Key-ways are built in to bind the adjacent sections. The dam has a total length of crest of 1,919 ft.; it has a lock at the southern end and head-gates at the other end. The water is raised 30 ft. by this dam.

The curved dam at Crescent also consists of two sections with a main arched dam, 1,487 ft. in length, an intervening rocky hill and a dam of smaller section across low land which will be flooded when the dam is completed. The total length of this dam, including head-gates, is 1,922 ft. Almost all the other dams have locks, but this dam does not for it marks the eastern end of the canalization of the Mohawk River. The pool back of this dam will be about 28 ft. higher than the present river level. The concrete in this dam is also cyclopean. The rocky hill, or ledge, at the site of this dam is an outcrop of a close-grained rock. The contractors have opened a quarry here and take the large stone as the basis for the cyclopean masonry. A crusher reduces the small stone to proper size for the concrete. The method of construction is similar to that used on the dam at Vischer's Ferry.

There are, of course, very interesting auxiliary structures that are necessary with the combined dams and locks, such as head-gates, guard-gates, retaining walls, core walls into abutting territory and dikes. In addition to the dams necessary for the direct operation of the canal, there are two large storage reservoirs which also require large dams.

The Barge Canal calls for the erection of many bridges but these we will not consider except as to the part concrete may play in their construction. The abutments and piers are, of course, to be made of concrete. The floor system of most of the bridges are to be of re-inforced concrete construction. The walks on the bridges are concrete. The interesting feature of the application of concrete to the bridges has been the new and original type of abutments and approaches (Fig. 3), which have been adopted for the highway bridges. An illustration quickly tells the story that these abutments and approaches are constructed of piers of re-enforced beams and floor slabs. The forward piers are of plain concrete and are built upon a concrete base or wall approximately 25 ft. long by 6

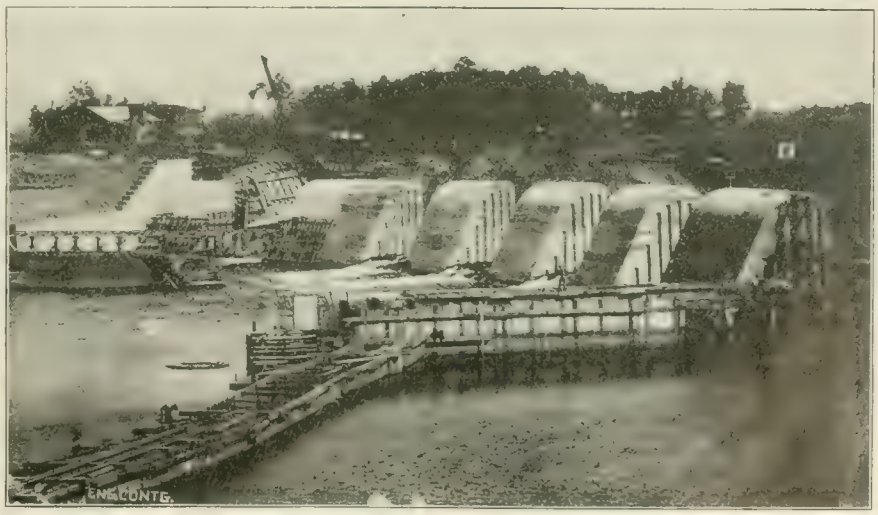


Fig. 2—Curved Dam at Crescent, Alternate Sections.

*Condensed and rearranged from a paper by Russel S. Greenman, read at the 1910 Convention of the National Association of Cement Users.

ft. wide and 6 ft. high. These piers carry the highway bridge as well as the short concrete span. The rear piers are made of 24-in. square reinforced concrete columns. By this construction a large amount of concrete is saved over the older form of solid abutment and wing walls. Also a large amount of embankment is saved by this method. The fill is protected by a stone paving on a slope of 1 to 1. It is calculated that, notwithstanding the larger cost of the reinforced concrete over

Fig. 3—Approach to Highway Bridge at Sylvan Beach, Reinforced Pier and Slab Construction.

plain concrete, a saving of $500 is made per single bridge approach span and abutment.

Reference has been made several times to some of the smaller structures. A special statement concerning each of these is hardly necessary as the design and construction is generally characteristic of similar structures on other works. It might be well, however, to call attention to the great saving of concrete that is made on high retaining walls by having recesses in the face of the wall. The same strength is obtained as though the wall were built of solid concrete, but quite a saving is made on cost. The breakwaters on Oneida Lake (Fig. 4) and dikes on river sections are also interesting pieces of work.

INSPECTION OF MATERIALS.

For the construction of the vast amount of masonry it was, of course, necessary to provide the best inspection of materials and workmanship. All materials proposed for use in the making of the concrete are carefully examined and tested and experienced men are placed as inspectors on the structures while being built.

As in all other large projects careful attention is given to the cement proposed for use. The engineer in charge of tests made visits to many of the leading laboratories and selected the best ideas in use in these. The laboratory was enlarged and thoroughly equipped with the very best apparatus for the testing of cement. Carefully trained testers follow the standard methods and make all standard tests. These consist of tests for setting, fineness, constancy of volume, tensile strength and specific gravity. Chemical examination is also made.

It was originally planned that the tests should be made on cement that was delivered in the storehouse on the work. The samples were taken from the stored cement and sent to the laboratory at Albany for the required tests. Tests were started as soon as the samples were received and the results were promptly given but, at best, 10 to 12 days elapsed from the time the samples were taken, shipped by express into the laboratory, given a 7-day test and reported to the engineer in charge of the contract. A contractor using large quantities of cement therefore had to have a large cement storehouse in order always to have accepted cement ready for use. Gradually a system of mill inspection of cement has developed. When a contractor places with a cement company an order for cement that is large enough to warrant stationing an inspector at the mill, an inspector is directed to sample one or more bins of cement—depending on the size of the bins. These bins are sealed with a seal of the Department of the State Engineer and Surveyor. The samples are forwarded by express to the testing laboratory at Albany and immediately tested. If the cement meets the requirements of the specifications it is accepted and held subject to the order of the contractor. Whenever this contractor wishes shipments made to the work, the inspector breaks the seal on the bin, inspects the loading of the car, or cars, seals each with the department seal, re-seals the bin and notifies the resident engineer in charge of the laboratory and the resident engineer in charge of the contract, of the shipment. When the cars arrive at the place of work, the seal must be intact and must be broken open only by the engineers on the contract. By this method only accepted cement is delivered on the work; and if he cares to do so, the contractor can use it immediately upon its arrival. The shipments from the mills have gradually increased until, on Oct. 25, 1909, a high-water mark of 31 car loads, or 5,150 bbls. of accepted cement was inspected by this department for the Barge Canal. The daily average for the week was 2,911 barrels. The amount of cement shipped is used as an indication of the amount of structural work being done by the contractors.

In the selection of aggregates for his concrete the contractor is first guided by the classification of his concrete and then he naturally wishes to use that material which he can secure most cheaply and still keep within his contract. However, in order to insure good concrete, proper sand and stone, as well as cement, must be used. The State therefore demands that the sand or screenings, and the stone or gravel, shall be approved by the Department of the State Engineer and Surveyor. Samples of these are sent to the testing laboratory and carefully examined and tested. The sand is examined under the microscope as to the character of its grains; it is passed through a nest of sieves to secure the grading and sizes of the sand grains; and both in the natural condition and washed, it is tested with cement for strength; and also tested for percentage of loam and voids.

If there is no good sand or gravel within economical hauling distance from the work, the contractor must necessarily import such material. In one notable instance, however, the contractors found that it would be more economical to wash and screen the gravel. They erected a plant (Fig. 5) at a cost of $90,000, and it is probably the largest temporary washing and screening plant ever erected. The capacity of the plant is 200 cu. yds. of gravel per hour.

In some cases where a desirable sand cannot be easily obtained, crushed stone screenings are used in place of the sand. It is required that these screenings shall be crushed from a hard, durable stone and that the particles shall be well graded. An excess of fine dust or powder must be screened out.

The crushed stone, proposed for use, must be from an approved kind and quality of rock—free from dirt and organic matter. In second-class and third-class concrete, gravel which is composed of hard and durable stones may be substituted for crushed stone. Either stone or gravel must be examined for the percentage of voids and the proportion of matrix may be varied so that there shall be an excess of 20 per cent of matrix over the natural voids of the loose aggregate.

In the structures where the concrete is massive cyclopean concrete is permitted and in many cases the contractors are building this kind of concrete. The specifications permit in massive concrete of the second or third class, where the section is not less than 4 ft., the placing of boulders and fragments of rock containing more than 1 cu. ft. These must be made free from all dirt and must be placed on their largest bed. They must be kept at least 6 ins. apart and none shall be within 2 ft. from the surface. The contractors who have taken advantage of this permit to make cyclopean concrete have, as a rule, used only very large stone in such massive structures as are some of the dams.

In connection with routine testing and inspection of materials frequent tests are made along special lines. Many of these have been made on the use of salt during freezing weather, amount of loam that is permissible, addition of collodial clay in order to produce impervious mixtures, the substitution of crushed stone screenings or iron-ore tailings in place of sand, the use of various waterproofing compounds and the various methods of surface finishing.

METHODS OF MIXING AND PLACING CONCRETE.

The large contracts under which the work on the Barge Canal is done make possible, and even necessary, large plants. As has been suggested, there have been many ways tried of doing this large work. In the manner of mixing and placing concrete the usual variation exists and also there is the large plants for the work.

The specifications demand that in all work where more than 200 cu. yds. of concrete is to be placed, the mixing shall be done by machines. Batch mixers only can be used and of these very many kinds are in use. Those most generally used are the cylindrical, or cubical, drum and the Haines mixer. The latter has been used both in a stationary position and as a movable mixer—being carried by a derrick from the place of loading to the place of depositing the concrete.

Fig. 4—Breakwater on Oneida Lake.

The mixing plants are sometimes stationed directly in the newly excavated canal channel and the materials are hauled over trestles and emptied into hoppers over the mixers. Most plants, are, however, placed at some point conveniently located near to rail or water service, and then the materials are transferred after being mixed. Some have the mixers on cars or movable platforms and empty the mixture directly from the machine into the forms.

In transferring the mixture from the mixer to the forms, when the two are much separated, various methods are used. The most popular method is the common bucket and car arrangement while others have preferred to transfer the buckets by cables. In one case, however, a belt conveyor system (Fig. 6) has been used. Because of the amount of concrete

Fig. 5—Sand and Gravel Washing and Screening Plant.

handled by this system, special consideration can well be given to it. Within a radius of one mile from Lock No. 4, several massive concrete structures—aggregating 250,000 cu. yds. of concrete—are planned to be constructed. Between two massive locks which, with the adjacent structures, would need about 100,000 cu. yds. of concrete, the first part of this plant was built. A capacity of 500 cu. yds. per working day of 8 hours was planned. The maximum output has been 450 cu. yds., or practically 1 cu. yd. per minute. To handle this quantity of material the plan, briefly described, is as follows: The sand and stone are dumped into separate hoppers over belt conveyors and carried by them to bins over the Haines mixer. When the bins are filled the sand or stone automatically passes through a chute into storage bins. The cement storehouse has a capacity of 10,000 bbls. of cement. Through the center of this passes a belt conveyor which carries the bags of cement up to the mixer. A great saving of labor in the handling of these raw materials is accomplished by this system as the only labor is the shoveling the sand or stone from the end of the car to the center and the placing of the bags of cement onto the conveyor. The concrete mixture is then carried by belt to the locks on three series of belts moving at the rate of about 450 ft. per minute—each succeeding belt moving a little faster than the previous one so that there will be a better division of the material that comes from the mixer. At the locks there was a large tripper car with a boom 45 ft. long. The concrete is tripped from the main belt to the boom belt. The boom would swing over an angle of 200° and would reach either side of the lock. In carrying the concrete on the belt a mixture, somewhat drier than desired, had to be used. To produce the proper consistency water was piped to the end of the boom and added to the mixture as needed. As it left the boom belt the concrete was collected into a narrow space by means of spouts. These were hung so as to swing freely and the concrete could be deposited at any point as desired. The lock walls were, as a rule, built in 40 ft. sections with the forms providing for a depth of concrete of 6 ft.

The plan just described was altered somewhat on one of the locks by doing away with the trestle in the center of the lock and building a light steel skeleton right on the site of the side of the lock. On this the belt was run and as the concrete reached the top of the skeleton a new section was built on top of the old and the old became an integral part of the lock—a reinforcement, as it were. It is claimed for the belt conveyor that it has decided advantages over a bucket and car method as it keeps the particles together and prevents the separation often occurring with the other methods. The whole mixing and conveying plant, just described, is operated by electric power.

There are definite rules and requirements for the proper placing of concrete into the forms. Care must be taken that the concrete shall be in place before the cement shall have taken an initial set, that it shall be put in place in layers so that it will make a dense and impervious monolith, and that newly laid concrete shall be protected against freezing when placed in during the cold months.

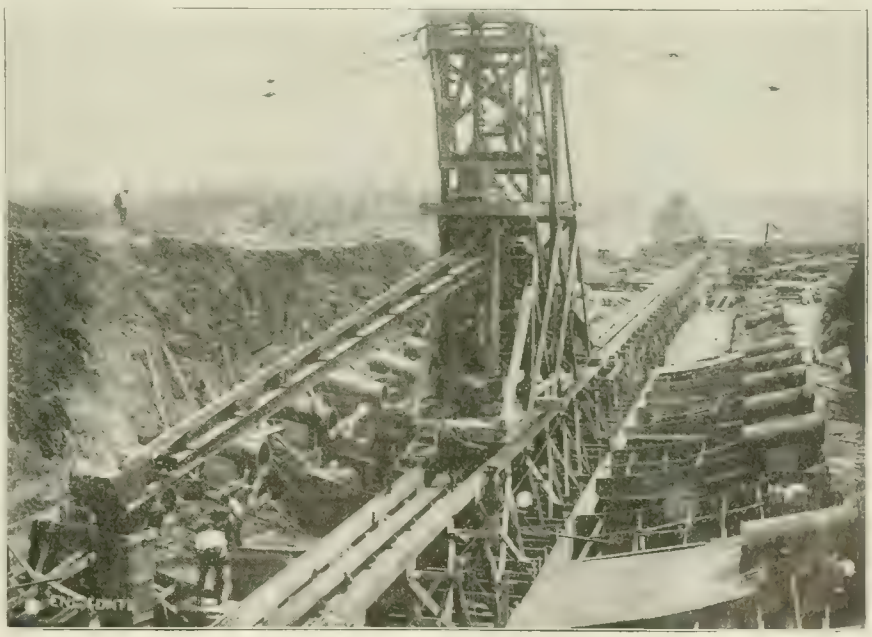


Fig. 6—Belt Conveyor System, Mixing and Conveying Concrete.

A project is under consideration for the development of 30,000 hp. on the east branch of the Kennebec River in Maine. S. W. Philbrick, Skowhegan, Me., is interested.

Protection of Cross-Ties from Mechaniacl Wear by Means of Plugs, Screw Spikes and Tie Plates with Estimates of Costs and Savings.*

It is a common practice in Europe to provide in cross-ties a wooden screw plug or dowel to receive the spike. The ties are bored with holes about 5½ ins. long and 1½ ins. in diameter. These holes are then threaded to about 1 in. The ties are then treated, usually with creosote, and the wood around the hole intended for the plugs is thoroughly impregnated. The plugs or dowels are also impregnated with creosote and are screwed home in the holes prepared for them, the tie is then sized and the tops of the plugs are smoothly cut off in the same operation. The number of spikes varies from two to four at each rail bearing.

The question may be asked, of what use are the plugs? In the first place, the boring of the tie previous to treatment makes it practicable thoroughly to impregnate it with a preservative against decay at the points where it is most vulnerable, namely, where the spikes are inserted, and where the wearing action of the tie plates and the rails occur. But there is another very good reason which will be shown by the table, giving the results of tests made for the purpose of determining the resisting power of various kinds of spikes against withdrawal under various circumstances, as follows:

	Mean. Lbs.	Maximum. Lbs.
Square spike in unbored tie	4,558	6,826
Round spike in unbored tie	2,478	6,066
Square spike in bored tie	4,082	5,810
Round spike in bored tie	4,108	6,940
Screw spike in bored tie	6,916	10,842
Screw spike in oak plug	8,170	9,724

Of course, the resistance of the driven spike as compared with the screw spike is very much greater, according to this table, than it would be after it had been used for a little while. After they are once loosened their power of resistance against an upward force is much less. It will be observed that the resistance of the screw spike against withdrawal is much greater than of the others.

A series of tests were also made to determine the comparative crushing strength of ties with and without a certain number of plugs. The conclusion reached as a result of these experiments is that the plug acts as a column, transmitting by means of its threads the pres-

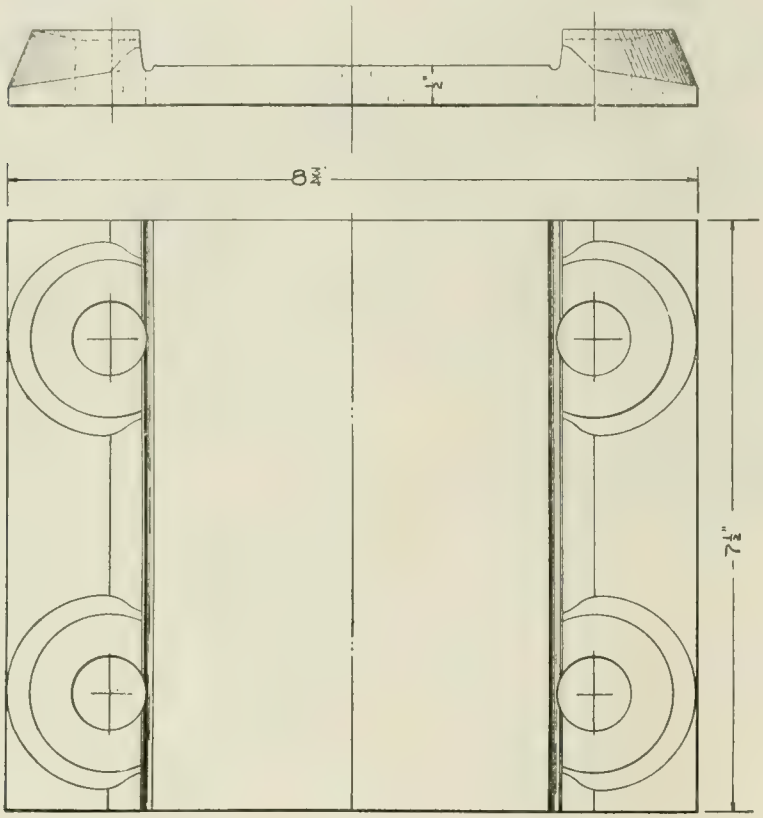
*Extracts from a paper by J. W. Kendrick, read before the American Railway Engineering and Maintenance of Way Association, March 15, 1910.

sure to which it is subjected from top to bottom instead of being concentrated upon the top layer.

If ties serve their purpose for upwards of 25 years on European roads and are afterwards useful, as is the case, for fence posts and other purposes, there is no good reason why approximately the same longevity should not be obtained in American practice. In order to secure this result it is necessary first to treat the ties with some preservative to prevent decay. In doing this first cost is of comparatively minor importance. The best proven treatment should be used, and there is no doubt that creosoting satisfies this requirement better than any other method. Ties may be fully creosoted; i. e., impregnated with all the creosote that the wood will take. They may be impregnated by the Rueping process, in which a portion of the creosote is extracted by exudation resulting from the expansion of the air forced into the wood cells during the process of treatment and by the after application of a vacuum. They may be treated by a mixture of zinc chloride and creosote, or by any other method that is of value. Proof of the value of a method of preservation does not depend upon actual use of the ties in track. The growth of the fungus that produces decay can be stimulated, and results can be obtained in a few months that would require years of actual service to develop.

The Atchison, Topeka & Santa Fe Ry. has adopted the Rueping process for the treatment of ties at its plant in Somerville, Tex., which has a capacity of about 2,500,000 ties annually. It uses crude oil with an asphaltum base at its plant in Aubuquerque, N. M., which has a capacity of about 750,000 ties annually. The oil treatment is considered experimental, and its adoption was based upon the results obtained in its experimental track on the Beaumont division in southeastern Texas, where ties treated in this way were perfectly sound after a period of 5 years, and are still in that condition after the expiration of 7 years from the time of their insertion. Untreated ties made of the same wood placed in this track decayed within 9 months. The Reuping process is rapidly taking the place of the full creosote treatment, which has been followed for years in Europe.

Second, tie plates of adequate length, width and thickness should be used in order to properly distribute the maximum pressures transmitted through the base of the rails to the upper surface of the ties. The properties of various kinds of wood, with respect to their ability to resist compressive strains, have been determined repeatedly. As the majority of the ties that will be used in the future will, as at present, be made of the soft and inferior varieties of wood, it is desirable to reduce the pressure upon the fiber to about 700 lbs. per sq. in. The maximum weight on a single engine driving wheel is about 30,000 lbs. It will probably be sufficient if we add 50 per cent to this to represent the effect of a suddenly applied load; in other words, to provide for the effect of impact. The rails and tie plates being securely fastened to the ties by screw spikes, the transmission of the effect due to the load on any wheel will be much more uniform than when cut spikes are used, in accordance with prevailing practice.



Tie Plate.

The accompanying cut of a tie plate shows one which has been adopted, among others, by the A., T. & S. F. Ry. This plate is 8¾x7½ ins., and is ½ in. in thickness. The effective area is therefore about 63 sq. ins., and the pressure on the tie incident to a load of 45,000 lbs. is just 700 lbs. per sq. in. The thickness (½ in.) has been found sufficient as a result of service under the heaviest power during a period of more than two years. It may be said that the width of this tie plate, 7½ ins., will require a change in the specifications, but in the interests of economy this change should be made. Narrower ties cannot be protected from wear, and consequently it will be unwise to go to the expense of treating them with preservatives. This plate is designed to support the head of the spike in its entirety, and this is very necessary for the purpose of securing satisfactory results.

Third, screw spikes should be so designed as to facilitate driving without injuring the shank. Where spikes are driven by hand this is not so important, but the only reason for tapering the head is the fancied advantage in forging the spike. It is practicable to forge them with cubical heads, and these are preferable. It is impracticable to apply screw spikes by hand in this country, without unnecessary expense, on account of the high wages that must be paid for labor, and the application of a machine driven tool to a truncated pyramidal head has been found to be difficult on account of the tendency of the tool to engage, then slip, so rounding the head as to impair its value for the purpose for which it is intended.

Fourth, it is desirable to introduce wooden screw dowels or plugs bored in the center to receive the screw spikes. The tie should be bored and threaded to receive these plugs at the treating plant, and before treatment, as impregnation by the preservative generally will be very much more thorough than if these holes are prepared after treatment. This method of procedure is considered very important because it is impossible to secure the impregnation of heartwood by any preservative, at least to any great extent, and if the tie is treated first and bored afterwards, the portion which is unimpregnated will be opened for the admission of moisture and fungi spores, which cause delay. The plugs or dowels should also be impregnated before they are inserted. The bearing surface of the ties should be sized and the plugs cut off at the same operation, to receive the tie plates, and thus insure proper and uniform bearing.

The question will naturally be asked as to the relative cost of adopting this form of construction as compared with that now in use. A proper machine at the treating plant will bore and plug 600 ties with 8 plugs each per day of 10 hours, at a cost of 3½ cts. per tie. The cost of making the plugs will be about 1½ cts. each. The cost of screw spikes will be 2.7 cts. each, of tie plates 21 cts. each. The cost of cut spikes will be 1.06 cts. each. Assuming 3,000 ties per mile of track, with 4 spikes per tie, that the same types of tie plates are used both with screw spikes, and that no dowels are provided for cut spikes, the relative cost per mile of track would be as follows:

One Mile of Track With Screw Spikes and Dowels.	
12,000 spikes at 2.7 cts. each	$ 324
6,000 tie plates at 21 cts. each	1,260
Boring ties for, and driving, 24,000 dowels, at 1 ct. each	240
24,000 wooden dowels at 1½ cts. each	360
Driving screw spikes (per mile)	150
Total	$2.334
One Mile With Cut Spikes.	
12,000 spikes	$ 127
6,000 tieplates at 21 cts. each	1,260
Driving cut spikes (per mile)	150
Total	$1,537

The difference in cost is considerable. The calculation assumes that tie plates will be used in either case, and true economy requires that this be done. The estimated cost of driving screw spikes is based upon work actually done under unfavorable conditions on a section of track about 5 miles in length on the Illinois division of this railway last fall. Unfortunately, the holes in the tie plates were a little too small, so that the screws acted as reamers to enlarge the holes before they could be driven home. The record of cost for driving 4,200 track feet—the best progress made in one day—indicated that there would be little or no difference between the cost of applying screw spikes and of driving cut spikes.

The element of increased cost is one which enters into any construction of superior type, and the real question is, Is it worth while? If this process is followed, the average life of the ties on American railways would, very conservatively speaking, be 21 years instead of about 7; that is, they would last three times as long as at present. Screw spikes should be applied as ties are renewed. Then at the end of a period of from 7 to 10 years any line of railroad pursuing this course would have provided its track with treated ties, screw spikes and so forth. Let us consider what this would mean if the railroad mileage of the United States were reconstructed in these respects:

Present (1910) trackage U. S. steam railroads .....350 miles
At present in track, about.....1,000 million ties
Present annual requirements....150 million ties
Average trackage added per year for past 7 years.....10,000 miles
Requiring yearly for new track..30 million ties
Present average life of ties.....7 years
Requirements, assuming annual increase in trackage, of 10,000 miles, for next 21 years.....4,000 million ties
Corresponding to over 200 billion board feet timber or 1-12th of our present standing forest.
Cost for 21 years with cut spikes:

Present cost per tie, including treatment, tie plates, spikes, etc.	$1.00 to $1.15
At present rate of increase in timber prices, cost as above, in 1931.	$1.75 to $2.00
Average cost during next 21 years, approximately	$1.55
Total investment in ties, present practice, to 1931	$5,500,000,000
Cost for 21 years, with screw spikes:	
Present cost per tie, average only 20 cents more than for cut spikes.	
Average present cost	$1.35
Average cost during next 21 years, if all renewal and new construction is made with screw spikes, approximately	$1.65
Tie requirements to 1931	less than 1,600 million ties
Cost of same	$3,500,000,000
Saving from use of screw spikes	$2,000,000,000

These figures are sufficiently large to command respectful attention. They will be proportionately correct for any mileage that may comprise any system or any mileage that may be assumed. They may err in gross because of the impossibility of determining the relative number of ties used in main lines, which should be so treated, and in yards, where such treatment would not be generally followed. With the national timber supply only sufficient to last 30 years, with the certainty that the cost of ties will increase more rapidly in the future than it has in the past, with the necessity for conserving the timber supply of the country in the interests of economy, and in order that timber may be obtainable for purposes for which no other materials are suitable, there can be no question that the time has come when this very important problem should receive the serious attention of every one having to do with maintenance of track. The saving that can be effected will represent an addition to the net earnings of the railroads of the country. The total saving indicated by the above statements amounts to 4 per cent upon the enormous sum of fifty billions of dollars.

Other important savings in connection with this method are those incident to the reduction in the enormous cost of transporting the great number of ties that are now required as compared with the lesser number that will be required if the sensible and more economical practice of European countries is followed. The average haul of crossties in 1905 being 500 miles, assuming the actual cost of transportation to the railroads to be 3 mills, the cost per tie transported was about 8 cts. and the cost of transporting the ties used annually, an average of 200,000,000 for the next 21 years, would amount to $16,000,000 per year. If the life of the tie be increased three-fold, the cost of the transportation will be decreased almost to one-third of this amount, or to $6,400,000 per year, and the difference between these two costs represents an annual saving to the railroads of the United States of $9,600,000 or about $200,000,000 for the period.

Again, a common estimate of the cost of inserting a new tie is 15 cts. This includes all the operations necessary for removing the old tie, inserting a new one, and restoring the ballast. Applying the cost of 15 cts. to the number of ties annually used results in showing a cost to the railroads of the nation for removing old ones of $30,000,000 annually, whereas, if the foregoing arguments are correct, this amount could be reduced to $12,000,000, and really the saving of $18,000,000 per year or $378,000,000 for the period of 21 years, constituting the difference between these two sums does not represent the entire saving because the reballasting or resurfacing is not completed at the time of the tie insertion, but in the aggregate vast indeterminate sums of money must be spent to restore the track to standard condition, subsequent to tie removals. These conditions do not take into consideration the cost of providing the enormous number of cars and locomotives required for the transportation of ties or a fair compensation to the railroads for the use of such equipment. If they are not required for this purpose, it will either be possible to get along with less equipment or to use them for the transportation of revenue business.

The above computations, which show the apparent saving due to the adoption of a more rational and thorough system of track construction, do not take into account any interest charges which will properly accrue in connection with that portion of expenditures for ties used in construction, which are paid for with the proceeds from the sale of bonds. The interest alone would amount to another indeterminate sum, according to the rate per cent, whether applied to the whole investment or only to that part in new track, whether compounded, etc. In any case it would run into the hundreds of millions.

It may be ventured that some substitute will be found for wooden ties. If the figures representing the average cost of ties during a period of 21 years are correct—and that cost is $1.55—there is very little probability that steel ties can be economically used. In the first place, they are not successfully used anywhere. Perhaps this statement is a little too positive, yet the testimony of American engineers who have investigated the subject abroad is to the effect that the men actually having to do with maintenance of track, even those who have had the longest experience with various types of steel ties, have very little to say in their favor. It must be remembered, too, that the cost of steel is destined to increase, not in the same ratio as the cost of timber perhaps—still it must increase appreciably. It is believed at the present time that all of the large existing bodies of ore have been located and approximately defined. If this is true, the exhaustion of these measures will be similar to that which must take place in our forest supplies. The coal measures of the United States and the tonnage that can be extracted therefrom can be computed at the present time with comparative accuracy. Without doubt the cost of coal must increase, and if it is also true, of which there can be no doubt, that the consumption of steel will increase enormously, its cost is bound to be higher. Of course, a satisfactory steel tie will be found, but the writer believes that it will be a combination tie made of steel and wood. If so, the problems of tie preservation and protection against mechanical wear will be similar to those which must be considered in connection with ties made entirely of wood.

A Collapsible Steel Horse or Trestle.

The steel horse shown by the accompanying illustration is adapted to all the uses to which the ordinary modern horse is put and is besides quite as light and far more convenient to handle and store. The latter advantages is due to the fact that the legs can be folded under and close up against the body of the horse. As will be seen the construction is of angles and butts with good stiff connections between legs and body. In the matter of strength this horse is claimed size for size to be superior to any other form. It is made in various sizes by the S. M. Hildreth Co., 2 Rector St., New York, N. Y.

Collapsible Steel Horse.

Specifications for Erection of Railroad Bridges.*

There is not much uniformity in the practice of railroad companies concerning the manner in which they manage the erection of bridges. Some companies whose bridges are of ordinary character and dimensions erect them with their own forces, others contract for the erection, others again erect the small bridges with their own forces and contract for the larger bridges.

The erection of a bridge, whether done by the railroad company's forces or by a contractor or by a combination of the two, embraces the use of erection plant, materials and labor required for performing a number of items of work. When done by the company's forces, the company furnishes all materials and plant and the separate items are distributed among the gangs properly equipped for the different characters of work, and no question arises as to what is included in the erection. When done by contract, the railroad companies in some instances construct spur tracks, unload and store materials, furnish free transportation and engine or work train service, flagmen and falsework, maintain traffic, frame and place ties; other campanies furnish none of these items.

It is necessary to construct spur tracks for the convenient handling of materials only when the structure is of some magnitude and is at a considerable distance from the nearest siding; or when the traffic is so heavy as to require erection with the least possible interference, in which case it is usually erected on the outside and pulled into position. While the construction of spur tracks is at times a necessary part of the erection, the railroad company's forces are better equipped for such work than are the contractor's, and it is therefore advisable, in all cases where such spur tracks are necessary, for the company to construct them with its own forces.

Cars can not always be permitted to remain for any considerable length of time on sidings. They should therefore be promptly unloaded and, if the material for the superstructure has been delivered in advance of the completion of the masonry, or when it is not expedient to start the erection immediately after the delivery of the material, the material should be unloaded and the cars released by the company's forces. It cannot be expected that the contractors will ship plant and men to unload the cars and then either wait until the masonry is finished or else move their forces away.

The materials used in the erection of a bridge are usually shipped to the nearest, unless a spur track has been constructed at the site. This siding may be quite a distance from the bridge site and will in that case require engine and work train service in order to get materials within handling distance of the erector's outfit. It is properly up to the railroad company, therefore, to furnish such service when required. It is optional with them whether they furnish all such service free of charge to the contractor, free for a limited number of days, or charge for every day's service furnished. Whether the work is done by the railroad company's forces or by contract, there will be expense to the railroad company, and it should be charged to the bridge.

When all such service is furnished free of cost, there is a possibility of abuse and calling for engines and work trains more than is necessary for the work. When each day's service is charged against the work, such service will be called for only when absolutely necessary, but in all cases of work train service there is involved more or less delay in furnishing the service on account of keeping the main tracks open for regular

*A paper by J. C. Greiner forming part of report of Committee in Iron and Steel Structures, American Railway Engineering and Maintenance of Way Association.

traffic service, and it frequently happens that but one or two hours' actual service is obtained during the day. A contractor cannot well include the cost of such interrupted service in his estimate, and thinks he has good cause for complaint when he is delayed and charged fully.

In order to avoid the abuse of engine service by contractors, a number of railroads furnish such service free of cost for a limited number of days, according to the judgment of the engineer, and charge the contractors regular service rate for all time in excess of that named. The writer thinks this will meet the conditions better than furnishing unlimited service free, or charging for all service, as it will have a tendency to make the contractor not call for service except when necessary, and when rendered will cause him to use it to the best advantage.

Practice also varies as to the transportation furnished by railroad companies to contractors. Some companies furnish no transportation whatever for men or materials, others will transport free over their lines the contractor's equipment, materials and men. This is therefore optional with the railroad, but as it involves a question of considerable expense, the contractor doing the work should know in advance whether or not he is to have free transportation. When such transportation is furnished by the railroad company, it is usually with certain restrictions as to trains and time.

While erection is in progress, flagmen must be stationed each way from the bridge in order to protect the trains and the work. These men should be familiar with train movements and should preferably be employes of the railroad company and under the company's complete control. Some roads furnish such flagmen and charge their wages to the contractors. The contractors understand this in advance, and add the cost of such labor to their contract price. Therefore, it makes no difference so far as the cost of the work is concerned whether the railroad company furnishes these flagmen free of cost or charges their time to the contractors, provided the contractors know in advance who is to pay the bill.

It is not necessary for a structure intended for temporary use to be designed with the same degree of strength and excellence that would be required should the structure be intended for permanent use. It, of course, must be of ample strength for the purpose and sufficiently substantial to prevent excessive motion. In designing such structures, therefore, it is proper to take into consideration their temporary use, that traffic, if any, will be operated at slow speed and that the structures are under constant supervision until finally removed. Materials must be suitable for the purpose, although they need not necessarily be new nor inspected with such refinement as would be applied to a structure that was to remain in service eight or ten years. It is well to properly proportion all parts for the maximum loads which will come upon them while in service, but it is not necessary to apply in these designs the unit stresses recommended for permanent regular service conditions. We all know that the unit stresses recommended by committees of this Association for timber trestles are safely exceeded time and again in regular practice. It would, therefore, be an unnecessary expense to use these low unit stresses in purely temporary structures used during the erection of a bridge.

Specifications for erection do not usually specify the permissible unit stresses, this matter being left either to the judgment of the erector or to the engineer who plans the work. It is advisable to fix a limit to these stresses and with suitable materials this limit could reasonably be placed 50 per cent in excess of limits recommended by Committee VII., as given in the Manual of Recommended Practice (1907).

In the construction of such falsework, there can be no reasonable objection to the use of round timbers instead of square timbers for the legs of bents, provided such timbers are of sufficient dimensions as not to exceed permissible stresses, and provided they are sawed off square to the axis of the stick.

When there is temporary falsework under an old bridge, placed by the railroad company for the purpose of supporting it until it can be renewed, the contractor who erects the new bridge should be permitted to use any part of this falsework during the construction of the new bridge, provided, of course, it is not wasted in cutting.

Some railroad engineers, even when they contract for the erection of a bridge, prefer to build the supporting structure for maintaining traffic, the contractor building only such additional temporary structures as may be necessary for the handling of the work. Frequently these temporary structures, whose only purpose is to maintain traffic, are constructed without any consideration whatever as to the requirements during erection, with the result that they have to be altered, cut down, or lengthened out before erection can proceed. If the railroad companies insist upon doing this work with their own forces, the contractor's men will work at a disadvantage or lounge about waiting for the railroad companies' forces to finish. From the writer's observation, he is not at all convinced that the railroad companies' forces are able to maintain traffic on falsework any safer or better than is done by the contractors' forces under efficient supervision, and, aside from this, when the two forces work on the same job at the same time, there is bound to be more or less interference and friction.

If the railroad companies build the temporary structure for carrying the traffic, the contractor is relieved of that responsibility, which means that the railroad company should always keep a force of men there to make the changes as the work progresses. In case the erection of a bridge is contracted for, it is evidently better to have the erector build the temporary structure for maintaining the traffic as well as that for erection purposes solely, in which case he is the responsible party, and on proper supervision by the railroad company the work will be just as well done and interference of forces will be avoided.

When, however, railroads insist upon maintaining the traffic with their own forces, the falsework should be placed so that it can be used for erection purposes as well as for maintenance purposes, and in such a manner as to interfere as little as possible with the work of the contractor.

Committee XV. has recommended that the floor decks in all cases be placed by the railroad companies' forces. The work should be well and accurately done in accordance with well-developed plans. Many ties have been spoiled by improper dapping on account of uncertainty of the requirements shown on undeveloped plans. The railroad companies' forces are just as liable to make such errors as are contractors' forces. If the contractors' forces are required to maintain traffic, it would appear better that they should also be required to frame and place the ties, as placing of these ties is necessarily a part of the maintenance of traffic, and if in any change of the old structure to the new structure, the railroad companies' forces are not available or are not on the ground, there will be delay in the execution of the work, or the contractor will have to put all ties in for his own protection.

In the case of solid floors where ballast is used, traffic must be carried on temporary stringers during the erection of the work. When the ballasting is done by the company's forces, as is customary, these stringers should be furnished and removed by them in order not to hold the contractor at the site after all his work has been finished.

Many railroads require that a special paint be used on their structures. As the paint applied after erection is a part of the material which enters into the permanent construction, it should be furnished either by the manufacturer of the steel work or by the railroad company, and the application alone left to the erector. Bridge erectors usually do not make a very good job of painting; for this reason a number of roads prefer to paint with their own forces, but, if the erection is done by contract, it is necessary for the contractors to know whether or not they are to do this work.

The question of responsibility during the construction of a piece of work could perhaps be more properly covered in the contract, but as the specifications form a part of the contract and are the governing rules for the execution of the work in the hands of the erector, it is well to define the contractor's responsibility in order that the man doing the work may know where he stands.

When erection work is done by the company's forces alone the question of responsibility does not arise. When done by the manufacturer or by an independent contractor, there is in all justice a division of the responsibility between the railroad company and the contractor. The contractor should undoubtedly be held responsible for all accidents, loss or damages to his own work, his materials or his plant, due to any cause, whatever. As the company's materials are in his hands, he should also be responsible for it in case of accidents, due to causes within his reasonable control. It is proper for him to carry insurance against injury to workman, and protect the company in case suit is entered. It is, however, not fair to make him responsible for damage to the company's property or materials when such damage is due to causes beyond his reasonable control, as this is a matter against which he could not protect himself. The mere fact that he had charge of the company's property at the time of such accident is no reason why he should pay such costs.

There should be no material difference in the requirements of specifications, whether the work is done by the company's forces, by contractors or by a combination of the two, since rules governing the proper execution of work are just as necessary for the company's forces as for the contractor's forces, and the work should be of ample strength and of workmanship suitable for the purpose, no matter who does it.

The following specifications are submitted for the purpose of discussion:

SPECIFICATIONS FOR ERECTION OF RAILROAD BRIDGES.

1. The work of erection shall include the furnishing of all labor, tools, equipment and materials, other than those which enter into the permanent structure, the removal of the old bridge, if any, and the construction of the new superstructure ready for the rails, all in accordance with the plans and specifications.

2. The railroad company when inviting proposals for erection will state where the materials will be delivered and whether on cars or stored, what materials, spur tracks for convenient handling of materials, transportation, engine or work train service and flagmen they will provide, and whether they or the contractor shall construct all falsework or protection work, remove old bridge, maintain traffic, construct solid floors, frame and place the ties, waterproof and paint the steel work. The contractor shall furnish the erection equipment and do all work specified in the inquiry and according to the requirements of the plans and specifications.

3. The method of erection, except where local conditions justify a special scheme, will generally be at the discretion of the erector, subject to the approval of the engineer.

Where conditions justify a special scheme, the requirements will be clearly stated or shown on plans.

4. Bridges shall be erected in accordance with approved plans of the falsework and permanent structure. Approval of contractor's plans shall not be considered as relieving the contractor of any responsibility.

5. Erection shall not be started until sufficient material has been delivered to enable the work to proceed continuously, nor until the erector has been authorized to proceed. It shall be conducted with a force of men and plant sufficient for speedy completion and in such manner as to be at all times subordinate to the unobstructed use of the tracks of the company, and so as not to interfere with other work in progress, or close thoroughfare by land or water, except under proper authority.

Traffic and work must be protected by flag-

men whenever necessary, and competent watchmen shall guard the work and materials against injury. All laws and ordinances applying to the work shall be complied with, the necessary permits obtained, and lights provided to protect work at night.

6. When engine or work train service is desired by the contractor, he shall give the proper railroad officials at least 24 hours' advance notice, and the company will furnish the service according to conditions stated as promptly as possible, consistent with railroad operations. When derrick cars are used on main tracks, their movements shall be in charge of a regular train crew.

7. When transportation of equipment, materials and men is furnished free over the company's lines, it shall be subject to such conditions as may be stated.

8. The railroad company will furnish all masonry to correct lines and elevations, and unless otherwise stated will make all changes in old masonry without unnecessarily impeding the operations of erection. The company's engineers will establish lines and elevations, but the erector shall compare the elevations, distances, etc., shown on plans, with the masonry as actually constructed, so far as practicable with spirit levels and steel tapes, before he assembles the steel. In case of discrepancy he shall immediately notify the engineer.

9. Cars containing materials or plant shall be promptly released upon delivery. Materials shall be placed on skids above the ground, laid so as not to hold water and stored and handled in such a manner as not to be injured and not interfere with railroad operations. The expense of repairing or replacing material injured in handling by contractors shall be charged to the contractors. Material when being unloaded and stored shall be compared with the shipping list and any shortage or injury shall be promptly reported.

10. The temporary structures for use during erection and for maintaining the traffic shall be properly designed and substantially constructed for the loads which will come upon them. All bents shall be thoroughly braced transversely, and held against longitudinal movement by diagonal bracing or lines of struts extending from face to face of piers or other approved anchorages. The bents shall be well secured against setting, and piles driven wherever firm bottom cannot be obtained by wedging down the bents.

The maximum permissible unit stresses in any member shall not exceed the unit stresses recommended in the Manual of 1907, page 85, for wooden bridges and trestles, by more than 50 per cent.

Temporary falsework placed by the railroad company under an old structure or for carrying traffic over a new opening may be used by the erector during erection, provided it is not unnecessarily cut and wasted.

11. When traffic is maintained by the company's forces, any changes in structures carrying the traffic, required for the purpose of facilitating erection by contract, shall be made by the contractor, under the supervision of the company's representative.

12. Metal work in old structures shall be dismantled without any unnecessary damage and loaded on cars or neatly stored at the site, immediately adjacent to the tracks and at a convenient grade for future handling, as may be directed. When a structure is to be used elsewhere, all parts shall be match marked, in accordance with diagram to be furnished by the engineer, and when the old bridge is composed of several spans, the parts of each shall be kept separate. All trestle work placed under the old bridge for support shall be considered part of the old structure.

13. All steel work shall be adjusted to correct position and true to lines before being permanently connected, threads of pins protected by pilot and driving nuts, and, wherever permanent bolts are used, the nuts effectively locked by checking the threads. Moderate drifting will be permitted in order to draw parts together, but not for the purpose of matching unfair holes. Such holes shall be reamed or drilled.

All splices and field connections shall be securely bolted before riveting, and important connections, such as tension splices and attachment of stringers and floor beams, shall have at least 75 per cent of the holes filled with bolts, when the parts are required to carry the traffic. When not carrying any traffic at least 50 per cent of the holes shall have bolts. Rivets in splices of members shall not be driven until the members have been subjected to the full dead load stresses.

Rivets shall be uniformly heated to a light cherry red color, and when driven shall completely fill the holes and be tight. The heads shall be full and uniform in size, concentric, free of fins, in full contact with metal and be painted immediately after inspection and acceptance. Rivets shall be inspected immediately after being driven and those rejected shall be cut out and replaced without delay.

14. Minor misfits which require a reasonable amount of reaming, cutting and chipping in order to permit accurate assembling shall be considered a legitimate part of erection. Errors in general dimensions and misfits or holes so badly matched as to require drilling or cutting apart of metal work cause extra work properly chargeable to the manufacturer. Such errors shall be reported to the engineer as soon as discovered and corrections made during the presence of the inspector who shall check the time required. All extra work ordered will be paid for at actual cost to the contractor for labor and materials, plus 15 per cent for use of tools and supervision.

15. Holes for anchor bolts, except where bolts are built into the masonry, shall be drilled by the erector and set in Portland cement grout or lead after the span is in place.

16. Bed plates shall be set level in exact position and have a full and even bearing over their entire surface, a thin layer of Portland or rust cement or lead being used for this purpose.

17. Floor decks shall be constructed strictly in accordance with the approved plans. In case of wooden floor decks, the ties shall be framed so as to give a full and even bearing on the girders and under the rails. The outer edges shall be sawed off to correct lengths and be in true line. Guard rails shall be dapped and framed to a tight fit over the ties and secured as shown on the plans.

When structures have a camber of more than one-half inch, ties shall be framed so as to take out all camber over this amount, except when the bridge is composed of one span only, in which case the camber may be neglected.

18. The paint used shall be of such color, quality and manufacture as may be specified. The metal shall be thoroughly cleaned of dirt, rust, loose, scale, blistered paint or paint which has been damaged in handling. Surfaces inaccessible after erection, such as bottoms of base plates, tops of stringers, etc., shall receive two coats before assembling in place and the balance of the metal work shall receive two coats after erection. There shall be sufficient time allowed between the coats to allow the first to dry before the second is applied, and no painting shall be done in wet or freezing weather nor when the surface of the metal is damp. Painting shall be done in good and workmanlike manner, subject to strict inspection during progress and after completion.

19. Upon completion of the steel work all surplus material, debris and temporary structures shall be removed and the premises left in a neat condition. The material from temporary structures, if the property of the company, shall be neatly stored near the site or loaded on cars as may be directed.

20. All work done and materials furnished shall be of good quality.

21. The work of erection shall at all times be subject to the inspection and acceptance of the engineer or his representative on the ground.

22. When work is done under contract, the contractor shall assume all responsibility for loss or damage to his own work, materials or plant, due to any cause whatsoever; also for all loss or damage to the railroad company's materials or property and to other property adjacent to the railroad, due to causes within his reasonable control.

He shall assume all responsibility for injury to the workmen, or the public or to any individual, and in case of accident or suit, he shall defend the suit in person, and relieve the company from all costs and expenses, and pay any judgments that may be recovered thereon.

He shall comply with the local or Government laws or ordinances controlling or limiting the manner of doing the work and shall take such precautions as may be necessary to protect life and property.

Cost of Patching Asphalt Pavement at St. Augustine, Fla., Using a Portable Repair Plant.

The city of St. Augustine, Fla., has a considerable yardage of asphalt pavement, some of which, for several years past, has been badly in need of repairs. As the city had no asphalt repair plant various makeships to methods have been employed for filling the holes, which appeared in the pavement. For several years past it has been the practice to fill these holes with brick.

During the past winter the city undertook a general scheme for repairing its asphalt pavement and for this purpose secured Hooke portable asphalt repair plant, paying $537 for it. The first patch was laid on Nov. 1 and the last patch on Feb. 1. During the period of 83 days a total of 4,290 sq. yds. of patches was put down. These patches were small in size and were scattered over several streets. Over 31,000 brick which had been used in patching these holes were removed and used for other purposes. The average thickness of the patches was 1½ ins., and the average number of square yards placed per day was 551.

As the local labor had had little experience in asphalt repair work, an experienced man was secured from Chattanooga to instruct the workmen and foreman, and he remained with the gang for the first ten days.

The repair gang consisted of the following:

	Per day.
One foreman	$ 4.00
4 laborers in asphalt plant at $2	8.50
2 laborers chipping old pavement and getting holes in condition to receive new material, at $1.50	3.00
Supply wagon and driver	2.50
Total per 8-hour day	$17.50

On the basis of an average yardage placed per day of 51, the unit cost of the labor was as follows:

	Per sq. yd.
Foreman	$0.078
Labor in asphalt plant	.157
Labor shipping, etc.	.060
Supply wagon and driver	.050
Total (55 sq. yds. per day)	$0.345

The cost of the materials used in the work was as follows:

Asphaltic cement, per ton	$26.20
Ridge sand, per cu. yd.	1.80
Portland cement, net, per bbl.	1.50
Wood, per cord	5.00

Owing to the rush with which the work was carried on holes were burned in the pan of the plant, the repairing of which cost $127.41. In addition to the patch work 1,270 sq. yds. of new concrete base was laid at a total cost of $990.60, or 78 cts. per square yd. This cost includes the removing of the brick patches and the relaying of the brick along the street railing line. The total cost of the work including repairs to plant and new concrete base was $3,425.77 or an average of 79.8 per square yard for the whole work. The cost of the asphalt patches alone, material and labor, was 56.67 per square yard. The work was undertaken at the suggestion of Mayor Eugene Masters, to which we are indebted for the above information.

Cost of Street Sprinkling.—The following table shows for ten years the miles of street sprinkled and the cost per mile for sprinkling in the city of Hartford, Conn.:

Year.	Miles.	Cost per Mile.
1899	11.37	$ 479.73
1900	47.40	556.30
1901	46.75	490.09
1902	48.20	489.10
1903	49.05	490.56
1904	50.04	492.44
1905	51.07	492.45
1906	52.12	335.66
1907	54.57	354.11
1908	56.11	344.70
	502.27	$4,516.14
Average	50.23	$ 451.61

The Grand Trunk Pacific Ry.

One of the largest railway undertakings at present under way is the construction of the Grand Trunk Pacific Ry. in Canada. Ground for this transcontinental road was broken at Fort Williams, Ont., on Sept. 11, 1905, and now 4½ years later, out of a total mileage of main line and branches of approximately 7,900 miles, there have been completed or are under construction approximately 4,800 miles or 60 per cent of the entire mileage authorized by the company's charters. Of the main line from Monston to Prince Rupert, a distance of 3,550 miles, a total of 2,000 miles has been placed under construction, on which there has been laid 1,795 miles of track which in some cases is made up of disconnected sections, and is therefore not all continuous. That portion of the line, however, from Winnipeg to Edmonton, 793 miles, has been constructed and has been in partial operation by the construction department for the past 18 months and within the past 90 days the track has been completed continuously from Edmonton westerly to Wolf Creek, 122 miles, thus completing the track laying on that portion of the line designated as the prairie section, Winnipeg to Wolf Creek, 915 miles. The track laying was also recently completed from Winnipeg to Fort William, thus making a continuous line from Fort William, via Winnipeg and Edmonton, to Wolf Creek, 1,360 miles, which however cannot be completed for practical operation for some months, as considerable work is required to be done on the easterly and westerly ends of the line, to put it in a suitable condition for the movement of regular trains. The other portions of the main line on which the rails have been laid are situated at different points east and west of the city of Quebec. During the past year contracts have been let for the construction work from Wolf Creek, Alberta, westerly to Tete Jaune Cache in the Rocky Mountains, 179 miles, and there are at present engaged on this section of the line 1,000 teams and a large number of men. Similar forces are also engaged on the construction of the line from Prince Rupert, the terminus of the Pacific coast, easterly to Aldemere, B. C., 240 miles. In addition the provincial governments of Saskatchewan and Alberta passed acts at the sessions of their legislatures in 1909, authorizing guarantees for the construction of branch lines by the Grand Trunk Pacific railway company in these provinces to the extent of 686 miles, comprising branch lines from the main line of the Grand Trunk Pacific railway to Yorkton, Regina, Battleford, Calgary, Lethbridge, McLeod and Coutts, the construction of which is at present under way. At the session of the Saskatchewan legislature in December, 1909, an act was passed authorizing the guarantee of the construction of additional branch lines by the Grand Trunk Pacific railway in that province, to the extent of 475 miles, comprising lines southeasterly to the United States boundary line, from the main line of the Grand Trunk Pacific railway to Prince Albert, and from Regina westerly to Moose Jaw, Calgary, etc., and the construction of these will be undertaken during the present year.

Petitions bearing the signatures of 18,759 voters have been submitted to the Common Council of Detroit, calling for a popular vote on the question of municipal ownership of the street railway system.

LETTERS TO THE EDITOR.

Reinforced Concrete Flat Plate Floors.

Sirs. I note a paper by Mr. MacMillan, presented at the National Association of Cement Users, given in your issue of March 23. In this connection the writer would call attention to the following points.

First. That in his experimental work he has taken open hearth medium steel, the yield point of which is well known, and has tested the construction to the yield point of the metal. His method is based on definite knowledge as to the stress in the metal under load and is not based on assumptions of any kind.

Mr. MacMillan has overlooked the statement in the writer's publications that the coefficients given by him hold good only for nearly a fixed ratio between the width of the belt and the column spacing and that there is a large variation where this ratio is departed from. In Mr. Mensch's designs, as the writer looks at it, he has departed from the economic width of belt, hence must use a larger coefficient for bending.

Mr. MacMillan's statement that the economy of the flat plate system disappears with rectangular panels is somewhat incorrect. The writer has put up many having dimensions 18x30 ft. If Mr. MacMillan had checked up his method by deflections we believe he would have come to different conclusions.

Yours truly,

C. A. P. TURNER.

Minneapolis, Minn., Mar. 24, 1910.

Technical Society Meetings.

The list following names those technical societies in which engineers and contractors are most interested, whose meetings are to be held within three months of the date of this issue. There are given for each society listed the date and place of meeting and the name and address of the secretary, to whom all communications and inquiries should be addressed.

American Water Works Association.—April 26-30, 1910. Annual convention at New Orleans, La. Headquarters, Gruenwald Hotel. Secy., J. M. Diven, Charleston, S. C.

Notes from Technical Societies.

Nebraska Conservation and State Development Congress.—Among the papers to be presented at this congress, which will be held at Lincoln, Neb., March 29 and 30, are the following: "Good Dirt Roads for Less Money," F. W. Chase; "Culverts and Bridges," M. M. Stearns; "Town and Rural Water Supplies," address by an authority on this subject, address illustrated by maps and stereopticon views representing actual conditions in Nebraska; "Forestation," H. A. Mast, U. S. Dismal River Forest Reserve; "Irrigation," E. C. Simmons, F. C. Krotter and A. W. Hamilton.

Personals.

Messrs. Edwin M. Evans and Charles F. Puff, Jr., Civil Engineers, have moved their office from 900 to 805 Rothschild building, 14 South Broad street, Philadelphia, Pa.

Major General Will T. Martin of the Jeff Davis Legion, C. S. A., died at his home, Montaigne, March 16. General Martin promoted and built the Natchez, Jackson & Columbus R. R. and was president until the road was sold to the Yazoo & Mississippi Valley R. R. He was 87 years old.

The City Council of Pleasant Ridge, Cincinnati, O., on March 16 accepted and adopted the surveys, maps, plans, designs and estimates of their engineer, Mr. Donald W. Caven, for a sewerage system and plant to cost approximately $227,000, and covering about 15 miles of vitrified pipe sewers.

Mr. L. H. Conklin, recently General Manager of the Scranton Electric Company, has taken a position with J. G. White & Co., Inc., New York, as Engineer in the Operating Department. Mr. Conklin, who was previously Superintendent of Lighting and General Superintendent of the West Penn. Rys. Co., of Pittsburg, has had a varied experience in electrical engineering work. He is a graduate of Pratt Institute of Brooklyn.

Catalogs Worth Having.

Engineers and contractors should have on file the latest catalogs of machines, tools and supplies that they use. In sending for catalogs reviewed or advertised in this paper, you will confer a favor on us if you will write directly to the advertisers and state that you saw the catalog mentioned in ENGINEERING-CONTRACTING. If you are in the market for tools, machinery or supplies, tell us and we will notify promptly the leading manufacturers.

Steel Tape.—Paper, 5½x7¼ ins., 32 pp. Chicago Steel Tape Co., Chicago, Ill.

A descriptive catalogue of steel tapes and field engineers' supplies.

Concrete Molds.—Paper, 9x11¾ ins., 20 pp. Miracle Pressed Stone Co., Minneapolis, Minn.

Describes molds for making concrete sewer pipe and drain tile, concrete culverts, double air space blocks and ornamental fans and forms, etc. Also shows some concrete mixing machines and finishing tools. Prices are given.

The Machinery List.—Paper, 4x6¼ ins. A. H. Hitchcock, Monadnock Blk., Chicago, Ill.

Users of sawmill and wood working machinery will find this little booklet very handy. It lists wood working machines of every description. It is published monthly and is free to machine users on application.

Specifications for Portland Cement.—Paper, 3½x6 ins., 4 pp. The American Bureau of Inspection & Tests, Chicago, Ill.

Contains specifications for Portland cement adopted by the American Society for Testing Materials. In addition a table is furnished showing the amount of materials required for a cubic yard of rammed concrete.

Concrete Porches.—Paper, 5¼x7 ins. The Simpson Cement Mould Co., Columbus, O.

This booklet tells how to build fine concrete porches. The information is given in a practical way accompanied by useful data on prices of concrete work. This company also sends a 37-page book describing the molds made by them together with handsome illustrations showing some of the ornamental effects produced by the use of concrete blocks and forms.

Underground Transmission Railway Signaling. Paper, 3¼x6 ins., 20 pp. McRoy Clay Works, The Rookery, Chicago, Ill.

A treatise on underground conduits for wires used to transmit electrical energy in railway signaling work. The advantages of underground transmission over exposed overhead wiring is pointed out. Some construction details of the conduits made by this company are shown.

Boiler Tests.—Paper, 6x9 ins., 24 pp. American Ship Windlass Co., Providence, R. I.

Contains the results of tests on boilers equipped with Taylor Gravity Underfeed Stokers.. Comparisons are made between stoker test quantities and hand firing test quantities.

Steel Bound Concrete Curb.—Paper, 6x9 ins., 8 pp. Steel Protected Concrete Co., Philadelphia, Pa.

This company sends an illustrated pamphlet with enclosed circular matter describing a system for protecting exposed corners on curbs, sidewalks, steps, columns, etc. The merits of the galvanized corner bars used by them are shown.

Wood Rock Drill.—Wood Drill Works, Chicago, Ill.

A three-leaf circular sent by this company describes the new model No. 5 Wood Rock Drill. This machine has a capacity of 50 ft. with a 4-in. hole at the bottom and is adjustable to the required working force.

Hydraulic Jacks and Pressure Pumps.—Catalogue No. 8. Paper, 4x7¼ ins. Richard Dudgeon, Broome and Columbia streets, New York, N. Y.

Contains descriptions, fully illustrated, of hydraulic jacks and pressure pumps of value to contractors. Directions for using these tools are given.

Reinforced Concrete Specifications.—Reinforced Concrete Construction Co., St. Louis, Mo.

This company sends a handsome portfolio of photographs of buildings erected by its construction forces and includes in the portfolio specifications which are up to date and well worth the attention of engineers and architects.

Contract News Section

of

ENGINEERING-CONTRACTING

A Consolidation of ENGINEERING-CONTRACTING—CONTRACT NEWS—ENGINEERING WORLD—THE DIRT MOVER.

Containing Items of Interest to Railroad, Public Works and Other Contractors.

The Doings of the Week.

The principal feature of railway construction work of the past week has been the awarding of contracts by the Canadian Pacific Ry. for new work in Western Canada. Foley, Welch & Stewart, St. Paul, Minn., and J. D. MacArthur Winnipeg, Man., got the greater part of these contracts, the former getting the bulk of the western work and the latter the work near Winnipeg. In addition J. Bradley secured the contracts for the C. P. line from Regina, Sask., to Colonsay, 140 miles and Janse, MacDonald & Timothy secured the contract for constructing the Western portion of the C. P. line from Outlook. A. Kirk, Antigouish, N. S., has been awarded the contract for constructing the ten-mile branch of the Intercolonial Ry. from George's River to Sydney Mines, Cape Breton. Other contracts let recently are as follows: The Callahan Construction Co., Knoxville, Tenn., for continuing the construction of the Wasioto & Black Mountain R. R. from Harlan, Ky., for a distance of 27 miles, the contract involving 550,000 cu. yds. of mountain rock work; J. C. Kelso, Galveston, Tex., for clearing, grading and fencing 16 miles of road bed for the Houston-Galveston Interurban Ry. in Galveston County, Texas; M. N. Sikes, Ramsey, Ala., for cleaning, grubbing and grading the 25-mile extension of the Alabama, Tennessee & Northern R. R., south from Geiger, Ala.; The Carter Construction Co., Chicago, Ill., for the revision of the main line of the Cincinnati, Hamilton & Dayton Ry., from Piqua Junction for a distance of 10½ miles and Morriss & Shepard, St. Paul, Minn., for 35 additional miles of Great Northern R. R. work, in North Dakota.—The Advisory Board for the New York State Barge Canal has approved plans for three additional contracts and bids will be asked shortly. These contracts are as follows: No. 62, for the improvement of the canal from the west line of Monroe County to the east end of Contract No. 9 at Eagle Harbor, a distance of 14.5 miles, the estimated cost being $2,152,330. Contract No. 27-A, for completing a section of the Champlain Canal from the south end of Dunhams Basin Road to the Hudson River at Fort Edward, a distance of 3.76 miles, estimated cost being $380,433. Contract No. 79, for the construction of a highway bridge over the Oswego Canal at Bridge St., Oswego, at a cost of $39,325.—The House Committee of the U. S. House of Representatives on March 22 agreed on a bill which provides for a substantial enlargement of the engineer corps of the army. The measure increases the number of officers in the higher grades and provides for filling vacancies in the second lieutenancies as far as practicable by promotion from West Point.—The Canadian government has decided to approve of the waterways treaty with the United States as drafted in 1908 with the senate rider. This treaty provides for control of international waters for power, irrigation and navigation purposes. The original treaty was approved by Canada, but in the course of its passage through the American senate a rider was added providing that existing rights of riparian owners on the St. Mary's river at Sault St. Marie in either country should not be affected. By the treaty the amount of water to be taken from the Niagara on the American side is limited to 20,000 cu. ft. per second and on the Canadian side to 36,000 cu. ft.—Steam shovel 213 working in the Culebra Construction District of the Central Division of the Panama Canal on March 5, broke all records for daily excavation since the commencement of work by the United States. During the working day of eight hours, that shovel excavated 4,009 cu. yds. of rock and earth, loading 211 Lidgerwood flats with the material removed. The shovel was under steam eight hours, was actually digging seven hours, and was waiting for cars etc., one hour.

Width of Macadam Roads.

A club has been formed by the merchants and farmers in one of the counties of a western state for the purpose of securing the construction of improved roads in the county. The club has gone about its work in a sensible fashion and has already secured the building of several miles of macadam roads. One of the slogans of the club is: "Take it off the sides and put it on the ends," the meaning being that a macadam road should be constructed only to a width suited to the demands of the traffic, and the money thus saved should be used in making the road of a greater length. We commend this slogan to the attention of road engineers. The standard width in this country for the macadamized roadway of improved roads is 16 ft. and many road engineers are accustomed to use this standard without considering whether the traffic is or is not sufficient to warrant such a width. Many country roads undoubtedly do not carry sufficient traffic to warrant a 16 ft. improved roadway, but they do have traffic enough to warrant an improved roadway of less width. Among the earliest road builders to appreciate this fact was A. J. Cassatt, late president of the Pennsylvania R. R. Mr. Cassatt, as is well known, was a civil engineer by profession, but it is less well known that he was very much interested in highway construction. However, for 15 years he served as Road Supervisor in Lower Marion Township, Pa., during which time he constructed over 40 miles of stone roads. In a letter written in 1897, at which time he was a director of the Pennsylvania R. R., he had the following to say regarding the economic widths of macadam roads: "Experience also teaches me that it is useless to make the roads too wide. For any ordinary country road we find it sufficient to spread the stone to a width of 12 ft.; this will be increased to 13 ft., or perhaps a little more, by the action of the roller. Thirteen feet is sufficient to allow two vehicles to pass without going off the stone, and in our neighborhood, which is a suburban one, and where there is considerable travel on all the roads, I think this is not too wide. In some country districts a lesser width would no doubt do, but it would seem to me that 8 ft. ought to be the minimum width, and that as between this and 12 ft. there would be no necessity for increasing the width, for, unless you went to the latter width, vehicles would have to turn on to the sides of the road to pass each other. On a road narrower than 8 ft. all the travel would be right in the center of the road, and the wheels would follow each other so that the road would be likely to wear into ruts. This, however, is theoretical on my part, as I have never built any roads less than 12 ft. wide."

They Also Serve.

The annals of construction work contain many instances of heroic deeds and devotion to duty. Seldom is a large piece of work completed without some man having shown the qualities which go to make a hero. In most cases these heroic deeds are quickly forgotten except by those directly concerned in them. But in some cases the deed is such that it is remembered long. Such a deed was the sacrifice of the two bridge men on the new Queensborough bridge over the East River at New York City. Here two steel men were working 100 ft. in the air, putting in place a heavy steel plate. Just as the plate was being put into place it began to slip. The two men realized that if it fell at least three of their comrades would be killed, so they thrust their bare hands into a crevice beneath the plate, which continued to grind down for a few minutes but was stopped before it did any other damage. The sacrifice stopped the plate but it crushed the men's hands so that they had to be amputated. Another example of heroism occurred a short time ago at Panama. In this case the hero was a Spanish laborer, Angel Alvarez by name, who was working as "dobey" man with the crew of a steam shovel in the Culebra cut at Bas Obispo. In reporting the occurrence the superintendent of construction in the Bas Obispo District said: "Alvarez had placed a 'dobey' consisting of ten or twelve sticks of dynamite on a rock in the bottom of the pit. One of the pitmen noticed a rock falling from the top of the bank and shouted to Alvarez, who, with rare presence of mind, tried to snatch the dynamite away. He succeeded in getting nearly all, but unfortunately did not get the exploder. The result was that Alvarez was the only one injured, notwithstanding the fact that the entire shovel crew, a conductor and a brakeman, were within 20 ft. of the explosion. There were seven or eight sticks of dynamite found on the ground in the immediate vicinity, which could have come only from this particular shot." In the explosion, Alvarez' right foot was fractured, right great toe burned off, right arm and side burned, and left side burned. He was taken to the Ancon hospital, and we are glad to record that he is now slowly recovering

The Plainfield Horse Car Co., of Plainfield, N. J., is to apply to the State Legislature for an extension of its charter for five years. If this extension is granted the company will take steps this year to establish a belt trolley line to extend from Metuchen to Plainfield, to North Plainfield, to Warrenville, to Dunellen, to South Plainfield to Oak Tree, thence to Metuchen. J. Fred MacDonald, Plainfield, N. J., is a director.

Messrs. Libbey and Dingley of Lewiston, Me., chief promoters of the proposed trolley line from Lewiston to Portland by way of Gray, have made arrangements to build the line themselves and will begin construction at the Auburn end within a month.

The street railway system at Missoula, Mont., owned by W. A. Clark, is to be extended, and it is possible that in the near future a line will be built along the east side of the Bitter Root river to Hamilton.

Confirmed Reports by Engineers and Contractors

RAILROADS, POWER DEVELOPMENTS, LEVEES, DRAINAGE AND IRRIGATION WORKS.

Railroads—Steam and Electric.

ALABAMA.

M. N. Sikes, Ramsey, Ala., has the contract for clearing, grubbing and grading the 25-mile extension of the Alabama, Tennessee & Northern R. R. south from Geiger, Ala., to the A. G. L. R. R. Mr. Sikes would like to hear from contractors having idle teams, and he could also use from 300 to 500 station men. Part of the work will be sublet. Buckner & Daniels, Panola, Ala., have the contract for the crossties and bridge work. Wm. Toxey, Cochrane, Ala., is chief engineer of the railroad, and John T. Cochrane, Mobile, is president.

ARKANSAS.

The Missouri & North Arkansas R. R. contemplates expending $750,000 on betterments between Leslie and Helena, Ark. A large force of men and several steam shovels have been at work north of Leslie loading ballast, some of which is hauled below Searcy. The company has purchased of the Baldwin Locomotive Co. several 120-ton engines of a special design for this road. Fred W. McNeil, Searcy, Ark., formerly of St. Louis, is engineer of maintenance of way and is revising the grades and alignment. All curves over 2 degrees will be spiraled with the Searles spirals and the roadbed put in shape, good for 40 miles per hour between Kansas City and Helena.

CALIFORNIA.

We are advised that the projected extensions of the Oakland Traction Co. in Oakland are of such character that they will be done under the direction of the company and with its own equipment.

Palmer, McBryde & Quayle, San Francisco, Cal., have been awarded the contract for constructing a five mile extension of the Pacific Electric Ry. from Pillsbury easterly. George E. Pillsbury, Los Angeles, is chief engineer of the railway.

H. Hauser, 509 Central Bldg., Los Angeles, Cal., has the contract for constructing the Richfield-Fullerton cutoff in Orange County for the Santa Fe. The contract includes 100,000 cu. yds. earth excavation, 120,000 cu. yds. embankment and 2,000 cu. yds. concrete masonry. None of the work is to be sublet, and it is to be completed in 60 days. The award of this contract was mentioned in our March 16 issue.

GEORGIA.

The construction of a railroad from Irwinville to Ashburn, Ga., is proposed, but no definite plans for building the road have been made as yet. W. A. Shingler, Ashburn, Ga., is interested.

ILLINOIS.

Surveys are now being made for the projected line of the Rock River Traction Co. As projected the total length of this line will be 124 miles with a route as follows: Princeton to Geneseo and Rock Island; Sterling to Geneseo; Morrison to Prophetstown, and Geneseo to Kewanee, and also to Galesburg. The time for awarding construction contracts has not yet been determined. F. W. Sears, Prophetstown, Ill., is Chief Engineer, and Hugh W. Cole, Geneseo, Ill., is President.

INDIANA.

The Walsh Construction Co., Davenport, Ia., as stated in our last issue, has the contract for constructing the Evansville, Mt. Carmel & Northern Ry. (Big Four line) from Mt. Carmel, Ill., to Evansville, Ind. The contract involves excavation, bridging, fencing, tracklaying and ballasting and includes 1,800,000 cu. yds. of earth excavation, 750,000 cu. yds. rock excavation, and a bridge over the Wabash River, 3,000 ft. long. John Hickey Bro., St. Louis, Mo., has the sub-contract for the concrete and trestle work.

KANSAS.

The Electric Traction Construction Co., 218 Scarritt Bldg., Kansas City, Mo., wishes to sublet 25 miles of railway work in Kansas on which there are 402,301 cu. yds. of grading, etc.

The Garden City, Gulf & Northern R. R. now has 42 miles of line in operation and 75 miles under construction from Garden City to Liberal, Kas. W. H. Cost, Garden City, Kas., is chief engineer, and B. M. McCue, Garden City, is president. The Kansas Construction & Irrigation Co., E. A. Tennis, president, Garden City, has the contract for constructing the line.

KENTUCKY.

The Callahan Construction Co., with home offices in the Empire bldg., Knoxville, Tenn., has just been awarded the contract for a further extension of the Wasioto & Black Mountain R. R., commencing at Harlan, Ky., and extending in a northeasterly direction along the mountains for 27 miles. This extension is in addition to a contract that the Callahan Construction Co. has already under way for the same road covering a distance of 24 miles and extending from Pineville to Harlan, making in all, 51 miles. This new contract comprises some 550,000 yds. of very fine mountain rock work, together with a large amount of excellent scraper work; also one tunnel 600 or 700 ft. long, and a considerable amount of cut stone bridge masonry, concrete work, etc. Mr. E. R. Keller, General Superintendent for the Callahan Company will be in charge of this contract and will be located at Harlan, Ky.; telegraph address, Harlan, Ky., via Hubbard Springs, Va. The company is arranging to put outfits on this work immediately and expects to complete same by late fall, so as to give the contractors the advantage of working during the summer months. Contractors interested in any of this work can confer with Mr. Keller at the above address, or can see Mr. Geo. W. Callahan, President of the company, at the home office, Knoxville, Tenn.

LOUISIANA.

Surveys have been completed for the projected 15-mile line of the Kinder & Northwestern Ry. The construction work has been let and three miles of the line completed. The road is to extend northwest from Kinder to the timber lands of the Peavey, Byrnes Lumber Co. The contractor for the work is a Mr. Walker of Kinder, La. A. J. Peavey, Shreveport, La., is President, and Frank Shutts, Lake Charles, La., is the engineer.

NEVADA.

The Tonopah & Goldfield R. R. has an engineering party now in the field running a preliminary line to Mono Lake. Nothing definite will be decided regarding construction until these surveys are completed, which will be some time in the future.

OHIO.

The Ashtabula Electric Street Ry. Co., Haskell Bldg., Ashtabula, O., is asking bids until Apr. 8 for the construction of 10 miles of electric railway. Profiles, etc., can be seen at the office of the company in Ashtabula.

Preliminary surveys have been completed and contracts let for the Ashtabula electric street railway and construction will be started soon by the contractors, A. F. De Meyo & Co. of New York. The line will be six miles long and will connect with interurban lines to Cleveland, Erie and Jefferson. Local capital and eastern parties are interested. Chapin & Bryson of Ashtabula, O., are the engineers.

The Carter Construction Co., 184 La Salle St., Chicago, Ill., has been awarded the contract for the revision of the main line of the Cincinnati, Hamilton & Dayton Ry., between Piqua Junction and Saunders, approximately 10½ miles.

The Hocking Valley Ry. Co. has authorized the installation of six standard passing sidings on the Toledo division and five on the Hocking division, making a total of eleven on both divisions. W. Michel, Columbus, O., is engineer maintenance of way.

OKLAHOMA.

The Arbuckle & Western R. R. Co. has filed its charter and will let contracts shortly for its projected line. As proposed this road is to be 180 miles long and is to extend from Ardmore, Okla., to Chickasha and Lawton. M. S. Forcythe, West Chester, Pa., is chief engineer and Oscar O. Ayres, Olathe, Kas., and Ardmore, Okla., is president.

Preliminary arrangements are being made for 30 miles of railroad from Chattanooga, Okla., to Davidson, Okla. Arrangements for securing the necessary capital for construction have been made. One survey has been made and final surveys are to be started at once. Construction contracts are to be let in about 30 days. The line will require four bridges of an average length of 40 ft. J. H. Ransom, Chattanooga, Okla., is president.

TENNESSEE.

The Tennessee Traction Co. now has surveys under way for its projected line. The projected length of this road is 210 miles and it is to extend from Memphis, Tenn., to Nashville, via Brownsville and Jackson, W. K. Burton, Memphis, Tenn., is President and Geo. E. Bushnell, Memphis, Tenn., is General Manager.

TEXAS.

The Gulf, Texas & Western Ry. has made preliminary surveys for a 4½ mile spur from Jermyn toward the Stewart Coal Mines. John T. Witt, Dallas, Tex., is Chief Engineer.

The Texas North & South R. R. Co., recently incorporated, is to have surveys started soon for its projected 330 mile line from Seymour, Tex., to San Antonio. L. E. Collins, Coleman, Tex., is president.

The Fort Worth Mineral Wells & Western R. R. Co. will build a line of interurban railroad between Fort Worth and Mineral Wells Texas, a distance of about 63 miles. Permanent location is about completed, bids will be received in about 60 days. Paul Hurley, Fort Worth, Tex., is secretary.

The Houston-Galveston Interurban Ry. Co. has awarded the contract for clearing, grubbing, grading and fencing approximately 16 miles of road bed to J. C. Kelso, Galveston, Tex. The contract extends from Clear Creek to a point about two miles south of Texas City Junction in Galveston County, Texas. J. B. Townsend, 410 First National Bank Bldg., Houston, Tex., is the engineer for the railway.

Surveys have been made and the capital has been secured for the construction of a 17 mile extension of the Sugarland Ry. from Juleff south to a connection with the State railroad at Anchor. Construction contracts are to be let at once. W. T. Eldridge, Sugarland, Tex., is president and W. C. Yearger, Sugarland, is chief engineer. This is a standard gage line.

VIRGINIA.

The Chesapeake & Ohio Ry. has completed surveys for a line between Charlottesville, Va., and Orange, but has decided not to build at present.

WASHINGTON.

The Big Bend Transit Co. has completed surveys for its projected 65 mile line from Spokane, Wash., to the junction of the Spokane and Columbia Rivers. William A. Nicholls, Spokane, Wash., is President.

WISCONSIN.

Alex. McGavock, Hanover, Ill., has 250,000 yds. of Chicago & Northwestern Ry. work from Winston Bros. Co. at Packwaukee, Wis., and would like to get into communication with some of his old men. The work will require about a year's time.

Power Developments, Levees, Drainage and Irragition Works.

CALIFORNIA.

Plans have been completed for a concrete bulkhead to be erected for the city of Ocean Park, Cal. The structure will cost $18,000 and is to be built on a foundation of concrete piles. The work is to be done under the Vrooman act and contracts will be let in about 40 days. G. F. Lewis, city engineer, Ocean Park, Cal., is in charge of the work.

COLORADO.

The directors elected by the Granada and Holly Irrigation District met on March 19 and organized by electing W. A. Merrill of Lamar president and C. G. Smeltz secretary. It is the intention of the directors to immediately call an election authorizing a $1,250,000 bond issue and commence construction not later than June 10. The construction consists of a reservoir fill requiring 800,000 cu. yds. of earth and 80 miles of ditch. The system when completed will reclaim 40,000 acres of choice lands in Prowers County, Colorado.

DELAWARE.

Following bids were received March 18 by Maj. R. R. Raymond, U. S. engineer, Wilmington, Del., for dredging in Mispillion and Appoquinimink rivers, Delaware: Miner Engineering Co., Washington, D. C., conditional upon award of contract for dredging St. Jones and Murderkill rivers, Del., 18 cts. per cu. yd. for Mispillion River and 18 cts. for Appoquinimink River; River & Harbor Improvement Co., Philadelphia, Pa., work to begin July 1, 1910, 40 cts. per cu. yd. for Mispillion River work and 14 cts. per cu. yd. for Appoquinimink River work. For dredging in the (1) St. Jones River and the (2) Murderkill River, Delaware, the following bids were received: The Rickards Dredging Co., Philadelphia, Pa., (1) 14 cts, (2) 14 cts.; River & Harbor Improvement Co., Philadelphia, Pa., (1) 11.8 cts., (2) 10.9 cts.; Miner Engineering Co., Washington, D. C., conditional upon award of contract for dredging Mispillion and Appoquinimink rivers, Delaware, (1) 18 cts, (2) 18 cts.

IDAHO.

The Kings Hill Extension Irrigation Co., Ltd., Medbury, Idaho, will build two large dams during the summer and fall. Regarding this work Mr. L. G. Bradley of Medbury, manager of the company, writes us as follows: "The engineering work is not yet completed to a stage where we can give definite plans and specifications, but one dam will be an earthen dam of approximately 270,000 yds., together with gathering and distribution system for the reservoir. It is in all probability a grader and steam shovel proposition. Some of the earth is readily available, but some of the material will have to be brought a distance of 1,000 to 1,500 ft. and mixed with the light material that is handy. Foundation has been thoroughly tested and all along the line of the canals has been tested, so that the ground is now ready for the inspection of the contractors. Contractors visiting the site should get off at the town of Hammett on the Oregon Short Line and they will be taken to the dam site to look over the ground, and as soon as we are where we can get plans and specifications ready they will be furnished with same and asked to bid. The second dam this company will build is of smaller size, but somewhat more of a problem. It was originally planned to make it a concrete dam, but now looks like a rock filled dam will be resorted to. This dam will be about 600 ft. across the top and 60 or 70 ft. high. The gathering and distribution system for this reservoir will also be built."

MINNESOTA.

The Drake & Stratton Co., Hibbing, Minn., has the contract for stripping at the Dale-Uno mine located two miles west of Hibbing. The work requires 3,000,000 cu. yds. of earth excavation and seven steam shovels will be used this summer.

Bids are asked by the Board of Water Commissioners of St. Paul, Minn., John Caulfield, secretary, for dredging the West Arm of Vadnais Lake, situated about seven miles from the City of St. Paul. The work will consist of about 1,500,000 cu. yds., the material being mostly vegetation and peat.

MISSISSIPPI.

The Mississippi Levee District, W. J. Shackelford, Chief Engineer, Greenville, Miss., is to open bids April 27 for the construction of two new levees in the district involving a total of 927,000 cu. yds. One of these levees is to be built at Riverton two miles below Rosedale, Miss. This levee involves the following work: Sec. 1, Sta. 1575 to Sta. 1610, 158,000 cu. yds.; Sec. 2, Sta. 1610 to Sta. 1640, 226,000 cu. yds.; Sec. 3, Sta. 1640 to Sta. 1664, 143,000 cu. yds. The other levee is to be built at Shiloh which is opposite Blanton or Smeeds on the Y. & M. U. R. R. This work is as follows: Sec. 1, Sta. 4233 to Sta. 4264, 122,000 cu. yds.; Sec. 2, Sta. 5264 to 4292, 130,000 cu. yds.; Sec. 3, Sta. 4292 to Sta. 4321, 148,000 cu. yds. All of the above levee will be put up from riverside pits and will have 8 ft. crown with a one foot topping and banquette with 20 ft. crown 8 ft. below top. A seep ditch may be required to be cut on landside 120 ft. from toe of slope and material from same placed in the levee embankment without extra compensation. The work is to be completed by Dec. 20, 1910.

OHIO.

Bids will be received until noon, April 2, by the Department of Public Service of Cleveland, O., Robert Hoffman, chief engineer, for dredging in the Cuyahoga River. The work of dredging is to be divided into two contracts, known as Section No. 1 and Section No. 2. No. 1 will include the lower portion of the river and No. 2 the upper portion. Bids will be received based upon the approximate quantities of 225,000 cu. yds. in Section No. 1 and 300,000 cu. yds. in Section No. 2. The dredged material is to be dumped upon a dump established by the government in Lake Erie, a distance of five miles from the mouth of the river. The bids are to be based upon cubic yard, scow measurement. The portion of the river to be dredged is about five miles in length.

OREGON

The Willow River Land & Irrigation Co. of Vale, Ore., has closed contract with Jas. A. Green, 226 La Salle St., Chicago, Ill., for the engineering and construction on its project, comprising approximately 25,000 acres of land in Malheur County, Oregon. This work includes building two earth fill dams, each about 100 ft. high together with the construction of complete distribution system.

TENNESSEE.

No bids were received March 18 by Maj. M. L. Walker, U. S. Engineers, Memphis, Tenn., for levee work in the White River levee district. This work consisted of one piece of levee enlargement near Kangaroo Point, containing about 115,000 cu. yds. The work was to be built to an 8-ft. crown with 3 to 1 slopes on both sides and a 1-ft. topping added to the 8-ft. crown. About 4 acres of light grubbing was included. The fill was to have an average rise over old levee about 4 ft. to the new 8-ft. crown and the work was to be completed not later than Jan. 1, 1911.

TEXAS.

Bids are being asked by W. A. Morrison, Cameron, Tex., Commissioner of the Hefley Improvement District of Milan County, until 10 a. m. April 9, for constructing a levee. The right-of-way is 100 ft. wide and contains about 20 acres of timber land all told. The levee is to be 5.36 miles long and will have an average base width of 26.5 ft. and an average height of 7.5 ft. It will contain about 121,728 cu. yds. of earth.

CANADA.

Bids are asked by Napoleon Tessier, secretary of the Department of Public Works, Ottawa, Ont., until 5 p. m., April 12, for dredging required at the following places in the province of Ontario: Byng Inlet, Cobourg, Goderich (Kincardine, Lion's Head and Port Elgin), Owen Sound, Picnic Island, Port Burwell (Port Hope and Whitby), Rainy River, River Thames, Rondeau, Sault Ste. Marie.

Bids are asked by the Canadian Light & Power Co., E. A. Robert, managing director, Montreal, Que., until April 9, for rock and earth excavation in the Beauharnois Canal, between Valleyfield and St. Timothee; also for intake works at Valleyfield, including coffer dam and culverts in the canal. Plans, specifications and full particulars may be obtained at the office of the Canadian Light & Power Co., Montreal, Que.

The Huntsville Railway, Light & Power Co. of Huntsville, Ala., and the Huntsville & Monte Sano Improvement Co. are stated to have reached an agreement whereby the projected extension of the electric line to Monte Sano will be built at once.

Hayes Bros. have resumed work on the contract for the dam at Owl Creek at Belle Fourche, S. D. Hickey Bros. & Burke, who have the contract for facing the dam with concrete blocks, have also started work.

The Tampa & Atlantic Construction Co. of Tampa, Fla., has been incorporated with a capital stock of $150,000.

The New Orleans, Mobile & Chicago R. R., W. F. Owen, general manager, Mobile, Ala., has surveys in progress for an extension from Middleton, Tenn., to the Ohio River.

Arrangements for financing the proposed Butte & Boise R. R. are well under way and engineering parties are to be placed in the field shortly to make the surveys. L. O. Leonard, Butte, Mont., is reported to be interested.

The Territorial Engineer of New Mexico has approved the application of Engineer Ernest H. Fischer of Albuquerque, Mex., for a large power proposition on the upper Pecos and its tributary, the Mora, 25 miles east of Santa Fe. A maximum appropriation of 150 second feet is granted to develop 5,000 hp. at a cost of $150,000, to supply Las Vegas, Santa Fe and Albuquerque with electric power.

The contract for constructing the double track between Missoula, Mont., and De Smet on the Northern Pacific Ry. has been let to Albert Walker, of Missoula, who has been working in the vicinity of Bearmouth for some time past. Track construction is to be started at Missoula at once and the work rushed through to completion in two months.

The Mobile & Ohio R. R. Co. will immediately begin the improvement of about 1,000 ft. of dock property owned by it between St. Anthony and Adams Sts. in Mobile, Ala. R. V. Taylor, Mobile, Ala., is General Manager.

The Hopedale Development Co., of Hopedale, La., has been awarded a contract for constructing a drainage canal about 40 miles long in St. Bernard Parish, Louisiana.

Items Concerning Contractors and Their Work

RAILROADS, POWER DEVELOPMENTS, LEVEES, DRAINAGE AND IRRIGATION WORKS.

Arkansas Notes.

FROM CORRESPONDENTS AND OTHER SOURCES.

Over $16,000 has been subscribed by the citizens about Corning, Ark., for the building of a spur from that town to Green's Spur, on the Frisco. J. E. Matthews, Democratic candidate for Sheriff of Clay County, is raising the subscription.

The Stuttgart & Rice Belt R. R. Co. has been chartered with a capital stock of $78,000. The road will extend through the rice counties of Arkansas, beginning at Mesa, in Prairie County, south to Stuttgart and thence to Cooper's Ferry, in Arkansas County, a distance of forty miles. The directors and incorporators are: J. R. Porter, L. H. Morphew, W. M. Price, George W. Fagan, J. A. Watkins, Walter J. Miller, Geo. C. Lewis, R. H. Toll, J. G. Thweatt, J. M. McClintock, Elliott Tollman, Edwin Pettit, John L. Ingram and Philip Reinsch.

The Memphis, Paris & Gulf R. R., now operating 106 miles of line, will shortly apply for articles of incorporation giving it permission to operate in Arkansas and Tennessee. It is stated that the right of way from Terrell, Tex., to St. Charles, Ark., has been surveyed and acquired. This is 346 miles and constitutes the main part of the division between Memphis and Dallas. H. C. McCluer, Nashville, Ark., is Chief Engineer.

The Arkansas Board of Railway Incorporators has granted the Gulf Magnolia & Northern R. R. Co. three years' additional time in which to build the road.

The Fort Smith Light & Traction Co., of Fort Smith, has asked the City Council of Van Buren for a franchise over certain streets.

The Fort Smith, Van Buren & Eastern Interurban Ry. Co. is to again apply to the City Council of Van Buren for a franchise. It is said that the company will guarantee to complete the line to Kibler, a distance of six miles, within two years.

Business men of Lockesburg have started a movement to induce the Iron Mountain R. R. Co. to extend the Arkansas and Louisiana branch of the system from Nashville to Locksburg.

California Notes.

FROM CORRESPONDENTS AND OTHER SOURCES.

Engineers of the Southern Pacific Co. have been making final surveys for an electric railway to connect Melrose and San Leandro.

The Fresno Traction Co., A. G. Wishon, Manager, Fresno, is planning to commence work in April on an extension of the Blackstone trolley line. Present plans include double tracking as far as Zapps.

Rodgers Bros. are working on their contract for clearing the right of way for the Sierra R. R. through the Curtis, Coburn and Snyder ranches near Rosedale.

The Stockton Terminal & Eastern R. R. Co. has applied to the City Council of Stockton for a franchise to operate cars in that city from Jenny Lind. The road is to enter Stockton on Acacia St., extended through Buttercup Grove.

Willliam M. Walsh of Auburn has been appointed timekeeper for the Southern Pacific Co., with jurisdiction along the line of the new cut-off improvement. His district will extend from Applegate Station to Colfax, with headquarters at the latter town.

L. W. Warmoth, Paskenta, is promoting a project for the construction of an electric railway from Paskenta to Sacramento.

Advices from Auburn, Cal., state that Joe Correa has contracted with the Southern Pacific Ry. Co. to remove 40,000 cu. yds. of earth and rock on the wagon road from Penryn to the J. H. Bickford place below Gold Hill, at a point where the cut-off intersects the road on the Penryn slope of Boulder Ridge. At one point the cut will be 59 ft. deep. Mr. Correa estimates it will take him five months to complete the work.

Press reports from Fresno quote F. U. Nofziger, who is engaged in securing rights of way for the proposed steam railroad from Porterville, Tulare county, to the foothill country at Springville, as stating that construction work on the new line will start not later than July 1 and that deeds for the necessary land have been secured from Worth to Globe, in the heart of the orange belt.

Harry Gray of Lincoln has been awarded the contract by the Pittsburg syndicate for excavating its canal in the Colusa reclamation district. The contract amounts to about $400,000 and calls for the removal of 1,500,000 cu. yds. of material.

Colorado Notes.

FROM CORRESPONDENTS AND OTHER SOURCES.

The directors of the Riverside Irrigation District have held a meeting at Greeley to complete arrangements for building the Wildcat reservoir on Wildcat Creek, to cost $100,000, and add to the present irrigation system of the district. It is estimated that the new reservoir will water an additional 10,000 to 12,000 acres, adjoining it on the east, and it is proposed to bond the district to pay for the reservoir.

It is reported here in Denver that the Chicago, Rock Island & Pacific R. R. has bought the Colorado & Eastern Road and is arranging for its own terminals into Denver, with a most important switch to the Denver stock yards.

The Huerfano Reservoir & Irrigation Co. of Denver has been incorporated, with a capital stock of $250,000, the incorporators being Lemeul J. Husted, Frank M. Keezer and Otis Beverstock.

The Denver, Colorado Springs & Pueblo Interurban Ry. Co. is securing right of way for its projected line. Location surveys are said to have been about completed. As now projected the line will make a detour to the east a short distance north of Colorado Springs, to avoid the high grade of the divide at Palmer Lake, with the result that it will be about eight miles from the present line of the Denver & Rio Grande Ry. at Husted. The two lines will gradually draw closer together as they near Denver. William Bulford, Denver, is president.

Work is to be resumed shortly on the Denver & Colorado Springs Electric R. R., which is to extend from Denver to Pueblo. Surveys have been completed as far as Palmer Lake. E. L. Briggs is Chief Engineer.

The Riverside Irrigation District Board, of Greeley, has awarded the contract for building Riverside reservoir No. 2 to D. A. Camfield, of Denver, and S. H. Shields for $500,000. The reservoir will receive its supply from the South Platte and Wildcat Creek, and will water 12,000 acres to be taken into the district on the east.

Final filings have been made in office of the State Engineer at Denver for three large reservoirs and a ditch for irrigating land in Bent County. The first reservoir will be constructed by throwing a dam 115 ft. high across the Purgatoire River. It will be known as Cuddoa Creek Reservoir No. 2, and will have a capacity of 107,100 acre ft. The estimated cost of this reservoir is $510,000. Another reservoir with a capacity of 86,540 acre ft. will be made by putting a 110-ft. dam across Cuddoa Creek. This one will cost $155,000, according to the engineer's estimate. The third and smallest reservoir will require a 75-ft. dam across Mud Creek, which will impound 16,118 acre ft. of water. It will cost $150,000. The high line canal which will distribute the water from these reservoirs will be 687,800 feet long with a 600 cubic foot capacity and will cost $1,600,000. F. H. Whiting of Denver is the engineer in charge of the work and Stephen A. Scott of Lamar is the president of the company which is undertaking the work. Granby A. Hillyar of Lamar is also interested in the project.

It is reported that A. H. Mohler, Vice-President and General Manager of the Union Pacific Ry. Co., has announced that construction work planned for Colorado and Wyoming, estimated to cost $12,000,000, will be started in the spring.

The Northern Colorado Railway Co. has been incorporated with a capital stock of $100,000 and proposes the construction of a railroad in Weld County. L. M. Fouts, W. C. Bradbury, T. C. Henry, et al., are the incorporators.

The Carr Reservoir & Irrigation Co. has been incorporated at Denver, Colo., with a capital stock of $100,000. The incorporators are Archie F. Finley, C. C. Rogers, Charles Finley, Dover, Colo.

Georgia Notes.

FROM CORRESPONDENTS AND OTHER SOURCES

The Atlanta & Northeastern Ry. Co. has practically completed arrangements for financing its projected interurban line, which is to connect Atlanta with Cummings and Creighton, Ga., and is to cost about $900,000. The system is to consist of two lines, diverging at Alpharetta, the main line continuing northeast to Cumming and the branch running north and slightly west to the Creighton mines. The length of trackage from Atlanta to Cumming will be 42 miles, and that of the branch from Alpharetta to Creighton, 18 miles, giving a total mileage of 60 for the entire system.

Right of way has been secured for the projected electric railway from Indian Springs to Griffin and application has been made to the state railroad commissioners to be allowed to issue bonds to the extent of $1,500,000 and $200,000 of stock. W. F. Smith, Flovilla, and L. W. Roberts, Atlanta, are the promoters. It is also intended to build the line on to Social Circle at an early date.

The Columbus Power Co., of Columbus, is planing to build a dam on the Chattahoochee River, 12 miles above Columbus, and B. H. Hardaway, Columbus, has been awarded the contract for building a railroad from Motts, Ala., on the Central of Georgia line, to the site of the dam for the purpose of hauling material and machinery. The dam will be 70 ft. high and will develop 24,000 h. p. for the use of industries in Columbus, West Point and Opelika, Ala.

Illinois Notes.

FROM CORRESPONDENTS AND OTHER SOURCES.

The local management of the street railway at Decatur is to submit estimates to the owners of this property for an extension of the line east to Geddis lane, a distance of about one mile.

The Terminal R. R. Association of St. Louis, W. S. McChesney, Jr., General Manager, St. Louis, Mo., has purchased 200 acres of land between East St. Louis and Madison and will spend about $250,000 in constructing yards and terminal facilities.

The trustees of the East Side Levee Sanitary District, Henry D. Sexton, President, Sexton Bldg., East St. Louis, has decided to construct a concrete retaining wall along the entire river from East St. Louis. The wall will cost about $82,000. One of the first undertakings of the construction department of the district will be the diversion of Cahokia Creek. The district is planning work which will cost about $6,500,000.

The St. Louis East Side Belt Terminal Ry. Co. has been incorporated with a capital

stock of $2,500 and headquarters at East St. Louis, Ill., and proposes the construction of a line from a point near Cahokia, Ill., near the Mississippi River in St. Clair County, to a point at or near Venice in Madison County, Ill. W. H. Hauss, East St. Louis, Ill.; Charles Smiley, O'Fallon, Ill.; F. W. Kraft, East St. Louis, Ill.; Albert E. Meintz, East St. Louis, Ill.; John L. Flannigen, East St. Louis, Ill., are the incorporators.

According to reports, preparations are being made by the division officials of the Chicago, Burlington & Quincy for the double tracking and improvement of portions of the Illinois division. The work includes the extension of the yards in Galesburg, Ill.

The Chicago, Milwaukee & Gary Ry., I. W. Troxel, chief engineer, Chicago, has completed plans for building shops, offices, switch tracks and rearrangement of yards in Rockford. The yards are to be entirely rearranged and 14 miles of switch tracks will be added to those which the company now operates. The place occupied now by the switch tracks will be devoted to "rip" tracks, on which cars in need of repair are to be run. The main tracks will be readjusted and an outgoing and an incoming line will be installed for trains going their respective ways.

Indiana Notes.

FROM CORRESPONDENTS AND OTHER SOURCES.

Good progress is being made with grading work on the South Bend & Logansport interurban line. Five grading outfits are now at work and it is expected that the line will be completed from South Bend to Lake Maxinkuckee by fall. It is also said that cars will be running from Logansport to South Bend by July 4, 1911.

Trippeer & Sons, Peru, Ind., have been awarded the contract by the city of Fort Wayne for doing its portion of the track elevation in that place.

Capital is being secured for the projected traction line between Warsaw and Wabash, and it is believed that construction work will be started soon. The line will be 34 miles long. John Brubaher, Warsaw, is interested.

Costello Bros., St. Louis, Mo., have started work on their contract in connection with the laying of double tracks between Indianapolis and Anderson on the Big Four. The work will proceed rapidly from now until Oct. 15, at which time it must be completed under the terms of the contract. The work will cost approximately $1,000,000.

The Toledo-Indiana Traction Co., of Toledo, O., has increased its capital stock from $10,000 to $400,000.

According to reports the Chicago, Indianapolis & Louisville Ry., W. A. Wallace, Chicago, Ill., Division Engineer, is planning the improvement of its Louisville division to such an extent as to require an expenditure of $3,000,000. Curves will be eliminated and the air line between Chicago and Indianapolis will be placed in the finest condition.

Advices from Indianapolis, Ind., are to the effect that construction work will be started the first week of April on the elevation of tracks from Michigan to New York St. It is expected that the improvement will be completed by Oct. 31.

Iowa Notes.

FROM CORRESPONDENTS AND OTHER SOURCES.

Work has been started on the completion of the seven mile interurban line of the Centerville Light & Traction Co., and it is expected to have cars in operation to Mystic, the terminus, by April 15. F. S. Payne, Centerville, is President.

O. P. Herrick, Des Moines, Ia., has the contract for straightening Beaver Creek in Des Moines and Beever Townships, the contract price being $38,536. J. G. Sullivan, Webster City, Ia., was awarded the contract for draining Swan Lake in Dallas Township, his contract amounting to $18,999.

Work on the proposed line for the Muscatine North & South R. R. is progressing rapidly toward Burlington, Ia. Subscriptions toward the necessary funds are coming in rapidly and $25,000 will be received from Burlington, when the road is completed to that point.

The Toledo & Tama Electric Ry. is considering extending its line at Tama for a distance of 10½ blocks.

Advices from Belle Plaine state that the Chicago & Northwestern Ry. will probably this year build the connecting link of its road between Alden and Eagle Grove. This looks probable, as the company has had the right of way for some time and if not utilized before 1911 it will revert to former owners. This line of road as now surveyed will enter the southern portion of Wright County and will probably pass through the townships of Vernon, Wall, Lake and Woolstock.

Kansas Notes.

FROM CORRESPONDENTS AND OTHER SOURCES.

The City Council of Kansas City has adopted a resolution asking the Metropolitan Street Railway Co. to extend the Quindaro Boulevard line west six blocks to the new city limits.

The contract for grading the first five miles of the Cherryvale, Oklahoma & Texas R. R. has been let to a Coffeyville contractor, and work will be started at once, running south from Caney through the northern portion of Washington County in Oklahoma to Wann. The road will be built immediately into Nowata and then southeast to Siloam Springs, Ark. The main line will pass through Bartlesville. Another line is to be built southwest through Pawhuska, Guthrie and Geary to the Red River. S. M. Porter, Caney, Kan., is President.

C. F. Propes, Nickerson, is advocating the construction of a street car line from Hutchinson to Nickerson.

Property owners along Owl Creek met at Humboldt and elected the following directors to have charge of the work of straightening out the stream: A. P. Fraker, T. C. Adams, W. R. Moore, C. E. Conklin and W. Tinch. The work will be in charge of an engineer.

Directors of the Dakota, Kansas & Gulf Ry., which proposes the construction of a railroad from Kearney, Neb., to Beloit, Kan., where a connection will be made with the Santa Fe, at a recent meeting authorized Engineer A. N. Bullitt to proceed with the permanent surveys. Carson Hildreth, Franklin, Neb., is General Manager of the company.

Business men of Raton and Des Moines, N. Mex., are promoting the construction of a railroad from Raton, N. Mex., to connect with the Santa Fe at Englewood, Kan., the western terminus of the Mulvane extension. A portion of the line between Des Moines, N. Mex., and Raton, N. Mex., has already been built. The line will pass through Liberal, Kan., and Stevens and Morton Counties. T. W. Hubbard, Liberal, Kan., is interested in the project.

The Kaw Valley Drainage District, W. H. Daniels, President, Kansas City, voted on March 22 on issuing $1,250,000 of bonds for improving the Kaw River.

Maryland Notes.

FROM CORRESPONDENTS AND OTHER SOURCES.

Bill has been introduced incorporating the Elkton, Fair Hill & Oxford Ry. & Power Co., with a capital stock fixed at $60,000, which may be increased to $500,000. The company proposes the construction and equipment of an electric line from a point in Elkton, Md., to Fair Hill and Cherry Hill in Cecil County to the borders of the state line. The incorporators of the company are Dr. C. P. Carrico, George E. L. Hess, John Langren, H. Eugene Mackin and Hester Hess.

A bill is before the Legislature of Maryland for the incorporation of the Maryland & Washington Traction Co., which proposes to construct an electric railway from Ellicott City, the terminus of the Ellicott City division of the United Railways, to Laurel, the terminus of the Washington Electric Railway Co. The distance between Ellicott City and Laurel is about 12 miles. The incorporators named in the bill are Harold Hardinge, Frank O. Rappanier, James Booker Clark and James Clark.

The Washington, Potomac & Chesapeake Co. has been incorporated, with a capital stock of $500,000, and proposes the construction of a railroad from Mechanicsville to Point Look Out. The incorporators of the company are Henry W. Watson, Philadelphia, Pa., William Shippen Roney, Albert R. Roney, S. Johnson Poe and Edgar Allan Poe of Baltimore, Md.

The Western Maryland Ry., H. R. Pratt, chief engineer, Baltimore, Md., is to construct a modern classification yard at Knob Mount, south of Cumberland, on the West Virginia division, which upon its completion will represent an expenditure of about $150,000.

A bill is before the state legislature of Maryland to incorporate the Deer Creek Electric & Power Co. The incorporators are all residents of Harford county, Md., where the source of water supply will be obtained. The project is backed by E. M. Allen. The water fall at Deer Creek is said to be capable of generating about 25,000 h. p. of electrical current.

The Lansdowne & Baltimore Ry. Co. has been incorporated, with a capital stock of $100,000, and proposes the construction of a railroad from Baltimore, Md., through Westport, through Landsdowne, thence to such points in Baltimore County or Anne Arundel County as its directors may determine. The incorporators are James Rittenhouse, Henry J. Emerich, S. Newton Robinson, Jr., Charles H. Werner, W. Elmer King, Ernest E. Robinson and Charles J. Hull.

The Board of Trade of Cambridge, Md., is considering a plan of cutting a canal to connect Cambridge Creek with the Blackwater River. The head waters of this river are less than a mile from Cambridge Creek and a canal connecting the two waters would give water communication between Upper and Lower Dorchester.

A bill is before the state legislature to authorize the Maryland & Pennsylvania R. R., G. E. Norris, engineer, Baltimore, Md., to extend its line to tidewater upon any route it may acquire from its present line east of Towson to the east side of the Patapsco river.

Michigan Notes.

FROM CORRESPONDENTS AND OTHER SOURCES.

Robert Oakman, Detroit, Mich., has completed plans for building an electric railway through the section northwest of Detroit. The line will run from the boulevard to 12th St., northerly along 12th St. to the 10,000-acre tract, thence easterly to Woodward Ave., connecting with the Detroit United's Victor and Oakland Ave. line. It will also extend northward and connect with the line of the Detroit Terminal railway. In connection with the Oakman Electric line a big factory subdivision scheme is also being worked out.

The Lake Shore & Michigan Southern Ry. is to increase the capacity of its freight house at Lansing. The improvement will necessitate the construction of considerable new siding and docks.

Petitions bearing the signatures of 18,759 voters have been submitted to the Common Council of Detroit, calling for a popular vote on the question of municipal ownership of the street railway system. Under the law 14,200 names were necessary to require the Council to submit the question to a vote.

The City Council of Bay City, Mich., has granted the Grand Trunk R. R. the franchise for which it had applied, admitting the company to the terminal site east of the river.

The Escanaba Traction Co., P. L. Utley, Manager, Escanaba, has plans well advanced for building a second power dam in the Escanaba river, and it is believed that construction work will be under way by June 1. The new dam will be located at Groos, near Bichler quarry, and it will have a 30-foot head of water sufficient to develop 2,000 H. P.

Minnesota Notes.

FROM CORRESPONDENTS AND OTHER SOURCES.

The City Council of Virginia has granted a franchise for a street railway to W. M. Prindle, Duluth. Mr. Prindle already has secured the right to use the county roads for the purpose of extending the line into an interurban service between Virginia, Gilbert and Eveleth. Ultimately, it is proposed to extend the lines to Buhl, Chisholm and Hibbing.

The Duluth Street Ry. Co., of Duluth, is to begin work at once on rebuilding the Seventh avenue incline and placing a double track service on it. The improvements will cost about $25,000.

The Minneapolis & St. Paul Suburban R. R. Co. has been incorporated with a capital stock of $1,000,000, the officers of the Twin City Rapid Transit Co., of St. Paul, comprising the board of directors. While the new company was formed primarily to correct some of the features in the old articles of incorporation of the Twin City Co., it is believed in many quarters that the building of an elevated road between the twin cities is one of the objects of the company.

The Minneapolis, St. Paul & Sault Ste Marie Ry. has made a proposition to the Commercial Club of Fargo, N. Dak., to come into Fargo, providing a right of way 50 ft. wide from the Red River into the city were secured with terminal facilities 330 feet wide by 500 ft. long. The new line will come from a few miles south of Detroit, Minn., on the Winnipeg line and then run in a southeasterly direction to the main line at Enderlin.

Estimates are being made by officials of the Northern Pacific Ry., for relaying track on the old Duluth, Minn., transfer road as far as Spirit Lake, Minn. W. L. Darling, St. Paul, Minn., is Chief Engineer of the company.

Duluth and the Ranges.

BY PETER F. MEAGHER.

William Hughes, superintendent of the Missabe Southern Ry. Co., was a caller recently. He did not know whether they are going to do any construction work the coming season or not.

Barnett & Record Co. of Duluth were awarded a contract for about $100,000 worth of concrete work on one of the docks of the Pittsburg Coal Co. at Duluth, Minn. C. J. A. Morris is the engineer in charge of the work.

Martin Cane, railroad contractor, was a caller at this office recently. He is figuring on starting on some railroad work in the very near future.

A. Nelson, team contractor, was a caller at this office recently, and we had him go out to North Dakota to look at some railroad work, of which he expects to take some, and will start on the same immediately.

John O'Neal of the firm of O'Neal & Sharrock, railroad contractors on the Milwaukee, was a caller here recently. They have enough work on the Milwaukee to keep them going the coming summer.

H. J. Cooper was a caller here a few days ago. He is not doing anything at the present time, but is figuring on several jobs.

The Barnett & Record Co. of Duluth was awarded a contract by the Great Northern Ry. Co. for the concrete and piling work on a new ore dock to be constructed for this company at Superior, Wis. This contract amounts to about $350,000. The Barnett & Record Co. was also awarded a contract by the Duluth & Iron Range Ry. Co. for an ore dock to be erected at Two Harbors, Minn.

Greer Thompson, general manager for the Drake & Stratton Co., was a visitor with us this week. He had just returned from a trip over its various contracts in the east and said he had quite a bit of work and expected a very busy season.

C. J. A. Morris of the contracting firm of Morris & Shepard, Globe Bldg., St. Paul, Minn., was a caller at this office. He has been in the city for the last few days. Mr. Morris is a very busy man at the present time, having three docks under way at Duluth and Superior and besides has about 75 miles of railroad work for the Great Northern R. R. in North Dakota. They were just awarded a few days ago 35 more miles and have some excellent grader and team work to let, and are looking for sub-contractors with outfits of that kind, who would like to get a full season's work. They are offering very nice prices, and the section of the country that they are working in is a very good one in which to work, and any sub-contractors looking for work will do very well to communicate with them.

Arthur Mitchell, general superintendent for the MacArthur Brothers Co. in this section, spent Saturday with us last week. They are rushing their two stripping contracts as fast as possible, and will continue to work both night and day shifts on the same until completed.

Horace Clark, representing the Macomber & Whyte Rope Co., was a caller at this office a few days ago. He left here to make a trip to Kansas and the southwest.

John Runquist, Duluth railroad contractor, received a new Model 60 Marion steam shovel the other day and has put it to work with a 3½-yd. car outfit on one of his contracts for the Duluth & Missabe Northern Ry. Co.

John R. Davis, one of the old time contractors, was a visitor with us this week, and left for North Dakota to look over some work on the Great Northern for Morris & Shepard, and I believe that he will take quite a piece of it.

Patrick McDonnell, Duluth contractor, was awarded a large paving contract by the city of Grand Forks, N. D., and will start on the same immediately.

W. F. King, a Duluth concrete contractor, is very busy at the present time putting in the large concrete abutments for the bridge that is being constructed to the site of the new United States Steel Co.'s steel plant that is going to be erected at Duluth.

Dale & Bumgardner, steam shovel contractors on the Soo line, at the present time have three steam shovels working full blast and have enough work to keep them busy for some time to come.

C. E. Jamieson, who is working on the Soo line, was a caller a few days ago. He was on his way to the woods to get some of his horses that he has had working there all winter. He has got enough work to keep him busy for the next two or three months.

The labor situation in Duluth and vicinity at the present time is in a very good condition. There is quite a bit of work going on of various kinds, and quite a few men are here. Work is opening up very rapidly in this section, and the surplus of laborers that we have here at the present time will not last very long. The wages being paid for common laborers run from $1.75 to $2 per day.

Missouri Notes.

FROM CORRESPONDENTS AND OTHER SOURCES.

Capt. F. W. Latimer, Galesburg, Ill., President of the Hannibal & North Missouri Interurban R. R., has accepted the proposition of the Commercial Club of Hannibal, relative to the extension of the line from Palmyra to Hannibal. According to the agreement the Commercial Club is to dispose of $40,000 of stock.

Plans are reported to have been prepared by the Springfield Traction Co., of Springfield, for the construction of a complete belt line running along Commercial, Broad, Nichols, Center and Oak Sts., and encircling practically all of the residence section of the city between Commercial and Center Sts.

The Missouri Interurban Ry. Co. which proposes to build an interurban line from Sedalia to Prairie Home, Mo., has effected its permanent organization as follows: President, A. W. Nelson, Bunceton; Vice-President, Frank Gemender, Cedro; Secretary, J. W. Mellor, Sedalia; Treasurer, E. W. Moore, Kansas City, Kan.

The Illinois Traction System, H. E. Chubbuck, General Manager, Peoria, Ill., is having plans prepared for the construction of its proposed terminals in St. Louis. The plans involve the expenditure of about $1,000,000 and include the construction of a main building 4-story, 70x70 ft., of brick, stone and iron construction, with a 148x150 ft. train shed. Trackage arrangements will also involve a considerable expenditure.

Right of way has been secured to Monett for the projected interurban line from Mount Vernon to Springfield and Carthage, promoted by F. C. Yentsch, of Mount Vernon. As now contemplated, the route will run west from Springfield to Paris Springs, Lawrence County, and to Mount Vernon, thence southwest to Hoberg, Freistatt and Monett, thence in a west and northwesterly course through Pierce City, Wentworth and Sarcoxie to Carthage.

It is now said that the Chicago, Burlington & Quincy Ry. will have work started in the near future on its extension from Mexico, Mo., to Kansas City. The plans are said to provide for an extension from Mexico to Macon, where it will connect with the route already there, while the other extension will run from Mexico to Kansas City, passing through Renick, Salisbury and Carrollton.

The Chicago, Milwaukee & St. Paul Ry. is considering an expenditure of $1,250,000 for the improvement of the Kansas City Division. D. J. Whittemore, Chicago, Ill., is Chief Engineer.

An ordinance is before the City Council of Kansas City to revive the grant of the Kansas City Interurban Ry. for a freight line and switch yards in the residence parts of the Brush Creek Valley.

W. E. Talley, President of the State Bank, Springfield, Mo., and owner of the "Sawdust" Central R. R., is considering the extension of his line from a point on his property to Senath, Mo., to connect with the St. Louis & San Francisco Ry.

J. B. Houseman, Engineering Contractor, has gone over the route of the proposed railroad from Spanish Lake to Jefferson Barracks, Mo. Promoters of the project believe it feasible.

Grade stakes for the projected line of the St. Joseph Heat, Light & Power Co. have been set as far as Savannah, and it is said that grading work will be started April 1. John H. Van Brunt, St. Joseph, is interested.

St. Louis Items.

BY A. B. KOENIG.

S. L. Powers, brother of the Louisville banker, J. D. Powers, is promoting an undertaking for the construction of a short line between St. Louis and Fort Smith. He said entrance to St. Louis may be obtained either on the Terminal tracks or on the tracks of the Manufacturers' Railway. Surveys for the new line have been made. A road is projected to connect with the Frisco or the Iron Mountain. If this plan fails, a new line all the way from Fort Smith to St. Louis is proposed. Mr. Powers has made considerable progress with the project.

Citizens of Gainesville, Texas, with $100,000 paid up capital, have organized the Gainesville, Oklahoma & Western Railroad. The charter provided for a line from Gainesville to Coalgate, Okla., thence southwest to the Fort Worth and Denver connection. A. E. Perry, representing Coalgate interests, is pushing the project.

The Lucin cut-off across Salt Lake is to be double-tracked at once. It calls for an outlay of $1,500,000.

The L. J. Smith Construction of Kansas City have put on five more gangs of 100 men each on its ballasting work on the Mo. Pac. R. R. in Kansas and Colorado.

R. C. Stripp auditor of the L. J. Smith Construction Co., passed through St. Louis last Saturday on his way to Kansas City from Arkansas.

J. A. Perdue of Pine Bluff, Ark., secured the contract for grading four miles of Fernwood & Gulf Railway out of Tylertown, Miss.

Callahan Construction Co., Empire Bldg., Knoxville, Tenn., has 27 miles of scraper, mountain rock and shale work on the L. & N. extension out of Harlan, Ky., to let. It has free transportation for outfits over the L. & N. R. R. from Louisville, Memphis, Birmingham and Atlanta. E. R. Keller, its general

superintendent, will be ready to sublet this work in quantities to suit outfits and will open an office at Harlan, Ky., on March 28.

Hickey Bros. secured the contract to do the concrete and bridge work on the new Big Four extension in southern Illinois and Indiana.

J. W. Skinner has secured all of the bridging and pile driving work on the Big Four R. R. from Mt. Carmel to Evansville from Hickey Bros.

Frank Skene and W. R. Hughes are going to do concrete work on the Big Four R. R. extension. They secured this work from Hickey Bros.

The Federal Commissary & Supply Co., of which Chas. A. Truitt is president and treasurer and L. E. Mitchell is secretary, has increased its capital from $20,000 to $50,000, all fully paid.

Sam A. McCoy of Boynton, Church & McCoy writes us from Billings, Mont., that they have some good work to let at that point.

Quite a large number of new street contracts are to be let by the city here in the fore part of April.

New York Notes.

FROM CORRESPONDENTS AND OTHER SOURCES.

A bill is before the State Legislature authorizing the city of Buffalo to issue $750,000 of bonds for the purpose of raising money to construct bridges and to construct, reconstruct and make extraordinary repairs to structures erected in pursuance of agreements made between the grade crossing commissioners and railroad companies.

The Maryland Dredging Co., which has barge canal contract No. 29 near Utica, is planning to begin dredging work in the near future. The company has constructed five new houses at the scene of their operations, for the accommodation of carpenters, foremen, engineers, etc. Another and larger structure will be erected for the great number of Italians to be employed. D. L. Taylor is in charge of the Utica work.

The Delaware, Lackawanna & Western R. R., D. J. Ray, Chief Engineer, Hokoben, N. J., has received bids for building a 5-mile cut-off between Henryville and Analomink on the Pocono Mountains. The cut-off will eliminate a number of sharp curves and the job, it is estimated, will cost about $400,000. The work includes the building of an arch 85 ft. high to span the Broadhead Creek. The arch will contain about 14,000 yards of concrete. The distance between Scranton and New York will not be decreased by the improvement, as it will mean the cutting out of several heavy curves now existing between the two points and the putting in of a greater number of slight curves.

The Corning & Painted Post Street Ry. Co., Howard Royal, Superintendent, Corning, is to extend its Bridge St. line to the New York Central yards and shops at North Corning this spring, also running past Sebring Park.

James G. Hayes and Quay A. Stumpf, both of Big Run, Pa., and Slyvanus D. Ward, of 63 Wall St., New York City, have taken out incorporation papers for the J. G. Hayes & Co., of Syracuse, and will engage in a general contracting business. The capital stock is $10,000.

The Village Trustees of Freeport, L. I., have granted a franchise for the South Shore Traction Co. to run a trolley line through that place. This is practically the connecting link between Patchogue and New York, and now that this consent has been given the line will be rushed to completion.

Ohio Notes.

FROM CORRESPONDENTS AND OTHER SOURCES.

The Toledo & Ohio Central R. R., J. A. Stocker, Chief Engineer, Toledo, is planning to begin work April 1 on its grade separation work at Columbus. The work includes the elevation of the Ohio Central and Hocking Valley tracks over six streets and two alleys, and the erection of an elevated structure at Broad Street for use of passengers as soon as the tracks are raised. The elevation of the Broad Street station will be about 12 ft.

The Lake Shore Electric Ry. Co. has applied to the County Commissioners at Sandusky for a 25-year franchise which will permit it to lay its tracks over the new bridge to be erected over the Huron River at Huron.

The Marietta, Columbus & Cleveland R. R. is planning to construct a 11-mile connecting link between Amesville and Athens. Final surveys for the line are reported to have been made by G. S. Leavenworth, Troy, N. Y. J. C. Riddell, Marietta, is General Manager.

It is now said that a new syndicate has taken hold of the Galvin Southern and will have construction work started in the near future. The line is to extend from Galvin to Mount Vernon and was projected a number of years ago. The entire right of way has been secured. Gasoline motor cars are to be used.

The Maumee Valley Railways & Light Co., of Toledo, is said to be considering the project of abandoning the Waterville branch of the road on the Lucas County side of the river above Maumee, and building up the river on the Wood County side, extending it to Haskins, O., with a spur across the river at Waterville.

The Lake Shore & Michigan Southern Ry. is said to be buying additional land along the portion of the high grade J. & F. branch between Dorset and Andover for an additional track.

Work will be commenced at once, it is said, on the double tracking of the Chesapeake & Ohio R. R. from Cincinnati, O., through to tidewater, Newport News and Norfolk. The work will require nearly all the $5,000,000 appropriation. F. I. Cabell, Richmond, Va., is Chief Engineer, M. of W.

The Cleveland Ry. Co., John J. Stanley, vice President, Cleveland, O., is stated to have decided to make extensive betterments to its entire system in Cleveland.

Oklahoma Notes.

FROM CORRESPONDENTS AND OTHER SOURCES.

All the property of the Altus, Roswell & El Paso R. R., now being constructed west from Altus, Okla., across the Texas Panhandle to Roswell, N. Mex., has been transferred to the Wichita Falls & Hollis Ry. Co. Practically all of the right of way between Altus and Hollis is ready for steel and all the bridges have been built. The Altus, Roswell & El Paso Ry. was organized and chartered two years ago by E. E. Kennedy of Abilene, Tex.

A state charter has been issued to the Arbuckle & Western R. R. Co., with authorized capital stock of $100,000, and headquarters at Ardmore, to build a line 110 miles in length between Ardmore and Chickasha, and a branch from Milo, near Ardmore, to Lawton, 80 miles. The estimated cost is $16,000 per mile. The directors are Oscar O. Ayers, J. A. Bivens, J. R. Pennington and R. A. Hefner of Ardmore and Emory S. Ayres of Edgington, Kan.

The City Council of Stillwater has granted a franchise for an electric railway system in this city to New York capitalists. According to the terms of the franchise work is to be started within 18 months.

The Commercial Club of Okmulgee has appointed a committee to confer with the Frisco officials with regard to the building of the proposed Fayetteville-Shawnee R. R. through that city. The road is to be built from the Arkansas town to Shawnee through Muskogee, and will tap the oil producing region of the state. Okmulgee is almost in the line of the survey for the road, and wants the road to enter that city.

The matter of constructing the Rock Island branch from Chattanooga, Okla., through Grandfield and Southwest Texas is to be placed before the directors of the company. The line has already been located and right of way procured. W. S. Tinsman, Chicago, Ill., is General Manager of the company.

Oregon Notes.

FROM CORRESPONDENTS AND OTHER SOURCES.

T. J. Miller, New York City, is stated to be promoting a project for the construction of an electric railway from Ashland, Ore., to Klamath Falls and the interior of Southeastern Oregon. The power for the new line will be furnished by Klamath Falls. The road will tap one of the most fertile districts of Eastern Oregon and one that has not at present any railroad facilities.

The annual budget of the Portland Railway, Light & Power Co. of Portland is said to provide about $4,500,000 for improvements this year. The main items are as follows: For street improvements and track reconstruction made necessary by city work, $1,020,000. For other track extensions and improvements, $200,000. For new equipment, $600,000. For new buildings, car barns, etc., $110,000. For work on power plants and substations under way, $1,250,000. For new light and power installations, $400,000. The balance of practically $2,000,000 will cover additions to power plants, work on sub and transformer stations, conduit transmission systems, machinery, and miscellaneous betterments in the light, power and railway departments. The street improvement and track reconstruction items apply to 60 different streets throughout the city, the length of the improvements varying from one block to two miles. The largest single item is $60,000.

Announcement has been made by J. H. Wilcox, of Portland, one of the incorporators of the Hood River Electric Light & Power Co., that active work will begin shortly on the proposed electric railroad. The new company has secured an option on the power site of the Hood River Power Co., and is also negotiating for other power interests there.

F. L. Smart, W. L. Chrisman and Charles N. Barrett, of the United Public Utilities Corporation of Philadelphia, Pa., which is financing the construction of the proposed electric road from Astoria to Seaside, are now in Astoria reorganizing the working forces, so that construction can be rushed this coming summer.

The City Council of The Dalles has granted a franchise for an electric railway to E. W. Thomas, of Philadelphia, Pa., who has announced that track laying will be commenced in the near future. Gasoline motors will be used at first.

A syndicate has purchased a tract of 61 acres in the Portland Heights addition to the city of Portland, and will develop it for building purposes. The improvements to be made include hard surface for every street, curbing, grading, sidewalks, sewers and water on every site, underground wiring, lighting the entire tract with cluster street lights, and other improvements. It is also said that the syndicate will build a street car line up Washington St. to serve the new tract. Dr. J. R. Wetherbee, Portland, Ore., is interested.

The Utah Construction Co., Ogden, Utah, has over 1,000 men employed on its contract for grading for the Oregon Eastern R. R., which is building a line to Klamoth Falls.

The Commercial Club of Prineville has taken up the matter of a railroad from the main line to Prineville. A committee has been appointed to procure data and confer with the lines now under construction.

The Coast Construction Co., with principal offices at Portland, Ore., has been incorporated with a capital stock of $10,000. The incorporators of the company are W. B. Scott, T. A. McDougall and F. H. Deshon.

Pennsylvania Notes.

FROM CORRESPONDENTS AND OTHER SOURCES.

The West Penn Rys. Co., Pittsburg, is shortly to begin work on a number of extensions in Western Pennsylvania. Among these is the proposed connection of the gap between Scott Haven, the terminus of the company's Yough valley line, and Hunker, on the main trunk line. This link will be completed, it is said, within the next 18 months, and during the present year West Newton will have connection with Greens-

burg, the county seat, by trolley via Hunker. Nearly all the right of way has been secured.

The City Council of Altoona has passed the ordinance granting a franchise to the Johnstown & Altoona Ry. Co. to enter the city. The company is to build an electric railway between Altoona and Johnstown and has obtained all the rights of way. Work will begin at once.

The Pennsylvania R. R. is planning to double track the Bald Eagle Valley R. R., which extends from Tyrone to Lock Haven. The work will include a number of changes at Eagleville, where a big curve and hill are to be eliminated. This will necessitate the construction of a number of deep cuts.

Residents of the west end at Williamsport have made a proposition to the Williamsport Passenger Ry. Co. for an extension of the tracks on West 4th St. for a distance of one mile.

Advices from Johnstown quote Superintendent F. R. Newman of the Southern Cambria Ry. Co. as stating that the company expects to begin work this spring on the construction of its line from South Fork to Ebensburg.

Willis E. Gray, of North East, Pa., has been engaged by New York capitalists to superintend the construction of a new railroad in the republic of Mexico.

The Pennsylvania R. R. Co. has completed the construction of its Midland railroad from Altoona to Bedford, Pa. This line gives Altoona a direct connection with Cumberland, Md.

Plans have been completed by the Baltimore & Ohio R. R. for the construction of improvements at Butler, Pa., and vicinity. The work will include the elevation of tracks and the construction of a passenger station and is estimated to cost in the neighborhood of $80,000. Work, it is said, will be started in about two weeks.

The governor of Maryland has authorized the Western Maryland to issue the balance of its unissued stock, amounting to approximately $26,000,000, below par for the purpose of building the new extension from New Haven, Pa., to Connellsville. H. R. Pratt, Baltimore, Md., is chief engineer of the company.

The Kistler-Lesh Co., Lock Haven, Pa., has secured a charter under the name of Rockfish Valley Ry. Co. and proposes the construction of a railroad from the Southern Ry. into Nelson and Albermarle counties. The officers of the company are Sedwick Kistler, Lock Haven, Pa., president; W. O. Bentley, Lock Haven, vice president; J. T. Coleman, Jr., Lynchburg, Va., secretary.

Surveys have been completed and right of way is now being secured for the proposed extension of the Northern Electric Railway Co. from Factoryville, Pa., to Binghamton, N. Y. As projected the line would run northeast from Factoryville through Lackawanna county to the town of Royal in Susquehanna and then describe a ziz-zag route northwardly through South Gibson, Jackson, Brushville and intervening villages, finally curving toward the northwest, as it approaches the New York state line to reach Binghamton.

Texas Notes.

FROM CORRESPONDENTS AND OTHER SOURCES.

The Boosters Club of Greenville, John H. Erickson, Secretary, has entered into an agreement with H. J. Meyers, of Dayton, O., and associates, for the installation of a street railway system in Greenville. The agreement provides for the construction of not less than five miles of standard gage 70-lb. T rail track. track.

The company projecting the Denton-Fort Worth Interurban line met recently at Denton, and perfected its formal organization, with the election of A. C. Owsley, J. C. Colt, B. H. Davenport, W. B. McClurkan, J. N. Rayzor and B. W. Blewett as directors, and A. C. Owsley, President; W. B. McClurkan, Vice-President; H. F. Schweer, Treasurer, and C. E. Scruggs, Secretary.

Construction work has been started on the interurban line from San Benito. The steel for the line has been ordered and contracts for ties placed, Ismael Montaloo and Luis Ramsey, of San Benito, receiving the contract for furnishing 20,000 ties each. The Hidalgo Construction Co. has the contract for grading, bridging and tracklaying. Ward Carpenter, who has charge of the concrete construction of the San Benito Land & Water Co., will have charge of the construction of the road. S. A. Robertson, San Benito, is interested.

R. L. Frisbee, C. E., Austin, is promoting a project for the construction of a line of railway from Beeville to Eagle Pass, through the counties of Live Oak. McMullen, La Salle and Dimmit.

The Dumont-Holmes Steel Concrete Co., of Chicago, Ill., has been granted a permit to do business in Texas. J. C. Dumont, the head of this company, has submitted a proposition to the city of Austin to put up a $1,000,000 concrete dam on the side of the granite dam across the Colorado River above the city which was washed away some years ago, and has deposited earnest money to the amount of $10,000 as an evidence of good faith. The question of accepting his proposition will be submitted by the city commission to the people of Austin to be voted upon. He proposes to replace the dam and establish a water and light plant system in connection therewith for a series of semi-annual payments of $25,000 each to continue for 20 years. He agrees to furnish the city with water and light free during that time but requires that he be in the meantime given control of the city's water and light system.

C. D. Johnson, of the firm of Frost-Johnson Lumber Co., of St. Louis, Mo., has closed a deal whereby his company acquired the Nacogdoches & Houston R. R., and property of the Hayward Lumber Co. The timber holdings and mills of the lumber company are valuable acquisitions while the railroad is standard gage, 20.1 miles in length, five of which were completed last fall. The terminals of the road were Nacogdoches and Oil City, but within the past few months the road has been extended a distance of five miles. Connections are made with the Houston, East & West Texas at Nacogdoches and with the Texas & New Orleans at Hayward.

The Kansas City, Mexico & Orient R. R. Co. has made application to the State Land Commissioner to purchase 240 acres of land, situated in the valley of the Rio Grande, near Presidia del Norte, where the international boundary stream will be crossed by that road. It is stated that the road will lay out a town upon the land and establish extensive terminals there. The Mexico division of the road is now being built up the Conchos Valley from Chihuahua to connect with the main line under construction through Texas. W. W. Colpitts, Kansas City, Mo., is Chief Engineer.

Good progress is being made with organization work for the beginning of construction on the Gulf Coast & Provident City Ry., recently chartered for the purpose of building a railroad 35 miles long from Waterhouse, on the Santa Fe, to Provident City, in the western portion of Wharton County, via Pierce, on the Southern Pacific.

The Artesian Belt Ry. has been graded 15 miles south of Christine, the present terminus, and the balance of the road to the Rio Grande will be constructed in a straight line. Dr. C. F. Simmons, San Antonio, is President.

The Bryan & College Interurban R. R. Co., which filed its charter on March 21, has its entire line graded and steel has been shipped. It is intended to have the line in operation early in June. The road will be 6½ miles long and will connect the city of Bryan with the A. & M. College. The line will be operated with gasoline motors, but electric power will ultimately be installed. The incorporators of the company are: W. H. Hunter, Crowley, La.; O. E. Gammill, W. E. Saunders, J. K. Parker, G. S. Parker, H. O. Boatwright, J. W. Doremus, J. E. Butler, J. T. Maloney, J. W. English, L. L. McInnis and A. W. Wilkerson of Bryan. Civil Engineer White, of Bryan, who had charge of surveys for the road, has started surveys for a new railroad from Bryan to the Brazos bottom. The road will tap the International & Great Northern at Smetena, six miles west of Bryan, and the tracks of that road will be used into Bryan. It will cross the river at Pitts bridge and run down the bottom, taking in all the big farms in the levee district.

The contractor on the Santa Fe extension from Lometa to Brady has moved his camp from Rochelle to the San Saba River in San Saba County, a distance of about 25 miles, and has begun grading from that point westward. Some of the sub-contractors on the Frisco who have completed their contracts have taken grading work on the Santa Fe line. All indications point to a rapid pushing of the work of extending the Santa Fe from Lometa to Brady, and probably westward through Concho County.

J. C. Kelso, Galveston, has been awarded the contract for grading 16 miles of right of way for the Houston-Galveston Interurban Co., reaching from a point two miles below Texas City Junction to Clear Creek. A contract for a like distance nearer Houston will be let in the near future. The work is what is known as embankment work and will average from 2 to 5 ft. higher than the surrounding land. The contract includes all ditching and grading. Contracts for 120,000 ties were also let, part for immediate delivery and the bulk for delivery beginning May 1. The road is being built by the Stone & Webster Engineering Corporation, under the direction of J. B. Townsend, engineer, First National Bank Bldg., Houston.

Work is progressing rapidly on the Santa Fe cutoff from Coleman, Tex., to Texico. Practically all grading has been completed from Coleman to Sweetwater, a distance of 85 miles. Steel has been laid on 25 miles of the line from Coleman to Jim Ned Creek, where a steel bridge 375 ft. in length and 115 ft. in height is being constructed.

It is said Chicago capitalists are promoting the construction of a railroad from Mineola to Paris, Tex., by way of Winnsboro and Mount Vernon, Tex.

Right of way has been guaranteed for the construction of the proposed Denton-Fort Worth interurban line from the Tarrant County line to Fort Worth, Tex. Stockholders are to meet soon at Denton, Tex., and elect officers and directors. President Owsley, Chamber of Commerce, Denton, Tex., is interested.

The Palacios, San Antonio & Pecos Valley R. R. Co. has been organized at Palacios, Tex., with a capital stock of $100,000 and proposes the construction of a line through territory not provided with transportation facilities.

The American Central Ry. Co.'s crew is running preliminaries for the first section of the proposed line between Miami and Vernon, Tex. As proposed the line will intersect the following roads: The Choctaw branch of the Rock Island at Texola, Mangum branch and the Wichita and Northwestern at Mangum, Okla.; the Orient at Olusta, and the Denver at Vernon, Tex.

W. L. Carwile, Pecos, Tex., president of the Pecos Valley Southern Ry., has filed his bond for $25,000 guaranteeing the construction of the proposed road with the trustees. Grading has already been started and Chief Engineer Anderson is planning for the construction of bridges, stations, etc., along the line and for shops at Pecos, Tex.

Citizens of Robert Lee, Tex., are taking steps to raise the necessary bonus to secure the construction of the proposed line from Colorado City to Robert Lee. After this section of the line is secured it will be extended to San Angelo, Tex.

The officials of the Kansas City, Mexico & Orient Ry. have signed a contract with the citizens of Del Rio for tne extension of the line 151 miles south from San Angelo to which point it is now built.

Advices from San Antonio state that the railroad that was being constructed between Gardendale, on the I. & G. N., and Carrizo Springs, by the Hust & Brundage Co., has been sold to J. E. Franklin of the Bankers' Trust Co. of St. Louis, and the work will be rapidly carried to completion. The Bankers' Trust Co. built and owns the Uvalde & Crystal City R. R., which is now extending its line from

Crystal City into Carrizo Springs from the north. The new road has been graded for nine miles and will be known as a connection of the Uvalde & Crystal City railroad, extending from Gardendale to Brundage, a distance of 45 miles.

The North American Dredging Co., of Galveston, started work Mar. 23 on its contract for the first section of the Houston-Galveston interurban line. This section of the work is 2.6 miles in length, reaching from the causeway to the city limits of Galveston on Galveston island. This job is a strip 150 ft. in width, of which 50 ft. is for the interurban and 100 ft. for the county roadway. The contract calls for a hydraulic fill and embankment roadway, which will run through the low bed of the island. Sand will be pumped from Moffat's bayou, bringing the roadbed ten feet above zero datum, which will be higher than any present railroad embankment. The dredging company intends to pump about 10,000 cu. yds. per day until the 250,000 or 300,000 cu. yds necessary to complete the first section are filled in. The contract for the second section has been let to J. C. Kelso as stated elsewhere in this column.

J. K. Hexter, F. B. Lander, J. N. Fagan, V. A. and A. A. Sitterle, all of Victoria have applied to the City Council of that city for a franchise for a street railway to use either electric or gasoline motor cars. It is the promoters' intention to have the line in operation from the main part of town to the ball park by April 21, when the ball season opens here. The line probably will be extended to the eastern and northern suburbs of the city.

Utah Notes.

FROM CORRESPONDENTS AND OTHER SOURCES.

The Ogden & Northwestern Ry. Co., of Ogden, has accepted the franchise granted it by the Commissioners of Box Elder County. The franchise gives the railway company the right to construct a trolley car line from the Ogden Hot Springs to Brigham City. The terms of the franchise are that the building of the road must begin within six months' time, and be completed within one year. Announcement has been made that the work of extending the trolley line already running to the Hot Springs would begin at once. The road will follow the open tableland at the base of the mountains, and little or no engineering difficulties will be encountered.

The Commissioners of Salt Lake County have been notified by the Utah Light & Railway Co. of Salt Lake City that it will extend its line from Murray to Sandy, and that it expects to have the extension in operation this summer.

The Southern Pacific R. R. is to expend about $500,000 in double tracking and raising the trestle across the great Salt Lake between Ogden and Lucin. An appropriation of $300,000 already has been made for this purpose.

The Sunnyside Reservoir Irrigated Land & Livestock Co. has filed application with the State Engineer at Salt Lake City for 1,600 acre-feet of water from the Cottonwood wash, in Carbon County. The company plans to operate near Sunnyside as soon as a reservoir can be constructed.

The Sego Irrigation Co. has been incorporated with a capital stock of $40,000 and headquarters at Provo. The directors and officers are James Clove, president; C. E. Loose, vice president; Preston Peterson, secretary; W. L. Biersach, treasurer, and A. L. Woodhouse.

Washington Notes.

FROM CORRESPONDENTS AND OTHER SOURCES.

Advices from Spokane state that work will probably be started shortly on the projected line of the Big Bend Transit Co., from Spokane to the Columbia River. A. W. Turner, Davenport, Wash., is General Manager.

The Valley Construction Co., of Kenewick, has been incorporated with a capital stock of $50,000, the incorporators being O. L. Hanson, D. F. Hildebrand and J. H. Knight.

The Great Northern, according to current reports, is considering an expenditure of $2,500,000 for the improvement of its line in the state of Washington during 1910. The line through the Cascade Mountains will have a 500-ft. right of way cleared of timber and rocks. A. Stewart, Seattle, Wash., is assistant chief engineer of the company.

Directors of the Northern Pacific Ry. Co. have notified the secretary of the state of Washington that the Sunnyside branch line will be extended to tap the principal cities in Yakima and Benton counties. A. Stewart, Seattle, Wash., is assistant chief engineer.

Location surveys are being made by engineers of the Great Northern Ry. for the construction of a line from Oroville, Wash., to Penticton, B. C. It is expected that construction work will be started on this line this summer.

According to announcement reported to have been made by A. H. Hogeland, St. Paul, Minn., chief engineer of the Great Northern Ry., steel will be laid on 20 miles of the new Oroville-Brewster extension by the end of April.

Wisconsin Notes.

FROM CORRESPONDENTS AND OTHER SOURCES.

The City Council of Stoughton has granted an extension of six months in the franchise of the Cincinnati Construction Co. The company expects to build an interurban line from Madison to Janesville this season, beginning May 1.

The Canadian Pacific Ry. is reported to have acquired a block of property in Milwaukee near Lake Michigan to be used as a terminal. With the Milwaukee acquisition the Canadian Pacific would have a Chicago line from the head of the lakes, with which Milwaukee would be directly connected. Surveys have already been made for a new route through Milwaukee.

M. Fugina and C. Schmoke, Fountain City, are purchasing swamp land in the Trempealeau bottoms near Trempealeau, with the object of reclaiming the land by drainage. About 10,000 acres of land will be affected and it is planned to build a levee, two drainage ditches and to erect a pumping plant.

The Milwaukee Western Electric Ry. Co. of Milwaukee has increased its capital stock from $200,000 to $1,000,000 for the purpose of building its proposed line this summer.

The town board of Oak Creek, Wis., has adopted resolutions endorsing the petition to the State Railroad Commission for the elevation of the railroad tracks on the south side.

The Crocker Chair Co., of Elton, is to have surveys started at once for a railroad from Elton north and into the timber lands of the company in the town of Langlade.

Canadian Notes.

FROM CORRESPONDENTS AND OTHER SOURCES.

H. Y. Macdonald, City Solicitor, of Regina, Sask., has been preparing an ordinance to grant a franchise to a company which proposes the construction of a street railway in Regina. Eight miles of track will be laid in the city this year, and arrangements will be made for the construction of a number of suburban lines, on which the work will be done in later years.

The Canadian Pacific Ry. is said to have acquired the interests of the Alberta Central Ry., with the idea of getting an easier grade across the Rockies, than the Kicking Horse pass affords. It is said work on this new line will be commenced this spring. It will run eastward from the coast to Red Deer, and thence to Saskatoon.

The Great Northern Ry. has location surveys under way for its line from Orville to Penticon, B. C. The line will be about 40 miles long and will probably be constructed this year.

The city of Sherbrook, Que., has granted a franchise to the Sherbrook Ry. Co. In return for the franchise the company promises to extend the system more than double what it is now, and will spend $500,000 in extensions and development of power plant. The company has an option on the water power of the Magog River, which runs through the city. Montreal capitalists are behind the scheme, and it is said that the system at Sherbrook will make connection with the proposed electric railway throughout the townships, starting from Montreal.

George Attwood, Prince Albert Sask., Chief Engineer of the Hudson Bay & Pacific Ry., has started surveys for the projected line from Prince Albert to Fort Churchill on the Hudson Bay. It is planned to have construction work started as soon as this survey is well advanced. The charter under which the road is to be constructed is an old one, but it has been renewed. It calls for the construction of 1,600 miles of railway from Prince Albert to Edmonton; to Lake Athabasca; and from Prince Albert to Fort Churchill. The project is being financed by the Hudson Bay & Pacific Railway Development Co., and J. A. Taylor & Co., New York, N. Y., are said to be largely interested in the enterprise.

The Dominion Minister of Railways has approved the route of the Alberta Central Ry. from Red Deer westerly to Rocky Mountain House. Plans and profiles have been prepared and it is believed that the line will be constructed by Dec. 1. J. Grant MacGregor, Red Deer, Alberta, is Chief Engineer.

Railroad contractors are taking advantage of the exceptionally early advent of spring and by the end of this month grading work will be commenced on the several lines in the Edmonton end of Alberta. Phelan & Shirley of Omaha, Neb., contractors for 80 miles of the extension to the main line of the Grand Trunk Pacific west of the Macleod River, have already commenced grading and within the next few weeks will bring several large outfits up from Omaha, where they have been employed on the extensions to the Union Pacific, and will put them to work west of the city. The Canadian Northern R. R. is also arranging for further construction on its branch into Calgary from Camrose, which is to be completed into the southern city this year. J. D. McArthur of Winnipeg, who has the contract for the completion of the Grand Trunk Pacific branch from Tofield into Calgary, this year, is also arranging to get his sub-contractors to work at a very early date.

The Canadian Pacific Ry. has just awarded a number of contracts for work in western Canada, Foley, Welch & Stewart, Stony Plain, Alberta, and St. Paul, Minn., and J. D. McArthur, Winnipeg, getting the bulk of the contracts. In the farther west most of the new work of the year will be done by Foley, Welch & Stewart, and near to Winnipeg it is expected that almost all the contracts will go to J. D. McArthur. Already a number of important contracts have been awarded to these two firms. In Alberta the Kipp extension will be built by Foley, Welch & Stewart. This line has been completed to the Little Bow River. It is now proposed to extend it from Carmangay to a point southeast of Calgary. Next year the line will be continued until a junction is effected with the Calgary-Macleod branch. The extension of the Langdon branch will also be built by the Foley, Welch & Stewart firm. This extension or spur leaves the Langdon branch at Irricanna and runs in a southeasterly direction, the intention being to afford facilities to the large numbers locating in the irrigation belt. The Weyburn extension will be built by the J. D. McArthur company and the expectation is that this company will remain on this work for several years, until the line is built through towards Lethbridge. Only 25 miles of the dump will be completed this year. The J. D. McArthur Co. will also build the Outlook extension. This is a 90 mile job, the work beginning on the north side of the Saskatchewan and continuing until the point is reached where the road branches off to Macklin. The contract for the line from Regina to Colonsay, 110 miles, was let to J. Bradley.

It is expected that entire section of the main line of the Grand Trunk Pacific between the McLeod River and Tete Juane Cache, a distance of 180 miles, will be under construction early this coming summer. Foley, Welch & Stewart, the contractors, have already sublet about 75 miles of the work in the McLeod district. The contractors have devoted the

past winter to packing in supplies by sleigh to points along the route as far west as the summit of the Rockies at Yellowhead Pass. Tete Juane Cache is 50 miles further west, and is on the Pacific slope.

The Canadian Northern Ry., M. H. MacLeod, general manager, Winnipeg, Man., is to shortly take bids from contractors for the building of portions of its line between New Westminster, B. C., and Hope, the latter at the western slope of the Hope mountains. Construction will also be carried on this summer at the various points between Kamloops and Hope, the route from Lytton following the Fraser River on the side opposite that occupied by the C. P. R. R.

A. Kirk, Antigonish, N. S., has been awarded the contract for the construction of a branch line of the Intercolonial Ry. some ten miles long, from George's River to Sydney Mines, Cape Breton. The contract is said to amount to about $250,000.

Work has been started at Papineauville, Can., on the construction of the proposed Little Nation River Ry., which is to run from Papineauville to Nominingue towards the northerly part of Labelle County, connecting with the Canadian Northern Ry. at Arundel. G. W. Seguin, city collector of Ottawa, Ont., is president of the company.

Information has been received by T. H. White, Vancouver, B. C., chief engineer of the Canadian Pacific Ry., stating that surveys have been completed between Tete Juane Cache and Yellowhead Pass at the summit of the Rockies. This completes the preliminary survey for the entire line between Yellowhead Pass and New Westminster, a distance of 450 miles.

The Canadian Pacific Ry., which controls the New Brunswick Southern Ry. between St. John and Calais, Me., is planning to straighten the road and to extend it to a junction with their main line at Mattawamkeag. J. G. Sullivan, Montreal, Que., is assistant chief engineer, Canadian Pacific Ry.

Mexican Notes.

FROM CORRESPONDENTS AND OTHER SOURCES.

The Chapala Hydro-Electric & Irrigation Co., of Guadalajara, Mexico, has plans for a direct trolley line between Guadalajara and the town of Chapala. Surveys were completed several months ago.

Arrangements have been made with the National Ry. of Mexico, Jas. M. Reid, Chief Engineer, City of Mexico, for the construction of a branch from La Capilla, a station on the main line of the Guadalajara division, 20 miles from Guadalajara, to the town of Chapala, on the northern shore of Lake Chapala. The distance is less than 25 kilometers. The state government will secure the right of way and bear the expense of preparing the roadbed.

Plans are said to be under way for securing the necessary capital for the extension of the Pan American R. R. through Guatemala and also the construction of a branch line into the interior of the State of Chiapas, and probably into the States of Tabasco and Campeche. David E. Unger, Gamboa, Oax., Mexico, is Chief Engineer.

Governor Damian Flores of the State of Guerrero has just granted the Mexican Pacific Ry. Co. a subsidy of $4,000 per kilometer on about 175 kilometers of track that will be built between the port of Acapulco and the port of Zihuatanejo. This state aid is supplemented by a liberal donation of land for terminals and right of way. The survey for the proposed road has already been made, and the construction will be pushed forward rapidly. The route of the new line between Acapulco and Zihuatanejo will parallel the Pacific coast the entire distance.

The Mexico Northwestern Ry. Co., a recently organized Canadian corporation, which has taken over the Chihuahua & Pacific road and the Rio Grande, has under construction 116 miles of line connecting Terragas and Madera, will start surveys at once for a line from San Antonio to Casibuiviachic, a distance of 15 miles west of San Antonio.

Alberto Legorreta is to have work started shortly on the construction of his new railroad between Queretaro at San Jose Iturbide in the State of Guanajuato. The line will be 40 kilometers long.

Bids are to be opened March 31 by W. H. Wallace, secretary of the Parkman Irrigation District, Sheridan, Wyo., for the sale of $150,000 irrigation bonds.

According to reports George E. Gunn, chief engineer for the Guggenheim interests, San Francisco, Cal., has completed plans for the construction of a railroad from Wabuska, Nev., to the new smelting plant in Mason Valley.

Articles of incorporation have been filed with the county clerk for the Athens & Tellico R. R. The company, which is subsidiary to the Louisville & Nashville, proposes the construction of a line from Athens, Tenn., to Tellico Plains, Tenn., a distance of 27 miles. The incorporators are J. B. Wright, James G. Johnson, Charles H. Seymour, J. H. Ringgold and R. C. Morrison. The company is capitalized at $25,000 and the principal offices are at Knoxville, Tenn.

Construction work is progressing rapidly on the extension of the Moshassuck Valley R. R. to tidewater. The work will include the construction of docks on the Pawtucket River near Woodlawn Station. D. C. Paton, Saylesville, R. I., is general superintendent of the railroad.

According to reports, Walter Douglas, Bisbee, Ariz., and two directors of the El Paso & Southwestern Ry. were recently in Phœnix, Ariz., making preparations for the extension of its system to that city.

It is reported that contracts have been awarded for the construction of the incline railway up Mill Mountain near Roanoke, Va.

Surveys are being made at Stanton, N. Dak., for the construction of a new depot and railroad yards.

The city council of Sheffield, Ala., has adopted an ordinance granting the Southern Ry. right of way for laying double tracks through the city. W. H. Wells, Washington, D. C., is engineer of construction of the Southern Ry.

Finances and material have been secured by the Payette Valley Railroad Co. and only the right of way must be secured between New Plymouth and Emmett before work can be started. H. E. Dunn, Payette, Idaho, is vice president and general manager of the company.

The U. S. War Department has directed Lieut. Col. G. W. Goethals, U. S. Engineer, President of the Panama R. R., Culebra, Panama, to arrange with the Panama Government for the survey of the Panama R. R. to the Costa Rican frontier. This extension has been projected for some time. Frederick Mears, Colon, Panama, is Chief Engineer, Panama R. R.

The citizens of Athens, Me., have voted to raise 5 per cent of the town's valuation to aid in constructing the electric road from Skowhegan, Me., to Athens.

The Chattanooga Southern R. R., E. C. Osborn, receiver, 111 Broadway, New York city, has been acquired by Newman Erb and associates of New York city. The road extends from Chattanooga, Tenn., to Gadsden, Ala., and has 98 miles of track.

A bill is before Congress for the incorporation of the Great Northern Alaska R. R. Co., which proposes the construction of a railroad in Northern Alaska. The company also owns a large amount of timber, copper and coal land in Alaska. Herman Barring, Wilkesbarre, Pa., is interested.

The Johnson City Traction Co., of Johnson City, Tenn., is to extend its line to the Carter Addition in that place.

BIDS ASKED.

Bridges.

Bids are asked on following work, the notes being arranged alphabetically by states:

LaPorte, Ind.—Until April 4, by County Commissioners for the construction of a bridge over the Kankakee River at English Lake. C. H. Miller is Auditor of county.

Lebanon, Ind.—Until 1 p. m., April 5, by County Commissioners for the construction and repair of nine bridges. B. F. Herdrich is Auditor of Boone County.

Richmond, Ind.—Until 11 a. m., April 9, by County Commissioners for the construction of Weaver bridge, steel, Weaver concrete culvert, Middleboro concrete bridge, and for steel approach to the Murray Bridge. Demas S. Coe is Auditor of Wayne County.

Shreveport, La. — Until 5 p. m., April 12 (change of date), by C. G. Rives, Comptroller, for the construction of steel traffic bridge over Red River at Shreveport, La. The cost of the structure is estimated at $300,000. Ira G. Hedrick, Keith & Perry Bldg., Kansas City, Mo., are the Engineers.

Hingham, Mass.—Until 10 a. m., April 8, by Lieut.-Col. Edward Burr, U. S. Engineers, Boston, Mass., for altering the highway bridge and street railroad bridge over Weymouth Black River on Lincoln St., Hingham, Mass.

Maryville, Mo.—Until April 8, by George S. Miller, County Engineer, for the construction of 8 new bridges and repairing 4 old ones in Nodaway County.

Hackensack, N. J.—Until 1 p. m., April 1, by Clerk of the Board of Chosen Free Holders for the construction of a new bridge over the Erie R. R. tracks at Montross Ave., Rutherford.

Reading, Pa.—Until 10 a. m., April 15, by A. L. Rhoads, County Controller, for repairing Hartz's Mill bridge, one-half mile south of Morgantown.

Waynesburg, Pa.—Until 1 p. m., April 5, by County Commissioners, for the construction of several bridges. James MacCracken is Clerk.

Green River, Wyo.—Until April 5, by Board of County Commissioners for the construction and completion of one steel bridge over Bitter Creek, at a point north of the Union Pacific R. R. track near Thayer Junction. The structure will have one 50-ft. span and a 12 ft. roadway. Heriot Riddle is County Clerk.

Colinville, Ont.—Until noon, April 6, by T. H. Holmes, Colinville, Ont., or Neil McGugan, Wilkesport, Ont., for constructing concrete abutments and floor for a steel bridge over the Sydenham River between the townships of Moore and Sombra.

Toronto, Ont.—Until noon, April 6, by A. J. McGee, Secretary-Treasurer, Temiskaming & Northern Ontario Railway Commission, 25 Toronto St., Toronto, Ont., for the construction of abutments to bridge at M. P. 48.91 and for construction of substructure of steel trestle for Wabis River, M. P. 119.13.

Buildings.

Bids are asked on following work, the notes being arranged alphabetically by states:

Washington, D. C.—Until 11 a. m., May 7, by R. C. Hollyday, Chief Bureau of Yards and Docks, Washington, D. C., for the construction of two officers' quarters at the navy yard, Puget Sound, Wash.

Newnan, Ga.—Until 3 p. m., April 29, by James Knox Taylor, Supervising Architect, Treasury Department, Washington, D. C., for the construction, complete, including plumbing, gas piping, heating, apparatus, electric conduits and wiring of the United States Post Office at Newnan, Ga.

Shelbyville, Ind.—Until 10 a. m., April 7, by County Commissioners for the construction of a barn on the poor farm. G. G. Huntington is Auditor of Shelby County.

Boston, Mass.—Until 3 p. m., May 5, by James Knox Taylor, Supervising Architect, Treasury Department, Washington, D. C., for the construction of the foundation, the basement and first floors of the extension, remodeling, etc., of the United States Custom House, Boston, Mass.

Boston, Mass.—Until 10 a. m., April 18, by Capt. A. W. Miller, Constructing Quartermaster, Boston, Mass., for the construction, plumbing, heating, electric wiring and fixtures of one double set of officers' quarters, one double set of non-commissioned officers' quarters, and one quartermasters' storehouse, at Fort Strong, Boston Harbor, Mass.

Jefferson Barracks, Mo.—Until 11 a. m., April 9, by Capt. Stanley H. Ford, Quartermaster, for remodeling 4 stable guard houses for enlisted men.

Rochester, Minn.—Until 3 p. m., April 26, by James Knox Taylor, Supervising Architect, Treasury Department, Washington, D. C., for the construction, including plumbing, gas piping, heating apparatus, electric conduits and wiring, of the United States Post Office at Rochester, Minn.

Waseca, Minn.—Until 2 p. m., April 16, by Waseca County Farmers' Elevator & Mercantile Association of Waseca, Minn., for the removal of the elevator, flour house and coal sheds owned by said association from its present lo-

cation to a new site and also for building foundation therefor on new site. James Byron is President.

Bayonne, N. J.—Until 10:30 p. m., April 14, by Board of Education of the city, Avenue C and 26th St., for necessary labor and material for the construction of public school building No. 11, between West 23d and West 24th Sts. W. J. Tomlin is Secretary of the Board.

Tacoma, Wash.—Until 3 p. m., May 11, by James Knox Taylor, Supervising Architect, Treasury Department, Washington, D. C., for the metal vault shelving for the U. S. post office and court house and custom house at Tacoma, Wash.

Milwaukee, Wis.—Until noon, April 17, by Board of Park Commissioners, for the construction of a children's shelter in Mitchell Park.

Fort D. A. Russell, Wyo.—Until 9:30 a. m., April 13, by Capt. V. K. Hart, Constructing Quartermaster, Room 3, Keefe Hall, Cheyenne, Wyo., for the construction, plumbing, wiring, for electric motors and lights, electric fixtures, furnishing and installing laundry machinery and equipment, boiler, feed, pump, etc.

Charleston, W. Va.—Until 3 p. m., May 4, by James Knox Taylor, Supervising Architect, Treasury Department, Washington, D. C., for the construction, including plumbing, gas piping, heating apparatus, electric conduits and wiring and standard clock system of an extension, remodeling, etc., to the United States post office and court house at Charleston, W. Va.

Fort Mackenzie, Wyo.—Until 2 p. m., April 18, by Constructing Quartermaster, for the construction and electric wiring of a reinforced concrete root house, Plan 195.

Lander, Wyo.—Until 3 p. m., May 2, by James Knox Taylor, Supervising Architect, Treasury Department, Washington, D. C., for the construction including plumbing, gas piping, heating and ventilating apparatus, electric conduits and wiring and standard clock system, of the United States Post Office at Lander, Wyo.

Kipling, Sask.—Until noon, April 15, by John Sproat, Secretary-Treasurer, for the erection and construction of a 4-round brick veneer school building with stone basement.

Roads and Streets.

Bids are asked on following work, the notes being arranged alphabetically by states:

New London, Conn.—Until 11 a. m., April 13, by Capt. F. T. Arnold, Constructing Quartermaster, New London, Conn., for the construction of approximately 1,700 lin. ft. of macadam road and 1,100 sq. yds. of concrete sidewalks at Fort. H. G. Wright, N. Y. Official advertisement of this work will be found elsewhere in this issue.

Atlanta, Ga.—Until 3 p. m., April 4, by Mayor and General Council, for the construction of creosoted wooden blocks on North Boulevard from Ponce de Leon Ave. to North Ave. The work includes approximately 3,500 sq. yds. R. M. Clayton is City Engineer.

Iowa City, Ia.—Until 2 p. m., April 1, by O. J. Slater, City Clerk, for the improvement of Washington St., between Linn St. and the B. C. R. & N. Ry. tracks, including 2,000 cu. yds. of grading, 1,200 lin. ft. of curbing, 4,450 sq. yds. of paving and for the improvement of Summit St., from the C. R. I. & P. Ry. to Kirkwood Ave., including 1,600 cu. yds. of grading, 2,700 lin. ft. of curbing, 4,550 sq. yds. of paving.

Belleville, Ill.—Until 3 p. m., April 4, by Board of Local Improvements, for the construction of 35,000 sq. yds. of street paving with vitrified brick, including excavating and curbing and a small amount of sewering. Fred J. Kern is Mayor. Official advertisement will be found elsewhere in this issue.

Frankfort, Ind.—Until 2 p. m., April 9, by County Commissioners for the construction of five gravel roads. Charles F. Cromwell is Auditor of Clinton County.

Fowler, Ind.—Until 1 p. m., April 9, by County Commissioners, for the construction of four gravel roads. Lemuel Shipman is Auditor of Benton County.

Madison, Ind.—Until 1 p. m., April 7, by County Commissioners for the construction of road in Monroe township. Gaylord F. Crozier is Auditor of Jefferson Township.

Wabash, Ind.—Until 1 p. m., April 23, by County Commissioners of Wabash and Grant Counties for the construction of a gravel road on the line between the counties. J. P. Noftzger is Auditor of Wabash County.

Noblesville, Ind.—Until 1 p. m., April 12, by County Commissioners, for the construction of seven gravel roads. George Griffin is Auditor of Hamilton County.

Baltimore, Md.—Until noon, April 7, by State Roads Commission, Union Trust Bldg., Baltimore, Md., for the construction of 52 miles of state road in counties as follows: Allegany—On the National Pike between Standard Oil warehouse and Pennsylvania Railroad crossing, a distance of about .53 miles, in one section. Macadam. On the National Pike between Six-Mile House and Allegany Grove, a distance of about 1.02 miles, in one section. Macadam. On the National Pike in Garrett County from the Garrett County line towards Piney Grove, a distance of about 2.38 miles, in one section. Macadam. On the National Pike between Six-Mile House and Flintstone, a distance of about 6.95 miles, in one section. Macadam. Anne Arundel—On the road between Owings and Mount Zion, from the end of the 1909 work to Mount Zion, a distance of about 5.19 miles, in one section. Grading, bridging and draining only. Calvert—On the road between Owings and Prince Frederick, from the end of the 1909 work towards Prince Frederick, a distance of about 3.09 miles, in one section. Grading, bridging and draining. On the road between Owings and Prince Frederick, from the end of the above section towards Prince Frederick, a distance of about 4.53 miles, in one section. Grading, bridging and draining only. Garrett—On the National Pike in Garrett County from the Garrett County line towards Piney Grove, a distance of about 2.38 miles, in one section. Macadam. On the road between Oakland and McHenry, from the end of the 1909 work to McHenry, a distance of about 6.66 miles, in one section. Macadam. St. Mary's—On the road between Mechanicsville and Leonardtown, from Hellen towards Leonardtown, a distance of about 5.20 miles, in one section. Macadam. Washington—On the National Pike from two miles west of Conococheague Bridge towards Indian Spring, a distance of about 4.29 miles, in one section. Macadam. On the National Pike from Clear Spring to Licking Creek, from the end of the above section, a distance of about 4.52 miles, in one section. Macadam. Wicomico—On the road between Mardella Springs and Sharptown, from the Riverton Road to Sharptown, a distance of about 2.61 miles, in one section. Carroll—On the road between Eldersburg and Gamber, a distance of about 5 miles, in one section.

Baltimore, Md.—Until 11 a. m., April 6 by Board of Awards, for the construction of pavement on the following streets and alleys: With granite blocks: Carey St., from the north side of Columbia Ave., to the South Side of Pratt St. with vitrified blocks: Addison Alley, from Ramsay St. to Wilkens Ave., Lovegrove Alley, from Adams Alley to North Ave.; Morton St., from Center St. to Hamilton St. With sheet asphalt, asphalt blocks, bithulithic or vitrified paving blocks: North Ave., from the east side of Payson St. to the East Side of Druid Hill Ave., except between the rails of the car tracks; Ostend St., from Race St. to Hanover St.; Wilkens Ave., from the east side of Fulton Ave. to the old Western boundary, except between the rails of the car tracks.

Brookline, Mass.—Until 4 p. m., April 4, by Selectmen at Town Hall, for the construction of coal tar concrete sidewalks, driveways, street crossings and gutters in the town of Brookline. Edward A. McEttrick is Secretary.

Minneapolis, Minn.—Until 5 p. m., March 31, by J. A. Ridgway, Secretary Board of Park Commissioners, for the construction of a park drive between Superior Ave. and 6th Ave. North, through Glenwood Park. Certified check $500 required with bid.

Eveleth, Minn.—Until 8 p. m., April 5, by D. P. McIntyre, City Clerk, for furnishing necessary labor and material for the construction of pavement on Grant Ave., including about 9,700 sq. yds.

Concord, N. H.—Until 1 p. m., April 18, by State Engineer, for the construction of 3,850 ft. of macadam road in Pembroke, N. H.

Fort Slocum, N. Y.—Until 10 a. m., April 9, by Capt. Peter F. Murray, Constructing Quartermaster, Recruit Depot, Fort Slocum, N. Y., for the construction of macadam roads, concrete curbs, and brick gutters at Fort Slocum.

Cleveland Heights, O.—Until noon, April 5, by H. H. Canfield, Clerk of the Village, Norfolk Road, for furnishing the labor and material for treating with oil for the purpose of laying the dust on and preserving the surface of Cedar Road from Overlook Road to Coventry Road: Bellfield Ave., from Cedar Road to Shaker Parkway; Grandview Ave., from Cedar Road to Shaker Parkway; Coventry Road, from Mayfield Road to Shaker Parkway; Fairmount Boulevard, from Coventry Road to Shaker Parkway; Stratford Road, from Fairmount Blvd. to Fairfax Road; Guilford Road, from Fairmount Blvd. to Monmouth Road; Lee Road, from Fairmount Blvd. to South Woodland Road; Mayfield Road from the westerly limits of said village to the easterly limits of said village. Hampshire Road from Coventry Road to Superior St.; Cadwell Ave. from Euclid Heights Blvd. to Hampshire Road; Euclid Heights Blvd. from Coventry Road to Superior St.; Lee Road from Mayfield Road to Superior St.

Cleveland, O.—Until 11 a. m., April 6, by Board of County Commissioners for the grading, draining and improving North Woodland Road No. 2, from Brainard Road to Chagrin River Road in Orange township. J. F. Goldenbogen is Clerk.

Bellefontaine, O.—Until noon, April 15, by Department of Public Service, for grading, curbing, macadamizing and paving Elm St., including 3,300 cu. yds. of excavation; 4,600 lin. ft. curb; 2,300 sq. yds. of paving; 4,700 sq. yds. macadam. Paul O. Batch is Clerk.

Cleveland, O.—Until 11 a. m., April 20, by Board of County Commissioners, for grading, draining and improving the Independence Road No. 2 from Harvard Road to the property line between Henry Krapf and Peter Schmidt, about 8,910 ft. south of Harvard Road, in Newburg Heights Village. John F. Goldenbogen is Clerk.

Xenia, O.—Until 10 a. m., April 25, by County Commissioners, for macadamizing 2 miles of the Jamestown-Bowerville Pike from the south corporation line of Jamestown to the Plymouth pike. S. Milton McKay is County Surveyor.

Sewers.

Bids are asked on following work, the notes being arranged alphabetically by states:

Newport, Ark.—Until 2 p. m., April 27, by City Secretary C. S. Henry for the construction of 6½ miles of sanitary sewers and a pumping plant estimated to cost $40,000. Lund & Hill, Little Rock, Ark., are Consulting Engineers.

Hamburg, Ia.—Until 8 p. m., March 31, by August Wagner, City Clerk, for the construction of a sewer from E St. along E St. to Washington St., and from E St. to H St., along Bluff St. and from D St. along Argyle St. to M St., and D St. along Main St. to K St. and from D St. to J St. along Park St., and from D St. to J St. along Washington St.

Berwyn, Ill.—Until 8 p. m., April 6, by Board of Local Improvements, George Norton, Secretary, for the construction of a vitrified tile pipe sewer in Morton Ave. estimated to cost $2,148.

Laporte, Ind.—Until April 11, by City Council, for the construction of a 78-in. reinforced concrete main sewer and two sub-trunks, one 60-in. and the other 54-in. in diameter.

Manhattan, Kan.—Until 3 p. m., May 3, by H. W. Hungerford, City Clerk, for the construction of a complete sanitary sewer system for this city. Con. M. Buck is City Engineer.

Leavenworth, Kan.—Until 5 p. m., April 26, by J. H. Kirmeyer, City Clerk, for the construction of District Sewer No. 9 and also for the construction of certain lateral sewers in Sewer District No. 9. Official advertisement will be found elsewhere in this issue.

Trenton, N. J.—Until 8 p. m., April 5, by Common Council for the construction of a sewer in Exton Ave., from the Philadelphia & Reading R. R. southerly to Stuyvesant Ave. Harry B. Salter is City Clerk.

Trenton, N. J.—Until 8 p. m., April 5, by Common Council for the construction of a sewer in Stuyvesant Ave., Prospect St., East Stuyvesant Ave., and Marion St. Harry B. Salter is City Clerk.

Auburn, N. Y.—Until April 5, by the City Clerk, for constructing a sewer in Seward Ave. South.

New York, N. Y.—Until 11 a. m., April 6, by President of the Borough of Brooklyn for the construction of sewers from 6 to 36 in. in diameter in that place. The work is estimated to cost about $33,756. Alfred E. Steers is President.

Lorain, O.—Until Noon, April 6, by Director of Public Works, for furnishing the necessary labor and materials for the construction of sewers as follows: Storm water sewer, in Oberlin Ave. from the present southerly terminus of said sewer as now constructed, southerly to W. 23rd St., together with the necessary manholes, intakes, etc. Illinois Ave. and F St., from E. Erie Ave. southerly in Illinois Ave. to F St., thence westerly in F St. to Georgia Ave. Long Ave. from 12th St. about 200 feet southerly. L. B. Johnson is Clerk.

Brandon, Man.—Pipe and Connections.—Until noon, April 1, by City Clerk, for supplying the following: 100 to 200 tons of cast iron pipe and specials; 3,000 ft. of 10 and 12-in. sewer pipe; brass goods for water connections. R. E. Speakman, Brandon, is City Engineer.

Saskatoon, Sask.—Until 7:30 p. m., April 11, by J. H. Truesdale, City Clerk, for furnishing necessary labor and material for laying water mains and sewer pipes and furnishing materials included.

Water Supply.

Bids are asked on following work, the notes being arranged alphabetically by states:

Quitman, Ga.—Until 8 p. m., April 6, by J. D. Wilson, Mayor, for furnishing necessary labor and material for the construction of one steel tower and a tank of 150,000-gal. capacity. H. S. Jaudon, Box 582, Savannah, Ga., is Engineer.

California, Mo.—Until April 7, by city, for the construction of a water works system estimated to cost $30,000. Burns & McDonnell, 804-23 Scarritt Bldg., Kansas City, Mo., are Engineers.

Fort Robinson, Neb.—Until 11 a. m., April 11, by Capt. M. H. Barnum, Constructing Quartermaster, for furnishing necessary labor and material for the installation of new boilers, new pump, feed water purification system, feed pump, etc., at Fort Robinson, Neb. Official advertisement of this work will be found elsewhere in this issue.

Ellenville, N. Y.—Until April 1, by Board of Water Commissioners, for construction of new reservoir. The work will include 11,500 cu. yds. of excavation, mostly rock; 300 cu. yds. of stone masonry; 120 yds. of concrete masonry; 510 ft. of 6-in. steel pipe; 480 ft. of 10-in. cast iron pipe, and one pressure regulating tank.

Platteville, Wis.—Until 7:30 p. m., April 7, by P. D. Hendershot, Jr., City Clerk, for the necessary labor and material for the construction of a steel tank 21 ft. in diameter by 30 ft. high. W. G. Kirchoffer, 31 Vroman Bldg., Madison, is Engineer.

Marshfield, Wis.—Until Noon, April 1, by R. Connor, 400 Central Ave., Marshfield, Wis., for drilling or boring a well on the Schwartz farm for the County Asylum.

Weston, Ont.—Until 8 p. m., April 18, by J. H. Taylor, Esq., Village Clerk, for the following works: Contract B, pump house; Contract F,

mechanical water filters; Contract G, electrically operated pumping machinery. Willis Chipman, 204 Mail Bldg., Toronto, Ont., is Chief Engineer.

North Battleford, Sask.—Until 8 p. m., April 19, by S. Cookson, Secretary-Treasurer, North Battleford, Sask., for the following works: Contract "A"—Pipelaying, waterworks and sewers. Contract "D"—Cast iron water pipes. Contract "E"—Fire hydrants, valves, etc. Contract "L"—Concrete reservior. Contract "X"—Sewage disposal works. J. A. Foley is Mayor, and Willis Chipman, Winnipeg and Toronto, is Chief Engineer.

Miscellaneous.

Bids are asked on following work, the notes being arranged alphabetically by states:

Fort Collins, Colo.—Reservoir.—Until April 14, by Robert S. Fedder, City Clerk, for constructing a storage reservoir on Bingham Hill. It is to have concrete sides and bottom and either concrete or frame roof, and a capacity of 5,000,000.

New London, Conn.—Light and Power Plant.—Until 10 a. m., April 30, by Capt. F. T. Arnold, Constructing Quartermaster, New London, Conn., for the construction of electric light and power plant and electric lighting system; installing new pumping plant and boiler at Fort Terry, N. Y. Official advertisement of this work will be found elsewhere in this issue.

Fort Barrancas, Fla.—Electric Lighting System.—Until 11 a. m., April 22, by Constructing Quartermaster, for the construction of an electric lighting system at the fort.

Tortugas, Fla.—Removing Wreck. — Until Noon, April 18, by Capt. George R. Spalding, U. S. Engineer, Jacksonville, Fla., for removing the wreck of schooner Nannie Bohlin in channel at Tortugas, Fla.

Boston, Mass.—Pressure Tunnel.—Until 2:30 p. m., by Metropolitan Water and Sewerage Board, Ashburton Pl., Boston, Mass., for constructing a pressure tunnel about 1,900 ft. in length and 6 ft. 4-in. in diameter inside the concrete lining, laying about 500 ft. of 80-in. steel pipe line covered with mortar and laying about 930 ft. of 60-in. cast iron pipe line for Weston Aqueduct Supply Main in Newton, Mass. The work will include about 950 cu. yds. of top soil excavation, 910 cu. yds. of top soil surfacing, 5,530 cu. yds. of earth excavation and 1,700 cu. yds of rock excavation in open trench, refilling trenches and building embankments with 8,900 cu. yds. of material, crushing 7,500 cu. yds of stone, 2,300 cu. yds. of concrete masonry in tunnel and 500 cu. yds. in open trench, 50 cu. yds. of brick masonry, and 200 cu. yds. of cement grout in tunnel.

Boston, Mass.—Fence.—Until 2:30 p. m., April 7, by Charles River Basin Commission, 367 Boylston St., Boston, Mass., for the furnishing and erecting an iron fence along the basin wall of the Charles River dam. The work will require about 1,600 lin. ft. of fence.

Boston, Mass.—Fire System.—Until 11 a. m., April 23, by R. C. Hollyday, Chief Bureau of Yards & Docks, Navy Department, Washington, D. C., for fire protection system in buildings Nos. 58, 60, 62 and 79 Navy Yard, Boston, Mass.

Grand Rapids, Mich.—Wall.—Until 8 p. m., March 31, by Board of Public Works for the construction of dock line wall along the west dock line of the Grand River between Wealthy Ave., and the South Front St. sewerage pumping station. Samuel A. Freshney is Secretary and General Manager.

New York, N. Y.—Electric Light & Power Plant—Until 10 a. m., April 12, by Board of Health, Department of Health, 55th St. and 6th Ave., Manhattan, New York City, for furnishing all the labor and materials necessary for the installation of an electric light and power plant, including engine, dynamo, generator, transformer, electric wiring and all other work incidental thereto, on the grounds of the tuberculosis sanatorium at Otisville, Orange County, N. Y.

Ashtabula, O.—Electric Railway.—Until April 8, by Ashtabula Electric St. Ry. Co., Haskell Bldg., Ashtabula, O., for the construction of 10 miles of electric railway for the Ashtabula Electric St. Railway Company. Work also noted under Confirmed Reports in this issue.

Milwaukee, Wis.—Breakwater.—Until Noon, April 7, by Board of Park Commissioners for the construction of a 600 ft. breakwater for the shore protection of the Lake Shore drive.

Excavation, Earth and Rock.

Bids are asked on following work, the notes being arranged alphabetically by states:

Chicago, Ill.—Dredging.—Until 10 a. m., April 25, by Maj. Thos. H. Rees, U. S. Engineer, Chicago, Ill., for dredging in Calumet River, Ill. Official advertisement of this work will be found elsewhere in this issue.

Boston, Mass.—Dam Work.—Until 2:30 p. m., April 4, by Charles River Basin Commission, 367 Boylston St., Boston, Mass., for the surfacing and grading the main portion of the Charles River Dam. Hiram A. Miller is Chief Engineer and William S. Youngman is Secretary. Work is also noted under Confirmed Reports in this issue.

Grand Rapids, Mich.—Embankment.—Until 8 p. m., March 31, by Board of Public Works, for the construction of a flood embankment from the Lake Shore & Michigan Southern R. R. embankment west to near Butterworth Ave., on the Frank Ball property near Wealthy Ave. William M. Gormley is President of the Board.

St. Paul, Minn.—Dredging.—Until noon, April 11, by Board of Water Commissioners, John Caulfield, Secretary, for dredging the west arm of Vadnais Lake, situated in St. Paul. The work will include about 1,500,000 cu. yds. of vegetation and peat. The work is also noted under Confirmed Reports in this issue.

Greenville, Miss.—Levee Work.—Until April 27, by W. J. Shackelford, Chief Engineer, Mississippi Levee District, Greenville, Miss., for the construction of two new levees in the district. The work is also noted under Confirmed Reports in this issue.

Newark, N. J.—Drainage System.—Until 3:30 p. m., April 5, by Essex County Park Commission, for the construction of a storm water drainage system on Park Ave., in Newark, East Orange, Orange and West Orange, Essex County, N. J. The work will include the following approximate quantities: 1,500 lin. ft. 8-in. vitrified pipe; 800 lin. ft. 10-in. vitrified pipe; 2,300 lin. ft. 12-inch vitrified pipe; 2,600 lin. ft. 15-in. vitrified pipe; 1,800 lin. ft. 18-in. vitrified pipe; 1,060 lin. ft. 20-in. vitrified pipe. 650 lin. ft. 22-in. vitrified pipe; 500 lin. ft. 24-in. vitrified pipe; 500 lin. ft. 24-in. reinforced concrete pipe, alternate bid; 400 lin. ft. 27-in. reinforced concrete pipe; 800 lin. ft. 30-in. reinforced concrete pipe; 90 reinforced concrete catch basins, 6 feet deep; 40 reinforced concrete catch basins, 7 feet deep; 150 cu. yds. brick masonry; 25,000 lbs. cast iron; 1,000 lbs. wrought iron.

Albany, N. Y.—Canal Work.—Until noon, April 7, by F. C. Stevens, Superintendent of Public Works, for Contract No. 90, including Erie Canal, Sec. 6; Oswego Canal, Sec. No. 1; Champlain Canal, Sec. 3. The work will call for furnishing and installing equipment for operating and lighting Lock No. 24, on the Erie Canal; Locks Nos. 1, 2, 7 and 8 on the Oswego Canal; Locks Nos. 9, 11 and 12 on the Champlain Canal.

New York, N. Y.—Dredging.—Until Noon, April 26, by Col. William T. Rossell, U. S. Engineers, 802 Army Bldg., 39 Whitehall St., New York City, for dredging in Passaic River, N. J.

New York, N. Y.—Dock Work.—Until 11 a. m., April 16, by R. C. Hollyday, Chief Bureau of Yards & Docks, Navy Department, Washington, D. C., for removal of a portion of Cob Dock at the New York Navy Yard.

Cleveland, O.—Dredging.—Until noon, April 2, by Department of Public Service, O. R. Hoffman, Chief Engineer, for dredging in the Cuyahoga River. The work is also noted under Confirmed Reports in this issue.

Cameron, Tex.—Levee.—Until 10 a. m., April 9, by W. A. Morrison, Cameron, Tex., Commissioner of the Hefley Improvement District of Milain County, for the construction of a levee about 5½ miles long, including about 121,728 cu. yds. of earth. Work is also noted under Confirmed Reports in this issue.

Marshfield, Wis.—Excavation.—Until Noon, April 1, by R. Connor Co., 400 Central Ave., Marshfield, Wis., for the excavating and removal of approximately 4,000 cu. yds. of dirt for the foundation for County Asylum on Schwartz farm.

Milwaukee, Wis.—Grading and Filling.—Until Noon, April 7, by Board of Park Commissioners, for the excavating and filling in with black soil of Center Plots in Highland Blvd., from Western Ave., to a point 300 ft. west of 40th St.

Ottawa, Ont.—Dredging.—Until 5 p. m., April 12, by Department of Public Works, Ottawa, Ont., for dredging in the Province of Ontario. Work is also noted under Confirmed Reports in this issue.

Montreal, Que.—Canal Work.—Until April 9, by A. E. Robert, Managing Director, for rock and earth excavation in the Beauharnois Canal, between Valleyfield and St. Timothee, also for intake works at Valleyfield, including coffer dam and culverts in canal.

Materials, Machines, Supplies, Etc.

Bids are asked on following work, the notes being arranged alphabetically by states:

Washington, D. C.—Regulator.—Until April 1, by Capt. F. C. Boggs, General Purchasing Officer, Isthmian Canal Commission, Washington, D. C., for furnishing a 5-in. water pressure regulator.

Washington, D. C.—Lumber, Steel, Etc.—Until 10:30 a. m., April 5, by Capt. F. C. Boggs, General Purchasing Officer, Isthmian Canal Commission, Washington, D. C., for furnishing lumber, steel, iron and manila rope.

Washington, D. C.—Castings.—Until 2 p. m., May 2, by Treasury Department, Bureau of Engraving and Printing, Washington, D. C., for furnishing during the fiscal year beginning July 1, 1910, brass castings and iron castings.

Washington, D. C.—Lumber, Steel, Etc.—Until 10:30 a. m., April 25, by Capt. F. C. Boggs, Isthmian Canal Commission, General Purchasing Officer, Washington, D. C., for furnishing lumber, steel, iron and manila rope.

Chicago, Ill.—Lumber.—Until 11 a. m., April 4, by Board of Public Works, for furnishing and delivering at the various bridges and viaducts in the city, white pine, yellow pine, white oak or burr oak lumber that may be required and ordered during the term ending Sept. 30, 1910. John J. Hanberg is Commissioner of Public Works.

Chicago, Ill.—Cement.—Until 11 a. m., March 31, by Board of Public Works, for furnishing and delivering at the City Pipe Yards, approximately 200 barrels of natural cement and 100 barrels of Portland cement. John J. Hanburg is Commissioner of Public Works.

Chicago, Ill.—Milling Machine.—Until 11 a. m., April 4, by Board of Public Works, for furnishing and delivering one Universal Milling Machine No. 2 at the water works shops. John J. Hanberg is Commissioner of Public Works.

Chicago, Ill.—Manhole Covers, Etc.—Until 11 a. m., April 4, by Board of Public Works, John J. Hanberg, Commissioner, for furnishing and delivering manhole and catch basin covers and other castings at the sewer pipe yards, Chicago Ave. bridge and 52d St.

Springfield, Mass.—Steel, Iron Castings.—Until 2 p. m., April 22, by Col. S. E. Blunt, Commanding Officer, for furnishing steel, iron castings, coal, oils, chemicals, gasoline, gunstocks, etc.

Sturgis, Mich.—Electrical Equipment.—Until 7 p. m., April 12, by Board of Public Works, for one vertical hydro electric direct connected unit of 600 kw. capacity, comprising one hydraulic vertical reaction turbine, shaft, bearings, one 600 kw. A. C. generator; one 45 kw. 125 volt vertical exciter unit, comprising turbine, shaft and exciter generator; one hydraulic governor for A. C. generator unit; 6 oil cooled A. C. single phase 60 cycle transformers, 2,300 to 23,000 volts, 200 kw. capacity each; one 3 panel switchboard with equipment for handling output of above apparatus. Official advertisement will be found elsewhere in this issue.

Vicksburg, Miss.—Stone.—Until Noon, April 18, by Capt. Clarke S. Smith, U. S. Engineer, Mississippi River Commission, Third District, Vicksburg, Miss., for furnishing 20,000 cu. yds. stone by railroad or water delivered in this district.

Vicksburg, Miss.—Brush and Poles.—Until Noon, April 19, by Capt. Clarke S. Smith, U. S. Engineers or Mississippi River Commission Third District, Vicksburg, Miss., for furnishing brush and poles for revetment work in this district.

Fort Robinson, Neb.—Boilers, Pumps, Etc.—Until 11 a. m., April 11, by Capt. Malvern-Hill Barnum, Constructing Quartermaster, Fort Robinson, Neb., for furnishing all material and labor for the installation of new boilers, new pumps, feed water purification system, feed pump, etc., pump house at Fort Robinson, Neb.

Corpus Christie, Tex.—Water Main, Etc.—Until noon, April 8, by Mayor, Clark Pease, for furnishing 4, 6 and 8-in. standard cast iron water main, cast iron specials, gate valves, valve boxes, lead and about 150 fire hydrants and all necessary supplies for laying and constructing about 8 miles of water main.

Winnipeg, Man.—Lead Pipe.—Until 11 a. m., April 5, by Board of Control, M. Peterson, Secretary, for supply of quantity of lead pipe delivered to the city yards, Ross Ave.

CONTRACT LET.

The following contracts have been let recently:

BRIDGES.

Westbrook, Conn.—Bridge—Union Bridge Construction Co., $4,685, for the construction of a combination steel and concrete bridge over the Menunketesuck River. Bids were opened Feb. 21.

Tell City, Ind.—Bridge.—Vincennes Bridge Co., Vincennes, Ind., at $7,200, for the construction of the new Oil creek bridge.

Mount Ayr, Ia.—Bridges.—Lintz Bros. Machine Works, Fort Branch, at $3,698, for the construction of 15 bridges, to be completed by Sept. 1.

Sioux City, Ia.—Bridge.—Lewis & Leeder, at $2,938, for the construction of a bridge over Perry creek at Market St.

Hutchinson, Kan.—Bridge.—Holmes & Eitel, Minneapolis, Minn., at $16,973, for the construction of the new reinforced concrete bridge over Cow creek, on Main St.

Topeka, Kan.—Bridge.—A. D. Johnson, Kansas City, Mo., at $32,350, for the building of the extension of the Melan arch bridge on the south side. The extension to the bridge will be the addition of one arch on the south end. It will be 148 ft. long. The contract for the work of excavating will be let later.

Minneapolis, Minn. — Bridge. — Minneapolis Steel & Machinery Co., at $1,894, for the construction of a bridge at Maple Grove.

St. Louis, Mo.—Bridge.—Missouri Bridge & Iron Co., Fullerton Bldg., St. Louis, Mo., at $59,864, for the reconstruction of the northern portion of the 18th St. bridge over Mill Creek Valley; Geisel Construction Co., 620 Chestnut St., St. Louis, Mo., at $8,945, for constructing the new substructure of the bridge. Bids were opened Mar. 15.

Butte, Mont.—Bridge.—Security Bridge Co., Minneapolis, Minn., for the construction of a steel bridge at lower Cottonwood. It will have a 50-ft. span with concrete approaches.

Cascade, Mont.—Bridge.—Midland Bridge Co., at $11,000, Kansas City, Mo., for repairing the Missouri river bridge at this city, and for moving the bridge over Muddy creek at Vaughn.

Oxford, N. C.—Bridge.—Roanoke Bridge Co. Inc., Roanoke, N. C., raising one 85 ft. span and erecting two 75 ft. spans at Blackwell's bridge, erecting one 108 ft. span and 92 ft. of,

approaches at Kimball's Mill. Bids were opened Mar. 7.

Belle Center, O.—Bridge.—Lewis Pickering, at $578, for the substructure of a bridge over Cherokee Man's Run in McArthur township; Bellefontaine Bridge Co., at $790, for the superstructure.

Voca, Tex.—Bridge.—Missouri Valley Bridge Co., St. Louis, Mo., at $9,900, for the construction of a bridge acros the San Saba near this town.

Colfax, Wash.—Bridges.—A. Valk, at $5,998 each, for the construction of three bridges, two in this city, the other in Pullman, each 116 ft. with tubular piers.

Everett, Wash.—Bridge.—American Pile Driving Co., at $51,924, for the construction of 280 ft. steel swing span, center and end piers, concrete drawing rist, 304 ft. pile trestle, 71 ft. steel trestle; all 20 ft. roadway, two 6-ft. sidewalks. Bids were opened March 14.

Snokomish, Wash.—Bridge.—American Pile Driving Co., Everett, at $51,924, for the erection of the new bridge at Snokomish.

ROADS AND STREETS.

Attalla, Ala.—Sidewalk, Curb and Gutter.—West Construction Co., Chattanooga, Tenn., at $8,924, for the construction of 5,200 sq. yds. of artificial stone sidewalk, and 8,000 lin. ft. of artificial combined curb and gutter. Hill & Campbell, Engrs., Gadsden, Ala. Bids were opened March 21.

Los Angeles, Cal.—Boulevard.—T. D. Doneghan Co., at $13,000, is reported to have received the contract for the construction of the harbor boulevard from South Main St., to Gardena, a distance of 20,000 ft. This contract does not include the furnishing of rock, as that is supplied by the county.

Lincoln, Ill.—Paving.—A. D. Thompson, Peoria, Ill., at $21,266, for the construction of pavement on Kickapoo St., from Broadway to Galena Sts., and at $7,229, for pavement on South McLean and Clinton Sts.

Danville, Ind.—Roads—George Miller, Lebanon, at $8,200, for the construction of the Hadley road; at $8,500, for the construction of the White road, and at $9,950, for the construction of the Reichard road. Walter Hadley, at $9,945, for the construction of the McClelland road.

Ames, Ia.—Paving.—William Horrabin, Iowa City, Ia., at $2.03 9-10 per yd., for the construction of 25,000 yds. of creosoted paving. The paving is to cover a half mile on Main St., and one block each way on intersections. Work is to be begun June 1 and is to be finished Nov. 1.

Creston, Ia.—Paving.—Hamilton & Schwartz, Shenandoah, Ia., at $1.68 per sq. yd. and $.34½ per ft. for curbing, for the construction of 25,000 sq. yds. of asphalt paving in this city.

Marion, Ia.—Curbing.—Concrete Construction Co., Cedar Rapids, at $.33 2/5, for the construction of curbing on the to-be brick paved streets and avenues in this city this year.

Sioux City, Ia.—Sidewalk.—Lewis & Leeder, for the construction of a sidewalk on the approaches to the new bridge over Perry creek at 17th and Geneva Sts.

Minneapolis, Minn.—Road.—James F. O'Neil, at $2,100, for surfacing the Mound road at Lake Minnetonka.

St. Paul, Minn.—Grading and Paving.—Following contracts were awarded by the county commissioners: J. J. Mergens, Excelsior, Minn., at $9,760, for grading Centerville Road from Manomin Road to Anoka county line; J. J. Mergens, at $14,680, for grading and macadamizing Lexington Ave., from Manomin Road to Turtle Lake Road; P. J. Ryan, St. Paul, Minn., at $12,800, for macadamizing Bald Eagle Lake Ave., from Smith's Hotel east to Bald Eagle Lake Ave.

Kansas City, Mo.—Roads.—Doboins & Wilson, at $13,750, for grading the Duck road, and at $6,772, for grading the Red Ridge road. The Duck road will be three miles in length and the Red Ridge road a little over two miles.

Kansas City, Mo.—Road.—Davidson Bros., at $1.65¾ per cu. yd., for resurfacing a portion of the road running from Dallas east to an intersection with the Holmes St. road, about two miles. The cost will approximately be $6,000.

Kansas City, Mo.—Grade and Drain.—Fern Bros., at $12,290, for grading and draining Holmes St., from 85th St. south to its intersection with the Kansas City and Martin City road, the distance being three and a fourth miles. Hood & Randall, at $5,471, to grade and drain Murphy road from the southwest corner of the city farm to Swope parkway and Raytown Blvd., the distance being two miles.

St. Joseph, Mo.—Grading.—Kelley & Buis, for grading Main St., from Poulin to Isabelle.

Corning, N. Y.—Paving.—J. R. Bradley, Corning, for the construction of about one and one-half miles of macadam pavement; J. R. Steele, Owego, N. Y., for the construction of about one and one-half miles of brick pavement.

Jamestown, N. Y.—Paving.—Warren Bros. Co., for the construction of 1,810 sq. yds. of bitulithic pavement in this city.

Oxford, N. C.—Road.—Emporia Concrete & Construction Co., Emporia, Va., for the construction of 20 miles of soil road. About 3,000 cu. yds. of excavation is required.

Cincinnati, O.—Road.—John Snyder, Norwood, O., at $10,463, for the improvement of Madison road from Cooper Ave., to Cornell Ave., in Sycamore Twp. Bids were opened Mar. 18.

Miami, Okla.—Paving.—Pardon S. Kaull, for the construction of 27,370 sq. yds. of bitulithic pavement in this city.

Portland, Ore.—Paving.—Warren Construction Co., for the construction of 20,306 sq. yds. of bitulithic pavement in this city.

Portland, Ore.—Paving.—Pacific Bridge Co., for the construction of 1,807 sq. yds. of bitulithic pavement in this city.

Fort Worth, Tex.—Paving.—Texas Bitulithic Co., for the construction of 17,500 sq. yds. of bitulithic pavement in this city.

Dallas, Tex.—Paving.—Texas Bitulithic Co., for paving May St., from Laurel to Terrell Ave., and Magnolia Ave., from South Main to Jennings Ave.

SEWERS AND WATER SUPPLY.

Tuscaloosa, Ala.—Sewer.—J. Whit Gurley & Co., Mobile, at $18,000, for the construction of a new sewer in this city.

Lodi, Cal.—Sewer System.—J. M. Appleton & Frederickson Bros., at $51,226, for the construction of the city sewer system. Gladding, McBean & Co., Lincoln, Cal., at $17,401, for furnishing all of the pipe. The contract is to be completed within 100 days.

Greeley, Colo.—Sewer.—Spicer & Wattson, Colorado Springs, Colo., at $18,659, for the construction of sewers in the city. Bids were opened Mar. 1.

Joliet, Ill.—Water Main & Sewer.—William Moran & Co., Joliet, Ill., for the construction of a water main on Meda Ave.; S. R. Spears, Joliet, for the construction of the Broadway St. sewer.

Burlington, Ia.—Sewer.—Bernard Bros. & Mercer, for repairing the Hawkeye sewer.

Davenport, Ia.—Sewers.—P. Connelly, at $.69, for the construction of a sewer in South St., between Davie and Division Sts. Hydraulic Concrete Construction Co., at $.93, for the construction of a sewer in Christie St., from Eddy to Fulton Ave., and Fulton Ave., from Christie to Jersey Ridge road.

George, Ia.—Waterworks System—Des Moines Bridge & Iron Co., at $10,400, for the construction of a waterworks system in this city, including 500 ft. of hose and a hose cart.

Sabetha, Kan.—Water Mains.—T. C. Brooks & Sons Co., Jackson, Mich., for the construction of 10 miles of water mains; The Western Valve Co., Kansas City, Mo., for hydrants and valves; Des Moines Bridge & Iron Co., Des Moines, Ia., for steel tower and tank; Mr. Stimpson, Sabetha, Kan., for the reinforced concrete reservoir.

Wakefield, Kan.—Waterworks.—Fred M. Clark, Savannah, Mo., at $15,000, for the construction of a water works in this city.

Mt. Sterling, Ky.—Sewer.—Paul & Kershner, Dayton, O., at about $50,000, for the construction of a sewer system in this city. The sewer will be 10 miles in length. The work is to be commenced by April.

Centralia, Mo.—Water & Sewer Systems.—Following contracts in connection with the water and sewer systems for this city were awarded: American Pipe Co., St. Louis, Mo., at $11,819, for furnishing the cast iron pipe necessary; Eureka Fire Hose Co., New York, N. Y., at $0.90 per ft. for furnishing 1,500 ft. of hose, including three 10 ft. fire nozzles and three reels; Des Moines, Ia., Iron & Bridge Co., at $4,500, for the 70,000 gal. water tank and the 125 ft. steel tower; Renswalter Co., Troy, N. Y., for furnishing hydrants of the Corey patent.

St. Joseph, Mo.—Sewers.—Board of public works awarded the following sewer contracts: Oscar Schmidt, for the construction of three sewers in districts 109, 94 and 112; E. F. Mignery, for a sewer in district 109; D. B. Kelley, in district 94.

Sedalia, Mo.—Sewers and Sewage Disposal Works.—William F. Hall, Clinton, Mo., at $38,624, for the installation of a complete sewage disposal works and sanitary sewers.

Albany, N. Y.—Sewers.—Following contracts have been awarded to John Doyle by the board of contract and supply: Sewer through the proposed sunken garden, $15,418; sewer in Manning Blvd., from Washington Ave. to Lancaster St. $971; sewer in Myrtle Ave., from Quail St. to Ontario St., $578; sewer in Putnam St., from Second Ave. to a point 500 ft. south, $496.

Monticello, N. Y.—Sewer System and Disposal Plant.—C. S. Lambie Co., Pittsburg, Pa., at $66,300 for the construction of the sewer system and $26,600 for the construction of the sewage disposal plant. Work will be commenced by April 1.

Dayton, O.—Sewer.—Hecker & Kerschner, at $6,801, for the construction of the Haynes St. storm sewer. The contract calls for a 36-in. concrete sewer with brick invert.

Clinton, Okla.—Sewer.—Heman Construction Co., St. Louis, Mo., at $17,838, for the construction of sewers in this city. Bids were opened Mar. 15.

Franklin, Tenn.—Extensions—Water & Sewer Systems—J. W. Worthington, of the Sheffield Cast Iron Pine & Foundry Co., at $35,000, for building the extension to the waterworks and sewerage systems. The work will be under the direction of Granberry Jackson, Mt. Pleasant.

Seattle, Wash.—Pipe Line.—Hans Pederson, for the pipe line extension between Harvard Ave., north and Lake Union and the new twin reservoirs at Green Lake. Steel pipe will be used and the line will be permanent, except across the lake, where it will rest temporarily on piles. Each reservoir will hold 50,000,000 gals.

EXCAVATION, MISCELLANEOUS, MATERIALS.

Phoenix, Ariz.—Pumping Engine.—Nordberg Mfg. Co., at $14,000, for furnishing the city with a 5,000,000 gallon capacity cross compound Corliss pumping engine. Bids were opened Mar. 14.

Laporte, Ind.—Building.—S. A. Lambert, for the construction of a new store building, corner of Main and Clay Sts., for F. H. Morrison. The structure will be of steel, brick and concrete construction throughout, and cost between $10,000 and $12,000. The building is to be completed before June 1.

Laporte, Ind. — Buildings. — Central States Bridge Co., Indianapolis, Ind., for the construction of two manufacturing buildings for the M. Rumely Co. The cost of the two buildings will be about $100,000. Both will be steel construction, with reinforced concrete.

Moscow, Ind.—Church.—Joe Bennett, at $3,182, for the erection of the new Christian church in this city.

Cherokee, Kan.—Boiler.—Pittsburg Boiler Works, for furnishing a boiler for the waterworks pumping plant.

Portland, Me.—Mooring Stones.—William S. White, Rockland, Me., at $756, is reported to have received the contract for furnishing mooring stones for use in the first lighthouse district for the fiscal year. Bids were opened Mar. 16.

Boston, Mass.—Oiling & Cleaning.—Following contracts were awarded by Supt. Emerson of the Street Department for street cleaning oiling and watering: John H. Winsloe, at $10,979, for street cleaning in Dorchester and Ashmont; F. B. McKinney, at $5,990, for street cleaning in Brighton; Joseph McGreevey, at $8,490, in West Roxbury; For oiling and watering, Thomas F. Lynch, at $5.18 per day for each double team, in South Boston and Dorchester north; J. P. O'Rioden, at $5.40, in East Boston and Charleston; J. H. McCarthy, at $5.25, in Brighton; M. McGinniss & Co., at $5, West Roxbury; John H. Winsloe, $4.94. Dorchester and Ashmont; James E. Noble, at $5.15, Roxbury south and Jamaica Plain; Joseph McGreevey, at $5, South End and Roxbury north; W. Gilligan Co., at $5.25, North End, West End and Back Bay.

Lowell, Mass.—Warehouse.—Albethaw Construction Co., Boston, Mass., for the construction of the new reinforced concrete warehouse of the Massachusetts Cotton Mills Co., this city. The dimensions are 100 ft. x 256 ft., 12 stories. Work is to begin at once. Architects, Lockwood, Greene & Co., Boston, Mass.

Kansas City, Mo.—Powder, Tools, Etc.—Mize Hardware Co., Independence, by the county court, for supplying powder and tools; Smith Mercantile Co., of this city, for supplying the graders and scrapers.

Addison, N. Y.—Lights.—Electric Light, Co., at $75 an arc light a year, for lighting the streets of the city with electricity.

New York City, N. Y.—Gate Valves.—Coffin Valve Co., Boston, Mass., for board of water supply, contract No. 42, for furnishing and delivering eight 3-ft. by 8-ft. two-sluice gates, eight 20-in. hand operated gate valves, ten 60-in. gate valves, with operating mechanisms, four 60-in. gate valves with individual electric drive, four 60-in. gate valves with gang drive, two 60-in. hydraulic lines of floor drive shafting, for structures at Ashokan reservoir, near Brown's Station, Ulster County, and at Croton Lake siphon, Westchester County, New York. Bids were opened March 8.

Fort Reno, Okla.—Tank, Tower—Des Moines Bridge Co., Des Moines, Ia., at $6,500, for the construction of the tank and tower. Bids were opened Mar. 14.

Cleveland, O.—Refrigerating Machinery.—Following bids were received for the installation of complete refrigerating machinery for drinking water system: Brunswick Machinery Co., $5,485; The Phoenix Ice Machine Co., Cleveland, 7,500; The Peerless Ice Machine Co., Cleveland, $8,413. Bids were opened March 23.

Cleveland, O.—Vacuum Cleaning System.—Following bids were received for the installation of a complete vacuum cleaning system for the Cuyahoga Court House: Connersville Blower Co., Connersville, Ind., $3,160; The Blaisdell Machinery Co., $3,350; Vacuum Engineering Co., $3,810; S. K. Elliott Electric Co., Cleveland, $3,900; The Vacuum Cleaner Co., $4,500. Bids were opened March 23.

Forest Grove, Ore.—Supplies.—Portland Wood Pipe Co., Portland, Ore., for furnishing 27,000 ft. of distributing mains, 40 Corey hydrants, cast iron fittings, etc., for this city.

Knoxville, Tenn.—Building.—Claiborne & Brooks, for the erection of the "Cherokee" building, a three-story and basement office building to be constructed at the corner of Church Ave., and Prince St., for Drs. S. R. Miller and G. O. Bicknell, from plans drawn by Gredig & Lynn, architects. The building will cost about $12,000.

Mexia, Tex.—School House.—Charlev Fuqua, for the construction of a new brick school house at this place.

Lemay, Utah.—Pipe.—Portland Wood Pipe Co., Portland, Ore., by the Southern Pacific Railway Co., for furnishing 29 miles of 8 and 6-in. pipe for head pressure varying from 150 ft. to 300 ft. head. This pipe is to be used in one line near this city, on the west side of Salt Lake,

and is to furnish water for tank and domestic service.

Salt Lake City, Utah.—Heating and Electric Plant.—Trent Engineering and Manufacturing Co., for the erection of the heating and electric plant for the Mormon church in the center of the block west of Temple square. The plant will cost between $150,000 and $200,000. Heat and electric power will be furnished by this plant for the Tabernacle, the Temple, the Assembly Hall, the new Utah Hotel, the Deseret News Building L. S. University, the new Vermont Building and the Sharon Building.

Milwaukee, Wis. — Water Pipe. — Michael O'Donnell, for furnishing the city for the use of the water department 500 tons of 20-in., 360 tons of 30-in. and 2,000 tons of 36-in. class "C" cast iron pipe, and 50 tons of class "C" special castings, at the following prices for laying: 4-in., $0.34 per lin. ft.; 6-in., $0.32 per lin. ft.; 8-in., $0.37 per lin. ft.; 12-in., $0.53 per lin. ft., and 16-in., $0.68 per lin. ft.

Milwaukee, Wis.—Water Gate Valves.—B. Hoffman Manufacturing Co., of this city, for furnishing and delivering to the city 300 6-in. gates, 50 8-in. gates, 30 12-in. gates, 15 16-in. gates at $15.50, $25, $40.95 and $73.75, respectively.

Calgary, Alta.—Building.—Carter, Halls Aldinger Co., at $125,000, for the construction of a 6-story business block in this city for Leeson & Lineham. It will be of cement and concrete construction.

PROJECTED WORK.

Bridges.

Items Arranged Alphabetically by States.

Van Buren, Ark.—A corps of Kansas City, Mo., engineers are sounding the river at this city preparatory to selecting a site for the proposed free bridge.

San Diego, Cal.—Engineers are preparing plans for the construction of an artistic trestle across the canyon at the entrance of Kensington Park, a new residence subdivision of San Diego.

San Rafael, Cal.—County Commissioners have rejected all bids for the construction of the Belvedere-Tiburon Bridge on account of their being too high. County Surveyor is to prepare new plans and specifications.

Hartford, Conn.—Board of Finance recommended that the City Council pass a resolution authorizing the Board of Street Commissioners to reconstruct the Farmington Ave. bridge and that an appropriation of $18,000 be made for the purpose.

Des Moines, Ia.—Engineering preparations for the West Seventh St. viaduct are progressing rapidly and it is expected by C. H. Cartlidge, Bridge Engineer, Chicago, Burlington & Quincy R. R., Chicago, Ill., that bids for a portion of the work will be advertised within 30 days.

Sioux City, Ia.—Street Committee is to take up the matter of constructing a bridge over Bacon Creek in the vicinity of Glass Ave., in accordance with the petition which was recently filed by the property owners.

Lewiston, Ill.—The Bridge Committee appointed by the County Board has decided upon the construction of a bridge in Bernadotte township.

Lincoln, Ill.—Arrangements are being made for the construction of a $7,000 bridge across Salt Creek on the new road going through Corwin township. Gus Knecht, Beason, Ill., and Adrew Eisiminger, Latham, Ill., are members of the supervisors' committee.

Rock Island, Ill.—Representatives of Henry and Rock Island Counties have decided to construct a bridge over the Rock River at Coloma, Ill. The structure as proposed is estimated to cost $50,000.

Fort Wayne, Ind.—County Commissioners have voted to build a new bridge across the St. Joe river connecting Lakeside and Sy Run Ave. district at the east end of Wagner St.

Richmond, Ind.—A petition has been circulated through Milton Township asking the County Commissioners to construct a bridge across Noland's Fork in the eastern section of this township.

Hiawatha, Kan.—County Commissioners have taken up the matter of constructing a new 110-ft. bridge across the Wolf River east of town to replace the present 60-ft. Dickinson bridge.

Louisville, Ky.—Hearing is to be held April 6, by United States War Department at Cincinnati, O., on the application of the Kentucky & Indiana Bridge and Railroad Co. to construct a bridge across the Ohio River between Louisville and New Albany, Ind. Plans for the structure have already been prepared by J. M. Johnson, President of the Louisville Bridge and Iron Co.

Worcester, Mass.—Directors of the Worcester & Providence R. R. have filed a petition with W. H. Towne, City Clerk, for permission to enlarge the bridge over South Bridge St.

Greenville, Mich.—The Pere Marquette R. R. Co., it is said, is planning the construction of a new bridge over the Flat river at this place. The structure will consist of two 50-ft. spans on concrete abutments.

Anthony, Minn.—Town Board has decided to construct a bridge across the Marsh River between Mrs. E. T. Saen's and Bjerland places.

Philipsburg, Mont.—Arrangements have been completed for the rebuilding of the county bridge across the Deer Lodge River at Drummond.

Polson, Mont.—Citizens have raised $3,000 toward the construction of the bridge across Pend'Oreille River opposite this place. The proposed structure will be 1,744 ft. in length.

Columbus, Neb.—The new bridge at Duncan was partly destroyed by an ice gorge recently and will be repaired at an estimated cost of $2,000.

Winnemucca, Nev.—Plans and specifications for the construction of the new county bridge over the Humboldt River at this place have been accepted by the County Commissioners and bids for the work will be advertised soon.

Fenton, N. Y.—Special elections will be held in this town and Chenango April 12, for the purpose of deciding whether the towns shall bond for the construction of a new highway bridge at Chenango Bridge.

Vernon, N. Y.—Council voted to expend $1,000 for the construction of foot bridges over Sconondoa Creek and Bartholomew's dike.

Fremont, Neb.—Commissioners of Dodge and Saunders Counties have decided to construct a new steel bridge over the Platte River south of this city. The steel structure will be 650 ft. in length.

Cincinnati, O.—F. E. Morris, Bridge Engineer, submitted plans and specifications to Director Sundmaker for the approval of the council. The plans call for the construction of three bridges. One to cross Burbank St. and the Cincinnati, Lebanon & Northern R. R. tracks, estimated to cost $14,850; another over the West fork of Mill creek, to cost $6,177, and the third over the Cincinnati, Lebanon & Northern tracks at Whittier St. to cost $7,075.

Cleveland, O.—City Council has referred a resolution authorizing a special election on the question of issuing $1,000,000 of bonds for the construction of a high level bridge connecting Clark Ave., S. E., and Clark Ave., S. W., to committee.

Cleveland, O.—According to reports the Erie R. R. is planning the construction of a double track lift bridge at this place.

Covington, O.—County and City are to take up the matter of repairing the bridge over the Banklick Creek.

Lisbon, O.—County Engineer French and J. Q. Rothany, Engineer, East Liverpool Traction & Light Co., have taken up the matter of repairing the bridge recently washed out.

Niles, O.—County Commissioners and Engineer Watson, Cleveland, O., have viewed the proposed site for the viaduct connecting Park Ave. extension with the city.

Portsmouth, O.—Citizens of Arion, O., have presented a resolution to the County Commissioners asking for the construction of a bridge at Arion, O.

Springfield, O.—As soon as plans are completed for the construction of the High St. bridge, the officials of the Cleveland, Cincinnati, Chicago & St. Louis R. R. will take up the matter with the City Council.

Basin, Wyo.—County Commissioners have ordered the construction of two new bridges, one over the mouth of the Pat O'Hara creek and the other at Meeteetse over the Greybull.

Brockville, Que.—City has voted to issue bonds amounting to $16,000 for the construction of six bridges throughout the town.

Roads and Streets.

Items Arranged Alphabetically by States.

Gadsden, Ala.—Property owners on Third St., have asked that that thoroughfare be paved with brick from Chestnut to Locust.

Gadsden, Ala.—Petition is being circulated among the property owners of South Fifth St., for the paving of that thoroughfare from Chestnut to Cherry.

Little Rock, Ark.—Superintendent of Public Works, E. A. Kingsley, has recommended the following improvements: That Scott St., from Third to 15th, be covered with asphalt at an estimated cost of $20,962; that Rock St., from the Iron Mountain railroad to Third St., be paved with brick at an estimated cost of $7,700, and Rock St., from Fifth to 15th Sts., be covered with asphalt at an estimated cost of $25,000.

Auburn, Cal.—Petition has been granted for the construction of a new road running from the Carl place on the Lincoln and Penryn road up Dutch Ravine to Newcastle.

Bakersfield, Cal.—Property owners on F St., between 19th St., and the Santa Fe depot are contemplating the paving of that portion of the thoroughfare.

Benica, Cal.—City has voted the issuance of $100,000 worth of street improvement bonds.

Sacramento, Cal.—Riverside road, from Sutterville to the brick yards is to be macadamized. Residents of the Upper Stockton road have asked the Board of Supervisors to asphalt 24 ft. of the road from 31st and P Sts., to the State Fair grounds at an estimated cost of $21,000.

San Rafael, Cal.—Supervisor Michael F. Burke will spend $120,000 for the improvement of highways in Marin county

Los Angeles, Cal.—Board of Supervisors have adopted specifications for the construction of the Whittier road from the city limits of this city to East Whittier, a distance of 10¾ miles. Bids are to be asked for at once.

Boulder, Colo.—Boulder Boosters' Club is back of a movement to build a scenic auto road from this city to Estes park.

Belleville, Ill.—Survey and the estimated cost of building the Belleville and Mascoutah road through Silver Creek bottom is being made by Asst. State Engineer T. R. Agg, of Springfield.

Benton, Ill.—Plans have been made for the construction of 36,200 sq. yds. of vitrified brick pavement on a Portland cement foundation. The work will include 21,650 lin. ft. of sandstone curb, concrete filler and 16,200 cu. yds. of excavation. The estimated cost of the work is $82,287. L. L. Harper, Belleville, Ill., is the engineer. A. S. Cleveland, Chairman Improvement Committee, has charge of the work.

Silvis, Ill.—This village is contemplating extensive paving improvements this coming summer.

Waukegan, Ill.—Improvement Board has passed a resolution for the paving of McAlister Ave. The improvement is estimated to cost $40,000.

Fairmount, Ind.—County Commissioners have been petitioned for the improvement of a highway in Fairmount township, Grant County, by grading, draining and paving with gravel or macadam.

Franklin, Ind.—County Commissioners have been petitioned for the improvement of the Murphy gravel road, in Hensley township, Johnson County, by grading, draining and paving with gravel.

Lafayette, Ind.—Plans are being formulated for an improvement of the riverside drive from this city to the State Soldiers' Home and the Tippecanoe battlefield. The plans contemplate a widening and macadamizing of the roadway for a distance of eight miles. The estimated cost is $50,000.

Logansport, Ind.—Plans and specifications are being prepared by City Engineer Harry Thompson for the construction of brick pavement on Sycamore St., from the north line of the Vandalia railroad right-of-way to the south line of Center St. Petition will probably be filed soon for the paving of the street north of Center St.

Muncie, Ind.—Board of works has granted permission to the county commissioners to pave with brick East Wysor and Broadway Sts.

Peru, Ind.—Petition will be presented to the Board of Commissioners of Miami County by residents of Washington township on April 5 for the construction of a three-mile gravel, macadam or other material road in that township.

Corydon, Ia.—A rock road will probably be built between Corydon and Bridgeport. Farmers are securing the necessary amount for the work.

Fort Dodge, Ia.—City Council has declared it necessary to pave the following streets with asphalt: Second Ave., south from 15th St. to west line of 17th St.; Third Ave., south from 15th St. to west line of 17th St.; Fourth Ave., south from 15th St. to west line of 17th St.

Oskaloosa, Ia.—A movement is on foot for the construction of a dragged road from Burlington through Fairfield, Ottumwa, Oskaloosa and Pella to Des Moines. The auto club of this city, Otis Nugent, President, is interested.

Manhattan, Kan.—Highway Engineer Gearhart has submitted plans for grading and dragging the Central Kansas-Colorado Blvd. This boulevard will parallel the new Santa Fe trail.

Colfax, La.—Petitions are being circulated throughout Grant Parish asking the Police Jury to grant an election for the purpose of voting on a 5-mill road tax for five years for the good road building in Grant.

Annapolis, Md.—A bill has been introduced in the House authorizing the county commissioners of Queen Anne's to issue $15,000 of bonds for the purchase of teams, carts, wagons and necessary machinery and implements for the construction of roads.

Kansas City, Mo.—Following resolutions for public work were sent to the Board of Public Works for adoption: Grading—Hardesty, from Fifteenth to Twenty-third; Walnut, from Fifty-ninth to Fifty-first; Denver, from Hughes to Seventeenth. Asphalt pavement — Fifty-fifth from Harrison to Troost. Brick block pavement —Twelfth, from Cleveland to Jackson; Twelfth, from Elmwood to Manchester. Artificial stone curbing—Twelfth, from Cleveland to Jackson; Twelfth, from Elmwood to Manchester. Artificial stone sidewalk—Prospect Avenue, from Thirty-ninth to Swope Parkway; Topping, from Twelfth to Fifteenth; Charlotte, from Twenty-fifth to Twenty-sixth; West Prospect Place, from Forty-fourth to Forty-fifth; Forty-fifth, from W. Prospect Place to Madison Avenue; Twenty-fifth, from Woodland to Michigan Avenue.

Kalispell, Mont.—County Surveyor has been instructed to survey and establish a wagon road from Bigfork to the reservation line on the east side of Flathead lake to connect with the road as surveyed from the town of Polson north to said reservation line.

Hastings, Neb.—Petitions have been circulated for the paving of Hastings and St. Joe Aves.

Hastings, Neb.—Petition has been submitted to the city council for the extension of Second St. pavement from Burlington Ave., to the west side of Briggs Ave.

London, O.—J. J. Shafer, auditor of Madison County, will sell bonds April 4, in the sum of $42,800 for ditch and road improvement.

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CHAS. S. HILL
C. T. MURRAY
F. A. SMITH } EDITORS
MYRON C. CLARK . . . PUBLISHER
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CONTENTS.

EDITORIAL:
A Noteworthy Article . . . 303
The Growing Confidence in Water Sterilization . . . 303
Some Records and Costs of Operation of the Cincinnati Filter Plant for Six Months of 1909 . . . 303

CONCRETE SECTION:
Concrete Building Construction of Separately Molded Members and Its Cost . . . 304

EARTH AND ROCK SECTION:
Method and Cost of Making a 16,000-cu. yd. Blast on the Pecos & Northern Texas Ry. . . . 307
Method and Cost of Cleaning 30,000 cu. yds. of Sediment from a Water-Works Reservoir . . . 307

ROADS AND STREETS SECTION:
Average Unit Prices and Some Details of Pavements Constructed in 1909 in a Number of Representative American Cities . . . .

WATER-WORKS AND SEWER SECTION:
The Groined Arch in Filter and Covered Reservoir Construction . . . 311

GENERAL SECTION:
First Cost of Plant and Cost of Generating and Distributing Electricity for Lighting, Edison Electric Illuminating Co. of Brooklyn . . . 319
Current Prices of Materials, Supplies and Small Tools Used in Construction Work . . 220

COMING TECHNICAL MEETINGS . . . 226
CATALOGS WORTH HAVING . . . 226

A Price Reference Number of Engineering-Contracting.

We have collected for this issue of ENGINEERING-CONTRACTING a large number of data on prices of materials, small tools and supplies used in construction work and many additional data on wages and prices of pavement and street work. Prices are variable things and in many cases the figures that we give will have changed in a few days or weeks, but for the most part they will not vary so much as to cease to be useful for rough estimating for some time. No contractor will make close estimates without actual quotations. The prices that we publish are not intended to or expected to nor should they be used to replace such quotations in making bids, but they are useful for general estimating purposes. They have been compiled with care and we trust that trial will prove their usefulness to our readers.

A Noteworthy Article.

A good many articles have been printed on the cost of producing electricity, although many of these have been estimated costs rather than records of actual performance. No article, so far as we know, has ever given the unit cost of producing and distributing electricity for lighting with any such completeness and detail as will be found elsewhere in this issue. We refer to our analysis of the first cost of the plant of the Edison Electric Illuminating Co., of Brooklyn, and of its operating expenses.

Of course most of the items of expense there given are higher in Brooklyn than they would be in cities of less size, for it is a curious anamoly that the larger the city the greater the unit costs of electric lighting are apt to be, excepting the items of fuel and general supervision. Even the use of mechanical stokers and other labor saving devices do not offset the higher wages paid to employees in large cities. But, more important than wages are the items of plant charges—interest, repairs and depreciation. High costs of real estate and buildings in a large city are to be expected, but one is apt to overlook the fact that the cost of pole lines and conduits is also sure to be much greater than in small cities. The transmission lines of this Brooklyn Edison Co. alone cost $175 per K. W.; yet the company rents a large amount of duct miles (at least 117 miles).

The interesting fact is brought out that 32½ per cent of the electricity produced is lost in transmission. This is slightly in excess of similar losses on Manhattan, which average 30 per cent. Here, again, is an item that has seldom been mentioned in any article on the subject of electric lighting.

The exceedingly low cost of repairs of electric generators is worthy of special attention. The first cost of the steam plant (boilers and engines) was very slightly more than the first cost of the electric generating plant, yet the cost of repairs of the steam plant was 17 times the cost of repairs of the electric generating plant. This ratio of 17 to 1 is, of course, unusual; still, as we shall show in a subsequent issue, a ratio of 4 to 1 existed in the power plant of the Interborough Rapid Transit Co. during the same year. Engineers have unquestionably overestimated the annual cost of repairs of electric generators, just as, in most instances, they have underestimated the repair costs of steam plants. We may add, however, that the whole subject of the cost of repairs to machinery is one that has never received in the technical press even a modicum of the consideration it deserves.

Henceforth it will be our object to secure and publish data on operation and maintenance of machines of all kinds, so that, in the course of time, we may parallel what we have already accomplished in publishing construction cost data. With this end in view, we urge our readers to contribute facts relating to the cost of repairs of machines and plants.

The Growing of Confidence in Wate Sterilization.

In discussing the filtration of water supplies the *Surveyor* (London) says:

It is obvious that well waters free from suspended matter and other waters of similar quality are often bacterially impure, and therefore require sterilization without filtration, the filtration in such cases being practically useless. We have often urged in these pages the importance of removing the matters in suspension from waters, and even from sewage effluents, before applying the sterilizing agent which otherwise is wasted in dealing with the organic matter. There can be no question as to the relative values of filtration and sterilization. There is no comparison. One might as well compare the relative values of pumping and filtration. Matters in suspension must be removed by sedimentation or filtration and cannot be removed by sterilization; to suggest such a process is absurd, but, on the other hand, if the filters are used for their legitimate purpose, viz., for the removal of suspended matters and not for the removal of bacteria—their rate of working may be greatly increased and the bacterial purification can then be best effected by sterilization.

The above shows the extent to which the idea of water sterilization has grown. Two years ago considerable opposition was met with when proposals were seriously made to sterilize water used for drinking and domestic purposes generally.

Professor W. P. Mason at the Milwaukee meeting in 1909 of the American Water Works Association stated that at first he was opposed to the use of bleaching powder as a disinfectant and had gone on record as not approving of the process. Now, however, he is a convert and was converted because of the results of many experiments. He found that the dose was exceedingly small that was required to produce satisfactory treatment. He believes that the consumers do not get any liberated chlorine, but that if they do the amount would be so small that it would not make much difference. He found that three-one hundredths of a grain of bleaching powder per U. S. gallon, measured as available chlorine, was sufficient to do good work and reduce the number of bacteria from a high figure to nearly zero. Water containing about 100,000 per c. c. was used and after the treatment the count was reduced to four, five, six and ten. Intestinal organisms were simply wiped out. The increasing popularity of disinfection will result in an increased use of filters. The many claims for bacteriological efficiency of filters and frequent failures to meet requirements deter many cities from attempting to improve water supplies. The use of filters, however, to reduce turbidity, hardness and alkalinity with disinfection for bacteriological effect in time of epidemic seems logical to even the most dull witted official.

The rate of flow may be considerably increased through filter beds under such arrangement, present rates being influenced largely by bacterial conditions. Cases have been reported, however, in which sterilized water has been badly affected by algae. Copper sulphate is a good algicide, but has not been proven an efficient or safe germicide. It may be necessary to use bleaching powder in combination with copper sulphate and chemists have a pleasant prospect in the water question. Something new is being learned each day and one difficulty is overcome as another is manifested.

Some Records and Costs of Operation of the Cincinnati Filtration Plant for Six Months of 1909.

The following operating data cover six months, Jan. 1 to June 30, 1909, of operation of the new filtration plant at Cincinnati, O., the costs of construction of which were summarized in our issue of March 30, 1909. During this six months' period the average amount of water filtered daily was 41,258,440 gals., using an average of 0.9 gr. of lime and 1.95 grs. sulphate of iron per gallon, or, stated in other terms, 2.06 ozs. lime and 4.46 ozs. sulphate of iron per 1,000 gals. The average cost of chemicals used was $1.99 per million gallons of filtered water. The total cost of coagulating and filtering the water was $4.62 per million gallons delivered to consumers, which includes the cost of operation, light, power, chemicals, fuel, maintenance, repairs, wash water and all supplies. The items of cost are as follows:

Item.	Total.
Labor	$11,959
714.9 tons coal	1,701
484.9 tons lime	3,181
1,047.8 tons sulphate of iron	11,190
Supplies	1,472
Electric power and light	2,442
Repairs	695
Express and freight	124
Insurance, tel. and transp.	65
188,967,348 gals. wash water	620
52,103,360 gals. water used and lost	171
Total	$33,620

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Concrete and Reinforced Concrete Section

Note: This section is devoted to methods and cost of constructing concrete and reinforced concrete structures. It will cover the selection, testing and proportioning of concrete materials; laboratory tests of concrete; concrete mixing, transportation and placing; fabrication and placing of reinforcement, and form construction and erection. It will also contain articles on new and interesting developments in the design of reinforced concrete.

Concrete Building Construction of Separately Molded Members and Its Cost.*

The more prominent examples of buildings constructed entirely of unit concrete members are the Textile Machine Works, at Reading, Pa.; the new building of the Edison Portland Cement Co., at New Village, and the car barns of the Central Pennsylvania Traction Co. In addition to these the author has designed and supervised the erection of several such buildings during the past summer, one of which is particularly interesting as regards comparative cost, since it illustrates the possibility of the system applied to the higher type of buildings, using the reinforced steel design with unit factory made floor members.

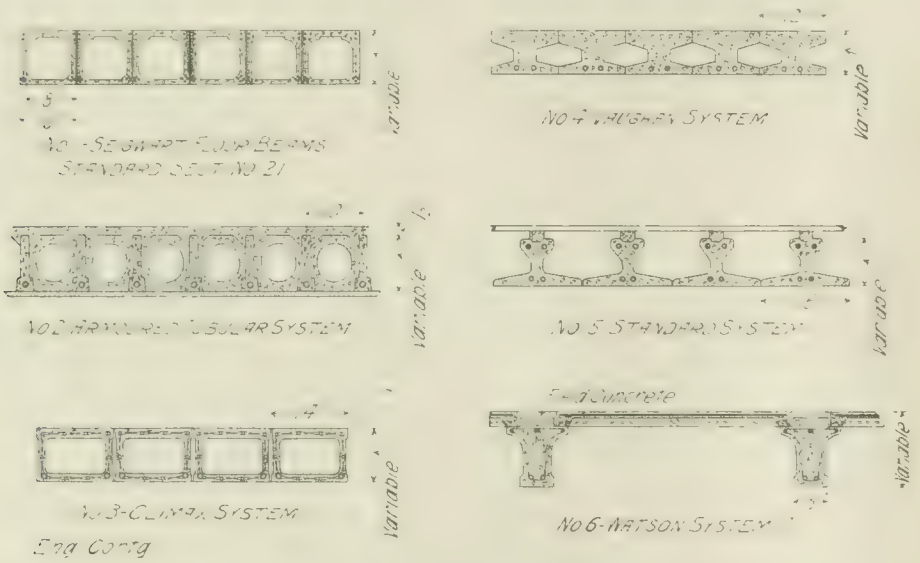

Fig. 1.—Various Systems of Separately Molded Reinforced Concrete Beam Construction.

The building of the Textile Machine Works was built by what is known as the Visitini System and was designed, and its erection by day labor supervised by the Concrete Steel Co. of New York. This building is described in detail in the excellent work written by Sanford E. Thompson, and published by the Atlas Portland Cement Co., entitled "Reinforced Concrete Factory Construction," from which the following brief description is taken. The cost of the concrete frame and floors, exclusive of curtain walls and finish, was found to be about 80 cts. per sq. ft. of floor area, not including cost of engineering and general expense. While this price would not be considered particularly low for concrete construction, the design of the members is such that they are rather expensive to fabricate; in fact 25 per cent of this cost was for forms, and carpenter work setting them up. For this reason this building did not give a proper comparison of the cost of the two methods. On the other hand, the buildings of the Edison Portland cement Co. (Engineering-Contracting, Oct. 2, 1907, and March 18, 1908), constructed by the unit system, showed an abnormally low cost. It will be remembered that this structure was a single story mill building, 144x360 ft., with 32-ft. columns, 24-in. girders and 12-ft. roof slabs, all made in the field, and the concrete members were made and erected for $6.60 per cu. yd. On account of special facilities for erection and handling, such tracks and locomotive cranes, and owing to the fact that raw materials were especially cheap (cement was taken at $1.00 per bbl., crushed stone 60 cts. per yd.), the unit cost per yd. for this structure is doubtless less than it would ordinarily be for such work, but even with the proper charges for plant rental and depreciation, and the usual cost of materials, and other fixed charges that any contractor doing similar work without special facilities would have, it would seem to indicate that $8 per cu. yd. for concrete in place would surely have covered the cost under average conditions. Cost of monolithic structures similar to this indicate plainly that the building could not be constructed by that method for anything like this price.

The car barns of the Central Pennsylvania Traction Co., designed and constructed during the previous summer under the supervision of Mason D. Pratt, City and Consulting Engineer of Harrisburg, Pa., is of exceptional value for the comparison of cost of these two particular types of construction, since four years previous an identical building was constructed by the monolithic system. (A full description of this structure with costs from information furnished by Mr. Pratt, was published in Engineering-Contracting of Jan. 19, 1910, and Mr. Watson's brief description is omitted.—Editors.) Mr. Pratt found that the cost of the monolithic building was 15 per cent greater than for the building constructed of separate units, the cost per cubic yard being about $9.25 for the unit building.

The author during the previous summer designed and supervised the erection of a unit concrete frame for a building which was somewhat similar to the above, in which he found the cost per cubic yard to be $20.40 erected. The difference in cost is doubtless due to the fact that the volume of concrete in the work was much smaller, and that the design was more complicated. The structural frame of this building consisted of columns, roof and crane girders, for a building 250 ft. long by 45 ft. wide, columns spaced 18 ft. centers. On account of the unusual poor foundations, it was necessary to design this frame as an articulate skeleton to prevent the settlement from causing damage. It seemed best for this reason to make the frame of structural steel, or separately moulded concrete members, as the cracking of the monolithic members from settlement might have proved serious. Bids were taken on a steel frame designed using Bethlehem beams for roof supports and columns. The actual cost of the frame erected in concrete was found to be almost identical to the lowest bid for structural steel frame, but the latter would not have been fireproof. The connections of the members in this structure were designed much like timber connections, i. e., by bolting together.

The notable feature of this work is the size of the roof girders. These were designed with the expectation that the building would be constructed with a concrete roof, but it was finally decided to put on a temporary timber roof. All girders are 43 ft. over all with clear span of 40 ft., weighing about 6 tons. They were paneled to reduce weight, and make a more economical section. All members were made in wooden forms, and for the reason that the amount of material was comparatively small the concrete was all mixed and placed by hand. The building, like the Harrisburg

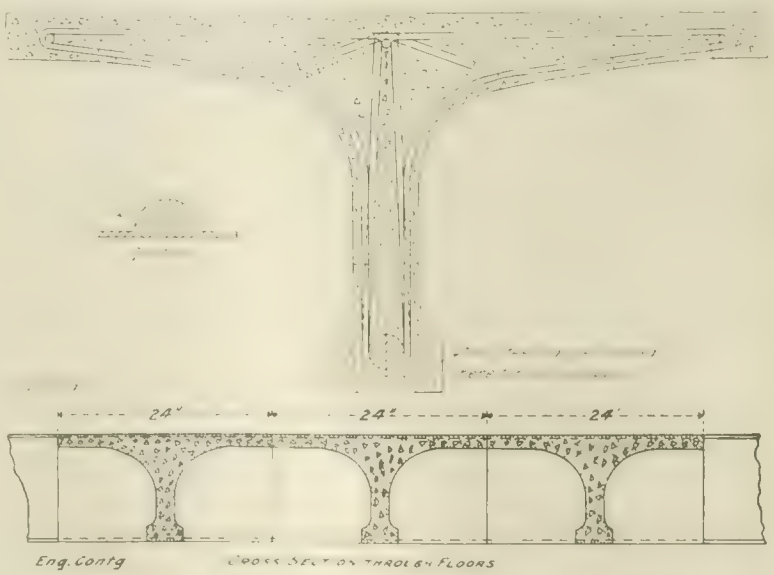

Fig. 2.—Details of Watson Separately Molded Beam and Sketch Showing Method of Assembling.

car barns, was erected with an ordinary stiff leg derrick. Table I shows the detailed cost and comparison with the cost of steel frame.

The most extensive use of separately moulded members has been in fireproof floor construction, where the members are made to take the place of terra cotta, or concrete fireproofing, and are usually manufactured in an established factory, where all the economies of manufacturing can be had. Such members are usually made in as large units as are convenient to handle in the field, and all of comparatively long spans. The beam is designed, and the concrete moulded in the most economical shape to give maximum strength with the minimum material. There are several types of such floor construction now on the market in Europe and America; the more prominent of which are illustrated by Fig. 1.

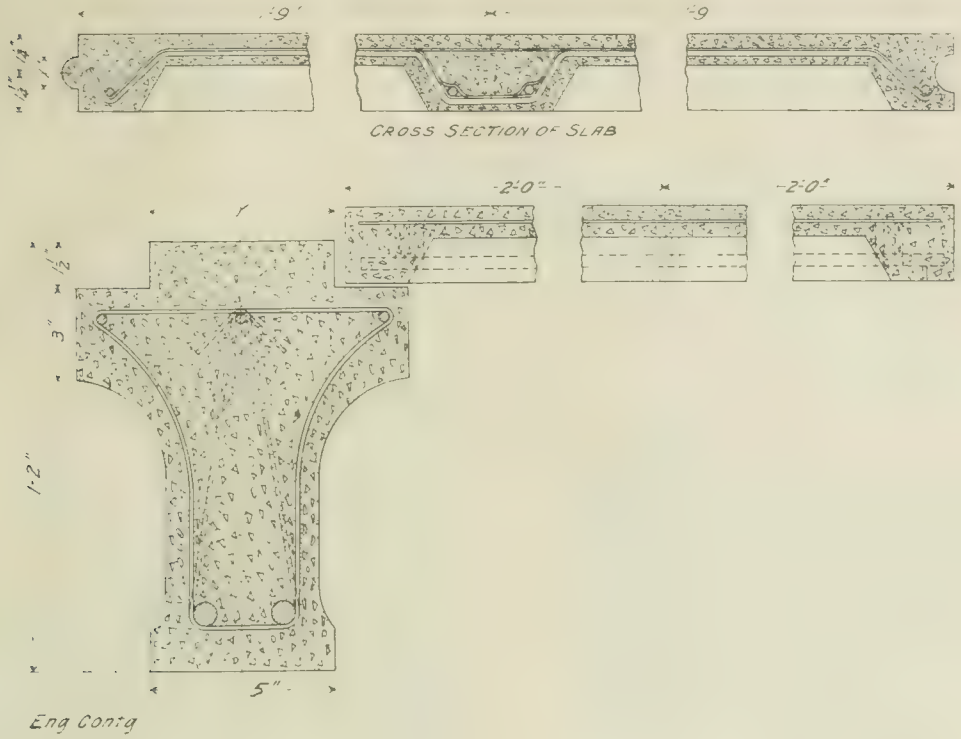

Fig. 3.—Details of Watson Combined Slab and Beam Construction of Separately Molded Members.

The first is what is known as the Seigwart System, designed by Hans Seigwart, an architect of Luzerne. Mr. Seigwart claims that there are over 50 factories throughout Europe making this type of floor, and that the Luzerne factory are manufacturing over a million feet per year. The only factory in Americ where these beams are made, known by the writer, is located at Montreal, Quebec; the company being comparatively new. The second system is what is known as the Armoured Tubular and is used extensively in England. The third, which is known as the Climax System, designed by S. M. Randolph, Chicago architect, and marketed by the Climax Co. of that city. The fourth, which is known as the Standard System, designed by and marketed by C. F. Buente, Pittsburg, Pa. The fifth, which is known as the Vaughan System, is marketed by the Vaughan Co. of Detroit, Mich. The sixth is a system designed by the author, and used by the Onondaga Litholite Co., Syracuse, N. Y., in some buildings recently constructed in that city.

Figure 2 shows the details and sections of the types of floors designed by the author for several buildings recently constructed by the Onondaga Litholite Co., Syracuse, N. Y. For long span and heavy loads, the T-sections are used, laid side by side. The width of the flange depending upon the space that beams are to fill, the load and span. For roofs and all floors having span less 20 ft. and loaded less than 200 lbs. per sq. ft., the combination of a slab and T-beam is used, the beams being spaced about 4 ft. centers, as shown by Fig. 3. The slabs are then laid between the beams and grouted at the joints. This particular design has worked out very satisfactorily and economically in actual construction, as it allows of great variation of design, and diversity of finish. Suspended ceilings are easily attached if desired, but the members themselves look very nice properly pointed and given a cement wash. This floor illustrates admirably the economy of weight of such construction; the beams were 22 ft. long, having about 19 ft. clear span, spaced 4 ft. 6 ins., C. to C., the floor carrying a load of 150 lbs. per sq. ft. and has been tested to 600 lbs. The total dead weight of this floor is but 37 lbs. per sq. ft., and the weight of the steel 2¾ lbs. per sq. ft., If the amount of concrete were reduced to slab form it would be less than 3 ins. thick. It is doubtful if any designer would attempt to build a flat slab of this length to sustain the same load with less than twice this thickness with the same amount of reinforcement.

Table II shows the comparison of dead loads and weights of steel per square foot of various floor systems now most extensively used, with a floor similar to the one just described. The comparison is made for the same span and load using the same values for the strength of steel and concrete.

Without taking time to give itemized cost of such floors actually constructed the writer would say that he has found it to vary from 15 to 30 cts. per sq. ft. erected, depending upon the various conditions of load, span and delivery. The average cost of steel fabricated is a little less than 2½ cts. per lb. in place, based on the present market value, showing that the cost of the concrete members vary from 50 cts. to $1.00 a cu. ft., not including steel. This price is very much greater than the cost of making and placing concrete blocks, and almost as great as for ornamental stone and it would indicate that a large reduction could be expected as the methods of manufacture are perfected, but even at this price they compare quite favorably with the cost of monolithic floors, for same spans and loads.

Figure 4 shows the method employed in making these beams. The slabs are made on edge in steel forms, each form containing 350 sq. ft. of slabs. The concrete is driven into place and around the reinforcement by means of a special jarring or vibrating machine.

In the construction of several buildings built for the Syracuse Cold Storage Co., the T-section beams were used for all floors, and the beam and slab construction for the roof; this was done on account of the heavy load the floor had to sustain, being 300 lbs. per sq. ft. and no floor being allowed in any case to touch the wall. One of these buildings, the main storage warehouse, is an excellent illustration that this type of floor construction, in conjunction with the reinforced, or fireproofed steel frame, is not only practical for buildings of considerable height, but economical as well. This building was a six-story and basement warehouse 78 ft. square. The building was originally designed for mill construction, but alternate bids were taken for monolithic concrete, and steel frame fireproofed, using sectional floors. The bid for the latter construction was considerably the lowest; in fact both bids were less than cost of the mill construction. On account of time and delivery and certain insulation details, it was found impractical to design steel work as ordinarily would be done for such a structure, i. e., using sufficient steel to sustain the dead load during

Fig. 4.—View of Forms for Casting T-Beams Shown by Fig. 2.

TABLE I.—DETAIL COST OF STRUCTURAL FRAME PLANT OF THE ONONDAGA LITHOLITE CO., SYRACUSE, N. Y., BUILT DURING 1909.

Reinforcing steel, bolts and wind bracing	$ 952.77
Lumber for forms	325.17
Concrete materials	488.83
General supplies	65.00
Labor of making and erection	899.60
Power, interest, plant and other general charges	250.00
Total	$2,981.37

Cu. yds. of concrete—148.
Cost per yd., $20.40.
Lowest bid for alternate design for steel frame erected, $3,000.

TABLE II. — SHOWING RELATIVE DEAD LOAD AND WEIGHT OF STEEL UNIT VS. PRESENT STANDARD FIREPROOF FLOOR CONSTRUCTION.

(Assumed span, 16 ft.; superimposed load, 150 lbs. per sq. ft.; tension in steel, 16,000 lbs. per sq. in.; compression in concrete, 630 lbs.; shear, 50 lbs.)

Description.	Dead load per sq. ft. Lbs.	Wt. steel per sq. ft. Lbs.
Flat slab	96	3.75
Concrete and tile	72	2.77
Slab and beam	56	2.41
Terra cotta	55	5.4
Unit slab and beam	45	2.75

erection, and so designed that the addition of the field concrete the member would be strong enough to carry live load with proper factor of safety; as has been done in several buildings with which you are all familiar, the most well known probably being the MaGraw Building in New York. The steel was therefore designed as would have been done if terra cotta fireproofing had been used.

The walls were 12-in. curtain walls. In order to get flat ceiling the supporting girders were all made of Bethlehem special girder beams. The concrete floor sections for this one building were transported by rail to the building, but for the other buildings they were delivered by team, and the cost was found to be about the same. They were unloaded by means of a boom attached to the frame, power being furnished by a gasoline hoist. They were distributed about the building and set in place by means of chain hoists on portable I beam trolleys, as shown by Fig. 5. The top flange of one beam in each panel was coped to allow the beams to enter, and the beams were slid into position on the lower flange, after which it was wedged up level, pointed underneath, the projecting reinforcement tied over the top flanges, and the spaces between the ends and edges grouted in solid.

It must be remembered that the building was designed for comparatively heavy loads, each floor except the top had to carry 300 lbs. superimposed. Tests were made on sections at regular intervals during manufacture and in no case did a beam fail, loaded with less than 900 lbs. per sq. ft., tested at an age of 21 days. The spans averaged about 15 ft. 3 ins. and the depth of all floors was 12 ins. The dead weight, not including the insulation and its protection, was 40 lbs. per sq. ft. The cost of the floors, as shown in Table III, was found to be 20½ cts. per sq. ft. erected; the cost of the steel frame and fireproofing about 21½ cts. per sq. ft.; the cost of engineering and superintendence about .02 cts. which should be proportioned about equally between the floors and frame, making a total cost of the floors 21½ cts. and the frame 22½ cts. per sq. ft., or a total of only 44 cts. per sq. ft., or 4 cts. per cu. ft. of volume for both frame and floor. It should be noted that this square foot measurement is the net floor area for the six floors and basement computed by the inside dimensions of the building.

On the same basis of costs found to obtain on this building it can be shown that a building of equal size designed to carry the same loads, but in which the peculiar conditions required in cold storage warehouses are not required, and designing the frame as the usual reinforced concrete structural steel frame is designed, could have been built for .57 cts. per sq. ft., or .05½ cts. per cu. ft.

The various advantages of such construction as outlined in the beginning of this paper, were well demonstrated in this building. In regard to speed of erection, it was found that four men and one engineer could unload and place about 1,500 sq. ft. of floors in an 8-hr. day; union iron workers being used for this work and paid at the rate of 50 cts. per hour. The building was found to be quite as rigid as any steel frame building with terra cotta or concrete floors and a section of floor was altered to make room for a scale pit on the ground floor in a very short time and at a small cost.

Fig. 5.—View Showing Method of Placing Separately Molded Slabs.

TABLE III.—DETAILED COST OF STORAGE WAREHOUSE SUPERSTRUCTURE, SYRACUSE COLD STORAGE CO.

(Building 78x78 ft. Steel frame, fireproofed, having basement, six storage floors and concrete roof. Floors designed for 375 lbs. total load. Total area of floors, 10,152 sq. ft. Volume, 424,480 cu. ft.)

	Cost.	Cost per sq. ft.	Cost per cu. ft.
Concrete materials in floors. Cement at $1.40 bbl.; stone at $1.10 ton	$ 1,156.30	$0.028	
Reinforcing steel in floors, f. o. b. shop	1,454.40	0.036	
Labor fabricating reinforcement	[illegible]	[illegible]	
Labor making floor sections and roof	2,605.69	0.064	
Labor erecting members	[illegible]	0.040	
Hauling and freight on members from factory (2 miles)	382.57	0.008	
Power, erection, tools and supplies	217.40	0.005	
Fixed factory charges, including power, interest and depreciation	500.00	0.012	
Total for floors in place (not including painting or grouting)	$ 8,283.89	$0.205	$0.0196
Structural steel erected	$ 7,050.00		
Materials for concreting floors and fireproofing steel	244.84		
Labor painting and concreting floors and fireproofing steel	1,149.00		
Lumber for forms used in fireproofing steel	150.00		
Freight delivery and cartage on field materials	50.00		
Tools, power and supplies	100.00		
Total for frame and fireproofing	$ [illegible]	$0.216	$0.0206
Engineering and superintendence	$ [illegible]	$0.019	$0.001
Total for floors, frame and fireproofing	$17,826.26	$0.44	$0.041
Brick curtain walls, stairs, trim, felt and gravel roof, and all other work to complete superstructure	$ 6,904.76	$0.17	$0.016
Total cost of superstructure	$24,731.02	$0.61	$0.057

Cost of the Philadelphia Filtration Works.

The first contract in connection with the Improvement Extension and Filtration of the water supply was made in 1900 for an experimental filter plant, but work did not begin on any of the permanent structures until 1901. Since the starting of the work about 170 contracts have been executed, covering about every class of work and material entering into water works and water purification construction. They embrace almost every type of pumping engines from a single centrifugal low service pump to a triple expansion high duty engine of the most modern design, as well as steam turbines driving single and double stage centrifugal pumps and electric generators; compound high speed engines, traveling cranes, locomotives, coal handling machinery, structural steel, buildings, tunnels, conduits and concrete work in almost all its forms.

Below will be found in round numbers the cost of the filtration work and its adjuncts, additions to the distribution system, also repairs made to machinery in the old pumping stations. These figures do not include land damages, expense incurred at the experimental station and administrative expenses, but do include the cost of engineering, inspection and such incidental expenses:

Lower Roxborough filters	$ 480,000
Lower Roxborough preliminary filters	100,000
Upper Roxborough filters	1,080,000
Belmont filters	2,480,000
Belmont preliminary filters	212,000
Belmont sedimentation basin	600,000
Torresdale filters	7,100,000
Torresdale preliminary filters	1,160,000
Torresdale intake	225,000
Torresdale pumping station, including buildings and pumps	723,000
Torresdale conduit	1,635,000
Lardner's Point pumping station, buildings and pumps	2,800,000
Oak Lane Reservoir	665,000
Distribution system	5,250,000
Repairs to pumps and stations	1,500,000
Queen Lane filters and equipment	1,900,000
	$27,910,000
*Additional distribution system	250,000
	$28,160,000

The Atlantic Coast Line R. R. has started surveys to secure a route for a line from Kissimmee, Fla., to Alligator Bluff, on Kissimmee River, 55 miles distant.

Earth and Rock Section

Note: This section is devoted to methods and costs of excavating earth and rock and building embankments. It will cover the grading of roads and railroads, diking and canal work, dredging, building reservoirs and earth dams, sewer and water pipe trenching, quarrying, etc.

Method and Cost of Making a 16,000-Cu. Yd. Blast on the Pecos & Northern Texas Ry.

BY C. S. YOUNG*

On the morning of March 8 there was fired what is conceded by railroad construction men of long experience, to be the largest blast in railroad construction that has ever been made in the state of Texas. This shot occurred on Mile 22 of the Pecos & Northern Texas Ry., a branch of the Santa Fe, known as the "Santa Fe cut-off."

Fig. 1.—View of 16,000-cu. yd. Blast From a Distance of 1,800 ft.

On the mile and a half of the construction being done by the Suderman-Dolson Co. of Houston, Texas, there is a fill containing about 90,000 cu. yds., the greatest height of which is 58.8 ft. at the head of bank, where the line crosses the Jim Ned Creek. The material for this fill is both borrowed from each side by machines and placed by wagons, and also hauled by cars from the big cut, a distance of about 4,000 ft. on an average. The big cut is a solid rock cut containing about 70,000 cu. yds. and the deepest cutting is 34.4 ft.

It was at the summit of this cut that the big shot was made. Eight holes were drilled on the center line, each being 22 ft. apart and ranging from 32 ft. to 37 ft. in depth. The first hole was about 18 ft. back from the crown of the preceding shot, the material of which had not been removed and still remained sloping down from the crown. This made quite a heavy pull for the first hole. The holes were drilled by a well machine, drilling a 4½-in. hole, at a cost of 50 cts. per foot. They were sprung three times, using 60 per cent dynamite; at the first 15 sticks were used, at the second from 50 to 60 sticks, and at the third from 250 to 300 sticks were used, springing the eight holes together. The tamping after each spring was drilled out by the well machine at a cost of $12 per day and requiring about twelve days altogether. The drilling out of the tamping after the last spring was almost as difficult as the original hole owing to slight raveling of some of the holes and to the slight shifting of some of the ledges of rock. In loading the holes FF and FFF black powder was used and they were loaded as follows:

	Kegs.
Hole No. 1	275
Hole No. 2	255
Hole No. 3	240
Hole No. 4	250
Hole No. 5	250
Hole No. 6	247
Hole No. 7	195
Hole No. 8	300

This makes a total of 2,012 kegs of 25 lbs. each, or 50,300 lbs. The total cost of the drilling, springing, dynamite, exploders, and powder was $3,725.

The total yardage of the cut that was broken by the shot was 16,113 cu. yds., and the measurement of the hole afterward showed a wasting of 12,007 cu. yds., or 74.5 per cent. As the holes were from 1.5 ft. to 2 ft. below grade it is reasonable to suppose that the 4,106 cu. yds. that were left at the bottom and on the slopes was loose material and if calculated with a 15 per cent swell for breaking there is the equivalent to 3,571 cu. yds. of solid material left from the shot. Calculated in this way there was a waste of 77.8 per cent of the cut at this part. At this writing the material has not been removed, but from the indications the slopes were not damaged in the slightest degree.

Fig. 2.—View of 16,000-cu. yd. Blast 15 Seconds After Firing.

The drilling, springing, and loading were done under the personal supervision of the writer and the battery was pulled by A. T. Warren, foreman of Camp No. 3, in charge of the work on the big cut.

*Superintendent of Construction, Suderman-Dolson Co., Atoka, Tex.

Methods and Cost of Cleaning 30,000 Cu. Yds. of Sediment from a Water-Works Reservoir.

The reservoir, known as Reservoir No. 1 of the Cincinnati, O., water works, had been in constant service for over two years. It was taken out of service on March 20, 1909, and allowed to stand for 4 days in order to allow complete sedimentation before drawing the water. The original turbidity of the water was 75 parts per million; after 4 days it was found to be 47 parts for a depth of 30 ft. and 50 parts at a depth of 40 ft. On March 30 the water was drawn off for a depth of 3 ft. during the night and allowed to stand during the day, when the mud was washed off the exposed slopes by hose streams under pressure of flushing pumps in the wier house. The following night the water level was again lowered to stand during the day, when the slopes were washed down. This procedure was repeated every 24 hours until April 9, when the water had become very turbid. The 30-in. drain was then opened, drawing off all the water and such mud as it carried. The deposit of mud remaining on the slopes and bottom was then disintegrated and slid to the drain opening by means of 1½-in. hose streams under heavy pressure. The depth of accumulated mud was found to be from 12 ins. to 36 ins. and the total amount removed was estimated as 30,000 cu. yds. Some 35,494,600 gals. of water were wasted in draining the reservoir and 16,902,600 gals. were used for removing the mud, or about 565 gals. per cubic yard of mud removed. The cost of cleaning was as follows:

16,902,600 gals. water, at $3.28 per mil. gals.	$ 55.44
22,032 kw. electric power, at 1.1 ct.	242.36
Labor operating pumps	57.94
Labor cleaning reservoir	427.27
Total	$783.01

The cost per cubic yard of mud removed was, for cleaning proper, 2.61 cts. Charging in the 35,494,600 gals. of water last in draining the reservoir at $3.28 per million gallons we have an additional item of $116.42, or 0.39 ct. per cu. yd., making a total cost of 3 cts. per cu. yd. The cleaning was completed May 1, 1909, and water was turned back into the reservoir on May 8. These data are computed from figures given in the report of Geo. H. Benzenberg, chief engineer, water works, Cincinnati, O.

Bids for Canal Excavation.—Bids for the excavation of a section of the Canal prism near Tabernilla, containing about 36,138 cu. yds., and a section near Bohio, containing about 166,272 cu. yds., were opened at the office of the Chief Quartermaster in Culebra, on March 1. An abstract of the seven proposals which were received follows:

Bidders.	Sec. A Tabernilla. Price per cu. yd.	Section B. Bohio. Price per cu. yd. Hard rock	Earth.	Soft rock	Hard rock.
Chas. Alberts	.30	.52	.42	.71	.92
B. B. Duncan	2 41/2	.34 1/8	.29	.50 1/4	.62 3/4
E. C. McFarland	.21	.26	.21	.25	.30
R. B. Stapleton	2 5 1/2				
R. P. Dixon	.24	.50	.40	.65	.80
George Forbes	2 2 1/2				
Hebard & Lombard	.27	.445	.257	.47	.64

Mr. McFarland was the lowest bidder in both sections.

TABLE I.
FRAM
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Roads and Streets Section

Note: This section is devoted to methods and costs of road and street construction. It will cover road building in all its details, the construction of pavements, sidewalks and gutters, the testing and use of paving materials and the machinery and tools used in road building and paving.

Average Unit Prices and Some Details of Pavements Constructed in 1909 in a Number of Representative American Cities.

The accompanying tabulations show the amount and average unit prices for various classes of pavement laid in 1909 in a number of representative American cities. In securing these data no attempt was made to obtain complete statistics for the United States. The purpose, rather, was to select cities in various sections of the country on the assumption that their practice and activity would be representative of the section in which they were located. In order to give as much data as possible regarding the local conditions under which the pavement was constructed, information was secured on the prevailing local prices for paving materials and the local cost of labor. These labor and material tables will be found on pages 320 and 323 in this issue. Similar tables showing the character and cost of paving, work done in 1906, were given in an issue of March 27, 1907; and like information on the paving work done in 1907 was given in the April 1, 1908, issue of this paper.

On the blanks sent to the city officials information was asked on only the kinds of pavement most commonly constructed. In many cities, however, various other types of pavement than those shown in the accompanying tables were constructed last year, and in the following notes we give a brief description of some of these types.

The only pavement constructed last year in Annapolis, Md., was 5,146 sq. yds. of shell-macadam. This pavement consisted of 3-in. of oyster shells and 3 ins. of broken stone and was constructed by day labor at a cost of 55.6 cts. per sq. yd. The pavement was covered with Tarvia "A" by contract at 12 cts. per sq. yd., making the total cost of the completed pavement 67.6 cts. per sq. yd.

TABLE SHOWING AMOUNT AND AVERAGE UNIT PRICE OF STONE BLOCK PAVEMENT LAID IN 1909 IN A NUMBER OF REPRESENTATIVE AMERICAN CITIES

	Sq. yds.	Av. price per sq. yd., including base and grading.	Guarantee years.	Total thickness pavement. Ins.	Concrete base. Thickness Ins.	Proportions
Akron, O.	1,253	$2.45	.	12[1]	.	.
Athens, Ga.	4,529	1.60	..	..	.	. . .
Aurora, Ill.	2,000	1.75†	.	..	.	..
Buffalo, N. Y.	5,954	1.35*	10	15	6	1—10
Butte, Mont.	9,351	1.21	14	12	6	1—3—5
Cambridge, Mass.	1,850	3.00	.	.	.	.
Camden, N. J.	16,210	.	..	..	.	.
Cleveland, O.	22,949[2]	3.33[3]	5	..	6	. . . .
Elizabeth, N. J.	25,250	1.90[4]	1	12	.	. . .
Everett, Mass.	6,565	3.55	.	11½	.	1—3—5
Fitchburg, Mass.	10,550	2.20[5]	..	..	.	. . . .
Hartford, Conn.	1,629	3.74*	1	12½	6	1—3—6
Haverhill, Mass.	3,264	1.85†	..	16[6]	.	.
Hoboken, N. J.	1,746[7]	1.10[8]	.	..	.	. . .
Holyoke, Mass.	1,445[10]	.61*	..	..	.	. . .
Kansas City, Mo.	31,520	3.10*	10	15	6	1—3—7
Lewiston, Me.	1,000	1.80	..	.	.	. . . .
Lowell, Mass.	15,959	3.22[9]	.	12	6	1—4—10
Minneapolis, Minn.	10,950	2.11[10]	.	.	.	. . . .
Newark, N. J.	17,835	3.07	.	12	6	. .
New Bedford, Mass.	15,623	3.75*†	.	12[3]	5	1 3 5
Pittsburg, Pa.	44,318[13]	1.98*	1	15	.	. . .
Pittsburg, Pa.	22,153[14]	1.83	1	12[4]	.	. . . .
Portland, Me.	626[15]	2.82	..	..	1	1 3 6
Portland, Ore.	306[16]	3.90[17]	20	12	6	1—3—6
Providence, R. I.	2,165	.	.	15	6	1—3—6
Providence, R. I.	3,536	.	.	.	.	. . .
Rochester, N. Y.	18,000	2.90	10	11	6	1 3 6
Scranton, Pa.	2,914[18]	2.45	.	9	.	. . .
Seattle, Wash.	26,382[18]	4.06*	.	13	6	1 1 2
Seattle, Wash.	1,984[19]	3.66*	6	12	5	1 1 7
Somerville, Mass.	15,580[18]	2.96	.	9	4	1 3 6
Springfield, Mass.	1,438	1.24[20]	.	..	.	. . .
St. Louis, Mo.	1,913[18]	2.70	5	12	6	1 1 4
Syracuse, N. Y.	1,459	3.50	10	14	6	1 . . 6
Tacoma, Wash.	23,312	3.26	..	12½	.	. . .
Troy, N. Y.	6,550	3.20[21]	..	..	..	. . . .
Worcester, Mass.	33,776	3.01	.	10	5	1 3 6
Youngstown, O.	2,559	..	..	12	.	.

*Price does not include grading. †Laid by day labor.
[1]Curb on sand base, 8 ins. on slag base. [2]Price includes curbs, the drains, grading and all work complete. [3]Laid on gravel base. [4]Medina. [5]$3.33 on 6 in. concrete base, $2.79 on sand. [6]Laid on 6 in. sand base. [7]Laid on natural gravel base. [8]Including sand base. [9]New Belgian block; in addition there was 7,000 sq. yds. of Belgian block relaid at 50 cts. per sq. yd. [10]Blocks were taken up from other streets and relaid on a gravel base. [11]For limestone blocks; for granite blocks, 2,079 sq. yds. of which was laid the price was $2.34 per sq. yd. [12]12 in. and 14 in.. [13]Ligonier block on 9 in. gravel foundation. [14]Ligonier block repaving; laid on 6 in gravel foundation. [15]In addition there were 2,615 cu. yds. laid at $2.46 per sq. yd. on a base other than concrete. [16]Miles. [17]On sand base. [18]Granite. [19]Sandstone. [20]Labor only; old blocks relaid on different street. [21]On 9 in.; $3.10 on 6 in.

Three cities reported the construction of concrete pavement last year. These were:

	Sq. yds.	Price per sq. yd.	Total thickness. Ins.	Guarantee. Years
Boise, Idaho	10,000	$1.52	8	5
Kansas City, Mo.	7,340	1.00	6	5
Salt Lake City, Utah.	1,620	1.60	8	5

The prevailing prices for concrete materials in these cities were as follows:

	Portland cement. Per bbl.	Broken stone. Per cu. yd.	Sand. Per cu. yd.
Boise, Idaho	$ 2.75	$ 1.06	$1.00
Kansas City, Mo.	1.00-1.20	1.25-1.50	1.25
Salt Lake City, Utah.	2.00	1.25	1.25

A considerable amount of pavement made of broken stone mixed with tar or asphalt was constructed during the past year and brief notes on this work follow:

Cambridge, Mass., constructed by day labor 15,402 sq. yds. of tar macadam 6 in. thick, the unit cost per square yard being 75 cts; this cost including grading. Broken stone cost $1.75 per cu. yd.; common laborers were paid $2 per 8-hour day and $5 to $6 was paid per day for teams with drivers.

At Cedar Rapids, Ia., 39,000 sq. yds. tarvia macadam was constructed, the average price for 13,000 sq. yds. being 64 cts. per sq. yd., and the average price for 26,000 sq. yds. being $1.02. These prices do include grading, which was paid for separately at 23 cts. per cu. yd. The total thickness of the pavement is 12 ins. Broken stone cost $1.35 per cu. yd., common labor was paid $2 for 9-hour day and team with driver $4.50.

At Cleveland, O., 3,578 sq. yds. of 9-in. tar macadam was constructed by contract, the average price per sq. yd. being $2.27. The pavement guarantee was 10 years.

A total yardage of 52,743 sq. yds. of asphalt macadam was constructed in Fresno, Cal., in 1909, the average cost per sq. yd. being as follows:

9,217 sq. yds., 7 in. thick.....$2.02
17,219 sq. yds., 5 in. thick..... 1.35
26,307 sq. yds., 4 in. thick..... 1.12½

The guarantee was one year. Broken stone cost $1.00 per cu. yd., and asphalt $12.50 per ton.

Common labor was paid $2.50 per 8-hour day and team with driver $4.

At Hamilton, O., 6,142 sq. yds. of 6-in. tarvia macadam was constructed, the average price per sq. yd., including grading, being 65 cts. Broken stone cost $1.25 per cu. yd., and common labor was paid $1.50 to $1.75 per 10-hour day, while $4.50 was paid for team and driver.

At Haverhill, Mass., 46,845 sq. yds. of macadam treated with Tarvia "A" was laid by city labor at a cost of 82 cts. per sq. yd., this cost including grading. The total thickness of the pavement was 6 in. to 8 in. Com-

TABLE SHOWING AMOUNT AND TOTAL COST OF PAVEMENT LAID IN 1909 AND AMOUNT PROPOSED PAVING WORK FOR 1910.

City.	City Engineer.	Pavement Laid in 1909. Miles.	Total Cost.	Proposed for 1910. Miles.	Total Cost.
Akron, O.	John W. Pryde	6[1]	$ 187,182	1[2]	$ 315,000
Albany, N. Y.	Walter Melius	3.3	.	.	. . .
Albuquerque, N. M.	James M. Gladding	....	.	.	. . .
Allentown, Pa.	Franz Engstrom	5.4	182,426	1[2]	300,000
Altoona, Pa.	Chas. D. Wentzel	.	.	.	89,000
Anderson, Ind.	Geo. A. Lupher	.	.	.	. . .
Annapolis, Md.	J. C. Little	.	3,810	.	25,000
Ansonia, Conn.	V. E. Clock	1	11,000	.	8,000
Athens, Ga.	J. W. Barnett	See tables		.	. .
Auburn, Me.	R. A. Swift	....	3,500	.	. .
Aurora, Ill.	M. J. Todd	2.8	.	.	. . .
Bangor, Me.	Philip H. Coombs	.	.	.	. . .
Bath, Me.	Stephen Littlefield	.66	3,000	1	5,000
Battle Creek, Mich.	E. F. Hand	.35	18,909	7[3]	31,500
Bay City, Mich.	Edward Wendt	See tables		.	. . .
Beaumont, Tex.	C. S. Sherer	See tables.		.	10,000[4]
Binghamton, N. Y.	John A. Gilis	.65	22,066	1.5	50,000
Bloomington, Ill.	Elmer Folsom	1	43,266	3.75	150,000
Boise, Idaho	L. I. Baldwin	.	1,200	.	. . .
Buffalo, N. Y.	Geo. H. Norton	8.8	152,378	.	. . .
Butte, Mont.	M. A. Foote	See tables.		.	. . .
Cairo, Ill.	W. B. Thistlewood	2.35	129,334	2.82	107,000
Cambridge, Mass.	L. M. Hastings	1.12	.	.	. . .
Camden, N. J.	L. E. Farnham	See tables.		.	. . .
Canton, O.	Phil. H. Weber	2.07	85,106	3.15	152,993

Cedar Rapids, Ia.	P. P. Smith	5.25	178,620	2.50[2]	60,000	
Charleston, S. C.	J. H. Dingle	1.8	67,795			
Charlotte, N. C.	Joseph Firth	See tables.				
Clinton, Ia.	R. C. Hart		10,000	.5		
Cleveland, O.	Robert Hoffmann	29.5	784,000	33	1,950,359	
Columbus, O.	Henry Maetzel	19.6	641,979			
Council Bluffs, Ia.	S. L. Elmyre	1.5	15,052		100,000	
Covington, Ky.	H. G. Abelmets	2.4	82,183		60,000	
Cumberland, Md.	J. C. Shriver	.9	14,342			
Danville, Va.	J. O. Wagman			1.1	70,000	
Davenport, Ia.	Thomas Murray	6.4	249,920		200,000	
Dayton, O.	F. J. Cellarius		14,500		220,000	
Decatur, Ill.	A. L. Alexander	See tables.				
Denver, Colo.	J. L. Hunter				66,000	
Detroit, Mich.	R. H. McCormick	13.08		13.08		
Dubuque, Ia.	Paul Iltz		8,960			
East Liverpool, O.	J. C. Kelly	1.25	34,719	3	79,300	
Easton, Pa.	John McNeal	2	16,879			
East St. Louis, Ill.	W. J. Crocken	1.25	38,167	3.25	175,400	
Elgin, Ill.	Carl E. Plum	1.1	60,804	2	125,200	
Elizabeth, N. J.	Wm. H. Luster, Jr.	1.64				
Elmira, N. Y.	Thurber A. Brown	.9	43,553			
Erie, Pa.	H. E. Briggs	5.58		4.5		
Evanston, Ill.	J. H. Moore	1.6	75,800	2.5	66,000	
Everett, Mass.	Christopher Harrison	.41	32,935			
Fitchburg, Mass.	David A. Hartwell	See tables.				
Fort Dodge, Ia.	Chas. H. Reynolds		44,552	3	100,000	
Fort Smith, Ark.	Mark H. Reed	19	99,000	1	1,200	
Fort Wayne, Ind.		.07	[illegible]	2		
Freeport, Ill.	John A. R. Daniels	2	75,000	2.5	68,200	
Fresno, Cal.	Chris. P. Jensen	1	89,076	2	80,000	
Grand Rapids, Mich.	L. W. Anderson	3	152,580			
Green Bay, Wis.	W. W. Reed			6	210,000	
Hamilton, O.	F. E. Weaver	2	88,000	2	85,000	
Harrisburg, Pa.	M. B. Cowden	3.8	145,605			
Hartford, Conn.	F. L. Ford		60,000		40,000	
Haverhill, Mass.	Geo. D. Hutchins	.4	8,897	4	102,000	
Helena, Mont.	Charles W. Helmick		2,383		7,000	
Hoboken, N. J.	Eugene Smith	.76	59,000	.65		
Holyoke, Mass.	James L. Tigue	See tables.				
Indianapolis, Ind.	H. W. Klausmann	1.6	414,333	10	400,000	
Jacksonville, Fla.	Philip Prieleau	See tables.				
Kansas City, Mo.	James L. Darnell	21.7	588,631	27	600,000	
Keokuk, Ia.	J. Ross Robertson	See tables.				
Kingston, N. Y.	John F. Hallinan	1.4	85,611	7	42,805	
Knoxville, Tenn.	J. E. Thompson	8.2	450,588			
La Crosse, Wis.	Geo. P. Bradish	1.5	37,336			
Lawrence, Kan.	Holland Wheeler	2.25	45,000	3	75,000	
Leavenworth, Kan.	Joseph O'Neil	3.92	105,517	3.65	111,300	
Lincoln, Neb.	Adna Dobson	1.3	49,800	3	125,000	
Little Rock, Ark.	E. A. Kingsley	4	200,000	8	350,000	
Lowell, Mass.	George Bowers	1.1	51,405	1.1	51,405	
Lynn, Mass.	Geo. S. Lethbridge	See tables.				
Madison, Wis.	John F. Icke	1	66,000	1	101,100	
Marinette, Mich.	Geo. B. Pike	.62	9,240			
Mankato, Minn.	John Wilson	.11	1,754		12,000	
Marion, Ind.	T. E. Petre	.85	19,677			
Michigan City, Ind.	H. M. Mills			1.5	18,000	
Meridian, Miss.	W. G. Wetmore	See tables.		5.32	300,000[10]	
Minneapolis, Minn.	Andrew Rinker	14.99	464,151			
Muskegon, Mich.	D. C. Tabor	1.37	35,739			
New Albany, Ind.	Chas. W. Appleto	See tables.				
Newark, N. J.	M. R. Sherrerd	7.12	313,861	12	500,000	
New Bedford, Mass.	Wm. F. Williams	1.9	84,560	5	100,000	
New Britain, Conn.	Francis H. Oldershaw	See tables.			66,000	
Newcastle, Pa.	C. H. Millholland	6.5	17,496	2		
Newport, R. I.	Wm. H. Lawton	See tables.				
Norristown, Pa.	S. Cameron Corson	2.38	8,215			
Ogden, Utah	Wm. M. Rostaph	1	101,353			
Ottawa, Ill.	W. H. Irwin	2.71	89,843			
Paducah, Ky.	L. A. Washington			7	6,048	
Passaic, N. J.	A. L. Petersen	See tables.				
Pawtucket, R. I.	Geo. A. Carpenter	See tables.				
Pensacola, Fla.	L. Earle Thornton	1.6	381,720	1	51,000	
Peoria, Ill.	Clay Belsley		43,000	10	200,000	
Pine Bluff, Ark.	E. Hale	See tables.			70,400[11]	
Pittsburg, Pa.	N. S. Sprague	13.18	631,872			
Port Huron, Mich.	E. R. Whitmore	1	14,500			
Portland, Me.	Bion Bradbury, Jr.	3.25	38,315	3.1	45,000	
Portland, Ore.	J. W. Morris	41	1,821,500	80	3,640,000	
Providence, R. I.		See table.		6	9,750	
Racine, Wis.	P. H. Connolly	8	123,903	9	111,000	
Reading, Pa.	E. B. Ulrich	See tables.			50,000	
Richmond, Ind.	Fred R. Charles	2.7	19,000			
Rochester, N. Y.	E. A. Fisher	12	567,000			
Rockford, Ill.	S. B. Hand	3.55	85,520			
Rock Island, Ill.	Wallace Treichler	1.23	63,400			
Saginaw, Mich.	R. W. Roberts	2.96	126,903	2.1	100,000	
Salt Lake City, Utah	G. F. McGonagle	4.18	411,331	9.5	720,000	
San Jose, Cal.	Chas. H. Pieper	3.65	118,404	12.45	167,000	
Scranton, Pa.	Wm. A. Schunk	4.89	219,663	4	91,683	
Seattle, Wash.	R. H. Thompson	30.33	1,639,768	30	1,600,000	
Selma, Ala.	Julien Smith	1	86,189	2[12]	18,500	
Sheboygan, Wis.	C. U. Bolen	2.27	76,333			
Sioux City, Ia.	G. Y. Skeels	3.5	185,124			
Somerville, Mass.	E. W. Bailey	3	85,400		35,000	
South Bend, Ind.	Wm. S. Moore	See tables.				
South Omaha, Neb.	Geo. W. Roberts	1.14	71,060	8.5[13]	415,000	
Spokane, Wash.	J. C. Ralston	2.66	197,597	20	1,500,000	
Springfield, Ill.	Frank H. Hamilton	5.5	176,119	6	210,000	
Springfield, Mass.	Chas. M. Slocum	See tables.				
Springfield, Mo.	H. G. Horton	See tables.				
St. Louis, Mo.	J. C. Travilla	21.38	1,013,563	28	1,515,309	
Streator, Ill.	F. W. Herbert	1.25	30,129			
Superior, Wis.	E. B. Banks	3.63	37,202	1	100,000	
Syracuse, N. Y.	Henry C. Allen	4.62	223,927	4.62		
Tacoma, Wash.	W. C. Raleigh	23.16	1,293,165	25	1,500,000	
Topeka, Kan.	W. S. Fulton	6	200,000	1	140,000	
Toledo, O.	G. W. Tonson	11.45[13]	309,227	4	200,000	
Trenton, N. J.	Abram Swan, Jr.	1.81	62,975		100,000	
Troy, N. Y.	E. L. Grimes	1.52	83,526			
Utica, N. Y.	Wm. F. Cogley	4	137,500	4.5	150,000	
Valparaiso, Ind.	Guy F. Stinchfield	98	26,636	2		
Vicksburg, Miss.	C. R. Twiss	.16	9,543	8	200,000	
Washington, D. C.	C. B. Hunt[14]	9	240,000	9		
Watertown, N. Y.	E. W. Sayles	.25	10,200	1.0		
Wheeling, W. Va.	C. B. Cooke	See tables.				
Wilkesbarre, Pa.	D. K. Finch	1.87	65,081	2.36	91,000	
Worcester, Mass.	F. A. McClure	2.85	92,121	2		
Youngstown, O.	F. M. Lillie	8.68	203,015			
Zanesville, O.	H. W. Harris	5	14,396			

[1]Brick, [2]40,000 sq. yds. [3]Expects to pave business district this year. [4]15,000 sq. yds. of brick to be laid this year. [5]For repairs. [6]Several blocks. [7]Contract let. [8]1.08 miles new pavement, 4.27 miles repaving and 19.24 miles resurfacing. [9]1,170 sq. yds. brick and 4,300 sq. yds. granite. [9].76 miles new pavement and .77 miles relaid. [10]Including storm sewers. [11]80,000 sq. yds. [12]Contract let. [13]6.86 miles of new paving and 4.59 miles of relaid pavement. [14]Engineer of highways.

mon labor was paid $2.25 per 8-hour day and $5.00 per day was paid for a team with driver. Broken stone cost $1.10 per cu. yd.

A total of 17,731 sq. yds. of macadam was laid in Holyoke, Mass., in 1909, by day labor, at a cost of 63 cts. per sq. yd. Water gas tar was used on the top coat and the macadam was laid on a gravel base. Broken stone cost $1.30 per cu. yd. f. o. b. Holyoke; common labor was paid 25 cts. per hour and $4.50 per 8-hour day was paid for team with driver.

At Keokuk, Ia., 11,000 sq. yds. of 10 in. macadam filled with Sarco was constructed at an average price of 95 cts. per sq. yd., this price not including grading, which was paid for separately at 47 cts. per cu. yd. The pavement consisted of an 8-in. base and a 2-in. top filled with Sarco road compound. Broken stone cost $1.25 per cu. yd. on car and common labor was paid $2 per 10-hour; $3.50 to $4 per day was paid for team and driver. The pavement guarantee was one year.

Oiled macadam to the extent of 33,071 sq. yds. was constructed in 1909 at Leavenworth, Kan., the average price per sq. yd., not including grading, being 88 cts. Grading was paid for separately at the rate of 37 cts. per cu. yd. The total thickness of the pavement was 12 in. Broken stone cost $2 per cu. yd.; common labor cost $1.75 per 8-hour day, and $3.50 per day was paid for team with driver.

At Lewiston, Me., over 8,000 sq. yds. of tar-asphalt macadam was laid by the city at a cost of 85 cts. per sq. yd., this cost including grading. The pavement consisted of a layer of crushed rock 4 in. thick after rolling, and a layer of finer rock 2 in. thick after rolling, filled with 50 per cent tar and 50 per cent asphalt. The pavement was finished off with very fine crushed rock spread in liquid hot tar and rolled. Broken stone cost $2.20 per cu. yd.; common labor was paid $1.75 per 9-hour day, and $4 per day was paid for team and driver.

Madison, Wis., has awarded the contract for 40,850 sq. yds. of asphalt filled macadam to be built this year. The average price per sq. yd., not including grading, was $1.20. Broken stone costs $1.13 to $1.60 per cu. yd. and asphalt costs $25 per ton; common labor receives $2 per 9-hour day, and $4.50 per day is paid for team and driver. The total thickness of the pavement is to be 12 ins.

At Mankato, Minn., 2,290 sq. yds. of macadam treated with unrefined coal tar was constructed at a cost of 76.4 cts. per sq. yd. The total thickness of the pavement is 7 in. Broken stone cost 80 cts. per cu. yd.; common labor was paid $1.75 per 10-hour day, and $3.50 per day was paid for team with driver.

A total of 23,015 sq. yds. of 8-in. thick macadam was constructed at Muskegon, Mich., last year. Of this amount 15,035 sq. yds. was macadam, with a poured asphalt filler and 7,980 sq. yds. was macadam with poured tarvia filler. The average price for the former type of macadam was 94 cts. per sq. yd., and the average price for the later type was 84 cts. These prices do not include grading, which was paid for separately at 50 cts. per cu. yd. Broken stone cost $1.20 per cu. yd. loaded on wagon at dock; common labor was paid $1.75 per 10-hour day and $4 per day was paid for a team with driver.

At Norristown, Pa., the Borough by day labor constructed 37,580 sq. yds. of macadam; 34,169 sq. yds. were constructed with Tarvia "X" and 3,411 sq. yds. with Indiana asphalt. The average cost per sq. yd., including grading and base, was 58 cts. The bottom consisted of 6 in. of sand and on this was 6 in. of crushed limestone. Broken stone cost $1.55 per cu. yd., and $1.50 per 10-hour day was paid for common labor; $3 per day was paid for single teams with drivers and $5 per day for double teams.

Passaic, N. J., constructed 5,481 sq. yds. of asphalt macadam, the work being done by contract at an average price of $1.19 per sq. yd. The guarantee was one year, and the total thickness of the pavement was 6½ ins. Broken stone cost $2.10 per cu. yd., and $1.50 per 10-hour day was paid for common labor; $5.50 per day was paid for team and driver.

At Portland, Me., 8,807 sq. yds. of bituminous macadam having [illegible] asphalt and tar heated surface was constructed by day labor

TABLE SHOWING AMOUNT AND AVERAGE PRICE OF MACADAM LAID IN 1909 IN A NUMBER OF REPRESENTATIVE CITIES.

	Sq. yds.	Av. price per sq.yd. including grading.	Guarantee years.	Price per cu. yd. for grading if paid separately.	Thickness macadam. Ins.
Ansomia, Conn.	15,300	$0.72	..	....	7
Bath, Me.	6,800	.50	0	....	7
Buffalo, N. Y.	45,910	2.20	10	....	17
Cambridge, Mass.	4,626	.75	..	....	..
Charleston, S. C.	5,707	.90	..	....	7
Covington, Ky.	16,854	.70	..	$0.23	12
Dubuque, Ia.	6,197	.70*	1	.30	12
Easton, Pa.	23,115	.36[1]	..	....	8[2]
Evanston, Ill.	8,598	1.00*	2	.20	12
Fort Smith, Ark.	45,000	.35	..	....	8[3]
Grand Rapids, Mich.	4,287	1.40*	1	.35	11[4]
Kansas City, Mo.	62,895	1.30*	2	....	12
LaCrosse, Wis.	16,855[5]	1.18	..	....	10[6]
Madison, Wis.	42,100	.75*[7]	0	....	12
Manistee, Mich.	12,050	.74	..	....	8
Minneapolis, Minn.	18,952	1.25[8]	..	....	10
New Bedford, Mass.	43,290	.60*[8]	..	....	12[9]
New Britain, Conn.	40,500	.57	..	....	..
Newport, R. I.	10,478	.40	..	....	6[10]
Passaic, N. J.	50,910	.67¼	..	....	7
Pawtucket, R. I.	12,000	.60	..	....	6
Port Huron, Mich.	2,600[11]	.65	..	....	..
Portland, Me.	13,326	.84	..	....	..
Portland, Ore.	11.6[12]	.92*	4	.25	10
Providence, R. I.	2.72[12]	....	..	....	6
Racine, Wis.	4,861	1.08	0	....	12
Richmond, Ind.	47,520	.40	..	....	..
Rockford, Ill.	40,004	.42*[8]	..	....	8
Sheboygan, Wis.	33,781[13]	1.02	0	....	12
Springfield, Mass.	49,892	.62[8]	..	....	..
St. Louis, Mo.	54,327[14]	.90*	..	....	..
Superior, Wis.	26,000	1.10*	0	.60	12
Syracuse, N. Y.	8,839	1.28	1	....	6[15]
Tacoma, Wash.	6,164	.95	..	....	10
Trenton, N. J.	6,350[16]	.71	1	..	8
Washington, D. C.	42,000	.60*[17]	5	..	9
Watertown, N. Y.	60,000[8]	.60	..	....	7
Wilkesbarre, Pa.	983	1.50	..	....	16
Worcester, Mass.	57,959	.85	0	....	6

*Does not include grading.
[1]20.5 cts. to 36.2 cts. [2]4-in. to 8-in. thick. [3]8-in. and 10-in. [4]Includes on 6-in. gravel base. [5]Granite top. [6]10-in. to 12-in. [7]Cost in 1910 is much more than in 1909 owing to heavier grading and wide streets. [8]Day labor. [9]12-in. middle, 6-in. at sides. [10]4 to 6-in. [11]Resurfacing with crushed hard heads. [12]Miles. [13]Granite top. [14]Macadam and telford. [15]6-in. and 8-in. [16]Traprock. [17]60 cts. to 70 cts.

at an average cost of $1.03 per sq. yd. Broken stone cost $1.20 per ton, and asphalt cost $3.83 per bbl. Common labor was paid $1.75 per 9-hour day, and $5 per day was paid for double team and driver.

A total of 37,839 sq. yds. of macadam was constructed in 1909 at South Bend, Ind. Of this amount 26,478 sq. yds. was asphalt (Sarco macadam) and 11,361 sq. yds. was treated with Tarvia "X." The average price per sq. yd. for the former type was 90 cts. and for the latter the average price was 70 cts. These prices do not include grading, 40 cts. per cu. yd. for grading being paid in connection with the asphalt macadam and 25 cts. per cu. yd. in connection with the tarvia-macadam. The total thickness of both types of pavement is 8 in. Broken stone cost $1.25 per cu. yd. Common labor was paid $1.75 to $2 per 10-hour day; teams with drivers were paid $4 per day.

At Superior, Wis., 15,982 sq. yds. of tar macadam was constructed at an average price of $1.46 per sq. yd. This price did not include grading, which was paid for at the rate of 60 cts. per cu. yd. The total thickness of the pavement was 12 in. Broken stone cost $1.70 per cu. yd.; common labor was paid $2.25 per 10-hour day, and $5 per day was paid for teams with drivers.

At Toledo, O., 15,193 sq. yds. of macadam having a 6-in. base and a 2½ tarvia or equivalent wearing surface was constructed at an average price of $1.08 per sq. yd., this price not including grading, which was paid for at the rate of 40 cts. per cu. yd. The macadam was constructed by contract, the guarantee being five years. The total thickness was 8½ to 9 ins. Broken stone cost $1.05 per cu. yd. f. o. b. cars. Common labor was paid $1.50 to $1.75 per 8 or 9-hour day, and teams with drivers were paid 50 cts. per hour.

A total of 19,976 sq. yds. of bituminous macadam was constructed by contract at Utica, N. Y., in 1909, the average price per sq. yd. being $1.04, not including excavation, which was paid for at the rate of 44 cts. per sq. yd. The total thickness of the pavement was 9 in., the sub-base being 3 in. The guarantee was one year. Broken stone cost $1.25 per cu. yd., common labor was paid $1.60 to $2 per 8-hour day and $4 per day was paid for teams with drivers.

A summary of the amounts laid and the average prices of the various types of macadam enumerated above follow:

City.	Kind.	Amount laid. Sq. yds.	Total thickness. Inches.	Average price. Per sq. yd.
Cambridge,	tar-mac.	15,402	6	$0.75
Cedar Rapids,	Tarv.-mac.	13,000	12	.64
Cedar Rapids,	Tarv.-mac.	26,000	12	1.02
Cleveland,	tar-mac.	3,578	9	2.27
Fresno,	asp.-mac.	9,217	7	2.02
Fresno,	asp.-mac.	17,219	5	1.35
Fresno,	asp.-mac.	26,307	4	1.12½
Hamilton,	Tarv.-mac.	6,142	6	.65
Haverhill,	Tarv.-mac.	46,845	6	.82
Holyoke,	w. g. tar.	17,731	..	.63
Keokuk,	Sar.-mac.	11,000	10	.95
Leavenworth,	oil-mac.	33,071	12	.88
Lewiston,	asp.-mac.	8,000	6	.85
Madison,	asp.-mac.	40,850	12	1.20
Mankato,	coal tar.	2,296	7	.74
Muskegon,	asp.-mac.	15,035	8	.94
Muskegon,	Tarv.-mac.	7,980	8	.84
Norristown,	Tarv-mac.	34,169	6	.58
Norristown,	asp.-mac.	3,411	6	.58
Passaic,	asp.-mac.	5,481	6½	1.19
Portland,	bit.-mac.	8,807	..	1.03
South Bend,	asp.-mac.	26,478	8	.90
South Bend,	Tarv.-mac.	11,361	8	.70
Superior,	tar-mac.	15,982	12	1.46
Toledo,	Tarv.-mac.	15,193	8½	1.08
Utica,	bit.-mac.	19,976	9	1.04

At San Jose, Cal., 14,150 sq. yds. of asphaltic concrete pavement was constructed, the average price per sq. yd., including grading and base, being $1.48. The total thickness of this pavement was 5½ in. The base was 4 in. thick, composed of 6 to 7 lbs. of asphaltic cement to 1 cu. ft. of aggregate. A total of 18,316 sq. yds. of bitumen pavement was constructed in this city, the average price including base and grading being $2.10 per sq. yd. The total thickness of this pavement, including the base, was 8 in. The base was 6 in. thick, made of 1-3-6 Portland cement concrete. Common labor was paid $2 per 9-hour day, and team and driver $5 per day. Cement cost $2.20 per bbl. Broken stone cost $1.60 per cu. yd., sand cost $1 per cu. yd., and asphalt cost $15 per ton. No guarantee was required.

At Springfield, Ill., 12,684 sq. yds. of asphaltic concrete was constructed, the average price, including base and grading, being $1.48 per sq. yd. The total thickness was 6 in., and the guarantee required was five years. In addition 12,625 sq. yds. of mineral rubber asphaltic concrete pavement was constructed in Springfield. The average price for this pavement, including base and grading, was $1.85 per sq. yd. The total thickness was 8 in., of which 6 in. was the 1-3-5 Portland cement concrete base. The guarantee was five years. Broken stone cost $1.20 per cu. yd. Cement cost 98 cts. per bbl., sand cost 75 cts. per cu. yd., and asphalt cost $22 per ton. Common labor was paid $1.80 per 9-hour day and $4 per day was paid for team and driver.

At Trenton, N. J., 3,505 sq. yds. of "Filbertine" pavement was constructed, the average price, including base and grading, being $1.50 per sq. yd. The total thickness of the pavement was 5½ in., which includes the 4 in. 1-3-6 Portland cement concrete base. The guarantee required was five years. In addition 2,198 sq. yds. of "Filbertine" resurfacing 1½ in. thick was laid on a Belgian block base, the average price per sq. yd. for this resurfacing being $1. Common labor was paid $1.60 per 10-hour day, and $5 per day was paid for team and driver. Portland cement cost $1.50 per bbl., broken stone cost $2.10 per cu. yd. and sand cost $1.33 per cu. yd.

The tables showing the amount and average unit prices of asphalt pavement, creosoted wood block pavement, and brick pavement laid in 1909 in representative American cities will be given in our next issue.

Uniform Municipal Reports.—The Bureau of Statistics of Massachusetts, Charles F. Gettemy, director, has issued Municipal Bulletin No. 1 in accordance with an act of the last legislature whereby the duty is imposed on him of prescribing forms or schedules for uniform annual returns, giving detailed classified receipts and payments, debts, assets and liabilities for cities and towns. The bulletin follows the statutes which have been passed from time to time regarding the legitimate operations of municipalities, and thoroughly analyzes and classifies them, with reference to act and section. With each item is given an explanation of the entries which must be made under it, so that the municipal accounting officer can find out exactly where to put every sum representing a receipt or expenditure, and just how to make the balance sheet for his corporation.

TABLE SHOWING AMOUNT AND AVERAGE UNIT PRICE OF BITULITHIC PAVEMENT LAID IN 1909 IN A NUMBER OF AMERICAN CITIES.

	Sq. yds.	Av. price per sq. yd., including base and grading.	Guarantee. years.	Price per cu yd. for grading if paid separately.	Total thickness of pavement, including base.	Concrete base. Thickness, ins.	Concrete base. Proportions
Beaumont, Tex.	6,834	$2.32	5	.....	7	5	1—3—6
Cambridge, Mass.	16,990	2.50	5	.....	6	..	.....
Charlotte, N. C.	11,000	2.15	5	.....	6	..	.....
Hoboken, N. J.	3,334[1]	2.18	5	.....	..	..	.....
Indianapolis, Md.	11,408	2.00*	9	$0.30	8	6	1—3—5
Meridian, Miss.	75,659	2.15	5	.....	7	5	1—3—5
Newark, N. J.	26,896	2.25	..	.....	9½	6	.....
Portland, Ore.	103[2]	2.10*	10	.30	6	..	.....
Springfield, Mass.	552	2.50	5	.....	7	5	1—3—6
St. Louis, Mo.	93,035	2.15*	5	.....	7	5	1—4—7
Troy, N. Y.	9,436	2.54	5	.....	..	..	.....
Watertown, N. Y.	4,000	2.40	5	.....	..	5	1—7

*Does not include grading.
[1]Laid on old macadam street. [2]Miles.

Water-works and Sewer Section

Note: This section is devoted to methods and costs of constructing sewers and water-works. It will cover the construction work for all details of water supply and sewerage, including sewage purification and water filtration.

The Groined Arch in Filter and Covered Reservoir Construction.*

The groined arch for reservoir and filter roofs has been frequently described in good articles (as for example that by Mr. Leonard Metcalf in the Transactions of the American Society of Civil Engineers for 1900, with valuable discussions by W. B. Fuller and others) and the writer's only excuse for this paper is his participation or acquaintance with the

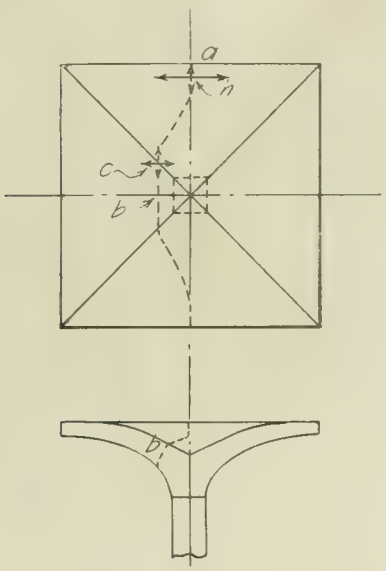


Fig. 1.

design of a number of recent important plants in connection with which fresh consideration has been given to old problems. Incidentally some useful data, mainly drawn from other papers, but extended where convenient, are collected in the paper.

The simple beam, the continuous girder, the simple arch with parallel ends, the retaining wall, and the suspension bridge, all handed down to us through generations of empirical engineering and architecture, succumbed a comparatively long time ago to the analysis of the theorist—at least so far as to yield passable hypotheses on which to tabulate the result of experience, thus permitting confident interpolation or extrapolation for new problems. The groined arch, though used centuries ago, remains a purely empirical type of structure, designed, or speaking more accurately, drawn, without satisfactory mathematical analysis and used without much knowledge of the factor of safety.

The groined arch has long been used in the architecture of public buildings, probably at least since the second century A. D., but its use in engineering structures has been greatly augmented in the last fifteen years by the advent of the covered slow sand filter plant and its attendant filtered-water reservoir, where the purified water is kept free from the algae-stimulating sun. To Mr. William Wheeler of Boston is due the credit for first using the groined arch in this country in water-works construction, the initial plants embodying it being the filters at Somersworth, N. H., and Ashland, Wis.

The reasons other than precedent for this use of the groined arch are in part as follows: (*a*) Absence of air pockets, thus permitting perfect ventilation. (*b*) Economy and simplicity, no reinforcing being used for ordinary conditions. (*c*) Uniform head room both longitudinally and transversely, thus permitting wires for lighting, and pipes or other devices for handling sand to be run level in either direction without waste of head room; also permitting economical lighting.

In 1903 Mr. Leonard Metcalf listed the groined arches in this country with their dimensions and other data, and that list was published in *Engineering News*, Dec. 24, 1903. The following Table I is extended from that of Mr. Metcalf's, the additions including, however, only certain of the larger recent works.

The commonest form of groined arch roof is one in which the intrados is composed of intersecting semi-elliptical cylindrical surfaces and the extrados of intersecting parabolic cylindrical surfaces. The ellipses and parabolas are generally the same in both longitudinal and transverse arches, but are sometimes different when some special dimension is to be matched in each direction. The floors under piers are generally parabolic groins. The following formulas for volume (Fig. 1) of

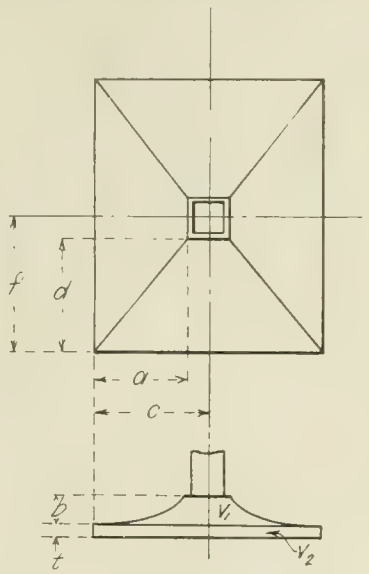


Fig. 2.

such groins were obtained from Mr. John H. Gregory, who worked them out with Mr. W. B. Fuller, while they both were resident at the Albany filter plant for Mr. Allen Hazen.

m = vol. included between plane through top of pier and plane tangent to intrados at crown.

n = vol. of parallelopiped included between planes parallel respectively to intrados and extrados at crown, *i. e.* apart vertically.

p = vol. included between extrados of arch and plane tangent to extrados at crown.

$v = m + n - p$

$m = 4b\ [cf + 2nd/3 - \pi/4\ (cd + af)\ ]$

$n = 4\ fct;\ p = 2/3\ fch.$

If the groin is square as is usual, $a = d$ and $c = f$; $m = 4b\ [C^3 + 2a^3/3 - \pi/2\ ac]$; $n = 4c^2t$; $p = 2/3\ c^2h$.

The floor of filters and covered reservoirs has usually been made of groin units similar to those used in the roof, but inverted, having parabolic instead of elliptical intrados, and having a flat instead of parabolic extrados because of resting on the ground. Mr. Gregory's formulas for volume (Fig. 2) of such units is as follows:

$v = v_1 + v_2$

$v_1 = 4b\ [cf - 2/3\ (af + cd) + ad/2]$

$v_2 = 4\ cft$

If groin unit is square, that is if $d = a$ and $f = c$

$v_1 = 4b\ [C^2 - 4/3\ ac + a^2/2]$

$v_2 = 4C^2t.$

Mr. Gregory has also developed formulas for the most economic shape of filter bed for use in sub-dividing a given area of filter surface into units of a given area. The economy is largely a matter of diminishing length of dividing and marginal walls and is not directly concerned with the roof, which is fixed, except at sidewalks, by total area. There are generally conditions of local topography that fix the layout within rather close limits. Nevertheless it is useful to remember that shape of beds affects economy.

In using Mr. Gregory's table it is necessary to obtain the ratio between cost of dividing walls and cost of outside walls per foot. In the latter cost must be included extra filling both for refill and embankment, also extra excavation to permit placing and to provide material for the extra embankment. With side walls of aqueduct section in ordinary cases this will result in a ratio of about 1 and the economical shape will have width 6/10 to 8/10 of the length, if there are six or more beds.

(*b*) Piers have generally been square but a tendency is noticeable to make them circular. (See, in order of date, lines 38, 40, 28, 29, 35, 41 of Table I). The circular pier has the advantage in construction that a thin sheet iron form can be used. It also gives a more effective distribution of material in the column. It causes a little complication at its junction with the square base of the roof groin unit but this is not serious as the corners of the roof groin base can be easily chamfered just above the pier by stucco blocks, so as to fit the circular top of the pier. Piers of the earlier fillers were enlarged by steps, where in the filter sand, to prevent direct passage of the water without proper filtering. The more recent filters have flaring bases but not steps. Walls of filters have gone through a similar development, batters being used where there were formerly steps.

Returning now to the matter of design, there are several methods of considering the groined arch roof as a support for vertical loads:

(A) The groined arch is often considered as a series of cylindrical arches (Fig. 3) cut off diamond-shape by the groin lines so that only these parts, *bb*, opposite the piers are full-centered, the balance being segmental of length constantly less as the intersections, *a* of groin lines are approached, this length being zero at these intersections. The arch forces traveling down the segmental arches meet corresponding forces from adjacent arches at the groin lines at an angle of 90° and are supposed to have a resultant, acting down the groin line into the pier. This method car-

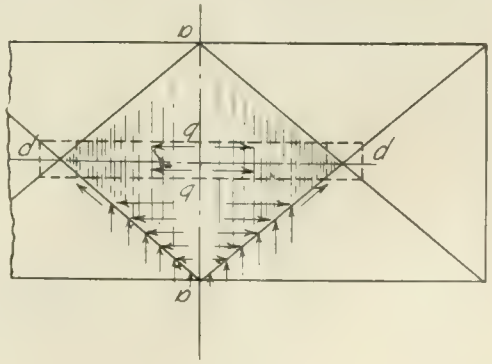


Fig. 3.

ries with it the thought that the arch should be thickened along the groin lines, *a p*, since otherwise there would be no arch to carry the diagonal resultants except what was filched from the adjacent segmental arches. Architecture has many examples of such thickening along the groin. Many of the engineers who design groined roofs, draw lines of resistance by the methods of graphical statics for the full-centered portion of the arch and assume that the segmental portions take care of them-

*From a paper by Thos. H. Wiggin read at the 1910 convention of the National Association of Cement Users.

Table I. Data on Groin Arch Roofs for Filters and Reservoirs

Ref. No.	Date	Location	Description	Area	Depth	Concrete	Steel	Piers Spacing & Size	Vol. used in Piers per Sq. Ft. Roof	Max. Pressure per Sq. Ft.	Cost per Sq. Ft.	Dead Load per Sq. Ft. allowed for Design	Intrados	Spring Line	Key	Remarks
1	1895	Albany, N. Y.	Filters, 8 bays, 97 ft. each	21,000	2'0"	1:2:5	None	24×24	None	11.7		12.5			10 6	
2	1896	Washington, D. C.	Filters, Nos. 1 to 24	11,000	2'0"	1:2:4	None	24×24	None	13	0.47	9.7			10 6	
3	1897	Washington, D. C.	Filters, Nos. 25 to 36	12,000	2'0"	1:2:4	None	24×24	None	13	0.225	9.7			10 6	
4	1898	Louisville, Ky.	Filters, 8 bays, 97 ft. each	24,000	2'0"	1:2:4	None	24×24	None	10	0.61	9.7			11 6	
5	1899	Concord, Mass.	Filters, 8 bays, 97 ft. each	24,000	2'0"	1:2:4	None	24×24	None	11	0.36	9.7			11 6	
6	1899	Albany, N. Y.	Filters, 8 bays, 97 ft. each	21,000	2'0"	1:2:4	30 lbs. Brick	24×24	None	11	0.182	9.7			11 6	
7	1899	Chicago, Ill.	Screenage basin, 100 ft. diam.	7,850	4'6"	1:2:4	6.25 Brick	30×30	None	16	0.277	12.5			7 8	
8	1900	Spokane, Wash.	Filters, pool 1	25,000	2'0"	1:2:4	4.33	25×25	None	12		12.5			7 8	
9	1901	Toledo, O.	Filters, pool 1	22,000	2'0"	1:2:4	2.77 Brick	20×20	0.94	16.3	0 29	12.0			7 8	
10	1902	Milwaukee, Wis.	Filters, 2 bays, 97 ft. each	14,000	2'0"	1:2:4	4.0	24×24	2.70	33.5		13.3			9 10	
11	1902	Toledo, O.	Filters, pool 2	22,000	2'0"	1:2:4	3.36	20×20	2.70	33.5	0 35	9.7			9 10	
12	1902	Newark, N. J.	Reservoir, 1 bay, 97 ft.	13,000	2'0"	1:2:4	3.77	24×24	2.70	33.5		13.3			13 15	
13	1903	Albany, N. Y.	Reservoir, 1 bay, 97 ft.	13,000	2'0"	1:2:4	3.21	18×18	0.75	17.0	0 40	10.4			10 12	
14	1903	Watertown, N. Y.	Filters, 2 bays, 97 ft. each	14,000	2'0"	1:2:4	4.0	24×24	None	11.7		12.5			9 11	
15	1903	Albany, N. Y.	Reservoir, 1 bay, 97 ft.	13,000	2'0"	1:2:4	3.21	18×18	0.75	17.0		10.4			9 11	
16	1903	Albany, N. Y.	Filters, 2 bays, 97 ft. each	14,000	2'0"	1:2:4	4.0	24×24	None	11.7		12.5			9 11	
17	1903	Watertown, N. Y.	Filters, 2 bays, 97 ft. each	14,000	2'0"	1:2:4	4.0	24×24	None	11.7		12.5			9 11	
18	1903	Albany, N. Y.	Reservoir, 1 bay, 97 ft.	13,000	2'0"	1:2:4	3.21	18×18	0.75	17.0		10.4			9 11	
19	1903	Albany, N. Y.	Filters, 2 bays, 97 ft. each	14,000	2'0"	1:2:4	4.0	24×24	None	11.7		12.5			9 11	
20	1903	Albany, N. Y.	Reservoir, 1 bay, 97 ft.	13,000	2'0"	1:2:4	3.21	18×18	0.75	17.0		10.4			9 11	
21	1903	Albany, N. Y.	Filters, 2 bays, 97 ft. each	14,000	2'0"	1:2:4	4.0	24×24	None	11.7		12.5			9 11	
22	1903	Albany, N. Y.	Reservoir, 1 bay, 97 ft.	13,000	2'0"	1:2:4	3.21	18×18	0.75	17.0		10.4			9 11	
23	1903	Albany, N. Y.	Filters, 2 bays, 97 ft. each	14,000	2'0"	1:2:4	4.0	24×24	None	11.7		12.5			9 11	
24	1903	Albany, N. Y.	Reservoir, 1 bay, 97 ft.	13,000	2'0"	1:2:4	3.21	18×18	0.75	17.0		10.4			9 11	
25	1903	Albany, N. Y.	Filters, 2 bays, 97 ft. each	14,000	2'0"	1:2:4	4.0	24×24	None	11.7		12.5			9 11	
26	1903	Herkimer, N. Y.	Filters, 2 bays, 97 ft. each	14,000	2'0"	1:2:4	4.0	24×24	None	11.7		12.5			9 11	
27	1903	Washington, D. C.	Filters, Nos. 25 to 36	12,000	2'0"	1:2:4	None	24×24	None	13		12.5			9 11	
28	1903	Washington, D. C.	Filters, Nos. 37 to 48	12,000	2'0"	1:2:4	None	24×24	None	13		12.5			9 11	
29	1903	Washington, D. C.	Filters, Nos. 49 to 60	12,000	2'0"	1:2:4	None	24×24	None	13		12.5			9 11	
30	1903	New Milford, N. J.	Filters, 200 × 0.97 acre, each 6	135,000	2'0"	1:2:4	3.4	20×20	2.70	33.5		13.3			9 10	
31	1903	New Milford, N. J.	Filtered water reservoir	135,000	2'4"	1:2:4	4.0	Dia. 28	3.64	38.6	4 27	15.5			10 12	
32	1906	Columbus, Ohio	10 filter and reservoir	121,561	Var.	1:2:4	3.77	20×20	None						9 10	
33	1905	Cincinnati, Ohio,	Filters, 28 × 0.4 acre, each, upper set	9,000	2'0"	1:2:4	3.5	20×20	2.70	33.5		13.3			9 10	
34	1907	Jersey City, N. J.	Filters, 104 × 0.4 acre, each	36,000	2'0"	1:2:4	3.5	20×20	2.70	33.5		13.3			9 10	
35	1907	Jersey City, N. J.	Filtered water reservoir	135,000	2'0"	1:2:4	3.5	20×20	2.70	33.5		13.3			9 10	
36	1906	Pittsburgh, Pa.	Filtered water reservoir	135,000	2'0"	1:2:4	3.5	20×20	2.70	33.5		13.3			9 10	
37	1907	New Orleans, La.	Filters, 16 × 0.4 acre, each	36,000	2'0"	1:2:4	3.5	20×20	2.70	33.5		13.3			9 10	
38	1907	Des Moines, Ia.	Filters, 12 × 0.4 acre, each	36,000	2'0"	1:2:4	3.5	20×20	2.70	33.5		13.3			9 10	
39	1907	Memphis, Tenn.	Filters, 10 × 1 acre, each	45,000	2'0"	1:2:4	3.5	20×20	2.70	33.5		13.3			9 10	
40	1907	Memphis, Tenn.	Filters, 10 × 1 acre, each	45,000	2'0"	1:2:4	3.5	20×20	2.70	33.5		13.3			9 10	
41	1907	Memphis, Tenn.	Filtered water reservoir, 52 acre	135,000	2'0"	1:2:4	3.5	20×20	2.70	33.5		13.3			9 10	
42	1907	Memphis, Tenn.	Filtered water reservoir, 52 acre	135,000	2'0"	1:2:4	3.5	20×20	2.70	33.5		13.3			9 10	
43	1907	Springfield, Mo.	Filtered water reservoir, 1 acre	1,500	2'0"	1:2:4	3.5	20×20	2.70	33.5		13.3			9 10	
44	1904	New York City	Filtered water reservoir, 1 acre	1,500	2'0"	1:2:4	3.5	20×20	2.70	33.5		13.3			9 10	

selves somehow down the groin lines without strengthening under the groin. Without an elastic theory for the groined arch it is impossible to compute with any mental satisfaction where the true line of resistance goes, ever assuming the rigidity of abutments. Lines of resistance are generally drawn so as to start at the crown at a point distant from the center of thickness by one-sixth that thickness. This results in a maximum compressive stress twice as great as the average, in accordance with the well-known middle-third theory. Figure 4 shows the result of a line of resistance drawn for the full-centered arch of the filtered water reservoir, Pittsburgh, Pa.

(B) The next method is best conceived of if one imagines the arch cut vertically along the groin lines. (Fig. 5.) The stresses in the segmental portion of the arch are conceived as converging gradually as the pier is approached. Or, in other words, the thrust from the segmental arches is converged over gradually to the full-centered part opposite the pier. Fig. 6 shows result by this method applied to the roof of the filtered water reservoir at Pittsburgh, this being comparative with the result of Fig. 4 mentioned above. The crown thrust is about three-fourths as great as is the barrel arch method.

(C) The next method consists in considering each square groin unit as a cantilever or inverted dome just as if no bearing existed with the adjacent groin units. (Fig. 7.) These are really two methods as the dome idea places the groin unit entirely in tension whereas the cantilever has tension and compression on any vertical or approximately vertical section just as in a beam. The concrete in the top of the arch at a point such as *h* would seem to have tension in two principal directions at right angles to each other as shown by the arrows and of intensities having something like the ratio indicated by length of arrows. By the "theory of elasticity" these tensions at right angles would each reduce the effect of the other in rupturing the concrete. Similarly on the under side, the compressions would aid each other. The magnitude of the effect due to similar stresses at right angles is considered as ⅓ or ¼: for example, a tensile strain in one direction will cause a compressive strain of ⅓ or ¼ its intensity, in a direction at right angles, and by that amount will diminish any tensile strain existing or tending to exist in this plane at right angles. The truth of this theory may be seen qualitatively by pulling in two directions on a wide rubber band. At point *a* stress apparently exists only in one direction, and at a point like *c* on the groin line equal stresses in each direction would exist. It is hard to see how the reduction in maximum strain could be over 1/6 to 1/8.

As for the dome conception, the groin unit is not well adapted for such action, being square instead of round and requiring sharp changes of direction in tying stresses at the groin lines. Tests, to destruction, made under the writer's direction, of several groin units 15 ft. square and standing unsupported on all sides, showed that the initial crack always came at the middle of one of the sides. The weakest section, while not exactly determinable, is probably about as shown by line *a b c a* Fig. 7. Fig. 8 shows a computation on this cantilever basis of the strength of the groin units of the filtered water reservoir,

† This table has not been thoroughly checked.
‡ Will not be built.
a Cost column covers cost in place only from springing line of roof.
b Earth cover and engineering not included unless so stated.
c Earth cover, etc., included total excl engineering only 10¢, [illegible] see Text. Steel Reinforcement.
d Including filling, manholes, etc., but excluding engineering.
e Cost per sq. ft. is est. from force acc'ts. Contr's. price was less. P[illegible] manufacturer.
f Including sand Stored [illegible]
g 4/5 of clear well with these arches.
h 1/5 of clear well with these arches.
i Carries filters, about 1100 [illegible] Reinforced with ½" square twisted bars, spaced 12" in both directions.
j Cost includes concrete and centering for bay without ventilator.
* These dimensions were scaled.

First 27 references compiled by Leonard Metcalf, see "Journal of New England Water Works Association." Remainder compiled by Morris Knowles and Thos. H. Wiggin.

Pittsburg. The exact determination of all loads acting on the cantilever and their centers of gravity is too burdensome to be justified in so crude a method. Fairly close approximation can be estimated, however, as will be evident from the following explanations.

Computation of Grain Unit as Cantilever (See Fig. 8): The Pittsburg filtered water reservoir was planned for a filling varying from 4½ ft. at the road in center down to about 4 ft. at the edges. It has actually only 3 ft. filling. In Table I the loading is taken as 3 ft. at 110 lbs. + 15 lbs. of snow, following out Mr. Metcalf's methods: total load 345 lbs. per sq. ft. In Tables II and III the results are carried out both for the actual loading on the above assumptions and for 4 ft. of filling at 100 lbs. plus 100 lbs. live load, the latter agreeing more nearly with assumptions used in design and also making the figures comparative with those of Mr. Caslerls arch computations given in Fig. 6. The loads and lever arms referred to the assumed surface of fracture are as follows:

Weight of Concrete: Half the groin unit less that part at pier within line of fracture. From Table I, average thickness 8.2 ins.

Wt. of ½ groin $\frac{8.2 \times 18 \times 9 \times 150 \text{ lbs}}{12} =$ 16,600 lbs.

Weight of pier to be deducted (dimension scaled from Fig. 8): irregular figure assumed to be a trapezoid):

Upper base 1.7 × 6 =	10.2
4 × midsection = 4 × 1.6 × 3.2 =	20.5
Bottom section = 1.125 × 2.25 =	2.5
Total	33.2

$\frac{33.2 \times 2.8}{6} \times 150 \text{ lbs.} = 2{,}300$

Net dead weight outside of surface of fracture = 16,600 — 2,300 = 14,300.

Lever Arm (eye estimation) 3.75 ft. equals 45 ins.

Earth Filling in Hollow Over Pier: Total quantity equals 4.34 cu. yds. (See Table I). From ½ of 4.34 yds. subtract part within line of fracture. (Dimensions are scaled from Fig. 8; irregular figure assumed to be a trapezoid):

	Lbs.
½ × 4.34 × 27 × 100 lbs =	5,860
Upper base 6 × 1.5 =	9.0
4 × midsec. = 4 × 5.6 × 1.4 =	31.4
Lower Base =	0.
Total	40.4

$\frac{40.4}{6} \times 2.17 \times 100 \text{ lbs.} =$ 1,460

Weight of earth filling in hollow and outside of surface of fracture = 5,860— 1,460 = 4,400

(Second assumption). Weight of same if assumed 110 lbs. per cu. ft. = 4,800

Lever arm (eye estimation) 2¼ ft. = 27 ins.

Four ft. of earth filling at 100 lbs. above plane through extrados at crown plus 100 lbs. live load:

Part outside of surface of fracture = (18 × 9-6 × 1.5) at 500 lbs. = 76,500 lbs.

(Second assumption). Three ft. of earth filling at 110 lbs. plus 15 lbs. snow load = (18 × 9-6 × 1.5) at 345 lbs. = 52,800 lbs.

Lever arm estimated at 4 ft. = 48 ins.

The tensile strength at the critical point at the top of the groin may be obtained by the usual formula for beams:

$f = \frac{My}{I}$ where f is the stress desired.

M is the moment, in inch lbs., of the loads.

y is the vertical distance from the center of gravity of the surface of fracture to the point where the stress is desired.

I is the moment of inertia of the surface of fracture. In the computations the projections of this surface is used and lever arms are measured from a point about 1 ft. out from the center of pier. Approximations are unavoidable.

The computations and results are shown in Tables II and III. It will there be seen that the dead load of the concrete alone results in a stress of about 65 lbs. per sq. in., while the 500 lbs. per sq. ft. and 345 lbs. per sq. ft. loadings above the extrados resulted in 460 and 340 lbs. tension respectively. It is therefore not surprising that the test groin units, standing alone break of their own weight or with at most a load of 200 lbs. per sq. ft.

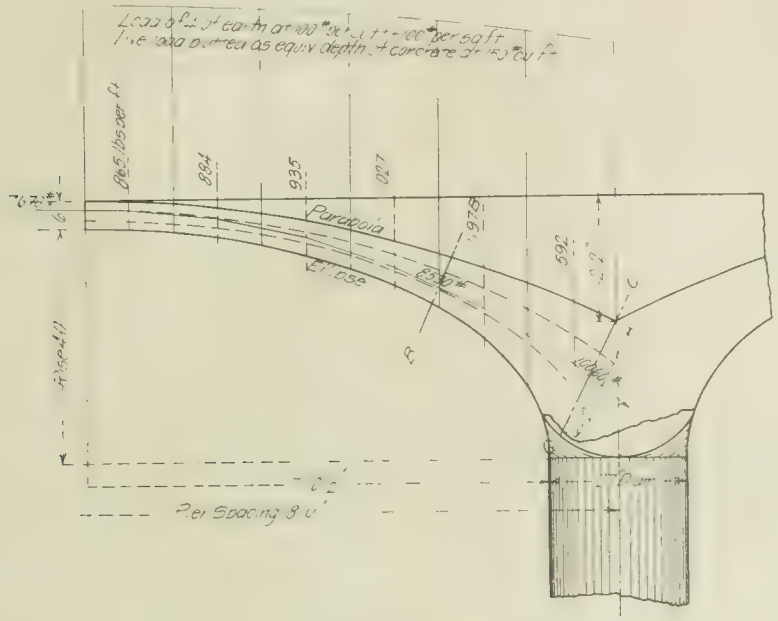


Fig. 4. Stresses in Groined Arches; Method Assuming Stresses Same as in Barrel Arches—Applied to Filtered Water Reservoir at Pittsburg, Pa.

TABLE OF STRESSES IN ARCH.

Location of Section.	Thrust per lin. ft. of arch	Area in sq. in.	Av. stress in lbs per sq. in.	Max. stress in lbs. per sq. in.
Crown	*7670	6 x12	106.5	213
HB	8530	10x12	71	142
CC	10060	25x12	33.5	

Crown thrust for whole groin unit 7670 × 18 = 138000 lbs.

EFFECT OF STEEL IN GROIN UNIT.

A natural suggestion for reinforcing a groin unit is to place a ring of steel around the unit in the manner indicated in Fig. 8. Such a device was used at Louisville (see line 4 of Table I). There are several ways of estimating quantitatively the effect of such steel.

(a) Consider that it assists the concrete in the upper part of the groin unit in carrying tension. It would then be necessary to add enough steel to bring the tension in the concrete down to a conservative unit, say 50 lbs. per sq. in. The steel could not be at the very outside fibre ($y = 1.25$, see Fig. 8) but might be say 1 ft. from the center of gravity of the concrete section. The neutral axis would be raised very much if enough steel should be added to the tension side so that the full dead and live loads might be carried with only 50 lbs. tension in the concrete. This would diminish the area of tension concrete and increase the steel needed. But assume, even, that the neutral axis does not rise: the steel would have

$$\frac{E_s}{E_c} \cdot \frac{1.}{1.25} \cdot 50 =$$

say 500 lbs. per sq. in. tension when the concrete had 50 lbs. There is approximately 3.1 sq. ft. of concrete surface above the neutral axis in the half section of fracture (see Fig. 8) and under the 500 lbs. per sq. ft. loading, Tables II and III, the tensile stress on it varies from 0 to 460 lbs. per sq. in. or roughly 230 lbs. average. To reduce this stress so as to make it vary from 0 to 50 as above assumed, or 25 lbs. average, would require, by this rough method of computing the quantity of steel, X sq. ft. as shown by the following: $144\ X \times 500 + (3.1 - x)\ 25 = 3.1 \times 230 \times 144$.

$X = 1.3$. That is, 1.3 sq. ft. of concrete on the tension side of each half section would have to be replaced by steel to bring the tension in the concrete down to 50 lbs. per sq. in. If proper account were taken of the rising of the neutral axis, the result would be considerably in excess of 1.3 sq. ft., but this result is sufficient to show the absurdity of the conception, which is treated at this length, only because it is often assumed that *somehow* by adding a little steel joint action will result between the steel and concrete in tension, and at nominal expense make a structure which will stand any abuse safely.

(b) Assume that the concrete takes no tension and that the compression on it may be as high as 600 lbs. per sq. in. *i. e.* the usual reinforced concrete beam theory. All warranted accuracy in computing the steel by these assumptions will result from estimating the "Centroid" of compressive stresses and using the lever arm between this centroid and the steel. For the full groin loading the neutral axis will drop and the centroid likewise from their positions without steel. The centroid without steel is about 1 ft. below the neutral axis and the outer fibre on the compressive side 1.4 ft. Assume 1.15 ft. as the distance of the new centroid. 1.05 ft. is the greatest practicable distance for the steel above the neutral axis. The steel hence has

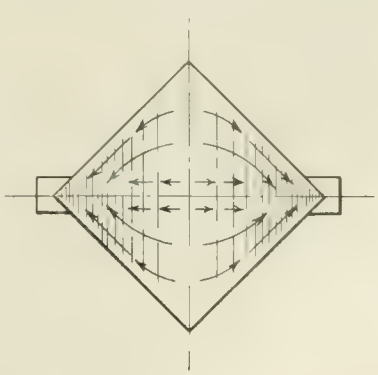


Fig. 5.

TABLE II.—COMPUTATION OF MOMENT OF INERTIA OF ASSUMED SURFACE OF FRACTURE.

No. of Secti'n	b	h	I_0	a	g	ag^2
1	1	.52	.012	.52	1.0	.52
2	1	.53	.012	.53	.90	.43
3	1	.55	.014	.55	.78	.34
4	1	.57	.015	.57	.60	.21
5	.5	.61	.009	.30	.40	.05
6	.5	.65	.011	.33	.25	.02
7	.5	.70	.014	.35	.08	0
8	.5	.80	.021	.40	.10	0
9	.5	.90	.030	.45	.40	.07
10	.5	1.1	.055	.55	.63	.22
11	.5	1.05	.048	.53	.75	.30
12	1.5	1.02	.125	1.53	.82	1.01
Total			.366			3.17

EXPLANATION.

$I_0 = \frac{1}{12} bh^3$.

g = distance from C. of G. of small section to neutral axis.

I for half section:

$I = \Sigma I_0 + \Sigma ag^2$ (All dimensions
$= .37 + 3.17 = 3.54$ in feet.)

I for whole section:

$I = 2 \times 3.54 \times 12^4$ (All dimensions in inches.)

TABLE III.—LOADS, MOMENTS, AND MAX. TENSILE STRESSES FOR LINE OF FRACTURE SHOWN.

No. of Line	Load. Description.	Load. Weight.	Assumed Lever Arm in Inches.	Moment in 1000 in-lbs.	Max. Tensile Stress due to Mom $f = \frac{My}{I}$
1	Concrete	14300	45	640	
2	Earth filling below crown at 100# per cu. ft.	4400	27	120	65
3	Earth above crown: 4′ at 100# per cu. ft. + live load = 100# per sq. ft. Total load = 500# per sq. ft.	76500	48	3680	
4	Total for 1+2+3			4440	
5	Earth filling below crown at 110# per cu. ft.	4800	27	130	460
6	Earth above crown: 3′ at 110# per cu. ft + 15# snow. Total = 345# as per table of groined arches.	52800	48	2540	340
7	Total for 1+5+6+ as per table of groined arches			3310	

a lever arm of 1.15 + 1.05 = 2.2 ft. For a moment of 4,440,000 in. lbs. the steel would have to carry

$$\frac{4{,}440{,}000}{2 \times 2.2 \times 12} = 83{,}000 \text{ lbs.}$$

and of mild steel 5 to 7 ins. would be needed. Tests have shown that lapping such steel is not successful on account apparently of the thin section of concrete splitting. Such reinforcement is hard to place satisfactorily around the corners as the extrados is depressed along the groin line so that the steel has to be kept out near the corner and hence turned sharply (See Fig. 8). This brings a heavy compressive stress on the concrete at the inside of the curve in the steel. The steel will apparently have about ⅝ as much tension at the groin lines as at the middle of the sides, or say 12,000 lbs. per sq. in. Assume a radius of 18 ins. for a bar 1½ ins. square as in the contract plans of the Pittsburg filtered water reservoir. Further, assume the stress is carried around the corner by uniform radical pressure as in cylinder under hydraulic pressure.

$1.5^2 \times 12{,}000 = 27{,}000$ lbs. in the bar.

The bearing pressure of the steel against the concrete would then be

$$\frac{27{,}000}{1.5 \times 18} = 1{,}000 \text{ lbs. per sq. in.}$$

Enough has been written, the writer thinks, to eliminate cantilever, or inverted dome action as the final reliance in carrying load. Arch action is adequate without aid from cantilever action.

Shrinkage and Temperature Changes.—But the problem is not so simple as it seems from the foregoing academic discussion of the arch theories. The disturbing elements are two: (a) Shrinkage of concrete in setting; (b) Expansion and contraction of concrete with change of temperature.

Groined arch roofs are usually laid in strips of random length and as they set, it is frequently possible to see upward between the strips. Less shrinkage takes place if sprinkling is faithfully done and the earth covering is put on early.

As for temperature, the concrete will usually be subjected, before the filters or reservoirs are put in service, to extremes from 90° to say 15° F or lower. This means a change in length of ⅝-in. in every 100 ft. or approximately ⅛-in. for every groin unit. To keep the arch action in those groins in which the concrete cannot endure a high tension in cantilever action (See Fig. 8 for magnitude of tension) it is apparently necessary for cracking to occur sufficient to move each side of the groin outward from the pier, a distance of about 1/16-in., *less* the slight movement resulting from the elasticity of the concrete when acting as a cantilever. If this cracking took place along the line of fracture assumed in Fig. 8, it would be visible at the crown on the inside but probably not elsewhere from the inside without minute examination. Such cracks are occasionally seen but no one has ever excavated on the outside so far as the writer knows to trace them for their full length. They would exist in their maximum size only in the coldest weather before the reservoir or filter was closed for service. Examinations are not usually made at such times in any unnecessary cases. After the works are in service the temperature would rarely be below 40° F and lesser cracks only would exist.

Aid Given by Earth Covering.—In all these considerations one factor has been neglected, viz., the value of the earth cover. Ordinary earth filling does not crack with reduced temperature, but more often expands due to freezing of water in the interstices. Mr. F. H. Robbins has pointed out that a very few pounds per square foot in the earth cover would transmit the crown thrusts without help from the concrete. If this action occurred the concrete would be held generally along its top surface by friction and cracks might be distributed. The earth filling the depression would in any case tend to hold the sides of the groin units away from the pier. No proved conclusion on the temperature matter can be drawn except that every groined roof that has not been admittedly maltreated in construction, by allowing the concrete to freeze or by pulling the centers prematurely, has stood successfully not only its uniform load from fill, but sundry extra loads, such as piles of construction material and heavy concentrated loads hung from the roof by rods. This throws the matter back to the initial proposition of the paper that the theory of groined roofs is incomplete, for the factor, or perhaps better, the margin of safety is undertaken.

Construction Stresses.—During the construction of groined arch roofs it is occasionally necessary to leave a strip of roof uncompleted so that a space intervenes between the completed roof and the side or end wall of the filter or reservoir. This leaves the groined arches without abutments and at once raises the question as to whether the forms may be removed and earth filling placed also. Construction foremen will tell tales of long edges exposed with the fill completely placed, but the writer has always been unable to substantiate these statements from the engineers in charge. At the Pittsburg filters, long strips of roof had to be omitted to form lanes through which the cableways could operate, but when filling was to be placed on the roof, diagonal bracing was required, strong enough to transmit the thrust to the floor. That this bracing was a wise precaution is attested by the fact that in spite of it some of the piers were lifted 1/16-in. or so from their bases on the side away from the braces and another opening took place at the top of the pier. Pictures are shown of teams or moderately heavy rollers going along close to the edge of a void the size of two or three groin units. When it is considered that such loads cover an area of perhaps 50 sq. ft. and are not even equivalent in weight to the earth which would be on that small area: further that the groin is usually

TABLE IV.—COMPUTATION OF SAFE LOADING ON ROOF OF FILTERED WATER RESERVOIR, PITTSBURG, ADJACENT TO AN UNFINISHED EDGE OF ROOF. CASE II.
FILLING TAPERED AS IN FIG. 10.

No. of Pier and Groin (Fig. 10).	*Resistance to Overturning 1000 Ft.-Lbs.	Total Resistance to Overturning 1000 Ft.-Lbs.	Safe Loading on Next Groin Unit (For Thrusts, see "Assumptions" above listed).
1	2	3	4
1 to 5 (Incl.)	Each 76	380	Own weight A_3 310
6	76	456	Own weight 310 Filling in hollow (b_3). 69 = 379 $456 - 379 = 77 + \frac{77}{375} = .20'$ fill over crown.
7	Own weight 76 Fill in hollow 22 $.20 \times 62 =$ 12 110	566	$566 - 379 = 187 + \frac{187}{375}$ 50
8	$75 + 22 =$ 98 $.50 + 62 =$ 31 129	695	$695 - 379 = 316 +$ 84
9	98 $84 \times 62 =$ 52 150	845	$845 - 379 = 466 +$ 1 24
10	98 $1.24 \times 62 =$ 77 175	1020	$1020 - 379 = 641 +$ 1 71
11	98 $1.71 \times 62 =$ 106 204	1224	$1224 - 379 = 845 +$ 2 25
12	98 $2.25 \times 62 =$ 140 238	1462	$1462 - 379 = 1083 +$ 2 90
13	98 $2.90 \times 62 =$ 140 278	1740	$1740 - 379 = 1361 +$ 3 65
14	98 $3.65 \times 62 =$ 225 323	2063	$2063 - 379 = 1684 +$ 4 00 + 50 lbs. per sq. ft. live load.
15	98 $4.50 \times 62 =$ 280 378	2441	$2441 - 379 = 2062 +$ 4.00′ fill over crown. + 150 lbs. per sq. ft. live load.

* See Items 5, 7 and 9 of Data above. † See Item C above.

entirely free from its earth load in such cases; further that friction between groins would carry the stress to the groins at the end of the void space, it would be indeed surprising if the arch did not easily endure the load.

It is recognized in construction that earth filling may be safely placed within a reasonable distance depending on the height of roof, of an incomplete edge of filter or reservoir groined roof and it is pertinent to inquire what the limits of safety are. The only resisting forces are the cantilever action in the groin units and the stability of the piers weighted with their superimposed groins. Two cases may be considered.

Case I.—Earth loading on roof terminated

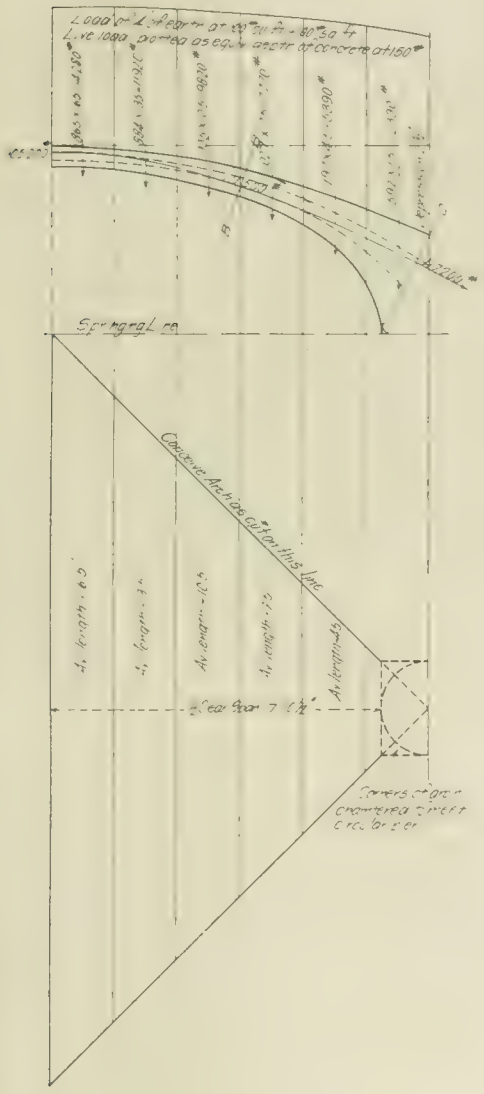


Fig. 6.—Stresses in Groined Arches; Method Assuming Arch Cut on Groin Lines.—Applied to Filtered Water Reservoir at Pittsburg, Pa.

TABLE OF STRESSES IN ARCH.

Sec. loc.	Thrust lbs.	Area sq. ins.	Av stress lbs. sq. ins.	Max stress lbs. sq. ins.
Crown	105,200	216"x6"	81.5	163
BB	111,700	108"x7.75"	133.5	267
CC	117,200	27"x25"	174	348

abruptly:

Let n = number of empty groins with piers that are necessary to resist the thrust from the loaded portion of roof.

Then for the filtered water reservoir at Pittsburg (see Table I).

Weight of one pier $= 3.98 \times 21.5 \times 150 = 12{,}800$ lbs.

Lever arm of pier $\frac{2.25}{2}$ — 17 ins. = .95 ft.

Weight of groin unit =

$$\frac{8.2}{12} \times 18^2 \times 150 = 33{,}200 \text{ ft.}$$

Lever arm of groin unit = 2.25 — .33 = 1.92 ft.

(This assumes that there is enough friction and continuity in the roof at the crown points to keep it in its original plane and not permit tipping. Otherwise the lever arm would be only half as great. Observations bear out the assumptions.)

(a) Assume thrust as in Fig. 6 = 105,200 lbs.; lever arm = 21.5 ft.

Then n (12,800 × .95 + 33,200 × 1.92) = 105,200 × 21.5; 75,900 n = 2,260,000.

n = 30. That is, it would take 30 groin units and piers, or 540 ft. of unloaded reservoir roof, to resist the overturn due to a full load on the adjacent roof. Whatever strength other groin units have as cantilevers, including any effect of continuity of several units, would constitute the only margin of safety. If it were not desired to risk the groins supporting their own weight as cantilevers, it would be necessary to leave the forms under the roof for a sufficient distance from the edge so that the stability of the supported groins would take the thrust from an unsupported unloaded groin. It is customary to thus leave forms in place. The number required to be supported by forms will appear from Case II below. It should be noted that any part of the weight of roof that is carried on wooden posts supporting forms is not available to resist overturn. The weights of forms coming on piers may be assumed to offset this deduction.

Case II.—Assume earth loading to be tapered off toward the edge. This will permit full loading nearer the edge than in Case I since the partial earth loading increases the stability. Even a reasonable estimate under the assumptions requires considerable detailed computation.

Data: (See Case I for certain results below listed):

1. Weight of one pier, 11,400 lbs.
2. Assumed lever arm of pier, .95 ft.
3. Weight of one groin unit, 33,200 lbs.
4. Assumed lever arm of groined units (also of any loading or groin unit), 1.92 ft.
5. Resistance to overturn of one pier and groin unit, 76,000 ft. lbs.
6. Weight of filling in hollow of groin, 4.34 yds. at 2,700, 11,700 lbs.
7. Resistance to overturn afforded by filling of hollow in groin unit = 11,700 × 1.92 = 22,500 ft. lbs.
8. Weight of one foot of filling at 100 lbs. or of 100 lbs. per sq. ft. live load 18 × 18 × 100 = 32,400 lbs.
9. Resistance to overturn afforded by one foot filling equals 32,400 × 1.92 = 62,000 lbs.
10. Load on one groin unit due to 4 ft. of filling and 100 lbs. sq. ft. live load = 500 × 18 × 18 = 162,000 lbs.

TABLE V.—COMPUTATION OF SAFE LOADING ON ROOF OF FILTERS 1 TO 46 AT PITTSBURGH, PA. ADJACENT TO AN UNFINISHED EDGE OF ROOF.

CASE II. FILLING TAPERED AS IN FIG. 11.

No. of Pier and Groin. (Fig. 11).	* Resistance to Overturn 1000 Ft.-Lbs.	Total Resistance to Overturn 1000 Ft.-Lbs.	Safe Loading for NEXT Groin Unit. (For Thrusts, see Assumptions above listed).
1	2	3	4
			Own weight (A_3) ..... 87.5 ft. lbs. Filling in hollow (b_3) 16.5
1 to 3 Incl.	Each 51	153	104 153 − 104 = 49 + $\frac{49}{112}$ = .44′ fill above crown.
4	Own weight 51 Fill in hollow 14 .44×48 = 21 86	239	239 − 104 = 135 + $\frac{135}{112}$ = 1.20′ " " "
5	51+14 = 65 1.2×48 = 58 123	362	362 − 104 = 258 + $\frac{258}{112}$ = 2.30′ " " "
6	65 2.3×48 = 110 175	537	537 − 104 = 433 + $\frac{433}{112}$ = 3.9′ " " "

Result indicates that full depth of filling could be placed on the 7th row of groin units from edge; i. e., about 90 ft. from edge.

* See Items 5, 7 & 9 of "Data" above. † See Item (C_3) above.

Thrust with 500 lbs. sq. ft. load (See Fig. 6) = 105,200 lbs.

Assumptions.—The thrust of 105,200 lbs. is due to the dead load, earth load and live load roughly in proportion to weight of each load but is more closely proportioned on the assumption that it is due to

(a) 8/10 of dead weight of groin unit; (b) ½ of filling in hollow of groin unit; (c) the whole of filling and live load above plane through extrados of crown.

The use of 8/10 and ½ the loads in (a) and (b) is due to the fact that a part of weight of groin unit and filling in hollow is concentrated near pier.

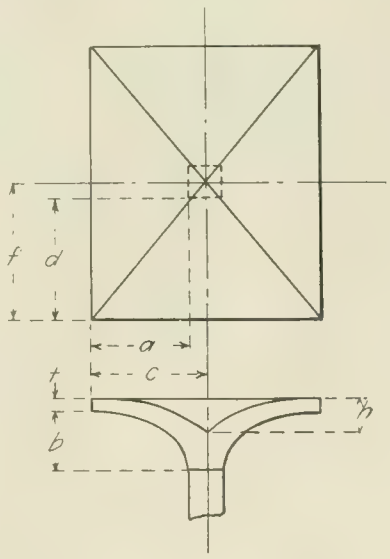


Fig. 7.

(a_1) 8/10 × 33,200 = ... 26,600
(b_3) ½ × 11,700 = ... 6,000
(c_1) 1 × 16,200 = ... 162,000
194,600

Causes thrust of 105,200 lbs.

(a_2) $\frac{26{,}600}{194{,}600}$ × 105,200 = ... 14,400 lbs.

thrust due to weight of given unit.

(b_2) $\frac{6{,}000}{194{,}600}$ × 105,200 = ... 3,200

assumed to be due to filling in hollow.

(c_2) $\frac{32{,}400}{194{,}600}$ × 105,200 = ... 17,500

assumed to be due to each foot of filling or 100 lbs. sq. ft. live load above crown.

(a_3) 14,400 × 21.5 = ... 310,000 ft. lbs.

TABLE VI.—CHARACTERISTICS OF [illegible]

*Ref. No.	Date	Location	Engineer	Pier Spacing.	Size of Base on Which Pier Rests.	Thickness Under Pier.	Thickness of Invert.	Average Thickness.	Thickness of Puddle.	Kind of	
6	1899	Albany, N. Y.	Allen Hazen	13'- 8"	30"x30"	15"	6"	8 2"	0		Filters.
9	1901	Phila., Pa., Low, Roxborough....	John W. Hill.....	15'-10"	36"x36"	14"	6"	8 0"	12"		Filters and Reservoir
11	1902	Upper Roxborough...		15'-10"	36"x36"	14"	6"	8 0"	12"		
18	1905	[illegible]		15'- 3"	36"x36"	14"	6"	8 1"	12"		
19				15'-10"	24"x24"	14"	6"	7 7"	12"		Filtered Water Res
20		[illegible]		15'-10"	36"x36"	14"	6"	8 0"	12"		33 Filters
21				15'- 0"	36"x36"	14"	6"	8 1"	12"		22 Filters.
22				15'-10"	24"x24"	14"	6"	7 7"	12"		Filtered Water Res
23		Washington, D. C.	C. A. M. Myer	14'- 0"	32"x32"	15"	6"	8 2"	0		Filters 1-24.
30		New York City, Stapleton	W. B. Bowker	17'- 6" x 16'- 8"	36"x36"	16"	8"	‡10 0"	0	Rock, Hardpan, etc	200 Filters.
31		[illegible]		22'- 4"	30"x30"	24"	12"	‡14 5"	0	‡Rock.	Filtered Water Res
39	1904	Pittsburgh, Pa.	Morris Knowles	15'- 0"	36"x36"	17"	8"	‡10 4"	0	Mostly Silt.	Filters 1-46.
40				18'- 0"	24"x24"	22"	10"	‡12 6"	0	Sandy Grav.	Filtered Water Res.
41	1908			14'-10"	[illegible]	[illegible]	[illegible]	6 6"	0	Sandy Grav.	Filters 47-56
44	1909	New York City, Hebrew	J. Waldo Smith.....	22'- 0"	36"x36"	‡18"	6"	8 0"	0	Hardpan.	Filtered Water Res.

*Sixty-four [illegible] Reports.
†Not built.
□Above design now abandoned and uncovered reservoir with flat floor to be built.
aPier foundation 6'x6'x12" thick, reinforced with 16-¾" sq. steel bars. (Total weight = 126#) Rest of floor 5" thick, except for 4"x12" water stops under diagonal joints.
‡Design for Rock—Rock now known not to exist.
=Bottom of floor under pier is 6" higher than bottom under invert, thus saving a pyramid of excavation and concrete 22'x 22'x 6", or an average of 2" over whole area. Excava. somewhat complicated. Done to improve drainage of excava. under piers.
xTwo layers of concrete instead of one layer of concrete and puddle. Feb., 1910.

Overturning moment assumed due to weight of groin unit.

(b₁) 3,200 × 21.5 = ... 69,000 ft. lbs.

Overturning moment assumed due to filling in hollow.

(c₁) 17,500 × 21.5 = ... 375,000 ft. lbs.

Overturning moment assumed due to 100 lbs. sq. ft.

(d) 105,200 × 21.5 = ...2,250,000 ft. lbs.

Overturning moment assumed due to total load.

The computation in the table results in permitting the assumed fill loading over the 18th pier from the edge. The table shows also that a filling of 3 ft. such as was actually used could be permitted over the 15th or 16th pier. Such relatively elaborate computations and applications of them have not been made in practice so far as the writer knows. Reservoirs of such large area exist at only a few places and the *filter* roofs are more stable by reason of lower and broader-based piers. Dividing walls also introduce stability about every 100 or 200 ft. This is so important a point in construction that a similar determination is given below for the Pittsburg filters to illustrate the more common problem. The thrust taken in connection with Fig. 9, will be applicable to Case I also.

Data For Case I and II (see also Table I, line 39):

1. Weight of one pier, 35.3 cu. ft. at 150 = 5,300 lbs.

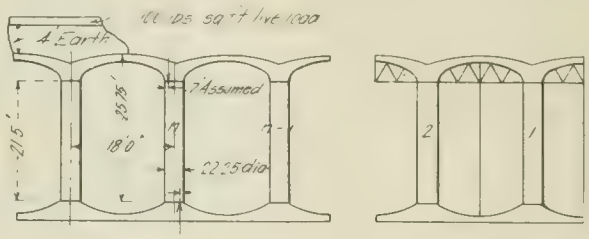


Fig. 9.

2. Lever arm of pier (assumed) = 1.33 ft.
3. Weight of one groin unit 15 × 15 × 7.3 ÷ 12 at 150 = 20,500 lbs.
4. Assumed lever arm of groin unit (also of any loading on unit) = 2.17 ft.
5. Resistance to overturning of pier = [illegible] of filling = 22,500 × 2.17 = 48,000 ft. lbs.
7. Resistance to overturning, afforded by filling in hollow = 6,560 × 2.17 = 13,000 ft. lbs.
8. Weight of 1 ft. of filling on a groin unit at 100 lbs. = 22,500 lbs.
9. Resistance to overturn afforded by 1 ft. of filling = 22,500 × 2.17 = 48,000 ft. lbs.
10. Weight of 3 ft. of filling on one groin unit = 67,500 lbs.

Assumptions (as before).

(a₁) .85 × 20,500 = ...17,600
(b₁) ½ × 6,560 = ... 3,300
(c₁) 1 × 67,500 = ... 67,500

88,400

causes thrust of 50,000 lbs.

(a₂) $\frac{17,400}{88,400} \times 50,000 =$ ....10,000 lbs.

thrust assumed due to wt. of groin unit.

(b₂) $\frac{3,300}{88,400} \times 50,000 =$..... 1,900 lbs.

thrust assumed due to filling in hollow.

(c₂) $\frac{22,500}{88,400} \times 50,000 =$ 12,800 lbs.

thrust assumed due to 100 lbs. sq. ft.

(a₃) 10,000 × 8.75 = ... 87,500 ft. lbs.

Overturning moment due to groin unit.

(b₃) 1,900 × 8.75 = ... 16,600 ft. lbs.

Overturning moment due to filling in hollow.

(c₃) 12,800 × 8.75 = ... 11,200 ft. lbs.

Overturning moment due to 100 sq. ft.

(d₃) 50,000 × 8.75 = ...438,000 ft. lbs.

Overturning moment due to total load.

Case I—Loading terminated abruptly as in Fig. 9.

51,000 *n* (See Item 5 of "Data" above) = 500,000 (See Item d₃ of "Assumptions above).

n = 12 that is, full loading could be placed on arch 180 ft. from edge.

Most of the piers of filters 1 to 46 at Pittsburg were concreted monolithic with the roof and hence offered further resistance, (as long as the roof acted continuously) to the extent that their strength as cantilever beams permitted. At 50 lbs. per sq. in. in allowable tension, each pier would add resistance, *R*, computable as follows:

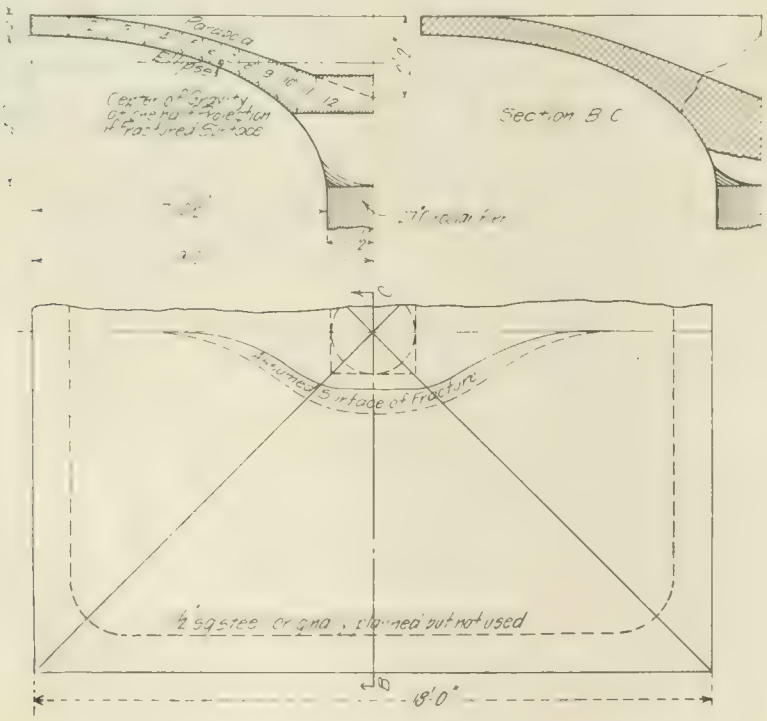

Parabola
Ellipse
Center of Gravity of Figure of Rotation if Fractured Surface
Section B C
Assumed Surface of Fracture
½ Section of area planned but not used
18'0"

Fig. 8.

is 50,000 lbs. per groin unit on the assumption of an arch triangular in plan as in Fig. 7.

There are two cases to be considered as before. The figure is drawn for case II, but,

groin unit = (5,300×1.33) + (20,500×2.17) = 51,000 ft. lbs.

6. Weight of filling in hollow of groin, 2.43 yds. at 2,700 = 6,500 lbs.

$R \times$ height of springing line $= 1.6 \cdot 50 \times 22 \times 22 \times 22.$

$$R = \frac{88{,}700}{8.75} = 10{,}000 \text{ lbs}$$

This is a considerable and in resisting a thrust of 10,000 lbs. A few piers cracked horizontally at springing.

The various computations above given show the most favorable conditions possible in that they assume continuity of the roof to the extent necessary to bring the roof load on the edge of the pier instead of the center, at the same time bringing the application of the horizontal thrust to the top of the pier instead of the crown of the arch. For winter conditions such assumptions would not be conservative for reasons that will be evident from the early part of the paper.

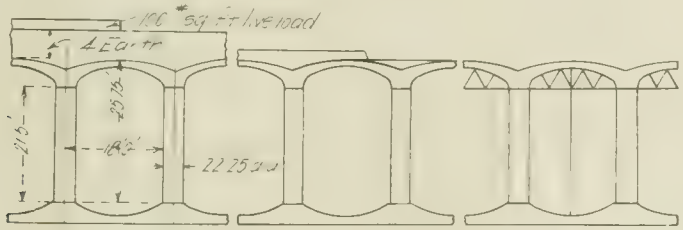


Fig. 10.

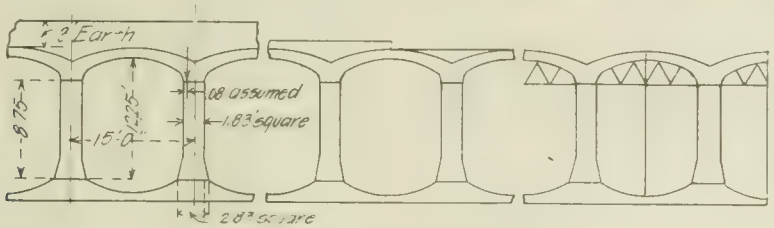


Fig. 11.

as that of the filtered water reservoir at Pittsburg, would be difficult to shore but the filters are much less so. The most convenient place to shore is opposite each pier, placing the upper end of the brace on the intrados, just above the pier, perpendicular to the thrust, and footing the brace at the base for the next pier. A depression could easily be made for such a brace. Such braces for the Pittsburg filters are about 17 ft. long and the horizontal projection of their length is about 14 ft., making the load $\frac{17}{14} \times 50{,}000 = 60{,}700$ lbs.

An 8 × 10-in. stick of reasonably good timber, with proper bearings at each end is adequate but blocking at either end with bearing across grain would permit movement and cause cracks to open at the springing line and at the base of the piers. Bracing is certainly more reassuring than a margin of unloaded groins, particularly for work that must stand over winter.

Floors of Filters and Reservoirs.—The common form of floors and methods of computing their volumes was described above. A tabulation of the floors of the various filters and reservoirs would be quite as pertinent and interesting as that for roofs given by Table I. The writer has had time to compile only a few important cases as shown by Table VI.

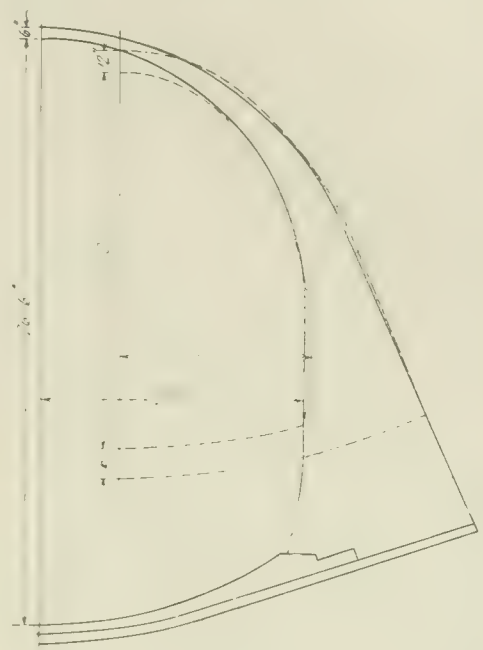


Fig. 12.—Side Wall of Pittsburg Filtered Water Reservoir Compared with Half Section of Catskill Aqueduct.

Fig. 13.—Approximate Design for Reinforced Concrete Beam and Slab Construction to Carry Load of 500 lbs. per sq. ft. in Addition to Dead Load.

Notes.—Assumptions used in design: $f_c = 600$, $f_s = 15000$, $R = 15$, per cent of steel $= 0.67$, $K = 91$ in formula $M = Kbd^2$, M at center of span 1-12 wl^2, over supports 1-12 wl^2.

Approximate quantities: Concrete = .81 cu. ft. per sq. ft. (average), steel 6.78 lbs. per sq. ft. (average).

Reference was made above to bracing unfinished edges of groined roofs where it is desired to fill up to the edge. High roofs, such

The groined arch floor has been as generally satisfactory as the groined arch roof. Groined arch floors are very easily screeded in dia-

mond-shaped pieces joining under piers along groin lines and along invert lines. The loads on the earth are comparatively light and the thicknesses, which have been merely guesses so far as the writer knows, have proved adequate. The Pittsburg filters and reservoirs are mostly on very porous ground and the lower layer of concrete was used in the 1904 design in place of puddle. A standard floor with minimum thickness 6 ins. as in most other plants, and puddle, was the alternative design not used. The 1908 Pittsburg filters contain an innovation in the use of a single flat floor lapping onto reinforced pedestal blocks under piers. The economy in material is evident from Table IV.

Side Walls and Division Walls.—Side walls of filters and reservoirs exhibit the same boldness of design as do the groined arch roofs. They are generally of the so-called aqueduct section but thinner, particularly at and near the crown, than aqueducts are made. This has an added significance because the side wall is generally concreted separately from the adjacent roof, so as to leave a joint along the crown, whereas the aqueduct is monolithic; and further the side wall has no opposing wall of the same shape and loading to keep a uniform condition, but instead has against it a long stretch of groined roof with varying temperature conditions. Figure 12 shows a section of the side wall of the filtered water reservoir at Pittsburg with a half section of the Catskill aqueduct superimposed. At the Washington filtration plant side walls are made like ordinary retaining walls in some cases and the groined arch carried out to them. Ths gives the same head room near the side walls as near piers or division walls. Dependence must be placed on immobility of filling behind such walls and this dependence appears not to have been misplaced—another example of successful boldness.

Division walls between filters are usually made of the same section as piers, and the floors beneath them are of the same section as the floors beneath piers, though they are sometimes thickened a little.

Comparison of Groined Arch Roof with Reinforced Concrete Slab and Beam Construction; Pittsburg Filtered Water Reservoir Used as Basis.—Figure 13 shows a design for reinforced floor to carry the same load as that assumed for the groin arch of the Pittsburg reservoir, viz., 400 lbs. of earth and 100 lbs. per sq. ft. live load. The units used for the reinforced concrete are as follows:

Compression in concrete, 600 lbs. per sq. in.
Tension in steel (mild), 16,000 lbs. per sq. in.
Ratio of moduli of elasticity, 15.
Straight line variation in compression of concrete moment which beam will carry $94bd^2$.
Per cent of steel, 0.67.

Beams and slabs designed for moment of $\frac{wl^2}{12}$ both at center and over supports. Any larger moments due to partial loading assumed to be cared for by increased stresses, since the final conditions are so uniform.

Figure 11 shows a roughly worked out design for the purpose of comparing costs. No shear computations have been made but rods are bent up "by eye." The design differs from much of the commercial practice in that the compression in the lower parts of the beams at supports where no slab exists has been provided for by deepening the beams instead of by assuming stronger concrete at these inconvenient points. The downward slope of the bottom of the girders toward their supports is perhaps too abrupt. The girders at supports are not quite deep enough to fulfill the formula $94\ bd^2$, but there is an excess of steel due to shearing provisions. The slab steel has not been worked out but the quantity is assumed to be $\frac{1}{3.4}$ of the quantity obtained by taking 0.67 per cent of the volume from the top to the center of steel at the bottom.

From Fig. 11 the average thickness of concrete in the reinforced construction is 9.7 ins., against 8.22 ins. for the groined arch roof of the Pittsburg reservoir; and the steel and other differences are still to be added. A comparison in more detail is as follows:

Groined arch roof:

$\frac{8.22}{12}$ cu. ft. of concrete at $6 per yard (22 cts. per foot)	$ .15
Charge for forms for each square foot	.10
Total relative cost per square foot	$ .25

Reinforced concrete roof:

8 cu. ft. of concrete at $6.90 per cu. yd. (25.5 cts. per cu. ft.)	$ .207
678 lbs. of steel at 2.75 cts.	.187
Charge for forms for each sq. ft. of roof, say	.15
Total	$ .54

The difference in price of concrete is made up of 40 cts., due to using 1:2:4 for the reinforced concrete instead of 1:3:5 as for the groined arch concrete, and 50 cts. assumed extra cost of rehandling or otherwise carefully placing the concrete around the steel. All assumed prices are intended to be so chosen as to favor the reinforced construction, if either. The reinforced construction might be credited with the filling in the hollow of the vaulting not necessary with the flat roof. This would amount to $\frac{4.34}{324} = .013$ yd. of earth filling per square foot, but this would cost less than ½ ct. In this comparison it is assumed that the high water line could be at the same distance below the flat roof as below the arched roof, and that air pockets formed above high water by the beams are unobjectionable.

It may be objected that it is not fair to compare a reinforced concrete structure capable of bearing, with a certain factor of safety nearly, on the elastic limit, a load per square foot of 400 lbs. of filling and 100 lbs. live, with a structure that, whatever it is thought capable of, is carrying only perhaps 315 lbs. per sq. ft. in addition to its own weight and doing this with an unknown margin of safety. A sufficiently close correction to the quantities in the reinforced construction resulting from reducing the load to 315 lbs. can be arrived at by assuming that the "effective" concrete and all the steel varies as the square root of the total load, thus:

Loads as used in design—

Dead load, lbs. per sq. ft.	120
Live load, lbs. per sq. ft.	500
	620

Revised loads—

Dead load, lbs. per sq. ft., say	105
Live load, lbs. per sq. ft.	315
	420

Effective concrete, say 8/10 of total.

Then revised effective concrete $= \sqrt{\frac{420}{620}} \times \frac{8}{10} \times .81 = .53$ cu. ft. per sq. ft.

Total revised effective concrete $= .53 \times \frac{7}{5} \times .81 = .60$ cu ft. per sq. ft.

Revised steel quantity $= \sqrt{\frac{420}{620}} \times 6.78 =$ 5.6 lbs. per sq. ft.

Revised relative cost $= .60 \times 25.5\text{c} + 5.6 \times 2.75 +$ say $.14 = 45\text{c}$ per sq. ft.

Again it may be said that it is not necessary to space the piers so far apart. The cost of the effective concrete and the steel would be reduced approximately in direct ratio of the revised to the original span. But the spacing computed by reducing the span would be more apparent than real, since the high piers are already about as spindling as desirable and the cost of forms per square foot of roof would probably increase with the greater number of units to be erected to produce the given area of roof. One who has watched the extremely rapid work of placing the groined roof by cableway (an average of 200 cu. yds. per day has been placed with one cableway during several months) would probably never feel moved to substitute, at least on a large plant, the complicated reinforced construction, even if the factor of safety of the groined arch is a little obscure. The New Haven filter plant is an example of the use of reinforced concrete for a small plant.

In conclusion the writer wishes to make acknowledgement to Mr. Morris Knowles, chief engineer of the Bureau of Filtration, Pittsburg, Pa., for permission to use the Pittsburg work as a text.

Report of Inspection on Deterioration of Tunnel Linings, Northern Pacific R. R.*

I made a careful inspection of the Bozeman tunnel, which tunnel is operated on a 2 per cent grade approaching thereto, such that while the grade is lighter in the tunnel, approaching same they have the 2 per cent grade to overcome and receive the effects of the engine when operating under this grade. This tunnel was lined in 1895-6 and is 3,650 ft. long. Approximately 300 ft. of the roof being lined with brick and the remainder with concrete, the sidewalls are constructed of concrete throughout. Proportions of concrete are 1, 3 and 5, and English Portland cement was used. In the 300 ft. of brick lining probably 50 brick have been disintegrated and removed entirely, probably due to joint action of frost, gas and blast of engines. The concrete lining in this tunnel as a whole was in good repair. At the ends of the sections of the roof I found disintegrated roofing from ½ to 2 in. or more in several places; I also found several places where the concrete had become removed, from the size of a chestnut to as large as a man's fist; also found in one place where they had more particular trouble with water during the work, the roof had sloughed off for a length of 20 ft. from three to six inches, the remaining portion of the concrete was as good today as when put in in the year 1896, from which I would conclude that the defective roof in the concrete portion was due to improper mixing of the concrete, same not being wet enough or that forms were removed too soon and allowed the blast to affect same before it was properly set up, or possibly the result was a joint action of the blast and improper mixing of the concrete.

We next visited the Mullen tunnel, which is approximately 3,900 ft. long and is located on the summit of the Rocky Mountains west of Helena on a 2 per cent grade. This tunnel was lined in 1892-3-4, the sidewalls are of concrete and the roof is lined with brick with the exception of the portals, which are lined with concrete. Proportions of concrete are 1, 3 and 5, and English Portland cement was used. The portals of this tunnel are in first-class condition and show no effects of weather, frost, gas or blast of locomotives. The brick lining has disintegrated. The bricks were not vitrified bricks, and as explained by Mr. F. J. Taylor, Division Engineer, who accompanied me on the inspection of this tunnel and who was in charge of the work when same was lined, the disintegration of the brick was largely due to frost action as much as to the effects of blast of locomotives or the gases from locomotives.

We next visited the Iron Ridge tunnel, which is located some five miles east of Mullen tunnel on the Helena Mountain, said tunnel being on a reverse curve 600 ft. long on a 2.2 per cent grade, and was lined in 1898 with concrete throughout, Atlas cement, proportions 1, 3 and 5. This tunnel showed up in splendid condition and there was practically no sign of disintegration throughout length of tunnel.

We next visited the Big Horn tunnel, which is located some 60 miles east of Billings, is 1,000 ft. long on a .5 per cent grade westbound and was lined in 1898 with concrete throughout, Atlas cement, proportions 1, 3 and 5. Travel on this portion of the line is not as heavy as at the other three tunnels inspected. The roof of this tunnel was in excellent condition. We discussed the repairs of the tunnels with the Supervisors who have had charge of same.

*Extract from report of Committee on Roadway, American Railway Engineering and Maintenance of Way Association.

Unclassified and General Articles

Note: This section is devoted to methods and cost articles on construction work not properly coming under any of the preceding classifications.

First Cost of Plant and Cost of Generating and Distributing Electricity for Lighting, Edison Electric Illuminating Co. of Brooklyn.

This company was incorporated in 1887. In 1907 it had a 23,650 K. W. plant, and produced 71,769,800 K. W. hrs. at the switchboard.

The following is an itemized statement of the plant and its rated capacity, as of June 30, 1907:

Station Equipment:	Total.
40 boilers, water tube	23,400 HP.
8 superheaters	6,000 HP.
5 steam engines, direct connected	14,750 HP.
2 turbo-units, D. C.	11,250 KW.
5 generators, direct. con., A.C.	12,400 KW.
1 booster	50 KW.
2 exciters, motor driven	250 KW.
2 exciters, steam driven	1,000 KW.
222 storage battery cells	5,120 amp. hrs.
1 rotary	1,000 KW.
3 transformers for rotaries	1,200 KW.
Substation Equipment:	
63 rotary converters, etc.	29,600 KW.
156 transformers	43,500 KW.
1,200 storage battery cells	18,875 amp. hrs.
7 balancers	450 KW.
13 boosters	650 KW.
31 motor generators	8,045 KW.

The company had 16,011 meters, and owned the following lamps:

Arc A-C, enclosed	577
Arc D-C, open	1,174
Arc D-C, enclosed	6,352
Nernst	2,711

It owned 3,039,132 duct feet of conduits, but rented much of its conduit space. There were 499 manholes on its subways. Exactly what other lines it owned June 30, 1907, is not reported, but on Dec. 31, 1907, the company reported the following circuits, divided into direct current and alternating current:

Overhead.	Direct.	Alternating.
Poles	1,218	10,931
Feet of street	299,638	576,280
Feet of circuit	918,348	513,892
Feet of wire	1,875,240	1,531,694
Million mil. ft. of wire	81,125	86,443
Underground:		
Feet of ducts occupied	1,698,877	656,300
Feet of street	689,382	99,528
Feet of circuit	1,495,057	810,354
Feet of wire	4,473,000	2,443,462
Million mil. ft. of wire	1,558,042	472,781

The cost of this plant is reported as follows:

1.	Generating station bldgs. and land	$ 674,666
2.	Substation bldgs. and land	650,559
3.	Other real estate	48,007
4.	Steam plant, generating station	1,051,796
5.	Electrical plant, generation station	965,824
6.	Substation apparatus	507,965
7.	Transmission lines, underground conductors, construction, poles and lines	4,136,009
8.	Construction, subways	239,950
9.	Services	973,558
10.	Line transformers	150,184
11.	Meters	301,677
12.	Arc lamps	242,607
13.	Tools and implements	20,955
14.	Office furniture and fixtures	50,131
15.	Appliances installed, miscel.	64,874
16.	Storage batteries	182,150
17.	Sundries, automobiles, etc.	74,526
	Total	$10,326,437

In addition to this another item of $3,618,245 is reported, called "Organization, merged companies, plants and franchises, etc., merger account." This item clearly represents little or no money expended for plant or land, as will be made more evident from the following analysis of the cost per K. W., ascertained by dividing each of the above 17 items by 23,650,—which is the rated K. W. capacity:

		Cost per KW.
1.	Generating sta. bldgs. and land	$ 29
2.	Substation bldgs. and land	28
3.	Other real estate	2
4.	Steam plant	44
5.	Electrical generating plant	41
6.	Substation apparatus	21
7.	Transmission lines	175
8.	Construction, subways (in part)	10
9.	Services	41
10.	Line transformers	6
11.	Meters	13
12.	Arc lamps	10
13.	Tools and implements	1
14.	Office furniture, etc.	2
15.	Miscel. appliances	3
16.	Storage batteries	8
17.	Sundries	3
	Total	$437

Items 7 and 8 should be merged, for Item 8 is clearly too small to include the entire cost of the conduits, since it amounts to only 8 cts. per duct foot. Mayer's "Telephone Construction, Methods and Cost" gives detailed costs of conduits in several cities, and the lowest is several times this amount.

During the fiscal year of 1907, the plant produced 71,769,804 K. W. hrs., at the switchboard, of which 47,613,138 K. W. hrs. were sold and 800,783 K. W. hrs. were used for station purposes. This leaves 32.5 per cent unaccounted for—lost in transmission, etc.

The operating expenses were as follows:

	Production Expense:	
1.	Salaries	$ 22,510
2.	Labor	136,116
3.	Fuel	285,654
4.	Oil, waste and sundries	17,355
5.	Water	28,449
6.	Repairs, buildings and structures	2,493
7.	Repairs, motive power	39,622
8.	Repairs, electric apparatus	2,296
9.	Station expense	2,330
10.	Purchased power (electric)	28,575
	Total production expense	$ 565,400
	Distribution Expense:	
11.	Salaries	$ 7,687
12.	Substation, labor and expense	98,607
13.	Rental of subways, etc.	117,162
14.	Incandescent lamp renewals	110,199
15.	Repairs, poles and lines	22,918
16.	Repairs, subways and cables	30,957
17.	Repairs, meters	4,872
18.	Repairs, transformers	187
19.	Repairs and expense, commercial arc lamps	89,711
	Total distribution expense	$ 482,300
	General Expense:	
20.	Salaries of officers	$ 18,850
21.	Salaries of office men	67,665
22.	Collecting and reading meters	19,797
23.	Legal expenses	19,009
24.	General expense	73,256
25.	Advertising	44,364
26.	Canvassing new business	82,917
27.	Insurance	47,884
28.	Miscellaneous	58,178
	Total general expense	$ 431,920
	Taxes and Rents:	
29.	Taxes, general	$ 86,916
30.	State franchise tax	61,584
31.	Lease halls, rentals, etc.	4,783
	Total taxes and rents	$ 153,283
	Grand total	$1,632,903

Dividing each of the above 31 items by the 71,769,804 K. W. hrs. produced, we have the following costs per K. W. hr. produced:

		Cts. per KW. hr.
	Production Expense:	
1.	Salaries	0.031
2.	Labor	0.190
3.	Fuel	0.400
4.	Oil, waste, etc.	0.024
5.	Water	0.039
6.	Repairs, bldgs.	0.003
7.	Repairs, motive power	0.056
8.	Repairs, electric appar.	0.003
9.	Station expense	0.003
10.	Purchased power (electric)	0.039
	Total production expense	0.788
	Distribution Expense:	
11.	Salaries	0.011
12.	Substation, labor and expense	0.138
13.	Rental of subways, etc.	0.163
14.	Incandescent lamp renewals	0.153
15.	Repairs, poles and lines	0.032
16.	Repairs, subways and cables	0.043
17.	Repairs, meters	0.007
18.	Repairs, transformers	
19.	Repairs and expense commercial arc lamps	0.125
	Total distribution expense	0.672
	General Expense:	
20.	Salaries of officers	0.029
21.	Salaries of office men	0.094
22.	Collecting and reading meters	0.028
23.	Legal expense	0.027
24.	General expense	0.101
25.	Advertising	0.061
26.	Canvassing new business	0.115
27.	Insurance	0.067
28.	Miscellaneous	0.080
	Total general expense	0.602
	Taxes and Rents:	
29.	Taxes, general	0.121
30.	State franchise tax	0.085
31.	Lease halls, rentals, etc.	0.007
	Total taxes and rents	0.213
	Grand total	2.275

This cost of 2.275 cts. per K. W. hr. is the cost per "K. W. hr. produced." To arrive at the cost per "K. W. hr. sold," divide each item by 67.5 per cent, for it must be remembered that transmission losses, etc., amounted to 32.5 per cent. Summarizing, we have the following unit costs:

	Cts. per KW. hr. Sold.	Produced.
Production expense	1.168	0.788
Distribution expense	0.995	0.672
General expense	0.892	0.602
Taxes and rents	0.315	0.213
Total operating expense	3.370	2.275

The question now arises whether the maintenance expenses for this year were normal or not. In all cases of this kind it is desirable to express the repairs and renewals costs in terms of K. W. of plant capacity. Therefore, if we divided the total annual costs of repairs (Items 6, 7, 8, 15, 16, 17 and 18) by 23,650 (the number of K. W. capacity), we have the following repair costs:

		Per KW.
6.	Repairs, buildings and structures	$0.10
7.	Repairs, motive power	1.67
8.	Repairs, electrical apparatus	0.10
15.	Repairs, poles and lines	0.97
16.	Repairs, subways and cables	1.31
17.	Repairs, meters	0.20
18.	Repairs, transformers	0.01
	Total	$4.36
14.	Renewals of incandescent lamps	$4.65
19.	Renewals and expense of arc lamps	$3.79
	Grand total	$12.80

The last two items partake more of the nature of providing supplies than of repairs, so that the true plant repairs are embraced in the other items, amounting to $4.36 per K. W. We have seen that the plant represents an investment of $437 per K. W., hence the current repairs were only about 1 per cent of the first cost. Even the steam plant, which cost $44 per K. W., had repairs of only $1.67 per K. W., or less than 4 per cent.

It is clear that to this actual cost of $4.36 per K. W. for repairs, there should be added a very considerable sum to provide for normal annual repairs over a long term of years, as well as for amartization. Exactly what percentage of the first cost should be allowed is difficult to determine. A study of the items of first cost of this plant would indicate that about 4 per cent of its first cost ($437 per K. W.) would provide for amartization and additional repairs sufficient to maintain a normal condition, or about $17.50 per K. W. Now each K. W. produced 3,032 K. W. hrs. at the switchboard; hence $17.50 ÷ 3,032 = 0.577 ct. per K. W. hr., which should be added to provide for depreciation and additional repairs for normal conditions. In like manner an interest charge of 6 per cent on the first cost gives us another 0.865 ct. per K. W. hr. produced. Summarizing, we have:

	Cts. per KW. hr. Sold.	Produced.
Total Operating Expense	3.370	2.275
Depreciation, etc.	0.855	0.577
Interest, at 6 per cent	1.273	0.865
Grand total	5.498	3.717

The average price at which current was sold was 6.6 cts. per K. W. hr., which indicates a net profit of fully 1.1 cts. per K. W. hr., for it is possible that our allowance for depreciation, etc., is too high. During the last half of 1907, the average income was 6.75 cts. per K. W. hr. Some current was sold to other electric companies and to street car companies for as low as 1.75 cts. per K. W. hr.

The amount of fuel used during the fiscal

year ending June 30, 1907, is not reported; but, during the last half of 1907, there were used 1.30 lbs. of coal per K. W. hr. generated, of which 85 per cent was anthracite and 15 per cent bituminous. The average price of the fuel was $1.60 per ton of 2,000 lbs. This very low price indicates a low grade of coal.

Among the Distribution Expenses is Item 13, which consists principally of the rental of conduits. It is not stated what the rate of rental was, but it was under $1,000 per duct mile per year, that being the rate paid by the New York Edison Co.

The employees and their total annual wages were as follows:

1	accountant, general	$ 1,898
1	[illegible]	224
10	[illegible]	6,564
[illegible]	[illegible]	1,296
2	[illegible]	1,234
[illegible]	[illegible]	[illegible]
2	[illegible]	1,681
[illegible]	[illegible]	[illegible]
112	[illegible]	[illegible]
11	[illegible]	10,511
[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]
45	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]
[illegible]

Rossmen, hoisting	.30
Riggers	3.50
Stone cleaners and pointers	3.06
Stone cutters, Brooklyn, base	.62½
Stone cutters, Manhattan	4.00
Steam shovel engineers, monthly	124.00
Stair builders	5.00
Steam fitters	5.00
Steam fitters helpers	3.00
Stone masons, Brooklyn, base	.55
Stone masons, Manhattan, base	.75
Stone setters	5.50
Stationary firemen	2.00
Tar, felt and waterproof workers	3.75
Tile layers	5.00
Tile layers helpers	3.00
Terra cotta workers, average	2.95

BRIDGES AND BUILDINGS.

Materials and Supplies.

Structural Shapes.—The following are the current prices for structural shapes f. o. b. Pittsburg:

I-beams and channels, 3 to 15 in., 1.50 to 1.55 cts. net.
I-beams over 15 in., 1.65 cts. net.
H-beams over 8 in., 1.75 cts.
Angles, 3 to 6 in., 1.60 cts.
Angles, over 6 in., 1.65 cts.
Tees, 3 in. and up, 1.65 cts.
Zees, 3 in. and up, 1.60 cts. net.
Angles, channels and tees under 3 in., 1.50 cts., base, plus 10 cts.
Deck beams and bulb angles, 1.80 cts. net.
Hand rail tees, 2.80 cts. net.
Checkered and corrugated plates, 2.80 cts. net.

Prices at Chicago for shipment from stock are as follows:

Angles, 3 to 6 in.	2.00
Angles over 6 in.	2.10
Beams and channels	2.10
Beams over 15 in.	2.10

The New York quotations for structural shapes are as follows:

Beams and channels, 3 to 15 in.	1.66@1.71
Zees, 3 in. and up	1.66@
Angles, 3x3 up to 6x6	1.66@1.71
Tees	1.81@
Steel bars, full extras	1.71@1.76

Plates.—The current prices for plates f. o. b. Pittsburg on the basis of net cash in 30 days are as follows:

Tank plates, ¾ in. thick, 6½ in. up to 100 in. wide, 1.55 cts. to 1.60 cts. base.
Gages under ¼ in. to and including 3/16 in. 1.80 to
Gages under 3/16 in. to and including No. 8, .15
Gages under No. 8 to and including No. 9, .25
Gages under No. 9 to and including No. 10, .30
Gages under No. 10 to and including No. 12, .40
Sketches, 3 ft. and over in length, .10
Complete circles, 3 ft. diameter and over, .20
Boiler and flange steel, .10
A. B. M. A. and ordinary fire box steel, .20
Still bottom steel, .30
Marine steel, .40
Locomotive fire box steel, .50
Plates in widths over 100 in. to 110 in., .05
Plates in widths over 110 in. to 115 in., .10
Plates in widths over 115 in. to 120 in., .15
Plates in widths over 120 in. to 125 in., .25
Plates in widths over 125 in. to 130 in., .50
In widths over 130 in., 1.00

Prices at Chicago for shipment from stock are as follows:

¼ in. and heavier, up to 72 in.	2.00
Over 72 in.	2.10
3/16 in. thick	2.50
No. 8	2.15

The following are the New York quotations on plates the prices being based on carload lots, with 5 cts. extra for less than carload lots. Terms, net cash, in 30 days.

Tank plates, ¾ in. thick, 6½ to 100 in. wide	1.71@ 1.76
Flange and boiler steel	1.81@ 1.86
Marine	2.11@ 2.16
Locomotive and fire box	2.21@ 2.26
Still bottom	2.01@ 2.06

Plates more than 100 in. in width, 5 cts. extra per 100 lbs.; plates, 3/16 in. in thickness, 10 cts. extra; gage Nos. 7 and 8, 15 cts. extra; No. 9, 25 cts. extra.

Sheets.—The current minimum prices for mill shipments from Pittsburg on sheets in car load and larger lots are as follows:

Galvanized roofing sheets No. 28, 2½ in. corrugations, $3.00 per square
Painted roofing sheets, No. 28 1.70 per square

Galvanized Sheets.

Nos. 13 and 14	2.50 cts.
Nos. 15 and 16	2.60 cts.
Nos. 17 to 21	2.75 cts.
Nos. 22 to 24	2.90 cts.
Nos. 25 and 26	3.10 cts.
No. 27	3.30 cts.
No. 28	3.50 cts.
No. 29	3.60 cts.
No. 30	3.85 cts.

Black Annealed Sheets:

Nos. 3 to 8	1.70 cts.
Nos. 9 and 10	1.75 cts.
Nos. 11 and 12	1.80 cts.
Nos. 13 and 14	1.85 cts.
Nos. 15 and 16	1.90 cts.

Box Annealed Sheets:

Nos. 17 to 21	2.20 cts.
Nos. 22 to 24	2.25 cts.
Nos. 25 and 26	2.30 cts.
No. 27	2.35 cts.
No. 28	2.40 cts.
No. 29	2.45 cts.
No. 30	2.55 cts.

Prices for sheets at Chicago for shipment from stock are as follows:

	Cts. per lb. Black.	Galvanized.
No. 10	2.25	3.20
No. 12	2.30	3.20
No. 14	2.35	3.20
No. 16	2.45	3.20
Nos. 18 and 20	2.80	3.35
Nos. 22 and 24	2.85	3.50
No. 26	2.90	3.70
No. 27	2.95	3.90
No. 28	3.00	4.10
No. 30	3.30	4.50

Usual extras for extreme width.

The following New York quotations on sheets are for 500-bundle lots and over, f. o. b. mill:

Gage.	Black.	Galvanized.
No. 30	2.55	3.85
No. 28	2.45	3.60
No. 28	2.40	3.50
No. 27	2.35	3.30
Nos. 25 to 26	2.30	3.10
Nos. 22 to 24	2.25	2.90

Freight Rates.—The freight rates from Pittsburg on finished iron and steel in car loads, per 100 lbs., is as follows: Birmingham, Ala., 45 cts.; Boston, 18 cts.; Buffalo, 11 cts.; Chicago, 18 cts.; Cincinnati, 15 cts.; Cleveland, 10 cts.; Indianapolis, 17 cts.; New York, 16 cts.; New Orleans, 30 cts.; Philadelphia, 15 cts.; St. Louis, 22½ cts.; St. Paul, 32 cts. For the Pacific Coast the rates are 80 cts. on plates, structural shapes and sheets, No. 11 and heavier; 85 cts. on sheets Nos. 12 to 16; 95 cts. on sheets No. 16 and lighter, and 65 cts. on wrought pipe and boiler tubes.

Building Paper.—Prices on building paper and tarred paper are as follows:

Building Paper.

	Per roll.
Rosin sized sheathing, 500 sq. ft. light weight, 25 lbs. to roll	38 cts.
Medium weight, 30 lbs. to roll	50 cts.
Heavy weight, 30 lbs. to roll	65 cts.
Black water proof sheathing, 500 sq. ft., light weight	75 cts.
Medium weight	95 cts.
Heavy weight	$1.30
Deafening felt 9 and 6 sq. ft. to lb., ton	40.00
Red rope roofing, 250 sq. ft. per roll	1.75

Tarred Paper.

1 ply (roll 400 sq. ft.), ton, carloads	$31.00
Less than carloads	32.00
2 ply (roll 108 sq. ft.), 40 lbs	48 cts.
3 ply (roll 108 sq. ft.), 60 lbs	68 cts.
Slater's felt (roll 500 sq. ft.), per ton	35.00
Per roll	70 cts.

Steel Rivets.—The following current prices for steel rivets are f. o. b. Pittsburg and are minimum on contracts for large lots, the manufacturers charging the usual advances of $2 to $3 per ton to the small trade. The terms are net cash, f. o. b. mill.

Structural rivets, ¾-in. and larger, 2.15 cts. base.

Nails.—The net prices in Chicago for nails in quantities are as follows:

Shingle Nails.

Size.	Standard gage and length.	Approx. No. in 1 lb.	Price per 100 lb.
3d	1¼ in. No. 13	350	$2.58
4d	1½ in. No. 12	256	2.43

Galvanized Shingle Nails.

Size.	Standard gage and length.	Approx. No. in 1 lb.	Price per 100 lb.
3d	1¼ in. No. 13	420	$3.08
4d	1½ in. No. 12	271	2.93

Barbed Roofing Nails.

Size.	Standard gage and length.	Approx. No. in 1 lb.	Price per 100 lb.
¾ in. barb R. F.	¾ in. No. 13	648	$2.88
⅞ in. barb R. F.	⅞ in. No. 12	413	2.78
1 in. barb R. F.	1 in. No. 12	384	2.73
1⅛ in. barb R. F.	1⅛ in. No. 12	339	2.73
1¼ in. barb R. F.	1¼ in. No. 11	231	2.68
1¾ in. barb R. F.	1¾ in. No. 10	151	2.58
2 in. barb R. F.	2 in. No. 9	103	2.48

Common Steel Wire Nails in Kegs of 100 lbs Each.

Size.	Standard gage and length.	Approx. No. in 1 lb.	Per 100 lb. keg.
2d	1 in. No. 15	900	$2.88
3d	1¼ in. No. 14	615	2.58
4d	1½ in. No. 13	322	2.42
5d	1¾ in. No. 12	254	2.43
6d	2 in. No. 12	200	2.33
7d	2¼ in. No. 11	154	2.33
8d	2½ in. No. 10	106	2.23
9d	2¾ in. No. 10	85	2.23
10d	3 in. No. 9	74	2.18
12d	3¼ in. No. 9	57	2.18
16d	3½ in. No. 8	46	2.18
20d	4 in. No. 6	29	2.13
30d	4½ in. No. 5	23	2.13
40d	5 in. No. 4	18	2.13
50d	5½ in. No. 3	13½	2.13
60d	6 in. No. 2	10½	2.13

Coated nails suitable for either machine or hand driving are sold at the same price as the above.

Casing Nails.

Size.	Standard gage and length.	Approx. No. in 1 lb.	Per 100 lbs.
2d	1 in. No. 16	1,140	$3.13
3d	1¼ in. No. 15	675	2.83
4d	1½ in. No. 15	567	2.63
6d	2 in. No. 13	260	2.48
8d	2½ in. No. 12	160	2.38
10d	3 in. No. 11	108	2.28
16d	3½ in. No. 10	69	2.28
20d	4 in. No. 9	50	2.28

Finishing Nails.

Size.	Standard gage and length.	Approx. No. in 1 lb.	Per 100 lbs.
2d	1 in. No. 17	1,558	$3.28
3d	1¼ in. No. 16	884	2.98
4d	1½ in. No. 16	767	2.78
6d	2 in. No. 14	346	2.78
8d	2½ in. No. 13	214	2.58
10d	3 in. No. 12	141	2.38
16d	3½ in. No. 11	91	2.38
20d	4 in. No. 10	64	2.23

Oils, Paints and Varnishes.—New York City quotations for linseed oil are as follows:

City, raw, American seed, 5 bbls or more	$ 0.80 @	$ 0.81
Less than 5 bbls	@	.80
City, single boiled, American seed, 5 bbls. or more	.81 @	.82
Less than 5 bbls	@	.83
City, double boiled, American seed, 5 bbls. or more	.79 @	.80
Less than 5 bbls	@	.83
Western raw	.79 @	.80
Calcutta oil, in any quantity	.90 @	

The following are the New York quotations for paint:

White Lead:

Standard dry, per lb	.06½@6¾ 0.06¾
In oil, pure	.07 @ .07¼
English, in oil	.09⅛@ .09½
Red lead, American	.06¾@ .07¼
Imported red lead, American	.09⅛@ .09
Orange mineral, American	.08 @ .10
Carmine, Wade	.10 @ .12
Pickle white, American	.08 @ .10
Litharge, American, powdered	.06¼@ .06⅜
English, glassmakers'	.09¼@ .09⅜
Zinc oxide, American	.05⅜@ .06⅛
French, red seal	.07½@ .08¼
Green seal	.10 @ .10½
German, red seal	.07⅜@ .07½

The prices on white lead are for large lots; ½ ct. additional is charged for small lots.

For dry colors the New York quotations follow:

Reds:

Carmine No. 40	$ 2.60 @ .65
Indian, A	.06¾@ .08½
Indian, E	.05 @ .05½
Rose Pink, A	.08 @ .10½
Tuscan, E	.07 @ .10
Vermilion, E, pure, 65	1.60 @ 1.70
Ext. A	.75 @ 1.10
Quicksilver, Veck	.70 @
Venetian red, A	.03 @ .05
Venetian red, E	.15 @ 1.50

Yellows:

Chrome	.12 @ .14
Deep, American	11.00 @ 13.00
French	.03½@ .02½
Golden	.04 @ .05

Blacks:

Drop	.02 @ .04
Carb	.06½@ .11
Carbon, lamp, pd	.16½@ .29
Drop	.03½@ .16
Ivory	.15 @ .21
Lamp, com	.02½@ .03¾
Peach	.06¾ @ .10

Blues:

Chinese	.29 @ .32
Prussian	.28 @ .29
Ultramarine	.05 @ .06
Cobalt	.03 @ .06¼

Browns:

Senna, Ital. lt. pd	.02⅞@ .09
Raw, powdered	.02⅝@ .07
American powdered burnt	.02⅛@ .03
Umber, raw, American	.02 @ .03¾
Burnt	.02⅛@ .02⅞
Turkey, powdered and burnt	.02½@ .03¼

Greens:

Chrome	.16½@ .25
Common	.03½@ .07½

The New York quotations per pound for varnish gums are as follows:

	Per lb.
Kauri—Pale	$ 0.36 @ $ 0.90
No. 1	.41 @ .49
No. 2	.20 @ .25
No. 3	.15 @ .18
Brown chips, ord	.07½@ .10
Elemi, gum	.12½@ .19½
Do dust	.03 @ .04
Damar, Batavia	.13 @ .14
Singapore	.06½@ .15
Copal, Sierra Leone, colored	.60 @ .80
Zanzibar, pure white	.75 @ .85
Thumb size	.42 @ .48
Sorts	.54 @ .56
Beam and pea	.25 @ .28
Manila, pale	.14 @ .18
Dark hard	.12 @ .15
Amber	.13 @ .15
Standard sorts	.13 @ .15
Nubs No. 1	.06½@ .08½
Nubs No. 2	.04½@ .05½
Chips No. 1	.05 @ .06
Chips No. 2	.03½@ .04
Asphaltum, Barbadoes	.02¼@ .03½
Cuban	.01⅛@ .05
Egyptian	.13½@ .13⅝

Lime and Plaster. The following are the wholesale current prices in 500 bbl. lots or more delivered to the trade in New York City. For the retail prices or prices for the material delivered to the contractors jobs in truck load lots as required about 25 cts. per bbl. should be added to the above prices.

State common, cargo rate, per bbl.	@$ 0.75
Rockland-Rockport, Com., per bbl.	.92
Rockland-Rockport, L., per bbl.	1.02 ....
Rockland-Rockport, special, 320 lbs.	1.37
Select finish, per 350 lbs., net	1.60 ....

Terms for Rockland-Rockport lime, 2 cts. per barrel discount, net cash, ten days for 500 bbl. lots.

West Stockbridge, finishing, 325 lbs.	$ 1.40
New Milford Lime	1.30
New Milford (small barrel)	1.00
Hydrated, per ton	$8.00 9.00

Plaster Paris.

Calcined, city casting, in barrels, 250 lbs.	1.45
In barrels, 320 lbs.	1.65
In bags, per ton	$8.50
Calcined, city casting, in barrels, 250 lbs.	1.45
In barrels, 320 lbs.	1.65
Neat wall plaster, in bags, per ton*	8.00
Wall plaster, with sand, per ton	5.25
Browning	5.25
Scratch	6.25

When sold in bags a rebate of 6¼ cts. per bag returned is allowed.

Mineral Wool.—New York City prices that contractors or builders would pay for mineral wool is $21 per ton. The material is packed in bags which are charged extra at 12 cts. each. For the middle west prices are as follows: Car load lots f. o. b. factory, South Milwaukee, Wis., $12 per ton; less than car load lots, $14 per ton.

Corrugated Roofing.—The following quotations on corrugated roofing are for small lots.

2½ in. corrugated.	Painted.	Galvanized.
No. 24, per 100 sq. ft.	$3.85	$4.80
No. 26, per 100 sq. ft.	2.95	4.00
No. 28, per 100 sq. ft.	2.60	3.75

Roofing Cement.—New York quotations for Texaco roofing cement is $25 per ton, car load lots, f. o. b. New York Harbor.

Waterproofing Cement.—New York quotations for Texaco waterproofing cement is $30 per ton, car load lots, f. o. b. New York Harbor.

SMALL TOOLS USED IN BRIDGE AND BUILDING WORK.

Nail and Riveting Hammers, Etc.—The following are net prices in Chicago for quantities of nail hammers and riveting hammers:

Nail Hammers.

No.	Weight, each.	Price, each.	Price per doz.
0	1 lb. 12 oz.	$0.625	$6.25
1	1 lb. 4 oz.	.45	4.50
1½	1 lb.	.425	4.25
2	13 oz.	.40	4.00
3	7 oz.	.375	3.75

The hammers are made of solid steel, polished with adze eye and plain or bell face, as desired.

Riveting Hammers (plain eye).

No.	Weight, each.	Price, each.	Price per doz.
0	4 oz.	$0.275	$2.75
1	7 oz.	.275	2.88
2	9 oz.	.30	3.00
3	12 oz.	.30	3.13
4	15 oz.	.33	3.25
5	1 lb. 2 oz.	.35	3.50
6	1 lb. 6 oz.	.375	3.75
7	1 lb. 10 oz.	.40	4.00

Bridge Builders' and Structural Steel Erectors' Special Tools.—The following prices are net prices in Chicago, for quantities, for special tools for bridge builders and structural steel erectors:

	Weight, lbs.	Face, ins.	Length, ins.	Price, each.
Riveting hammers	4	1½ and 1⅝	8½	$1.25
Flogging hammers	7	1¾	7	1.50
Napping hammers	3	1⅛	6	1.00
Rivet "buster"	5½	1½ in. sq.	6	.80
Straight blade cold cutter		1¼ in. sq.	6½	.80
Cross blade cold cutter		1½ in. sq.	6½	.80
Side set or cutter		1½ in. sq.	6½	.80
Handle gouge		1½ in. sq.	6½	.85

The net prices of other tools used by bridge builders and structural steel erectors are as follows:

	Price, each.
Straight dolly	$2.75
Club dolly	3.25
Spring dolly	5.00
Heel dolly	4.50
Half round seamers	.65
Hand gauges	.35
Hand chisels	.35
Rivet tongs, pickup at heating, per pair	.70
Riveting clamp	3.75

Rivet snaps or sets for button head or conical head rivets cost as follows:

¾-in. to ⅞-in., each	$1.20
¾-in., each	1.25
⅞-in., each	1.40
1-in., each	1.50

The net cost of barrel shaped drift pins follow:

7/16-in., each	$0.10
9/16-in., each	.11
11/16-in., each	.12
13/16-in., each	.16
15/16-in., each	.17
1 1/16-in., each	.19

The net cost figures for heading out punches are as follows:

⅜-in. to ¾-in. inclusive, each	$0.80
⅞-in. to 1-in. inclusive, each	.85

Mortar and Brick Hods.—The net prices for wooden mortar and brick hods in quantities at Chicago are as follows: Mortar hods, carrying 150 lbs., 80 cts. each, or $8 per doz.; wooden brick hods, carrying 90 lbs., 60 cts each, or $6 per doz. The hods have tin lined shoulder blocks and rough hickory handles. Steel mortar and brick hods can be bought at the following net prices at Chicago: Brick hods, 23x7x10 ins., weighing, with handle, about 8 lbs., $1.00 each, or $10 per doz.; mortar hods, 24x11¾x12 ins., weighing, with handle, about 11 lbs., $1.20 each, or $12 per doz.

CONCRETE AND REINFORCED CONCRETE.

Cement.—The present prevailing price for Portland cement for Chicago and vicinity is about $1.05 per bbl. f. o. b. Chicago.

Reinforcing Bars.—The following prices for concrete reinforcing bars are for car loads, f. o. b. Chicago, mill shipments:

	Base per 100 lbs.
Open hearth steel, medium	$1.68
Open hearth steel, high carbon	1.73
Open hearth steel, cold twisted	1.78
Rail carbon steel, high elastic limit	1.60
Rail carbon steel, high elastic limit, hot twisted	1.65

Less than carloads, 10c per 100 lbs. advance.

For shipment from stock at Chicago the prices are as follows:

	Cts. per lb. Plain.	Deformed.
¾-in. and larger	1.90	215
⅝-in.	1.95	222½
½-in.	2.00	227½
⅜-in.	2.15	255
¼-in.	2.40	290

EARTH AND ROCK EXCAVATION.

Supplies.

Blasting Materials.—The following are the general net prices for Chicago and vicinity for blasting materials.

Dynamite.

	2,000-lb. lots. per 100 lbs.	Less than 2,000 lbs. per 100 lbs.
25% nitroglycerine	$10.80	$11.55
30% nitroglycerine	11.20	11.95
35% nitroglycerine	11.60	12.35
40% nitroglycerine	12.00	12.75
45% nitroglycerine	12.50	13.25
50% nitroglycerine	13.00	13.75
60% nitroglycerine	14.00	14.75
Contractors' powder	8.00	8.50

Blasting Batteries.

10 holes	$10.00
30 holes	15.00
1 to 50 holes	30.00
1 to 100 holes	45.00

Electric Fuses.

	Single strength. Per 100.	Double strength. Per 100.
4' S. S.	$3.00	$3.50
6' S. S.	3.54	4.04

Fuse.

Single tape, per 1,000 feet	$3.65
Double tape, per 1,000 feet	4.40
Crescent, per 1,000 feet	4.20

Tools and Equipment.

Dump Carts.—Net prices for certain types of contractors' dump carts, f. o. b. factory in Ohio, are as follows:

Light cart, capacity 21 cu. ft. or 2,500 lbs., weighing 700 lbs., at $42; heavy cart, capacity 24 cu. ft. or 3,500 lbs., weighing 900 lbs., $45. For carts with hoppers 10 ins. deep add $9.50 to the above figures, and for carts with automatic end gates add $8.50.

Hand Shovels.—Net prices for standard railroad contractors' and mining shovels, at Chicago, in quantities, are as follows: We give prices for four grades: (1) Extra grade made of best crucible steel, finely finished with best white ash handles; (2) first grade shovels, also made of crucible steel, and grades (3) and (4) made of open hearth steel. The net price in Chicago on these four grades are as follows:

Size.	Size blade. Width, ins.	Size blade. Length, ins.	Extra grade Per doz.	1st grade. Per doz.	2d grade. Per doz.	3d grade. Per doz.
2	9½	11¾	$8.91	$7.83	$6.48	$5.70
3	9¾	12¼	9.18	8.10	.....	.....
4	10½	12½	9.45	8.37	.....	.....

The above prices are for black finish; for polished add 50 cts. per doz. Shovels with square or round points, "D" or long handles are all the same price. The size No. 2 is the one commonly used. For sewer or brick shovels made in No. 2 size, but having a shorter and heavier blade for clay and other heavier material, net prices are as follows:

	Each.	Per doz.
Extra grade	$1.00	$10.00
Second grade	.648	6.48

The net prices at Chicago for spades, plain strap, polished, "D" handle or long handle, are as follows: For size No. 2: Extra grade, $9.18 per doz.; fourth grade, $5.40 per doz. Extra grade shovels made the same as "D" handle moulders' shovel, but with straighter, stiffer and heavier blades, for finishing concrete in sidewalks, in forms, etc., sell for $13.86 per doz.

Telegraph Shovels and Spoons.

Telegraph shovels made of fine crucible steel with white grained ash handles, and extra length 22-in. straps and black finish, can be bought in quantities at the following net prices, f. o. b. Chicago.

Length of handle.	Extra Grade. Per doz.	First Grade. Per doz.
6	$12.69	$11.07
7	13.77	12.15
8	14.85	13.23
9	17.00	15.39
10	19.17	16.65

The net prices in quantities for telegraph spoons with regular 9-in. straps and black finish are as follows:

Length of handle.	Extra Grade. Per doz.	First Grade. Per doz.
6	$12.42	$10.80
7	13.50	11.88
8	14.58	12.96
9	16.74	15.12
10	18.90	17.28

The greater bulk of all telegraph shovels and spoons sold are those with 8-ft. handles.

Ditching and Drain Spades.

The net prices at Chicago for ditching and drain spades are as follows:

Length of blade.	Extra Grade. Per doz.	Third Grade. Per doz.
14-in.	$11.34	$8.40
16-in.	11.01	8.70
18-in.	11.88	9.00
20-in.	12.15	....

Skeleton ditching and drain spades made of solid cast steel with solid sockets, especially adapted for mucky and sticky soil, can be bought at the following net prices in Chicago: Ditching spades, square point, 6½x18-in., $22.80 per doz.; drain spades, round point, 4½x18-in., $21.60 per doz. Drain cleaners' with 6½-ft. handles for finishing tile ditches can be bought at the following net prices:

Size of blade. Length. Ins.	Width. Ins.	Per dozen.
15	4	$10.80
15	5	11.10
15	6	11.40

Hand Tools for Rock Drilling.—Net prices at Chicago for sledges, striking and drilling hammers, etc., in quantities, are as follows:

Sledges and Hammers.

Double face and cross pein oil finish sledges and hammers, 5-lb. to 24-lb. weight, 7½ cts. per lb; striking and drilling hammers, long pattern, 3 to 4½ lbs., 10 cts. per lb.; 5 to 14 lbs., 7½ cts. per lb.; stone sledges, 10 to 24 lbs., 7½ cts. per lb.

Net price for stone drills at Boston is as follows: Stone drills, 1 and 1⅛-in. octagon steel, 2 to 6-ft. lengths, 12 cts. per lb.

Hoes.—The net prices at Chicago for garden or field hoes, forged from best hoe steel, with 4½-ft. selected white ash handles and 7½-in. blade, are $4.35 per doz. for hoes with solid socket and $3.90 per doz. for hoes with solid shank. Grub hoes, adze eye, can be bought at the following net prices:

No.	Weight, lbs.	Size, ins.	Price, each.	Price, per doz.
1	3½	3¾x10¾	$0.295	$2.95
2	4	4 x11¼	.31	3.10
3	4½	4¼x11½	.315	3.15

Contractors' special caisson grub hoes, heavy pattern, 5 lbs. weight, 4¼x11½-in., can be bought at the net price of 60 cts. each, or $6 per doz.; an extra heavy pattern for hard pan, 8 lbs. in weight and 3x12 ins. in size, can be bought at the net price of $1.50 each, or $15 per doz.

Picks and Mattocks.—Net prices at Chicago for picks and mattocks, in quantities, are as follows:

Railroad or Clay Picks.

Weight, lbs.	Price, each.	Price per doz.
7½	$0.52	$5.23
8½	.54	5.54

The above have adze eye, pick and chisel points, and are made of high grade solid steel. The points are made of crucible tool steel.

Standard Dirt Picks.

Weight, lbs.	Price, each.	Price per doz.
5 to 6	$0.32	$3.15
6 to 7	.34	3.37
7 to 8	.36	3.60
9 to 10	.45	4.50

Drifting Picks.

Weight, lbs.	Price, each.	Price per doz.
4½	$0.38	$3.85
6	.45	4.57

These drifting picks have adze eye and the points and are of the best grade of crucible tool steel.

Mattocks (Adze Eye).

	Weight, lbs.	Size blade, ins.	Size cutter, ins.	Price, each.	Price, doz.
Short cutter	5	3½x7½	2½x4¼	$0.36	$3.60
Long cutter	5½	3½x7½	2½x5¼	.36	3.60

Pick mattocks, weighing 5½ lbs., with a blade 4⅛x8½ ins. and a cutter 8½ ins. can be bought at a net price of $4.25 per doz.

Post Hole Diggers and Augers.—Net prices at Chicago for post hole diggers and augers are as follows:

Post Hole Diggers.

	Lgth. blade. ins.	Wt. to doz. lbs.	Price each.	Price per doz.
Eureka, standard pattern	9	110	$0.72	$7.20
Eureka, heavy pattern	9	140	1.05	10.50
Hexagon	9	120	.84	8.40
Champion	6	140	.60	6.00

Post hole augers with blades 6-in., 7-in., 8-in. or 9-in. can be bought for $1.00 each.

Grading and Road Plows.—For grading and road plows net prices at Chicago are about as follows:

Railroad or Grading Plows.

No. of horses.	Weight, lbs.	Cut, ins.	Price, each.	Extra points, each.
2 to 4	150	10	$18.50	$4.25
4 to 6	175	10	22.00	4.25
6 to 8	230	12	26.00	5.15
12 to 14	280	12	35.00	5.75

Contractors' or township plows, right or left hand, cutting a furrow 10 ins. wide and from 6 ins. to 12 ins. deep, and weighing 145 lbs., can be bought for $16.50 each. A heavier plow, weighing 205 lbs., costs $20 each. Extra points are not included in above price, but can be bought for $2.25 each extra. Road plows, all steel, with cast iron, cutting 12 ins., and weighing 170 lbs., can be bought for $21. Rooter or hard pan plows weighing 305 lbs. cost $30 each.

Scrapers.—Net prices at Chicago on the several kinds of scrapers named below are as follows:

Ox Shovels.

Size No.	Approx. capac., cubic feet.	Top of back to cutting edge.	Width, ins.	Depth, ins.	Weight, lbs.	Price, each.
		Size of Bowl.				
0	10	36	35	11½	133	$13
00	13	38½	37	13½	178	17
000	17	46	42	16	210	21

These shovels are made of pressed steel and are used for ditching along railroad tracks. They are usually drawn by locomotives. The above prices are for steel bail for No. 0 and chain bails for Nos. 00 and 000. The shovels have wooden handles 3x48 ins.

Buck Scrapers.

No.	Capacity, cu. ft.	Cutting edge width, ft.	Bowl gage, No.	Ends, ins.	Cutting edge width, thickness	Weight, lbs.	Price, each.
3	12	3	10	¼	13½x⅜	325	$18.75
2	14	4	10	¼	13½x⅜	350	19.50
1	18	5	10	¼	13½x⅜	375	21.00

No. 1 tongue scrapers and ditchers, 48 ins. wide, and weighing 133 lbs., sell at the net price of $7 at Chicago. Flat board scrapers, 48 ins. wide, and weighing 75 lbs. each, can be bought at the net price of $5.50 each.

Net prices at Chicago for drag scrapers are as follows:

	Each
No. 1. 7-ft. capacity, with runners	$5.15
No. 2. 5-ft. capacity, with runners	4.85
No. 3. Ditching scraper, 3 cu. ft. capacity.	4.70

The above prices are for scrapers having a bowl without seam or lap, with handles on top. For drag scrapers with bowls pressed from a single sheet of specially hardened steel and with handle sockets on the sides, net prices are as follows: 7 cu. ft. capacity, 94 lbs. weight, with runners, $4.86 each; capacity 5 cu. ft., 80 lbs. weight, with runners, $4.55. For drag scrapers without runners deduct 30 cts. from above prices; for drag scrapers with double bottoms add 50 cts.

Shovel Handles.—Net prices at Chicago for white ash "D" shovel, spade and scoop handles are as follows:

	Per doz.
Shovel, bent and riveted	$2.55
Spade, bent and riveted	2.46
Scoop, bent and riveted	2.55
Ditching spade, bent and riveted	3.00
Shovel or spade, straight, riveted	2.46
Shovel, straight, Maynard pattern	2.46

The net prices for long shovel, spade and scoop handles are as follows.

	Per doz.
4½-ft., shovel, bent	$2.40
4½-ft., spade, bent	2.10
4½-ft., scoop, bent	2.40
4½-ft., shovel, straight, Maynard pattern	2.10

Malleable "D" with wood head and malleable fork and socket can be bought for $1.00 per doz. Malleable "D's" with iron head cost $1.25 per doz.

Tool Handles.—Net prices at Chicago for tool handles in full crate quantities are as follows:

	Per doz.
Nail hammer, adze eye, 14-in	$0.45
Riveting hammer, 12-in	.40
Riveting hammer, 14-in	.40
Blacksmith, 18-in.	.50
Blacksmith, 20-in.	.60
Hatchet, regular, 14-in	.45
Hatchet, broad, 18-in	.60

The above are for second growth hickory with wax finish, clear and white, and free from all imperfections. They are packed 5 doz. to the case. The net prices for hickory axe handles, both single bitted and double bitted, 36 ins. long, are $2.45 per doz. for extra grade and $1.25 for No. 1 grade. Railroad pick handles, 36 ins. long, can be bought at $2.88 per doz. for extra grade second growth hickory, at $2 for second growth ash, and at $1.50 for second growth hickory, plain finish. The net prices for sledge, tool and maul handles are as follows:

Length, ins.	Price per dozen. Extra grade.	No. 1 grade.
24	$1.00	$0.70
28	1.25	.80
30	1.40	.95
36	1.70	1.15

Grub hoe handles, 36 ins. long, of second growth hickory, with wax finish, can be bought for $2.90 per dozen. Adze handles can be bought for $2.52 per doz.

Tampers.—The net prices for tampers with handles are as follows, No. 1 having steel plate base, No. 2 a cast plate base and No. 3 a round cast plate base:

No.	Size base, ins.	Wght. finished.	Price each.	Price per doz.
1	5 x 8	13	$1.50	$15.00
1	10x10	16	1.65	16.50
1	12x12	26	1.80	18.00
2	6 x 6	8	.78	7.80
2	6 x 7	13	.91	9.10
2	7 x 8	14	.98	9.80
2	8 x 8	15	1.04	10.40
2	10x10	20	1.25	12.50
3	5 x 6	14	1.43	14.30
3	7 x 7	20	1.50	15.00
Curb	1 x 3½	3	.62	6.20
Curb	4 x 4	5½	.78	7.80
Curb	3½x6	6½	.82	8.20
Comb. curb	1x3½	8½	1.50	15.00

The above prices are for tampers with wooden handles.

Wooden Wheelbarrows.—Net prices at Chicago for wooden wheelbarrows in quantities are as follows: Full bolted wooden railroad wheel barrows, with heavy steel wheel, 16½ ins. in diameter, sells at $1.85 each, or $19.75 per doz. Bolted wooden mortar barrows, weighing 60 lbs. each, with tight box, 10 ins. deep at handles and 13 ins. at wheel, sells at $2.75 each, or $27.50 per doz. Bent handled wooden stone barrows can be bought at $3.50 each, or $40.75 per dozen. Folding wooden barrows, with removable sideboards and double frames, 4 cu. ft. capacity, sells at $3 each, or $32.50 per doz.

Tents.—The following are the net prices at Chicago for stable tents, stable tent roofs and wall tents of the sizes commonly used by contractors and engineers:

Stable Tents.

Size.	Wall.	Pole.	10-oz. double filling or 8-oz. army duck.	12-oz. double filling or 10-oz. army duck.
24x28	5	12	$ 89	$101
24x42	5	12	122	136
24x60	5	12	164	185
24x75	5	12	206	221

The above prices are for stable tents complete with poles, stakes, guys and two tackles for setting up.

Stable Tent Roofs.

Size.	Perpendicular.	10-oz. double filing or 8-oz. army duck.	12-oz. double filling or 10-oz. army duck.
24x28	7	$ 58	$ 65
24x42	7	82	92
24x60	7	116	128
24x75	7	138	156

The above prices are for stable tent roofs with gable ends, but without walls, complete with poles, stakes, guys and two tackles for setting up.

Regular Wall Tents.

Size.	Height of center.	Height of wall.	10-oz. duck, single filling.	10-oz. duck, double and twisted filling or 8-oz. army.
9½x12	7½	3	$10.55	$11.75
12x14	8	3½	14.15	18.80
14x18	9	4	20.85	23.25
16x24	11	5	31.65	35.20
18x30	11	5	42.65	47.45

The above prices are for wall tents complete with poles, stakes, guys and keys; the prices do not include flies.

PAVING AND ROAD CONSTRUCTION.

Materials.

Asphalt.—The prevailing current prices for asphalt at Chicago and vincinity are as follows:

Refined Trinidad asphaltum, $25 per net ton f. o. b. New York. Waterproofing asphaltum, $25 to $35 per net ton for natural asphalt in solid form.

Vitrified Brick.—The current prices for vitrified paving brick, f. o. b. Chicago, are $24 to $26 per M.

Granite Blocks, Curbing, Cross-walks, Etc.—The following are the Chicago prices for carload lots, shipments only f. o. b. Chicago, for granite blocks, etc.,

No. 1 standard blocks, $1.55 per sq. yd.

No. 1 special dressed blocks, $2.00 per sq. yd.

Granite curbing, 5x14 ins., 65 cts. per lin. ft.

Granite cross-walks, 5x18 ins., 70 cts. per lin. ft.

Crushed granite, macadam sizes, $1.75 per cu. yd.

Crushed granite, sizes between ¼ in. and 1 in., $2.00 per cu. yd.

Granite screenings, $3.00 per cu. yd.

Rough stock in sizes under 50 cu. ft., 65 cts. per cu. ft.

Paving Cement, Macadam Binder. — Current prices for Texaco brands are as follows:

Texaco paving cement, $25.00 per ton, carload, f. o. b. New York harbor.

Texaco macadam binder, 90-95 per cent asphalt, 11 cts. per gallon, in bulk, f. o. b. New York harbor and Philadelphia.

Wood Blocks, Creosoted.—The following are the approximate current prices for the above:

4-in. deep creosoted blocks in Chicago at the present time cost in the neighborhood of $1.85 per sq. yd., when treated with 16 lbs. of oil to the cubic foot of timber, and $1.95 per yd. when treated with 20 lbs.

NET PRICES OF TOOLS USED IN PAVING AND ROAD CONSTRUCTION.

Asphalt or Tar Rakes.—Asphalt or tar rakes made of solid steel, with drop shank, strap ferrules, 5-ft. selected white ash handles and 18-in. square iron shank, sells at a net price for quantities, at Chicago, of $12.85.

Asphalt Mattocks.—The net prices for asphalt mattocks in quantities, at Chicago, are as follows. For a mattock with crucible steel cutter and chisel ends, weighing 9 lbs., the cost is 90 cts. each, or $9 per doz. A mattock with double cutter, weighing 8 lbs., can be bought for 60 cts. each, or $6 per doz.

Bricklayers Hammers.—The following are net prices for bricklayers hammers, in quantities, at Chicago:

Weight without handle.	Price per dozen. Plain eye.	Adze eye.
1 lb. 2 oz.	$4.95	$5.85
1 lb. 8 oz.	5.40	6.30
2 lbs.	5.85	6.75
2 lbs. 8 oz.	6.30	7.20

Cement Workers' Tools.—The following are current net prices, f. o. b. Boston, Mass., for tools used in constructing and finishing cement sidewalks:

Jointers.

	Per doz.
Iron, nickel plated	$ 5.60
Iron, nickel plated, steel center	5.80
Solid bronze	12.80

The above are for jointers, 2¾ ins. wide by 6 ins. long, with both ends rounded; cuts ½ in. deep.

For jointers 9 ins. long, 3 ins. wide, cutting ½ in. deep, prices are as follows:

	Per doz.
Iron, nickel plated	$11.52
Solid bronze	17.28

Narrow Jointers.

Iron, nickel plated, ½-in. cutting blade	$ 6.40
Solid bronze, ½-in. cutting blade	13.60

These jointers are 1¾ ins. wide, 8 ins. long, and have both ends rounded. The same prices prevail for the above jointers with ¼-in. blade.

Straight End Jointers.

	Per doz.
Iron, nickel plated	$6.40

PREVAILING PRICES IN 1909 FOR MATERIALS USED IN PAVEMENT CONSTRUCTION IN REPRESENTATIVE AMERICAN CITIES.

City.	Portland cement. Per bbl.	Broken stone. Per cu. yd.	Sand. Per cu. yd.	Paving brick. Per sq. yd.	Asphalt per ton.	Creosoted wood block. sq. yd.
Akron, O.	$1.35	$1.20	$0.75	$ 0.72[1]	.....	.....
Albany, N. Y.	1.70	1.50	1.10	27.00*	.....	.....
Annapolis, Md.	.....	1.30†	.....	.....	.....	.....
Ansonia, Conn.	1.52	1.60	1.25	.....	.....	.....
Auburn, Me.	.....	2.20	1.00	.....	.....	.....
Bath, Me.	.....	3.00	1.00	.....	.....	.....
Battle Creek, Mich.	1.05	.....	.65	.73[8]	.....	.....
Bay City, Mich.	.90	.....	.60	.75	.....	.....
Beaumont, Tex.	1.60	1.50	.65	1.00	$21.00	.....
Binghamton, N. Y.	1.30	1.00[2]	1.50	.....	.....	.....
Bloomington, Ill.	1.25	1.30	1.10	.85	30.00	.....
Buffalo, N. Y.	1.10	.90	.90	.....	.....	.....
Butte, Mont.	2.95	1.25[3]	.85	1.12	.....	.....
Cairo, Ill.	.....	1.50	.90	.....	.....	.....
Cambridge, Mass.	1.35	1.75	1.00	.....	.....	.....
Camden, N. J.	1.25	1.35	.50	1.75	.....	.....
Canton, O.	.....	.....	1.00	1.20	.....	.....
Cedar Rapids, Ia.	1.25	1.35	1.00	.88	.....	.....
Charleston, S. C.	1.80	1.70	.88	1.12	.....	.....
Charlotte, N. C.	1.85	1.25	.75	.....	.....	.....
Clinton, Ia.	1.60	1.25	.75	.....	.....	.....
Columbus, O.	1.25	1.35	1.35	.75	21.00	.....
Covington, Ky.	1.10	1.15	.90	.70	.....	.....
Cumberland, Md.	1.25	1.10	.90	15.85*	.....	.....
Davenport, Ia.	1.65	1.25	.50	1.00	.....	.....
Decatur, Ill.	1.80	1.25	1.00	.82	.....	.....
Denver, Colo.	1.51	1.80	.75	.....	.....	.....
Detroit, Mich.	.85	.57†	.50[4]	.85	24.75[5]	$1.73
Dubuque, Ia.	1.65	1.00	1.50	.80	.....	.....
East Liverpool, O.	.....	.....	.....	.48	.....	.....
Easton, Pa.	1.05	1.02†	1.75	.....	.....	.....
East St. Louis, Ill.	1.10	1.00	.78	.65[6]	.....	.....
Elgin, Ill.	1.25	.90	1.10	.65	.....	.....
Elmira, N. Y.	1.25	1.00†	1.00	1.08	.....	.....
Erie, Pa.	.95	1.25[8]	.85	.78	28.00	.....
Evanston, Ill.	1.30	1.25	1.25	.85	.....	.....
Everett, Mass.	1.65	.60[9]	1.01	1.19	.....	.....
Findlay, O.	.....	.60	1.00	.....	.....	.....
Fitchburg, Mass.	1.60	.62†	.65	.....	.....	.....
Fort Dodge, Ia.	1.30	1.50	1.25	.....	.....	.....
Fort Smith, Ark.	1.50	1.25	.60	.....	.....	.....

Fort Wayne	1.40	1.05	.90	.85		
Freeport, Ill	1.50	.50[60]	1.00	.75[61]		
Fresno	2.—	1.00	1.00	....	12.50	
Grand Rapids	1.10	1.6[—]	.60	.86		1.60
Hampton, Va		1.25	.90	..		
Harrisburg, Pa		1.00	.75			
Hartford, Conn	1.50	1.75	1.25		30.00	
Haverhill, Mass	1.40	1.10	2.50			
Helena, Mont	2.50	1.50	1.00	22.00*		
Holyoke, Mass	1.35	1.20	1.00			1.63
Indianapolis, Ind	1.75	1.50	1.50	1.00	23.81	1.65
Kansas City, Mo	1.00	1.25	1.25	.64	28.00	2.10
Keokuk, Ia		1.25[59]	1.10			
Kingston, N. Y	.85	1.00	.50	..		
Knoxville, Tenn	1.50	1.25	.80[24]	19.00*		
La Crosse, Wis	1.10	1.15	.50	.70		
Lawrence, Kan	1.1[—]	1.0[—]	.60	.63		
Leavenworth, Kan	1.15	1.00	.50	.60		
Lewiston, Me		2.20	1.00			
Lincoln, Neb	1.20	1.[—]	.75	.95[57]		
Little Rock, Ark	1.70	1.75	.80	1.00		
Lowell, Mass	.84	2.00		1.24[7]		
Lynn, Mass	.8[—]	.85[54]	.9[—]			
Madison, Wis	1.35	1.[—]	.90[29]			1.[—]
Manistee, Mich	1.40	1.20	.60			
Manhattan, Mont		.80	.50	..		
Marion, Ind	1.20	1.25	.60	.74	28.50	
Meridian, Miss	1.25	1.50[31]	1.00	20.00*		1.[—]
Minneapolis, Minn	1.15	1.80	.80	.97		1.[—]
Muskegon, Mich	1.15	1.2[—]	1.00[24]	..		
New Albany, Ind	1.15	.9[—]	.80	.70		
New Bedford, Mass	1.22	1.52	1.07			
New Castle, Pa	1.15	1.[—]	1.50	.70		
Newport, R. I	1.75					
Newton, Mass	1.60	1.35	.50			
Norristown, Pa	1.1[—]	1.[—]	1.0[—]	.9[—]		
Ottawa, Ill	1.35	1.2[—]	.75	.76		
Passaic, N. J		2.10	.50	..		
Pawtucket, R. I	1.55		1.0[—]	..		
Pensacola, Fla	1.75		1.10			
Peoria, Ill	1.20	1.27	1.00	.73		
Pine Bluff, Ark	1.04	2.00	1.0[—]			
Port Huron, Mich	.9[—]					
Portland, Me	1.60	1.[—]		1.09	1[—]	
Portland, Or	2.40	2.00	1.40			
Providence, R. I	1.56	1.50	.15[61]	1.00		
Provo, Utah	2.00	.75[30]	.75			
Racine, Wis	1.70	1.30	1.00	.85		
Reading, Pa	1.0[—]	1.20[33]	1.00*	1.50		
Richmond, Ind	1.50	.87	1.00			
Rochester, N. Y	1.25	1.50	1.25	.90		
Rockford, Ill	1.30		.50	1.00		
Rock Island, Ill	1.20	1.00	.50	15.00*		
Saginaw, Mich	1.00	1.45	.90	.75	28.00	
Salt Lake City, Utah	2.00	1.75	1.25		27.50	
San Jose, Cal	1.20	1.60	1.00		15.00	
Scranton, Pa	1.10	1.50	1.25	1.00	26.00	
Seattle, Wash		.90[43]	.90[45]	1.[—]	20.[—]	1.30[47]
Selma, Ala	1.75[48]		.40	.8[—]	25.00	
Sheboygan, Wis			1.25	.75	1.05	
Sioux City, Ia	1.[—]	2.10	1.15	1.00[—]		1.[—]
Somerville, Mass	1.1[—]	1.0[—]				
South Bend, Ind	1.20	1.25	.90			
Spokane, Wash	2.75	1.25	1.10	2[—].00	26.00	
Springfield, Ill	.98	1.20	.75	.65	22.[—]	
Springfield, Mass	1.4[—]	.85[54]	1.00			1.[—]
Springfield, Mo	1.2[—]	1.[—]	1.50	.90	34.60	
South Omaha, Neb	1.00	1.62	.60	23.00*		
St. Louis, Mo	1.3[—]	1.15	1.1[—]	.80		1.50
Streator, Ill	1.25	1.10	1.00	.7[—]		
Superior, Wis	1.25	1.70	.75	1.00		1.[—]
Syracuse, N. Y	1.[—]	1.25[54]	1.00[55]			
Tacoma, Wash	.6[—]	1.50	1.50	1.20		
Terre Haute, Ind	1.30	.85[56]		.7[—]		
Topeka, Kan	1.[—]	1.80	1.00	.84		
Toledo, O		1.05[57]	.60[58]	18.0[—]	28.00	
Trenton, N. J	1.[—]	1.[—]	1.3[—]	.95		
Troy, N. Y	1.30	1.50	1.10	..		
Utica, N. Y	1.2[—]	1.25	1.00			
Valparaiso, Ind	....	1.15	.60	.85		
Vicksburg, Miss	1.80	1.75[59]	1.65			
Washington, D. C	1.[—]	1.50[61]	.7[—]	.9[—]		
Watertown, N. Y	1.1[—]	1.00	1.00	1.08		
Wheeling, W. Va			1.30	.67		
Wilkesbarre, Pa	1.[—]	.9[—]	1.35	..		
Worcester, Mass	1.34	1.6[—]	1.25	1.15		2.25
Zanesville, O	1.[—]	1.00[62]	1.00	.60		

*Per M. †Per ton.

[illegible] depending on length of haul. Screened gravel. Broken slag. [illegible] cts. to 60 cts. and screened gravel 65 cts. to 70 cts. [3]Gravel, [8]Washed gravel delivered, [9]60 cts. to 70 cts. [11]Crushed slag, [12]Gravel at 85 cts. per cu. yd. [13]$1.25 net. [14]Delivered. [17]At bank. [17]$1 to $1.20. [18]$1.25 to $1.50. [19]On car. [22]Net. [25]$1.25 to $1.35. [28]80 cts. to $1.00. [25]$19 to $25. [26]95 cts. to $1.10. [27]Block granite. [29]$1.13 to $1.60. [29]90 cts. to $1.25. [30]For large contract. [31]Delivered. [32]Loaded on wagon at dock. [33]On car. Lime stone. [34]Trap. [35]Delivered. [36]Blocks. [37]At bank. [39]Per bbl. [40]Gravel. [41]In bank. [42]With bags at 7½ cts. returned. [43]Trap. [44]Gravel at bunkers. [45]At bunkers. [46]Asphaltic cement. [47]For 4-in. [48]Per ton. [49]Portland $1.[—] natural $1.00 [49]Blocks, $20 per M; brick, $16 per M. [50]$1.15 to $1.30. [51]Per ton on cars. [52]$1.35 to $1.50. [53]$1 to $1.15. [54]$1.25 to $1.50. [55]$1 to $1.15. [56]Bank gravel. [57]F. o. b. cars. [58]On dock. [59]$1.25 to $1.50 [60]Gravel. [61]Plus haul. [62]Gravel.

Iron, nickel plated, steel center	8.00
Solid bronze	13.60

The jointer is 3 ins. wide by 6 ins. long, with one end straight and the other rounded. The above prices also prevail for narrow, straight-end jointers 1¾ ins. wide and 8 ins. long with one straight end and one rounded end.

Corner Tools.

	Per doz.
Iron, nickel plated	$ 5.60
Solid bronze	12.80

The above is 6 ins. long with sides 1½ ins. long.

Gutter Tools.

	Per doz.
Iron, nickel plated, for gutter 1 in. deep, 3½ ins. wide	$11.52
Iron, nickel plated, for gutter 1½ ins. deep, 5 ins. wide	14.40
Solid bronze, for gutter 1 in. deep, 3½ ins. wide	17.28
Solid bronze, for gutter 1½ ins. deep, 5 ins. wide	24.00

Driveway Groovers.

Iron, nickel plated, ¾ in. cut	$11.52
Solid bronze, ¾-in. cut	17.28

Same prices for a tool making a wider groove. The above grooves are 3 ins. wide by 9 ins. long with both ends rounded.

Radius Tools.

	Per doz.
Iron, nickel plated, ⅜-in. or ¾-in. radius	$4.80
Solid bronze, ⅜-in. or ¾-in. radius	9.60

Edgers.

Reversible handle edgers, 2½ ins. wide, 5½ ins. long, with a radius of ⅜ in., made of rolled bronze, cost $12 per doz.

Square edgers, 3 ins. wide, 6 ins. long, both ends rounded, cutting edge 1½ in., cost as follows:

	Per doz.
Iron, nickel plated	$ 8.00
Solid bronze	13.60

Curbing edgers, 3½ ins. wide, 6 ins. long, with 2-in. turned edge and radius of 1½ ins., can be bought at the following figures:

	Per doz.
Iron, nickel plated	$11.52
Solid bronze	17.28

Curbing edgers 10 ins. long cost as follows:

	Per doz.
Iron, nickel plated	$17.60
Solid bronze	26.88

Bevel edgers, 2¾ ins. wide and 6 ins. long, with ⅜-in. bevel, cost as follows:

	Per doz.
Iron, nickel plated	$ 7.60
Solid bronze	12.80

The above prices also prevail for bevel edgers with ⅝-in. bevel and for ⅜-in. edgers, 6 ins. long. For ⅜-in. edgers, 10 ins. long, the following are the prices:

	Per doz.
Iron, nickel plated	$14.40
Solid bronze	24.00

Narrow edgers, 8 ins. long, 1¾ ins. wide, can be bought at the following figures:

	Per doz.
Iron, nickel plated	$8.640
Solid bronze	14.40

The last named prices also prevail for edgers 3 ins. wide, 6 ins. long, with 1-in. turned edge and ¾-in. radius. For ¾-in. edgers, 10 ins. long, the cost is as follows:

	Per doz.
Iron, nickel plated	$14.40
Solid bronze	24.00

Rollers.

Indentation rollers 10 ins. long and 4 ins. in diameter cost as follows:

	Each
Iron, nickel plated	$3.20
Bronze	9.60

For indentation rollers 8 ins. long and 3 ins. in diameter the cost is as follows:

	Each
Iron, nickel plated	$ 5.60
Bronze	11.20

Driveway rollers, 10 ins. in diameter and 4 ins. long, having ½-in. grooves 2 ins. apart, cost:

	Each
Iron, nickel plated	$3.20
Solid bronze	9.60

For rollers making grooves 3 ins. apart the cost is as above. Line rollers, 10 ins. long and 4 ins. in diameter, 6 grooves to the inch, cost as follows:

	Each
Iron, nickel plated	$3.20
Solid bronze	9.60

Same prices prevail for line rollers with grooves ⅜ in. apart. Roller edgers ⅜-in. to ¾-in. radius, cost as follows:

	Per doz.
Iron, nickel plated	$ 8.[—]0
Solid bronze	14.40

Roller jointers 2 ins. long and 2 ins. in diameter cost the same as the roller edgers last mentioned.

Paving Rammers.—Net prices at Chicago for paving rammers are as follows.

Kind.	Weight, lbs.	Price, each.
Granite rammer	56	$10
Cobblestone rammer	50	[—]

Rollers.—Hand rollers, 1-horse rollers and reversible road rollers can be bought at the following net prices, f. o. b. Chicago.

Hand Rollers.

No.	Diameter. Ins.	L'gth. Ins.	No. sections.	Face. Ins.	Weight. Lbs.	Price each.
1	15	15	2	7½	150	$ 7.15
2	15	22	3	7½	200	9.40
[—]	20	16	2	8	225	10.50
[—]	20	20	2	10	250	11.65
6	20	24	3	[—]	300	14.90
8	20	30	3	10	350	16.15
9	24	20	2	10	400	17.40
10	24	24	2	12	450	20.65
12	24	30	3	10	500	22.90
14	28	24	3	8	500	22.90

The outer edges of these rollers are beveled. They are turned smooth and silver finished.

Horse Rollers.

No.	Diameter. Ins.	L'gth. Ft.	No. sections.	Face. Ins	Weight Lbs.	Price each.
80.	36	4	4	12	3,000	$141
81.	36	5	5	12	3,500	161
82.	36	6	6	12	4,000	180
83.	48	3¾	3	15	4,000	186
84.	48	5	4	15	5,000	228
85.	48	6¼	5	15	6,000	270
86.	54	3¾	3	15	6,000	276
87.	54	5	4	15	8,000	363
88.	54	6¼	5	15	10,000	450

Reversible Road Rollers.

No.	Weight. Tons.	Diameter. Ins.	Width. Ins.	Price each.
10.	4	56	54	$360
20.	5	58	54	450
30.	6	60	54	540

Stone or Ballast Forks.—Net prices for extra grades stone or ballast forks in quantities, at Chicago, are as follows:

No. tines.	Length tines. Ins.	Width fork. Ins.	Weight per doz. Lbs.	Price per doz.
8.	13½	11¼	76	$12.00
10.	13½	11½	88	15.00
12.	11½	13¾	96	17.40

The above prices are for forks with natural finish, wide strap ferrules and heavy caps, with wood "D" ash handles.

Stone Hooks.—Hop or stone hooks in quantities can be bought at Chicago at the following net prices: 4-tined, diamond backed, extra heavy hook, 5 ft. handle, at $9 per dozen; 4-tined

diamond backed, light hooks, 4½ ft. handles, at $7.80 per dozen.

Two-Man Rakes.—Two-man rakes, used in leveling broken stone, sell at the following net prices, for quantities, at Chicago:

	Per doz.
10-tooth	$21.25
12-tooth	24.75
14-tooth	28.25

RAILWAYS.

Materials and Supplies.

Rails and Track Supplies.—Current rates at Chicago, f. o. b. cars at works at Chicago and vicinity, are as follows on lots of rails 500 tons and over with necessary fastenings:

Standard quality No. 1 Bessemer rails, $28 per gross ton.

Standard quality No. 1 open hearth rails, $30 per gross ton.

Angle bar splices, 1.50 cts. per lb.

Spikes, 1.85 cts. per lb.

Bolts with square nuts, 2.45 cts. per lb.

Bolts with hexagon nuts, 2.60 cts. per lb.

The prices mentioned contemplate furnishing rails in 33-ft. lengths with 10 per cent of shorts, diminishing by even feet down to 24 feet. Where rails are required in 60-ft. lengths, add $2.00 per ton to the above prices. If ordered in lots less than 500 tons down to carloads, there is an additional cost of $2.00 per ton to the prices mentioned above.

Other quotations on light rails at Chicago are as follows:

	Per ton
20 to 45 lb.	$27.00
50 to 55-lb.	27.50
16, 20 and 25 lb.	28.00
12 lb.	29.00

The following quotations are per gross ton delivered at Chicago:

Relaying rails, standard sections....$24 to $25.00

Old iron rails..... 19 to 19.50

Old steel rails, less than 3.10 17.50 to 17

Tools.

Bars.—Net prices at Chicago for solid steel bowl bits, lining bars, claw bars and hammered tamping bars, are as follows:

	Per lb.
Crowbars	4 cts.
Lining bars	4 cts.
Claw bars, goose neck	4 cts.
Claw bars, with heel	4 cts.
Railroad tamping bars	4½ cts.

Track Tools.—Net prices at Chicago for track tools are as follows:

	Per lb.
Mauls, 6, 8, 10 and 12-lb.	5½ cts.
Chisels, 4½, 5 and 7 lb.	5 cts.
Pinches, 4, 4½ and 5 lbs.	5 cts.
Railroad track tongs, 17 lbs., pair	7½ cts.
Rail forks, each 15 lbs.	7 cts.

SEWERAGE AND WATER SUPPLY

Materials and Supplies.

Water Pipe.—The following are about the present current prices per net ton, f. o. b. New York, from stock for bell and spigot cast iron pipe.

	Per net ton.
4 in.	$28.50
6 in. to 12 in.	27.50
16 in. up	27.50

For gas pipe add $1 per net ton.

Cast iron pipe specials are 3½ cts. per lb.

Lead pipe is $6.10 per 100 lbs.

Merchant Pipe.—Net prices on wrought merchant pipe, f. o. b. New York, from stock are as follows:

	Cts. per foot. Black.	Galvanized.
⅛-¼ in.	1.71	2.59
⅜ in.	1.65	2.42
½ in.	2.3	3.32
¾ in.	2.65	3.80
1 in.	3.80	5.45
1¼ in.	5.18	7.42
1½ in.	6.21	8.91
2 in.	8.28	11.88
2½ in.	13.23	18.98
3 in.	17.37	24.92
3½ in.	21.85	31.35
4 in.	25.	36.
4½ in.	30.	43.
5 in.	34.	48.
6 in.	44.	63.
7 in.	71.	112.
8 in.	85.	127.
9 in.	102.	153.
10 in.	128.	192.
11 in.	143.	214.
12 in.	156.	234.

Valves and Valve Boxes.—The following are about the current prices for valves and valve boxes for delivery at Chicago:

	Each.
4-in. hub end valves	$ 7.50
6-in. hub end valves	12.00
8-in. hub end valves	17.50
10-in. hub end valves	25.50
12-in. hub end valves	32.50
14-in. hub end valves	48.00
16-in. hub end valves	60.00
18-in. hub end valves	84.00
18-in. if geared	100.00
20-in.	94.00
20-in. if geared	109.00
20-in. if geared and with by pass	140.00
24-in.	140.00
24-in. if geared	165.00
24-in. if with by pass	200.00
30-in. geared	290.00
30-in. if with by pass	3.35
Valves boxes	3.50

Averaging a depth of trench of 5 to 6 ft.

Manhole Covers.—Current prices, f. o. b. New York for manhole covers are 3½ to 4 cts. per lb. for standard shapes.

Sewer Pipe.—The larger manufacturers of vitrified sewer pipe are using about the following basis for quotations on sewer pipe, f. o. b. work, the discount being taken from the standard Western price list printed below:

	Per cent.
3-in. to 6-in.	80
8-in. to 12-in.	77½
15-in. to 18-in.	75
20-in. to 24-in.	70

For the larger sizes the following are the net prices per foot:

	Per ft.
27-in.	$1.00
30-in.	1.30
33-in.	1.85
36-in.	2.15

Western Price List of Standard Vitrified Pipe.

Inside diameter.	Weight per foot.	Price per foot.	Price per length.	Price of Y branches, each.	Price of T branches, each.	Double branches, Y and T, each.	Price of stopped ends, each.	Price of reducers, each.	Length of pipe.	Weight per length.	Number of pipe per car.
3	$0.45	$0.50	$0.60	$1.70	$0.90	$0.45	11½	6	1,650
4	.60	.65	.80	2.10	1.20	.60	12½	10	2,800
5	.25	.75	1.00	2.50	1.50	.75	13⅜	12	2,330
6	.30	1.00	1.20	2.90	1.80	.90	17⅜	16	1,750
7	.35	1.25	1.40	3.50	2.10	1.05	13⅜	18	1,550
8	.45	1.65	1.80	4.50	2.70	1.35	23½	24	1,100
9	.50	1.75	2.00	5.00	3.00	1.50	21½	27	1,040
10	.60	2.10	2.40	6.00	3.60	1.80	24.	30	930
12	.75	2.75	3.00	8.00	4.50	2.25	30.	40	700
15	1.00	3.75	4.00	....	....	3.00	33½	60	470
18	1.50	4.75	6.00	....	....	4.50	34¼	85	330
20	1.75	7.50	7.00	....	....	6.00	4	105	270
21	2.00	6.75	8.00	....	....	6.00	4	110	260
24	2.50	8.00	10.00	....	....	7.50	4	135	210
27	3.25	15.25	16.25	....	....	16.25	4½	145	129
30	4.00	20.00	20.00	....	....	20.00	4½	270	108
33	5.00	25.00	25.00	....	....	25.00	5	320	90
36	6.00	30.00	30.00	....	....	30.00	5½	365	81

Sizes 3-in. to 6-in. inclusive in 2-ft. lengths.
Sizes 8-in. to 24-in. inclusive in 2½-ft. lengths.
Sizes 27-in. to 36-in. inclusive in 3-ft. lengths.
*Both P Traps and Running Traps are made with or without hand holes.
†Double branches, both T and Y above 12-in. made only to order.
Branches, increasers, decreasers, slants, 27 to 36-in. are 3 ft. long.

Pipe Fittings.—The following are net cast iron prices at New York City for pipe fittings:

Extra Heavy Flange Unions.

Size, ins.	1	1¼	1½	2	2½	3	3½	4
Each	$1.75	$2.25	$2.50	$3.00	$4.00	$5.00	$6.00	$7.00

Standard Wrought Couplings.

Size, ins.	4	6	8	10	12
Black	.25	.65	1.05	1.85	2.50
Galvanized	.37	.97	1.58	2.44	3.32
R. & L. black	.50	3.13	4.25	5.75	7.00
R. & L. galvanized	.68	4.29	5.77	6.32	9.52

Brass Globe and Angle Valves.

Size, ins.	½	¾	1	1¼	1½	2	4
Screwed	$2.25	$3.00	$4.00	$5.50	$6.50	$8.00	$30.00
Flanged	1.15	1.60	2.65	4.00	4.75	7.50	30.00

MISCELLANEOUS SUPPLIES AND TOOLS.

Axes.—Net prices at Chicago for axes in quantities are as follows:

	Weight Lbs.	Price each.	Price per doz.
Single bitted	3½ to 4½	$0.50	$5.25
Single bitted	4 to 5	.55	5.75
Single bitted	5 to 6	.65	6.50
Double bitted	4 to 5	.85	8.50

Handled axes bring the following net prices:

	Each.	Doz.
Single bitted, Michigan pattern, 4 to 5 lbs.	$0.80	$ 8.25
Single bitted, Michigan pattern, 5 to 6 lbs.	.90	9.00
Double bitted, Michigan pattern, 4 to 5 lbs.	1.10	11.00

Mortar Hoes.—The following are net prices at Chicago for mortar hoes forged from best hoe steel, with 6 ft. selected white ash handles and solid shanks.

Mortar hoes, weighing 45 lbs. per dozen, 55 cts. each or $5.75 per dozen; mortar mixing hoes with two holes, 60 cts. each or $6.25 per dozen.

Pails.—Net prices at Chicago for various kinds of pails are as follows:

Galvanized, regular.

Capacity. Quarts.	Weight per dozen. Lbs.	Per dozen.
10	24	$2.05
12	28	2.30
14	30	2.75

Galvanized, extra heavy.

Capacity. Quarts.	Weight per dozen. Lbs.	Per dozen.
12	39	$3.55
14	33	3.85
16	37	4.45

Galvanized cement pails with double braced bottom, extra heavy, of 14 quart capacity, can be bought at $8 per dozen. Heavy oak wooden pails with iron bails, 14 quart capacity bring a net price of 55 cts. each or $5.50 per dozen. Common pine pails, 2-hoop, cost $2.50 per dozen; with three hops they cost $3 per dozen.

Sewer Builders' Mauls.—Net prices for mauls for sewer builders, etc., with selected hickory handles and iron bound head range from $1.40 each for 6 x 8 and 6 x 9-in. sizes to $1.50 each for 7 x 9, $1.60 for 7 x 10 and $1.70 for 8 x 10-in.

Manila and Sisal Rope.—The net prices at Chicago for various kinds of rope, in quantities, are as follows:

Manila Rope.

	Per lb. Cts.
All sizes above ⅜-in. diameter	8½
12-thread or ⅜-in. diameter	9
6 and 9-thread or ¼-in. and 5/16-in. diameter	9½
Fine 6-thread, or 3/16-in. diameter	10
3-thread laid or 3/16-in. diameter	9½
Tallow laid	9
Hawser laid	9½

Sisal Rope.

All sizes above ⅜-in. diameter	8¼
12-thread or ⅜-in. diameter	8¾
6 and 9 thread or ¼ and 5/10-in. diameter	9¼
Fine 6-thread or 3/10-in. diameter	9¾

Wire Rope.—The discounts from the following standard lists to the larger consumer are 42½ per cent and 2½ per cent for galvanized and 50 per cent and 2½ per cent for plain. The prices in the following standard lists are cents per foot.

Standard Hoisting Rope.
19 Wires to the Strand.

No.	Diam.	Extra strong Swedish iron.	Cast steel.	crucible steel.	Plow steel.
000	2⅜	1.70	2.10	2.55	3.00
0	2½	1.40	1.75	2.10	2.50
1	2¼	1.17	1.42	1.70	2.00
2	2	92	1.11	1.34	1.56
3	1¾	80	93	1.15	1.35
4	1⅝	63	74	91	1.08
5	1½	57	65	80	93
5½	1⅜	48	56	67	77
6	1¼	40	46	55	63
7	1⅛	33	38	45	52
8	1	26	30	36	43
9	⅞	20	23	28	34
10	¾	16	18	22	26
10½	⅝	12	14	16½	19
10½	9/16	10	12	14	16
10¾	½	8	11	12½	14
11	7/16	7½	10	11½	13
10½	⅜	5	9½	11	12½
11c	5/16	3⅔	9¼	10⅝	12¼
10d	¼	2½	9	10½	12

Transmission or Haulage Rope.
7 Wires to the Strand.

No.	Diam.	Extra strong Swedish iron.	Cast steel.	crucible steel.	Plow steel.
11	1¼	51	60	75	90
12	1⅛	43	51	64	75
13	1⅛	36	43	53	61
14	1⅛	29	34	41	51
15	1	23	28	34	41
16	⅞	17½	22	26	32
17	¾	14	16	20	25
18	11/16	12	13½	17	20
19	⅝	10	11	14	17
20	9/16	8	9	11½	14
21	½	6½	7½	9½	11
22	7/16	5½	6½	7¼	8
23	⅜	4½	5½	6	6½
24	5/16	3¾	4½	5	6
25	9/32	3¼	4	5	5½

Galvanized Wire Rope.
7 or 12 wires to the strand.

Circumference.	Approx. Diam.	7 wires to strand.	12 wires to strand.
5½	1¾	44	46
5¼	1 11/16	41	43
5	1⅝	38	40
4¾	1½	35	37
4½	1 7/16	31	33
4¼	1⅜	27	29
4	1¼	24	25
3¾	1 3/16	21	22
3½	1⅛	18	19
3¼	1 1/16	16	17
3	1	14	15
2¾	⅞	12	13
2½	13/16	10	11½
2¼	¾	9	9¾
2	⅝	8	9
1¾	9/16	7	8
1½	½	6	7
1¼	7/16	5	6
1⅛	⅜	4	5
1	5/16	3½	4½
		7 strands, 7 wires each.	6 strands, 7 wires each.
⅞	9/32	3	4¼
¾	¼	2½	4
⅝	7/32	2¼	3½
½	3/16	2	3

General Prices at New York City.—The following are general prices at New York City for some materials and supplies used in construction work:

Rip rap, from 60 to 70 cts. per yard alongside; building stone, from 65 to 80 cts. per yard alongside; steam ashes (hard coal), 20 cts. to 30 cts. per yard alongside; steam ashes (soft coal), 15 to 20 cts. per yard alongside; earth fill, 12 to 20 cts. per yard alongside; earth fill, 20 to 35 cts. per yard in place; gravel, 75 to 85 cts. per yard alongside; sand, 35 cts. alongside; disposing of excavations, 12 to 18 cts. per yard, scow measurement; derrick boats, $10 to $25 per day as per capacity and lifting power; flat scows for hire, $5 to $6 per day.

Methods of Refuse Collection and Disposal in Boston, Mass., with Some Cost Data.

The general plan of collection followed is to divide the refuse into two general classes: (1) garbage proper and (2) ashes and rubbish. In some sections of the city a further separation is made into ashes and combustible refuse. There is also another class of waste, the refuse from the markets, which is not collected by the city, but which is disposed of in connection with the city wastes. The quantities of these several kinds of refuse in 1908 were as follows:

Kind of refuse.	Total tons.	Ave. tons per day.
Ashes	311,586	998
House offal	78,615	252
Waste and rubbish	13,566	44
Market refuse	9,382	30
Total and average	413,149	1,324

The city is divided into 9 sanitary districts and the following tabulation shows the population, tons of refuse per capita, and cost per ton per capita for collection and disposal for 1908:

Sanitary district.	Population per acre	Pounds per capita	Cost per ton per capita
1 South Boston	50	795	$0.91
2 East Boston*	36.2	796	0.60
3 Charlestown	47.7	1,017	1.05
4 Brighton*	8.8	1,216	0.82
5 West Roxbury*	3.1	1,025	0.49
6 Dorchester*	19.3	1,002	0.54
7 Roxbury	37.7	1,038	1.10
8 and 9 S. End and Back Bay	50.5	2,318	2.15
10 N. and W. Ends	115	2,132	1.89

*Collection and disposal by contract.

In general, it will be seen, the collection in the suburban districts is made by contract and in the more settled and in the business districts by day labor.

The total amount of refuse collected by contract in the four districts indicated was 83,720 tons and 133 men and 88 horses were employed by the contractors. These contractors also disposed of the refuse collected by them, feeding the garbage to hogs. Two or more contractors handled the refuse in each district, the tonnage handled by each and the contract price per ton being as follows:

District.	Kind of Refuse.	Tons.	Price per Ton.
E. Boston, ashes and waste		8,010	$0.78
E. Boston, offal		5,806	1.13
Brighton, ashes and waste		4,925	0.68
Brighton, offal		3,125	0.74
W. Roxbury, ashes and waste		8,018	0.68
W. Roxbury, offal		2,230	1.12
Dorchester, ashes and waste		40,697	0.64
Dorchester, offal		10,909	1.83

The total tonnage of 83,720 tons cost to collect and dispose $92,389, or an average of $1.10 per ton.

The total tonnage collected by day labor was 320,047 tons, with a force consisting of 607 men and 260 horses. The city also maintains a shop employing 38 mechanics to manufacture and repair equipment. To collect and dispose of this 320,047 tons cost in 1908 $648,866, or an average of $2.03 per ton.

In comparing the costs of day labor and contract work the report says:

The cost of contract work is doubtless lower than would be the case if the contractors were precluded from profiting by feeding the garbage to swine, and there are other features of the department's contract work, notably the shorter hauls and the elimination of the charges for transportation to sea, tending to complicate any comparison with the cost of day labor.

Taking day labor and contract work together it will be seen that a total of 403,767 tons, exclusive of market refuse, was collected and disposed of at a total cost of $741,255, or a unit cost of $1.84 per ton.

Of the 311,586 tons of ashes and house dirt collected during 1908, 87,000 tons, or 28 per cent, were discharged upon the city scows and dumped at sea beyond the harbor limits. The remaining 244,586 tons were deposited upon dumps in various parts of the city. Of the 78,615 tons of garbage, 67,454 tons were delivered to the New England Sanitary Product Co. and conveyed to the reduction works of the company at Spectacle Island. The remainder, amounting to 11,161 tons, or 14 per cent of the total quantity collected, was disposed of by the suburban district contractors and used, to a greater or less extent, for the feeding of swine beyond the city limits.

Of the combustible waste and refuse, 12,050 tons were conveyed to the refuse destructor, where the material is sorted, a part of it sold and the remainder burned, the ashes being discharged upon the dumping scows. The remaining combustible waste and refuse, amounting to 1,516 tons, was disposed of upon dumps.

The market wastes from the downtown section of the city, amounting in 1908 to 9,382 tons, were discharged upon the dumping scows and disposed of at sea with the ashes and other refuse, the total carried to sea being thus 96,382 tons. Market wastes from other sections of the city were disposed of in connection with the house dirt and ashes. Small quantities of refuse are disposed of by other means, which are negligible in considering the general question; for instance, a number of hotels and restaurants dispose of their own garbage. Also several persons have established routes for the collection of paper, which is understood to yield them some revenue.

The report discusses disposal by incineration and by reduction, and makes the following recommendation:

The commission recommends the disposal of the city's entire waste by burning in modern incinerators of the so-called English "Destructor" type, operated by forced draft and at a temperature of not less than 1,500° F. Such destructors should be introduced gradually, beginning with the district in which the need is most urgent and extending to other districts of the city as required.

The plan of combining disposal by incineration in destructor plants of the type recommended above, with a garbage reduction plant so designed as to prevent the escape of foul odors, might enable the city to dispose of its waste effectually and satisfactorily by contract, at less cost than by the burning of mixed waste in its own destructor plants. The contract plan tentatively outlined to the commission involved both the collection and disposal of all wastes at a cost much less than would be required if the work were done by the city. It has already been pointed out that this plan admits of separating the collection of the waste from its disposal, and the commission recommends that if the plan be again presented, either in its original form or as thus modified, the desirability of its adoption must be given careful consideration.

Whether the present methods of disposal of refuse are continued, or whether the method of incineration with the accompanying advantage of a single collection of unseparated material is adopted, the question remains whether it is more advantageous to the city to do the work itself or to let it out to one or more contractors.

The majority of the members of the commission are of opinion that it would be to the advantage of the city in either case to do the work by contract, and, if a suitable contractor can be found, that it would be better to let the entire work of collection and disposal for the whole city to one contractor. The reasons in favor of this view are briefly as follows:

They believe that the work can be done more cheaply by contract, as contractors have more control over their working forces than the city departments have over theirs. There is less chance for politics to enter in and more incentive to do the work economically. Especially, if a method of disposal is adopted in which there are products from the refuse to be sold, they believe that the city would be at a great disadvantage in disposing of such products as compared with a private concern. They also think it desirable that the city should escape a large investment in horses, carts and similar equipment, which are assets of fast depreciating value and susceptible of great waste and extravagance in their initial purchase if attended to by inexperienced or inefficient officials. There are other advantages of the contract system, as, for instance, that the more work that is let out by contract the less liability there is of having pensioners or incompetent or superannuated men on the city pay rolls. Further, that it is an advantage to know just what the expense will be year by year, and not have the amount fluctuate violently according to the competence or incompetence of the head of a city department. They find from the experience of the City of Boston that work of this character has been done by contract for much less than the cost by day labor, and they are of opinion that, with competent supervision, the work can be as well done by contract as by day labor. The danger that a contractor will employ inefficient or low-grade and objectionable men or teams to collect refuse from the houses of the citizens can, in the opinion of the majority of the commission, be readily overcome by suitable provisions in the contract. They feel that if the city officials having charge of the enforcement of the contract show any disposition to do their duty, there will be no difficulty in detecting the contractor in the violation of such provisions, because practically every citizen will be glad to complain of any inconvenience to which he may be put by the contractor or his men.

*Abstracted from the report of the special commission to investigate the subject of garbage collection and disposal in Boston, Mass.

Technical Society Meetings.

The list following names those technical societies in which engineers and contractors are most interested, whose meetings are to be held within three months of the date of this issue. There are given for each society listed the date and place of meeting and the name and address of the secretary, to whom all communications and inquiries should be addressed.

American Water Works Association.—April 26-30, 1910. Annual convention at New Orleans, La. Headquarters, Gruenwald Hotel. Secy., J. M. Diven, Charleston, S. C.

American Electrochemical Society.—May 5-7. Annual meeting at Pittsburg, Pa. Secy., Jos. W. Richards, South Bethlehem, Pa.

Appalachian Engineering Association.—May 6-7. Annual meeting at Winston-Salem, N. C. Secy., Henry M. Payne, Morgantown, W. Va.

National Fire Protection Association.—May 17-19. Annual meeting at Chicago, Ill. Secy., Franklin H. Wentworth, 87 Milk St., Boston, Mass.

American Railway Association.—May 18. Annual meeting at New York City. Secy., W. F. Allen, 24 Park Pl., New York City.

International Railway Fuel Association.—May 23-26. Annual meeting at Chicago, Ill. Secy., D. B. Sebastian, 327 La Salle Station, Chicago, Ill.

National Electric Light Association.—May 23-28. Annual meeting at St. Louis, Mo. Secy., T. C. Martin, 29 West 39th St., New York City.

American Society of Mechanical Engineers.—May 31-June 3. Spring meeting at Atlantic City, N. J. Secy., Calvin W. Rice, 29 West 39th St., New York City.

Engineers' Society of Pennsylvania.—June 1-3. Annual convention at Harrisburg, Pa. Secy., E. R. Dasher, Gilbert Bldg., Harrisburg, Pa.

Catalogs Worth Having.

Engineers and contractors should have on file the latest catalogs of machines, tools and supplies that they use. In sending for catalogs reviewed or advertised in this paper, you will confer a favor on us if you will write directly to the advertisers and state that you saw the catalog mentioned in ENGINEERING-CONTRACTING. If you are in the market for tools, machinery or supplies, tell us and we will notify promptly the leading manufacturers.

Steel and Concrete.—Paper, 6x9 ins., 32 pp., ill. Blaw Collapsible Steel Centering Co., Pittsburg, Pa.

Contains an able discussion by Mr. J. F. Springer on reinforced concrete in its application to various kinds of concrete construction, such as bridges, piling, chimneys, fireproof construction in buildings, marine construction, telegraph poles, railroad ties, etc. The use of collapsible steel centering in different kinds of concrete work is also shown.

Foundry Machinery.—Paper, 3x5½ ins., 24 pp. Northern Engineering Works, Detroit, Mich.

A booklet containing descriptions and views of some of the foundry equipment manufactured by this company.

Non-Chokable Diaphragm Pumps. — The Barnes Mfg. Co., Mansfield, Ohio.

A two-page circular pamphlet calling attention to the non-chokable diaphragm pumps made by this company.

Contract News Section

of

ENGINEERING-CONTRACTING

A Consolidation of Engineering-Contracting—Contract News—Engineering World—The Dirt Mover.

Containing Items of Interest to Railroad, Public Works and Other Contractors.

The Doings of the Week.

The principal development in the way of new railroad construction work has been the report that the Western Maryland Ry. had already taken bids for constructing its extension from Cumberland, Md., to New Castle, Pa. We have no information at this time as to the successful contractors.—As was expected the directors of the Atchison, Topeka & Santa Fe Ry. have authorized an issue of $43,686,000 50-year 4 per cent convertible bonds to enlarge the capacity of the lines now in operation.—A large contract is to be let shortly by the East Side Lever Sanitary District, of East St. Louis, Ill. This contract calls for moving some 1,500,000 cu. yds. of dirt and is estimated to cost $800,000. This is the first piece of work in the extensive improvements planned by the district, for which it is planned to expend about $6,500,000.—The principal irrigation contract for the past week was secured by the Wogan-Wilcoxon Construction Co., of Denver, Colo. This contract called for the construction of the Sanchez dam and dike and the Culebra-Sanchez canal for the Costilla Estates Development Co., and amounted to $500,000.—Among the railroad contracts of the week are the following: Costello Bros., for 50 miles of betterment work on the Big Four, between Indianapolis, Ind., and Muncie, Ind.; E. G. Spaulding, for the first 50 miles of grading work for the Osage & Western Ry., west from Vinita, Okla.; J. D. McArthur & Co., Winnipeg, for the construction of a branch line for the Grand Trunk Pacific Ry., south from Regina, Sask., to the American boundary near Portal; Hartley & Ford, Bay City, Tex., for the grading work for a 19-mile section of the Houston-Galveston Interurban Ry.; Continental Construction Co., Caney, Kan., for the construction of the first 5-mile section of the Cherryvale, Oklahoma & Texas Ry.; J. C. Carland & Co., Toledo, O., for the realignment of the Big Four tracks between Middleton and Miamisburg, the contract amounting to about $80,000, and for constructing the last section of the Belt Line into Cleveland, O., this contract amounting to about $1,000,000.—The Pennsylvania R. R. last week opened for public inspection its tunnel and terminal improvements from Harrison, N. J., to Sunnyside, L. I. The section is 16.5 miles long and the company has thus far expended $102,000,000 and will expend $16,000,000 before the improvement is completed. Train service is due to begin late in June, or early in July, with an initial card of 1,000 trains daily.—Extensive improvements are proposed near Hammond, Ind., if a reported plan of the New York Central lines is carried out. According to this plan Gibson, a place near Hammond, is to be made the operating center for the lines. The plan is said to contemplate the expenditure of about $20,000,000 for improvements to the system. The chief of these will be the double tracking of the Chicago, Indiana & Southern R. R. all of the way from Indiana Harbor to Danville. This would open up a north and south railroad system between Indiana Harbor and New Orleans.

Eight Eighty Eight.

At a recent oyster roast at Galveston, Texas, Julius Kruttschnitt, director of maintenance of the Harriman system, was high man in number of oysters consumed and was awarded a medal in honor of his achievement. Mr. Kruttschnitt acknowledged the honor and the medal in the following manner:

I acknowledge with keen pleasure
Your medal, which I'll treasure,
Though for such a poor performance
I feel it was not deserved;
While I had the table beaten,
I could easily have eaten
A barrelful of oysters,
As luscious as were served.

At a function so important
I felt I surely Ortont
To eat as many oysters
As I really might have ate,
So while I took the medal
I was pressing the soft pedal
On a hunger which, for oysters,
A Roast can not abate.

Your tally, as recorded,
And for which I am awarded,
Announces to the world at large
I ate seven eighty-nine,
But this score is not amazing
When I tell you, without fasing,
I eat as many oysters
Each day before I dine.

In your figures too I notice
A slight lapsus oysterotis,
For the number I demolished
Exceeded what you state;
While I practiced self denial,
Yet my oystermeter dial
Records in figures clearly
I ate eight eighty-eight.

A Tip on the Water Jet.

The water jet has been employed for so many years as an aid in putting down piles that its use is familiar to all contractors. Some contractors, however, in using the jet make the mistake of having too small a nozzle and too great a velocity of discharge of the water. A small nozzle and great velocity seems to compact the material and in many cases acts as a hindrance in putting down the piles. On the other hand a large nozzle and a large volume of water under low pressure seem to lift out the particles and clear the way for the pile. Some contractors are now using low pressure, high volume pumps with the water jet and are meeting with much success. In one case that came under our observation the contractor was using a 4-in. hose and a 2½-in. nozzle. So our tip on the water jet seems to be a large nozzle.

Drainage of Southern Swamp Lands.

If it is right for the government to advance funds for the construction of irrigation systems for the bringing of water to lands that need it, it is equally right for the government to advance funds for devising plans for taking away water from the lands that don't need it. Such seems to be the general belief in the southern states, which have more than their share of the 76,000,000 acres of wet and overflowed swamp land in the United States. Acting on this belief the southern states are asking for a small government appropriation with which to make surveys so that the work of reclaiming these lands can be carried out by private capital. Louisiana, which has 7,000,000 acres of overflowed land within its boundaries, is taking the lead in the matter, and has already sent several delegations to Washington to secure the government's aid in starting the work of reclamation by making comprehensive surveys.

Revised Estimate.

James J. Hill has revised his estimate of the country's needs for additional railway facilities. Some four years ago he announced that it would require $1,100,000,000 per year for five years to make this country's railroad facilities equal to the demands upon them. He now says that $1,600,000,000 a year for the next six years is needed by the railroads of the country to escape congestion such as it has never before experienced. In a recent interview in New York city he said: "This country is up against a stone wall and it can't see either end or top. The importance of our railroads' condition is not realized. To my way of thinking it is of more importance than a total failure of crops. Congestion of freight such as has been experienced this winter is not caused by too few cars. More equipment would only make more congestion. What the country needs is additional terminal facilities and track sidings."

A mechanic's lien on a street of a Kentucky city has been filed by a supply company to enforce the collection of a claim amounting to some thousand dollars, alleged to be due for material used in paving the street. The lien makes the city and a street railway company traversing the street with its track defendants. If the claim is not paid, the lien gives the plaintiffs the right to sue for debt and to sell the street to the highest bidder.

In order to renew the life of a franchise which the New York State Public Service Commission had threatened to cancel, the New York Traction Co. ran an antiquated horse car over the asphalt pavement of Park row in that city. The company believes that it will not be necessary to operate any more cars over the route for at least a year.

An English railway expert is authority for the statement that a speed of 150 miles per hour by railway trains is technically possible today and will be commercially feasible within the next ten years, provided the railway serves great centers of population yielding a large amount of traffic. The motive power would be electricity, and as the high horse power required for the attainment of such speed would necessitate motors of enormous size and weight, it would be necessary to use three if not four rails.

Work has been resumed on the Arroyo Hondo irrigation project near Santa Fe, N. Mex. Three dams are to be built and it is planned to have one of these completed by June 1. E. E. Meice, of the office of Henry A. Allen & Co., Consulting Engineers, Chicago, Ill., is in charge of the work.

Confirmed Reports by Engineers and Contractors

RAILROADS, POWER DEVELOPMENTS, LEVEES, DRAINAGE AND IRRIGATION WORKS.

Railroads—Steam and Electric.

CALIFORNIA

Surveys have been made for the projected 126-mile line of the Sacramento & Sierra Ry., which is to extend from Sacramento to Lake Tokai, Cal. Construction contracts have not been let as yet. J. M. Graham, 37 Stoll Bldg., Sacramento, Cal., is chief engineer.

INDIANA.

Tripeer & Son, Peru, Ind., have been awarded the contract by the city of Fort Wayne for doing its portion of the track elevation work at Calhoun St., Fairfield Ave. and Broadway St., at Fort Wayne.

The Triad Engineering & Construction Co., R. F. D. No. 1, Plymouth, Ind., wants teams for use on its contract in constructing the interurban line from Plymouth to South Bend. The company also wants two or three good grade builders, not foremen.

The contract recently let to Tripeer & Son, Peru, Ind., for track elevation work at Fort Wayne, Ind., mentioned in our last issue, includes 21,000 cu. yds. of earth excavation and 1,300 cu. yds. of concrete masonry. None of the work is to be sublet.

IOWA

Surveys are now being made for the projected line of the Charles City Western Ry. Co., and $300,000 of capital has been secured for the construction of this road. The work will be handled by the company. The projected length of this line to be built this year is 15 to 20 miles and the route is southwest from Charles City, Iowa. H. E. Bennett, Charles City, Iowa, is assistant general manager.

KANSAS.

The contract for constructing the first five miles of the Cherryvale, Oklahoma & Texas Ry., from Caney, Kan., has been let to the Continental Construction Co. of Caney, Kan. B. J. Dalton, Lawrence, Kan., is chief engineer of the Cherryvale, Oklahoma & Texas Ry.

The Gulf & Northwestern Railway has completed surveys and bonds to aid in the construction of the road have been voted by cities along the route throughout the state of Kansas. Construction contracts will be let soon. The projected length of this road is about 500 miles and it is to extend through the western tier of counties, starting at Sterling, Colo., and terminating at Oklahoma City, Okla. James A. Sprague, Goodland, Kansas, is vice-president.

MISSOURI.

The Hannibal & Northern Missouri R. R. Co. has completed surveys for its projected 98-mile line from Hannibal, Mo., to Kirksville, Mo. The necessary construction capital for all work to be done this season has been secured and contracts will be let in about 30 days. The Roberts & Abbott Co., Cleveland, O., is the engineer. F. W. Latimer, Galesburg, Ill., is president.

MONTANA

Surveys have been made for the Butte & Boise Ry. As projected, this line will be 400 miles long, and it is estimated that the cost of construction will be about $20,000,000. S. H. Bracy, 1606 Tribune Bldg., Chicago, Ill., is interested.

NORTH DAKOTA.

I. T. Adams, railroad contractor, Room 810, Columbus Savings & Trust Co. Bldg., Columbus, O., will sublet about 20 miles of good work, mostly slip scraper work and about 80 per cent of it borrow, on the Midland Continental Ry. between Edgeley and Jamestown, N. Dak. This is very nice work, as there is no rock nor timber to contend with, and the company wants this grading done so that the track can be laid this fall.

TENNESSEE.

The Tennessee Central R. R. Co. is contemplating some extensive improvements and extensions, but as yet nothing definite has been decided upon. Leon F. Lonnbladh, Stahlmar Bldg., Nashville, Tenn., is chief engineer.

TEXAS

The Tucumcari Portales & Gulf R. R. has completed surveys for the first 50 miles of its line and is now open for bids for constructing this section. The total projected length of this line is 250 miles and its route is via Texico or Portales to Pyote and south 125 miles. M. J. Healy, Pyote, is president.

The Arkansas Terminal Ry. Co. has made surveys for its projected 7-mile line to a connection with the S. A. & A. P. Ry., across Harbor Island to jetties. The capital for construction has been partly secured and construction contracts will be let in 30 days. The grading is now being thrown up by dredge by the Bowers Southern Dredging Co. of Galveston, Tex. C. S. Corrigan, Aransas Pass, Tex., is chief engineer, and E. O. Burton, San Antonio, Tex., is president.

The Texas Central R. R. has completed location from De Leon through Sipe Springs, Rising Star and Cross Plain. The contract has been let to Kamer Bros., general contractors, Sweetwater, Texas, who now have practically the entire line covered with sub-contractors. Material is being received in De Leon for track laying and bridge building, which will be pushed right along behind construction, with the intention of moving this year's crop. B. T. Quarles is engineer in charge of construction. C. H. Sharman, Waco, Tex., is chief engineer of the Texas Central R. R.

VERMONT

The Rutland Railway, Light & Power Co., Geo. S. Haley, general manager, Rutland, Vt., will build by day labor its extension from Fairhaven to Poultney, Vt. There will be seven miles of single track trolley line, 60-lb. rails, steam railroad construction, and two 3/0 trolley wires, bracket construction. The work requires 100,000 cu. yds. earth excavation, 10,000 cu. yds. rock excavation, 500 cu. yds. concrete masonry, 500 cu. yds. stone masonry and two girder 50 ft. steel bridges.

Power Developments, Levees, Drainage and Irragition Works.

ARKANSAS.

The Southern Drainage Co. of Paragould, Ark., has been awarded the contract for drainage work for Drainage District No. 9 of Clay county, Arkansas. The work includes 490,000 cu. yds. of earth excavation, and the contract price was 10 cts. per cu. yd. J. D. Mitchell, Rector, Ark., is the engineer.

GEORGIA

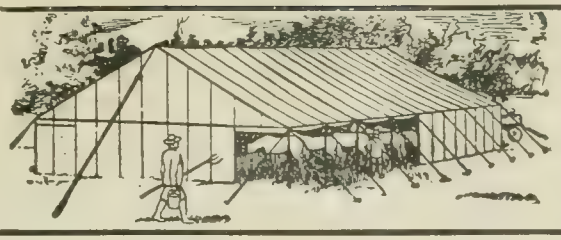
Geo. M. Gadsdere, Savannah, Ga., has been awarded the contract for constructing riprap revetment in seawall at Fort Screven, Ga., the contract price being $12 per ton for material and labor.

Bids were opened March 21 by Col. Dan C. Kingman, U. S. Engineers, Savannah, Ga., for dredging 23,100 cu. yds. of refractory material for the improvement of the harbor at Brunswick, Ga., the contract being let to P. Sanford Ross, Inc., Jersey City, N. J., at $2.80 per cu. yd. and $20 per month for board of inspectors. The other bids on the work were as follows: Coastwise Dredging Co., Norfolk, Va., $2.95 per cu. yd.; Roderick G. Ross, Jacksonville, Fla., $3.25 per cu. yd.

COLORADO

Contracts for the enlargement of the canal of the Otero irrigation district in Otero county, Colorado, were let March 26, as follows: Concrete work, Fox & Smith, Florence, Colo.; tunnel, William Leonard, Lamar, Colo.; dredge work, Sherwood Bros. of Indiana; excavation, Krang Bros., La Junta, Colo., J. H. Kellicher, La Junta, Colo., Allsworth, Foxworthy & Evans, La Junta, Colo., and J. R. Edgerton, La Junta, Colo. The contract is divided into sections and includes the following: Earth excavation, 563,706 cu. yds.; rock excavation, 35,000 cu. yds.; embankment, 25,000 cu. yds.; rock tunnels, 2,850 lin. ft.; 60 A-truss, 34-ft. span wood bridges and 1,000 cu. yds. of concrete masonry. The concrete work is to be completed May 1, 1910; other work March 1, 1911. Contracts for piling are to be let later. H. P. McKean, Opera House Block, Rocky Ford, Colo., is resident engineer and manager.

The contract for the Sanchez dam and dike and the Culebra-Sanchez canal has been awarded by the Costilla Estates Development Co. of Colorado Springs to the Wogan-Wilcoxon Construction Co. of Denver, Colo.; the basis of the contract being actual cost plus an agreed sum for profit. The company will also pay the contractors, as an incentive to economy, one-third of the amount saved under an agreed fixed maximum price, and the contractors agree to share one-third of the amount by which the fixed maximum price is exceeded. Construction is to start at once. The Costilla Estates Development Co. owns 548,000 acres of land in one tract in Costilla County, Colo., and Taos County, New Mexico; the waters of the Sanchez Reservoir will be used to irrigate 60,000 to 75,000 acres of valuable agricultural land on a fertile mesa about 15 miles from the reservoir. The Sanchez dam will be built of earth, laid in 9 inch layers, sprinkled and rolled, to a maximum height of 125 ft. and will be 1,500 ft. long on the crest with 20 ft. top berm, and contain about 525,000 cu. yds. The elevation of the base of the dam is 8,317 feet above sea level, the slope on water face will be 3 to 1 and on down stream slope 2 to 1. The Sanchez dike will be built across a low swale in the rim of the basin and will be 4,000 ft. long, 30 ft. maximum height and contain about 290,000 cu. yds. of earth; the slopes will be the same as for the dam. The Culebra-Sanchez Canal, which will act as the feeder for the Sanchez Reservoir is eight miles long and has a carrying capacity of 606 cu. ft. of water per second of time. The Sanchez Reservoir has a capacity of 104,000 acre feet and will be five miles long and two miles wide at the high water line. The reservoir is located seven miles south of San Luis, Colo., or 23 miles south of Garland, Colo., which latter town is located on the Denver and Rio Grande R. R. The San Luis Southern Ry., of which Mr. L. D. Blauvelt, M. Am. Soc. C. E., is Chief Engineer, is a subsidiary holding of the Costilla Estates Dev. Co. The railway has been built from Blanca on the D. & R. G. R. R. to San Acacio, a town on the Estates Co.'s property 16 miles distant, and will be extended to the state line during the coming summer. The outlet works of the Sanchez Reservoir consists of a reinforced concrete valve tower 15 ft. inside diameter, 135 ft. high and connected with top of dam by a 300 ft. steel foot bridge; the tower wall contains 11 inlet valves, having a combined capacity of 750 cu. ft. per second; from the base of the tower will extend a reinforced concrete conduit having 60 sq. ft. cross section area, 600 ft. long and a carrying capacity of 750 cu. ft. per second, the water from the reservoir will be drawn



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through this conduit and be carried in the natural channels of Ventero Creek and the Culebra River for a distance of 10 miles to the main headgates of the diversion canals which carry the waters to a series of storage reservoirs from which waters for irrigation purposes are drawn as needed. The officers of the Costilla Estates Development Co. are: Hon. Franklin E. Brooks of Colorado Springs, President; Mr. Gerald Hughes of Denver, Vice-President and Treas.; Mr. H. Alexander Smith of Colorado Springs, Secretary; Mr. O. V. P. Stout of Lincoln, Neb., Consulting Engr., and Mr. W. D. Waltman, Assoc. M. Am. Soc. C. E., Resident Engineer in charge of work.

MINNESOTA.

Bids are being asked by Samuel G. Iverson, state auditor, St. Paul, Minn., until 2 p. m., April 15, for constructing two drainage ditches suitable for dredge work. These ditches are No. 89, located in St. Louis county, Minn., 112,757 cu. yds., and Ditch No. 93, located in Aitkin county, 65,509 cu. yds.

The Minnesota River Improvement & Power Co., a corporation with a capital stock of $1,000,000 and power to incur an indebtedness of $1,000,000, has just perfected its organization and is actively at work selling stock. The company is composed of the people along Big Stone and Traverse lakes and the Minnesota river. The company proposes to dike Big Stone lake and turn the Whetstone river above the dike into the lake and make a reservoir out of it; also to construct two other reservoirs between Big Stone lake and the Mississippi river for the purpose of preventing the overflow of the Minnesota River valley in times of high water and at the same time to utilize the water at the dams for power and light purposes. The company expects to construct a dam at Big Stone lake and install a power plant; also to improve the power at Granite falls this season. A. B. Kaercher, Room 3, Old Capitol Bldg., St. Paul, Minn., is president.

NEW YORK.

No bids were received Mar 29 by Col. W. M. Black, U. S. Engineers, New York city, for dredging in Patchogue river, Great South bay, N. Y., and Brown's creek, N. Y.

OKLAHOMA.

C. Lincoln McGuire, Davis, Okla., owning gas ground and zinc ground, 17 miles apart, desires to get these tracts connected with an 8-in. gas main and equipped with drilling rigs, mine hoisting machinery and mills, glass works and zinc smelters.

OREGON.

The Eastern Oregon Irrigation Co., controlling 30,000 acres of fruit land in Baker county, Oregon, is at the present time adjusting preliminary matters, and it is hoped that they will soon be shaped up so that work on the proposed diversion dam and the upper part of the main canal system can be started late in the coming summer. E. M. Blake, 301 Overland Bldg., Boise, Idaho, is general manager.

WISCONSIN.

Pastoret & Lawrence Co., Duluth, Minn., has been awarded a contract for constructing about six miles of drainage work near Rice Lake, Wis., the contract price being $53,458.

The Louisville Ry. Co. of Louisville, Ky., has decided to have work started on an extension of its Fern Creek interurban line from Fern Creke to Mt. Washington, Ky., a distance of eight miles.

The City Council of New Orleans, La., has adopted an ordinance providing for the sale of an electric railroad franchise from the head of Morgan and Patterson Sts., in Algiers, to a point on the Mississippi River below the city.

The work of grading and ballasting the Louisiana Railway and Navigation Co. tracks between New Orleans, La., and Baton Rouge is being rapidly pushed, and it is expected that the tracks will be in first class condition by the early summer, when the Frisco proposes to inaugurate its Mexican service. Much of the work has already been done, and loads of gravel are being rushed from the Gravel beds owned by President Edenborn, to be used on the tracks.

The Rockfish Valley Railroad Co. of Lynchburg, Va., recently chartered, proposes to build a line 15 miles long in Nelson and Albemarle counties from a point on the Southern Ry. between Elmer and Covesville to Nelly's Ford. The incorporators are Sedgwick Kistler, president; W. O. Bentley, vice-president, both of Lock Haven, Pa.; J. T. Coleman, Jr., secretary, Lynchburg, Va.; J. M. Beck, treasurer, Boston, Mass.; Wilson Kistler, Lock Haven, and J. D. Easely, Lynchburg.

Chicago, New Orleans & Improvement Co., recently incorporated with a capital stock of $60,000, will reclaim about 7,000 acres of marsh land by building a main levee, constructing dams and canals and installing pumping plant. The estimated cost of the improvement is $150,000. Nelson A. Baker, New Orleans, La., is vice-president, and Richard Fitzgerald, Chicago, Ill., is president.

Construction work has been started on the extension of the Kentucky Highlands R. R. from a point near Taylor's Distillery to Versailles. M. M. Wheeler, Central City, Ky., is treasurer and chief engineer of the company.

Reports from Norfolk, Va., state that the Harris Construction Co., Damascus, Va., has been awarded the contract by Wilton E. Mingea, Abingdon, Va., president of the Virginia-Carolina R. R., for the construction of that line from Abingdon to Jefferson. As projected the line will run from Abingdon, via Jefferson, Ashe County, N. C., to Wilkesboro, in that state, forming a new feeder for the Southern Rys. and the Seaboard Air Line.

The complete grading outfit of L. J. Smith Contracting Co. has arrived at Flagstaff, Ariz., and work on the Santa Fe between Flagstaff and Williams will be started at once. According to the contract, the job will be completed by December, 1910.

Surveys are now under way for the construction of a railroad from Saltville, Va., in Washington County, to Moccasin Gap, on the Virginia-Tennessee state line at the junction of the Holston River and the Virginia & Southwestern R. R.

The Lexington & Eastern Ry., according to reports, is planning the extension of its line from Jackson up the north fork of the Kentucky River to the mouth of Quicksand Creek, several miles east of Jackson, Ky., to connect with a narrow gage line under construction by the Stevenson Lumber Co. from their timber land in the upper end of the county to the mouth of Quicksand. John Marston, Jr., Lexington, Ky., is chief engineer of the L. & E. Ry.

The Juniata Valley Construction Co. has been incorporated in New Jersey with a capital stock of $100,000 and proposes to engage in general contracting business. The incorporators of the company are A. J. Starr, H. E. Steel, S. W. Fisher, B. T. Goddard and Howard and E. Truax.

The following is a brief summary of the present status of new railroad construction in North Dakota. Minneapolis, St. Paul & Sault Ste. Marie—Plaza to Williston, 105 miles, survey completed; Courtney to Washburn, 112 miles, survey completed; Grand Forks to Courtney 91 miles, survey supposedly under way at the present time. Chicago, Milwaukee & St. Paul—Harlem to Valley City, 56 miles, survey completed; McLoughlin, S. D., to New England, N. D., 147 miles, grading practically completed. Northern Pacific—Mandan to Stanton, 56 miles, already graded and ready for steel; Mandan to Fort Yates, 78 miles, already graded and ready for steel; Cannon Ball to the western boundary line, 168 miles, partially surveyed; Edgeley to Emmonsburg, 90 miles, all surveyed; Sanborn to Sanger, 147 miles, survey completed; Oakes Junction to Gwinner, 27 miles, survey completed. Great Northern—Fargo to Surrey, 260 miles, survey completed and contract let for grading; Stanley to western boundary of state, 84 miles, survey completed and grading partially finished.

The Nebraska Transportation Co. of Omaha, Neb., which proposes the construction of an interurban line from Omaha to Fremont, Neb., has secured options on 85 per cent of the necessary right of way between those two cities.

The commissioners of Iredell County, North Carolina, have authorized an issue of $50,000 of 30-year 5 per cent bonds, and have placed them with the Statesville Air Line R. R. Co. This is under a subscription of Statesville township, which voted the bonds in aid of the railroad which is to be built from Statesville to Mount Airy, N. C., 64 miles, via Turnersburg, Harmony, Houstonville, Yadkinville, Boonville and Dobson. W. B. Turner, Statesville, N. C., is President.

The officials of the Delaware, Lackawanna & Western R. R. received permission from the authorities of Catasauqua, Pa., to construct a line into that place. G. J. Ray, Hoboken, N. J., is chief engineer.

The State Assembly of New Jersey has passed a bill to revive the charter on the State Line Trolley Co., which proposed to build a line from Paterson north to Ridgewood. The bill permits the State Line Traction Co. to operate a line from Paterson to Ridgewood in Bergen County via Hawthorne and Midland Park. Preston Stevenson of Paterson, N. J., is interested.

The Grand Trunk Ry., H. G. Kelley, chief engineer, Montreal, Que., will start definite location surveys for its projected extension of the Central Vermont Ry. into Providence, R. I. as soon as the Rhode Island legislature grants the charter now before that body. It seems very likely that the legislature will grant the charter and Mr. Kelley has been ordered to Providence to be in readiness to start the surveys.

Items Concerning Contractors and Their Work

RAILROADS, POWER DEVELOPMENTS, LEVEES, DRAINAGE AND IRRIGATION WORKS.

Alabama Notes.

FROM CORRESPONDENCE AND OTHER SOURCES.

The Alabama City, Gadsden & Attalla Street Ry. Co. is to at once start in on building a one-mile extension at North Gadsden, Ala.

Eastern capital is reported to be interested in a project for the construction of an electric railway from Florence to Huntsville. The proposed route is from Florence to St. Florian, via Bailey Spring, Killen, Crossroads, Rogersville, Athens, on to Huntsville. Surveys have not been made as yet. Thurston H. Allen, Florence, Ala., is interested.

The Birmingham & Atlantic R. R. has location surveys under way for a line from Anniston to Montgomery. The plan proposes using the 23 miles of line already in operation as a link. S. C. Oliver, Talladega, Ala., is superintendent.

Arkansas Notes.

FROM CORRESPONDENCE AND OTHER SOURCES.

Citizens of Rogers have about raised the necessary sum to secure the construction of the projected interurban line from Rogers, Ark., to Decatur by way of Bentonville. This is the project promoted by J. D. Houseman and G. G. Southerland, of St. Louis, Mo.

As proposed the line will extend west from Rogers to Decatur, a small town 28 miles distant on the Kansas City Southern, with a spur track running from the main line into Bentonville.

The Arkansas State Board of Railway Incorporation has granted the Gulf, Magnolia & Northern Ry. Co. an extension of 18 months time to complete the proposed line from Magnolia, in Columbia County, westward through Waldo to Hope, in Hempstead County, a total distance of about 35 miles. S. Q. Sevier is President of the company.

The Rock Island, Arkansas & Louisiana R. R. Co., has filed a certificate with the secretary of state, increasing its capital stock from $15,660,000 to $30,000,000.

California Notes.

FROM CORRESPONDENCE AND OTHER SOURCES.

Preliminary surveys are to be made for the extension of the Petaluma & Santa Rosa electric railway from Graton in Green Valley to Guerneyville, and also for a branch line to Camp Meeker.

Advices from Chico quote Almon E. Smith, president of the Butte-Magalia Consolidated Mines Co., as stating that tunnel 3,500 ft. long, which will connect the Mammoth Channel with Feather River, will soon be under construction.

The San Joaquin Light & Power Co., a subsidiary of Huntington's Pacific Light & Power Company of Los Angeles, will at once begin the expenditure of $1,250,000 on a plant on the north fork of the San Joaquin river, near Fresno, where a minor plant has been in operation several weeks. The larger plant will develop 22,000 HP. and supply light and energy to Fresno, Madera, Fowler, Hanford, Selma and as far south as Coalinga and the adjacent oil fields. The immediate work involves the construction of a dam 125 ft. high, behind which will form a deep lake 16 miles in circumference.

City Engineer Turner of Oakland has about completed plans for the wharf-wall to be built in the estuary from Broadway to Myrtle St., at Oakland. This is part of the proposed extensive harbor improvement for Oakland. Col. W. H. Heuer, U. S. Engineer, retired, has been retained as Consulting Engineer for the work.

It is reported here in San Diego that the Atchison, Topeka & Santa Fe Ry. will abandon its plan to enter San Diego by means of the proposed Soledad tunnel and instead will build a new line from Del Mar to La Jolla and from La Jolla to the mine now used, thus avoiding the long climb over the hills and shortening the running time one hour. It is believed that the cost of constructing the line will be reduced 60 per cent by the change.

Colorado Notes.

FROM CORRESPONDENCE AND OTHER SOURCES.

The Wilcoxson-Wogan Construction Co. of Denver and has the contract for constructing the large reservoir in the San Luis Valley for the Costilla Development Co. The work will cost about $500,000, it is said.

Work has been resumed on the concrete work of the Barker Meadow dam, which is being built by the Central Colorado Power Co. near Nederland. The concrete work was suspended last fall on account of freezing weather when the dam had reached a height of 100 ft.

The Clay Creek Reservoir & Irrigation Co. has been incorporated with a capital stock of $240,000, the incorporators being J. M. Wright, E. C. Pike and C. M. Scott of Lamar.

Residents of Trinidad have organized a company to build a railroad connecting that city with the San Luis Valley. The plan is to extend the Colorado & Wyoming Ry., a coal and timber road, from Tercio, 35 miles west of Trinidad, into Antonito. This would require the construction of about 75 miles of new track. R. M. Hosea, Pueblo, Colo., is chief engineer of the Colorado & Wyoming Ry.

Surveys have been made for the power transmission line which the Glenwood Light & Water Co. will soon build from Shoshone, connecting its own power station in Glenwood with the plant of the Central Colorado Power Co. at Shoshone. W. L. Reynolds, C. E., Denver, was in charge of the surveys.

The Elk River Anthracite Ry. Co. of Steamboat Springs has been incorporated with a capital stock of $50,000, the incorporators being Arthur L. Wessels, Alden V. Wessels and C. E. Bivens.

A. M. De Remer and John Olson of Denver have been awarded the contract for repairing the break in the dam of the Julesburg reservoir and for rebuilding the 2½ miles of railroad track washed out by the flood. It will cost $75,000 to rebuild the 250 ft. of dam and $25,000 to replace the railroad bed. The washout occurred because water leaked through a natural formation of gypsum rock underlying the dam.

James D. Schuyler, consulting engineer, Los Angeles, Cal., who has been investigating the Colt canal and Lake Meredith reservoir projects, has advised the Arkansas Valley Ditch Association to take immediate steps to acquire and carry through the project.

The Omer Irrigation District has employed Field, Fellows & Hindelider, consulting engineers, Denver, Colo., to draw plans and specifications for a dam across the Apishapa River, near the mouth of Gyp Creek, 20 miles south of Fowler, in the Omer country. At a point conveniently near a large natural reservoir the dam will be built across the deep canon and will be 60 ft. high and possibly 70. The dam extending across the canon will be from 600 to 700 ft. across at its topmost point. When the estimated cost of this work is obtained a meeting will be held at which the holders of land in the Omer district will confer with the owners of the Omer canal and arrange for the purchase of this ditch by the Omer irrigation district. The ditch is 16 miles long and there are 10,000 acres of land under it.

It is now reported that the Rock Island system is behind the Denver & Gulf R. R., and will finance the construction of that line from Dallas northwest to Denver and Colorado Springs, Colo. The object in constructing the Denver & Gulf is not only to get a direct route from the Gulf coast to the proposed outlet of the Rock Island to the Pacific Coast, but to put the Rock Island in a position to make important connections for the Northwest. The Denver & Gulf was chartered recently in Colorado, Texas and Oklahoma to build across the Panhandle country of Oklahoma from Texhoma northwest to the Colorado state line. Construction is now said to be in progress near Texhoma and contracts have been entered into with cities along the proposed line.

The Brighton Gardens Reservoir & Land Co. of Brighton has been incorporated with a capital stock of $11,000, the incorporators being D. F. Carmichael, W. G. Lovelace, and B. J. Prendergast.

Attorneys of the Southern Pacific R. R. have secured right of way for the road and depot grounds and an early commencement of construction on the proposed line from Gallup to Farmington, Colo., is expected.

The Denver, Laramie & Northwestern Ry. is actively engaged in securing right of way along the Box Elder Valley from Wellington, Colo., and through the Virginia Dale Country.

Charles Cole and James Counter of Brighton are to construct the Laramie seepage and drainage ditches, which will irrigate 13,150 acres in Weld and Adams counties. The source of supply is from the Brighton and certain sloughs and marshes in that vicinity. The work will cost about $26,000.

The Paradox-Pacific Construction Co. has been formed, its primary object being the construction of the Paradox Valley railroad, which is designed to afford an outlet for the products of 300,000 acres of the most fertile land in southern Montrose and northern San Miguel counties. The incorporators of the company are Carmon Layton of Montrose, who has been working for more than two years on the plans for the railroad; Fred L. Lucas, vice president and general manager of the Denver Reservoir Irrigation Co., and Samuel Brown, Jr., and Jamot Brown, principal promoters of the Colorado & Southern Irrigation Co. The Layton Engineering Co. of Montrose will begin at once making the final locations for the road. The line has already been surveyed and the general route located, but several minor changes probably will be made before the route is finally approved. The road will be, as now planned, about 105 miles in length. It will join the Denver & Rio Grande either at Montrose, according to the original plans, or at Colona, about eight miles farther south. It will then make a broad detour to the southward, reaching some of the fertile mesas of northern San Miguel county, will pass through the towns of Norwood and Shenandoah, over the Sage flats, and thence up Dry Creek valley to Paradox.

Georgia Notes.

FROM CORRESPONDENCE AND OTHER SOURCES.

It now looks as though construction work would be started early this month on the projected electric railway of the Atlanta & Northeastern R. R. from Atlanta to Cumming and the Creighton mines. As proposed there will be one line to Alpharetta, at which point two lines will diverge, one going to Cumming and the other to Creighton, a distance of 42 miles and 18 miles respectively. The road will follow the course of Peachtree road to Roswell. The incorporators of the company include J. P. Brooks of Alpharetta, R. P. Jones, J. L. Murphy, J. I. Tinsley, C. L. Harris, F. Carter Tate, and W. R. Ottwell.

The Waycross & Florida Central R. R. Co. has applied to the secretary of state for a charter providing for the construction of a line from Waycross, Ga., to Lake City, Fla., a distance of more than 70 miles. The headquarters of the company will be at Waycross, Ga., and the incorporators are C. J. Haden, C. H. Johnson, Charles E. Johnson, W. C. Dod-

son, E. S. Lewis, C. R. McCormack, Atlanta, Ga.; J. S. Blalock, Jonesboro; R. W. Nelson, Jersey City; George W. Deen, W. E. Sirmans, Waycross, Ga.

The Atlanta, Georgia Railway & Electric Co. has applied to the city council of Atlanta for permission to construct lines of electric railway along the following routes in the city of Atlanta: Along Ormond St. from Pulliam St. to Washington St.; along Washington St. from Ormond St. to Jefferson St., thence along Jefferson St. to Crew St.

The Augusta, Ga., and Columbia, S. C. Chambers of Commerce are to take up the matter of having the Atlantic Coast Line Ry. Co. extend its line from Ehrahardt to Denmark or Bamberg. E. B. Pleasants, Wilmington, N. C., is Chief Engineer of the company.

Idaho Notes.

FROM CORRESPONDENCE AND OTHER SOURCES.

The Utah Construction Co., Ogden, Utah, has work under way on double tracking the Oregon Short Line in Port Neub Canyon between McCammon and Inkum, Idaho.

The Salt Lake-Idaho R. R. Co., an Oregon Short Line project, has filed its articles of incorporation at Boise. The company proposes to build a line from Saline, on the Lucin cutoff, north through Kelton, and pass down Raft River Valley to Minidoka, Ida. This line would connect the Southern Pacific, the Minidoka & Southwestern and the Oregon Short Line through the Twin Falls district. The total length of the new road is estimated at 150 miles. The capital stock of the company is fixed at $160,000, of which W. H. Bancroft, general manager, Oregon Short Line, Salt Lake City, Utah, subscribed the major part as trustee, while J. M. Davis, D. E. Burley, P. L. Williams, and F. H. Knickerbocker each hold one share as an incorporator.

Harold Caldwell, city engineer of Boise, has started preliminary surveys for an electric railway from Caldwell to Roswell.

The Southern Idaho Reclamation Co. of Mountainhome has filed plats for right of way for the pipe line and reservoir. The latter will have a capacity of 313,332 acre feet.

The Idaho Northern R. R. has had two surveys made for its proposed extension from Emmett, the present terminus, to Smith's Ferry, a distance of 70 miles. Two plats of the survey have been filed and it is believed that construction work will be started this spring. E. P. Spalding, Wallace, Idaho, is general manager.

The Commercial Club of Coeur d'Alene is advocating the construction of a street car line from Post Falls to Dalton Gardens.

Information has been received in Boise, Ida., to the effect that surveys are now being rushed to completion and construction work will be started on the proposed western branch of the Gilmore & Pittsburg R. R. about June 1.

Illinois Notes.

FROM CORRESPONDENCE AND OTHER SOURCES.

Yoder & Schwartz have commenced work on their contract for constructing a 33 mile canal that is to drain the swamp land near Libertyville and near Roundout, along the Chicago, Milwaukee & St. Paul R. R. This district is generally known as Skokie swamp. About 6,000 acres will be drained.

The Chicago & Eastern Illinois R. R. is said to be planning to build a short spur at Alton to cost about $29,000, by which it will gain an entrance to this city over the Illinois Terminal R. R.

The Baltimore & Ohio R. R., which recently took over the Chicago Terminal Transfer R. R., property at Chicago, is contemplating making many improvements to the property. The plans which are being worked out are said to contemplate the ultimate expenditure of several million dollars, one million dollars having been set aside for track elevation during the present year.

The directors of the Atchison, Topeka & Santa Fe Ry. have authorized an issue of $43,686,000 50-year 4 per cent convertible bonds to enlarge the capacity of the lines now in operation.

The East Side Levee Sanitary District, Henry D. Sexton, President, Sexton bldg., East St. Louis, is stated to be calling for bids on excavating the diversion channel for Cahokia Creek. This channel will start at the junction of Cahokia and Indian creeks, west of Edwardsville, and ten miles north of East St. Louis. It will be 4½ miles long and to construct it will require moving 1,500,000 cubic yards of dirt at an estimated cost of $800,000.

Announcements have been made, it is said, that the Illinois Central R. R. Co. has decided to lay double track on its line from Freeport to Chicago, Ill. The work according to measurements will include about 115 miles of track. H. R. Safford, Chicago, Ill., is Chief Engineer Maintenance of Way.

It is reported that the Cleveland, Cincinnati, Chicago & St. Louis Ry. has awarded contracts for the construction of 20 miles of line from Stonefort, Ill., to Metropolis, Ill. George P. Smith, Cincinnati, O., is Chief Engineer of the C. C. C. & St. L. Ry.

According to reports from Harrisburg, Ill., the Oil & Coal Belt Ry. Co., recently organized to construct a line from Terre Haute, Ind., to Cairo, Ill., has secured an option on the uncompleted Galatia, Harrisburg & Southeastern Ry. A. G. Russell, Chicago, Ill., is Chief Engineer of the O. & C. B. Ry. Co.

The Marion Ry. Co. with principal office at Marion, has been incorporated with a capital stock of $10,000, and will construct a line from a point on the Herrin & Southern Co.'s line of railroad, now in process of construction, about three miles southwest of Marion, Ill., to and through the City of Marion and thence in a northerly direction to the City of Johnston City, all in Williamston county, Illinois. The incorporators and first board of directors are A. E. Harper, William Duff Haynie, E. J. Hughes, L. D. Doty and C. A. Rickett, all of Chicago, Ill.

Indiana Notes.

FROM CORRESPONDENCE AND OTHER SOURCES.

The Wabash R. R. and Pennsylvania R. R. have begun work on their track elevation work at Fort Wayne. J. S. Danes is in charge of the Wabash work and Fred Graham, division engineer, is in charge of the Pennsylvania work. The city's portion will be done by Trippeer & Sons, Peru, Ind.

The New York Central Lines are reported to have decided to establish at Gibson, near Hammond, an operating center for all its lines in the Chicago district. The plan contemplates the expenditure of about $20,000,000 for improvements to the system. The chief of these will be the double tracking of the Chicago, Indiana & Southern R. R. all of the way from Indiana Harbor to Danville. This will cost over a million dollars in itself and will open up a north and south railroad system between Indiana Harbor and New Orleans.

The Pennsylvania R. R. is said to be planning to build an extension north in order to compete with the Big Four at Evansville. The latter railroad has just awarded contracts for building an extension to Mount Carmel.

The Burns Construction Co., Isabella Bldg., Chicago, Ill., which is to build a traction line from Indianapolis to Washington and on to Evansville, has purchased of Ziba Graham the Washington Street Ry., which it will operate in conjunction with the proposed interurban line.

Iowa Notes.

FROM CORRESPONDENCE AND OTHER SOURCES.

The Ottumwa Railway & Light Co. of Ottumwa, which is controlled by H. M. Byllesby & Co. of Chicago, is planning the extension of the Ward St. line out Chester Ave. to Wapello St. and the addition of a half mile more line on the Sheridan Ave. route in Ottumwa.

Grading work on the Iowa & Omaha Short Line Ry. is well under way and the contractor, William Lane, has established one grading camp and expects shortly to have another in operation, with the idea that the road bed will be ready for the track by July. By that time the full complement of track material will be on hand. Bridge work will probably be done as the track is laid in order that material may be hauled by train to the places where it is to be used.

The Chicago & Northwestern Ry., R. W. Richardson, division engineer, Sioux City, is to double the capacity of its yards at Sioux City and is planning to have the work started in May.

The commissioners of Crawford county, at Denison, and the Harrison county commissioners are taking steps for securing a new channel for the Boyer River. About 18 miles of new channel come in Crawford county.

John McAndrews, Kankakee, Ill., has been awarded the contract for straightening the Ocheydan River through a part of Clay County. The river's course, which now is about 48 miles in length, will by ditch be made into 11.55 miles.

The directors of the Des Moines & Sioux City R. R. Co., which is projecting an electric railroad to connect Des Moines, Sioux City and Fort Dodge, have signed a contract with the American Engineering Co. of Indianapolis, which made the survey, permitting this company to dispose of the entire bond issue of $8,000,000 at 81 cents. When the bonds are placed, the board of directors agree to give bond in the sum of $10,000 to provide the right of way. Already about 65 miles of the total distance, 218 miles, has been given, gratis. The company holds option on about 60 miles of the balance.

The Rundell Land & Improvement Co., of Iowa City, proposes to construct an electric street railway in that city.

The Citizens' Railway & Light Co., of Muscatine, has increased its capital stock from $750,000 to $1,500,000.

Kansas Notes.

FROM CORRESPONDENCE AND OTHER SOURCES.

The McKinley syndicate has purchased the property of the Topeka Electric Ry. Co. at Topeka.

The Motor Grand Traction Co. of Belleville, Kas., which proposes the construction of a motor car line from Chester, Neb., to Wichita, has started preliminary surveys from Canton to Roxbury and from Canton to Goerrel. E. S. McNutt, Belleville, is interested.

An ordinance is to come before the city council of Kansas City asking the Metropolitan Street Railway Co. to build a car line on 18th St. from Central to Minnesota Aves. in that city.

The Wichita Railway & Light Co. of Wichita has ordered 1,000 tons of steel to be used in improvements at Wichita, to include a double track on South Main St.

The Union Pacific R. R. proposes to ballast 220 miles of its branch lines in Kansas this year.

The Kearney & Beloit Ry. Co. of Kearney is reported to have secured capital in England to the extent of $5,000,000 for the building of the project. Permanent surveys for the line are about completed.

The Oswego, Columbus & Cherryvale Electric Ry. Co., capitalized at $50,000, and with headquarters at Oswego, has been chartered. The company proposes to build a road from Columbus to Cherryvale, 47 miles. The incorporators are S. B. Miller, Oswego; D. Christman, W. J. Jones and G. Torbert, Altamont; I. M. Hinds, Mound Valley; David Dunbar, Hallowell; C. A. Mitchell, Cherryvale, and T. F. Stice, Oswego.

Michigan Notes.

FROM CORRESPONDENCE AND OTHER SOURCES.

Work has been started on the extension of the Coloma-Benton Harbor interurban line into Coloma. As soon as the grading and track construction work of the extension has been completed the working force will be greatly increased and operations for electrifying the Paw Paw Lake branch will be commenced.

Hoose & Person, Iron Mountain, have been awarded a contract by the Rogers-Brown Ore Co. for stripping with steam shovels about 150,000 cu. yds. of overburden at the Portland

mine, at the western end of the Marquette range. In addition to the stripping the company has arranged for the mining of 250,000 tons of ore. The overburden is shallow. Hoose & Person are completing the work of stripping 50,000 cu. yds. of surface material from the Antoine Ore Co.'s Traders mine, Menominee range. Another steam shovel has been added to the firm's equipment.

The Cummer-Diggins Co., Cadillac, according to reports, is to extend its present logging railway running through Selma township in section 7.

According to reports the work on the roadbed of the Detroit, Bay City & Western R. R. is steadily progressing. Trestle has been completed over the Quanicassee River and the grading crew is heading eastward. Handy Bros., Bay City, Mich., are constructing the line.

Citizens along the proposed right of way are to petition the Grand Trunk Ry. Co. to extend its tracks through Ashley to Saginaw, Mich. The Board of Commerce of the latter city is at the head of the movement.

Minnesota Notes.

FROM CORRESPONDENCE AND OTHER SOURCES.

A resolution is before the city council of Minneapolis asking the Twin City Rapid Transit Co. to extend the Chicago Ave. line into the Lake Amelia district.

Castle Brothers of Crookston have been awarded the contract of stripping the Great Northern Ry. gravel pits at Bagley and Downer, the former on the Cass Lake line and the latter on the main line to St. Paul. Several work trains will be put on in the near future and the work of ballasting the tracks for the season will be started. The entire track from Crookston to Duluth will be ballasted.

The Hanna Coal Co. will spend about $300,000 this year for the erection of a new dock at Duluth.

The Zenith Furnace Co. is planning to extend its Duluth dock 600 ft. and greatly increase its capacity. New rigging will be installed and other improvements will be made.

A. Guthrie & Co., St. Paul, Minn., have the contract for constructing the Great Northern line from Fargo, N. Dak., to Surrey, N. Dak. The contract is said to call for 225 miles of grading.

V. T. Reilley, Omaha, Neb., who has a contract for grading for the new railroad track along the bluffs east and north of Watson, has established a camp at Milan. Mike McGlenn and John Carson, Omaha, Neb., have sub contracts on the work.

Construction work on the Thief River Falls Division of the Soo has been resumed all along the line. C. E. Jamieson is working on a six-mile contract near Schley. Richard Evans of Minneapolis has the contract for 17 miles of grading between the "narrows" at Cass Lake to the Mississippi River in the city limits of Bemidji. He has a large force at work. John Moberg of Bemidji has the contract for grading eight miles from the Mississippi River at Bemidji to a point one mile west of Wilton. The contracts held by Evans and Moberg call for the completion of their grades ready for the steel not later than June 30. The greater part of the right of way will be ready for steel July 1, but some will not be graded until August 1.

Work has been resumed laying 90-lb. steel on the Duluth-Staples line of the Northern Pacific Ry. Ballasting and laying steel on the road between Deerwood and Brainard, Minn., will also be rushed to completion.

The Chicago, Milwaukee & St. Paul Ry. Co. is making rapid progress on the double track work between Richmond and Wabasha, Minn. The company has acquired a 10-acre sand pit near Minnesota City from which it will secure ballast for the line.

The Barnett & Record Co. of Duluth, has begun work on its contract for pile driving and making the concrete piers and cribs for the Pittsburg Coal Co.'s dock at Duluth. The Brown Hoist & Machinery Co. of Chicago will furnish the bridge work and the machinery for the dock, and the Great Lakes Dredge & Dock Co. will do the filling. When complete the dock will be 2,200 ft. long and 800 ft. wide.

The Twin City Rapid Transit Co., of St. Paul, is reported to be planning track building in St. Paul that will give Minneapolis a direct line to Stillwater. At present Minneapolis passengers for Stillwater must transfer in St. Paul. The new line will be laid on Maryland St., from Lake Como to some point south of Lake Phalen, to Hazel Ave., connecting with the present Wildwood-Stillwater line.

Missouri Notes.

FROM CORRESPONDENTS AND OTHER SOURCES.

The Monarch Construction Co. has been incorporated with a capital stock of $10,000, of which all has been paid in. The headquarters of the company, which proposes to engage in general railroad construction business, will be 316 Liggett Bldg., St. Louis, Mo. The incorporators are William Buck, Philip A. McDermott, Louis W. Kieburtz and Thomas H. Sprink.

Although no definite statements have been made, it has been reported here in St. Louis that the St. Louis, Iron Mountain & Southern R. R. Co. is considering the construction of a cutoff from Greenwood to Pike City to shorten the main line between Kansas grain fields and New Orleans, La. E. F. Mitchell, St. Louis, Mo., is Chief Engineer of the company.

Citizens of Bethel, Mo., have raised half the amount necessary to secure the construction of the extension of the Shelbyville R. R. to that place, a distance of 8 miles.

The reported acquirement by George D. Rosenthal of St. Louis of the controlling interest in the toll highway bridge over the Missouri river at Jefferson City is believed to be one of the final steps preliminary to the construction of an interurban line across the state. Mr. Rosenthal is interested in the construction of the proposed interurban line connecting St. Louis and Kansas City and it is thought that the line will be built into Jefferson City over the new bridge.

St. Louis Items.

BY A. B. KOENIG.

The L. J. Smith Construction Co., 1111 Commerce Bldg., Kansas City, Mo., has some fine steam shovel and rock work to let on the Santa Fe R. R. in Arizona. Free transportation from points west of Kansas City.

The Morey-Falhaber Construction Co., 1212 Chemical Bldg., St. Louis, Mo., has a lot of soft sand stone, loose rock and earth work on the Santa Fe R. R., near Lameta, Texas, to sublet. Write the company to Lameta, Tex.

The Walsh Construction Co. has 400,000 yds. of good side borrow work on the Big Four R. R. in southern Illinois and Indiana to let. In reference to this work write the company to St. George hotel, Evansville, Ind.

Costello Bros. secured 50 miles of betterment work from the Big Four R. R. between Indianapolis and Muncie, Ind. This is good scraper and machine work. They will sublet this in quantities to suit outfits and have opened an office in the Claypool Bldg., Indianapolis, Ind.

Wm. O'Connor is in town idle at present.

F. M. Skene is getting ready to begin on his concrete work on the Big Four R. R. in southern Indiana.

We welcome to the contracting fraternity Wm. Hughes, who begins on his first concrete contract on the Big Four R. R. between Mt. Carmel and Evansville, Ind. We wish you success, Hughes.

Keating Bros. have taken 150,000 yds. of work from the Walsh Construction Co. on the Big Four R. R. in southern Illinois and Indiana.

Henry Schweizer is in here looking for some new work for his team outfit.

Montana Notes.

FROM CORRESPONDENCE AND OTHER SOURCES.

W. H. Smead has made a proposition to the Chamber of Commerce of Missoula, Mont., for the construction of an electric railway from Missoula to Polson on the Flathead reservation. As projected the line would be about 75 miles long. The Chamber of Commerce appointed a committee to take up the matter.

Preliminary surveys are now under way for the projected line of the recently incorporated Virginia City Southern Electric Ry. Co. of Virginia City. This company plans to build a line from Lyon in the Madison Valley via Ennis and Virginia City to Alder. The incorporators of the company are Luther H. Leber of New York city, W. A. Clark, A. J. Bennett, Karl Elling, and George Ed. Gohn of Virginia City. Mr. Leber is already engaged in building an electric railroad from Kenyon City to Cooke City.

The Northern Pacific Ry. is reported to have found a feasible route for an extension of the Staples Division from the terminus at Oakes, N. Dak., through to Forsythe, Mont. The proposed route west would take the road across country to Edgeley, in LaMoure county, N. Dak. From there the route west would be through southern Logan, central Emmons, southern Morton, southern Hettinger, southern Billings and connect with the main line of the Northern Pacific at Forsythe, Mont.

New York Notes.

FROM CORRESPONDENTS AND OTHER SOURCES.

I. A. Hodge & Co. are making good progress with the excavation work for their barge canal contract near Mechanicville. On March 23, with two "dummy" engines taking care of the cars, Steam Shovel Engineer William Hinghouse loaded 210 4-yd. cars in 205 minutes. The next day in eight hours 425 cars were taken out, an average of nearly a car a minute. S. W. Andrews is superintendent for the contractors.

A bill is before the state legislature appropriating $25,000 for the Superintendent of Public Works, Albany, to dredge the outlet of Keuka lake from the lake to the steamboat docks in the village of Penn Yan and to widen and deepen the channel.

Bids were opened March 29 by the State Superintendent of Public Works, at Albany, for several barge canal contracts, the low bidders being as follows: Contract 21, three miles in extent, just west of Genesse River, Lane Bros. & Co., of Altavista, Va., $1,323,150; contract 39, dredging of Oswego River between Three Rivers and Fulton, James Stewart & Co., of New York, $1,048,670; contract 78, construction of a dike on Oswego River, near Fulton, Cunningham & Woodward, of Hudson, $47,721. Bids were rejected on contract No. 73, for the dredging of the Hudson between Northumberland and Stillwater, a distance of about 15 miles, and this will be readvertised.

The Southwestern New York Traction Co., of Bolivar, N. Y., has been incorporated with a capital stock of $200,000, the incorporators being C. M. Van Curen, A. J. Matson and J. F. Care of Bolivar.

The Genesee River cut off of the Erie R. R. is practically completed and it is believed that it will be put in operation some time in May. All that remains to be done is the removal of earth slides in two places and steam shovels are now at work doing this. The cut off will eliminate a bad grade between Hornell and Cuba and adds the third side to a triangle having Hornell, where the Buffalo division branches off from the main line, Portage on the Buffalo division and Cuba on the main line as its three points. From Hornell to Cuba there is a bad grade on the main line, which the heavily laden east bound freight trains had difficulty in negotiating. To obviate this a line 34 miles long, running southeast from Portage to Cuba, was planned at a cost of several million dollars. In building this cut off it was necessary to construct two long viaducts, one over the Genesee valley and river near Belfast, 3,120 ft. long and 145 ft. high, where it crosses the river, and the other over Rush creek, 1,920 ft. long and 150 ft. in the air. Both have been laid with a single track, but are wide enough for a second track when it becomes necessary.

Ohio Notes.

FROM CORRESPONDENTS AND OTHER SOURCES

The H. E. Culbertson Co., Cleveland, has started work on its contract for the extension of the ore yard of the Youngstown Sheet & Tube Co. at Youngstown. The work includes 10,000 cu. yds. of concrete, 25,000 cu. yds. of excavation and 50,000 ft. of piling.

Improvements contemplating the expenditure of $1,400,000 are proposed for the Kanawha & Michigan Ry., of which F. B. Sheldon, Columbus, is chief engineer. These improvements contemplate new trackage, tunneling, and the elimination of curves.

The Lake Shore & Michigan Southern, the Pennsylvania and Big Four have submitted a preliminary plan to the city officials of Cleveland for a new union depot to cost $2,250,000.

Lane & Co., Norfolk, Va., have begun work at South Portsmouth on their contract for double track work on the Chesapeake & Ohio between South Portsmouth and St. Paul.

Oklahoma Notes.

FROM CORRESPONDENTS AND OTHER SOURCES

The Tulsa Street Ry. Co. of Tulsa is considering double tracking its line for some 13 or 14 blocks on South Main St. in Tulsa.

The Eastern Oklahoma Traction Co., recently chartered with a capital stock of $50,000, proposes the construction of a 251-mile line to Tulsa, thence to Wagoner, Sapulpa, Webers Falls, Checotah, Okmulgee, and Oklahoma City. Parties interested in the railway have incorporated the Railway Construction Co., with a capital stock of $50,000, to have charge of building the line. H. B. Spaulding, R. N. Eggleston, J. W. Maddox, L. R. Kershaw, W. L. Tull, J. B. Furry, and Roy Bowman, all of Muskogee, are interested.

The Commercial Club of Cheyenne has accepted a proposition for the construction of an electric railway to that city. The club will furnish right of way through the county and $35,000 bonus, the bonus becoming due when the road is completed into Cheyenne and passenger and freight traffic in progress. The electric line will build from Oklahoma City, Hobart, and Sayre to Cheyenne.

The Sallisaw, McAlester & Southern Ry. has started preliminary surveys under the direction of M. J. Smith for its line from Coalgate to Savanna, Okla.

Steel is on the way for the Enid, Ochiltree & Western R. R., chartered some time ago to build east from Dalhart, Tex., to Enid. From Dalhart the road will be built first to Wilcoe, it being expected to run trains over that line by July 1. From Wilcoe, construction will be extended to Ochiltree, the officials of the road intending to reach Dumas by Sept. 1.

The construction of an interurban railroad from Wilburton, Okla., to Fort Smith, Ark., is proposed by the Citizens Electric Co., of which James M. Connell, Wilburton, Okla., is President.

Grading work on the first 50 miles of grade of the Osage Western Ry. has been started at Vinita and a second contract will be let this month. The line will run through Vinita, Bartlesville, Pawhuska, Bliss, Billings and Enid. The deal for the use of the Rock Island branch from Billings into Enid has been called off and an independent line will be built. The construction of the line from Vinita to the junction of the Salt Fork and Arkansas rivers, near White Eagle, has been financed by the sale of bonds to St. Louis financiers.

M. J. Smith, Engineer, Sallisaw, McAlester & Southern R. R., with corps of surveyors, has the preliminary survey under way for the construction of the proposed line from Coalgate, Okla., to Savanna.

According to advices from Guthrie, Okla., the Osage & Western Ry. Co. has awarded the contract for grading the first 50 miles of line from Vinita westward to E. G. Spaulding. The permanent survey west of Vinita is progressing rapidly toward Pawhuska, the route west of the latter city being already located.

E. E. Poe, Comanche, Okla., representative of the Milroay Oil & Gas Co., is promoting the construction of the proposed Red River Valley & Texas R. R. Co. Commercial Clubs of the cities along the right of way are assisting in the work. As planned the line will run from Ardmore, Okla., to New Sneed, Oil City, Milroy, Loco, Comanche, Walters, Loveland, Mercer and Frederick, Okla., to Chillicothe, Tex.

Grading work for the Cherryvale, Oklahoma & Texas R. R. has been started just across the Oklahoma state line from Caney, Kas. The branch to Fayetteville, Ark., will be first built. From there the road will be constructed to Perry, Okla., and thence to El Paso, Tex. The line is expected to be completed to Wann, Okla., within four months. This is the Porter road, and S. M. Porter, Caney, Kas., is president.

Oregon Notes.

FROM CORRESPONDENTS AND OTHER SOURCES

The Coos Bay Rapid Transit Co. has filed its articles of incorporation in the office of the secretary of state. The company proposes to build an electric railway system to include Marshfield, Empire, North Bend, and other towns on Coos Bay. The capital stock is $1,000,000 and the incorporators are L. D. Kinney, George M. Everett, and George W. Kitchen.

The Normetco Dredging Co. of Portland has been incorporated with a capital stock of $50,000, the incorporators being William A. Adams, James Steel, Frank N. Clark, and C. N. Atkinson.

Robert Wakefield of Portland, who has the contract for building the $150,000 jetty at the mouth of the Sunslaw River, has established headquarters at Florence for this work. Lumber and scows for the work have been ordered. Rock will be scowed from up the Sinslaw River and several small steamers will be employed towing them.

The Astoria, Pacific Coast & Southern Ry. Co. of Astoria has been incorporated with a capital stock of $500,000, the incorporators being B. Van Dusen, Edward E. Gray and J. E. Higgins.

The Fairdale, Trisp & Tillamook R. R. Co. has been organized with a view to furnishing a link in a railroad from Carlton on the west side line of the Southern Pacific to Tillamook. Russell Hawkins, one of the incorporators, is manager of the Whitney Co., Ltd., of Portland,, which owns large tracts of timber in Clatsop county and is now building a logging road into the timber from Blind Slough on the lower Columbia. The Fairdale-Tillamook branch will have no connection with this road. The new project will connect with a logging railroad now being built from Carlton to Fairdale by the owners of the Carlton Lumber Co.

Advices from Oregon City state that construction work will be started on the Clackamas Southern Ry. within 60 days. The right of way from Oregon City to Silverton through Beaver Creek and the Molalla Valley has been obtained and a resurvey has just been made from Inskeep's place, at Beaver Creek to Oregon City.

The Arnold Irrigation Co. is spending $35,000 on improvements to the distributing water system. The largest undertaking will be the building of a new flume 12 ft. wide and 3 ft. deep and 1¼ mile long. The body of it will be of 2-in. lumber, and the supporting timbers and foundation will be constructed in most substantial manner. The intake will be enlarged and permanent gates installed. Approximately three miles of old canal will be widened. It is planned to build from six to eight miles of new canal on the east lateral, which runs eastward into the Arnold section; and also some three or four miles of new work on the north lateral.

The Central R. R. of Oregon, R. H. England, general manager, Union, Ore., has surveys under way for an extension of the road from Union, Ore., through the Grande Ronde Valley and over the Blue Mountains to Walla Walla, Wash.

The Astoria, Pacific Coast & Southern Ry. Co. has been incorporated with a capital stock of $500,000, and proposes to construct, equip and operate an electric or steam railway between Astoria and Tillamook. The new company has been organized to succeed the Astoria, Seaside & Tillamook Ry. Co. The incorporators are B. Van Dusen, Edward E. Gray and J. E. Higgins.

The Fairdale, Trash & Tillamark Ry. Co. has been incorporated with a capital stock of $10,000 and principal office at Portland, the incorporators being Russell Hawkins, John M. Gearin and A. B. Wastell.

The U. S. Light House Department has awarded the contract for making repairs to the wharf at Tongue Point buoy station to John A. Fastabend of Astoria, at $4,397, by the Lighthouse Department.

The Pacific Diking Co. of Astoria, has been incorporated with a capital stock of $5,000, the incorporators being Charles Schwegler, Frank Behnke and William Schwegler.

Pennsylvania Notes.

FROM CORRESPONDENTS AND OTHER SOURCES

The Conestoga Traction Co. is making surveys toward Oxford with a view to extending its lines in that direction.

Residents of Essington have submitted a proposition to the Philadelphia Rapid Transit Co. for the extension of the Elmwood Ave. line to Essington.

Bids for the construction of the Western Maryland Ry. extension from Cumberland, Mo., to Connellsville, Pa., are reported to be in the hands of H. R. Pratt, chief engineer, Baltimore, Md. It is planned to have the work completed in two years. The improvement will require an expenditure of $12,000,000.

The supervisors of Porter Township, Schuylkill County, have granted to the Reiner City, Tower City & Johnstown Ry. Co. the right to construct a line between the towns mentioned above. The line will be operated by motors.

E. B. Smith & Co. of Philadelphia, who are largely interested in the Lehigh Valley Transit Co., are reported to have purchased the Philadelphia & Western Ry.

The United Fuel Gas Co. of Pittsburg, Pa., is said to be planning considerable additional pipe line construction in connection with recently announced acquisition of West Virginia properties of Columbia Gas & Electric Co. of Cincinnati, O. The purchase included control of 100,000 acres gas territory, 500 miles pipe line, etc.

Texas Notes.

FROM CORRESPONDENTS AND OTHER SOURCES

The Texas Traction Co. of Dallas has negotiations under way for taking over the Denison-Sherman interurban, thus making a continuous line between Dallas and Sherman.

Citizens of Solado are taking steps to secure an extension of the Belton-Temple Traction Co.'s line from Belton to that place, a distance of 10 miles. It is proposed to raise a bonus of $40,000 and to give free right of way.

The second grading contract for the Houston-Galveston Interurban Ry. has been let. Hartley & Ford, Bay City, secured the contract, which covers a 19-mile stretch from the end of the Kelso contract at Clear Creek to Brays Bayou, a few miles south of Houston. The work will require a large amount of culvert construction, which will be done by the contractors. The railway company has awarded the Galveston Creosoting Co. the contract for approximately 500,000 ft. of creosoted bridge timbers, enough material for the construction of 36 bridges and culverts, three of which are of considerable size. Those over Brays Bayou and at Dickinson Bayou are the largest, with the exception of the Clear Creek bridge, which will be about 700 ft. long.

The Harrison Construction Co. of San Antonio has been incorporated with a capital stock of $10,000, the incorporators being George W. Nock, W. L. Cullen, and A. L. Metlock.

The Missouri, Oklahoma & Gulf Ry., the Kenefick line, now under construction, has taken out a charter in Texas for a branch beginning at the connection with the southern extremity of the bridge to be constructed across the Red River in the northern part of

Grayson county, at a point on the boundary line of the states of Texas and Oklahoma, about seven miles east of the line extending due north from the city of Denison and running thence in a southerly and southeasterly direction for a distance of not more than ten miles. The incorporators are William Kenefick of Kansas City, E. R. Jones of Muskogee, W. P. Dewarz of Muskogee, J. T. Buckner, John T. Suggs, R. S. Legate, G. L. Blackford, Edwin Camack, Arthur Miller, and Fred Ruark, all the latter of Denison. J. J. Harrison, Calvin, Okla., is chief engineer, M., O. & G. Ry.

The city of Austin voted yesterday (April 5) on the question of accepting the proposition of the Dumont-Holmes Steel Concrete Co. of Chicago, mentioned in our last issue, to rebuild the dam across the Colorado River above the city for $1,000,000. It is believed that the proposition carried.

The Quanah, Seymour & Rockport Ry. has been formed to succeed the Quanah & Gulf Ry., and will file its charter shortly. All cities along the projected route have signed contracts and it is believed that the road will be constructed soon. L. E. Walker is president; Harry Koch, Quanah, is a director.

Surveys have been started from Coleman for the projected line of the Texas North & South Ry. One survey goes from Coleman north to Seymour and the other south to San Antonio.

Business men of Silverton and Plainview are taking steps to secure the construction of a railroad to connect the two places. The road would be about 35 miles long, and Plainview citizens have offered to give $100,000 for it.

The Fred A. Jones Co. of Dallas has begun work on its contract for the construction of the dam, spillway and foundations for the pumping station at the White Rock reservoir site for the city of Dallas. The contract price is $255,000 and the work is to be completed in 330 days. A contract for the first earthwork has been let to the Larkin Contracting Co.

C. C. Fredericks of Amarillo has submitted a proposition to the Chamber of Commerce of Denton to build a line west from the city to some undetermined point on the Santa Fe. The proposition asks for right of way, depot grounds and a $50,000 bonus.

George Byrne, Houston, has completed his contract for constructing the dam for the International & Great Northern Ry. reservoir, one mile east of Taylor.

The State Railroad Commission has ordered the secretary of state to register bonds for the Bartlett & Florence R. R. and the Roscoe, Snyder & Pacific, the former to have $116,500 in bonds on 11 miles from Bartlett to Jarrold. The latter is to register $254,500 on the extension from Snyder to Fluvanna.

Work has been started by the Wichita Falls & Northwestern Ry., now in operation from Wichita Falls, Tex., to Altus, Okla., and the construction of the line is being rapidly pushed into Elk City. Woodward is the next objective point, the intention being to build the road into Kansas, making a direct line from the Kansas wheat belt to the gulf.

According to advices from Denison, Tex., the Missouri, Kansas & Texas R. R. Co. has awarded James Stewart & Co. the contract for the construction of the company's new car shops at that place. The work is estimated to cost $100,000.

J. M. Waggstaff and W. G. Swenson of Abilene, Tex., are reported to have completed arrangements for the construction of the Texas Central line to that city. Surveys are also under way for the construction of a line from Abilene, Tex., to the coal fields in Eastland County, a distance of 40 miles. H. S. McCall, Waco, Tex., is resident engineer.

Bids for the construction of the Abilene Central R. R. between Abilene and Rising Star, Tex., are reported as being received by J. H. Waggstaff, Abilene, Tex. The work includes 56 miles of main line and 6 miles of siding and switches.

The Gainesville, Oklahoma & Western R. R. Co. of Gainesville has been chartered with a capital stock of $100,000 and proposes to build a line of railroad from Gainesville south to a connection with the Rock Island to Bridgeport, in Wise County, and from Gainesville north to the Red River at Orleans. The line will be about 80 miles long. The incorporators include J. C. Whaley, George E. N. Ball and S. M. King of Gainesville.

Porter A. Whaley, secretary of the Chamber of Commerce, Quanah, Tex., is taking up the matter with President F. A. Bourne of Ardmore, Okla., to secure the construction of the River Valley & Texas R. R. from Comanche, Okla., to Quanah.

C. D. Kiser, who has just completed the third mile on the Frisco extension, has moved to the Santa Fe two-mile contract on the Sellman ranch. Jack Collins, who has just completed a contract on the Sterling City extension out from San Angelo, has moved his outfit to the Santa Fe line, near Richland Springs.

Bucy & Burkhead have started work about six miles from Rising Star on their grading contract on the Texas Central extension from DeLeon to Rising Star. Henby Brooks, another contractor, has started work about three miles east of Rising Star. Work will also be started on the De Leon end soon, the grading from De Leon to Rising Star is to be completed by Aug. 1 and the road to be completed about Sept. 1.

The Texas Building Co. has begun work on its grading contract on the first section of the Brownwood North & South R. R.

Utah Notes.

FROM CORRESPONDENTS AND OTHER SOURCES.

The A. B. Corey Construction Co. of Ogden, Utah, has begun work on its contract for the construction of a 28-mile pipe line for the Southern Pacific from Strong's Knob to Lemay, on the western side of the lake. The line will cost $100,000 and will be an addition to the pipe line built by the Southern Pacific two years ago from Terrace to Lemay.

The Iron Mountain, St. George & Grand Canyon R. R. Co., recently incorporated, is said to be meeting with success in financing its proposed line, and it is believed likely that construction work may be started soon. As proposed the line is to extend from Thurmo, Beaver county, on the San Pedro, Los Angeles & Salt Lake R. R., south to Cedar City and Kanarra, in the coal region, and thence southwest through St. George to the Santa Fe R. R., in the Hualapai valley, at or near Kingman, Ariz., with a long branch from below Kanarra, southeast through the oil and timber regions to the Grand Canyon of the Colorado River, and shorter but important branches from near Cedar City to the great coal field and iron mountains of Iron county, Utah. J. R. Walker, Charles Read, Elias S. Kimball, A. Hanauer, Jr., Archibald E. Rykert, John H. Woodmansee, and M. T. Burgess, all of Salt Lake City, are interested.

The Utah Copper Co. of Bingham has had engineers in the field completing surveys for the Bingham & Garfield R. R., a subsidiary company organized two years ago to cohstruct a railroad from the Bingham properties to the concentrator at Garfield.

Now that the Western Pacific Ry. is nearly finished to San Francisco, George Gould, it is said, proposes to build a line to Los Angeles. Surveys have been started to complete the lines between Marysvale, Utah, and San Diego, via Los Angeles, and surveys are now being carefully revised that were made 10 years ago by order of Gen. W. J. Palmer and Col. D. C. Dodge. Marysvale is 193 miles southwest of Salt Lake City and the route from there traverses a line parallel to the San Pedro, but on the other side of the range and through a more fertile region.

The Iron Mountain, St. George & Grand Canyon Ry Co. recently incorporated with a capital stock of $24,000,000 by Utah and Los Angeles parties, has filed its articles of incorporation in the office of the county clerk at Phoenix, Ariz. They propose to build a road from Thermo, Utah, a point on the San Pedro, Los Angeles & Salt Lake R. R., to Kingman, Ariz., by way of Cedar City, Harmony, Kanara and St. George. It is also proposed to construct a branch line from Kanara through the Buckskin timber range to the Grand Canyon and for a connection with Los Angeles it is intended to build another branch line from some point on the main line to Maopa or a nearby point on the Los Angeles-Salt Lake road.

West Virginia Notes.

FROM CORRESPONDENTS AND OTHER SOURCES.

The Kanawha & Parkersburg Ry. Co. of Charleston, W. Va., has been formed and proposes the construction of a railroad from Dunbar, near Charleston, to Parkersburg. A number of surveys have been made. E. T. Crawford, M. H. Straughan and Frank Cox, all of Charleston, W. Va., are interested.

The Baltimore & Ohio R. R., J. A. Spielman, engineer maintenance of way, Wheeling, W. Va., is to spend $300,000 for the construction of a new freight depot and terminals at Wheeling.

The Norfolk & Western Ry., according to reports, has completed surveys for a line from Wharnecliffe, W. Va., to Pinnacle Creek. The line will be about 60 miles long and will extend up Ben Creek and Gilbert Creek. It will open up extensive coal lands.

Charles A. Simms & Co. of Philadelphia, Pa., have started preliminary work on their contract for improving the Grafton, W. Va., yards of the Baltimore & Ohio R. R.

The Fairmont & Pittsburg Ry. Co. has been organized in West Virginia and proposes the construction of a line from Fairmont north via Blacksville and Waynesburg to Pittsburg, Pa., a distance of about 75 miles. The company is also authorized to construct a loop line from Fairmont northwest to Mannington, Blacksville and Morgantown, thence along the Monongahela River, returning to Fairmont, W. Va. As yet nothing definite has been done.

Washington Notes.

FROM CORRESPONDENTS AND OTHER SOURCES.

Construction work will probably be started early this month on the Bellingham-Skagit county interurban line, which is to be built by the Stone & Webster Engineering Corporation. Engineering offices have been opened on the fourth floor of the Sunset block in Bellingham preparatory to beginning construction work.

The Western Washington Railway & Navigation Co. of Aberdeen has been incorporated with a capital stock of $100,000 and proposes to construct an interurban line from Grays Harbor to Puget sound, by way of Elma and Shelton. This is the line recently mentioned as being promoted by W. B. Sammons and C. C. Quackenbush.

New York capitalists are reported to have promised sufficient capital for the construction of the proposed canal of the Olympia Canal Co. on the condition that the people of the state secure the right of way and do the preliminary work. The proposed canal will run from Olympia by way of the Black lake to the Chehalis river, which it is designed to dredge to Aberdeen from the point of entrance of the canal. About $30.000 is needed for the preliminary work, and it is said much of this has already been subscribed in Tacoma. E. L. Kenyon, Olympia, Wash., is secretary.

P. M. Coyne & Son have started work on their contract for constructing a 4,000,000 gallon reservoir for the city of Port Townsend and Fort Worden.

Sanderson & Porter of New York and San Francisco are reported to have obtained control of the Grays Harbor Power & Light Co. interests between Aberdeen, Hoquiam, and Cosmopolis for $2,000,000. The transaction is said to mean immediate construction of an interurban line from Aberdeen to Puget sound cities. The sale includes electric light plants at Hoquiam and Aberdeen, the street railway system between Hoquiam and Aberdeen, and Electric park ball grounds.

Residents of Chehalis are securing right of way for a projected electric line, to run 8 miles northeast to Newaukum Prairie, with a view of continuing farther at a future date. No company to build the line has been organized, but it is believed that capital will

be found when the right of way has been obtained.

W. L. Harris & Co. and Otto Hanson have completed their contracts on the Boulle-Trumbull branch of the Milwaukee and have moved their outfits. Mr. Hanson moved his outfit to Spokane, where he has 10 miles of work extending from Dishman's store to Spokane bridge. W. J. Harris & Co. stored their outfit at Palouse for the present.

Eastern stockholders in the Washington Railway & Electric Co., which proposes the development of a power project located at Sultan, have taken over the interests of C. A. Hudson and John C. Denny of Everett; George D. Emery of Seattle and John Kirkpatrick of Butte, and it is reported actual work will be started this month. The power site is one of the best in this section of the northwest. Here the Sultan River extends through a canyon, and the plan is to build a concrete dam 120 feet high to retain the waters, which engineers estimate will generate 50,000 hp. As planned the water is to be used in a three-level system, three subbasins. A further plan of the company is to construct a railroad from the Sultan canyon to the town of Sultan, 17 miles. The power to be generated will be sold in various cities on Puget Sound for industrial purposes.

Officers of Fort Worden are agitating the construction of an extension of the Port Townsend Southern R. R. to that place.

Construction work has been progressing rapidly on the North Yakima & Valley R. R., and the line is now completed from Granger north through Zillah, Wash.

The Spokane, Portland & Seattle Ry., T. H. Crosweli, Chief Engineer, Portland, Ore., will this year spend $1,500,000 for equipment and improvements.

Wisconsin Notes.

FROM CORRESPONDENTS AND OTHER SOURCES.

The Wisconsin Light & Power Co., which owns the dam at the foot of lower Birch lake, is making preparations to remove the present wooden dam and to replace it with a roller concrete dam 4 ft. higher than the old one.

Lisk & Gifford Construction Co., Davenport, Ia., has begun grading on part of the cut-off of the Soo line between Withrow and New Richmond, Wis. It will grade the portion between Withrow and the St. Croix river, a distance of about eight miles.

McIntosh Bros. have 300 men at work reconstructing an old abandoned tunnel at Tunnel City for the Chicago, Milwaukee & St. Paul Ry. The tunnel is 1,300 ft. long and the contract is said to amount to $1,000,000.

The Chippewa Valley Railway, Light & Power Co. of Eau Claire has purchased the Chippewa Falls Water Works & Lighting Co., including the light, water and gas plants, with unlimited franchises for Chippewa Falls.

Canadian Notes.

FROM CORRESPONDENTS AND OTHER SOURCES.

The city council of Regina, Sask., has granted a street railway franchise to J. W. DeC. O'Grady, J. A. Anderson, and J. Geddes, all of Winnipeg, Man. According to the terms of the franchise seven miles of track must be laid by Dec. 1, 1910.

The Canadian Northern Ry, track laying outfit has resumed operations on the Shellbrook extension. The grade is completed to within 20 miles of Big River and it is the intention of the railway company to have the line completed by the middle of the year. It is understood that 400 teams and 600 men will be employed.

John Bradley, the contractor, mentioned in our last issue as having been awarded the C. P. Ry. contract for constructing 110 miles of line from Regina, Sask., to Colonsoy, has his headquarters in Brandon, Man. He is now completing the Craven-Bulyea line of 25 miles on which his outfit has been at work all winter, uninterrupted by cold weather or snow. On the C. P. work he will use some 800 teams and over 1,500 men.

The Canadian Northern Ry. has completed the survey of the Swan River branch into Vonda, Sask., and it is believed that the line will be completed this summer as only 25 miles remain to be done. Vonda will be the terminal for a few years pending its extension to Saskatoon.

The Lake Superior Steel Corporation, owner of the Algoma Central & Hudson Bay Ry., is planning an expenditure of about $5,000,000 for extensions to the road. It is expected that the contract will be let this summer for the construction of the extension of the Algoma Central to connect with the Canadian Pacific R. R. The road is already graded from the end of the rails to the Montreal River, while from the north the line from Helen Mine at Michipicoten is graded as far south as the river. C. N. Coburn, Sault Ste. Marie, Ont., is chief engineer.

The Grand Trunk Pacific Ry. has awarded a contract to the J. D. McArthur Co. for the construction of a branch line south from Regina to the boundary near Portal. Contracts have also been let for the completion of a line north from Regina to Melville on the main line of the Grand Trunk Pacific.

The Grand Trunk Pacific R. R. Co. has acquired between 50 and 60 acres of land on the shores of Courtenay Bay for terminal facilities. It has not yet been decided by the officials whether the line will enter St. John, N. B., over the Intercolonial tracks from Moncton or by a direct line from some point in Queen's County. C. C. Van Arsdol, Prince Rupert, B. C., is division engineer of the Grand Trunk Pacific.

A bill is before the railway committee of the House of Commons to incorporate the Toronto Eastern Ry. Co., which proposes to construct a line from Toronto to Cobourg, thence to Peterboro', from Oshawa to Lindsay, from a point in the township of Scarboro' to Uxbridge, and from Oshawa to a point on the water front of Lake Ontario.

The railway committee of the House of Commons has reported a bill to incorporate a company to be known as Montreal, Kapatachuan & Rupert Bay Co. to build a railway from Montreal to Rupert Bay, on Hudson Bay, a distanceof 450 miles. The proposed route is through the counties of Hochelaga, Maisonneuve, Laval, Two Mountains, Argenteuil, Labelle and Pontiac.

Construction outfits have begun to arrive at North Battleford, Sask., preparatory to commencing grading on the Canadian Northern branch line from North Battleford to Prince Albert. It is also said that steel will be laid this year on the 50 miles of grade on the North Battleford-Athabasca line.

Track-laying on the Grand Trunk Pacific Ry. from Prince Rupert, B. C., has been started under the direction of D. J. Dempsey. He will put down the terminal tracks and lay the first 100 miles of main line east from the terminal city. The outfit at present on this work consists of five locomotives, one track-layer, five cabooses, 56 flat cars, two box cars, one water cart, one machine car, six outfit cars, two telegraph outfit cars and a private car.

Mexican Notes.

FROM CORRESPONDENTS AND OTHER SOURCES.

S. Pearson & Son, Lt., contractors, City of Mexico, have started preliminary work for the construction of the Conchos River dam of the Mexican Northern Power Co. The contractors have about completed a broad gage railroad from St. Rosalia to the site of the dam. About 40,000 H. P. will be developed and it is planned to have the dam completed in 1912. W. J. Davis, San Francisco, Cal., is chief engineer of the Power Company, and G. F. Greenwood, Montreal, Que., is President.

The Mexican Pacific Ry. (National Lines of Mexico) is reported to have acquired the concession held by the Mexican-American holding company to build a railroad from Salina Cruz to Manzanillo, a distance of 930 miles, and thence down the west coast.

The construction of a new line of railroad from Tucson, Ariz., to a point on the Gulf of California, north of Guaymas, is proposed by Frank Murphy, Prescott, Ariz., President of the Santa Fe, Prescott & Phoenix Ry. The road would be used as a route for ores from the smelters in Arizona to deep waters. Charles T. J. Lantry of the Lantry Constructing Co., Kansas City, Mo., is reported to have the contract for constructing the road.

Right of way is now being secured by the Northern Pacific for the construction of its branch line from Pingree to Wilton, N. Dak.

The Middle Island R. R. Co., of Middlebourne, W. Va., has been incorporated with a capital stock of $5,000 and proposes to build an electric railway from Sistersville by way of Middlebourne, Shirley and Center Point to Clarksburg. The incorporators are T. Moore Jackson, C. P. Stout, of Clarksburg; I. M. Underwood, John F. Shore, Thomas P. Hill, of Middlebourne.

The Southern Land & Water Co., of Lake Charles, La., has been chartered with a capital stock of $200,000. The company will deal in real estate and is empowered to build, erect and maintain canals, irrigation ditches, wells, pumps, and things of that nature. The directors are: David R. Swift, president; William Briggs, vice president, and Thomas G. Trotti, secretary and treasurer.

The Hampton Roads Navigation Co. of Norfolk, Va., has been incorporated with a capital stock of $500,000, for the purpose of building and operating docks, etc. The officers of the company are Charles S. Thorne, president; T. F. Farrell, vice-president; G. W. Woodruff, secretary and treasurer—all of No. 1 Broadway, New York.

The Garrett County Railway Co. has been incorporated in Maryland with a capital stock of $200,000 and proposes the construction of a line from Oakland to Mountain Lake Park, Deer Park, Thayerville, Accident, Grantsville and Frostburg, Md., also from Accident to Friendship and from Grantsville to the Pennsylvania line. The incorporators are G. J. Gugey, Henry M. Speicher, George Padgett, W. Ravenscroft and Charles Lightshier.

BIDS ASKED.

Bridges.

Bids are asked on following work, the notes being arranged alphabetically by states:

Montgomery, Ala—Until noon, April 11, by J. S. Pinckard, 17 South Perry St., Montgomery, Ala., for the construction of a concrete bridge over the Central of Georgia R. R. tracks on Madison Ave.

Red Bluff, Cal.—Until April 8, by Board of County Supervisors, for the construction of a county bridge across the Sacramento River, at Tehama, Cal.

Santa Rosa, Cal.—Until noon, April 7, by F. L. Wright county clerk, for the construction of bridges and culverts on the roads between Headsburg and Geyser.

Weiser, Ida.—Until April 11, by County Commissioners for the construction of three steel wagon bridges in different parts of this county.

Hardin, Ill.—Until 10 a. m., April 11, by County Commissioners for the construction of an arch stone bridge across the creek on county road between Barney Droege's and Henry Doege's.

North Chicago, Ill.—Until noon, May 14, by Bureau of Navigation, Navy Department, Washington, D. C., for the construction of a concrete arch bridge and connections thereto at the U. S. naval training station, Great Lakes, North Chicago, Ill.

Cumberland, Md.—Until 1 p. m., April 16, by County Commisioners for the construction of a steel and concrete bridge over the Potomac River between Luke, Md., and Piedmont, W. Va.

St. Joseph, Mo.—Until 2 p. m., April 11, by M. Weber, City Clerk, for the construction of the superstructure for a swing bridge on Wayne St. over the Morrison Channel and the Michigan Central tracks.

Nelson, Neb.—Until noon, April 19, by County Clerk, for the construction, completion and repairing of all the wood and steel bridges to be built or repaired in said county during the year commencing April 19.

Syracuse, N. Y.—Until 1:30 April 11, by Board of Contract and Supply, for constructing a reinforced concrete arch bridge over Onondaga Creek at Dickerson St., in the city of Syracuse, N. Y. John J. Halloran is secretary of the board.

Batavia, O.—Until noon, May 2, by J. L. Larkin, County Auditor, for the construction of

the substructure and superstructure of a bridge over Stonelick Creek on the Xenia road near Edenton, in Clermont County.

Cleveland, O.—Until 11 a. m., April 23, by Board of County Commissioners, for the construction of bridge work per report No. 2585, Concrete culvert, Coventry Road, E. Cleveland township; Report No. 2586, Concrete culvert, Coventry Road, E. Cleveland township.

Buffalo, Okla.—Until 1 p. m., May 2, by Board of County Commissioners, for necessary labor and material for the construction of the three wooden truss bridges, 40 ft. long and 14 ft. roadway, on pile foundations. E. L. Hubbard is County Clerk.

Buildings.

Bids are asked on following work, the notes being arranged alphabetically by states:

Mare Island, Cal.—Until 11 a. m., May 14, by Bureau of Yards & Docks, Navy Department, Washington, D. C., for the construction of an ordnance storehouse at the Navy Yard, Mare Island, Cal. R. C. Hollyday is chief of the bureau.

New London, Conn.—Until 10 a. m., May 6, by Capt. F. T. Arnold, Constructing Quartermaster, New London, Conn., for the construction, plumbing, heating, electric wiring and fixtures of one double and two single company officers' quarters, one guard house, one ordnance shop, one coal shed and one wagon shed at Fort H. G. Wright, N. Y. Official advertisement will be found elsewhere in this issue.

Fort Screven, Ga.—Until 11 a. m., April 25, by Constructing Quartermaster, Fort Screven, Ga., for the construction, plumbing and electric wiring of one double set civilian employes' quarters.

Covington, Ind.—Until 4 p. m., April 12, by School Commissioners, for the construction of a basement and one story school building of 15 rooms. E. J. Martin is secretary.

Jeanerette, La.—Until noon, April 16, by L. A. Moresi, chairman of Building Committee, for the erection of school building at Jeanerette, La. Favrot & Livaudais, Ltd., 839 Gravier St., New Orleans, La., are the architects.

Austin, Minn.—Until 3 p. m., May 9, by James Knox Taylor, Supervising Architect, Treasury Department, Washington, D. C., for the construction complete, including plumbing, gas piping, heating apparatus, electric conduits and wiring of the United States Post Office at Austin, Minn.

Great Falls, Mont.—Until 3 p. m., May 10, by James Knox Taylor, Supervising Architect, Treasury Department, Washington, D. C., for the construction, including plumbing, gas piping, heating and ventilating apparatus, electric conduits and wiring and standard clock system of the U. S. Post Office and Court House, at Great Falls, Mont.

New York, N. Y.—Until 11 a. m., April 15, by Board of Water Supply, 910, 299 Broadway, New York, for Contract No. 74, for the construction of a field office building and horse shed for division and section engineers in the White Plains division of the Catskill Aqueduct, at a site 1½ mile east of Elmsford Station on the Putnam division of the New York Central and Hudson River R. R., in the town of Greenburg, N. Y.

New York, N. Y.—Until 11 a. m., April 12, by Lawrence Gresser, president of the borough of Queens, for all material and labor required for furnishing and installing electric combination and gas lighting fixtures in the Queens County Court House, Long Island City, borough of Queens, city of New York.

New York, N. Y.—Until 11 a. m., April 11, by C. B. J. Snyder, Superintendent School Buildings, Department of Education, corner of Park Ave. and 59th St., Manhattan, New York, for completing and finishing the new fireproof main stairs at public school 46, 156th St. and St. Nicholas Ave., borough of Manhattan.

New York, N. Y.—Until 11 a. m., April 11, by C. B. J. Snyder, Superintendent of School Buildings, Department of Education, corner of Park Ave. and 59th St., Manhattan, New York, for alterations, repairs, etc., at public schools 5, 9, 10, 43, 46, 54, 81, 93, 132, 157, 165, 166, 169, 170, 179, 184, and 186, and Wadleigh High School, borough of Manhattan.

New York, N. Y.—Until 11 a. m., April 11, by C. B. J. Snyder, Superintendent of School Buildings, Dept. of Education, corner Park Ave. and 59th St., for alterations and repairs, etc., at public schools 48, 80, 95, 102, 118, 128, 134, 139, and 140, borough of Brooklyn.

Newark, O.—Until 3 p. m., May 7, by James Knox Taylor, Supervising Architect, Treasury Department, Washington, D. C., for the construction complete, including plumbing, gas piping, heating apparatus and electric conduits and wiring of the U. S. Post Office at Newark, Ohio.

Cleveland, Tenn.—Until 3 p. m., May 6, by James Knox Taylor, Supervising Architect, Treasury Department, Washington, D. C., for the construction, including plumbing, gas piping, heating apparatus, electric conduits and wiring of the United States Post Office at Cleveland, Tenn.

Puget Sound, Wash.—Until 11 a. m., May 7, by Bureau of Yards and Docks, Navy Department, Washington, D. C., for the construction of an oil storage house at the United States Navy Yard, Puget Sound, Wash.

Appleton, Wis.—Until 3 p. m., May 12, by James Knox Taylor, Supervising Architect, Treasury Department, Washington, D. C., for the construction complete, including plumbing, gas piping, heating apparatus, electric conduits and wiring, of the United States Post Office, Appleton, Wis.

Cheyenne, Wyo.—Until 5 p. m., April 19, by Water and Sewerage Committee, for labor and materials for the construction of a reinforced concrete valve house, five miles from Cheyenne.

Ottawa, Ont.—Until 5 p. m., April 15, by Napoleon Tessier, Secretary, Department of Public Works, for restoration of and additional story to Military Stores building, Ottawa, Ont.

Roads and Streets.

Bids are asked on following work, the notes being arranged alphabetically by states:

San Diego, Cal.—Until 11 a. m., April 25, by Lieut. C. A. Lohr, Constructing Quartermaster, San Diego, Cal., for the construction approximately 3 miles of roadway, including gutters, culverts, etc., through military and naval reservations, Fort Rosecrans, Cal.

Clarinda, Ia.—Until 7:30 p. m., April 12, by C. W. Stuart, City Clerk, for the construction of about 20,500 sq. yds. of concrete pavement of 5 ins. of Portland cement concrete.

Fort Des Moines, Ia.—Until 3 p. m. April 28, by Constructing Quartermaster, Fort Des Moines, Ia., for the resurfacing of certain macadam roads at Fort Des Moines, Ia., including approximately 44,000 sq. yds.

Perry, Ia.—Until April 15, by City Clerk, for the construction of the following paving work: Contract 1—20,000 sq. yds. Warren's bitulithic pavement on a concrete foundation; 9,500 ft. of combined curb and gutter; 5,000 cu. yds. of grading. Contract 2—33,700 sq. yds. of creosoted block on a concrete foundation; 18,850 ft. of 6x20-in. cement curb; 11,000 cu. yds. of grading. Charles Wilson is City Engineer.

Oak Park, Ill.—Until 4 p. m., April 12, by B. C. Brandstadt, Secretary, Board of Local Improvements, for resurfacing Euclid Ave. with an asphalt pavement, between South Blvd. and Madison St., Oak Park Special No. 200; also for constructing an asphalt pavement and granite concrete combined curb and gutter on 64th Ave. between Madison St. and Jackson St., Oak Park Special No. 203. Official advertisement of the work will be found elsewhere in this issue.

Peoria, Ill.—Until 2 p. m., April 11, by Board of Local Improvements, for the resurfacing with asphalt of the roadways of the following: Seventh Ave., from Franklin to Union Sts.; Hamilton St., from Monroe to Glen Oak Av.; Hamilton St., from Randolph to North St.; North Jefferson Ave., from Hamilton to Cornhill St. George F. Simmons is president of the Board.

Covington, Ind.—Until 1:30 p. m., April 5, by County Commissioners, for the construction of a gravel road in Mill Creek township. W. B. Gray is auditor of Fountain county.

Rockville, Ind.—Until 1:30 p. m., April 5, by County Commissioners, for the construction of a gravel road in Jackson township. H. A. Henderson is auditor for Parke county.

New Castle, Ky.—Until April 12, by Fiscal Court of Henry County, for the construction of 41 miles of turnpike roads. Work includes hauling, spreading and breaking rock.

Boston, Mass.—Until noon, April 12, by Highway Division, Street Department, for constructing macadam roadway and artificial stone sidewalks in Mechanic St., Roxbury.

Boston, Mass.—Until noon, April 12, by Highway Division, Street Department, for constructing macadam roadway and artificial stone sidewalks in Edgar St., Roxbury.

Boston, Mass.—Until noon, April 11, by Highway Division, Street Department, for constructing macadam roadway and artificial stone sidewalks in Wentworth St., Dorchester.

Boston, Mass.—Until noon April 11, by Street Department, Highway Division, for the construction of a macadam roadway and artificial stone sidewalks in Whitman St., Dorchester.

Lincoln, Neb.—Until 1 p. m., April 8, by Roscoe C. Ozman, City Clerk, for the construction of paving throughout the Paving District No. 174.

Cincinnati, O.—Until noon, April 22, by County Commissioners, for the improvement of the Symmestown road between Billiard's hill and Weller School, in Symmes township. Under Spec. No. 973. Fred Dreihs is clerk.

Cincinnati, O.—Until noon, April 29, by Board of County Commissioners, for improving North Bend and Burnt School House Roads, from Harrison pike to what is known as Fiffin Pike or Lincoln Ave., Green township. Fred Driehs is clerk.

Cleveland, O.—Until 11 a. m., April 16, by Board of County Commissioners, for the grading, draining and improving of the Bradley Road, from Lake Road to North Ridge Road, in Dover township. Frank R. Lander is County Surveyor. John Goldenbogen is clerk of the Board.

Columbus, O.—Until noon, April 12, by Director of Public Service for the improvement by grading and paving of portions of 16 streets, avenues and allies.

Ellensburg, Wash.—Until April 11, by City Clerk, for the construction of 23 blocks of paving in the business district of the city. The work includes 49,200 sq. yds. of paving; 17,000 cu. yds. of excavation; 16,000 ft. of concrete curbing.

Moose Jaw, Sask.—Until 8:30 p. m., April 11, by W. F. Heal, City Clerk, for the following work: Contract A—Furnishing material and constructing 33,300 sq. yds. of pavement. Contract B—Furnishing material for and constructing 13,500 lin. ft. of combined curb and gutter. Contract C—Furnishing material for and constructing 115,500 sq. ft. of concrete sidewalks.

Sewers.

Bids are asked on following work, the notes being arranged alphabetically by states:

Kissimmee, Fla.—Until 7:30 p. m., April 12, by City Council for the necessary materials and labor for the construction of a complete water works and sewer system. J. R. Gilbert is City Clerk.

Boston, Mass.—Until noon, April 8, by Sewer Division, Street Department, for cleaning sewers in Dorchester Ave., and other specified streets.

Boston, Mass.—Until noon, April 8, by Sewer Division, Street Department, for supporting tracks for proposed sewerage works under the tracks of the Boston & Albany R. R. at Salt Creek, Brighton.

Albert Lea, Minn.—Until April 15, by C. J. Dudley, City Clerk, for the construction of 1,496 lin. ft. of 8-in. sewers; 298 lin. ft. of 12 and 22 in. double sewers, 8 to 14 ft. deep; 320 lin. ft. of 12 to 20 in. double sewers, 8 to 12 ft. deep; 210 lin. ft. of 10-in. drains; 9 manholes, 6 catch basins. William Barneck is City Engineer.

Madison Barracks, N. Y.—Until 2 p. m., April 28, by Constructing Quartermaster, for the construction and repair of about 840 ft. of sewers.

Columbus, O.—Until noon April 12, by Director of Public Service, for the construction of sewers in portions of six alleys, streets and avenues. H. S. Holton is director.

Mamaroneck, N. Y.—Until 8:30 p. m., April 6, by Village Trustees, for the construction of approximately 4,525 lin. ft. of sewers. Charles W. Buckter is clerk.

Reidsville, N. C.—Until 8 p. m., April 21, by Board of Commissioners for the necessary labor and material for the construction of a system of sanitary sewers for the town of Reidsville, N. C. The work includes approximately 10 miles of vitrified pipe sewer from 8 to 15 ins. diameter, three sewage pumping stations and reduction tank. L. H. Hardy, Jr., is Town Clerk and E. W. Myers, Greensboro, N. C., is engineer.

Lima, O.—Until noon April 14, by Board of Control, for furnishing material and labor necessary for the construction of a sewer from Third St., to the south corporation line, by way of Blaine Ave., Fourt and Metcalf Sts. Glen I. Wallace is secretary of the Board.

Lorain, O.—Until noon April 16, by Director of Public Service, for furnishing the necessary labor and material for the construction of a storm water sewer in Colorado Ave., East Erie Ave., Connecticut Ave. and A St. L. B. Johnson is clerk.

Perry, O.—Until noon April 9, by Board of County Commissioners, for furnishing necessary labor and material for sewerage system, tunnels, floors, etc., in the Perry County Infirmary. George T. Drake is clerk of the Board.

Youngstown, O.—Until noon April 7, by Director of Public Service, for furnishing the necessary labor and materials for sewering Penn Ave., between Oak St. and Augustus St., between Penn Ave and Hine St. W. H. McMillin is clerk.

Youngstown, O.—Until noon, April 7, by Director of Public Service, for furnisihng necessary labor and material for the construction of sewers in Penn Ave., between Oak St. and Augustus St., Augustus St., between Penn Ave. and Hine St. W. H. McMillin is clerk.

Tyndall, S. Dak.—Until 7 p. m., April 14, by city, for the construction of an electric light plant and changes and improvements to present water works system. J. J. Maus is City Auditor.

Abilene, Tex.—Until 3 p. m., April 9, by city for the construction of a concrete storm sewer. The work includes about 760 ft. of 42-in. sewer; 1,480 ft. of 48-in. sewer; 300 ft. of 60-in. sewer, with necessary laterals and intakes. The average depth of the excavation is 8 ft. C. E. Leonard is Supervising Engineer.

Moose Jaw, Sask.—Until 8:30 p. m., April 11, by W. F. Heal, City Clerk, for trenching and laying 7,100 lin. ft. of 10-in. and 12-in. sewer pipe.

Water Supply.

Bids are asked on following work, the notes being arranged alphabetically by states:

Fort Oglethorpe, Ga.—Until 11 a. m., April 14, by George Vidmer, Captain, Constructing Quartermaster, for sinking two 8-in. tubular wells at the post.

Springfield, Ill.—Until noon, April 11, by Board of Administration, for the construction of a steel tower and tank at the Kankakee State Hospital, Kankakee, Ill. Frank D. Whipp is Fiscal Supervisor.

Boston, Mass.—Until 10 a. m., April 23, by Capt. A. M. Miller, Constructing Quartermas-

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CHAS. S. HILL
C. T. MURRAY
F. A. SMITH } EDITORS

MYRON C. CLARK . . . . . PUBLISHER
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CONTENTS.

EDITORIAL: Page

The Efficiency of the Engineering Administration of the U. S. Reclamation Service 327

CONCRETE SECTION:

Design and Construction of Retaining Walls for the Pennsylvania R. R. Terminal Station, New York City 328

Some Experiments on the Cost and Durability of Cement Drain Tile 330

An Analysis of Concrete Bridge Failures . . 332

Some Methods of Water-Proofing Concrete Structures with Results from Practice . . 335

ROADS AND STREETS SECTION:

Average Unit Prices and Some Details of Pavements Constructed in 1909 in a Number of Representative American Cities . . 337

Experimental Work of the New York State Highway Commission in 1909 with Glutin and with Resurfacing with Bituminous Macadam and Asphalt Macadam 338

A New Type of Mixing Plant for Bituminous Paving Mixtures and Data on the Cost of Constructing Asphaltic Concrete with It 341

WATER-WORKS AND SEWER SECTION:

A Novel Method of Placing Cast Iron Wells in a Water-Works Crib 342

GENERAL SECTION:

Construction of a 135-Mile Wood Stave and Cast Iron Pressure Pipe Line for Railway Water Supply with Some Costs . . 346

A New Design of Steam Pile Driver 348

Cost of the New York Subway and of Operating It 348

LETTERS TO THE EDITOR 349

PERSONALS 350

CATALOGS WORTH HAVING 350

Wood Piling and Ground Water Level.

A point not so often allowed for as it should be in planning the use of wooden piles is the change in water level that is likely to occur particularly in large cities, where sewers, subways and other structures affecting underground water levels are continually being constructed. Wooden piling to be permanent must be entirely below water and engineers plan their permanent pile structures always with this in mind. It cannot be too confidently assumed, however, that piles whose tops are well below water when the foundation is built will still be below water level a few years later. This fact is being continually brought to mind by rebuilding work going on in New York, Chicago and other large cities. Bulkheads built at certain points along the Chicago River of piles capped with concrete and having the piles submerged when built now show the pile tops exposed. Changes in the drainage conditions have lowered the water level. In tearing down recently a building constructed some ten years ago in Milwaukee on pile foundations the pile tops were found some 3 ft. above the water level, though when the building was constructed they had been placed below it. The sewerage and drainage work of the intervening years had lowered the original water level. The same fact was noted in our issue of Jan. 12, 1910, in connection with the Cambridge Building in New York city. The lesson of these occurrences is obvious, for no one can doubt that they represent quite common conditions. Ground water levels depend entirely on drainage conditions, and in cities drainage conditions are seldom the same for any long time. The engineer who puts in permanent pile work therefore runs a hazard of having it exposed to rot by succeeding constructions affecting ground water levels unless he is very certain of his conditions.

The Efficiency of the Engineering Administration of the U. S. Reclamation Service.

ENGINEERING-CONTRACTING holds no brief for the engineers of the U. S. Reclamation Service. It does not believe in the policy of the Service of doing a large portion of its construction work by force account and it has said so, and, when the occasion seems to warrant, it will say so again. This journal, however, has never questioned the honesty of purpose of the Reclamation Service Engineers in resorting to the policy of day labor work; it can even see how they may have considered it to be, under the conditions, the only policy. It does not think that their decision to use day labor had any other motive than to serve best the interests of the public. Neither does ENGINEERING-CONTRACTING believe because this mistake has been made or because other errors in details will be discovered that the engineering administration of the Reclamation Service is necessarily inefficient. It believes that a count will show many more things to praise than things with which to find fault.

We make these statements here because of the communications which have come to us in various forms, seeking for criticism in our columns of the engineering work of the Reclamation Service. One of these communications is printed among our Letters to the Editor this week. We publish this letter because it represents the opinion of others as well as of the writer and because its assertions are the mixture of truth and fallacy that characterizes the assertions of others besides the writer, and for the same reasons we shall comment in detail on its statements.

One correspondent's first count against the management of the Reclamation Service work is its employment of inexperienced engineers. The Service has employed inexperienced engineers—it had to. All of the engineers it employed, however, were not inexperienced even at the first; we can call to mind the names of a number whose proficiency in hydraulic and irrigation work ranked very high. It was almost necessarily the fact that many of its engineers at first should lack specific experience in reclamation work. Enough engineers with experience were not available under the conditions. A reclamation engineering corps had to be trained and developed. There was no other resort and had there been it is by no means certain that the method adopted would not have been the best. The important question is: Has this trained reclamation engineer corps been developed? We believe that it has been in large measure. Certainly no one can believe that the present force of Reclamation Service engineers as a whole, or even in large part, could be replaced off-hand with a force equally trained and experienced in the work. If it can, then truly a charge of inefficiency of engineering management is warranted.

It is doubtless true that individual cases exist where better men could be had and should be got. It is also true that many of the better men and some of the very best have resigned from the Service. This brings us to the third and fourth counts made by our correspondent, and, incidentally, to some others not made by him. Insufficient pay for competent engineers is a true charge. Incidentally it is a true charge applied to engineers' services generally. The engineers directing the Panama Canal work, as this journal has said before, are paid absurdly little in proportion to their responsibilities and duties. Most of the resignations of engineers from the Reclamation Service, at least until very recently when other considerations have entered into the question, have been to accept better paying positions elsewhere. Our correspondent charges the head of the Reclamation Service with inability to see and correct this condition among others. Probably it is true that he is unable to correct, but it is, so far as we can judge, not true that he is unable to see the need for correction. We shall consider this point immediately, but first let us point out that because the pay in the Reclamation Service for competent engineers is insufficient it does not follow that these engineers are as a whole incompetent.

The heads of the Reclamation Service have not been blind to the matter of insufficient pay or to the matter of resignations of its best trained engineers. In the testimony of Chief Engineer Arthur P. Davis before the committee of Congress now investigating the Service will be found repeated statements of the fact that the salaries paid by the Service are lower than those paid in the commercial world, and that it is only by imbuing the men with pride in the Service and with the feeling that their ability is recognized and commended by the Service that able men can be kept. To quote Mr. Davis' words:

> It has been the constant effort and chief function of the director and myself to find the right kind of men, to recognize ability when we see it and keep it satisfied with appreciation so that we can hold it. The highest function of administrative ability is that of recognizing ability in others and commanding it. The Reclamation Service does not pay high enough salaries to hold men by the inducement of salaries alone.

This statement indicates no lack of ability to see that salaries in the Service are low for the services rendered by competent men; it does indicate on the contrary that the drawback is fully appreciated and that effort has been made to offset it by the only substitute that appeals to one's ambition.

Our correspondent brings up the charge of severe treatment of contractors by the Service; he hints even at trickery and underhand methods. This accusation has been made before and has been vigorously denied by the engineers of the Reclamation Service. Beyond this the evidence offered to the public has not gone, and judgment must be withheld until we have something more on which to base it than mere accusation and denial.

Our correspondent considers that the Reclamation Service engineers are no better prepared now to make correct estimates than they were when work was first begun. We cannot agree. These engineers have had actual experience in irrigation work and having done much of the work by day labor they have collected a vast number of cost data. They cannot help being better prepared now to make correct estimates.

ENGINEERING-CONTRACTING would not see the Reclamation Service engineers relieved one whit from their accountability to the public, it would not have them protected by a shadow from a critical accounting of their work, but it would have reason and justice.

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Concrete and Reinforced Concrete Section

Note: This section is devoted to methods and cost of constructing concrete and reinforced concrete structures. It will cover the selection, testing and proportioning of concrete materials; laboratory tests of concrete; concrete mixing, transportation and placing; fabrication and placing of reinforcement, and form construction and erection. It will also contain articles on new and interesting developments in the design of reinforced concrete.

Design and Construction of Concrete Retaining Walls for Pennsylvania R. R. Terminal Station New York City.*

The excavation for the Pennsylvania R. R. terminal station in New York city is a rectangular pit bounded by 7th and 9th avenues on the east and west and by 33d and 31st streets on the north and south.

The plan, from the earliest stages, contemplated founding the retaining wall on the surface of the rock, where of suitable quality, and afterward excavating the rock in front of the toe of the wall to sub-grade. This plan was definitely adopted soon after the borings were completed, on account of the great danger of blasting out large quantities of rock in timbered trenches close to buildings founded on soft material, and also to avoid the additional cost and delay that would have been caused by carrying the walls to sub-grade. The retaining walls in 7th Ave., south of the viaduct, and in 9th Ave., north of the viaduct, were not governed by the same conditions as in the streets. The dip and quality of the rock at both points required that the walls be carried to sub-grade, and they are, in fact, face walls; the 9th Ave. wall, in particular, having little thrust to retain, is very light.

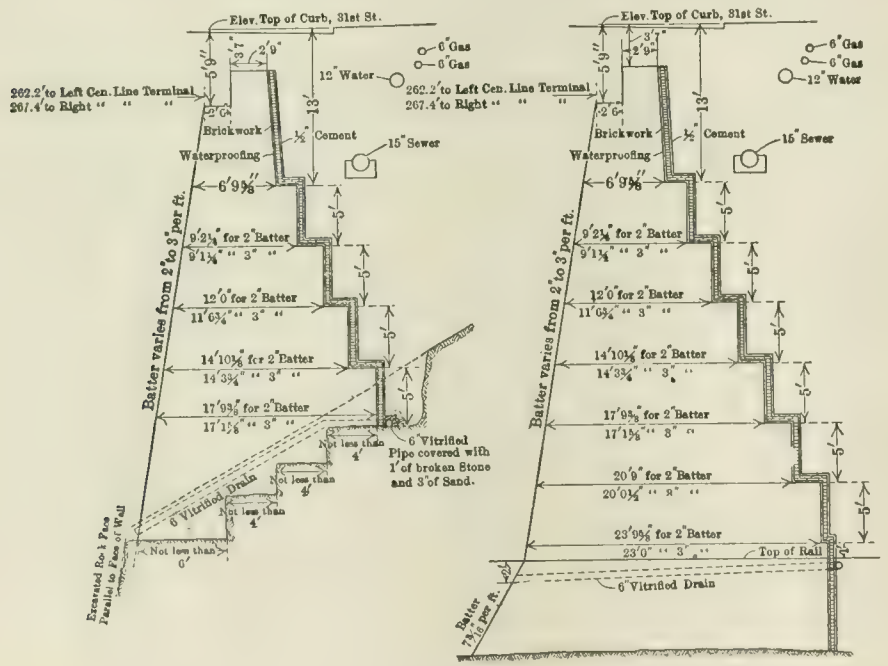


Fig. 1—Typical Sections of Retaining Walls Pennsylvania Terminal Station.

The results aimed at in the design and location of the retaining walls in 31st and 33d streets were: 1st. A perfectly stable wall under all conditions that might reasonably be expected; 2d. As much room as possible at the elevation of the top of the rail; 3d. The least necessary interference with adjoining property during construction; and, 4th. The most economical wall that would fulfill the other conditions.

The assumptions made in designing the wall were as follows: 1st. Weight of concrete, 140 lb. per cu. ft. 2d. Weight of material from the surface of the ground to a depth of 12 ft. (which was shown by tests made in bore-holes to be the elevation of the ground-water surface), 100 lbs. per cu. ft.; and angle of repose, 30°. The distance of 12 ft. below the surface was the depth of the inverts of the sewers, which undoubtedly drained the ground above them, thus accounting for the standing of the ground-water in planes practically parallel with the surface. 3d. Weight of buildings back of wall neglected, as that of the present type which will about equal the cellars filled with material at 100 lbs. per cu. ft., and if large buildings are erected in the future they will undoubtedly be carried to rock. 4th. Reaction from superstructure, live and dead load, 20,000 lbs. per lin. ft. of wall. 5th. Weight of materials below the 12-ft. line, 124 lbs. per cu. ft., ascertained as follows: The material was considered as weighing 165 lbs. per cu. ft. in the solid, and having 40 percent of voids filled with water at 62.5 lbs. per cu. ft., the resulting weight being

$$\left(165 \times \frac{60}{100}\right) + \left(62.5 \times \frac{40}{100}\right) = 124$$

lbs. per cu. ft. Various angles of repose were used for this material in the investigation, and it was finally decided that 30° was the greatest angle that could be expected, whereas the worst condition that could be anticipated was that the sand and water would act separately and give a pressure as follows: Hydraulic pressure from liquid weighing 62.5 lbs. per cu. ft. plus pressure from sand with angle of repose at 30° and weight as follows:

$$\text{Weight of 1 cu. ft. in air} = 165 \times \frac{60}{100} = 99$$

lbs. Weight of water displaced by 1 cu. ft. $= \frac{60}{100} \times 62.5$ lbs. $= 37.5$ lbs. Weight in water therefore $= 61.5$ lbs. per cu. ft.

These combined weights of course are equal to the weight of the combined material in the previous assumption. 6th.—The usual requirement that the resultant of both horizontal and vertical forces should at all points fall within the middle third of the wall, or, in other words, that there should be no tension in the concrete.

With these assumptions, investigation was made of walls with various batters and differently designed backs. This investigation developed the fact that the reaction from the superstructure was so great that for economy both in first cost and space occupied the batter must be sufficient to cause that reaction to fall within or very close to the middle third. Nothing could have been gained by having that reaction fall back of the front of the middle third, as the wall was required to be stable against the full pressure before the superstructure was erected, and in case it should ever be removed, or, to state the matter more clearly, the reaction from the superstructure was so great in comparison to the weight of the wall that if it fell in front of the resultant of all the other forces the width of base required would be greatly increased to make the wall stable after the superstructure fell back of the resultant of all the other forces, the width of base could not be correspondingly decreased without danger of the wall being overturned before the superstructure was erected. The least batter that would answer those conditions was found to be 2 ins. per ft.

For convenience in designing and economy in constructing the steel work the faces of the bridge seat and of the back wall were laid parallel to the center line of the terminal and in elevation on line parallel to the top of the curb and as near to it as the economical depth of steel would permit, without bringing the finished construction above the plane fixed in the ordinance. As there is a variation of 13 ft. in the elevation of the top of the curb of 31st St. above the top of the rail and a variation of 18 ft. in 33d St., a uniform batter, with the top parallel to the center line, would produce a toe varying in distance from it and from the other constructions. It was decided, therefore, for the sake of appearance, to make the face of the wall (or wall produced) at the top of the rail parallel to the center line and to vary the batter accordingly, using the 2-in. batter previously mentioned as the minimum. This gave a maximum batter of 3 ins. per ft. The variation is so gradual that it is unnoticeable, and is not sufficient to introduce any complications in construction.

The wall was designed with a stepped back, primarily to allow the water proofing and brick protection to be held in position more readily. The first step was put at 13 ft. below the surface of the ground. This gave a vertical back above that point for a 3-in. battered face, and a slightly battered back for sections having a less batter in front. Below that point a step was added for each 5 ft. of depth to the elevation of the top of the rail, or to the foundation of the wall if above that elevation. As the horizontal distance of the heel of the wall at its greatest width from its face at the top of the rail would determine the effective room to be occupied by the wall, it was determined to make the back vertical below the top of the rail and gain the necessary increase in width below that point by making a heavy batter on the face.

The type of wall having been thus determined, calculations were made of the width of base required for each ¼-in. batter from 2 to 3 ins. inclusive, first for a depth of 13 ft. below the top of the curb and then for each 5 ft. below that elevation, to a depth corresponding to the distance between the top of the curb and the top of the rail at the point of greatest variation. These widths of wall were determined for the two pressures previously decided on, and curves were then plotted showing the thickness of wall required for each batter calculated and for each pressure. Typical sections of the wall and pipes back of it are shown by Fig. 1.

The plant employed for the retaining wall work comprised: Three cableways, with 35-ft. towers of 12x12-in. yellow pine timber

*Extracts from a paper by George C. Clark, Proceedings American Society of Civil Engineers, Vol. XXXVI, p. 480.

capable of spanning 350 ft. and operated by 7x10-in. double-drum Lambert hoisting engines mounted with 25-h.p. Lambert upright boilers; five stiff-leg derricks, with masts from 35 to 50 ft. long and booms from 45 to 60 ft. long, operated by 7x10-in. Lambert double-drum and swinging gear engines, mounted with 25-h.p. upright Lambert boilers; six Cameron pumps, varying in size from 7x6x13 ins. to 10x8x16 ins., the first dimension referring to the diameter of the steam cylinder, the second to that of the water and the third to the stroke; five Rand sheeting drivers; two Ransome ¾-cu. yd. concrete mixers, mounted on frame, with kerosene driving engine; drills drawn from pit plant as required.

Excavation for Retaining Walls.—Two essentially different methods were used in excavating for and building the retaining walls; one, construction in the trench, the other, construction on the bench. In general, the trench method was used wherever the rock on which the wall was to be founded was 12 ft. or more below the surface of the street, or what is perhaps a more exact statement, as it includes the determining factor, where the buildings adjoining the wall location were not founded on rock.

In the trench method the base of the wall was staked out on the surface of the ground, the required width being determined by the elevation of the rock, as shown by the borings. The contractor then added as much width as he desired for sheeting and working space, and excavated to a depth of about 5 ft. before setting any timber. In some cases the depth of 5 ft. was excavated before the cableway or derrick for the excavation was erected, the wagons being driven directly into the excavation and loaded by hand, but usually the cableway was first erected and buckets were used from the start. After the first 5 ft. had been excavated, two sets of rangers and struts were set, the first in the bottom of the excavation and the second at the level of the street surface, supported by posts resting on the bottom rangers. The sheeting was then set, and all voids back of it were filled with clean earth and well tamped. The toe of the sheeting was kept level with the bottom of the excavation until the ground water was reached, after which it was kept from 3 to 5 ft. ahead of the digging.

The sheeting used was 3-in., in variable widths; it was always tongued and grooved on the side of the trench next to the buildings and in the deeper excavations on both sides of the trench, and was driven by wooden mauls above the ground water level, but steam sheeting drivers were used below that elevation. Struts, rangers, and posts were generally 12x12 ins.

Some exceedingly bad material was encountered in the deeper excavations, beds of quicksand being passed through, varying in thickness from 1 to 18 ft., the latter in 31st St. between 7th and 8th avenues in the deepest excavation made. After encountering the fine sand in that trench, no headway was made until a tight wooden cylinder was sunk through the sand by excavating the material inside of it and heavily weighting the shell with pig iron. When this cylinder had reached the gravel, which lay below the sand, it was used as a sump, and the water level was kept below the bottom of the excavation, which permitted good progress. Sand continued to flow under the sheeting to such an extent, however, that the front walls of four adjoining buildings were badly cracked and had to be taken down and rebuilt. All the stoops along this trench settled and had to be repaired.

The bench method of excavating for the retaining wall was very simple, and was used only where the rock lay near the surface and the adjoining buildings were founded on it, the overlying material being in such case dry and consequently firm, little or no shoring was required. The method was to extend the pit excavation to a width of 2 or 3 ft. beyond the proposed back of the retaining wall, and to carry that width down to the depth required for its base, below which the excavation was narrowed to 1 ft. inside of the face of the wall and continued either before it was built or subsequently.

Retaining Wall Construction.—The concrete walls were built in sections 50 ft. in length, except where that spacing would bring an expansion joint under a girder pocket or just on line with a tier of struts, in which cases the section was shortened as required. Trenches were never allowed to remain open at the full depth, the concreting being started as soon after the necessary length of rock had been uncovered as the forms and preliminary work for a section could be prepared. Each section was a monolith, except in a few cases where very heavy rains made it impossible to hold the laborers.

The various operations in building the concrete wall are shown by Fig. 2. Guide planks, *"a a,"* Section *"A-A,"* were securely spiked to alternate tiers of struts for the length of the section, the face of each guide plank being set on line with the intended face of the concrete wall, and 2-in. tongued and grooved spruce plank were laid along the guide plank to the height of the bottom strut and securely braced from the front sheeting. A 4-in. brick wall was built simultaneously on line with the back of the wall to the height of the first step. Where the bottom strut was below that elevation, the brickwork was left low at that immediate point and built up when the strut was removed. The brick wall was then water proofed on the side toward the concrete and loose laps of the water proofing were allowed to hang over the brickwork and at least 8 ins. down the back. A 6-in. vitrified pipe drain was then laid along the surface of the rock just outside of the brick wall, the joints in the pipe being caulked with oakum saturated in cement, and pointed with cement mortar above a line 1 in. below the horizontal diameter, the remainder of each joint being left open. Cross drains were laid from tees in the back drain to the face of the wall at all low points in the rock and at least for every 25 ft. of wall length, the joints of these discharge pipes being caulked and cemented throughout. The surface of the rock was then washed and scraped clean, and was covered with about 1 in. of mortar, after which the section was ready for concrete.

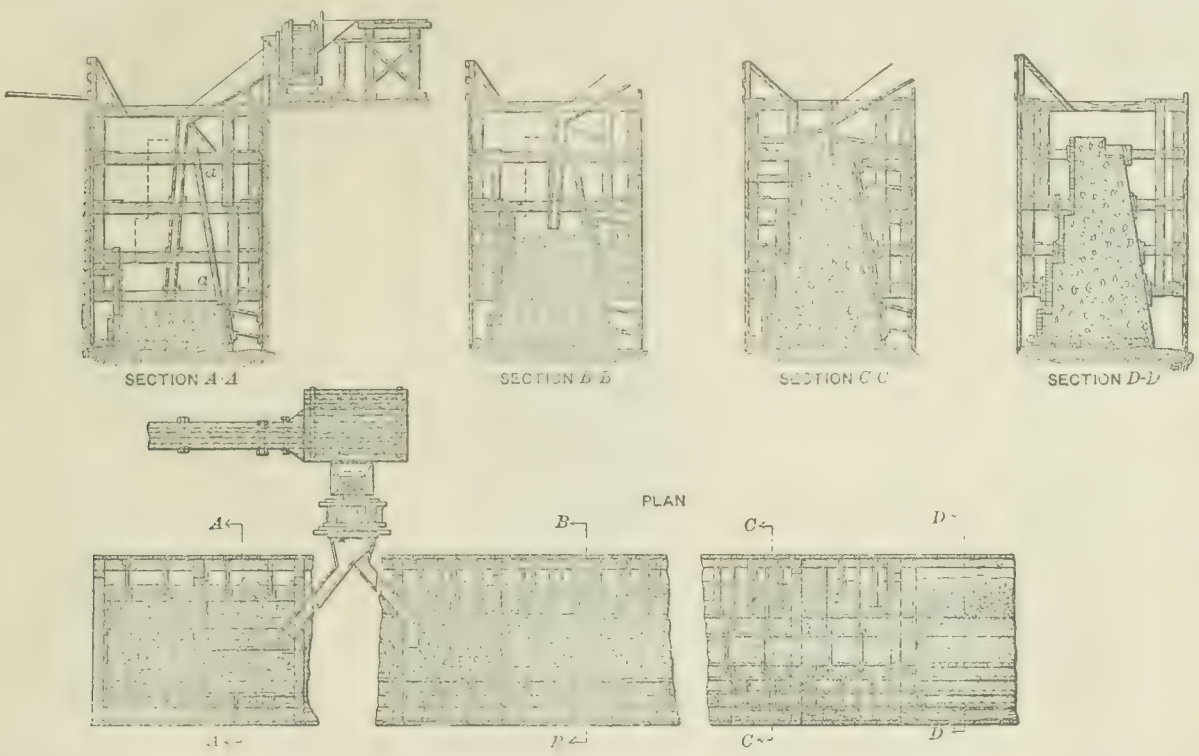


Fig. 2—Sketches showing Forms For and Methods of Concreting Retaining Walls, Pennsylvania Terminal Station.

The building of monolithic sections in trenches required that the thrust from one set of struts be taken by the concrete before the set above could be removed, and necessarily caused slow progress, the rate at which concrete was deposited being just sufficient to prevent one layer from setting before the next layer above could be placed.

The concrete used was mixed in the proportions of 1 part of cement to 3 parts of sand and 5 parts of stone, in 2-bag batches, in ¾-yd. and 1-yd. Ransome portable mixers mounted with air-driven engines on the same frame. These mixers were placed at the surface, and were charged with barrows, the correct quantities of sand and stone for each batch being measured in rectangular boxes previous to loading the barrows. The concrete was discharged from the mixer into a hopper which divided into two chutes, only one of which was used at a time, the concrete being shoveled from the bottom of the chutes to its final position. Facing mortar, 2 ins. thick, was deposited simultaneously with the

concrete, and was kept separate from it by a steel diaphragm until both were in place, when the diaphragm was removed and the two were spaded together. The bottoms of the guide planks were cut off just above the concrete as it progressed, and as soon as the wall had reached a strut at one end of the section that strut was removed, the form was built up to the next strut, at front and back, and braced to the sheeting, so that by the time the entire length of the section had been carried up to the level of the first line of struts, forms were ready at one end for the succeeding layers. The layers of concrete never exceeded 8 ins. in height, and at times there were slight delays in the concreting while the carpenters made ready the next lift of forms, but such delays were rarely long enough to permit the concrete to take its initial set.

After a section of concrete had firmly set, both back and front forms were removed and the thrust from the sides of the trench was transferred directly to the finished wall. The face of the wall was rubbed with a cement brick to remove the marks of the plank and was then coated with a wash of thin cement grout. The water proofing and brick armor were then continued up the back of the wall, the spaces between the lines of braces being first water proofed and bricked and the braces transferred to the finished surface, after which the omitted panels were completed. The water proofing consisted of three layers of Hydrex felt, of a brand known as Pennsylvania Special, and four layers of coal tar pitch. The pitch contained not less than 25 per cent of carbon, softened at 60° F. and melted at a point between 96° and 106° F. The melting point was determined by placing 1 gramme of pitch on a lead disk over a hole 5/16 in. in diameter, and immersed in water which was heated at the rate of 1° per minute; the temperature of the water at the time the pitch ran through the hole was considered as the melting point.

In order to prevent the water proofing from being torn at the joint between sections when they contract from changes in temperature, a vertical strip of felt 6 ins. wide was pitched over each joint, lapping 3 ins. on each concrete section. The back of this strip was not pitched, but was covered with pulverized soapstone, so that the water proofing sheet was free from the wall for a distance of 3 ins. on either side of each joint.

Concreting was continued during the severest weather, one section being placed when the thermometer was 5° above zero. When the thermometer was below the freezing point both sand and stone were heated by wood fires in large pipes under the supply piles; the temperature of the mix was taken frequently, and was kept above 40°. Numerous tests made while the work was in progress showed that, while the temperature fell slightly soon after the concrete was deposited, it was always from 2° to 5° higher at the end of 2 hours. The face and back of the concrete were prevented from freezing by a liberal packing of salt hay just outside the forms.

A vertical hog trough, 24 ins. wide and 9 ins. deep, was placed in one end of each section for its full height below the bridge seat, into which the next section keyed, and when the temperature at the time of concreting was below 50° F. a compression joint was formed by placing a strip of heavy deadening felt, 2 ft. wide, on the end of the completed section next to the face and covering the remainder of the end with two ply of the felt and pitch water proofing; the one ply of deadening felt near the face was about the same thickness as the two ply of water proofing, and was used to prevent the pitch from being squeezed out of the joint to the face of the wall.

The excavation for the retaining walls in 31st and 33d streets was in all cases made of sufficient width to receive the sewers, which were laid as soon as the back-fill, carefully rammed and puddled, had reached the proper elevations; the back-filling was then completed, and the gas and water mains were afterward laid in separate trenches.

The sections of concrete built in trench varied in height from 13 to 59 ft. from the base to the top of the back wall. With the exception of the 7th Ave. wall, 50 ft. in height, and the 9th Ave. wall, 62 ft. in height, none of those sections constructed by the bench method was more than 14 ft. The forms and bracing for these walls were substantially the same, except that the low walls were built in lengths of approximately 50 ft., while the forms for the 7th and 9th avenue walls were only 20 ft. long.

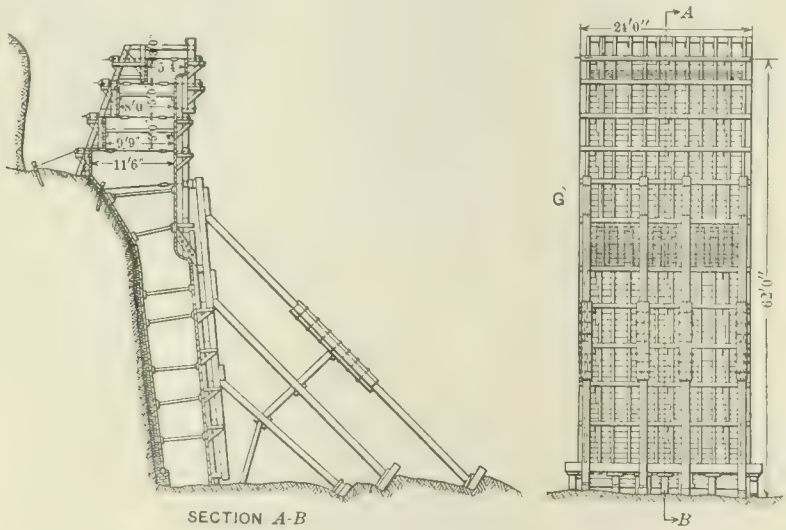


Fig. 3—Sketch Showing Forms and Bracing for Ninth Ave. Retaining Wall.

The forms and bracing for the 9th Ave. walls are shown by Fig. 3. These forms were built in one piece and moved ahead from section to section, and they were firmly braced from the bottom with raker braces to a point 36 ft. above the base, the upper part being held in place by ¾-in. bolts passed through the forms and anchored by cables to bolts grouted into the rock behind.

After the forms had been set and braced, an 8-in. brick wall was laid up the face of the rock, containing a vertical line of three-cell hollow tile block every 5 ft. of length, and laid to conform as nearly as possible to the face of the rock, all voids being filled with broken stone. Water proofing similar to that described for the walls in the trench was then applied to the brick and tile wall for the full height, and firmly braced to the front forms, the braces being removed as the concrete reached them. The concrete was mixed at the street level and deposited through chutes, as described previously.

The Wacanaw Lumber Co. of Bolton, N. C., which has 10 miles of railroad in operation, is reported to be considering extending the road from Makota to Southport, a distance of 20 miles.

Some Experiments on the Cost and Durability of Cement Drain Tile.*

Since the Ontario Agricultural College began College Extension work on the subject of Farm Drainage some five years ago there have been numerous inquiries for information on the subject of cement tile. People usually wanted to know two things, first, whether the cement tile could be made cheaper than the clay tile, and second, whether they would be durable. When these inquiries first began to come in there were not, so far as I am aware, any extensive or conclusive data as to the durability of cement drain tile, nor was there any grave question about their durability. There was a general impression, however, that they should prove durable, judging from the manifold conditions in which concrete had proven its usefulness. Therefore, at first we concerned ourselves with the cost of manufacturing cement tile by hand, for the point made by most of the inquirers was that they were thinking of procuring molds and making their own tile.

For use in our experiments on the cost of manufacture, the London Concrete Machinery Co. furnished us with one of their two-piece cement tile machines, since taken off the market. And the experimentation was undertaken by Mr. A. M. Shaw, one of our students, who had had considerable experience in cement work with his father, the late Mr. Robert Shaw, of Niagara Falls, Ont., who for several years did much of the road contracting in his locality. During the months of April and May, 1908, experiments were conducted in making cement tile.

While writing the report of these experiments in the latter part of the year we learned of the controversy over the durability of the cement drain tile, and we must confess that the ideas of cement being soluble was a new one to us. After reading the attack on cement and the answer to it we counselled our farmers to go slowly in the adoption of cement tile, believing that the uncertainty in our own minds at least about their durability was sufficient to warrant such action. At the same time, however, we decided to conduct some tests in order to learn for ourselves something about the solubility of cement, and to deduct from the information thus obtained some idea of the probable durability of cement tile. Those experiments were begun in February, 1909, and have been continued until the present. Besides the points already mentioned the porosity of cement tile received some attention during our experiments.

The Cost of Making Cement Tile by Hand.—The tile made by the London two-piece machine were hexagonal on the outside, being ¾ in. thick in the thinnest part and considerably thicker at the corners. Mr. Shaw found that, mixing his own material, he could make a shade over 500 complete 3-in. tile a day when everything was once in order. The material had to be mixed quite dry in order that the molds might clean, so dry, indeed, that it was impossible to tamp it close enough to make a compact tile. By oiling the molds it was found that the material might be mixed much wetter, but still not wet enough to make what we consider a good tile. We also thought that considerably more material was used in the tile than would be necessary for a round tile; and besides, the amount of handling required for two-piece tile was double that for one-piece. These features led us to doubt whether this type of machine would ever be popular with the farmers. On consultation with the company we found that they had arrived at the same conclusions, and that they were withdrawing the machine from the market. These circumstances at first led us to think that the work done on this phase of the problem was of little practical value, and we discouraged the extensive publication of the results, although we placed them in our annual report, just as a matter of record. On second thought, however, we have changed

*A paper by Prof. W. H. Day, Ontario Agricultural College, Guelph, Ont., read before the Canadian Cement and Concrete Association.

our minds somewhat, for the following reason: The rate of manufacture determined must represent fairly well what might be expected with a round-tile machine of similar dimensions—the round tile would be slower to tamp but there would be only half as many pieces to handle. And as a matter of fact we have since learned of a hand machine for round tile, recently invented, on which one man can make about 500 tile a day, thus establishing that the rate of manufacture determined in our experience is in all probability a fairly representative one.

We found further that 6 cu. ft. of sand and 1 bag of cement (approximately a cubic foot) would make 78 complete 3-in. tile. But a round tile ½ in. thick requires only 55 per cent as much material as the one made on the London two-piece machine, hence the material mentioned above would make 100.55x78 or 142 tile, providing they were tamped to the same compactness. As they could be made wetter they would likely be somewhat more compact. This, however, would be counterbalanced by the use of another half bag of cement making the proportions 4 of sand to 1 of cement (too poor for really strong tile), so that we may fairly see from our figures that 6 cu. ft. of sand and 1½ bags of cement there can be made 142 3-in. tile, say 140 in round numbers. This gives us a means of arriving at an estimate of the cost of making 3-in. tile, ½ in. thick by hand, when the price of material is known. In Guelph we pay $1 a yard for sand and $1.90 for cement. At these prices:

6 cubic feet of sand cost	$ 0.22
1½ bags of cement cost	0.71
Total price of material for 140 tile	$ 0.93
Total price of material for 500 tile	3.32
Wages of man for 1 day	2.00
Total cost of 500 tile	$ 5.32
Total cost of 1,000 tile	$10.64

In this estimate no allowance is made for hauling the material, as this can be offset against the hauling of clay tile, if it is desired to make a comparison between the cost of the two kinds.

The prices used in estimate may be high in some localities, but knowing that 6 ft. of sand and 1½ bags of cement will make 140 tile and that a good man can make about 500 tile a day on certain types of machine the cost of manufacture may be figured out to suit cost of materials in various localities. Or again, if type of machine is such that a man can make only 400 instead of 500 in a day the cost of the tile can readily be calculated. Next we come to the solubility tests.

Experiment I.—Sample, a piece of tile weighing 43.256 grams, after being dried to constant weight at 215° F. This tile was made by the "dry process" in April, 1908, in proportions 6 of sand to 1 of cement. For a few days after being made it was watered daily, and then it was submerged in water for a period of six weeks, after which it was removed and transferred to a storage cellar, where it remained until solubility experiments began. Tile quite porous. After the small piece had been dried to constant weight it was placed in distilled water for four days, then removed, dried, weighed, and again placed in fresh distilled water. As convenience allowed it was dried, again weighed, and once more placed in fresh distilled water. This was repeated 16 times, the total period of solution being 148 days and the total loss in that time was 0.113 grams. The total cement in the sample was 7.1794 grams, hence at this rate the cement would all dissolve in 27.7 years. The experiment was next performed with water from the artesian wells at the College. This water is high in total solids, about 460 to 480 parts per million, made up chiefly of bicarbonate of calcium, bicarbonate of magnesium, or the compound bicarbonate of calcium and magnesium. There is also a small amount of chlorine in it. The sample was tested five times in this water, the total period of solution being 47 days and the total loss in weight .090 grams. At this rate it would take only 10 years to dissolve all the cement in the sample.

Experiment II.—Sample, a piece of tile, proportion 6 to 1, made on London two-piece machine May, 1908, watered daily for a week after making, stored in cellar till November, 1909, mixed much wetter than sample used in experiment I, so wet, indeed, that the molds would not clean well. Dry weight 43.213 grams. The treatment was the same as in experiment I, only the number of tests in distilled water numbered 8 instead of 16, the total period in the water being 73 days. During the period the sample lost .025 grams, at which rate it would take 57.4 years to dissolve all the cement in it. When put in the well water the loss in 47 days was .090 grams, which rate would use up all the cement in 10.3 years.

Experiment III.—Sample, a piece of wet-mixed tile, made the same time as No. 2 and watered and stored in the same way. Dry weight 36.2795 grams. Treatment, distilled water for 73 days, well water for 47 days. This sample lost only slightly in distilled water and gained .0333 grams in well water. At this rate it would last for ever.

Experiment IV.—Sample, a piece of tile, proportions 4 of sand to 1 of cement, made by Mr. George Holden, of St. Marys, on the London Automatic cement tile machine. Watered daily for a week after being made, and then stored in our laboratory until October, 1909. Dry weight 20.4792 grams. Treatment, same as II. and III. Loss in distilled water in 73 days = .0387 grams. At this rate the sample would last 26.5 years.

Experiment V.—Sample, a piece of tile, proportions 4 of sand to 1 of cement, made by same maker as No. II, cured and stored in the same way. Dry weight 35.781 grams. Treatment, same as others. In 73 days in distilled water the loss was .0175 grams, at which rate the sample would last 102.2 years. In 47 days in well water the sample gained .0165 grams in weight, and thus would never disintegrate.

Experiment VI.—Sample, a piece of clay tile, about average quality, possibly burned a little slack. Dry weight 36.660 grams. Treatment, in distilled water 48 days, weighed 5 times in well water 47 days, weighed 5 times. Loss in distilled water 1.159 grams, at which rate the sample would last only 9.1 years. Loss in well water .081 grams, at which rate the sample would last 58.3 years.

In estimating the time that samples would last it has been assumed that they would be subject to solution 365 days in the year and that the rate of solution would be uniform. The first of these conditions certainly would not hold in practice. During a large portion of the year, possibly half, tiles are dry and not subject to solution, and consequently would last twice as long as the periods mentioned, provided the rate of solution during the other half of the year was constant.

We had hoped to establish something definite as to the rate of solution, but we have failed to do so yet. The rate of solution seems to fluctuate with some factor other than time, probably temperature. Just when our curve for rate of solution would reach a constant for two or three readings, this variation would occur and prevent conclusions. In all samples the rate of solution in distilled water appeared to fall off, slowly in most cases, but very rapidly in a few, especially in the case of the clay tile. When placed in the well water the samples all behaved irregularly at first, giving either large losses or else large gains, and these losses or gains fell off rapidly.

Three other experiments were performed which probably come nearer natural conditions than the previous experiments do. Three half tiles were placed in running well water on May 6th, 1909, where they have been ever since. At the end of six months they were dried, weighed, and replaced in the water. Then last week they were dried and weighed again. The results are as follows:

Experiment VII.—Sample, a half tile, proportion 6 to 1, made on London two-piece machine, dry process, May, 1908, watered for a week, stored in cellar. Dry weight 1797.5 grams. Treatment, in running well water for 10½ months, weighed at 6 months and at 10½ months. Result, tile gained in weight each time. Total gain 3.4 grams.

Experiment VIII.—Sample, same as in 7. Dry weight 1910.25 grams. Treatment, same as 7. No change in weight in first 6 months, a gain of 4.05 grams in next 4½ months.

Thus these two samples would never disintegrate at this rate.

Experiment IX.—Sample, a half tile, proportions 6 to 1, made on London two-piece machine, made very wet, so much so, indeed, that tile would not hold shape, and molds would not clean. Allowed to dry, getting a few showers of rain, and then stored in cellar. Dry weight 2001.0 grams. Treatment, same as in 7 and 8. Tile lost 1.90 grams first 6 months and 2.7 grams next 4½ months. At this rate the sample would last 63.4 years.

It is worthy of note with regard to these three samples that those made by the dry process, and therefore very porous, were the ones to gain in weight, while that made by the wet was the one to lose.

The behavior of these three large samples contrasts so strangely with that of the small samples as to indicate that experiments with small pieces are apt to be very far from actual conditions. For instance the rate of solution for the piece of clay tile would indicate that that sample would all dissolve in less than two generations. And in much less time than that the tile would be so weak as to give way under soil conditions. Experience has shown that such does not occur, and hence we must conclude that the conditions are so artificial that it is not safe to base arguments as to durability upon such tests. It is even doubtful whether the large tile in running well water is very close to natural conditions. In the soil there will be much very fine sediment in the form of clay and colloid particles to lodge in the pores and prevent solution. The process of accretion shown in two out of three of these large samples would doubtless be much more rapid in the soil. Another reason for the slower solution in the large samples was the cooler temperature maintained by the constant introduction of cold water. Basing our conclusions on these larger samples we are not able to see any danger of the cement tile crumbling.

It is our intention to continue the work on the solubility, as we realize there is much yet to be learned about it.

Porosity.—With regard to the porosity we find that it varies with the proportions of cement, with kind of sand used, and also with the method of making. The more cement used, the finer the sand, or the wetter the mix, the less porous the tile. But even the most compact ones tested were much more porous than clay tile.

Asphalt Grouted Sewer Pipe Joints.—In some of the German cities sewer pipe joints are made by grouting in asphalt. The pipes, which must be absolutely dry and clean, are placed in position, and strands of tarred jute are caulked into the joints, then a band of clay puddle is fixed around the pipe against the annular space for the jointing material and natural asphalt melted to a temperature of about 380° F. is poured through an opening made in the clay band at the top part of the pipe. According to the Municipal Engineer of Elberfeld, Germany, the asphalt must be very fluid and free from impurities, which might cause bubbles to form, and the melting tank must be kept closed to prevent the escape of the light volatile oils. Artificial asphalt made of tar compounds has been found to be unsuitable. The quantity of material used is as follows:

Diam. pipe (in.)	4	6	9	12	15
Tarred jute (lb.)	0.5	0.66	0.82	1.43	2.20
Asphalt (lb.)	1.43	1.98	2.92	4.62	6.76

After completion the sewers are tested by an air pressure of from 3.7 lb. to 5 lb., which is maintained for ten minutes.

The pipes are usually made in lengths of 1 metre, and it is found that the cost of the sewers is decreased by reason of the fewer number of joints. Pipes over 18 in. in diameter are usually surrounded with concrete.

An Analysis of Concrete Bridge Failures.*

The opponents of concrete have in the past hailed every case of failure in concrete construction as an additional demonstration of the entire unsuitability of the material for strong and permanent engineering works. In order to ascertain the ground, if any, on which the representations of the opponents of concrete bridges are based, the writer has looked into the cases of concrete bridge failures of which he could obtain reliable information pointing to the cause of failure. The data thus collected are presented below in as concise a form as possible consistent with a full statement of the circumstances in any way likely to aid in placing the responsibility. Some attention is given to cases of pronounced cracking of spandrel and wing walls, since such developments, while not incapacitating the bridge for present traffic, constitute failure to the extent of impairing the bridge aesthetically if not materially shortening its life. From this evidence the cause of failure (complete or partial) is deduced in each case and a summing up of the cases is presented at the close of the paper.

Fig. 1—View Showing Abutment of Concrete Bridge After Collapse of Girder Span.

Case 1.—Reinforced-concrete slab or flat-top bridge of 10 ft. span intended to carry a fill of 13 ft. above the top of the slab; slab, 12 ins. thick reinforced by longitudinal rods ¾ in. in diameter spaced 12 ins. c. to c., and transverse rods of the same size 2 ft. c. to c.; spandrel walls, 2 ft. thick at the bottom reinforced by vertical ¾-in. round rods, 2 ft. c. to c.

After the concreting had been completed nearly two months and some 10 ft. of the earth fill had been placed, the centers were struck with the result that almost immediately the slab collapsed under the weight of the fill alone, leaving the spandrel and wing walls intact as shown by Fig. 1.

An examination of the wrecked structure at once directed suspicion to the design rather than to the materials or workmanship. The concrete was apparently of correct proportions, had set satisfactorily, and had evidently been placed with care. Computations based upon measurements of the slab taken after the failure showed a fibre stress of 41,500 lbs. per sq. in. in the steel and 1,100 lbs. per sq. in. in the concrete under a 10-ft. fill. Apparently, no special care had been taken properly to anchor the longitudinal reinforcing rods, so that under this stress, considerably in excess of their elastic limit, they had pulled through the concrete, as was evidenced by the polished state of the concrete in contact with these rods. The failure can therefore be attributed wholly to defective design.

Case 2.—This structure, which is typical of a number of reinforced-concrete girder bridges completed in a county in the State of Indiana some 3½ years ago, was of span 15 ft. in the clear and 16 ft. clear roadway. Two longitudinal girders 15 ft. 10 ins. c. to c. carrying a 7-in. slab comprised the superstructure. Upon this slab was placed a 12-in. earth fill and in addition it was supposed to carry a uniformly distributed load of 200 lbs. per sq. ft. or a 20-ton road roller. The slab was reinforced by tranverse rods of a sectional area of 0.78 sq. in. each, 1 in. from the bottom and 10 ins. c. to c. and by longitudinal rods ½-in. in diameter and about 3 ft. on centres.

Before the striking of the centers, Mr. Daniel B. Luten, President of the National Bridge Co., in a communication to *Engineering News*, pointed out the weakness of the design and questioned its safety. He showed that under dead load alone the compression in the concrete of the slab would be about 1,000 lbs. per sq. in. and the tension in the steel would be nearly 20,000 lbs. per sq. in., while for the specified live load consisting of a 20-ton roller these figures became 3,000 and 55,000 lbs. per sq. in. respectively.

Before Mr. Luten's letter had appeared in the journal mentioned, startling confirmation of his deductions was given by the collapse of the bridge under a traction engine the day following the removal of centres. From the testimony of the engineer in charge of the engine, the bridge gave way when the rear wheels were about in the centre of the span, and indications pointed to the slab as the initial source of failure. Careful examination of the wrek disclosed no broken steel and failure was apparently caused by excessive compression in the concrete of the slab. Under the loading of the traction engine, which weighed about 16,500 lbs. and of which 9,000 lbs. were concentrated on the rear axle, this compression could not have been less than 1,800 lbs. per sq. in., with the tension in the steel about 32,500 lbs. per sq. in. The corresponding stresses in the girders were about 1,000 lbs. per sq. in. for the concrete and 20,000 lbs. per sq. in. for the steel. The compression in the concrete of the slab was therefore nearly equal to the ultimate strength of a good concrete one month old, and in excess of the strength of the material used, which appears to have been of poor quality—on account of the presence of "dirt" in the sand. Very bad design and lack of care in preparation of the concrete were, therefore, clearly responsible for the collapse.

Case 3.—Reference has been made to a number of girder bridges similar in design to that of Case 2, constructed during the same year as the latter, in the state of Indiana. One of these of 24-ft. span developed a bad crack in one of the beams shortly after the striking of the centers, but managed to hang together and carry the traffic for about 1½ years. There was no load on the bridge when it finally fell and no evidence could be discovered of any weakening or undermining action from floods or other causes. It, therefore, appears that its downfall, like that of its companion in disaster, was due to the errors of an inexperienced or careless designer.

Case 4.—Plain concrete railroad culvert of 20 ft. span and 10 ft. rise, carrying a fill of about 10 ft. over the crown; crown thickness about 18 ins.; foundations were carried 4 or 5 ft. below the natural level of the ground. The situation of the bridge was on marshy soil and the foundation-bed was of soft clay with considerable organic matter present, *but no piles whatever were used.*

As the filling was placed on the arch, cracks began to develop, in the case of the west wall, passing vertically up the wing walls near

Figs. 2 and 3—Views Showing Concrete Arch Cracked by Settling of Foundations.

*A paper by C. R. Young, of Barber & Young, Bridge and Structural Engineers, Toronto, Ont., read at the convention of the Canadian Cement and Concrete Association at London, Ont., March 30, 1910.

their junction with the spandrels, then crossing this corner and trending to the crown of the arch, reaching it at about one-quarter of the length of the barrel in from the face of the spandrel walls (Figs. 2 and 3). In the east wall a large vertical crack passed from

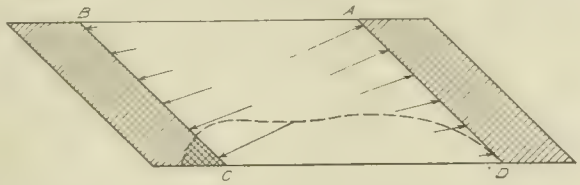


Fig. 4—Diagram Showing Cause of Failure of Concrete Skew Arch.

the footing up the soffit to near the crown, where it joined a large horizontal crack running along nearly the whole length of the arch barrel. In addition to these very prominent cracks many other tributary cracks of lesser extent developed.

Careful examination of the cracks in conjunction with the originally level mold board lines conclusively showed that the abutments had settled from 4 to 6 ins. under the heavy load of the fill, and that the insecure foundations were wholly responsible for the failure.

The writer is indebted for the above information to Mr. F. L. Somerville, M. Can. Soc. C. E., under whose observation this failure came, but who was in no way responsible for the design or construction of the bridge.

Case 5.—A plain concrete railroad culvert 10 ft. in span carrying an embankment 52 ft. in depth, was constructed in the winter. The foundation-bed was of soft clay and no piles were used. In the following spring when the frost came out, a portion of the barrel near the middle collapsed under the weight of the fill and a part of one end with one of the wing walls gave way under the sliding of the embankment.

The explanation offered for this failure, and one that appears reasonable, was that the spring thaw had destroyed the even bearing of the culvert on the foundation-bed and that the barrel had thus been resolved into a beam at several points, the wrecked end portion acting as a cantilever. Had reinforcement been used, which is particularly desirable in winter work of this class, the structure would no doubt have safely withstood the adjustment.

Case 6.—A reinforced-concrete arch highway bridge of about 30 ft. span and of low rise was constructed with abutments resting directly upon a quicksand bed and in a situation involving the excavation of a new channel for the stream. Shortly after the striking of the centers the arch ring collapsed, although subsequent computation showed the design to be sufficient.

While the early removal of the forms may have been to a small extent responsible for the failure, the excavation for the new channel appears to have immediately precipitated the fall. Under the considerable weight of the arch, and favored by the removal of material between the abutments, lateral flowing of the quicksand with attendant settlement and tilting of the abutments naturally followed. Had the foundation-bed been piled, this development could not have taken place. Faulty design of foundations was, therefore, primarily responsible for the failure; but, unless some of the piles had been driven on a batter, bad cracking of the spandrels would have occurred under the conditions named.

Case 7.—Some seven years ago a Monier arch of considerable size and built at an extreme skew, collapsed at Bendigo, Australia, with loss of life. The failure was sudden and unattended by any premonitory signs of distress, unlike the recorded character of failure of Monier arches, which had been tested to destruction in Europe and elsewhere. In view of the fact that the abutments were especially massive and securely founded on solid rock and that the materials were excellent, the contractor attributed the disaster to incorrectness in the received theory of skew arches, and retained the services of the late Professor W. C. Kernot, of the University of Melbourne, to conduct a thorough investigation and report upon the cause of failure.

By means of measurements of the deformation of loaded India rubber models and by ingenious electrical experiments on a metallic model, corroborated by mathematical calculations, Professor Kernot was able to show that Rankine's theory of the skew arch, which had

Fig 6—View of Crack in Spandrel Wall of Arch Represented by Fig. 5.

up to that time been universally accepted, was altogether erroneous. Rankine's view, as stated in his "Applied Mechanics," was that "the forces which act in a vertical layer or rib of a skew arch with its abutments, are the same with those which act in an equally thick vertical layer of a symmetrical arch with its abutments, of the same dimensions and figure, and similarly and equally loaded." It followed from this assumption, therefore, that the design of a skew arch in no way differed from the design of a right arch of the same span as the span of the former, measured parallel to the longitudinal axis of the bridge. Professor Kernot, however, conclusively demonstrated that there is a great intensification of stress along the short diagonal *AC* of a skew arch (as indicated by the arrows in Fig. 4), the actual stress being almost double the stress along lines parallel to *AB*. At the same time the stress along the long diagonal *BD* was excessively small.

The existence of such a stress condition is particularly serious since the acute angles of the abutments are of insufficient mass properly to resist the augmented thrust in the direction of the short diagonal, and if the skew be large, the factor of safety low or the test load unusually heavy, the abutments may give way at these points. This is precisely what happened at Bendigo, for the acute angle *C* of one of the abutments was literally pulverized over the double-hatched portion by the local intensification of the stress, and the part of the arch enclosed by the irregular dotted line and the line *CD* had consequently fallen.

The cause of this failure lies unquestionably in the lack of knowledge at that time of the true principles of proportioning skew arches and their abutments.

Case 8.—The most recent concrete bridge failure of magnitude occurred on Feb. 28, 1910, when a reinforced-concrete arch highway bridge of three spans over the Flat Rock River near Edinburg, Ind., collapsed during a flood of exceptional height. The bridge had been open to traffic for about eight months and during that time had stood one severe flood, accompanied by an ice jam.

As designed, the structure consisted of one central span of 90 ft. and two side spans of 75 ft. each, all foundations to be on piles. Although the design was submitted by a well-known and responsible concrete bridge company, the County Commissioners decided, with the wisdom born of inexperience, to save money by omitting the piling and carrying the piers and abutments down to a somewhat greater depth than originally contemplated. Beyond furnishing the design, which appears to have been entirely satisfactory with the possible exception of insufficient provision for flood waters, the bridge company had nothing to do with the work, and the County Commissioners for whom the bridge was built had no engineer to advise them or supervise the construction. In spite of this, and to the credit of the contractor, the materials and workmanship were of excellent quality, many of the particles of stone and gravel of the concrete having split instead of being torn out of their place by the collapse.

Upon careful examination of the wreck it was found that the scour actuated by a considerable quantity of lodged drift had undermined the upstream end and one side of one pier, causing it to tip forward and endwise, and resulting in the fall of the two arches which it carried. The other pier being thus left without support to counteract the thrust of the remaining arch, likewise tilted, allowing this span to drop vertically into the river. There was no evidence to point to any other cause of failure than undermined foundations,

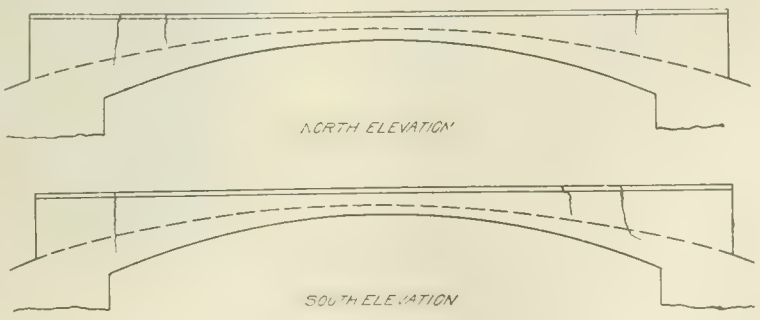


Fig. 5—Sketches Showing Cracked Spandrel Walls.

and the responsibility for this rests with those who altered the original plans and specifications.

Case 9.—The most extensive failure in reinforced-concrete bridge construction of which records are available is that of the City Bridge across the Illinois River at Peoria, Ill. On May 1, 1909, three spans and the two intermediate piers of a six-span arch structure, which had been opened to traffic only a few weeks, collapsed before the supporting centers had been struck. The wrecked spans were each Melan arches 125 ft. in the clear, of 13½ ft. rise, and of the solid spandrel type. Practically all of the earth filling was in place at the time of failure. The two ruined piers were specified to be founded upon piles driven to bed rock, though subsequent investigation showed that probably most of the piles stopped at less stable material. In addition, the piles were to be enclosed by permanent water-tight tongue-and-groove sheet-piling or Wakefield piling to safeguard the pier foundation against scour; but, in spite of repeated warnings on the part of the consulting engineers, this was not done, nor was any protection in the way of riprapping provided by those directly in charge. As a result, during the high water of the spring of 1908, the scour was most serious, in the case of one pier reaching to 3.8 ft. below the base of the pier, or 11 ft. below the original bed of the river.

Since the design and construction of the superstructure was apparently entirely satisfactory, it was, therefore, not difficult to assign the cause of failure. The lateral support and the frictional resistance of the piles under the two piers in question having been largely removed by the excessive scouring action of the water, buckling and considerable settlement would naturally follow. This action was no doubt largely precipitated by a serious settlement and movement in a shoreward direction of one of the abutments, which began a year prior to the collapse of the structure.

Under such circumstances, there is little doubt that the cause of failure was insecurity of foundations.

Case 10.—This is not a case of total or even partial collapse, since the bridge in question has been in constant service since its completion some two years ago. It affords, however, an excellent example of spandrel wall cracking, and as such will be used to illustrate a general discussion of this defect, which, as has already been stated, constitutes failure to a limited degree.

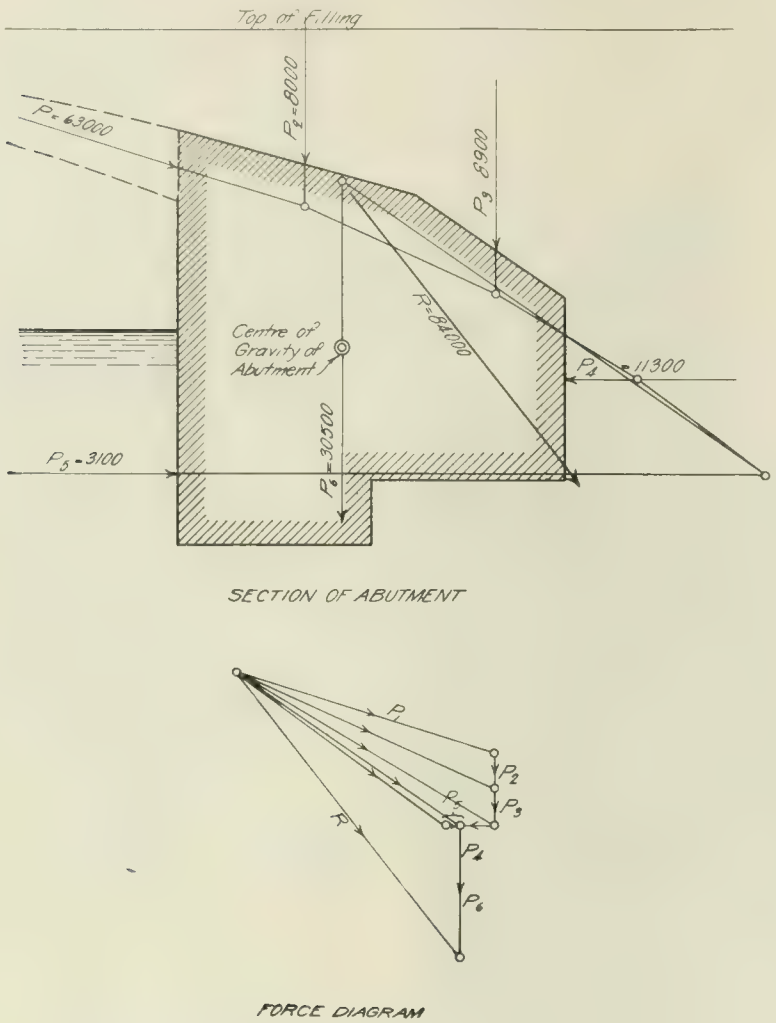


Fig. 7—Diagram Showing Cause of Spandrel Wall Cracks Shown in Fig. 5.

This bridge, having a span of 60 ft. in the clear, a rise of 6 ft. and a crown thickness of 15 ins., developed pronounced cracks in the spandrel walls, as shown by Fig. 5, immediately upon the striking of the centers, although the spandrels are reinforced in the region of the springings by three longitudinal ¾-in. round rods. One of these rods is in the coping and the others are located at distances of 1 ft. and 3 ft. below it. Each of the abutments rests upon a large number of vertical piles driven into quicksand.

The conspicuous character of the cracks is evident from Fig. 6, giving a photographic view of one of them in the southeast spandrel wall. In this case the crack passes well into the ring, although not as far as the one in the southwest spandrel, which reaches practically to the center of the ring, as shown in Fig. 5.

With the object of explaining the existence of these cracks in spite of the longitudinal reinforcement in the spandrels, the writer obtained information concerning the dimensions of the abutments and constructed the diagram shown in Fig. 7. In this diagram the various forces acting upon the east abutment are shown in magnitude, direction, sense and point of application for a vertical longitudinal rib or strip, 1 ft. in thickness. The thrust of the arch P is given for the weight of the arch ring and filling only, since the spandrel cracking occurred without any live load on the span. $P2$ and $P3$ are the weights of the two trapezoidal prisms of filling resting on the abutment; $P4$ represents the lateral pressure of the earth filling acting on the vertical projection of the abutment and tending to force it forward into the stream; $P5$ is the pressure of the water and the saturated material of the stream bed, acting on the face of the abutment, and $P6$ is the weight of a strip of abutment 1 ft. thick reduced for buoyancy of the submerged portion. These various forces, when combined, produce a resultant action, R, on the base of the abutment having a magnitude of 84,000 lbs. and passing altogether outside of the base instead of cutting it near the center, as it should in a properly designed abutment.

With the aid of Fig. 7, the spandrel cracks in this arch are, therefore, not difficult to explain. If the abutment were merely a simple block of masonry acted upon by the forces indicated in the diagram, with no others operating, it would overturn about the lower right hand corner; but, the presence of the spandrel walls with their reinforcement supplies sufficient resisting moment to preserve equilibrium, although not without overstressing them and causing the very pronounced cracks indicated.

Fig. 8—View Showing Typical Breaking Away of Wing Wall.

Apart from the obvious effect of this se-

rious error in the design, it is probable that spandrel cracks would have still occurred, although not to the same extent, as shown in Fig. 5. The abutments, as has been noted, were founded on vertical piles driven into quicksand, and under the thrust of the unusually flat arch lateral yielding of the piles would in all probability have been followed by cracking of the spandrels. The practice of founding arch abutments on piles, none of which are driven on a batter, or where no abutment ties are employed, is in the majority of cases likely to result in unsightly or dangerous cracks.

Spandrel cracks are so often found in concrete arches that their presence cannot always be attributed to badly designed abutments or to yielding foundations. The writer knows of one case where spandrel cracking occurred in an arch the abutments of which were founded upon solid rock and where, it is believed, the design was in general satisfactory. The spandrels, however, contained no longitudinal reinforcement, and the settlement of the crown when the centers were struck had induced sufficient negative bending moment in the spandrels near their junction with the abutments to overcome the tensile strength of the concrete and cause conspicuous cracking. In all probability no such development would have taken place if the spandrel walls had been well reinforced, certainly not with properly designed arch ring and abutments.

The objectionable practice of inserting gas pipe or other metallic hand-rail posts in the spandrels of arches, strongly favors the development of spandrel cracks. Since the temperature of the exposed metal rises more rapidly than that of the concrete under the heat of the sun's rays, the posts expand more rapidly than the concrete and cause cracking of the latter at every post, which apparently increases with time on account of the swelling action of the rust at the surface of the spandrel wall.

Case 11.—The badly cracked wing wall shown in Fig. 8 is typical of a great number of like cases which exist throughout the country. Such a development does not, of course, put the bridge out of commission; but it necessitates the expense of shoring and repairs and at the same time provides a never-failing stimulus for remarks uncomplimentary to engineers. The source of the trouble is generally in bad design, and sometimes in careless workmanship. In this case, the wing wall is about 24 ft. high, 3 ft. thick at the base and 18 ins. at the top, *with no reinforcement whatever.* The workmanship and materials were good and the failure is, therefore, entirely due to the absurd proportions of the wall. A number of cases of cracking of correctly designed wing walls at their junction with abutments are known to the writer, where trouble might have been avoided by a small amount of horizontal reinforcement at the corners.

Conclusion.—Summing up the eleven cases cited, the principal, and therefore primary, causes of failure are found to be as follows:

Causes of Failure.	No. of Cases.
Design of foundation originally defective or rendered defective by alterations not approved by the designing engineers	6
Design of superstructure defective	5
Total	11

It therefore appears that in the cases discussed over one-half of the failures occurred from defective design of foundations. Especially significant is the fact that in the case of the two most extensive failures described, the original designs and specifications for the foundations were satisfactory and that the disastrous results were caused by alterations in the plans, made by persons in authority without professional advice. The time is coming when engineers in self-protection will refuse to allow their plans and specifications to go out and suffer interpretation and alteration by laymen, but will insist upon the same expert attention to the work under construction as in the designer's office.

A feature of the above tabular statement which may occasion some surprise is the fact that in all of the cases considered failure was primarily due to errors in design, either of sub-structure or superstructure, and that the material, except to a limited degree in Case 2, was not in any way responsible for the unfortunate results.

It is perhaps unnecessary to remark that no special selection of cases was made for the purposes of this paper, but every case has been included concerning which reliable data could be obtained in a short space of time. Since these cases are probably typical of most of the failures of concrete bridges, there does not appear to be any ground for the disquieting statements which have been made by interests antagonistic to concrete with the object of discouraging the use of a material in engineering works.

Some Methods of Water-Proofing Concrete Structures with Results from Practice.

There are few classes of work where the waterproofing of concrete structures has elicited more attention than railway work. Practice here is quite as various and fully as unsettled as elsewhere, as is evidenced by a recent report of the committee on masonry of the American Railway Engineering and Maintenance of Way Association. Many useful data are contained in the replies of various railway engineers to the circulars issued by this committee and we present in abstract such of them as seem of most general interest.

The following is extracted from a letter by Mr. Hugo Schmidt, division engineer, Chicago City Railways Co. His deductions are based on experiences in large car barn con-

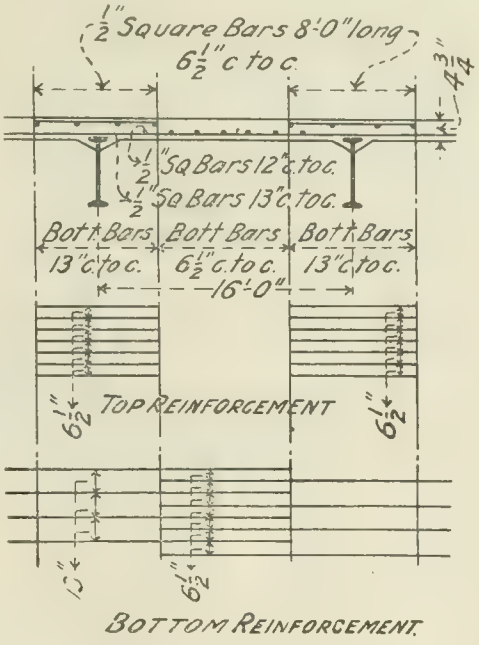


Fig. 1—Original Reinforcement of Car Barn Roof, Chicago City Railways.

struction in the city of Chicago. He says in part, in reference to the waterproofing of the roofs over these barns:

My conclusion is that reinforced concrete roofs for car house purposes can be designed sufficiently waterproof without the use of a waterproof covering. This necessitates a careful proportioning of the steel reinforcement, a distribution of the steel taking care of all the live and dead loads being a solution of only the easier part of the problem. Our design as per Fig. 2, while being an improvement over the work previously done, does not entirely solve the problem. The cost of extra steel required for this purpose should not be as high as the cost of a waterproof covering, and if the workmanship can be carefully supervised, a roof of this kind should require no such maintenance expense as is necessary with all common roof coverings.

The roofs of these buildings were intended only to shed rain water and absolute watertightness was not required, so that as an example of waterproofing methods they are hardly applicable to waterproofing in general. The methods used and results obtained are, however, of interest. Figure 1 shows the design previously used. The buildings constructed after Plan 1 are about three years old. The total roof area is something over 3 acres and is practically watertight. The worst leaks are found at places where down-spout headers are set into the slab. Only two instances were noted where leaks occurred at joints between different days work. This is accounted for by the fact that where possible in all cases joints were made at the centers of spans so that the deflections of the roof slabs would tend to close the joints on top. You will note in Fig. 1 that the top reinforcing bars all stop at the quarter point, also that two of the four bars supporting the top bars are located at the extreme ends of the top bars. A few months after completion it was found that characteristic cracks had developed on the top closely following the ends of the upper reinforcing bars. These cracks were found at about 25 per cent of the rods. Although only a few of these cracks allowed water to come through it was desired to secure a design with a more even distribution of materials near the top surface so as to eliminate as much as possible the effect of cleavage lines.

The newer car houses have roof slabs supported by reinforced concrete girders as shown by Fig. 2. In this case it will be noted that every third reinforcing bar is continuous along the top and the bars supporting the top bars are kept away as far as possible from the ends of the top bars. Although these roofs are only 18 months old it is evident that this is a substantial improvement over the old type. By this method cracks at the ends of the top irons have been almost entirely eliminated (in one car house measuring 265 x 420 ft. there were only two such cracks).

Mr. J. L. Campbell, engineer, maintenance of way, El Paso & Southwestern System, cites the following experiences in the use of waterproofing materials. The structures were four large concrete lined reservoirs carrying 12 ft. of water. They were made by excavation in the surface of the earth sufficient to raise embankments necessary to contain 12 ft. of water plus a margin of 2 ft. The earth so used proved to be unsuitable for reservoir work in that it shrunk and dissolved under the action of water. Consequently a great amount of trouble in the of settlement and cracks in the linings of the first two tanks in particular, in which the concrete was not reinforced, was encountered. Even in the last two reservoirs in which the lining was reinforced with ⅜-in. rods on 12-in. centers in two directions, there was a settlement at one point sufficient to produce small cracks, causing a leakage of 1½ ins. per day. The concrete lining is 4 ins. thick, made from a 1:2:4 mix, and covers approximately 160,000 sq. ft.

The materials used for waterproofing were soap, alum and asphalt. Two ounces of alum to 1 gal. of water and ¾ lb. of castile soap to 1 gal. of water were used, applying two coats of soap and two coats of alum alternately. This treatment rendered the concrete practically waterproof, there being no measurable leakage. As an extra precaution the reservoir linings were covered with as much pure asphalt as the surface would carry after the soap and alum had been applied. Of the results of this procedure Mr. Campbell says: "There is no measurable leakage through concrete waterproofed in this manner." A waterproofing material manufactured by the Elaterite Paint and Mfg. Co. was used on one of the reservoirs in place of asphalt with practically the same results.

The following method described by Mr. R. N. Begien, division engineer, Baltimore & Ohio R. R., is used to protect against rainfall in deck bridges over highways. Concerning the method of waterproofing used the following explanations were given: The material is tarred felt weighing 14 lbs. to 100 sq. ft. and American coal tar pitch; this was laid 6 ins. to the weather and the entire surface of each lap was thoroughly mopped with hot

pitch; after this covering was in place the whole surface was again coated with pitch.

No prediction was ventured as to the effectiveness of this waterproofing, the work having been done only recently. From previous experiences with roofing of this class it was judged that the life would be short owing to

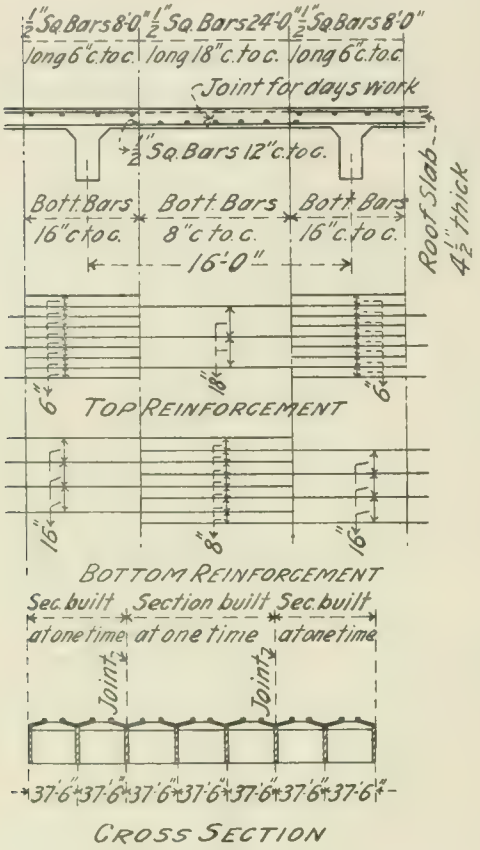

½" Sq. Bars 8'0" long 6" c. to c.
½" Sq. Bars 24'0" long 18" c. to c.
½" Sq. Bars 8'0" long 6" c. to c.
Joint for days work
½" Sq. Bars 12" c. to c.
Bott. Bars 16" c. to c.
Bott. Bars 8" c. to c.
Bott. Bars 16" c. to c.
16'-0"
Roof Slab 4½" thick
TOP REINFORCEMENT
BOTTOM REINFORCEMENT
Sec. built at one time
Section built at one time
Sec. built at one time
Joint
Joint
37'-6" 37'-6" 37'-6" 37'-6" 37'-6" 37'-6" 37'-6"
CROSS SECTION

Fig. 2—Revised Reinforcement of Car Barn Roof, Chicago City Railways.

the rotting of the felt, no matter how protected. From experience on other bridge work the idea was advanced that a finish of a mixture of 1 part cement and 2 of sand thoroughly applied about 1 in. thick will protect metal work and prevent leaks where reinforced concrete has been used, providing always that proper expansion has been allowed.

Some work similar to the above was done by Mr. O. E. Selby, engineer, bridges and structures, Cleveland, Cincinnati, Chicago & St. Louis, R. R. Eight ballasted bridges with waterproofed floors were built over streets in and about Indianapolis in connection with track elevation. In each case the floor was built of transverse I beams covered with a reinforced concrete slab about 4 ins. thick; on top of this was placed the waterproofing, which consisted of four or five layers of wool felt cemented with pitch or asphalt. Coal tar pitch in all cases except two.

Some idea of the effectiveness of this method may be obtained from the following observations taken since the completion. The West Washington St. bridge has been in service about two years and has no leaks whatever. The National Road bridge has five or six places where drops of water come through, mostly over the bents. The Kentucky Ave. bridge has about the same number of leaks similarly located. The Massachusetts Ave. bridge has more leaks than any other because this was the first one done, and details for joining the waterproofing to the girders and stiffners were not as good as those adopted later. Kentucky Ave. bridge, Chicago division, has a number of leaks sufficient to show white on the ironwork. These are the result apparently of the complicated nature of the details in changing from through to deck construction. At Kentucky Ave. there have been some leaks under the ends of the girders and floor, allowing water to run down the face of the abutment. This was not a serious matter, but was corrected later by carrying the waterproofing membrane down over the back of the abutment.

In Fig. 3 is shown the design of a waterproof bridge The plan shown here is being used in railroad bridge work by Mr. Robert Trimble, chief engineer, maintenance of way, Pennsylvania lines west of Pittsburgh. The structure shown (Fig. 4) is a steel trough bridge over the subway at Fifty-fourth place, Chicago. The troughs run parallel with the street and extend from abutments on each side to columns in the middle of the street. The length of the troughs is 27 ft. 3 ins.

The troughs are filled in with concrete to a minimum distance of 2 ins. above the top. The concrete is finished smooth and sloped so as to carry the water out from under the track to gutters along the sides. When possible the water is drained from the center toward both ends by putting in a summit. When this cannot be done the water is all carried to one end of the bridge. On top of this concrete floor five layers of Hydrex felt are placed; each layer overlaps the next by four-fifths the width of the felt. Each course is swabbed with swabbing material furnished by the Hydrex company, excepting the bottom layer; no attempt is made to furnish a bond between the concrete and the waterproofing material. The felt extends over both ends of the bridge and well down over the abutments. The felt is protected by a layer of concrete 2 ins. thick, the top surface of which is finished smooth.

This method is credited with giving the best results of any tried. The bridge is practically watertight, only two small leaks having occurred. These are near a column and along a girder. Bridges which have no columns are giving the best results, as the most trouble is experienced with cracks forming over the columns.

Some interesting observations on the use of waterproofing materials and the use of steel reinforcement in securing waterproof concrete structures were made by Mr. Chas. M. Mills. Basing his opinions on tests made by himself and from observations of the results of methods used on work, also in view of trials made with waterproofing materials compounded with concrete in mixing he advanced the conclusion that it is better to build a structure waterproof in itself than to build one and try to make it waterproof afterwards; that the elimination of the permanence of extraneous waterproof materials is very desirable, and the expense of securing a proper concrete mixture and of the necessary longitudinal reinforcement to give desired results is less than that of applying waterproofing.

The following description of methods used on the Market St. subway, Philadelphia, built by Mr. Mills, was given. The structure has walls of reinforced concrete, floors of concrete reinforced when necessary, and roofs either of reinforced concrete, concrete jack arches on steel beams, or reinforced concrete slabs on steel beams. Notwithstanding the fact that the ground water is tapped and pumped into sewers, the structure was designed to be waterproof, one reason being that at the time it was thought that the ground water might exceed the quantity that could be economically handled and that the drains would have to be closed. Where the backfilling contained clayey material the walls are under head, especially after heavy or protracted storms. Certain deep parts of the structure are under head permanently, being below the drains.

After observing the results obtained in the early part of the work, the use of waterproofing materials was stopped on all parts of the building except the roof. Reliance for water tightness was then placed on longitudinal steel rod reinforcement aided by making the concrete with a graded aggregate having an appreciable amount of fine material mixed wet and well spaded around the forms.

Three-fourths of 1 per cent of deformed steel bars was used on the latter part of the work with satisfactory results, since there is no leakage except in a few spots where bad joints were made in the walls, or where the work was otherwise defective. No expansion joints were made in the walls, and this quantity of longitudinal reinforcement distributed the shrinkage due to hardening and the contraction due to falling temperature, so the cracks are usually less than 1/100 in. wide, as found by measurement, and average about 40 ft. apart on typical wall. The cracks show a line of incrusted salts frequently, left by the evaporation of in-filtering water originally, and many are entirely clean. All are dry and have not at any time leaked in the usual sense of the word. Clay or silt has been carried in from the exterior and choked the fissures. A large increase in the percentage of longitudinal reinforcement could have been made and still have kept well within the cost of waterproofing, which involves expensive details and labor, in addition to the cost of waterproofing materials themselves and the direct application. A moderate increase in the percentage would reduce the fissures so that they would be scarcely visible, with corresponding increase in efficiency in water exclusion.

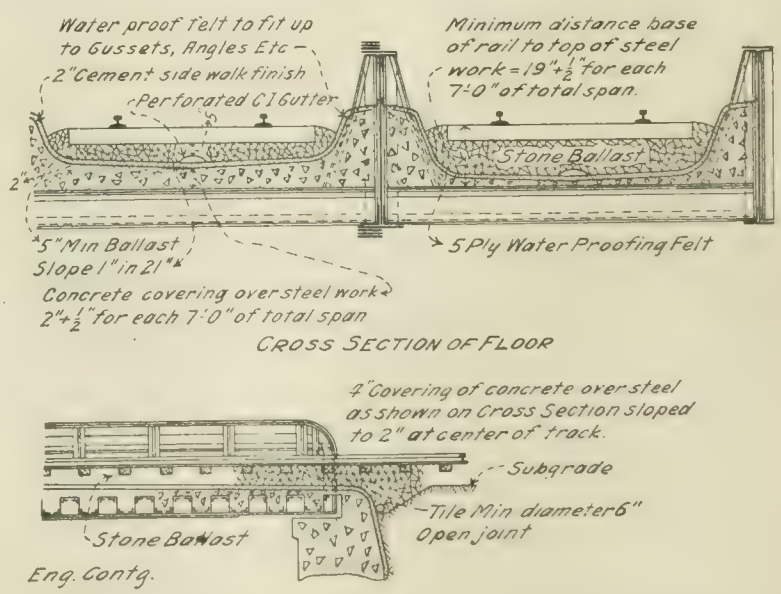

Water proof felt to fit up to Gussets, Angles Etc —
2" Cement side walk finish
Perforated C I Gutter
Minimum distance base of rail to top of steel work = 19" + ½" for each 7'-0" of total span.
Stone Ballast
2"
5" Min Ballast Slope 1" in 21"
5 Ply Water Proofing Felt
Concrete covering over steel work 2" + ½" for each 7'-0" of total span
CROSS SECTION OF FLOOR
4" Covering of concrete over steel as shown on Cross Section sloped to 2" at center of track.
Subgrade
Tile Min diameter 6" Open joint
Stone Ballast
Eng. Contg.

Fig. 3—Method of Waterproofing Bridge Floors, Pennsylvania Lines West of Pittsburg

All the roofs were waterproofed with rock asphalt mastic placed in two layers, each layer 1½ ins. thick. The results have been found satisfactory after five years' service on the part of the work finished first. When the roof consisted of jack arches on steel beams, steel mesh or small steel rods were used to prevent fissures between the webs of the beams and the concrete, and the precaution was taken throughout the structure where waterproofing was used to prevent cracks by the insertion of

longitudinal reinforcement, to assist in maintaining the integrity of the waterproofing envelope. The waterproofing might have been omitted on the roof provided the percentage of longitudinal reinforcement had been increased and assurance felt that the quantity of the concrete work could be kept to a high standard, which it was impracticable to do under the difficult conditions under which it was placed, and further provided that sufficient grade were given the roof for drainage. The grade used on this roof was about 1½ per cent.

Originally it was intended to waterproof all of the sidewalls and in the early stages of the work some waterproofing was applied. This consisted of three coats of a residuum from the refining of petroleum with two intervening layers of burlap or muslin. The waterproofing penetrated and partly saturated the burlap or muslin, so that the resulting envelope was a solid mass. Layers of asphalt and felt were not used for several reasons; one reason was that the source of leaks when they occur is hard to locate, since the leakage flows along the laminations of the envelope, more or less separation of the layers being unavoidable even with the utmost care in placing them. Another reason was the decay of such materials on other work after relatively short periods of exposure, the decay hastened by the gas liquors and other matter with which water under city streets is charged. The permanence of the materials which were used has not been ascertained, though indications point to failure. No trouble from leakage has occurred where they were used, this result perhaps being due in part to the logitudinal reinforcement placed in the walls, about one-half of 3/10 per cent.

Mr. A. M. Kinsman, chief engineer, Baltimore & Ohio R. R., has written a letter containing along with other matter a description of methods used in waterproofing cellar walls constructed in very wet ground. A small hand pump was necessary to keep the water down while the walls were in the course of construction. On the third day the forms were removed and Young's compound applied, the water in the cellar having been lowered to come up around the concrete. It was found that this method was not successful in keeping out the water. A pump was then installed and the water again lowered, an additional thickness of 3 ins. of concrete added to the 10-in. wall on each side making the total thickness 16 ins.; the compound again applied was again a failure, the pumps being unable to keep the water away from the concrete while setting. A well was then dug outside of the cellar walls with a view to reducing the external pressure. The walls were then recoated with 2 ins. of Winslow's compound, the pressure kept away from the walls while hardening and allowed to dry thoroughly; the pump then being stopped, the water ran to its usual level outside the walls and the method proved effective, as the cellar has been dry for the past 18 months.

Cost of Pumping.—The total amount of water pumped at the Harrisburg, Pa., waterworks in 1909 was 3,658,533,150 gals., and the cost of pumping was as follows:

Items.	Per mil. gals.
Coal	$1.38
Supplies	0.36
Repairs	0.31
Oil and waste	0.20
Reservoir	0.43
Labor	1.83
Total per million gallons	$4.51

Cost of Maintaining Water Mains.—The city of Harrisburg, Pa., had in 1909, 67 miles and 1,147 ft. or say 67.22 miles of water mains. The cost for the year to keep these mains in repair, change them to new grades when necessary, change hydrants and look after 9,000 meters was as follows:

Horses and wagons	$ 528.47
Supplies	443.23
Materials and repairs	1,749.44
Salaries	4,907.50
Total	$7,628.64

This is at a rate of $113.48 per mile.

Roads and Streets Section

Note: This section is devoted to methods and costs of road and street construction. It will cover road building in all its details, the construction of pavements, sidewalks and gutters, the testing and use of paving materials and the machinery and tools used in road building and paving.

Tables Showing the Amounts and Average Price of Brick, Asphalt and Creosoted Wood Block Pavements Laid in 1909 in a Number of Representative American Cities.

The accompanying tables, pages 337, 338 and 339, show the amount, average price and some details of brick, asphalt and creosoted wood block pavements laid in 1909 in a number of American cities. On our April 5 issue corresponding tables were given containing similar data on stone block pavement, bitulithic and macadam. Tables were also given in the April 6 issue on pages 320 and 323 showing the prevailing local prices for materials and the cost of labor in the cities in which the paving work was done.

TABLE SHOWING AMOUNT AND AVERAGE PRICE OF BRICK PAVEMENT LAID IN 1909 IN A NUMBER OF REPRESENTATIVE AMERICAN CITIES.

	Sq. yds.	Kind of filler.	Depth of sand cushion. Ins.	Av. price per sq. yd. including base and grading.	Guarantee, years.	Price per cu. yd. for grading if paid separately.	Portland cement concrete base. Total thickness pavement. Ins	Thickness. Ins.	Proportion.
Akron, O.	103,137	Tar	[2]	$1.37*[1]	..	$0.22	..	6	1-3-8
Altoona, Pa.	76,708	Grout	1½	2.26	5[2]	....	11	6	1-3-8
Albany, N. Y.	56,816	Cement grout	1½	2.04	5	....	11½	6	1-3-6
Aurora, Ill.	24,750	Sarco[3]	2	1.74	1½	....	12[4]	6[5]	1-7[6]
Battle Creek, Mich.	13,676	Cement	1½	1.38	..	....	10½	5	1-8[7]
Bay City, Mich.	38,562	Asphalt[8]	1½	1.70	5	....	10½[9]	5[10]	1-3-5
Beaumont, Tex.	6,952	Asphalt[11]	2	2.25[12]	..	....	10	6	1-3-6
Binghamton, N. Y.	12,748	Cement	1½	1.80	0	....	11½	6	1-2-5-6
Bloomington, Ill.	4,348[13]	Sand	2	1.60	10	....	10	4	1-3-5
Buffalo, N. Y.	14,719	Cement grout	1	3.17	10	....	11	6	1-10
Butte, Mont.	20,959	Cement	2	3.75	14	....	12	6	1-3-5
Cairo, Ill.	46,172	Asphalt	2	1.98*	2	.25	11	5	1-3-6
Canton, O.	43,740	Tar[14]	2	1.60[15]	1	....	12[16]	6	1-2-4
Cedar Rapids, Ia.	110,060	Sand	2	1.53½*	5	.29½	10	4	1-3-5
Charleston, S. C.	21,637	Sand	2	1.44	5	....	..	..	.....
Charlotte, N. C.	3,000	Cement grout	1	2.70	..	....	..	..	.....
Cleveland, O.	343,786	Cement	2	1.56[17]	3	.35	..	6	1-3-6
Columbus, O.	245,256	Pitch	1	1.54*	5	.40	11	6	1-4-8
Council Bluffs, Ia.	7,017	.....	..	2.07½	1	....	11	5[18]	1-3-5
Covington, Ky.	10,659	Cement grout	1½	1.69	5	.23	12	6½	1-2½-5
Cumberland, Md.	8,700[19]	Sand	2	....	0	....	..	..	.....
Davenport, Ia.	69,063	Sand	2	1.55*	2	.38	11	5	1-3-6
Dayton, O.	8,220	.....	..	1.51	..	....	..	..	.....
Decatur, Ill.	39,221	Asphalt	2	1.80	5	.35	10[20]	4[21]	1-4-3
Detroit, Mich.	5,183	Grout	1½	2.54	3	.30	11½	[illegible]	1-3-6
Dubuque, Ia.	1,439	Sand	2	1.75	1	.30	12	[illegible]	1-3-7
East Liverpool, O.	24,407	Sand	2	.99	1	.35	14	..	.....
Easton, Pa.	319	Sand[22]	2	1.33[23]	5	....	12	6	1-3-6
East St. Louis, Ill.	25,110	Cement	[illegible]	1.52*	1	.20	12	6	1-3-6
Elgin, Ill.	27,985	Sand	2	1.65	5	....	11	5	1-3-6
Elizabeth, N. J.	12,430	Grout	2	2.36	5	....	11½	6	1-3-6
Elmira, N. Y.	20,078	Cement	2	2.12	5	....	..	6	1-3-7
Erie, Pa.	13,070	Asphalt	1½	1.60	..	....	..	..	.....
Evanston, Ill.	16,415	Sand	1½	1.75*	2	.20	10¾	5	1-3-7
Everett, Mass.	2,850	Cement	2	3.35	..	....	11	5	1-3-5
Fort Dodge, Ia.	6,625[24]	Pitch	1	2.14	5	.35[25]	10	5	1-2-4
Fort Smith, Ark.	100,000[26]	Sand	4	.81¾	..	....	..	..	.....
Fort Wayne, Ind.	5,107	Cement[26]	2	....	5	.40	12	6	1-3-6
Freeport, Ill.	45,000	Sand	2	1.29*	..[27]	.25	12[28]	..	.....
Grand Rapids, Mich.	59,856	Cement	1½	1.74⅔*	5	.22⅔	11½	6	1-3½-7
Harrisburg, Pa.	8,652	Cement	1[29]	1.99	5	....	11	6	1-3-8
Helena, Mont.	867	Grout	2	2.75	..	....	..	4	1-3-6
Hoboken, N. J.	2,180	Cement grout	1½	2.60	5	....	..	5	1-3-6
Indianapolis, Ind.	76,406	Cement	2	2.00*	9	.30	..	6	1-3-5
Jacksonville, Fla.	80,000[30]	.....	..	1.45	..	....	..	..	.....
Kansas City, Mo.	16,531	Cement grout	..	1.58*	5[31]	....	..	6[32]	1-3-7
Keokuk, Ia.	2,550	Sand	2	1.50*	1	.46	12[33]	..	.....
Kingston, N. Y.	35,671	Cement	2	2.40	5	....	..	6[33]	1-2-5
Knoxville, Tenn.	8,568	Cement grout	2	1.95*	5	.50[34]	..	4[35]	1-3-6
LaCrosse, Wis.	7,218	Sarco	2	2.41	..	....	12	6[36]	1-2½-5
Lawrence, Kan.	54,000	Cement grout[37]	1½	1.30*	1[38]	.35	9	4	1-3½-7
Leavenworth, Kan.	51,625	Grout	1½	1.49*	5	.37	9½	4[39]	1-3-6
Lincoln, Neb.	20,360	Sand[40]	2	1.95	1[41]	.40[42]	11	5	1-3-6
Little Rock, Ark.	80,000	Concrete	2	2.00*	5	.45	..	5	1-3-6
Marion, Ind.	11,838	Sand	1½	1.66	1	....	14	..	.....
Meridian, Miss.	8,836	Grout	1	2.13	5	....	10	5	1-3-5
Minneapolis, Minn.	8,078	Pitch	1	2.21[43]	..	....	10	5	1-3-6
New Albany, Ind.	19,504	Sarco	1	....	5	....	10	5	1-3-6
Newark, N. J.	62,631	Cement	1½	2.20	..	....	10	6	.....
New Castle, Pa.	.....	Cement	1½	1.35*	5	.40	11½	6	1-3-8
Norristown, Pa.	3,912[44]	Cement grout	1½	2.10	..	....	10½	4½	1-2½-6
Ottawa, Ill.	41,010[45]	Sand	2	1.55	0	....	..	..	.....
Passaic, N. J.	911	Cement grout	2	2.74	1	....	10	4	1-3-5
Pensacola, Fla.	80,000	Sand	1	1.97	5	....	10	5	1-3-5
Peoria, Ill.	40,000[46]	Sand	1	1.02*	1	.33⅓	10	..	.....
Pittsburg, Pa.	43,248	Asphaltic c'm't	1	1.84*	5	.42 4/5	11	6	1-3-6
Pittsburg, Pa.	6,934[47]	Asphaltic c'm't	1	1.65 4/5	5	....	11	6	1-3-6
Port Huron, Mich.	11,050[48]	Cement	2	1.03*	5	.15	..	..	.....
Portland, Me.	640	Cement	2	3.18	..	....	..	5	1-3-8
Providence, R. I.	451	Grout	1	....	..	....	10½	6	1-3-6
Racine, Wis.	30,775	Asphalt	1	1.93	0	....	10	5	1-3-5
Reading, Pa.	1,100	Grout	1	1.98	1	....	9	4	1-3-6
Rochester, N. Y.	53,000	Cement grout	1	1.75	10	....	11	6	1-3-6
Rockford, Ill.	8,532	Asphalt	1½	1.75*	5	.20	.	5	1-3-6
Rockford, Ill.	62,949	Asphalt	1½	1.86 3/5	5	.40	..	..	.....
Rock Island, Ill.	21,600	Sand	2	1.62	..	.40[50]	11	5	1-3-5
Saginaw, Mich.	25,939	Cement	1	1.54*	0	.35	11	6	1-3-5
Scranton, Pa.	6,967	Cement	2	2.19⅔	5	....	12	6	1-3-7
Seattle, Wash.	75,513	Cement grout	1	2.70*	..	.55	11	6[51]	1-4-7

Selma, Ala.	30,000	Sand	2	1.97	..	....	11	5	1-3-6
Sheboygan, Wis.	6,621	Cement	1½	2.05	6	....	12	6	1-3-5
Sioux City, Ia.	49,690	Sand	1	2.08	..	....	..	4	1-3-6
South Bend, Ind.	799[62]	Cement	1	1.36*	..	.35	11	..	.....
South Omaha, Neb.	21,510	Sand	1½	1.98*	1	.18	10½	5	1-3-6
Spokane, Wash.	.....	Sand	1	3.10	..	....	..	5	1-3-6
Springfield, Ill.	63,875	Asphalt	1	1.50	5	....	11	6	1-3-5[53]
Springfield, Mo.	13,789[64]	Asphalt	..	2.31¾	..	....	..	5	1-3-7
St. Louis, Mo.	161,135	Grout	2	1.75*	5	....	11	6	1-4-7
Syracuse, N. Y.	20,925	Cement	1	2.22	10	....	10	6	1-3-6
Tacoma, Wash.	19,206	.....	..	2.91	..	....	11	5	1-3-6
Topeka, Kan.	90,714	Asphalt[55]	5	1.39*	..	.33	12[56]	..	.....
Toledo, O.	66,961	Grout[57]	1½	1.70*[58]	5	.40	..	6	1-4-6
Troy, N. Y.	10,863	Cement grout	1	2.28	5	....	..	..	.....
Utica, N. Y.	2,316	Grout	1	....	5	....	10	5	1-3-7
Valparaiso, Ind.	16,562	Sand	2	1.31	2	....	12[59]	..	.....
Vicksburg, Miss.	3,405	Grout	1	2.18*	5	.45	..	6	1-3-7
Watertown, N. Y.	4,400	Cement grout	2	1.65	5	....	..	..	.....
Wheeling, W. Va.	49,348	Sand	1½	1.18	5	....	..	..	.....
Wilkesbarre, Pa.	21,915	Cement	2	2.14	5	.50	12	6	1-2-5
Woonsocket, R. I.	416[60]	.....	..	2.50	..	....	..	5	1-3-6
Worcester, Mass.	1,675	Cement	1	2.87	0	....	10	5	1-3-6
Youngstown, O.	136,905	Grout	1½	....	..	....	9½	..	.....
Zanesville, O.	13,134	Sand	2	.90	1	.25	12	..	.....

*Does not include grading.

[1]$1.05 to $1.10 on 12-in. sand base; $1.37 on concrete base. [2]Optional with city to be extended for another five years. [3]Sarco and cement. [4]11-in. and 12-in. [5]6-in. on business streets, 5-in. on residence streets. [6]1-7 bang gravel. [7]Gravel. [8]Asphalt and cement. [9]10½ and 11½. [10]5-in. on residence streets, 6-in. on business streets. [11]Also cement 1 to 1. [12]Laid by city. [13]Also 14,504 sq. yds. using asphalt filler. [14]Tar and asphalt. [15]$1.60 on concrete base, $1.20 on gravel base. [16]14-in. thick when gravel base is used. [17]$1.56 on 6-in. concrete base, $1.20 to $1.40 on other bases. [18]4-in. or 5-in. base. [19]On 9-in. stone base. [20]10-in. and 11-in. [21]4-in. and 5-in. [22]Cement grout, also sand. [23]Repaving. [24]Brick blocks. [25]Extra grading. [26]All brick used were made in Fort Smith; they were laid in a single course on a sand base. Some were laid on brick laid flat. [26]Sand, cement and tar. [27]Guarantee until final acceptance by city. [28]Brick laid on 6-in. stone foundation. [29]1-in. to 2-in. [30]Laid on sand base. [31]5 to 7 year guarantee; 5-in. to 6-in. concrete base. [32]6-in. crushed stone, 2-in. sand, 4-in. brick. [33]Natural cement used for concrete base. [34]$0.50 per cu. yd. for earth, $0.55 per cu. yd. for loose rock and $3.50 per cu. yd. for solid rock. [35]With 6-in. concrete base the price per sq. yd. was $2.08. [36]Natural cement used for concrete base. [37]Cement grout and sand. [38]5 per cent of payment retained for 1 year. [39]6-in. Natural cement 1-2-5 concrete base also used. [40]Some pitch filler was also used; price per sq. yd. given is for sand filler. [41]1 and 2 years. [42]Extra excavation above curb; price for paving includes grading below curb top. [43]By day labor. [44]Block. [45]Laid on gravel 5-in. thick after rolling with 12½-ton roller. [46]Laid on 5-in. bank gravel base. [47]Repaving. [48]Removing old cedar blocks and repaving with brick on old 6-in. concrete base. [49]Laid on 6-in. macadam base. [50]40 cts. per cu. yd. for all grading over 12-in. Price per sq. yd. includes grading to 12-in. [51]Also laid in 5-in. concrete base. [52]Laid on gravel base. [53]1-3-5 for stone aggregate; 1-6 for gravel aggregate. [54]In addition 1,857 sq. yds. of brick was laid on 5-in. concrete base using asphalt filler, at $2.24 per sq. yd.; 1,427 sq. yds. were laid on 5-in. concrete base using sand filler, at $2.06 per sq. yd., and 2,221 sq. yds. were laid on 5-in. concrete base using cement filler, at $2.09½ per sq. yd. [55]Asphalt; also sand. [56]Consists of two courses of brick, the bottom course being grouted. [57]Grout or sand. [58]$1.40 per sq. yd. on 8-in. macadam foundation. [59]Includes 6-in. macadam base. The material from the old macadam streets was used for foundation, but required regrading of entire street as well as crushing of old cobble stones in gutters. [60]Laid on a bridge.

TABLE SHOWING AMOUNT AND AVERAGE PRICE OF ASPHALT PAVEMENT LAID IN 1909 IN A NUMBER OF REPRESENTATIVE AMERICAN CITIES.

	Sq yds.	Portland cement, concrete base. Thickness binder, ins.	Thickness surface, ins.	Av. price per sq. yd. including grading.	Guarantee, years.	Price per cu. yd. for grading if paid separately.	Thickness, ins.	Proportions.
Albany, N. Y.	2,863	1	1½	$2.35[1]	5	.....	5	1-7[2]
Aurora, Ill.	32,800	1½	1½	1.70	5	.....	5	1-3-5
Bay City, Mich.	45,495	1	1½	1.85	5	.....	6	1-10
Buffalo, N. Y.	51,805	1½	2	3.52[3]	10	.....	4	1-2-5
Camden, N. J.	10,226	1	1½	1.69	5	.....	6	1-3-6
Cleveland, O.	9,832	1	[4]	2.03	10	$0.40	6	1-4-8
Columbus, O.	26,205	1	[4]	1.85*	10	.40	6	1-3-6
Davenport, Ia.	43,457	1½	1½	1.85*	7	.38	5	1-3-6
Detroit, Mich.	20,247	1½	[4]	2.59	..[4]	.30	6	1-3-6
Elgin, Ill.	3,679	1	1½	2.10	5	.....	5	1-3-6
Erie, Pa.	84,920	1½	1½	1.49	5	.....	5	1-3-8[5]
Hamilton, O.	33,862	1	1½	1.96	5	.....	6	1-3-7
Harrisburg, Pa.	54,765	1	2	1.80	5	.....	6	1-3-8
Hartford, Conn.	22,875	1½	1½	2.70*	5	.67	6	1-3-6
Hoboken, N. J.	604	1	[4]	1.66[6]	5	.....	.	.....
Indianapolis, Ind.	60,667	1	[4]	2.00*	9	.30	6	1-3-5
Kansas City, Mo.	202,971	1½	1½	1.80*[7]	10	.....	5	1-3-7
Knoxville, Tenn.	.....	1	1½	1.67*[8]	5	.50[9]	4	1-3-6
Little Rock, Ark.	20,000	1½	1½	2.20*	5	.45	5	1-3-6
Newark, N. J.	2,775	1½	[4]	2.04	..	.....	6	.....
Ogden, Utah	36,323	1½	1½	2.40	1	.70	6	1-3-6
Pittsburg, Pa.	18,634[10]	1	[4]	2.53*	5	.....	6	1-3-6
Pittsburg, Pa.	49,283	1	[4]	2.31	5	.73	6	1-3-6
Portland, Ore.	6.4[11]	1	[4]	2.10*	10	.30[12]	5	1-3-6
Racine, Wis.	20,680	1	[4]	1.83	5	.....	5	1-3-5
Rochester, N. Y.	100,000	1	[4]	1.85	10	.....	6	1-3-6
Rockford, Ill.	25,879	1	[4]	1.98*[13]	10	.23	6	1-3-6
Saginaw, Mich.	33,900	1	1½	1.68*	5	.35	6	1-3-5
Salt Lake City, Utah.	105,377	1½	[4]	2.35*	5	.80	6	1-3-6
San Jose, Cal.	35,788	.	[4]	1.53	.	.....	6	1-3-6
Scranton, Pa.	76,728	1	[4]	2.17	5	.....	6	1-3-7
Seattle, Wash.	416,416	1	[4]	1.76*	5[14]	.55	4	1-4-7
Selma, Ala.	11,000	½	[4]	2.25	5	.....	5[15]	1-3-6
Sioux City, Ia.	17,230	1	1½	2.05	.	.....	4	1-3-6
South Bend, Ind.	7,455	1½	1½	1.67*	5	.35	5	1-8
South Omaha, Neb.	5,925	1	1½	1.89*	5	.20	4	1-3-6
Spokane, Wash.	.....	1	[4]	2.50	10	.....	5	1-3-6
Springfield, Ill.	5,563	1	1½	1.80	5	.....	6	1-3-5
St. Louis, Mo.	107,616	1½	1½	2.00*[16]	5	.....	5	1-4-7
Syracuse, N. Y.	45,507	1	1½	2.20	10	.....	6	1-3-6
Tacoma, Wash.	167,887	1½	[4]	2.06	.	.....	5	1-3-6
Toledo, O.	4,167	1	[4]	1.89*	5	.40	6	1-4-6
Trenton, N. J.	22,247	1	[4]	1.98	5	.....	4	1-3-6
Utica, N. Y.	36,420	1	[4]	1.95	5	.....	5	1-3-7
Washington, D. C.	65,000	1½	1½	1.69*[17]	5	45[18]	6	1-3-7
Wilkesbarre, Pa.	7,616	2	1	2.04	10	.50[20]	6	1-2-5

*Does not include grading.

[1]Old foundation used. [2]Bank gravel. [3]Price includes curbs, tile drains, grading and all work complete. [4]City plant. [5]Washed gravel. [6]On Belgiam block base. [7]Does not include grading. [8]$1.67 on 4-in. concrete base, $1.78 on 5-in. concrete base, $1.87 on 6-in. concrete base. [9]$0.50 per cu. yd. for earth excavation, $0.55 for loose rock and $3.50 for solid rock. [10]Repaving. [11]6.4 miles of roadway. [12]30 cts. to 75 cts. [13]$1.58 per sq. yd. for asphalt, $0.40 for 6-in. concrete base and $0.27½ for 3-in. concrete base. [14]5 and 10 years. [15]Both Portland and Natural cement concrete. [16]Does not include grading. [17]$1.46 to $1.69. [18]Earth excavation, 45 cts. per cu. yd.; old macadam excavation, 55 cts. per cu. yd. [20]Extra grading: price per sq. yd. includes grading to sub-grade.

Experimental Work of the New York State Highway Commission in 1909 with Glutrin, and with Resurfacing with Bituminous Macadam and Asphalt Macadam.

During the past year the Bureau of Repairs and Maintenance of the New York State Highway Commission has done a considerable amount of experimental road construction work, in an effort to develop economical forms and methods of construction which would be suited to various weights and classes of traffic. Several highways were selected and experimental forms of resurfacing and uses of materials were carried out under the direction of the county road superintendent in order to obtain accurate data as to the cost and effectiveness of such treatment. This experimental work is described in the recently issued report of the New York State Highway Commission, and the following notes have been taken from the report:

ROAD TREATMENT WITH GLUTRIN.

Road No. 651, Clinton county, which runs from Keesville to Clintonville, gave considerable trouble in the spring and early summer months by raveling. There was also a great deal of complaint about the dust. The road was constructed of a local limestone in the season of 1908. The Robson Process Co.'s plant was situated at Ausable Forks, about six miles west of the end of road No. 651, and inasmuch as they were anxious to demonstrate what their product would do, arrangements were made with the company to treat this road with glutrin. Previous to this treatment the Robson Co. had treated about a mile of road immediately to the west of road No. 651 with their product and it had proved fairly successful in preserving the road from ravel and in laying the dust. The total length of road No. 651 treated with glutrin was 5.58 miles. The number of gallons used was 10,187 and the cost of the treatment to the state was $1,293.75, or $230 per mile. The material was applied by sprinklers much in the same manner as oil is applied. The results have proven satisfactory. Since the application of the glutrin the road surface has hardened and there is very little, if any, indication of the ravel which was so noticeable and troublesome before. The road is not absolutely dustless, but the dust nuisance is very materially reduced. The road has a very fine appearance, showing no discoloration, but retaining the original color of the stone. It is proposed to treat this road with glutrin again this year in order to thoroughly try out the merits of the product and to obtain more accurate data as to the cost of applying.

RESURFACING WITH BITUMINOUS MACADAM BY THE PENETRATION METHOD AND MIXING METHOD.

In the early part of the season of 1909 the State Highway Commission decided to construct two pieces of asphalt macadam for experimental purposes in Oneida county on two of the principal highways leading out of the city of Utica. The roads selected for this experimental work were the Utica-Paris road No. 71, extending southeast from the city of Utica through the town of New Hartford to the town of Paris, and the Deerfield road No. 3, extending easterly from Deerfield Corners, in the town of Deerfield, to the Herkimer county line.

These are two of the most important thoroughfares in Oneida county, being subjected to a great amount of heavy traffic, including automobiles and motor trucks.

The work was performed by the Barber Asphalt Paving Co., using syenite stone from the quarries at Little Falls, N. Y., and Genasco road cement, a Barber Asphalt Paving Co. product.

Utica-Paris Road No. 71—The method used on this road is what is known as the penetration method. A section of the original macadam on this road, 2,177.5 ft. in length and 12 ft. wide, was resurfaced to a depth of 3 ins. The width of the original macadam on this

TABLE SHOWING AMOUNT AND AVERAGE PRICE OF CREOSOTED WOOD BLOCK PAVEMENT LAID IN 1909 IN A NUMBER OF REPRESENTATIVE AMERICAN CITIES.

	Sq. yds.	Kind of filler.	Av. price per sq. yd. including grading.	Guarantee years.	Price per cu. yd. for grading if paid separately.	Total thickness by pavement. Ins.	Portland cement for concrete base. Thickness. Ins.	Proportion.
Clinton, Ia.	4,000	Pitch	$2.00*	1	$0.40	9	5	1-6[1]
Detroit, Mich.	2,783	Sand	3.40	5	.30	11	..	1-3-6
Easton, Pa.	4,683	Cement grout	2.22[2]	5	....	10½	6	1-3-6
Fort Dodge, Ia.	12,500	Pitch	2.43¾	5	....	9[3]	5	1-2-4
Grand Rapids, Mich.	1,709	Pitch	2.40*	5	.39	11	6	1-3½-7
Hoboken, N. J.	2,600	Sand	3.52	5	.50	..	6	1-3-6
Holyoke, Mass.	1,420	Sand[4]	2.78	..	....	8	3½	1-3-5
Indianapolis, Ind.	8,733	Asphalt	2.55*	9	.30	..	6	1-3-5
Kansas City, Mo.	390	Pitch	2.69*[5]	10	....	10	5	1-3-7
Madison, Wis.	6,800[6]	.....	2.80*	0	....	10	5	1-3-5
Meridian, Miss.	18,635	Sand	2.28	5	....	9½	3½	1-3-5
Minneapolis, Minn.	143,338[7]	Pitch	2.58	..	....	10	5	1-3-6
Newark, N. J.	4,518	.....	3.20	..	....	9½	6	.....
Pensacola, Fla.	80,000	Sand	2.22	5	....	9½	5	1-3-6
Pine Bluff, Ark.	32,000	Sand	2.20	5	....	9	5	1-3-5
Sioux City, Ia.	13,400	Pitch	2.88	..	....	8	4	1-3-6
Springfield, Mass.	12,431	.....	3.31	5	....	9	5	1-3-6
St. Louis, Mo.	6,516[8]	Sand	2.75*	5	....	11	6	1-4-7
Toledo, O.	3,366	Sand	2.48*	5	.40	..	6	1-4-6

*Does not include grading.
[1]1-6 gravel. [2]Repaving. [3]3-in. blocks. [4]Expansion joint along curbs. [5]Does not include replacement of foundation. [6]1910 contract. [7]Laid by day labor. [8]Blocks treated with 20 lbs. creosoted oil per cu. ft. timber.

road was 16 ft. The road has been resurfaced at different times since its construction, so that there was from 4 to 5 ins. resurfacing from 8 to 10 ft. wide, on top of the original macadam. This necessitated the removal of from 7 to 8 ins. of macadam at the center to 3 ins. at the edge to bring the new section to avoid a high crown. The new section being only 12 ft. wide, a shoulder was left of old macadam 2 ft. wide on either side of the new section. The percentage of grade, maximum, for a length of 500 ft. was 3.26 per cent; the minimum per centage of grade for 667 ft. was .5 per cent. The percentage of grade for the mean length of 2,177.5 ft. was 1.71 per cent. The maximum crown was 6 ins. and the minimum crown was 4 ins. Construction work was started Aug. 27 and completed Sept. 22.

A 10-ton roller with spikes on the rear rollers was used to loosen the old macadam so that it would be easily shoveled into wagons and removed from the work. After the removal of the top course of old macadam the bottom course was found intact, approaching concrete in its solidity. Upon the old bottom course was spread a 4-in. layer of 1½-in. stone, which was rolled with a 10-ton roller until compressed to 3 ins. This course was then poured with Genasco road cement, using about 2 gals. per square yard of surface; this amount was sufficient to coat all exposed surfaces of the stone. About ½ in. of dry, screened grit was immediately spread over the surface and rolled with a 5-ton tandem roller. After this surface was well rolled all the loose grit was swept to the sides and the squegee course applied. This squegee course consisted of pouring about ½ gal. of Genasco road cement to each square yard of surface and well broomed in, after which the grit which had previously been swept to the sides of the road was swept back on the road surface to a thickness of about ½ in. and thoroughly rolled with both the 5 and 10 ton roller. After this course was completed, the road, which had been entirely closed to traffic during the work, was opened to the public. The tendency of the traffic was to grind the grit into the squegee course, forming a smooth, elastic surface resembling in appearance an asphalt pavement.

The Genasco road cement used in the work was hauled in barrels from the Barber asphalt plant in Utica, a distance of about three miles, melted in kettles placed alongside the road and heated to a temperature of 300 to 350° F. before being placed in the road, using the barrel staves for fuel. The cement was carried in pails from the kettles to the work and fan-sported sprinkling pots were used for the pouring. This does not make a dustless road, but apparently this nuisance will be to a great extent overcome. The noise of the ordinary macadam road or pavement is practically avoided and the elasticity of the surface makes it easy for travel. A summary of the work done and data on its cost are given in Table I, and in Table III a comparison is given with the costs by this mixing method.

TABLE I.

General Figures.

Average rate of progress of construction of metal surfacing per working day, sq. yds.	120.97
Average number hours per working day	176.4
Average rate of progress of using bituminous material per day in gallons	658.27
Cost of heating bituminous materials per gal.	$0.00918
Total cost in place of bituminous materials per gal.	$0.1974
Total cost in place of bituminous materials per sq. yd.	$0.4920
Cost of pouring bituminous materials per gal.	$0.0304
Cost of 1½-in. stone in place per sq. yd.	$0.2867
Cubic yds. of 1½-in. stone (loose measure)	321.36
Cubic yds. of grit (loose measure)	96.44
Total cu. yds. of stone and grit (loose measure)	417.80
Stone used, per cent.	77
Grit used, per cent.	23
Gallons of Genasco road cement	7,241.00
Number of gals. Genasco road cement used per sq. yd.	2.494
Pounds of coal used by rollers	12.500.00
Unit Cost of Material:	
Genasco road cement, f. o. b. cars, Utica, per gal.	$0.115
Genasco road cement delivered on work, per gal.	0.1312
Stone (1½) f. o. b. cars, Utica, per cu. yd.	1.1800
Stone (1½) delivered on work, per cu. yd.	1.85
Grit—f. o. b. cars, Utica, per cu. yd.	1.18
Grit—delivered on work, per cu. yd.	1.80
Hard wood, 4 ft. long—delivered on work, per cord.	9.00
Soft wood, 4 ft. long—delivered on work, per cord.	7.00
Coal—delivered, per ton.	3.60
Costs Per Square Yard:	Per sq. yd.
Removing old macadam, per sq. yd.	$0.16730
Laying 1½-in. stone, per sq. yd.	0.08090
Pouring first course, including rolling and application of grit.	0.06170
Squegee course, including drying and application of grit and rolling.	0.01419
Hauling Genasco about 3 miles.	0.00809
Hauling tools to the work, about 3 miles	0.00912
Unloading 1½-in. stone and hauling about 1 mile.	0.04030
General expense, rainy days, holidays, idle time, etc.	0.01730
Coal for rollers.	0.00775
Cost of labor, including allowance for services of superintendent for 21 days at $5 per day.	0.43100
Allowance for equipment.	0.10800
Total cost for labor and equipment.	0.53900
Total cost for material per sq. yd.	0.57080
Total cost for material and labor per sq. yd.	1.10980
Cost of labor per mile.	$3,843.84
Total cost for labor and material, per mile	$7,861.92

Deerfield Road No. 3.—Work was begun on this road at a point about one mile east of Deerfield Corners. As originally constructed, the macadam on this road was 12 ft. wide. Since its construction it had been resurfaced with macadam to a depth varying from 1 in. to 3 ins. A portion of the macadam was to be removed to avoid a high crown. The length of the section resurfaced was 2,177.5 ft. and the width resurfaced was 12 ft., the depth of the resurfacing being 3 ins. The percentage of grade (maximum) was 1.25 per cent for a length of 325; the percentage of grade (mean) for length of 1,566 ft. was .707 per cent. Construction work was started Sept. 25 and was completed Oct. 13. The maximum amount of crown was 3 ins. and the minimum was 1 in.

The macadam was loosened by hand labor, no scarifier or roller being used for this purpose. Through an arrangement with the town superintendent of Deerfield the old stone was hauled from the work, to be used on town roads, at the expense of the town.

On this road the mixing method was used. The stone used was 1½-in syenite of uniform size from Little Falls. The bituminous material was the same as that used on road No. 71. The stone and grit were shipped by boat to Utica, where the materials were mixed and hauled to the work, a distance of about three miles. The stone and Genasco cement were mixed in the proportion of 1 cu. yd. of stone to 126 lbs. of Genasco cement and the mixing continued until each stone became thoroughly coated with the cement. The Genasco cement was first heated to 300° F., but this temperature was reduced to 100° after a trial had demonstrated that this temperature was too high for practical purposes, as the stone and cement at the higher temperature had a tendency to separate during transportation from the plant to the work. The mixture was dumped upon an iron mixing board in the center of the road and shoveled on the grade and shaped by experienced asphalt rakers. The surface was rolled hot with a 5-ton tandem roller and compressed to a depth of 3 ins. About ½ in. of grit was then placed on the surface and thoroughly rolled, after which the loose grit was swept to the sides of the road and the squegee course applied the same as on road No. 71. As soon as the squegee course was completed the section was opened to traffic. The surface of this road is not as smooth as the Utica-Paris road No. 71, otherwise the appearance of the road is very similar. A summary of the work done and some data on its cost are given in Table II. In Table III a comparison of the costs by the penetration method is given:

TABLE II.

General Figures:

Average rate of progress of construction of metal surfacing per working day, sq. yds.	139.2
Average number of hours per working day	195.66
Average rate of progress using bituminous material, per day, in gals. (macadam course 254.11 and surface coat 162), total	416.11
Cubic yards of 1½-in. stone used (loose measure)	210.12
Cubic yards of grit used (loose measure)	65.36
Stone used, per cent.	78
Grit used, per cent.	22
Gallons of Genasco road cement	3,745.00
Pounds of soft coal used	31,400.00
No. gal. Genasco used per sq. yd., macadam course	1.095
No. gal. Genasco used per sq. yd. for surface coat	0.698
Total number gal. Genasco used per sq. yd.	1.793
Pounds of coke used for heating tools used on work.	1.480.
Unit Cost of Material:	
Genasco road cement, f. o. b. cars, Utica, per gal.	$0.115
Stone (1½-in.) f. o. b. boat, Utica, per cu. yd.	1.450
Grit, f. o. b. cars, Utica, per cu. yd.	1.180
Soft coal per ton, delivered.	3.60
Coke per ton, delivered.	6.00
Costs Per Square Yard:	Per sq. yd.
Cost of removing old macadam.	0.1677
Unloading 1½-in. stone from boat.	0.0209
Unloading grit	0.0079
Mixing asphalt macadam.	0.0754
Hauling asphalt macadam about 3 miles	0.0575
Laying asphalt macadam.	0.135
Hauling grit about 3 miles.	0.0111
Hauling tools	0.0057
Cost of labor, including allowance for use of equipment and services of superintendent and foreman.	0.6350
Cost for material.	0.4550
Total cost of labor and material.	.09
Cost of coal used in mixing asphalt-macadam	0.2707
Cost of labor per mile, including equipment and services of superintendent and foreman.	$4,070.04
Total cost, labor, material and equipment for mile.	7,682.40

RESURFACING WITH ASPHALT MACADAM.

During the spring of 1909 the State Highway Commission decided to resurface Loudon road No. 22 with asphalt macadam and during the progress of the work to investigate so far as possible different classes of asphalt oils and

TABLE III. — COMPARATIVE FIGURES ON THE COST OF BITUMINOUS MACADAM BY THE PENETRATION AND MIXING METHODS.

General Figures:	Utica-Paris road.	Deerfield road.
Method	Penetration	Mixing
Depth of resurfacing, ins.	3	3
Average rate of progress of construction of metal surface, sq. yds.	120.97	139.2
Average number of hours per working day	176.4	195.66
Average rate of progress using bituminous material per day in gals.	658.27	416.11
Amount of 1½-in. stone used (loose measure), cu. yds.	321.36	240.12
Amount of grit used (loose measure), cu. yds.	96.44	65.36
1½-in. stone used, per cent.	77	78
Grit used, per cent.	23	22
Amount of Genasco road cement used, gals.	7,241	3,745
Amount of Genasco road cement used per sq. yd., gals.	2.494	1.793
Soft coal used by rollers	12,500	31,400
Coke used for heating tools on work, lbs.		1,480
Costs:	**Per sq. yd.**	**Per sq. yd.**
Removing old macadam	$0.16730	$0.1677
Laying 1½-in. stone, per sq. yd.	.08090	.....
Pouring first course	.06170	.....
Squegee course	.01419	.....
Mixing asphalt macadam	.....	.07540
Hauling asphalt macadam about 3 miles	.....	.05750
Laying asphalt macadam	.....	.13500
Hauling Genasco cement about 3 miles	.00809	.....
Hauling grit about 3 miles	.....	.01110
Hauling tools to work	.00912	.00570
Unloading 1½-in. stone and hauling 1 mile	.04030	.....
Unloading 1½-in. stone from boat	.....	.02090
Unloading grit from cars	.....	.00790
General expenses, rainy days, idle time, etc.	.01730	.....
Coal for rollers	.00775	.....
Allowance for equipment	.10800	.....
Labor cost, including superintendent	.43100	.....
Labor cost, including allowance for equipment, superintendent and foreman	.53900	.63500
Cost of material	.57080	.45500
Total labor and material	$1.10980	$1.09000
Cost of labor, per mile	$3,843.84	$4,070.04
Total cost labor and material per mile	7,861.92	7,682.40

methods of placing to determine their durability and costs.

In order that the methods might be changed at the will of the commission and new methods that might be brought to its attention tried, the work was performed under the day labor system.

The Loudon road is on the county system of improved public highways and extends from a point in the westerly boundary of the city of Albany near the Northern boulevard, westerly through the village of Loudonville to the village of Newtonville, a distance of 3.41 miles, in the town of Colonie, and has a macadam surface 16 ft. wide. The road passes through a comparatively thickly settled residential portion of Albany county and is probably subject to as heavy traffic as any improved road in this country. This traffic is composed largely of automobiles. During the season of 1907 a portion of this road and the one adjoining, No. 119, was resurfaced by the state engineer with screenings, using Tarvia as a binder.

At the beginning of the season of 1909 the road was in a very bad condition. The macadam surface had raveled and was so rough that the earth shoulder was being used by traffic instead of the macadam surface for a large portion of the road. Work was commenced Aug. 2 in organizing a force and hauling materials to the work.

The road was prepared for the surfacing by first building up an earth shoulder on each side of the road and as this was being done the ditches were cleaned, obstructions in outlets removed, intersecting roads graded to meet new grade, and any unsightly brush, etc., removed. The cost of this work was as follows:

19,950 lin. ft. ..... 4.7 cts. per lin. ft.
3.77 miles ..... 244.82 per mile
33,520 sq. yds. ..... 2.8 cts. per sq. yd.

At first where Tarvia was encountered the old surface was roughened by picks, but later this was discontinued as unnecessary. The old surface was swept by hand with straw and metal brooms so that a satisfactory bond between the old and new surfacing could be secured. Thirty-three thousand five hundred and twenty square yards of surface was thus prepared at a cost of 1 ct. per square yard. This price includes some resweeping which falling leaves made it necessary to perform.

The materials were delivered by steam cars and boats to North Albany, Menands and Schenectady. The delivery points were changed as the work progressed to secure the minimum haul by teams.

At Schenectady the materials were reloaded onto cars of the Schenectady Railroad Co. and hauled by them to Lathams Corners. From Menands and North Albany it was necessary to haul up grades over a mile in length of over 10 per cent.

The cost of hauling and total costs of materials delivered on the work is as follows:

From Dock, North Albany: 1½-in. stone, 2.2 miles average haul $1.23 per cubic yard, 56 cts. per cubic yard mile. From Menands: 1½-in. stone, 2.1 miles average haul $1.01 per cubic yard, 18 cts. per cubic yard mile; ½-in. stone, 2.1 miles average haul 96 cts. per cubic yard, 46 cts. per cubic yard mile; iron tailings, 2.1 miles average haul $1.06 per cubic yard, 50 cts. per cubic yard mile. From North Albany: ½-in. stone, average haul 2.05 miles $1.18 per cubic yard, 57 cts. per cubic yard mile; iron tailings, average haul 2.05 miles $1.28 per cubic yard, 62 cts. per cubic yard mile. From Lathams Corners: 1½-in. stone, average haul 1.7 miles 53 cts. per cubic yard, 31 cts. per cubic yard mile; ½-in. stone, average haul 1.7 miles 48 cts. per cubic yard, 28 cts. per cubic yard mile; iron tailings, average haul 1.3 miles 43 cts. per cubic yard, 33 cts. per cubic yard mile. From North Albany: Oil, average haul 2.7 miles 78/100 cts. per gallon, 3/10 cts. per gallon mile; coal, average haul 4 miles $1.55 per ton, 38 cts. per ton mile.

The cost of stone delivered on the work was as follows:

	Per cu. yd.
Cost f. o. b. Albany, Menands, Lathams Corners	$1.51
Cost unloading	.38
Cost hauling	1.07
Total per cubic yard on work	$2.96

The stone used for new surface was of the 1½-in. size and included trap rock from the quarries of the Rockland Lake Trap Rock Co., Rockland Lake, N. Y., and limestone from the quarries of the Callanan Road Improvement Co. at Bethlehem, N. Y.

There was used on the work as new course 1,898 cu. yds. of trap rock placed between stations 0+00 and 155+50. There was also used 60 cu. yds. of 1½-in. and ¾-in. maintenance stone and 1,313 cu. yds. of limestone, which were placed between stations 155+50 and 188+55, making a total of 3,271 cu. yds. spread over 33,520 sq. yds. of surface. This course averages 3½ ins. in depth, loose measure, and was spread at a cost of 9.4 cts. per cubic yard, or .9 ct. per square yard of surface, loose measure, or 1.2 cts. per square yard rolled. The total cost of the 1½ ins. of stone laid was $3.05 per cubic yard, loose measure, or $4.06 rolled in place. To determine the cubic yardage of materials, loose measure, ten wagon loads of each size were weighed. One and one-half inch stone was found to weigh 2,550 lbs. per cubic yard, ½-in. stone 2,330 lbs. per cubic yard and iron tailings 2,980 lbs. per cubic yard.

The oil used on the work with the exception of the Genasco road cement was received at North Albany in tank cars; the Genasco road cement was contained in barrels. It was necessary to raise the temperature of the oil in tank cars to approximately 170° F. before it could be pumped readily. These cars were fitted with steam coils and steam was lead to them from a steam boiler provided for this purpose. The oil was pumped from the cars into wooden rectangular tanks which were fitted with steam coils and hauled in them to the work, where steam was lead to the coils from a steam roller and oil raised to pumping temperature. The pumps used were similar to those used on canal boats and found satisfactory. Some trouble was experienced with leather packing for the valves and it was found necessary to repack the pumps every day on an average.

Four different oils were used—Gulf Refining Co.'s repair binder, Standard repair binder, Standard asphalt macadam binder, under specifications No. 1, New York state, and Genasco road cement.

The Gulf Refining Co.'s oil was used between stations 87+10 and 102+87. The method used is known as the penetration method, and was employed as follows:

The course of 1½-in. stone was first laid, rolled and ½-in. screenings spread at the rate of 2 cu. yds. to the 100 ft., approximately, and rolled in. Oil was now applied at the rate of 1.9 gals. per square yard and the surface rescreened with ½-in. screenings and rolled. The surface was then swept free from screenings and oil was applied for a squegee course at the rate of .7 gal. per square yard, screened with iron tailings and rolled. This was left for a day and as fast as the oil appeared at the top the surface was rescreened with iron tailings. In all about 7 cu. yds. to 100 ft. were used. The cost of applying was as follows, this cost including only labor, rent of oiler and cost of oil:

	Per gal.
Cost 7,631 gals.	$0.0624
Heating to pump	0.0064
Pumping	0.0071
Hauling	0.0078
Applying (man, oiler and team)	0.0143
Spreading screenings	0.0253
Total	$0.1232

Standard repair binder was used between stations 30—00 and 87—10. Standard macadam asphalt binder under specification No. 1, New York state, was used between stations 0—00 and 30+00, also 102+89 and 173+36. The method employed is known as the puddled method and was employed as follows:

The course of 1½-in. stone was first laid, rolled and filled by water puddling with ½-in. screenings and some iron tailings at the rate of approximately 4 cu. yds. to 100 ft. The surface was then broken up with blunt pointed forks and rolled lightly. Oil was now applied at the rate of approximately 1 gal. to the square yard, the road screened with ½-in. stone and rerolled. The surface was then swept free from screenings and oiled, and a squegee course was applied at the rate of approximately ½ gal. to the square yard, screened with iron tailings and rerolled. The work was now left for a day and as fast as oil appeared on the surface the course was rescreened. In all about 7 cu. yds. to 100 ft. were used.

Genasco road cement was used between stations 173+36 and 188+55, the end of the work. The method employed in puddling was the same as that used in spreading the Standard products except that the Genasco road cement was applied in one coat at a rate of approximately 1.5 gals. to the square yard instead of in two coats.

The average cost of applying oil by the puddling method appears below, also the cost of applying Genasco road cement:

Average Costs by Puddling Methods.

	Per gal.
Cost of oil, 50,054 gals.	$0.0550
Heating to pump	0.0059
Pumping	0.0066
Hauling	0.0078
Applying (man, oiler, team)	0.0143
Spreading screenings	0.0252
Puddling	0.0058
Breaking up	0.0032
Total	$0.1238

Cost of Genasco Road Cement Spread.

	Per gal.
Cost of 4,307 gals.	$0.1156
Pumping	0.0041
Hauling	0.0078
Applying (man, oiler, team)	0.0143
Spreading screenings	0.0252
Total	$0.1669

In spreading oil, an oiler manufactured by Gaylor, Fox & Whalen was employed. This oiler consists of a heater of about 300 gal. capacity in which the oil is contained. Under the boiler a fire box is provided using wood as fuel. A small steam boiler is used to generate steam which is led to the spreading device, heating it to a temperature to allow free pass-

age of the oil. The amount of oil applied is regulated by the speed of the moving apparatus.

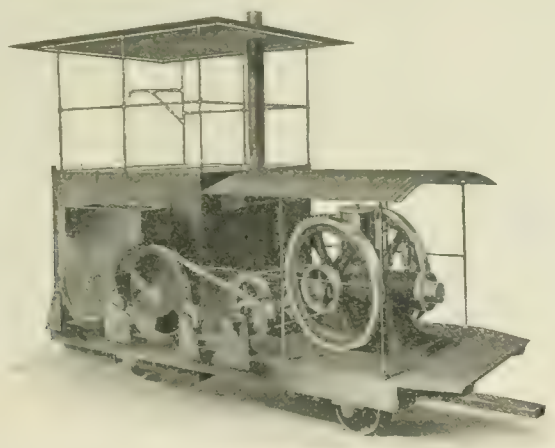
The work of repairing this road was completed Nov. 19, 1909. A summary of the cost based on the number of square yards surfaced and separated into the various items is as follows:

	Per sq. yd.
Superintendent, rent of plant, time keeping, watchman and general	17.4
Building shoulder	2.8
Preparing surface	1.
Cost of stone and screenings, f. o. b. Albany, Menands and Schenectady	25.6
Unloading stone	6.5
Hauling stone and screenings	18.1
Spreading stone	.9
Rolling	1.7
Cost of oil, f. o. b. Albany	10.0
Heating oil	1.3
Pumping oil	1.0
Hauling oil	1.4
Applying oil	4.0
Spreading screenings	4.5
Puddling	1.5
Total	97.7

Culvert, 199-50, $117.

A New Type of Mixing Plant for Bituminous Paving Mixtures, and Data on the Cost of Constructing Asphaltic Concrete with It.

Uniformity in the proportioning of ingredients and in the temperatures at which they are heated and mixed is one of the principal factors in the manufacture of bituminous paving mixtures. It is further desirable that the hot mineral aggregate and the hot bitumen should be quickly and uniformly mixed with as little loss in heat as possible, and that the resulting homogeneous mixture should then be quickly and evenly spread and thoroughly rolled. There has recently been placed on the market a mixing plant designed especially to meet the above conditions. This plant is complete in itself, measuring and heating the mineral aggregates and uniformly mixing them with the proper amount of bituminous cement, which cement is also heated and measured by the plant. In this plant the heating and mixing drums are placed in a casing and in the same casing, immediately above, are situated the two melting kettles. The entire interior of the casing is heated by fuel oil, giving a constant, uniform temperature entirely around both drums, the bottom and four sides of the melting kettles. As the entire casing or housing is lined with heavy asbestos, the full benefit of the heat generated by the fuel oil is obtained. The machine is duplex, and while the material is being heated and mixed in one drum, other materials are being placed in the other drum without the loss of time by laborers, thus allowing the drums to discharge the hot mixtures alternately.



Goodwin Duplex Mixing Plant for Bituminous Pavements.

In front of the housing and on same frame are the boiler and steam engine, or a fuel oil engine, whichever is desired. The latter has the advantage that $4 to $6 per day is saved in fuel and that no fuel expense is incurred except during operation. Licensed engineers or firemen are not required with the fuel oil engine. This plant is also equipped with a fuel oil tank having sufficient capacity for a day's supply for the engine, also a day's supply for heating the mixing drums and melting kettles.

An air compressor is supplied, also a tank for same, sufficiently large to operate the oil burner and agitate the material in the melting tanks. This compressor is directly connected and thoroughly protected from the weather. A water tank is provided for supplying water to either the oil engine or steam boiler.

In transporting the plant by rail the upper railing and the small stack are detached. The plant is then hauled on its own wheels to a flat car and by the use of skids from the end of the car and a block and tackle the plant is placed on the car ready for shipment.

In operating the plant it is placed on or adjacent to the roadway under construction and within wheeling distance for the barrows. Sufficient materials and supplies for two days' paving are placed convenient to the plant.

The proper proportion of the two or more different size stone and sand is measured in batches, in one of the several simple ways, and then shoveled into either one of the hoppers leading to the heating drums. When the moisture has been driven off the sand and stone and they are sufficiently hot, the proper amount of hot bitumen is introduced into the same mixing drum by gravity from the measure placed on the opposite side from the stone and sand hoppers. When the materials are thoroughly mixed and the proper temperature obtained, the door at the end of the drum is opened and the contents of the drum automatically discharged into wheelbarrows placed on the side of the plant when they are immediately wheeled to the place of operation.

The man situated on the top of the housing attends to the placing of the stone and sand alternately into the drums, and also runs the proper amount of hot bitumen from either tank in the measure. The melting tanks are filled by the use of the lift on top of the housing, which brings the bituminous material from the ground and places it in the tanks, where it is melted and then run by gravity into the measure. The drums, revolving independent of each other, are under the supervision of the plant engineer, who stops either one of them when the doors are opened or closed.

The capacity of any plant for heating and mixing materials of this class depends principally on the amount of moisture in the mineral aggregates, the melting point of the bitumen, the climatic conditions, and the efficiency of the plant used. Under ordinary conditions it is claimed that this plant will heat and mix 70 tons of a mixture composed of stone, sand and bitumen in ten hours and as paving of this class will average 200 lbs. per square yard when compressed to 2 ins., this gives the plant a capacity of 700 sq. yds. per day for ten hours. However, 600 sq. yds. is all that is claimed for it. In a paving mixture known as sheet asphalt, which is composed of sand, inorganic dust and asphalt, the capacity of the plant would be about 10 per cent less than for a stone mixture, as the sand contains a large percentage of moisture, a higher melting point asphalt is used and more mixing and heating are required.

The following estimate on the cost of bituminous pavement work with this plant is based on average prices and will of course vary with local conditions:

Plant Equipment.

Heating and mixing plant	$3,000.00
Ten-ton roller, three wheels	2,500.00
Fire wagon	217.50
4 steel barrows, 5 cubic feet	58.00
2 asphalt tampers, 4x10	5.00
6 rakes, 18-in. steel shank	9.00
6 shovels, all steel	6.00
6 shovels	4.50
Total	$5,800.00

Working Force.

	Total per day.
1 foreman	$4.00
1 plant engineer	3.00
1 roller engineer	3.00
2 rakers at $2.25	4.50
1 tamper	2.00
1 kettleman	2.00
1 mixer man	2.00
4 wheelbarrow men at $1.75	7.00
2 shoveling stone and sand at $1.75	3.50
1 general laborer	1.75
15	$32.75

Cost of Materials and Supplies Delivered on the Operation.

Asphalt, per net ton (tare allowed)	$20.00
Stone, per net ton	1.65
Stone screenings, per net ton	1.50
Sand, per net ton	1.25
Fuel oil, per gallon	.05
Coal, per ton	3.50
Lubricating oil, per gallon	.30

Using the above figures as a basis, the following is an estimate of the costs on the construction of one mile of 2-in. asphaltic concrete, 16-ft. roadway:

	Cost per working day.	Cost per sq. yd.
Fixed charges, depreciation of equipment	$ 1.58	$0.00263
Fixed charges, interest on equipment	1.26	.00210
Fixed charges, transportation on equipment	6.00	.01
Labor	32.75	.05458
Material, asphalt	84.00	.14
Material, ¾-in. stone	34.65	.05775
Material, stone screenings	31.50	.0525
Material, sand	17.25	.02875
Supplies, fuel oil	2.50	.00416
Supplies, coal	4.38	.0073
Supplies, lubricating oil	.15	.00025
Miscellaneous expenses, repairs, etc.	1.48	.00246
Totals	$217 50	$0.3625

The cost per square yard is figured on the basis of an output of 600 sq. yds. per day. Depreciation is figured at 7½ per cent per annum for 275 working days and interest on equipment at 6 per cent for the same period.

The plant described above is known as the Godwin duplex plant. It is handled by W. S. Godwin, Box 95, Times Square station, New York city, to whom we are indebted for the descriptive matter and the cost figures.

Cost of Removing and Testing Meters.—A system of removing and testing meters is now being developed at Harrisburg, Pa., from the knowledge gained in testing the oldest meters in the department. It has been decided to remove, clean and test all meters commencing with the one longest in service and by reason of the information secured map out a plan for use that will enable the future tests to be made at the proper time. In doing this work in 1909 1,970 meters were taken out, 1,712 were cleaned, tested and new parts put in those needing them. Of these 76 had to be sent to the factory and the balance were repaired at the meter shop. Of the meters taken out, 916 needed very little or no material to make them register correctly and no charges were made for their removal, cleaning, testing and resetting. The charges made against the 796 that did need considerable attention were $1,473, an average of $1.85 per meter charged for, of 86 cts. per meter removed and of 16 cts. per meter in use.

Water-works and Sewer Section

Note: This section is devoted to methods and costs of constructing sewers and water-works. It will cover the construction work for all details of water supply and sewerage, including sewage purification and water filtration.

A Novel Method of Placing Cast Iron Wells in a Water Works Crib.

The work under contract with George W. Jackson, Inc., for the construction of the new Southwest Lake and Land Tunnel for the city of Chicago is rapidly nearing completion and particular interest attaches to the methods adopted for placing the heavy cast iron wells in the permanent crib in Lake Michigan, about 2 1/6 miles from the shore.

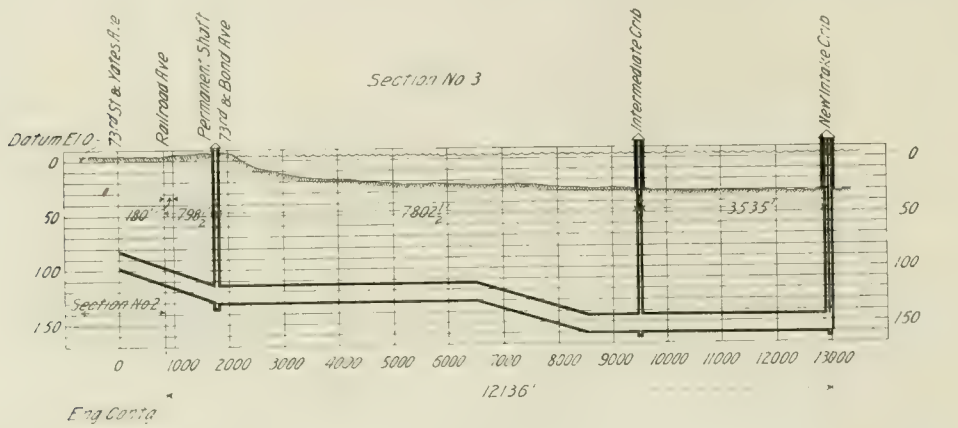


Fig. 1—Profile of Lake Section of Southwest Land and Lake Tunnel, Chicago Water Works.

Figure 1 shows the tunnel in profile. The intermediate crib, 7,802 ft. from land, has been used as a working shaft and will be sealed when work is completed. It was on this crib that a fire occurred about one year ago in which a number of workmen lost their lives. Figure 2 shows the alignment of the tunnel as proposed by the engineers for the city, the angle being at the land shaft.

This idea was abandoned and the angle made at the temporary construction crib as shown. Figure 3 shows the tunnel as constructed. The concrete in the lining is a 1:3:6 mix. The depth of the tunnel below the surface is shown on the profile, this depth being selected so the tunnel would be in solid rock all the way, thus doing away with troubles experienced in driving older tunnels and making it possible to prosecute the work without using air. On shore the tunnel is only 90 ft. below datum, datum being practically at ordinary surface water level in Lake Michigan. The tunnel lining was to be as nearly as possible a minimum of 12 ins. in thickness and the specifications provided for excavation to a neat line 17 ins. outside the inner face of the tunnel, with no projections exceeding 5 ins. Profiles were taken at 5-ft. intervals and the sum of the base areas of the projections in any 5-ft. length of tunnel could not exceed 15 per cent of the total area formed by multiplying the length of the outer neat line by 5 ft., all base areas being measured on this line.

The share shaft was driven through a surface stratum of gravel, boulders and sand pockets overlying a bed of hard clay resting on the rock. Steel sheet piles of the Jackson interlocking type, 50 ft. long, were driven through the bad material into the clay in a circle 21 ft. inside diameter, before beginning excavation. The work proceeded with no more difficulty or drawbacks than are usually incidental to work of this nature. The intermediate crib surrounding the temporary working shaft is hexagonal in form and made of heavy timbers. Inside this crib was driven a shaft of steel sheet piling in 50-ft. lengths in a circle having a diameter of 16 ft., with another shaft of piling 20 ft. long driven into the clay, 11 ft. 5 ins. diameter, the space between the steel shells being packed with clay. The depth of water was 33 ft. After the disastrous fire of Jan. 20, 1909, the coroner's jury exonerating the contractors from all blame, the superstructure of the crib was rebuilt in conformity with specifications prepared under the supervision of the city officials. Figure 4 is an interior view of the intermediate crib while under construction, the frame on the left being a part of the tramway system, the large cable wheel showing.

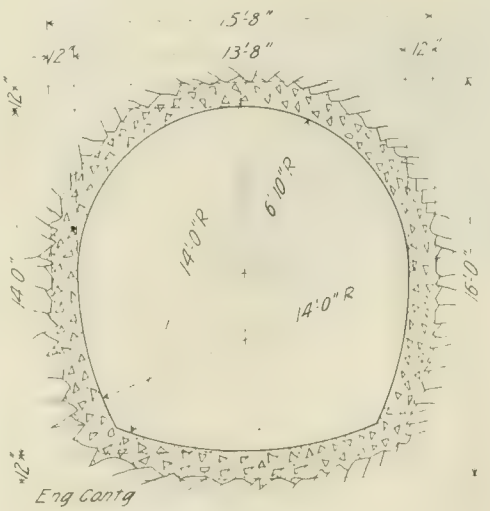


Fig. 3—Transverse Section of Southwest Land and Lake Tunnel.

The tramway was similar to aerial tramways used in mountainous districts, Fig. 5 showing it in the lake. The towers were 65 ft. in height and 1,100 ft. apart, the foundations being 28 ft. in diameter at the base of the tower. The towers were built by driving the legs into the clay lake bed, the continuation of the legs below water level being steel channels. Around each tower was placed a wooden ring, conical in shape, the vertical plank or staves being banded with iron, the length of the wooden protection being such that the bottom was below probable wave action. Broken stone was placed inside and allowed to run out below in mound form. The construction described was that adopted after lighter towers without good protection had been damaged by an ice flow. The large towers finally adopted went through the two years of service without damage by waves or ice.

The aerial cableway is claimed by every one connected with the work to have been an absolute success, for the work has been pushed continuously in all weathers. If this means of transport had not been adopted and boats relied upon for the transport of laborers and materials there would have been frequent interruptions on account of bad weather and ice floes. By the terms of the contract work had to be prosecuted in four headings, hence the temporary crib 7,500 ft. off shore.

The permanent crib is shown under construction in Fig. 6 and the steel stiffening trusses inside are shown in Fig. 7. Details of the crib are shown in Fig. 8, a reproduction from the construction drawings. The bottom diameter is 111 ft. 2⅝ ins. and the top diameter 109 ft. 1¾ ins., the total height being 46 ft. 4 ins. The floor is of timber grillage 4 ft. 4 ins. thick and for a height of 24 ft. 4 ins. the side walls are of timber grillage 26 ft. thick with 8 intake ports each 7 ft. square. The timber portion of the crib is sheathed on both sides with 3¾-in. yellow pine planking. Two concentric steel shells placed on top of the wooden portion formed an interior well 60 ft. in diameter with two pairs of stiffening trusses crossing the well to take care of launching and sinking strains. Between the shells are 24 radial diaphrams of steel, giving additional stiffness and forming compartments. Riprap stone, all under 12 ins. in size, was placed in the compartments as ballast when the crib was launched and floated to position, the parts in the lower portion being closed. When the crib was sunk the riprap stone was taken out and deposited around the base, all the pockets being then filled with concrete. The upper part of the crib was built of masonry, the faces being dressed granite with concrete backing or core, to an elevation of 13 ft. 4 ins. above datum.

In the well are two 14-ft. intake shafts of cast iron with six gates and hoisting gear, the construction being shown in plan and elevation in Fig. 9. The method adopted for getting the heavy cast iron cylinders into position is credited to Mr. Daniel O'Connor, the general superintendent for the contractor, and is essentially the feature of the work most interesting to contractors because of the ingenuity displayed in the conception and carrying out of the work. The Jackson sheet steel forms for concrete shafts were used as shields to carry the shafts down through the lake bottom and clay substratum to rock, where the connection was made with the upraise from the tunnel. The first work done was to blast holes through the timber bottom 4 ft. 6 ins. thick, to let the shields through. Holes 2 ins. in diameter were drilled as close together as possible in a circle for each shaft, and the form of bit found most successful after several trials is shown in Fig. 10, steam drills being used carried on the cross bracing trusses. After the circles were completed holes were drilled in the center and loaded with dynamite, this method of blasting proving good, the outer circle of holes weakening the timber so it broke out nicely.

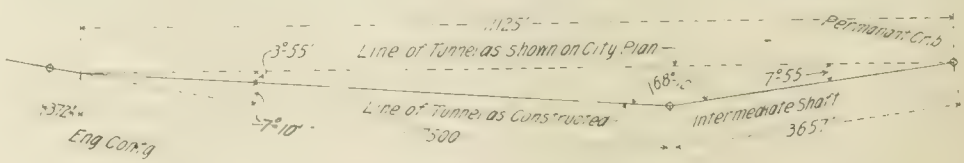


Fig. 2—Alinement of Lake Section of Southwest Land and Lake Tunnel.

Fig. 4—View of Intermediate Crib in Course of Construction.

The Jackson sheet steel forms were then lowered into place, sections being bolted to the top as the shield was lowered through the hole in the timber bottom. When bottom was reached the lower end of the bottom section became a cutting edge, the flange having been removed for this purpose. Bags of sand were used to weight the shields when the lake bottom was reached. When clay was reached and the shields made perpendicular, guide rails were placed inside to guide the heavy cylinders of the intake shafts. The shields were then filled with sand to a height of 1 ft. above water level, the sand being taken out on the tug in bags. It was later used for concrete work in the crib. It was a comparatively easy matter to lower the light shields, but trouble was experienced in doing this part of the work, and proved the wisdom of the method adopted for putting in the heavy cylinders, which consisted in placing the lower section inside the shield and sinking it by "mucking" out the sand, the weight of the cylinder increasing as each section was added and forcing the lower edge into the sand. The inside diameter of the shields was 15 ft. 8 ins. and the outside diameter of the intake shafts is 14 ft., which gave very little clearance, for the steel plates were 7/16 in. thick, with 3½x3½x⅜-in. angles for frames. The tops of the intake shafts are 8 ft. 6 ins. above datum and the heavy cast iron sections 8 ft. wide were sunk to a depth of 46 ft. 5 ins. below datum, when the section containing the lowest gate section, 9 ft. 6 ins. wide, was put on, followed by the upper gate section of the same size, the two top sections being 6-ft. rings. Concrete was placed between the shield and the cast iron cylinder up to the bottom of the lower gate section. Below this point the shield was left in place and the portions of the shield above were raised by jacking up, the jacks supported by the cylinder. Below the lower gate section the shaft down to the tunnel was reduced to a diameter of 12 ft. 3 ins. by a concrete lining, the total thickness of this lining being 20½ ins. Below the bottom of the cast iron cylinders excavation was carried on in the usual method in the clay, the Jackson sheet steel forms being put in place section by section to form a lining to the shaft until it was completed and ready for the concrete lining, the steel lining being left in place. This method was used down to the rock, where connection was made with the uprise from the tunnel.

The work was done under the supervision of Mr. George F. Samuels, present acting city engineer, and the following data on number of men and time consumed on the work are from the daily reports of the city inspectors, the reports being public records. A day's work was 9½ hours, from 7 a. m. to 5:30 p. m., and a double shift was 24 hours, from 7 a. m. to 7 a. m. of the day following. A tug and a launch were used daily. An assistant foreman was on the job all the time and occasionaly a foreman was there also. In putting down the time the item of foreman has been lumped. No wages are given in the reports, but union wages were paid.

Timber trusses were first put across the well to carry a working platform on which to place the drilling machinery and carry material. After everything was cleared the following force placed the trusses and platform and rigged up the drilling machinery for the west shaft:

	Days time charged.
Superintendent	2
Foreman	8
Laborers (3 to 7 each day)	40
Fireman	10
Engineer	6
Blacksmith	3
Diver	3
Machinist	1
Tug and crew	3
Launch and crew	3

Fig. 5—Aerial Tramway Construction with Steel Towers 1100 ft. Apart and 65 ft. in Height, Setting on Rock Foundations, 28 ft. in Diameter at the Top and Increasing in Size Towards the Bottom.

After drilling 66 holes, each about 40 ins. deep, in the bottom for the west shaft a second drill was set up and a centrifugal pump put in to pump out the shaft. From 8 to 14 holes were drilled per day with one

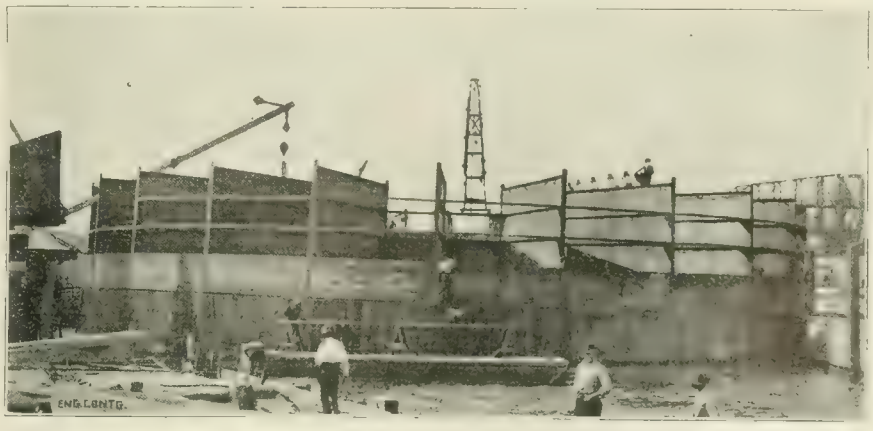


Fig. 6—Intake Crib in Course of Construction.

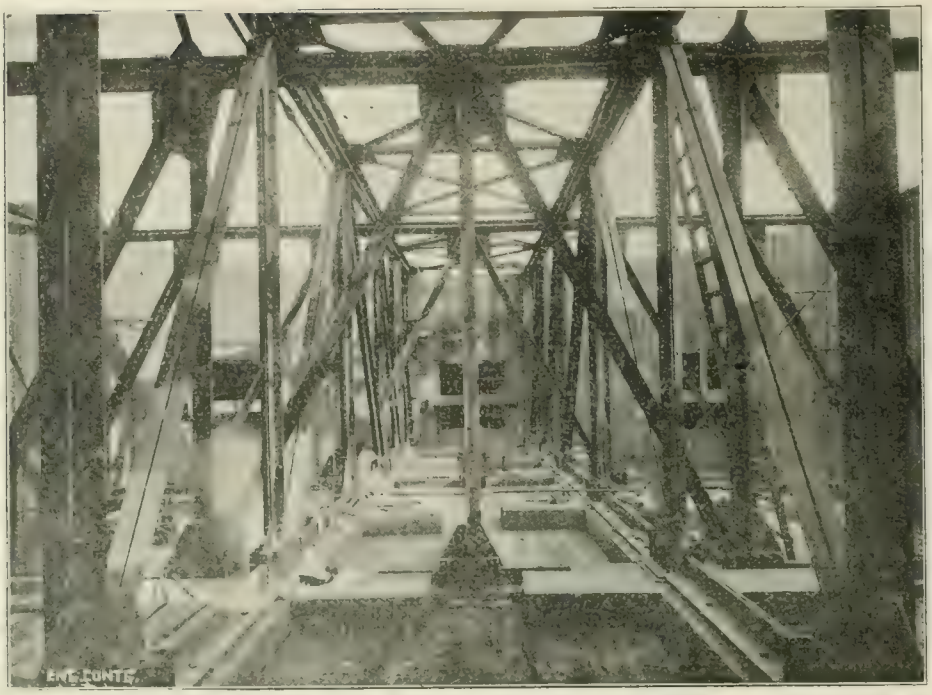


Fig. 7—Interior View of Intake Crib Showing Stiffening Trusses.

machine and when the two drills were working each one drilled from 8 to 9 holes daily; 154 holes were drilled partly through and 111 holes drilled through. In the following table drillers, helpers and laborers are lumped under one heading of laborers:

	Days time charged.
Superintendent	5
Foreman	30
Laborers (2 to 7 daily)	100
Engineer	28
Fireman	30
Blacksmith	8
Diver	8
Machinist	12

Two ⅞-in. wire ropes were stretched across the crib from which to suspend the shields and castings, and the drills and pump were set temporarily over the east shaft while the shooting was done in the west shaft. Work was stopped several days on account of stormy weather, this work being done in March and April. The time as recorded is not well segregated as between shooting in the west shaft and drilling in the east shaft, but as nearly as a segregation may be made from the records, time chargeable to the shooting is about as follows:

	Days.
Foreman	5
Laborers	37½
Engineer	5½
Fireman	6
Diver	13
Machinist	12

Drilling for the east shaft commenced before the shooting in the west shaft was finished, two drills being used. The following time covers the drilling in east shaft, shooting timbers in east shaft and lowering shield in west shaft, the operations not being segregated in the daily reports. A derrick and a pile driver were also set up. In lowering the shield some tight barrels were attached to relieve the weight until bottom was reached, 30 being used on the west shield. When the shield reached clay it was jetted down and ballast piled on top to help force it down, a diver and helper working at the bottom. A pump was placed in the west shield after it had entered the clay 2½ ft., but after the water had been lowered 1 ft. it suddenly filled again. An orange peel bucket was tried in the shaft, but not proving a success was taken out. A platform was placed across the shield and weighted with gravel. A diver located a leak in the second section of the shield, a number of bolts having sheared, evidently because of the shooting. This was stopped, but another leak opened when the cutting edge passed through a sand pocket. The orange peel bucket was again put into service and a diver was almost constantly at work mucking around the cutting edge inside, with some trips on the outside to locate and stop leaks. When the shield was down 8 ft. into the clay the pumps were taken out and everything cleared. The bolts connecting the second and third rings from the bottom were removed and drift bolts substituted so the upper sections could be lifted readily when required. Several times the pumps had been started and once succeeded in lowering the water as much as 8 ft. The shield did not go down plumb, but had to be pulled over with hoist and tackle and shifting of weights, extra shield sections being used with the gravel, and at one time 18 bbls. filled with water were added. The last time the pumps were used the water was lowered to within 10 ft. of the bottom, when another leak occurred and the shaft filled at the rate of 1 ft. per minute with both pumps (No. 3 Nye diaphragm pumps) working. About 700 bags of sand were brought from shore and cylinder sections for the west shaft. One was dropped and broke. Guide rails, 8 in number, were placed in the west shield to guide the cylinder sections, for the clearance was small. The following is the force account reported for the foregoing work:

	Days.
Foreman	60
Laborers, helpers, etc.	400
Miners	6
Engineer	58
Fireman	60
Diver	42
Machinist	10
Pile driver (crew 6 men)	4
Launch (crew 1 man)	2

No doubt some of the labor would be saved on a similar job. The pumping was a

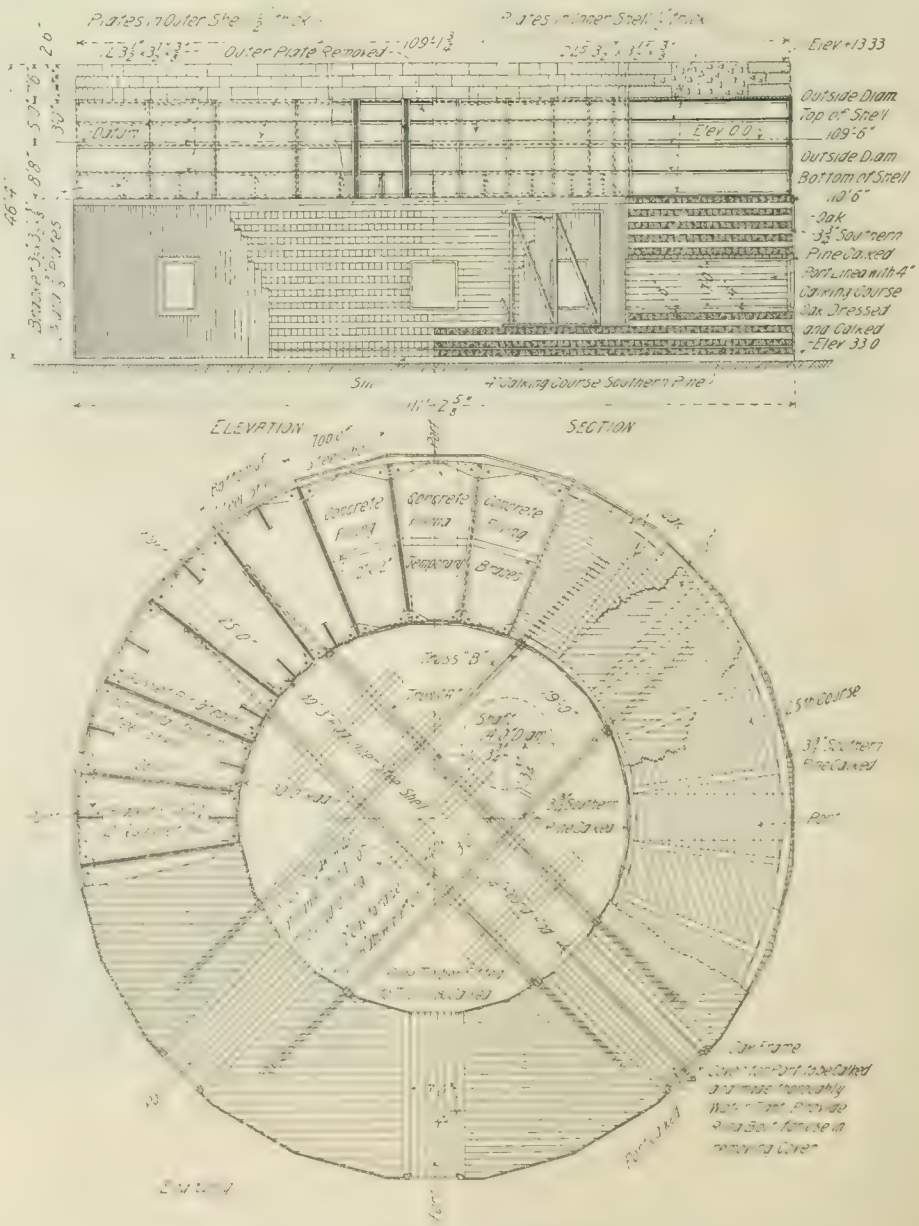


Fig. 8—Details of Intake Crib.

costly item and did not seem to be very successful. The shield was not heavy enough of itself to penetrate readily even with the orange peel bucket excavating and the diver mucking. The lightening effect of submergence was apparently not taken fully into consideration, and trouble resulted in maintaining verticality. The gravel and extra shield sections placed on top had to be shifted and a projecting platform put on to carry 18 barrels filled with water. These weights had to help carry the shield down and also overcome the buoying due to submergence. This no doubt had a little to do with the leaks. Had weights been attached in some way lower inside the shield, less trouble might have been experienced. No doubt the contractor has a full account of all losses of time for each man, but the public records merely record each day's work and give the number of men employed and their rating.

When the work of putting in sand commenced the water was 31 ft. deep in the shield. Ten working days were required to put the sand in bags, carry it to the crib and fill the shield until the sand stood 1 ft. above water level. Some cylinder sections were also handled. Two foremen were employed and the force account was as follows:

	Days.
Foremen	15
Laborers	116
Engineer	10
Fireman	10
Diver	3
Blacksmith	2
Carpenter	1

After filling the shield with sand it took 11 working days to sink the bottom of the cylinder to a depth of 29 ft. below the water surface. The upper sections of the shield were then removed by jacking and placed on a scow. When about ready to place the first gate section the stiff legs gave way and it dropped into the lake. For this work the force account stood as follows:

	Days.
Civil engineer	6
Rodman	5
Foreman	13
Laborers	84
Engineer	12
Fireman	12
Diver	3
Machinist	5
Carpenter	8

The old shield was placed on a scow, a new derrick was built, the old derrick repaired and the lost gate section recovered in good order. A diver with laborers was employed inside the cylinders and a Nye pump kept at work. While going through the sand the cylinder dropped 3.7 ft. one day and 5.1 ft. the next day. At a depth of 38.4 ft. below the water surface hard clay was struck, after which it was found necessary to pile sand bags on top of the cylinder to weight it. A leak started and the diver found 4 ft. of torpedo sand in the bottom, which had come in from between the shield and cylinder. The space was refilled with sand and as the cylinder went down bags of sand were piled on top until at the last the total number of bags was 6,236. As the cylinder went into the clay the diver was apparently principally employed in packing clay around the cylinder and stopping leaks, while the No. 5 Nye pump kept the water down during the mining. The force account was as follows:

	Days.
Foreman	69
Laborers	300
Engineer	56
Fireman	46
Divers	35
Civil engineer	14
Rodman	14
Carpenters	21
Machinists	12
Electricians	7

The number of working days was about 50, but some of the days charged to foremen were due to night shifts and also to the fact that a number of foremen on work temporarily stopped were used here as superior workmen.

To blast and remove floor timber in the east well preparatory to sinking the shield took 10 working days with the following force:

	Days.
Foremen	10
Laborers	47
Engineer	11
Firemen	13
Diver	10
Carpenters	6

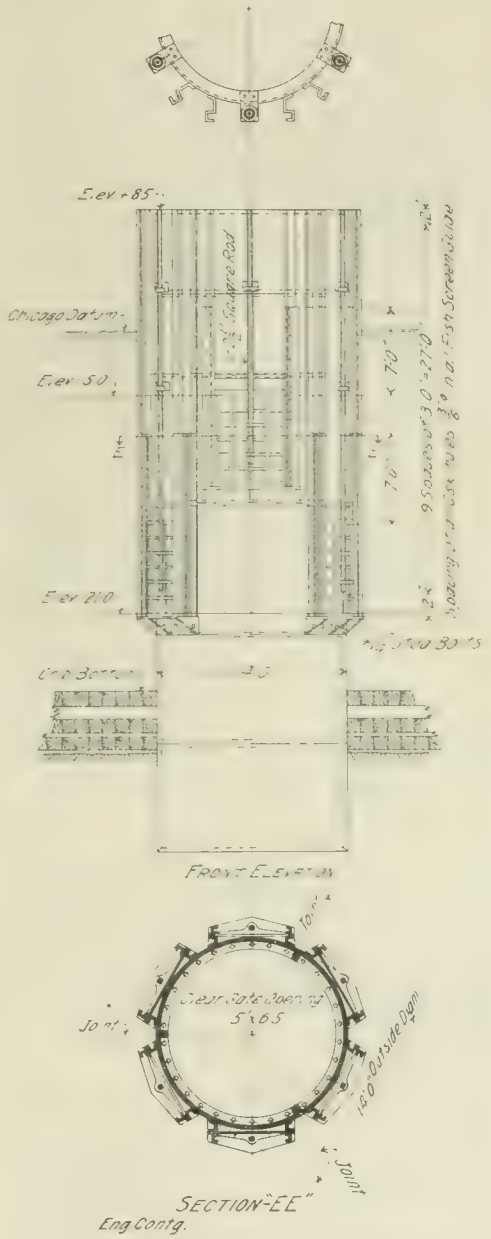


Fig. 9—Details of Intake Shafts.

It took 12 working days to get the cutting edge of the shield for the east shaft down into the clay 5 ft. and 34.2 ft. below the water surface. The shaft was dry and there had been no trouble with leaks. To weight the shield there had been used 1,950 bags of sand, reported as weighing a total of 102.37 tons.

Fig 10.—Auger Bit for Boring Holes in Wood Bottom of Crib.

The filling of the shield with sand was commenced and at the same time the bags were removed. When 5 ft. of sand had been put in and only 400 bags remained on top, the shield suddenly collapsed. To get to this point the force account showed:

	Days.
Foremen	11
Laborers	66
Engineer	12
Firemen	17
Diver	12

To remove the wrecked shield, clean up and get ready for lowering a new shield required the following men:

	Days.
Foreman	6
Laborers	44
Engineer	7
Fireman	9
Diver	7
Carpenters	11

It required 28 sticks of dynamite in 5 shots to loosen the shield after a number of bolts had been cut.

In 19 working days after cleaning out the shield the new shield was placed, sunk to depth, and filled with sand to the level of the lake surface. A total of 1,380 bags of sand was used to weight it. The shield was 14 ins. out of plumb at the top, but was pulled over and guide rails for the cylinder placed before the sand was put in. The lower edge of the cast iron cylinder was trimmed to form a cutting edge. Up to this point the force account was as follows:

	Days.
Foreman	10
Laborers	119
Engineer	20
Fireman	19
Diver	18

No particular trouble was experienced in placing and sinking the cylinder for the east shaft. The notes state that on Nov. 24 "had excavated 28 cu. yds. sand when 4 rings of cylinder in place sunk exactly in place down 29.4 ft." The work here described commenced on March 12, 1909, and on Nov. 16, 1909, the first ring of the cylinder for the east shaft was connected and sinking commenced. On Dec. 17 the cutting edge was down 35 ft. and the shield had been removed. Work was closed down for the winter, but has been again resumed and the task will be shortly completed.

To get the cylinder down 35 ft. and well into the clay so no trouble would be feared in resuming work the following force account was reported:

	Days.
Foremen	18
Laborers	110
Engineer	25
Firemen	28
Divers	18
Riggers	24

Up to the time work was stopped for the winter the cylinder had not been weighted, but the gate sections had been placed.

Charges for Water for Building Purposes.—The following schedule of charges for water for building purposes has been adopted by the water works department of South Bend, Ind.:

Per 1,000 brick laid	$0.06
Per cord stone laid	0.15
Per 1,000 cement blocks laid	0.50
Per 100 sq. yds. plastering	0.20
Per 100 sq. ft. cement walk	0.20
Per 100 lin. ft. cement curb	0.20
Per 100 sq. ft. cement floor (3 ins. or less)	0.10
Per 100 sq. ft. cement floor (over 3 ins.)	0.20
Sprinkling or dipping brick per 1,000	0.05
Per 100 cu. ft. of concrete	0.30
Meter rates for building purposes per 1,000 gals.	1.00

Reconstructed Tunnel Lining.—The report of the Committee on Roadway of the American Railway Engineering and Maintenance of Way Association contains the following recommended practice in lining railway tunnels: "We recommend the use of concrete for the permanent lining of tunnels requiring support. We recognize, however, that in certain conditions, e. g., when the movement of the material through which the tunnel is excavated is so rapid that concrete will not have time to reach a permanent set, a brick lining must be constructed. When brick are used for tunnel lining, that portion of the arch for a horizontal distance of five feet each side of the center line of track should be of vitrified brick laid in Portland cement mortar."

Unclassified and General Articles

Note: This section is devoted to methods and cost articles on construction work not properly coming under any of the preceding classifications.

Construction of a 135-Mile Wood, Stone and Cast Iron Pressure Pipe Line for Railway Water Supply with Some Costs.*

The works described here were developed to supply water for locomotives and other railway purposes for some 128 miles of the El Paso & Southwestern Ry. in New Mexico. They comprise a 422,000,000-gal. storage reservoir, three 2,500,000-gal. service reservoir and 135 miles of 16-in. to 3½-in. pipe line. Only the pipe line work is described here.

Starting at the storage reservoir at the elevation of 7,728 ft. the pipe line has the profile shown by Fig. 1. The line first strikes the railway from inland at Coyote, thence it follows the line. To Coyote the line is a gravity line; thence to Corona the water has to be pumped; from Corona to Santa Rosa the flow is again by gravity. A study of the profile developed a system of hydraulic grades, pipe diameters, and open stand-pipes limiting the pressure to 130 lbs. per sq. in., except on 19 miles of the pump main between Coyote and Corona where the estimated maximum pressure is 310 lbs. Investigation justified the assumption that wood pipe under a pressure of 130 lbs. would give satisfactory service for 25 years, on which basis it would be less expensive than cast iron, and therefore it was used. Cast iron was considered preferable to steel for pressures not exceeding 310 lbs. on account of its greater durability.

Wood Pipe.—Machine made, spirally wound, wood stave pipe, made in sections from 8 to 12 ft. long, with the exterior surface covered with a heavy coat of asphalt, was selected in preference to unprotected, continuous stave pipe. The diameters were not so great as to require the latter. The first 40 miles of wood pipe was furnished by the Wykoff Wood Pipe Co. of Elmira, N. Y., and the Michigan Pipe Co. of Bay City, Mich., delivered the remaining 76 miles.

The pipe is wound with flat steel bands of from 14 to 18 gage and from 1 to 2 ins. wide. The machine winds at any desired pitch and tension. At each end the spiral wind is doubled two turns, the second lying over the first and developing a frictional resistance similar to that of a double hitch of a rope around a post. The ends of the band are held by screw nails or a forged clip, the latter being the better. It has two or three spikes on the under side which seat into the stave, and two side lugs on top which turn down over the band. The latter passes twice over the seat on the clip, the first turn holding the clip to the stave, while the second turn is held by the lugs, which are hammered down over it. The end of the band is then turned back over the clip and held down by a staple. The staves are double tongued and grooved and from 1⅜ to 2 ins. thick. The smaller thickness is sufficient. The exterior face of the staves should be turned concentric with the axis of the pipe and form a circle, so that the band will have perfect contact with the wood. The joints are formed by turning a chamber in one end of the pipe and a tenon on the other, or both ends are turned to a true exterior circle and driven into a wood or steel sleeve. The chamber and tennon were used in this work. Finally each piece of pipe is covered with as much hot asphalt as it will carry.

The specifications required bands of mild steel, of 60,000 lbs. strength, with an elastic limit half as great. The winding was spaced to limit the tension to 15,000 lbs. per sq. in. If severe water hammer is present, the ordinary working stress should be materially less than the latter, otherwise the spiral bands will stretch enough to permit the water to spurt out between the staves. This was determined to be true on 4,500 ft. of 12-in. pipe connecting the Carrizozo Reservoir with a water column at the roundhouse there. In pumping tests at the mills, attempts were made, at various times, to burst the pipe, but they never succeeded. Before the elastic limit was exceeded, the water was running out between the staves as fast as the pump forced it in. On the following day, pipe thus tested would carry the pressure for which it was designed without leaking. Except for defects in the band, pipe of this kind will not burst in the service for which it is properly designed. This is true, without exception, of the 100,000 pieces of pipe in this service.

There has been some trouble with a number of the riveted splices on the banding. Such a splice occurs for every spool of banding used. In every case where one of these splices has pulled apart, the break was the result of defective riveting, permitting the rivets to pull out. In no case has a rivet been found sheared off, and even one good rivet appears to be sufficient to prevent rupture. The explanation is found in the high frictional resistance between the band and the pipe, which distributes the weakness of a bad splice over several adjacent turns of the band around the pipe. The band loosens a few turns only on either side of a parted splice, generally not more than three. In no case has any pipe been removed from the trench, repairs being made without interruption to the flow of water. It is desirable to substitute welding for the riveting of these splices. The trouble is not present with the round band, the wrapped splice of the latter giving practically 100 per cent efficiency.

The flat band was chosen for this work because it is the more effectively buried in and protected by the asphalt, and will not crush the soft wood staves under high pressure. The longevity of either the flat or the round steel band is dependent primarily on effective protection against contact with corrosive elements. Wrought iron should be used for this kind of service, and, for the same reason, for many other purposes.

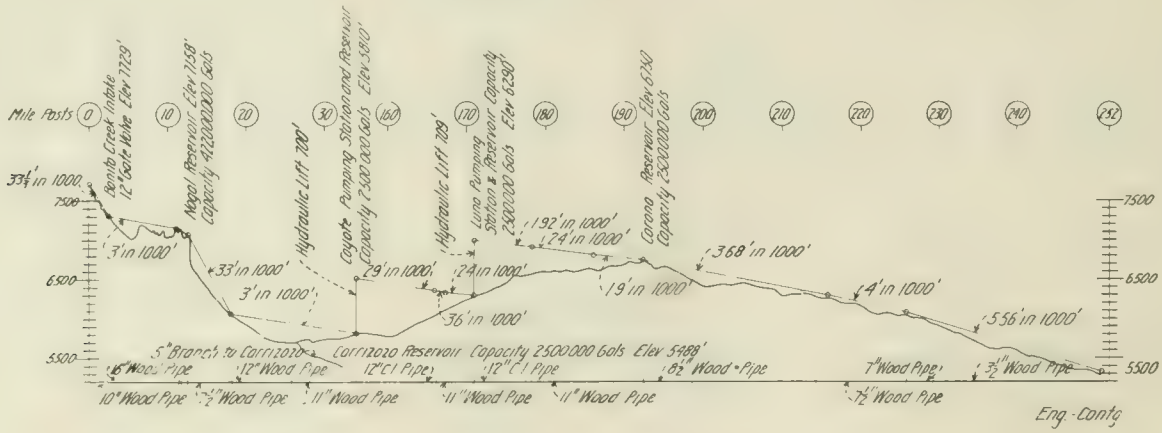
The staves of this pipe are of Michigan and Canadian white pine. This pine cannot now be had of clear stuff or in long lengths in large quantities, otherwise it is unexcelled. Douglas fir and yellow pine, coarser and harder woods, have the advantages of clear lumber and long length. Cypress is not as plentiful, and redwood is costly. The mill tests did not determine definitely the minimum degree of seasoning necessary, and press of time compelled the acceptance of some rather green lumber. Service tests do not show that there is any abnormal leakage from pipe made of such lumber, and it could not now be distinguished in the trench by such tests. Undoubtedly, however, thorough air seasoning should be required.

Owing to its small size, a part of the 3½-in. pipe was bored from the log. This was a mistake, for bored pipe has a rough interior and a reduced capacity. The inspection and culling are difficult and unsatisfactory, and imperfections readily apparent in a stave frequently escape detection in bored pipe.

The chamber and tenon of this pipe is an all wood joint, 4 ins. deep. An iron sleeve makes a better and stronger joint. It compensates for any lack of initial tension in the banding over the chamber of the wood joint, and secures full advantage of the swelling of the wood. Cast iron is better than steel; it is more rigid, and its granulated surface breaks up the smoothness of the wood surface swelling against it. One objection to the cast iron sleeve is that of cost, but it adds 4 ins. to the effective length of every section of pipe, as compared with the wood joints. On the Pacific Coast a banded wood stave sleeve is used with success.

To preserve the banding from corrosion and the wood from exterior decay, the pipe is thoroughly enveloped in refined asphalt having a flow point adjusted to the prevailing temperature during shipment and laying. One grade can be used through a considerable range of temperature. This coating endured a 2,000-mile shipment successfully. Each piece was carefully inspected along the trench and any break in the coating was thoroughly painted with hot asphalt. Enough of the latter came in barrels, with the pipe, from the factory.

The first 37 miles of this pipe has been in service for two years. Recent inspections show the coating to be in excellent condition and the steel underneath to be bright and clean. In some cases, where the initial pres-



Profile of 135 Mile Pipe Line for Railway Water Supply.

*Abstracted from a paper by J. L. Campbell in the Proceedings American Society of Civil Engineers, Vol. XXXVI, p. 531.

sure and leaking between the staves of the dry pipe were great, the escaping air and water lifted the coating into bubbles. At some points where this lifting was great enough to rupture the asphalt, and the soil is heavily charged with alkali, some corrosion has begun.

The integrity and impermeability of this asphalt coat are quite as vital as constant saturation. This coating protects the entire pipe from exterior contact with destructive agencies. With such effective exterior protection of the wood, this coated pipe has quite an advantage over continuous stave pipe.

Each piece of pipe goes directly from the winder to the asphalt rolls, then to an adjacent sawdust table, then back to the rolls, then to the table again, and then to the dry finishing rolls at the opposite end of the table. The coating thus consists of two layers of asphalt and two of sawdust. When the pipe leaves the finishing rolls, the coat is hard and smooth and about 3/16 in. thick. This describes the coating as done at Bay City, Mich.

At Elmira, N. Y., one application of asphalt through a bath of hot asphalt as it was wound, thus coating its under side also. This initial and sawdust only, without a finishing dry roll, completed the work; but the band was run treatment of the band on the Wykoff pipe is necessary because the exterior of the stave is neither planed nor turned to a circle. The exterior of the pipe forms a polygon and the band is in perfect contact only at the angles. The theory in regard to the Michigan pipe is that the perfect contact of the band and the wood on the true exterior circle excludes air from the under surface of the metal and prevents corrosion. Experience appears to justify this theory.

Cast Iron Pipe.—Beginning at the first pumping plant at Coyote, at Mile 156, and running up to Mile 166, and again commencing at the Luna pumps, at Mile 171, and extending up to Mile 179, the minimum pressure on those portions of the pump main is more than the 130 lbs. per sq. in. allowed for wood pipe, and the final estimated maximum pressures run up to 310 lbs. The selection of iron pipe for these pressures was, first, as between steel and cast iron, and, second, as between the lead joint of the standard bell and spigot pipe and the machined iron joint of the universal joint pipe. Again, the choice was as between lead and leadite for the bell and spigot pipe. Cast iron was selected because of the certainty of its long life and the bell and spigot pipe was selected on the basis of comparative costs for pipe laid. The standard lead joint was chosen on the result of tests. This cast iron pumping main has a diameter of 12 ins. throughout.

Makers of standard bell and spigot pipe urged the usual heavy weights selected for municipal service and heavy water hammer. Three pressures—viz.: 217, 260, and 304 lbs.—were used for the division of pipe weights, on which the standard pipe makers specified shell thicknesses of 0.82, 0.89, and 0.97 in. Eliminating water hammer and adopting a working stress of 2,400 lbs. the thicknesses are reduced to 0.54, 0.65, and 0.76 in. To make the latter conform to the specifications of the New England Water Works Association, the pipe was cast to 0.57, 0.65, and 0.77 in. The reduction in cost amounts to $52,811. By the provision of air cushions the writer's anticipation of no water hammer on the pumping main has been fully realized.

There was a question about the reliability of the lead joint at 300 lbs. The writer had a section of 12-in. pipe, with standard joints containing 22 lbs. of lead, laid and tested to 500 lbs. without sign of failure or leakage. The joints were calked down 3/16 in. below the face of the bell. Of 8,700 joints thus made in the field, not one has blown out or failed. A few weeped slightly on top, and they were made permanently tight by additional calking. The present maximum pressure is 278 lbs. These joints are the standard joints specified by the New England Water Works Association. It should be borne in mind that there is no water hammer on this line. In 8,700 joints, 198,000 lbs. of lead and 3,200 lbs. of oakum were used, or 22.76 and 0.37 lb. per joint.

Leadite was tested in competition with lead, but it leaked at 100 lbs. and failed under a sustained pressure of 300 lbs. It is a friable material, and cannot be calked successfully. Its principal ingredient appears to be sulphur. The failure was by slow creeping out of the joints. It is melted and poured, but not calked. It has attractive features for low pressures and for lines not subject to movement or heavy jarring.

Air Cushions.—To prevent water hammer on the pumping main, all pumps are provided with large air chambers. In addition and as the special feature for absorbing the shock of pumping under high pressure through a pipe 21 miles long, a large air chamber in the form of a closed steel cylinder, 5 ft. in diameter and 15 ft. long, is mounted on the pumping main outside of the pump house. This cylinder is set on its side, in concrete collars, directly over the pipe beneath, to which it is connected by a 12-in. tee, in which a 12-in. gate valve is set. The cylinder is provided with a glass gage, cocks, etc. It was designed for a working pressure of 300 lbs. and at each pumping plant it has proved to be entirely air and water tight. As indicated by sensitive gages on the pump main, just beyond these large air chambers, the latter absorb all the water hammer which gets beyond the air chamber on the pumps.

Pipe Line Leakage.—There is no measurable leakage from the iron pipe. By thorough inspection and measurement at the end of two years, leakage on the wood pipe, between Coyote and Bonito Creek, from the 11 and 12 in. pipe, was found to be as follows:

On 8.6 miles, 11-in. pipe, 146,600 gal. per day = 17,046 gal. per mile.
On 4 miles, 12-in. pipe, 14,829 gal. per day = 3,702 gal. per mile.

The 7½-in. pipe on this section appears to be leaking less than the 12-in. pipe. Inspection and measurement of it are to be made in a short time.

There is no material leakage from the 10 and 16-in. pipe between Bonito Creek and Nogal Reservoir, as determined by velocity and volumetric measurements. The greatest probable error in the velocity measurements would not exceed ½ per cent. If such error existed, and was all charged to leakage, it would amount to but 17,204 gals. per day, or 1,582 gals. per mile, out of a daily delivery of 3,784,000 gals.; but the measured discharge of the pipe, as determined by the velocity, was 5.84 sec. ft., while the mean maximum volume of this water over the weir at the end of the pipe is recorded by the weir as 5.88 sec. ft.

From Coyote east along the railway the wood pipe is remarkably tight. The rate of leakage from it, as determined by 600 observations uniformly distributed, was as follows:

11-in. pipe = 120 gal. per mile per day.
8½- and 7½-in. pipe = 268 gal. per mile per day.

The maximum rate on 1 mile was 1,613 gals. The minimum found was zero.

The observations were made by uncovering a joint and measuring the leakage therefrom for 10 mins. A graduated glass measuring to drams was used. The rate of leakage varied from 5 drops to 45 ozs. in 10 mins. Of the joints uncovered 57 per cent was found to be leaking. It is rather remarkable that, in the large leakage of the 11 and 12 in. pipe between Coyote and Bonito, only one out of every eight joints was leaking. This indicates a physical defect in such joints. The largest leak found on one joint was at the rate of 17,280 gals. per day. Leakage between or through the staves is not measurable, as it is not fast enough to come away in drops unless there is some imperfection in the wood.

The insignificant leakage of 120 gals. stated above is from the 11-in. pipe in the pumping main between Coyote and Corona. The present maximum working pressure on it is 100 lbs. per sq. in. All the figures given above include visible and invisible leakage, the latter being such as does not appear on the surface. The visible leakage is but a small part of the total.

Generally, any ordinary leak is readily stopped by pine wedges. Sometimes a loose joint requires individual bands bolted around it. Bran or saw-dust is effective in stopping the small leaks which cannot be reached by the wedges. The good effect of the latter is likely to be destroyed by a rapid emptying of the pipe. If the water is drawn out faster than the air can enter through the air-valves, heavy vacuums are formed down long slopes, and the air forces its way in through the joints and between the staves. The result is that the pipe will frequently leak badly for some time after it is refilled, although it may have been tight previously.

Pipe Breakage.—The breakage or damage to the wood pipe in shipment occurred on the ends, the tenons being most exposed to injury from shifting in the cars. The damage due to the shipment and handling of the Elmira pipe was 1 per cent and one-half as much for the Bay City pipe. Less than 6 pieces out of 100,000 laid, have had to be removed from the trench.

The iron pipe came from Chattanooga, and was badly handled in transit. Much of it was transferred en route, and 6 per cent was broken when received. The breaks were generally cracks of the spigot end. Of this broken pipe, practically all was cut and laid. The average cut was about 16 ins. from the spigot end of 533 pieces. This cut has caused no trouble in the trench.

At least 27 pieces of cracked pipe got past the field inspectors and into the trench. This cracked pipe began blowing out at a pressure of 50 lbs., and continued until the full normal pumping pressure was reached, when the breaks suddenly ceased. These pipes were broken out at the rate of 1 or 2 per day, with an occasional day between breaks. A 24-hour work-train service was maintained. The pipe gang soon became skilled, and could put in a new section of pipe in from 4 to 6 hours. Each break generally caused an interruption of about 6 hours to the pumps on the section where it occurred. The best record was 3 hrs. and 50 mins. from the stopping to the starting of the pumps. This strenuous life lasted 30 days. Most of these breaks were in or near the middle of the pipe. Evidently, the field inspectors were not expecting cracks in that locality. An inspection usually indicated that the pipe had been struck by the bell of another one in the vicinity of the break. All pipes were lifted from the car carefully and laid down at the trench along the track in a single movement by a logging crane, and were not broken in such handling. Three breaks only have been reported as due to defective metal or casting. No break of a sound shell of full thickness has been found.

Trenching.—Deep frosts are unknown in this section. The pipe was laid so that the top was about 1 ft. below the surface of the ground. The trenching was a simple matter. Part of the work between Bonito and the railway on the Carrizozo plain was done by Buckeye ditchers. All other ditching was done by a railroad plow followed by pick and shovel, or by the last two tools only. The ditcher could open 2,000 ft. of trench per day, but averaged about 500. The plow and 35 men could open 3,500 ft. A chain about 6 ft. long separated the end of the plow beam and the double tree. In this way the trench was plowed to the bottom. Two mules, two men and a scraper could back-fill 3,500 ft. per day.

Pipe Laying.—Between Bonito and the railway, one gang of ten men could lay 4,000 ft. of 12-inch pipe per day. The average was much less, owing to a variety of causes. At the end, the railway company added to the contractor's force, and laid the last 10 miles of pipe in 7 days, there being a half dozen separate gangs at work. Along the railway, the day's record on wood pipe was 4,000 ft. of 11-in., 6,200 ft. of 7½-in. and 8,345 ft. of 3½-in. pipe laid by a gang of eight men after the pipe was distributed along the trench. These eight men, of whom five were Americans, laid 76 miles of pipe, and became expert. Their operation was like the working of a clock.

On the 12-in. iron pipe, the regular day's work was 96 joints, or 1,152 ft. of pipe laid and caulked. The record was 1,644 ft. Two gangs laid 101,300 lin. ft. in 60 days. Such

a gang consisted of 1 foreman, 1 inspector, 8 caulkers, 4 yarners, 1 melter, 1 pourer, 1 helper and 10 men putting pipe into the trench.

Cost Data.—The pipe from Bonito to the railway was laid by contract. The price was 18 cts. per lin. ft. laid and back-filled from the railway to the Nogal Reservoir, and 28 cts. from Nogal to Bonito. In addition, 50 cts. per ton per mile was paid for hauling pipe, and extra compensation for setting valves. From Coyote, east along the railway, the work was done by the railway company under the writer's direction.

The total cost of laying 384,300 ft. of wood pipe, from 11 to 3½ in. in diameter, was $18,156.77, or 4.72 cts. per ft., divided as follows:

Ditching	$0.0249
Laying	0.0113
Back-filling	0.0110
Total	$0.0472

This includes unloading from the cars. Train service cost ⅓ ct. per ft. additional. The pipe gang, including back-filling, consisted of 1 foreman, at $100 per month, one assistant foreman at $75, and about 30 Mexicans at $1 per day. The rates were the same in the ditching gang. The plow team cost $6 per day. Including all general expense, the cost does not exceed 6 cts. per lin. ft.

The cost of laying 101,300 ft. of 12-in. cast-iron pipe was $23,826.67, or 23.5 cts. per ft., divided as follows:

Ditching	$0.0249
Laying	0.1180
Back-filling	0.0110
Lead	0.0790
Oakum	0.0014
Total	$0.2343

This includes train service and unloading pipe, but nothing for tools. The foreman and inspector received $100 per month, the caulkers, $3; pourer, $3; melter, $2.50; 2 pipe-men, $2, and laborers, $1 per day. Professional caulkers wanted $5 per day. Carpenters, blacksmiths, and boiler-makers made good caulkers; their work is standing perfectly under a 275-lb. service.

The cost of the pumping plants complete per horsepower is as follows:

	Per hp.
Pumps	$ 79.00
Boilers	18.70
Building	41.70
Total	$139.40

The approximate cost per million gallons of storage capacity is as follows:

Nogal Storage Reservoir	$ 103.00
Carrizozo Service Reservoir	3,040.00
Coyote Service Reservoir	2,880.00
Luna Service Reservoir	3,480.00
Corona Service Reservoir	2,720.00

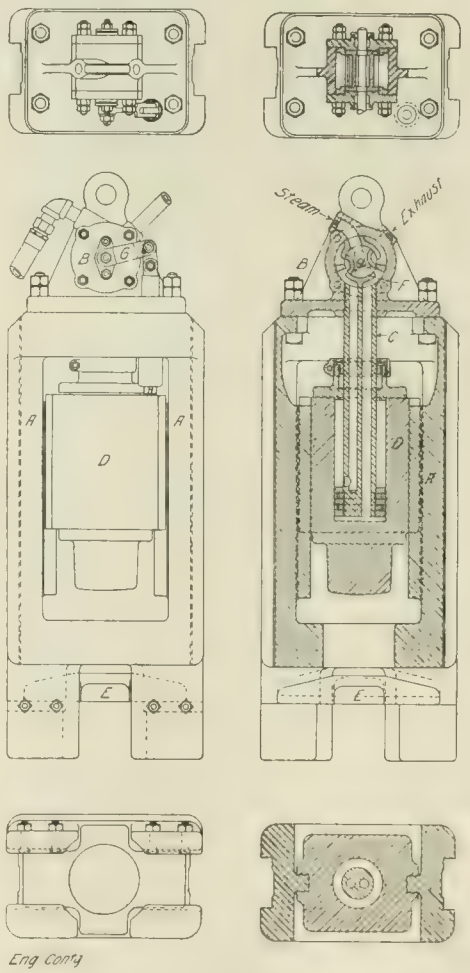
To cover general expense, 3 per cent should be added to all the costs above given. The costs per foot of pipe-laying include the setting of all specials, valves, and stand-pipes. The difference of cost in laying 11-in. and 3½-in. wood pipe is not nearly as great as the difference in diameter or the total quantity laid on record days. While the record is 4,000 ft. and 8,345 ft., the 76 miles of pipe of all diameters were laid in a total time, including all delays, of 223 days, or an average of only 1,723 ft. per day. The cost of the 11-in. pipe is covered by 7 cts. per ft. The pipe was laid by a single gang as fast as it was received from the factory.

A New Design of Steam Pile Driver.

The steam pile driver and the drop hammer pile driver have somewhat distinct fields of utility. For rapid driving of many piles close together the steam driver has, perhaps, superior advantages. Broadly, there are two types of steam pile drivers. In machines of the first type the steam acting under a piston raises a weight which is allowed to drop by gravity. In the second type of steam driver a double acting steam cylinder is employed; the steam after lifting the weight is turned and applied on top to propel the hammer downward at greater velocity than would result if it dropped by gravity alone. The steam driver illustrated by the accompanying drawings belongs to the second type described. It is the invention of A. A. Goubert of New York, N. Y., to whom we are indebted for the information which follows:

In the steam driver illustrated the novelty is introduced of making the piston and rod stationary and the cylinder movable. The cylinder forms the hammer. The reason given for this arrangement is that the percussion effects are taken by the heavy mass of the cylinder-hammer and do not affect the piston rod, pistons or other lighter parts. Referring to the illustrations: The driver consists of a heavy cast frame *A*, made to work in guides, which carries on its top a valve chest *B* from which is suspended rigidly the piston rod *C* and piston. The cylinder *D* is a heavy casting which slides on the piston rod and has on its bottom a nose or pene which strikes on a loose anvil *E* resting on the pile top. The bottom of the frame *A* sits over the head of the pile and at its top is an eye-ring to permit hoisting or lowering.

Referring to the construction in detail it will be seen that the piston rod *C* has two



Details of Goubert Steam Pile Driver.

bored channels which admit the steam alternately beneath and above the piston. This admission of the steam is controlled by a double D-valve *F* operated by a crank arm *G*, to the end of which is hung a weighted plunger *H*. When the cylinder nears the end of its up-stroke it hits and raises the plunger *H* which turns the valve so as to admit steam under the piston. The cylinder is forced down and strikes the blow and the percussion of this blow causes the plunger *H* to drop and reverse the steam to above the piston which forces the cylinder up again. Suitable springs in the plunger *H* prevent injurious shocks and regulate its movement.

As will be seen from the drawings this driver is notably free from fastenings likely to be loosened by concussion and the valve and valve actuating mechanism are comparatively simple and sturdy. The driver is made in three sizes, suitable for sheet piling 4 ins. thick up to round piles 18 ins. in diameter. The anvil block is cruciform so that it can be used for driving sheeting or round piles. Size No. 2 for 9 to 12-in. bearing piles has an 800-lb. ram and weighs altogether 2,000 lbs. The hammer strikes from 150 to 200 blows per minute. The height from top of pile to center of the lifting eye is 5 ft. 2 ins.

Cost of the New York Subway and of Operating It.

The underground railway in New York City, known as the Subway, is operated by the Interborough Rapid Transit Co., although the Subway is owned by the city. We shall consider the first cost of the Subway as it exists today, the cost of equipment and the cost of operation.

Contract No. 1, for construction and operation, was executed Feb. 21, 1900, with John B. McDonald, and provided for the construction of the present Subway (and its elevated portions) extending from the Postoffice to Kings bridge on the Broadway division and to 180th St. on the Lenox division. The contractor had to furnish the power plant and equipment (rolling stock) at his own expense. On Oct. 27, 1904, the first train was run from the Postoffice to 145th St.

As originally built under this contract (No. 1), there were 58 miles of single track in subway and tunnels and 11 miles of single track in the elevated portions, a total of 69 miles of single track, distributed as follows:

	Miles of Road-bed.	Miles of Tracking.
Single track line, arched tunnel	0.14	0.14
Double track line, standard	4.17	8.34
Double track line, arched tunnel	3.95	7.90
Double track line, in single tubes	1.36	2.72
Three track line, standard	2.20	6.60
Three track line, arched	0.17	0.51
Four track line, standard	5.64	22.56
Four track line, in double track arches	0.38	1.52
Five track line, standard	0.74	3.70
Eight track line, standard	0.25	4.00
Total subway	19.00	57.99

This is equivalent to an average three-track road.

In addition there were 2½ miles of elevated road on the West side and 3 miles on the East, or a total of 5½ miles of double track, or 11 miles single track elevated.

This includes all the lines from Chambers St. (Postoffice) to 230th St. on the Broadway (or West) side and to Bronx Park, 180th St., on the Lenox (or East) side.

The original bidding sheet contained the following items:

1,700,00 cu. yds. earth excavation.
921,000 cu. yds, rock excavation.
368,600 cu. yds. tunnel excavation.

2,989,600 cu. yds. total.
773,000 cu. yds. back fill.
65,000 tons steel.
7,900 tons cast iron.
489,000 cu. yds. concrete.
18,500 cu. yds. brick.
775,800 sq. yds. waterproofing.
6,640 sq. yds. vault lights.
305,380 lin. ft. of track.
48 railway stations (5 express).

Assuming that there were only 3,000 tons of steel and 2,000 cu. yds. of concrete per mile of double-track elevated, and charging all the rest to the subway, the following would be the quantities per mile of single track of subway for the 58 miles:

	Per mile single track.
Earth excavation, cu. yds.	30,300
Rock excavation, cu. yds.	15,900
Tunnel excavation, cu. yds.	6,360
Total excavation, cu. yds.	52,560
Backfill, earth	13,330
Steel, tons	835
Cast iron, tons	135
Concrete, cu. yds.	8,630
Brick, cu. yds.	220
Waterproofing, sq. yds.	13,380
Vault lights	114
Track (rails, ties, ballast, etc.), miles	1
Stations, number	0.7

NOTE.—Of the 58 miles of single track in subway, 12.6 miles were in arched tunnels or tubes, thus greatly reducing the total yardage of excavation, also reducing the steel.

There were only two bids on this entire work, and the contract was awarded (Jan. 16, 1890,) to John B. McDonald, for the lump sum of $35,000,000. The other bid was $39,300,000, by Andrew Ouderdouk. Since there were no unit prices bid, it is not possible to

give the exact cost of the subway as distinguished from the elevated part of this railway. Assuming, however, that the elevated portion (5½ miles double track) cost as little as $2,000,000, we have $33,000,000 left for the 58 miles of single track in the subway portion, or nearly $570,000 per mile of single track subway. Note, however, that exceedingly high prices would have to be applied to every item to give any such total. Unquestionably such high prices were used by the contractor, and that he was able to bid high was largely due to the nature of the contract, whose great size eliminated competition of smaller contractors. Moreover, the contractor bound himself to operate the Subway for 50 years after its completion, to install an electric power plant and to furnish adequate equipment, none of which was embraced in his $35,000,000 price. Since this was the first project of its kind in America, the problematical nature of the financial success affected the bidding price.

Under Contract No. 1, the following has been the cost to the city up to June 30, 1908:

Original contract	$34,483,000
Extra work	5,544,428
Total paid to contractor	$40,027,428
Terminals	1,750,000
Real estate	2,368,527
Interest on corporate stock	3,695,166
Total	$47,841,121

Contract No. 2, the Brooklyn extension of the Subway, was awarded July 21, 1902, to the Rapid Transit Subway Construction Co., with which Mr. McDonald was allied. The price was $2,000,000 for the construction plus $1,000,000 for real estate. The contract price was far less than the actual cost, for the Rapid Transit Co. desired to control the situation. It is claimed by the company that they expended $10,000,000 in excess of the amount received from the city. This Brooklyn extension (Contract No. 2) involved building a double track line from the Postoffice to the Battery, a tunnel under the East River and a subway to the intersection of Flatbush and Atlantic avenues, Brooklyn, a total distance of about three miles.

The cost to the city, under Contract No. 2, has been as follows up to June 30, 1908:

Original contract	$1,803,530
Extra work	1,281,611
Total paid contractor	$3,085,141
Real estate	$1,805
Interest on corporate stock	282,400
Total	$3,449,346

This makes the grand total of Contracts Nos. 1 and 2 amount to $51,290,467.

The cost has been exceedingly high, and is not a safe criterion by which to judge the probable cost of similar work in the future, even in New York City. The only published data of actual cost to the contractor are to be found in ENGINEERING-CONTRACTING, Feb., 1906, reprinted in the second edition (1910) of Gillette's "Handbook of Cost Data." These units costs show that the subway work, expensive as it has been, has cost far less than the city has paid.

As for the equipment, the contracts provided that 3-car trains should be run on the local lines at 2-min. intervals, and 4-car trains on the express lines at 5-min. intervals, that each car should seat at least 48 people, that express trains should be able to maintain a schedule speed of 35 miles per hour, including 10 secs. stops every 1½ miles. Local trains were to have a schedule speed of 15 miles per hour.

The motor cars first installed were provided with two 200 HP. motors, or 400 HP. each, and a loaded motor car weighed 43½ tons. A trailer car weighed 33 tons loaded.

The power house was 211x693 ft. x 123 ft. high, total nearly 18,000,000 cu. ft. The cost has not been made public.

The power originally provided was 11 generators of 5,000 K. W. each, or a total of 55,000 K. W.

The first order placed for power plant machinery (in 1901) was as follows:

6—5,000 KW. alternators.
3—250 KW. exciters.
26—1,500 KW. converters.
78—558 KW. transformers.
8—motor-generator starting sets.

It was stated that the price of this electric equipment was $1,500,000, which is equivalent to $50 per K. W. of generator power.

The equipment (rolling stock) consists of 850 cars, of which 500 are wooden and 350 steel. The cost of the wooden bodies was $3,350 each, and the cost of the steel bodies was $5,500 each. About 60 per cent of the cars are motor cars, the rest being trailers. The total cost of these cars, including their electrical equipment, is reported at $8,650,058, which is a little more than $10,000 per car.

The Interborough Rapid Transit Co. reports to the Public Service Commission, June 30, 1908, that the electrical plant, land and equipment had cost them as follows:

1.	Engineering and superintendence	$ 487,030
2.	Electric line construction	4,552,796
3.	Buildings and fixtures used in operation of road	4,571,822
4.	Power plant equipment	6,140,776
5.	Shop tools and machinery	70,182
6.	Cars	8,650,059
7.	Miscellaneous	709,655
	Total "equipment"	$25,182,320
8.	Real estate used in operation	1,417,728
	Total "equipment" and real estate	$26,600,048

If we add to this the $51,290,468 paid for construction by the city, we have a total of $77,890,516, not including the $10,000,000 said to have been lost by the contractors on Contract No. 2, above mentioned.

On the basis of a 55,000 K. W. power plant, we see that the plant cost as follows:

	Per KW.
Electric line construction	$ 83
Buildings and fixtures	83
Power plant equipment	112
Real estate	25
Total	$303

The mileage operated in 1908 was as follows:

	Miles.
First track	24.63
Second track	24.00
Third track	13.77
Fourth track	7.50
Total trackway	69.90
Sidings and turnouts	9.35
Total track	79.25

In round numbers, therefore, it would appear that the Subway system has cost more than $1,000,000 per mile of single track, including power plant and rolling stock. However, the enormous traffic accounts in large measure for this cost, since 33 per cent of the total first cost is charged to power plant, rolling stock, electric line, construction, etc. Since the $26,600,000 expended for this purpose provides for power plant and equipment that delivered 44,000,000 car miles in 1908, we have an investment in power plant and equipment amounting to about 60 cts. per annual million car miles. Statistics given in Gillette's "Handbook of Cost Data" (1910 edition) show that the rolling stock alone of the street railways of Massachusetts cost 26 cts. per annual million car miles. If we consider merely the $8,650,000 worth of rolling stock on the New York Subway, we see that it amounts to less than 20 cts. per annual million car miles. Therefore, what seems at first to be an almost incredibly high first cost of equipment, proves to be reasonable when measured in terms of the service it performs.

The Subway began operation in 1905. The operating expense for 1908 was as follows:

	Maintenance of Way and Structures:	
1.	Track and roadway	$ 361,476
2.	Electric line	79,587
3.	Buildings and fixtures	74,230
4.	Undistributed expense	27,620
	Total maintenance of way	$ 542,913
	Maintenance of Equipment:	
5.	Steam plant	$ 100,379
6.	Electric plant	21,054
7.	Cars	365,004
8.	Electric equipment of cars	378,231
9.	Shop expenses	62,023
10.	Undistributed expense	16,487
	Total maintenance of equipment	$ 943,178
	Operation of Power Plant:	
11.	Wages	$ 210,501
12.	Fuel	683,915
13.	Water	67,703
14.	Lubricants and waste	20,846
15.	Miscel. supplies and expenses	29,891
16.	Undistributed expense	42,366
	Total operation of power plant	$1,055,222
	Operation of Cars:	
17.	Superintendence of transportation	$ 20,498
18.	Wages of conductors	571,379
19.	Wages of motormen	215,690
20.	Wages of miscel. car service men	146,322
21.	Wages of car house employes	50,007
22.	Car service supplies	45,587
23.	Miscel. car service expense	40,815
24.	Hired equipment	425,366
	Total operation of cars	$1,515,664
	General expenses:	
25.	Salaries, gen. officers and clerks	$ 133,287
26.	Printing and stationery	7,927
27.	Miscel. office expense	18,531
28.	Miscel. general expense	27,505
29.	Damages	61,437
30.	Legal expense due to damages	29,503
31.	Miscel. legal expense	58,743
32.	Insurance	19,354
	Total general expense	$ 366,337
	Grand total	$4,423,313

The total car miles was 44,005,213. The cost of operation per car mile was 10.05 cts., and can be estimated in cents per car mile with sufficient accuracy by multiplying any of the above 32 items (expressed in millions) by 2.25.

The following is a summary of the cost:

	Per car mile, etc.
Maintenance of way and structures	1.18
Maintenance of equipment and power plant	2.22
Operation of power plant	2.38
Operation of cars	3.58
General expense	0.69
Grand total	10.05

The following statistics of the year's operation are of interest:

555,271 car miles per mile of all track.
30,538 car hours per mile of all track.
2,529,209 passengers per mile of all track.
199,740,688 passengers at 5 cts. each.
699,000 passengers at 4 cts. each.

The motor cars have two 200 HP. motors, and weigh 43½ tons loaded. A trailer weighs 33 tons loaded.

There were 850 cars (60 per cent of which were motor cars). The cost of maintenance of this equipment was $821,744 ÷ 850 = $967 per car for the year 1908. The cars averaged a first cost of $10,000 each; this cost of maintenance was nearly 9.7 per cent for cars that were almost new.

Since 44,005,213 car miles were traveled by these 850 cars, the average was nearly 51,800 miles per car per year, or 143 miles per day.

Since maintenance of power plant cost $121,433, we have a maintenance cost of only about 2 per cent, but it must be remembered that this is a new plant, and that the maintenance costs are steadily rising, being twice as great in 1908 as they were in 1906.

In 1908, some 50 steel cars were built and electrically equipped at a cost of $13,930 per car. A recent report of the Philadelphia Rapid Transit Co. states that the steel motor cars used on their elevated roads have cost $12,500 complete.

In a subsequent issue we shall give the cost, per K. W. hr., of electric power developed for operating the Subway.

LETTERS TO THE EDITOR.

A Criticism of the Engineering Management of the U. S. Reclamation Service.

Sirs: I note that Senator Heyburn has introduced a resolution calling for a statement of the estimated amount of money which will be required to complete all the irrigation projects begun by the Federal Government. It will probably devolve upon the present heads of the U. S. Reclamation Service to furnish that information. I desire to call your attention to the fact that the present engineers are the same who made the original estimates for the service. It is estimated that the administration of Mr. F. H. Newell has been inefficient, which I believe is well founded.

The article from which I gleaned the following information states that Mr. Newell should have known the amount of money available for the Reclamation Service, and governed himself accordingly. The excuse offered for the deficiency, by his supporters, is "the increase in the cost of labor and materials," which I claim does not apply. My assertion is based upon the

fact that much of the work let under contract was done when the low prices prevailed; this being the case, the cost to the Federal Government would not be increased, but would fall upon the contractor.

I assert as a constructing engineer and contractor that I believe the real cause for the cost of the reclamation projects so exceeding the estimates is chargeable to the ineompetency of the Reclamation Service engineers, and can be summed up under the following subjects: (1.) The employment of inexperienced engineers. (2) Commercializing the profession. (3) Insufficient pay for competent engineers. (4) Inability of the head of the department of the Reclamation Service to see and correct these conditions.

At previous times and now the U. S. Reclamation Service has employed many competent engineers, but they are not retained long, for the reasons above stated.

In general, therefore, the basis of estimates has been wrong. Contractors upon these projects have been greatly abused and dealt with by sharp practices in order to keep down costs. Many have become bankrupt, and many have not yet received fair and just estimates, and therefore settlements are pending. Now the well informed contractors of the country realize these conditions and will not bid a reasonable price upon government work under the Reclamation Service.

I do not believe the present personnel of the Service can any more estimate the costs of work under their management today than they could at the beginning.

For your further information I will cite the following: draw your own conclusions: On Feb. 1, 1906, bids were submitted by numerous contractors upon the construction of the Payette-Boise Project, Idaho. Messrs. Conway & Willhite were the successful bidders on Schedule 3 Main Canal from Indian Creek to Deer Flat Reservoir. The contract was granted and upon the basis of the engineer's estimate amounted to a liability of $95,400.00; owing to change of plans and erroneous classification in the original estimate, these contractors were paid a total of $224,588.85, or over 135 per cent more than was originally estimated. The records of the Reclamation Service will show the truth of this statement. Many similar cases are available.

Yours respectfully,

H. D. PAGE.

Boise, Idaho, March 30, 1910.

Automatic Regulating Dams.

Sirs. In reply to Subscriber's query in your issue of March 23, regarding any form of automatic sluice or flood gate, will say: A gate designed by the writer for use in the Peri-Yar District in India may fulfill his requirements. The gate which was 6 ft. square was swung on a horizontal axis consisting of an iron rod 2 ins. in diameter and firmly fastened to the gate 18 ins. from the bottom. It worked in oiled grooves on the side, and was so weighted at the bottom that when the water started to flow over the top, the gate overbalanced and assumed a horizontal position down stream with the water. When the pressure was relieved, the overweighted bottom pulled the gate into position. This gate could be adapted if necessary, so that the top portion would swing up stream as Subscriber mentions but would not allow the passage of driftwood and other debris, which would be caught between the gate and the floor.

A novel type of automatic regulating gates for dams was used in the Bhatgur dam in India, designed by Mr. J. E. Whiting, M. Inst. C. E. The gates are balanced by counter-weights in pockets in the masonry similar to the usual window weights, and as the water raises it flows into those pockets by means of little holes. This water reduces the weight of the counterpoises and the gate sinks into a slot. As the water recedes, the pockets are emptied and the counter-weights pull the gate back into position again.

A type of gate designed to allow flood waters to pass over it and very commonly used in Australia, is shown at page 238 of Wilson's "Irrigation Engineering." The advantages of this gate are first, that it allows flood water and drift wood to flow over the top; second, the amount of water released can be easily regulated, and third, in opening the gate the clear water is drawn off leaving the silt at the bottom. By means of a rocker nut on the wheel shaft, many adaptations of this gate can be made.

While not automatic, a series of 31 quick opening gates was used in the Lake Avalon dam, Pecos Valley, New Mex. The gates were hinged at the side like a door, and could be opened by the stroke of a hammer on a latch bar at each gate and the water flows through them immediately. To close them, flash boards were placed on the inner side to take off the pressure. Details of this gate can be seen in the "Engineering News," Sept. 17, 1896.

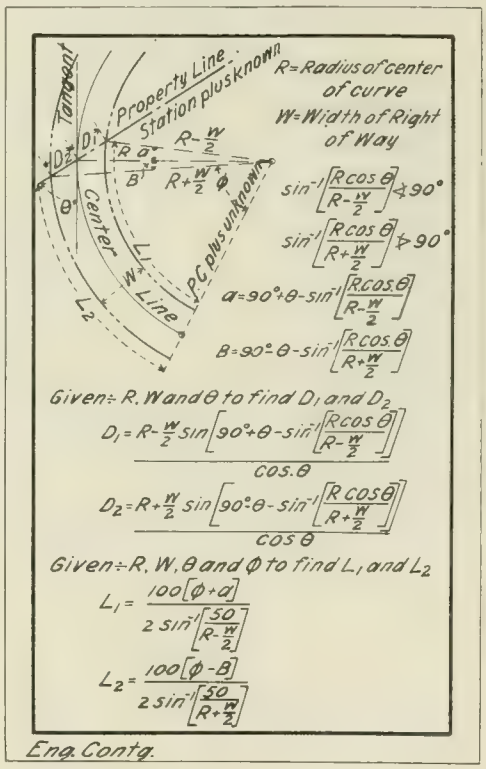
None of these gates mentioned are absolutely water tight.

W. D. ROHAN.

634 22nd Street.
Denver, Colo., April 4, 1910.

How Should a Draftsman Read These Notes?

Sirs: Concerning the letter under the above title from Sutphen, W. Va. (Eng.-Contg., March 2, 1910) showing a difference of opinion between a transitman and a draftsman, I would say that it was an error on the draftsman's part not to notice that the sum of the angles did not equal 180°. I think, however, that the transitman should have shown in his notes the angle to the


Tangent
Property Line
Station plus unknown
R=Radius of center of curve
W=Width of Right of Way
Center Line
P.C. plus unknown
Given:- R, W and θ to find D1 and D2
Given:- R, W, θ and Φ to find L1 and L2
Eng. Contg.

tangent to the curve at the point of intersection. I disagree with him when he says he would have to turn two angles, one depending on the other. The station plus of the point of intersection fixes the deflection of sta. 44 from the P.C. or the P.T. of the curve. Had he turned the angle from the P.C. or the P.T. to the intersecting tangent and subtracted the deflection angle, it would have given him the required angle, and that with one reading of the vernier. To avoid such disputes as he mentions, the general rule should be to always turn the tangent angle. Remembering, of course, that every rule has its exceptions.

I enclose a small blue print (made to fit in a field book) of some formulas which may be useful to your readers. In making right-of-way sketches to be attached to deeds where the description follows the boundary, it is necessary to calculate the distance shown on the blue print. The values of D_1 and D_2 are correct whether Theta is forward angle to the right or left. The values of L_1 and L_2 are based on the general

curve formula, $L = \frac{100 \text{ delta}}{\text{degree of curve}}$

I would like to have the opinion of others as to whether the length as I use it, or the actual length of arc, should be used. I base my opinion on the fact that in all other cases curve lengths shown are calculated from the formula above given.

Unimportant as these matters are, they are the subject of more or less discussion in the office.

M. C. HUTCHINS,
Chief Draftsman Waynesburg & Blacksville St. Ry. Co.
Waynesburg, Pa., March 3, 1910.

Personals.

Mr. W. W. Wallace, advertising manager of the Berger Manufacturing Co., Canton, O., died on March 29, 1910.

Mr. L. H. Conklin, recently general manager of the Scranton Electric Co., Scranton, Pa., has been engaged by J. G. White & Co., New York City, as engineer in its operating department. Mr. Conklin was educated at Pratt Institute, Brooklyn, N. Y., and has had a wide experience in electric operating and construction work. He is a member of the American Institute of Electrical Engineers.

Caleb Wheeler Durham, Civil Engineer, died Monday, March 28, 1910, at Peekskill, N. Y., in the 63d year of his age. He was born Feb. 6, 1848 at Tunkhannock, Pa. As a young man he served in the Civil War as a private, first in the 42d Regt. Pennsylvania Volunteer Militia in 1863, and in the 195th Regt. of the same state in 1864. He subsequently studied at the University of Michigan, in the class of '69 and commenced work as an assistant engineer in the employ of the New York Central Railroad. In 1872 he was principal Assistant Engineer on the location of the Texas and Pacific Railroad in Arizona and New Mexico. The previous year he was engineer in charge of construction of a section of the Chicago and Northwestern Railroad and subsequently in general practice in Chicago as engineer and surveyor. He invented an improved hot air furnace embodying the principles now recognized as essential in the best types of furnace, and a system of hot air heating and ventilation, and in 1880 invented and afterward carried on business of installation of the Durham System of house drainage, consisting of wrought iron or steel pipe with special threaded fittings, now almost universally employed in large buildings. On the recommendation of Col. Waring he installed the entire drainage system in the Capitol at Washington. He married May 28, 1873, Clarissa Safford Welles of Ann Arbor, Michigan, who died in 1907. They are survived by four sons. Mr. Durham was a member of the Chi Psi fraternity, one of the early members of the Civil Engineers' Club of the Northwest and a charter member of the Engineers' Club of New York. For 19 years he was a member of the American Society of Civil Engineers.

Catalogs Worth Having.

Engineers and contractors should have on file the latest catalogs of machines, tools and supplies that they use. In sending for catalogs reviewed or advertised in this paper, you will confer a favor on us if you will write directly to the advertisers and state that you saw the catalog mentioned in ENGINEERING-CONTRACTING. If you are in the market for tools, machinery or supplies, tell us and we will notify promptly the leading manufacturers.

Engineers' Office and Field Instruments and Supplies.—Paper folder, 3½x6 ins., 9 pp. The Engineering Agency Supply Dept., Monadnock Block, Chicago.

Concrete Separator.—Paper, 3½x6 ins., 12 pp. Concrete Separator Co., 1123 Broadway, New York City.

Illustrates and describes a simple device for separating wall forms in concrete work.

"Industrial" Railway.—Paper, 3½x6 ins., 80 pp. C. W. Hunt & Co., 45 Broadway, New York City.

This pamphlet deals briefly with the mechanical principals and interesting details of narrow-gauge track and rolling stock.

Glyco Metal.—Paper, 4½x7¼ ins., 80 pp. Joseph T. Ryerson & Son, 16th and Rockwell Streets, Chicago, Ill.

A description of this metal with useful information and rules for users of bearing metal.

Tool Steel.—Paper, 4½x7½ ins., 64 pp. Joseph T. Ryerson & Son, 16th and Rockwell Streets, Chicago, Ill.

A description of the various lines of high-grade tools handled by this company, together with directions for treating to insure best results.

Ore Grinding Machinery. The Evans-Waddell Chilean Mill. Paper, 6x9 ins., 14 pp. Bulletin No. 29 of the Power & Mining Machinery Co., Milwaukee, Wis.

Rock Crushing Machinery.—Paper, 6x9 ins., 70 pp. Catalog No. 4. Power & Mining Machinery Co., Milwaukee, Wis.

A description of the McCully Gyratory Crusher, with design for small, medium and large sized crushing plants.

Engineering-Contracting Monthly Review Index of Civil Engineering Literature.

A classified index and review of the civil engineering papers, articles, reports, pamphlets and books published during the month just passed is given in the succeeding pages. The literature indexed and reviewed—with the exception of books—relates solely to civil engineering. In the section devoted to Book Reviews all books in all branches of engineering are listed as received and such of them as seem worthy are reviewed as fully as due regard for conciseness will permit. In choosing books for review rigid selection is exercised. Next to careful choice of books for review timeliness of review is sought. All books are reviewed within a month of their receipt. The same statement is true of the articles and papers that are indexed. Also, as in choosing books for review, the choice of articles and papers for indexing is based on merit. Numerical strength in "titles indexed" is not sought; excellence of selection is sought.

The purposes of the Monthly Review Index are: First, to inform civil engineers and contractors of the articles and papers of merit that are published each month, in such a way as will give a clear idea of their character and scope; second, to supply the user with the date and place of publication, the length of each article and the cost at which it can be secured. The name, adopted abbreviations, place of publication and price per number of each periodical examined for civil engineering articles are given in the list immediately following. The other information is given in the index proper for each article separately.

Books reviewed will be sent post paid on receipt of price by the Book Department of ENGINEERING CONTRACTING; periodicals, etc., containing articles indexed should be ordered direct from the publishers.

LIST OF PERIODICALS INDEXED.

American Architect (Am. Arch.), New York, N. Y.; w; 7x10 in.; 15 cts.
American Builders' Review (Am. Bldrs. Rev.), San Francisco, Cal.; m; 7x10 in.; 50 cts.
American Carpenter and Builder (Am. Car. & Bldr.), Chicago, Ill.; New York, N. Y.; m; 7x10 in., 20 cts.
American Engineer and R. R. Journal (Am. Engr. & R. R. Jl.), York, N. Y.; m; 7x10 in.; 20 cts.
American Gas Light Journal (Am. G. L. Jl.), New York; N. Y.; w; 10x13 in.; 10 cts.
American Institute of Electrical Engineers Proceedings (Am. I. of E. E. Proc.), New York, N. Y.; m; 4x7 in.; 50 cts.
American Machinist (Am. Mchst.), New York; w; 7x10 in.; 15 cts.
American Society of Civil Engineers Proceedings (Am. Soc. C. E. Proc.), New York, N. Y.; m; 4x7 in.; 75 cts.
American Society of Mechanical Engineers Journal (Am. Soc. M. E. Jl.), New York, N. Y.; m; 4x7 in.; $1.
Annales des Ponts et Chaussees (An. P. & C.), Paris, France; m.
Applied Science, Toronto, Ont.; m; 6x9 in.; 30 cts.
Architects and Builders Journal (Arch. & Bldrs. Jl.), Baltimore, Md.; m; 9x13 in.; 20 cts.
Architects and Builders Magazine (Arch. & Bldrs. Mag.), New York, N. Y.; m; 5x8 in.; 20 cts.
Architect and Engineer of California (Arch. & Engr.), San Francisco, Cal.; m; 5x7 in.; 15 cts.
International Railway Congress Bulletin (Int. Ry. Cong. Bul.), Brussels; m; 50 cts.
California Journal of Technology (Cal. Jl. of Tech.), Berkeley, Cal.; m; 4x7 in.; 35 cts.
Canadian Architect (Can. Arch.), Toronto, Ont.; m; 7x19 in.; 20 cts.
Canadian Cement and Concrete Review (Can. Cem. & Conc. Rev.), Toronto, Ont.
Canadian Engineer (Can. Engr.), Toronto, Ont.; w; 7x11 in.; 20 cts.
Canadian Machinery and Manufacturing News (Can. Mach. & Mfg. News), Toronto, Ont.; m; 7x10 in.; 15 cts.
Canadian Mining Journal (Can. Min. Jl.), Toronto, Ont.; bi-w; 7x10 in., 20 cts.
Canadian Municipal Journal (Can. Mun. Jl.), Montreal, Que.; m; 6¾x10 in.; 10 cts.
Canadian Society of Civil Engineers Proceedings (Can. Soc. C. E. Proc.), Montreal; m; 4x7 in.; 50 cts.
Carpentry and Building (Carp. & Bldg.), New York, N. Y.; m; 11x8 in.; 10 cts.
Cassier's Magazine (Cas. Mag.), New York; m; 5x8 in.; 35 cts.
Cement, New York, N. Y.; bi-m; 5x8 in.; 35 cts.
Cement Age (Cem. Age), New York, N. Y.; m; 4¾x8 in.; 15 cts.
Cement and Engineering News (Cem. & Eng. News), Chicago, Ill.; 7x10 in.; 25 cts.
Cement Era (Cem. Era), Chicago, Ill.; m; 7x10 in.; 10 cts.
Cement-Record (Cem. Rec.), m; 4¾x8 ins.; 15 cts.
Cement World (Cem. Wld.), Chicago, Ill.; m; 9x11 in.; 10 cts.
Chemical Engineer (Chem. Engr.), Chicago, Ill.; m; 4x7 in.; 15 cts.
Clay Worker (Cl. Wkr.), Indianapolis, Ind.; m; 7x10 in.; 20 cts.
Compressed Air (Comp. Air), New York, N. Y., m; 5x7 in.; 10 cts.
Concrete, Detroit, Mich.; m; 6x9 in.; 15 cts.
Concrete Age (Conc. Age), Atlanta, Ga.; m; 9x11 in.; 10 cts.
Concrete and Constructional Engineering (Conc. & Cons. Eng.), London, England; m; 5x7 in.; 35 cts.
Concrete Engineering (Conc. Eng.), Cleveland, O.; m; 7x10 in.; 10 cts.
Contract News, Chicago, Ill.; bi-w; 7x10 in.; 10 cts.
Contractor (Contr.), Chicago, Ill.; bi-w; 7x10 in.; 20 cts.
Cornell Civil Engineer (Cor. Civ. Engr.), Ithaca, N. Y.; m; 4x7 in.; 25 cts.
Domestic Engineering (Dom. Engr.), Chicago, Ill.; w; 6x9 in.; 10 cts.
Electrical Age (Elec. Age), New York, N. Y.; m; 7x10 in.; 10 cts.
Electrical Review (Elec. Rev.), New York, N. Y.; 8x10 in.; 10 cts.
Electric Railway Journal (Elec. Ry. Jl.), New York, N. Y.; w; 7x10 in.; 10 cts.
Electrical World (Elec. Wld.), New York, N. Y.; w; 7x10 in.; 10 cts.
Electric Traction Weekly (Elec. Trac. Wkly.), Chicago, Ill.; w; 7x10 in.; 10 cts.
Engineer (Engr. Lon.), London, England; w; 4x11 in.
Engineer (Engr.), Chicago, Ill.; bi-w; 7x10 in.; 20 cts.
Engineering (Eng.), London, England; w; 8x11 in.
Engineering-Contracting (Eng.-Contg.), Chicago, w; 7x10 in.; 10 cts.
Engineering Digest (Eng. Dig.), New York; m; 5x8 in.; 20 cts.
Engineering and Mining Journal (Eng. & Min. Jl.), New York; w; 7x10 in.; 15 cts
Engineering Magazine (Eng. Mag.), New York; m; 5x7 in.; 35 cts.
Engineering News (Eng. News), New York; w; 8x11 in.; 15 cts.
Engineering Record (Eng. Rec.), New York; w; 8x11 in.; 10 cts.
Engineers' Club of Philadelphia Proceedings (Engr.'s Club, Phila. Proc.), Philadelphia; qr; 4x7 in.; 25 cts.
Fire and Water Engineering (F. & W. Eng.), New York, N. Y.; 8x11 in.; 10 cts.
Le Genie Civil Paris, France; w.
Good Roads Magazine (Gd. Rds. Mag.), New York, N. Y.; m; 7x10 in.; 10 cts.
Industrial Magazine (Ind. Mag.), Cleveland, O.; m; 4x7 in.; 10 cts.
Industrial World (Ind. Wld.), Pittsburg, Pa.; w; 7x10 in.; 10 cts.
Insurance Engineering (Ins. Eng.), New York; m; 4x6 in.; 25 cts.
Iron Age, New York, N. Y.; w; 7x11 in.; 15 cts.
Iron Trade Review (Iron T. Rev.), Cleveland, O.; w; 7x10 in.; 15 cts.
Irrigation Age (Irr. Age), Chicago, Ill.; m; 7x9 in.; 10 cts.
Journal Association of Engineering Societies (Jl. Assoc. Engr. Soc.), Boston, Mass.; m; 4x7 in.; 30 cts.
Journal Franklin Institute (Jl. Frank. Inst.), Philadelphia, Pa.; m; 4x7 in.; 50 cts.
Journal New England Waterworks Association (Jl. N. E. W. W. Assoc.), Boston, Mass.; q; 4x7 in.
Journal Western Society of Engineers (Jl. W. Soc. Engrs.), Chicago, Ill.; bi-m; 4x7 in.; 50 cts.
Journal of Electricity, Power and Gas (Jl. Elec., P. & G.), San Francisco, Cal.; w; 7x10 in.; 10 cts.
Journal of Worcester Polytechnic Institute (Jl. W. P. I.), m; 4x7 in.; 20 cts.
Machinery, New York, N. Y.; m; 7x11 in.; 20 cts.
Marine Review (Marine Rev.), Cleveland, O.; w; 7x10 in.; 15 cts.
Mines and Minerals (Mi. & Mls.), Scranton, Pa.; w; 7x9 in.; 20 cts.
Mining and Scientific Press (Min. & Sci. P.), San Francisco, Cal.; w; 7x11 in.; 15 cts.
Mining Reporter (Min. Rep.), Denver, Colo.; w; 7x10 in.; 15 cts.
Mining World (Min. Wld.), Chicago, Ill.; w; 7x10 in.; 10 cts.
Modern Machinery (Mod. Mchy.), Chicago, Ill.; m; 7x10 in.; 10 cts.
Municipal Journal and Engineer (Mun. Jl. & Eng.), New York, N. Y.; w; 7x10 in.; 10 cts.
Municipal Engineering Magazine (Mun. Eng. Mag.), Indianapolis, Ind.; m; 4x7 in.; 35 cts.
Ores and Metals (O. & M.), Denver, Colo.; bi-w; 6x10 in.; 10 cts.
Pacific Building Engineer (Pac. Bldg. Engr.), Seattle, Wash.; w; 9x11 in.; 15 cts.
Popular Mechanics (Pop. Mech.), Chicago, Ill.; m; 5x7 in.; 10 cts.
The Polytechnic (Poly.), Troy, N. Y.; m; 5x8 in.; 15 cts.
Power and Engineer (Pwr. & Engr.), New York; m; 7x10 in.; 20 cts.
Railway Age Gazette (R. R. Age Gaz.), New York; w; 8x11 in.; 15 cts.
Railway Master Mechanic (Ry. M. M.), Chicago; m; 7x10 in.; 10 cts.
Railway and Engineering Review (Ry. & Eng. Rev.), Chicago, Ill.; w; 9x11 in.; 10 cts.
Railway and Locomotive Engineering (Ry. & Loco. Eng.), New York, N. Y.; m; 7x10 in.; 20 cts.
Railway and Marine World (Ry. & M. Wld.), Toronto, Ont.; m; 7x10 in.; 15 cts.
Railway Engineering and Maintenance of Way (Ry. Eng. & M. W.), Chicago, Ill.; m; 7x10 in.; 10 cts.
Roadmaster and Foreman (Rd. & For.), Chicago; 7x10 in.; 10 cts.
Rock Products (Rk. Prod.), Chicago, Ill.; bi-w; 9x11 in.; 10 cts.
Rose Technic, Terre Haute, Ind.; m; 4x7 in.; 15 cts.
School of Mines Quarterly (Sch. Min. Quart.), New York, N. Y.; qr; 4x7 in.; 50 cts.
Schweizerische Bauzeitung, Zurich; w.
Scientific American (Sci. Am.), New York; w; 9x14 in.; 10 cts.
Scientific American Supplement (Sci. Am. Sup.), New York, N. Y.; w; 9x14 in.; 10 cts.
Sibley Journal of Engineering (Sib. Jl. Eng.), Ithaca, N. Y.; m; 4x7 in.; 20 cts.
Stevens Institute Indicator (Stev. Inst. Ind.), Hoboken, N. J.; m; 4x7 in.; 20 cts.
Street Railway Bulletin (St. Ry. Bul.), Boston; m; 6x10 in.; 10 cts.
Surveyor (Surveyor), London, England; w; 6x11 in.; 10 cts.
Technology Quarterly (Tech Qr.), Boston; qr; 4x6 in.; 35 cts.
U. S. Department of Agriculture Bulletin (Dept. Agr. Bul.), Washington, D. C.; 4x7 in.
U. S. Geological Survey Bulletin (Geo. Surv. Bul.), Washington, D. C.; 4x7 in.
Waterproofing and Fireproofing (W. P. & F. P.), Detroit, Mich.; m; 7x10 in.; 10 cts.
Zeitschrift d. Oest. Ing. u. Arch. Ver. Vienna; w
Zeitschrift d. Ver Deutscher Ing.; Berlin; w.

ROAD AND STREETS.

Method and Cost of Road Surfacing with 2-in. Concrete Cubes.—Eng.-Contg., March 2, 1910, ½ p.; Eng. News, March 3, 1910, ⅔ p.

Describes an interesting method of road construction using 2-in. concrete cubes. Methods of construction and costs are given.

Concrete Pavement Construction at Richmond, Ind.—Eng.-Contg., March 2, 1910, ½ p.

A brief description of the several constructions of concrete pavement that have been used in Richmond, Ind., since 1896. Methods of construction are stated and notes given on durability.

Work of the Municipal Asphalt Repair Plant of Brooklyn, N. Y., in 1909, with Detailed Costs of the Repair and Maintenance of Asphalt Pavements.—Eng.-Contg., March 16, 1910, 2 pp.

This article gives a complete statistical report of the work of the Municipal Asphalt Plant at Brooklyn, N. Y., for the year 1909. Tables are given summarizing the cost of maintenance work, cost of restoring pavement openings and cost of general maintenance of asphalt pavements. These costs are itemized and given in detail. The article is a valuable one for city engineers.

Suggested Standard Specifications for Macadam, Brick, and Granite Block Pavement, Creosoted Wooden Block Pavement and Concrete Pavement.—Eng.-Contg., March 9, 1910. 2¾ pp.; Eng. News, March 17, 1910. 2½ pp.

This is a reprint of the specifications decided upon at the convention of City Officials held in Chicago to draw up standard paving specifications. The specifications given cover all the different forms of pavement mentioned in the title.

Data on Steam Road Roller Practice in English County Councils.—Eng.-Contg., March 9, 1910, 1¼ pp.

This article gives actual records of steam road roller performance as determined by various county councils of England. These records will be found of value to American road builders.

Data on Street Cleaning in St. Louis, Mo.—Eng.-Contg., March 9, 1910, ⅔ p.

Gives statistics of the amount of street cleaning work in St. Louis, Mo., describes the organization and presents average unit costs.

Suggested Standard Practice for Pavement Bonds and Guarantees and Suggested Specifications for Asphalt and Bituminous Pavements.—Eng.-Contg., March 23, 1910, 3 pp.; Eng. News, March 10, 1910, 1 p.

This is a reprint of the report produced at the Chicago Meeting of City Officials for Standardizing Paving Specifications on the subject named in the title.

Some Methods and Costs of Oiling Roads in St. Louis with a Description of a New Construction Employing Molded Slabs of Bitumen and Aggregate.—Eng.-Contg., March 23, 1910, 2⅔ pp.

This is an exceedingly interesting article giving blank forms for keeping records and costs of oiling roads. A special method of asphalt macadam road construction using thin molded slabs of asphalt is described.

Cost Data on Macadam and Gravel Roads Construction in Peel County, Ontario.—Eng.-Contg., March 30, 1910. ½ p.

Describes briefly methods of constructing a number of crushed stone and gravel roads and gives itemized cost of this construction.

Method and Cost of Snow Removal in St. Louis, Mo., by Flushing it Through the City Sewers.—Eng.-Contg., March 30, 1910, 1⅓ pp.

Describes method followed in disposing snow by flushing it through the city sewers at St. Louis, Mo. A map is given showing the location of the snow traps and details of the snow trap construction are also illustrated.

Experimental Work of the New York State Highway Commission.—Eng. Rec., March 12, 1910.

Summarizes data obtained in experiments made to determine the cost and effectiveness of certain materials and methods for building and resurfacing roads. Glutrin, bituminous macadam, concrete cubes, asphalt macadam, and concrete constructions were experimented with and also various kinds of surface dressings.

Municipal Asphalt Plant, Kansas City, Mo.—Eng. Rec., March 5, 1910, 1½ pp.

Describes construction of a plant having a capacity of 7,000 sq. yds. of 2-in. topping per 8-hour day. A lay-out plan of the plant is given. The plant has several novelties in labor saving devices for storing and handling raw materials.

State Road Work in New York in 1909.—Eng. Rec., March 5, 1910, 2¼ pp.

Summarizes the report of the State Commission of Highways of its first year's work. The organization is outlined, and the adopted lines of improvement are explained for each class of highways. Under maintenance many data and some costs are given of work of oiling roads.

Standard Paving Specifications.—Mun. Jl. & Eng., Mch. 9, 1910. 3 pp.

Contains a report of the convention recently held in Chicago to standardize paving specifications and presents the specifications adopted for brick pavement; stone blocks; concrete work; concrete sidewalks; concrete curb and guter; pavement foundations; concrete pavements.

Bituminous Highway Construction.—By C. A. Kenyon. Cont., Mch. 1, 1910. 1½ pp.

Condensed from a paper read before the 1910 Annual Convention of the Indiana Engineering Society. Gives methods and costs.

Specifications for Sheet Asphalt Pavement, Bituminous Concrete Pavement, Concrete Sidewalks, Curbs, Gutters and Pavement and Creosoted Wood Block Pavement.—Mun. Eng. Mag., April, 1910. 10 pp.

The above are the specifications drawn up by the various committees of the "Organization of City Officials for Standardizing Paving Specifications," which held its first convention at Chicago, Feb. 21 to 26, 1910.

Some Curb Details.—Mun. Jl. & Eng., March 23, 1910. 1 p.

Contains descriptive matter and illustrations regarding high curbs in business and residence streets, steps in curbs, curb corner guards, and gives details of concrete curb and gutter with vitrified brick edge.

Pollution of New York Harbor.—By Kenneth Allen, Mun. Jl. & Eng., March 23 and 30, 1910. 6 pp.

The author describes in a general way the investigations that have been conducted by various state commissions to investigate the conditions attending the disposal of sewage in the metropolitan district. A considerable amount of data collected by the various commissions is given in the article.

Amount of Pavement in the United States.—Mun. Jl. & Eng., March 2, 1910. 10 pp.

Tables containing statistics concerning paving in all the cities of the country of over 30,000 population and in many cities of less size. The first table shows the amount of the several kinds of pavement in the United States in miles, up to the end of 1907. These figures were compiled by the U. S. Census Bureau. Another table compiled by the Municipal Journal and Engineer brings the figures up to Jan. 1, 1910. And still another table shows the amount in square yards and miles of the several kinds of pavement laid in 1910.

Wood Block Paving Specifications.—Mun. Jl. & Eng., March 2, 1910. 1 p.

The specifications adopted by the Board of Estimate and Apportionment of New York City for use in that city.

Asphalt Block Paving in Toledo.—By F. O. Consaul. Mun. Jl. & Eng., March 2, 1910.

The article describes the composition of the asphalt blocks and gives the specifications of the city of Toledo, O., for the blocks and their laying.

Redressing Granite Paving Blocks.—By S. C. Thompson. Mun. Jl. & Eng., March 2, 1910. 1½ pp.

Describes the method of repaving a portion of Webster Ave., New York City, with old granite blocks taken up and redressed with new heads. The manner of recutting the old blocks is illustrated.

Economics of Street Pavements.—Mun. Jl. & Eng., March 2, 1910. 2½ pp.

A valuable article discussing the comparative value of different kinds of pavement and showing how this value can be determined. Estimates on the costs of granite block pavements, sheet asphalt pavements and macadam pavements, and their comparative value and economy are given. The matter is taken from the reports of Samuel Whinnery to the Boston Finance Commission.

Street Paving.—Mun. Jl. & Eng., March 2, 1910. 39 pp., ill.

This is the annual "Paving Number" and the articles are on "Brick Pavements in Ohio," "Smooth Granite Block Pavements," "Economics of Street Pavements," "Wood Blocks," "Asphalt Pavements," "Amount of Paving in American Cities."

London Paving Materials.—Surveyor, March 18, 1910. 4 pp.

Notes taken from the 7th Annual Report of the Metropolitan Paving Committee of London, England. The notes treat of the kinds of pavement laid in the various districts of the city, and give some details regarding them. Tables are given showing the average initial cost of laying the several kinds of pavements, and the engineer's opinion as to the wearing qualities. Wood block appears to be the principal type of pavement laid.

Dustless Roads.—Surveyor, March 28, 1910. 2 pp.

The article, which is taken from the last issued report of the Dust and Dustless Roads Committee of the Royal Automobile Club, contains an interesting summary of the causes of dust. Figures are also given as to the amount of tar-mac and tar treated macadam in the several road districts.

A Comparison of Cost and Efficiency of Methods of Street Lighting.—By N. R. Birge. Mun. Eng. Mag., April, 1910. 5 pp.

The author gives comparative costs of operating an open arc system and series luminous arc rectifier system. Comparisons are also made between carbon, filament and tungsten incandescent lamps.

Detroit Municipal Asphalt Plant.—By Len G. Shaw. Mun. Jl. & Eng., March 2, 1910. 1 p.

Contains cost figures on the operation of the municipal asphalt plant of Detroit, Mich., for 1909.

Brick Pavements in Ohio.—Mun. Jl. & Eng., March 2, 1910. 12½ pp.

General descriptive articles dealing principally of the brick pavements constructed in the city of Cleveland, Cuyahoga County and Columbus. A description of the method of constructing the brick paved roads in Cuyahoga County is also given. Some data on the cost of operating the municipal asphalt operated repair plant at Columbus, O., is likewise included.

Smooth Granite Block Pavements.—By W. A. Howell. Mun. Jl. & Eng., March 2, 1910. 2½ pp.

Includes specifications for new form of granite block pavement, being close joints grouted with cement, laid in Newark, N. J., last year. In addition a considerable amount of interesting information is given regarding the construction of this type of pavement in Newark.

Asphalt Repairing in St. Augustine.—Mun. Jl. & Eng., March 2, 1910.

Describes the repairing of asphalt pavement at St. Augustine, Fla., with a portable plant and gives data on the cost of the work.

SEWERS.

Sewage Disposal Ideals.—By W. C. Easdale. Surveyor, March 11, 1910. 4 pp.

In this article the author points out the usefulness of all ordinarily accepted methods of sewage disposal, and makes many useful comments upon the various systems. He also brings out many practical points regarding general designs, details of construction and management. The discussion of the paper is given in the March 18 and 25 issues of The Surveyor.

Sewage Distribution Tests at Mount Vernon, N. Y.—By C. A. Hammond. Eng. News, March 24, 1910. 2½ pp.

Distribution accomplished by letting sewage fall in solid cylindrical streams from overhead nozzles and strike splash cups set 2 ft. above filter surface. Tests made to determine discharge of various sized nozzles and relative efficiency of spray distribution produced by splash cups of different form under various conditions. Results are given in tables and diagrams.

Sewage Treating Station of the Sanitary District of Chicago.—By Langdon Pearse. Eng. News, March 31, 1910, 5¼ pp.

Gives plans of sewage testing outfit of the station and details and views of special features of apparatus. The object of the investigations is explained, the testing plant and methods of conducting the test work are described and some results of the investigations are given.

Reinforced Concrete Sewer Bridge.—Eng. Rec., March 26, 1910. ¾ pp.

Bridge consists of two parallel reinforced concrete girders carried on piers 33 ft. apart and having joined between them and supported by them a 24-in. circular reinforced concrete conduit. Structural details are shown and described, method of construction outlined and itemized costs are given.

Necessary Elements for Water Works Valuation.—Eng. Rec., March 12, 1910. 1⅔ pp.; Eng. News, March 10, 1910. 1 p.

Outlines four common methods of valuation, discusses each and then outlines the elements to be considered in the method of valuation by reproduction. Describes first making of inventory and then outlines the requirements for close and just estimating from the inventory.

Large Storm Sewer Supported on Piers.—Eng. Rec., March 19, 1910. 1⅓ pp.

Shows section and views of rectangular reinforced concrete sewer supported by piers under the side walls. The structural portions are described with some account of the method of construction and a statement of bidding prices. The use of collapsible bents for the inside forms will interest contractors.

WATERWORKS AND HYDRAULICS.

Feather River Hydro-Electric Plant, Great Western Power Co.—Ry. & Eng. Rev., March 5, 1910, 3 pp., ill.

A description of the rebuilding and enlargement of a 60,000-hp. plant in California. The original tunnel was built nearly 30 years ago for gold mining purposes.

Laying 12 Miles of Pipe in Colorado.—Cont., March 1, 1910. 3 pp., ill.

An interesting description of the laying of 12 miles of 36-in. reinforced concrete pipe under exceptional difficulties in a mountainous country.

Structural Features of a 24-Mile Steel Pipe Line for the Portland, Ore., Water Works.—Eng.-Contrg., March 2, 1910, 1¾ pp.

Illustrates details of the 24-mile steel pipe line to be built for the Portland, Ore., water works. Gives abstracts of the specifications relating to various features of the pipe line work.

Plans and Specifications for Early Timber, Earth and Masonry Dams Built in Connecticut.—Eng.-Contg., March 9, 1910. 4¾ pp.

This article is interesting as presenting plans and sections of a large number of dams built in Connecticut previous to 1891. The several dams are briefly described and many extracts are given from the specifications controlling their construction.

Method and Cost of Constructing a Concrete Water Tower at Victoria, B. C.—Eng.-Contg., March 9, 1910. 2½ pp.

Describes a water works tower of reinforced concrete, 109 ft. high and 22 ft. in diameter. The methods of construction are described in detail and the forms for the concrete work are illustrated. Complete itemized unit costs of the work are given.

Method and Cost of Reforesting the Marginal Lands of the Wachisett Reservoir Metropolitan Water Works, Boston, Mass.—Eng.-Contg., March 23, 1910. 2 pp.

An interesting and somewhat unique article describing the methods employed in planting trees along the margin of a large water works reservoir. The methods of growing trees in nurseries and of replanting them are given in detail. Itemized costs of the work are also given.

Some Costs of Construction of the Cincinnati, Ohio, Filtration Plant.—Eng.-Contg.. March 30, 1910. ⅓ p.

Summarizes the costs of the main features of the Cincinnati Filtration Plant and compares these costs with the cost of the filter plant at Columbus, Ohio.

Construction of the Barker Dam.—Contractor, March 15, 1910. 4 pp.

Describes structural features and general methods of constructing a rubble concrete dam of 140,000 cu. yds. The contractors plant is described in some detail.

Partial Failure of Concrete Dam at Austin, Pa.—Eng. News, March 17, 1910, 2 pp.

Describes construction of and illustrates details of concrete dam 320 ft. long and 42 ft. high. Account of cracking and partial failure is given. Failure charged to unset concrete and to water getting under dam.

Action of St. Louis Water on Metals and Alloys.—Eng. Rec., March 19, 1910. 1⅓ pp.

The St. Louis water is treated with lime and sulphate of iron and this article presents test results of the action of this water on iron, zinc, alloys, copper and aluminum.

Construction of the Rainbow Falls Hydroelectric Development.—Eng. Rec., March 12, 1910. 4⅓ pp.

A description of the dam and hindworks construction of a water power plant operating under a head of 180 ft. The dam is a rock filled timber crib structure, 1,145 ft. long, and required some 5,000 M ft. of lumber, 5,500 cu. yds. of concrete and 50,000 cu. yds. of stone filling in its construction. The contractor's plant and general method of construction are described.

Ground Arch in Filler and Reservoir Construction.—Eng. Rec., March 12 and 19, 1910. 4⅓ pp.

A mathematical and economic investigation of the ground arch under the headings of volumes of elliptical ground arch units, effect of steel in groin unit, shrinkage and temperature changes, aid given by earth covering, construction stresses, floors, side and division walls, stub and beam construction. A very reliable paper on filter design.

RIVERS, HARBORS AND CANALS.

Structural Features of New Concrete Recreation Pier at Albany, N. Y.—Eng.-Contg. March 23, 1910. 2 pp.

Describes briefly and illustrates very completely the plans for a recreation pier having concrete bulkhead walls and boat-landings.

Relation of Forests to Stream Flow.—By Wm. W. Hurts. Eng. News, March 3, 1910, ¾ p.

Summarizes results of a detailed study of the records of the Tennessee and Cumberland rivers to determine effect of deforestation on floods. Records refute completely for these rivers the notion that there is any connection between deforestation and floods.

Influence of Floods on Climate and on Floods.—By W. L. Moore. Eng. News, March 3, 1910, 3⅓ pp.

Report of an investigation to determine the matter stated by the chief of the U. S. Weather Bureau. A very full discussion of the subject, leading to the conclusion that the run-off of rivers is not materially affected by any other factor than precipitation and that floods are neither of greater frequency nor magnitude since deforestation than before.

Movable Dam Across the Red River at St. Andrew's Rapids.—By H. P. Borden. Eng. Rec., March 26, 1910, 4¾ pp.

Notable as describing the first dam of the Camere curtain type to be constructed on this side of the ocean. The structural features are very fully described, some of the more important details are illustrated and the theory and method of operation is explained.

Distribution of Sea Water in the Charles River Basin After excluding Tidal Waters.—By M. F. Sanborn. Eng. News, March 10, 1910, 2 pp.

Presents diagrams, tables and descriptive matter showing rate of freshening of the water in the Charles River Basin after excluding tidal waters. Studies were also made to determine the vertical circulation caused by wind and rains and the interchange of fresh and salt water brought about by the operation of the lock.

Special Type of Head Gate for Irrigation Canals.—Eng. Rec., March 12, 1910, ⅔ pp.

Illustrates and describes briefly a reinforced concrete head gate structure, designed to do away with scour in soft channels. A suggestive article for irrigation engineers.

RAILWAYS.

Construction of the Western Pacific Ry.—Ry. & Eng. Rev., March 12, 1910, 2 pp., ill.

An excellent description of the building of a western railway. Maps and profiles are presented together with 77 reproductions of photographs and working drawings of structures.

Forestry Work of the A., T. & S. F. Ry.—Ry. & Eng. Rev., March 12, 1910, 4 pp., ill.

A very good article on the cultivation of the eucalyptus, a fast growing timber tree of great value.

Reinforcement of Conduit Rails at Washington, D. C.—By Philander Betts. El. Ry. Jl., March 12, 1910, 2½ pp., ill.

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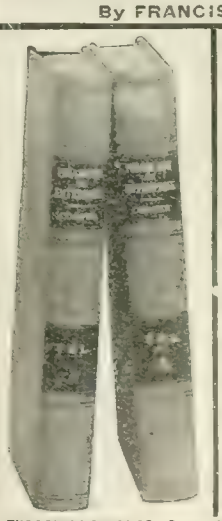

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derground power conduit, thus eliminating overhead trolley wires and poles to carry them. Yokes to carry the rails are placed 5 ft. apart, but the track sagged. This article describes methods and costs of placing reinforced concrete longitudinal girders under each rail bearing on the yokes, thus giving a rigid track.

Cost Iron and Steel Car Wheels.—El. Ry. Jl., March 12, 1910. 3 pp., ill.

A number of questions had been asked in Hartford shops of the Connecticut Company about car wheels. Mr. Beebe of the Griffen Wheel Co. went down on invitation and answered all the questions, this article containing the questions and answers.

The Hudson Bay Railway.—Eng. Rec., March 12, 1910, 1⅔ pp.; Eng. News, March 2, 1910, 1⅓ pp.

Summarizes the results of the surveys made for the proposed railway line to Hudson Bay at Ft. Churchill. Gives outline of character of country passed through and its natural resources, and describes physical characteristics of possible line with estimates of cost and other data. The report shows that the average open season of Hudson Bay at Ft. Churchill is 5 months.

Empaline Shops, Southern Pacific Railroad of Mexico.—Eng. Rec., March 12, 1910, 2 pp.

Shows lay-out plan of shop plant and gives a general description of the main structural features. Of value chiefly as showing plant lay-outs.

Oak Point Flout Bridges on the East River.—Eng. Rec., March 12, 1910, 3⅔ pp.

General description with essential plans of bridges for transferring railway cars from land to car flounts. The plant is notable for its size and for its mechanical completeness.

Unit Movements at Terminal Stations.—By H. Niel Harding. Eng. Rec., March 12, 1910, 2⅓ pp.

Presents as a basis for figuring the expense of handling freight at railway terminals, the product of the number of unit movements and the average load moved. Presents duties from actual records as to number of unit movements per hour and minute and average loads. Illustrates the use of these data in reducing expenses and increasing capacity. An unusually suggestive article.

Cost of Electric Operation of Steam Railways.—Eng. News, March 31, 1910, 2⅓ pp.

Discusses design of electriclocomotion, first cost of electrification, cost of operation, cost compared with steam, etc. A notably interesting paper.

New Subway Line for New York City; Its History.—Eng. News, March 10, 1910, 2 pp.

Gives map of original rapid transit subway, including extension to Brooklyn, of later Fourth Ave. subway line in Brooklyn, and of new triborough subway line now planned for construction. A historical outline of the development of these lines is given and the legal and other conditions affecting the construction, financing and operation of the new lines are described.

Economical Freight Transference at Railway Terminals and Shipping Docks.—By H. Neil. Harding. Eng. News, March 3, 1910, 5¾ pp.

Gives a number of costs of handling freight at terminals, points excessive proportions of terminal costs, describes present methods of freight handling and gives principles that must govern any mechanical arrangement for freight handling. Describes a "transpherage" on "space covering" system of overhead telpher lines, with diagrams showing range of application, etc. A notably suggestive article.

Protection of Cross-Ties From Mechanical Wear by Means of Plugs, Screw Spikes and Tie Plates, with Estimates of Costs and Savings.—Eng.-Contg., March 30, 1910, 1¾ pp.

This article endeavors to demonstrate by means of estimates and actual cost figures the saving which can be made by protecting cross-ties from mechanical wear by using plugs, screw spikes and tie plates. It is an unusually suggestive article to railway maintenance of way engineers.

Some Notes on Cost of Treating Ties with Preservatives.—Eng.-Contg., March 16, 1910, ¾ p.

A valuable article on the costs and economics of treating railway ties. A comparison is made between the cost of treating seasoned and unseasoned ties. Costs of treatment and returns on investment are discussed.

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BRIDGES, BUILDINGS AND FOUNDATIONS.

New Formulas for Base and Bearing Plates.—Eng.-Contg., March 16, 1910, 1¼ pp.

This article summarizes the formulas developed as a result of a series of experiments made at the University of Illinois. The article is a valuable one to structural and bridge engineers.

Specifications for Erection of Railroad Bridges.—Eng.-Contg., March 30, 1910, 2¼ pp.

A paper discussing the consideration which should be taken into account in preparing specifications for the erection of steel railroad bridges. A sample specification is included in the article.

Inside Glazed Greenhouses in the Berlin Botanical Gardens.—Eng. News, March 17, 1910, 2 pp.

Shows general plans of framework, including arched roof of 100 ft. span and 77 ft. rise for tropical building, describes general construction and illustrates and describes construction of inside glazing adopted to keep the steelwork from the moist inside air and render it more accessible for painting and repair.

Steelwork of the Bryant Building, New York.—Eng. Rec., March 26, 1910, 2⅔ pp.

Shows foundation plan, grillages and typical roof, columns and wall girders, details of structural steel frames for a 30-story building. The description is of the structural features alone.

Cantilever Construction and Wind Bracing Details in the People's Gas, Light & Coke Co. Building, Chicago.—Eng. News, March 10, 1910, 1½ pp.

This 21-story office building has its walls in two points supported above the third story carried on cantilever of 4 ft. 5 ins. projection; the supporting wall columns of the three lower stories are set back this distance to permit placing along the fronts a row of monolithic granite columns. Drawings and description of the cantilever construction are given and also details and description of the system of wind bracing adopted.

Steelwork in the New York Municipal Building.—Eng. Rec., March 19, 1910, 4⅓ pp.

Describes the general structural features of the steel framework for this 25-story building and for the 15 additional stories of tower. Plans are shown of typical column and beam lay-outs at various heights and details are shown of wall supports, column pedestals and footings and similar details. The treatment is purely descriptive.

Shepardstown Viaduct, Norfolk & Western Railway.—Eng. Rec., March 19, 1910, 2 pp.

The bridge is a combined steel tower viaduct and riveted truss bridge on masonry piers, having a total length of 1,438 ft. and a greatest height of 120 ft. General details are shown of the tower buts, plate girders for viaduct and the truss spans. The description is of the structural features alone.

New Plant of the Carters Ink Co.—Eng. Rec., March 19, 1910, 2 pp.

Shows block plan and floor plans of four-story L-shaped factory building, with a general description of the reinforced concrete structural features.

Reinforced Concrete Machinery Warehouse.—By H. M. Boyajohn. Eng. Rec., March 12, 1910, 1⅔ pp.

The warehouse is 100x400 ft., with a contral bay 50 ft. wide open to the roof and two side bays with galleries. The interesting details are the reinforced concrete columns, crane girders and gallery floors. Detail drawings of these are given.

Reconstruction of the Boyleston Street Bridge at Boston.—Eng. Rec., March 5, 1910, 4½ pp.

Describes in detail the structural features of the reconstruction work required to strengthen a 216-ft., pin connected skew span to carry heavy street railway traffic. Drawings of the various structural features are given.

CONCRETE AND REINFORCED CONCRETE.

Some Methods and Costs of Building Reinforced Concrete Cisterns.—Eng.-Contg., March 30, 1910, 1¾ pp.

This is an unusual article because of the cost data which is given on reinforced concrete tank construction. Five different tanks are described and the complete itemized cost of each is given.

Construction and Cost of an Inexpensive Steam Curing Oven for Concrete Block Plants, with Some Notes on Operation.—Eng.-Contg., March 30, 1910, 1⅓ pp.

This article describes the construction of a small curing oven, discusses the best methods to be followed in curing concrete blocks, and gives many figures of costs of oven construction and of operation.

A Method of Depositing Concrete by Chutes in Building Construction, with Costs of Actual Work.—Eng.-Contg., March 30, 1910, 1¾ pp.

Describes and illustrates a method of depositing concrete through chutes for building construction. The practice adopted in constructing a number of buildings is described and general figures of costs are given. An article of much interest to concrete building contractors.

Cost of Constructing a Reinforced Concrete Fence Around a Shaft Top.—Eng.-Contg., March 30, 1910, 1⅓ pp.

This is a very interesting article describing the method of constructing a reinforced concrete fence around the edge of a shaft top. The method of handling the forms is of particular interest. Unit costs of the work are given.

A Simple Method of Computing the Strength of Flat Reinforced Concrete Plates.—Eng.-Contg., March 23, 1910, 4¾ pp.; Eng. News, March 31, 1910, 3¼ pp.

This is a comprehensive investigation of the subject of methods of computation of flat reinforced concrete plates. The discussion is largely mathematical and chiefly of interest to designing engineers.

Method of Constructing Concrete Lining for Bergen Hill Tunnels; Pennsylvania R. R. Tunnel Extension to New York City.—Eng.-Contg., March 16, 1910, 8⅓ pp.

This is a very complete description of the methods employed and plan used in lining a twin tube railway tunnel with concrete. The work called for the laying of electrical conduits and for complete water-proofing. These features are described in detail. A table is also given showing the labor force employed, the rates of wages paid and the total daily labor expense.

Results of Tests of Model Concrete Arches Made in Connection with the Design of the Medina Aqueduct, New York Barge Canal.—Eng.-Contg., March 16, 1910, 3¾ pp.; Eng. News, March 10, 1910, 3¼ pp.

The tests were made on a series of model arches. The testing apparatus is described, tables are given of the loads which the arches supported and diagrams and figures are presented showing the methods of failure.

A Comparison of the Efficiency and Economy of Different Designs of Reinforced Concrete Columns.—Eng.-Contg., March 9, 1910, 3½ pp.; Cement, March, 1910, 13 pp.

An unusually valuable article on concrete columns. It gives the results of a series of tests tending to show the comparative economy of concrete, reinforced concrete and structural columns. The data given will be found of special value to the designing engineers.

Methods and Costs of Sinking the Brier Hill Concrete-Lined Shaft, Michigan.—Eng.-Contg., March 2, 1910, 1¾ pp.

Describes the method of sinking and lining a circular shaft with concrete. Drawings are shown of the concrete plant and the forms used and the itemized cost of the lining is given.

A Method of Heating Broken Stone in Wagons for Concrete Work.—Eng.-Contg., March 2, 1910, ⅓ p.

This article describes a simple method adopted for heating broken stone in wagons. A grid of steam pipes was lowered on top of the load and live steam turned on.

A Method of Long Span, Light Floor, Reinforced Concrete Construction, with Comparative Costs.—Eng.-Contg., March 2, 1910, 1 p.

This article shows drawings for a 53-ft. reinforced concrete girder. It also makes some comparisons of cost between this girder construction and fireproof steel construction.

Method and Cost of Constructing a Concrete Block Warehouse.—Eng.-Contg., March 2, 1910, 1¼ pp.; Eng. News, March 10, 1910, ½ p.

This article describes the methods employed in constructing a one-story warehouse of concrete blocks and gives itemized cost of manu-

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facturing the blocks and placing them in the walls of the building.

Comments on Contracting for Concrete Bridges with Description of a Form of Cost Recording.—Eng.-Contg., March 2, 1910, 1⅓ pp.

Describes a cost-keeping system intended for reinforced concrete bridge work. Illustration of blanks used are given and the method of collecting and recording the costs is described.

Method of Laying Concrete Under Water, Using a Tremie; Detroit River Tunnel.—Eng.-Contg., March 2, 1910, 2 pp.; Eng. News, March 17, 1910, 3 pp.; Cement, March 1910, 7 pp.

A general descriptive article relating to the methods adopted for placing concrete under water in constructing the Detroit River Tunnels of the Michigan Central R. R. The concrete was deposited by means of tremies, and a full description of the concreting plant and the methods and results of the work is given.

Representative Concrete Structures on the New York Barge Canal and Methods of Inspecting, Mixing and Handling Concrete.—Eng.-Contg., March 30, 1910, 2⅔ pp.

A general descriptive article relating to the various classes of concrete work being done on the New York Barge Canal. Representative structures are described and the methods of inspecting materials and mixing and placing concrete are outlined. Some of the plants illustrated are of unusual size and are novel in design.

Short Span, Single Track Concrete Arch Bridges.—Eng. Rec., March 19, 1910, 1⅓ pp.

Shows details of two reinforced concrete arches under embankment, describes structural feaures and gives itemized costs.

Twelve-Story Reinforced Concrete Building Without Interior Columns.—Eng. Rec., March 5, 1910, 1¼ pp.

The building described is 110½x48 ft. Details of the reinforced concrete framing are described and illustrated.

Standard Building Regulations for the Use of Reinforced Concrete.—Eng. Rec., March 5, 1910, 2¼ pp.

A reprint of the building regulations submitted by the National Association of Cement Users to little ballot for adoption as a standard of the association.

Further Tests on Effect of Electrolysis on Concrete.—By O. L. Etinge. Eng. News, March 31, 1910, 2 pp.

Describes methods and gives results of tests of effect of electrolysis on concrete blocks and briquettes. Conclusion is that direct damage of electricity is practically nothing.

Reinforced Concrete Arch Highway Bridge in Indiana Wrecked by Erosion of Foundations.—Eng. News, March 17, 1910, 1¾ pp.

Shows details of bridge as built and sketches and photographs of failure and describes construction and conditions found by study of wreck. Failure determined to be due to undermining of one of the piers by flood.

Reinforcing Compression Members of Concrete in a Plain Transverse to the Line of Thrust.—By R. A. Cummings. Eng. News, March 17, 1910, ⅔ p.

Gives results of a series of tests made on short reinforced columns reinforced in transverse plans with flat plates or wires or bands. Some interesting results are obtained.

EARTH AND ROCK EXCAVATION.

Some Records of Work with a Scraper Bucket Excavator on the New York Barge Canal.—Eng.-Contg., March 23, 1910, 1 p.

Describes work in excavating a canal section with a scraper bucket excavator. Complete record of 21 days' operation of the excavator are given, with a statement of the number of men employed in the work. An interesting article to earthwork contractors.

Method of Trenching for a Sewer at Auburn, N. Y., Using a Revolving Steam Shovel.—Eng.-Contg., March 2, 1910, ¾ p.

A brief article describing the method of constructing some 13 miles of sewer trench using a revolving steam shovel. The method of operating the shovel, the force required and the progress of work are stated.

Method of Making a 14,280-Cu. Yd. Blast in Basalt Rock, with Some Data on Costs.—Eng.-Contg., March 2, 1910, ⅔ p.

Illustrates plan of the tunnels and describes

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Method of Making a Steam Shovel Cut of Two Lifts in One Lift.—Eng.-Contg., March 2, 1910, ½ p.

Describes briefly the arrangement of tracks and shovels for excavating a cut in one lift which would normally have been excavated in two lifts.

Methods of Open Cut Rock Excavation at the Pennsylvania R. R. Terminal Station at New York, with Some Data on Drill Reformance.—Eng.-Contg., March 16, 1910, 2⅓ pp.

Describes in a general way the methods adopted in excavating some 521,000 cu. yds. of rock and earth for the foundations of the Pennsylvania R. R. Terminal Station at New York City. A special feature of the work was excavating under the structure of an elevated railway without disturbing traffic. diagrams are given showing the sequence of operations by which this task was performed.

Methods and Cost of Excavating Twin Tunnels Through Trap Rock for the Pennsylvania R. R. Tunnel Entrance to New York City.—Eng.-Contg., March 9, 1910, 6½ pp.

This is one of the most valuable articles on tunnel excavation that has been published for a long time. It gives very complete records of drilling and mucking work and also gives costs which will be found unusually valuable to tunnel men.

Shapes of Drill Bits in Use, with Comments on Efficiency and on Sharpening and Tempering.—Eng.-Contg., March 23, 1910, 1½ pp.

This article is interesting as showing by diagrams the various shapes of drill bits used in rock excavation and mining work in America and Europe. The characteristics of the several shapes of bits are discussed and the advantages and disadvantages of each shape are stated. The article concludes with some instructive suggestions on the best methods of sharpening and tempering drill bits.

Heavy Regrading by Means of Hydraulic Sliming, at Seattle, Wash.—By G. H. Moore. Eng. News, March 31, 1910, 3¼ pp.

Describes plant and methods of operation employed in reducing the grade of Denny Hill, comprising 46 city blocks by hydraulic sliming. Maps and profiles of the work and views of plant are given. The methods of operation are described. A general descriptive article.

Dredging Nome Beach Sands.—Min. & Min., March, 1910, 2 pp., ill.

Describes a form of dredge used in Alaska to mine the gold found in the sand and gravel on the beaches near Nome. Dipper and bucket dredges have been found to be unsatisfactory in mining under water where there is tidal action, so caissons are employed.

A Self-Dumping Barge.—By A. F. Wiking. Eng. News, March 10, 1910, 1 p.

Describes a barge the weight distribution of which can be so changed by means of air and water tanks that it can be tilted, dumped and righted by mechanical means.

Instrument for measuring and Recording Tunnel Sections.—Eng. News, March 3, 1910, ¾ p.

Illustrates and describes an instrument for recording graphically exact cross-sectional outline of a tunnel excavation. This outline is recorded to scale over a scale drawing of the planned tunnel section.

MISCELLANEOUS.

Strength of Treated Timber.—Eng. News, March 24, 1910, ½ p.

Conclusions from various tests of treated timber showing generally that treated timber is weakened by high steam preservers and heavy impregnation and is little affected by light impregnation.

Methods of Filing and Indexing Drawings and Photographs, Board of Water Supply, New York City.—Eng.-Contg., March 2, 1910, 1½ pp.

Describes in detail a filing system which has been used with success for a large organization.

History of the Ordnance Survey.—By J. J. Amos. Surveyor, March 25, 1910, 4½ pp.

An interesting article containing much information on the history of the English ordnance survey and on the methods of making it. A specially valuable part of the article is the description of the preparation of the ordnance maps.

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The Relation of the Steam Turbine to the Modern Central Station Practice—With Discussion.
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facturing the blocks and placing them in the walls of the building.

Comments on Contracting for Concrete Bridges with Description of a Form of Cost Recording.—Eng.-Contg., March 2, 1910, 1⅓ pp.

Describes a cost-keeping system intended for reinforced concrete bridge work. Illustration of blanks used are given and the method of collecting and recording the costs is described.

Method of Laying Concrete Under Water, Using a Tremie; Detroit River Tunnel.—Eng.-Contg., March 2, 1910, 2 pp.; Eng. News, March 17, 1910, 3 pp.; Cement, March 1910, 7 pp.

A general descriptive article relating to the methods adopted for placing concrete under water in constructing the Detroit River Tunnels of the Michigan Central R. R. The concrete was deposited by means of tremies, and a full description of the concreting plant and the methods and results of the work is given.

Representative Concrete Structures on the New York Barge Canal and Methods of Inspecting, Mixing and Handling Concrete.—Eng.-Contg., March 30, 1910, 2⅔ pp.

A general descriptive article relating to the various classes of concrete work being done on the New York Barge Canal. Representative structures are described and the methods of inspecting materials and mixing and placing concrete are outlined. Some of the plants illustrated are of unusual size and are novel in design.

Short Span, Single Track Concrete Arch Bridges.—Eng. Rec., March 19, 1910, 1⅓ pp.

Shows details of two reinforced concrete arches under embankment, describes structural feaures and gives itemized costs.

Twelve-Story Reinforced Concrete Building Without Interior Columns.—Eng. Rec., March 5, 1910, 1¼ pp.

The building described is 110½x48 ft. Details of the reinforced concrete framing are described and illustrated.

Standard Building Regulations for the Use of Reinforced Concrete.—Eng. Rec., March 5, 1910, 2¼ pp.

A reprint of the building regulations submitted by the National Association of Cement Users to little ballot for adoption as a standard of the association.

Further Tests on Effect of Electrolysis on Concrete.—By O. L. Etinge. Eng. News, March 31, 1910, 2 pp.

Describes methods and gives results of tests of effect of electrolysis on concrete blocks and briquettes. Conclusion is that direct damage of electricity is practically nothing.

Reinforced Concrete Arch Highway Bridge in Indiana Wrecked by Erosion of Foundations.—Eng. News, March 17, 1910, 1¾ pp.

Shows details of bridge as built and sketches and photographs of failure and describes construction and conditions found by study of wreck. Failure determined to be due to undermining of one of the piers by flood.

Reinforcing Compression Members of Concrete In a Plain Transverse to the Line of Thrust.—By R. A. Cummings. Eng. News, March 17, 1910, ⅔ p.

Gives results of a series of tests made on short reinforced columns reinforced in transverse plans with flat plates or wires or bands. Some interesting results are obtained.

EARTH AND ROCK EXCAVATION.

Some Records of Work with a Scraper Bucket Excavator on the New York Barge Canal.—Eng.-Contg., March 23, 1910, 1 p.

Describes work in excavating a canal section with a scraper bucket excavator. Complete record of 21 days' operation of the excavator are given, with a statement of the number of men employed in the work. An interesting article to earthwork contractors.

Method of Trenching for a Sewer at Auburn, N. Y., Using a Revolving Steam Shovel.—Eng.-Contg., March 2, 1910, ⅔ p.

A brief article describing the method of constructing some 13 miles of sewer trench using a revolving steam shovel. The method of operating the shovel, the force required and the progress of work are stated.

Method of Making a 14,280-Cu. Yd. Blast in Basalt Rock, with Some Data on Costs.—Eng.-Contg., March 2, 1910, ⅔ p.

Illustrates plan of the tunnels and describes

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the method of loading a blasting charge of some 3,500 lbs. of powder.

Method of Making a Steam Shovel Cut of Two Lifts in One Lift.—Eng.-Contg., March 2, 1910, ½ p.

Describes briefly the arrangement of tracks and shovels for excavating a cut in one lift which would normally have been excavated in two lifts.

Methods of Open Cut Rock Excavation at the Pennsylvania R. R. Terminal Station at New York, with Some Data on Drill Reformance.—Eng.-Contg.. March 16, 1910, 2⅓ pp.

Describes in a general way the methods adopted in excavating some 521,000 cu. yds. of rock and earth for the foundations of the Pennsylvania R. R. Terminal Station at New York City. A special feature of the work was excavating under the structure of an elevated railway without disturbing traffic. diagrams are given showing the sequence of operations by which this task was performed.

Methods and Cost of Excavating Twin Tunnels Through Trap Rock for the Pennsylvania R. R. Tunnel Entrance to New York City.—Eng.-Contg., March 9, 1910, 6½ pp.

This is one of the most valuable articles on tunnel excavation that has been published for a long time. It gives very complete records of drilling and mucking work and also gives costs which will be found unusually valuable to tunnel men.

Shapes of Drill Bits in Use, with Comments on Efficiency and on Sharpening and Tempering.—Eng.-Contg., March 23, 1910, 1½ pp.

This article is interesting as showing by diagrams the various shapes of drill bits used in rock excavation and mining work in America and Europe. The characteristics of the several shapes of bits are discussed and the advantages and disadvantages of each shape are stated. The article concludes with some instructive suggestions on the best methods of sharpening and tempering drill bits.

Heavy Regrading by Means of Hydraulic Sliming, at Seattle, Wash.—By G. H. Moore. Eng. News, March 31, 1910, 3¼ pp.

Describes plant and methods of operation employed in reducing the grade of Denny Hill, comprising 46 city blocks by hydraulic sliming. Maps and profiles of the work and views of plant are given. The methods of operation are described. A general descriptive article.

Dredging Nome Beach Sands.—Min. & Min., March, 1910, 2 pp., ill.

Describes a form of dredge used in Alaska to mine the gold found in the sand and gravel on the beaches near Nome. Dipper and bucket dredges have been found to be unsatisfactory in mining under water where there is tidal action, so caissons are employed.

A Self-Dumping Barge.—By A. F. Wiking. Eng. News, March 10, 1910, 1 p.

Describes a barge the weight distribution of which can be so changed by means of air and water tanks that it can be tilted, dumped and righted by mechanical means.

Instrument for measuring and Recording Tunnel Sections.—Eng. News, March 3, 1910, ¾ p.

Illustrates and describes an instrument for recording graphically exact cross-sectional outline of a tunnel excavation. This outline is recorded to scale over a scale drawing of the planned tunnel section.

MISCELLANEOUS.

Strength of Treated Timber.—Eng. News, March 24, 1910, ½ p.

Conclusions from various tests of treated timber showing generally that treated timber is weakened by high steam preservers and heavy impregnation and is little affected by light impregnation.

Methods of Filing and Indexing Drawings and Photographs, Board of Water Supply, New York City.—Eng.-Contg., March 2, 1910, 1½ pp.

Describes in detail a filing system which has been used with success for a large organization.

History of the Ordnance Survey.—By J. J. Amos. Surveyor, March 25, 1910, 4½ pp.

An interesting article containing much information on the history of the English ordnance survey and on the methods of making it. A specially valuable part of the article is the description of the preparation of the ordnance maps.

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PUBLICATIONS RECEIVED.

The Waterproofing of Structures with Special Reference to Sub-level Construction, the Envelope Method and the use of "Tunaloid."—Boston, Mass. J. A. & W. Bird & Co., 34-35 India St. Paper 6x9 ins. 45 pp. illustrated.

This trade publication is an excellent discussion of waterproofing, one of the important items in modern construction work. Half the pages contain matter that would not be out of place in a first class text book. The portion given over to a description of the materials manufactured by the company issuing the book is distinct from the technical discussion so the reader is not deceived or confused. It is an excellent example of good advertising.

The Fire Tax and Waste of Structural Materials in the United States.—By Herbert M. Wilson and John L. Cochrane. U. S. Geological Survey, Washington, D. C. Paper 6x9 ins.; 30 pp.

Gives data on fire waste, analysis of fire losses, causes of fire waste and cost of fire restriction. Comparisons are made with European figures.

Facts About the South.—By Richard H. Edmonds. Manufacturers Record Publishing Co., Baltimore, Md. Paper 6x9 ins.; 72 pp.

A statistical review of the industrial and commercial growth of the southern states.

Proceedings American Water-Works Association.—Published by the Association, Secy. J. M. Diven, Charleston, S. C. Cloth 6x9 ins.; 796 pp.; illustrated; $5.

Contains the proceedings, progress and discussions at the 1909 convention of the Association. A valuable collection of papers for any water-works engineer or superintendent.

Proceedings American Railway Bridge and Building Association.—Published by the Association, Secy. C. A. Lichty, 215 Jackson boulevard, Chicago, Ill.

Contains the committee reports and discussions and the business proceedings of the Association at its 1909 annual convention.

Report Ohio State Board of Health.—Published by the Board, Secy. C. O. Probst, Columbus, O. Cloth 6x9 ins.; 352 pp.

To engineers the parts of this report of most interest will be the vital statistics, and the reports of individual studies of water-supply and sewerage conditions at the various towns and cities of the state.

BOOK REVIEWS.

Practical Talks on Contracting.—Chicago, Ill. The Contractor Publishing Co. Cloth, 5½x8½ ins.; 128 pp.; illustrated, $1.50.

This book contains a collection of articles of practical interest reprinted from the "Contractor." Mr. Frank B. Gilbreth writes on "Systematizing a Contractor's Office." Mr. A. O. Davison has four articles: "Organization—How to Effect and Maintain It;" "Office System for Construction Work;" "Important Things to Consider in Estimating;" "The Operation of Camps and Commissaries." Mr. C. Arthur Warden writes on "Liability Insurance for Contractors," "Purchasing Records," "Tool and Equipment Records," "Daily Reporting System," "Earthwork Records." Mr. E. S. Hanson has an article entitled "Between Profit and Loss," and one on "How Contractors Use Photography." Reading matter like this is very good and the book can be recommended.

Oil Engines.—By A. H. Goldingham. Spon & Chamberlain, New York, N. Y. Cloth 4¾x7¾ ins.; 260 pp.; illustrated; $2.50.

This is a treatise on the oil engine as distinguished from the gas engine, that is it considers only engines burning kerosene, crude oil, coal oil, distillate, parafin, etc. It discusses first the design and construction of oil engines and second their erection, testing, installing, running and repairing. These second portions are, naturally, those which will most interest the construction engineer and contractor. The chapter on testing is particularly good, methods of conducting tests and apparatus used for testing being fully described. This chapter and chapters VII to IX, inclusive, on instructions for running oil engines, repairs and oil engine troubles are of practical value to the user. The remaining chapters take up oil engine design and construction facts, portable engines, etc. The present is the third edition of this book and it shows considerable revision of previous editions.

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The Doings of the Week.

The Transandean railway tunnel in Chile was formally opened on April 5. The tunnel, 12,000 ft. above sea level, is five miles long, and furnishes direct communication between Valparaiso and Buenos Aires.—A special committee of the Board of Estimate of New York city on April 6 decided to set aside $60,000,000 for new subway construction. This money will be used for the construction of the Broadway-Lexington Ave. subway and the Broadway-Lafayette Ave. subway in Brooklyn. Work on both routes will probably be started this year.—The stockholders of the Southern Pacific Co. on April 6 authorized the $50,000,000 increase in bonds on the company's property in San Francisco and San Mateo county, California. The proceeds of the bonds will be used to cover the original cost of the properties and to provide for their further improvement.—Two large contracts for work on the New York State Barge Canal were let last week. James Stewart & Co., 30 Church St., New York city, secured Contract No. 39 for dredging in the Oswego River between Three Rivers and Fulton, N. Y., and Lane Bros. Co., Altavista, Va., secured Contract No. 21 for work located near Rochester, N. Y.—Among the railroad construction contracts let recently are the following: Rinehart & Dennis Co., Washington, D. C., for six miles of work on the Carolina, Clinchfield & Ohio Ry. in Russell county, Va.; the Western Engineering Co., Emmett, Idaho, for grading the 19 mile extension of the Payette Valley Ry. in Idaho; the Alan Construction Co. for constructing the six mile traction line of the Beech Grove Traction Co. from Indianapolis, Ind.; W. P. Tierney & Co., Nelson, B. C., for constructing a 10-mile extension of the Kettle Valley lines; J. Hargrave & Co., Winnipeg, Man., for constructing the second line of double track for the Canadian Pacific from Winnipeg to Portage La Prairie, 56 miles; H. A. Whittier, Norwich, N. Dak., subcontract for 100 miles of team work on Great Northern Ry. from Surrey, N. Dak.; Dalton & Whyman, Amarillo, Tex., for two miles of street railway at Albuquerque, N. M.; the Utah Construction Co., Ogden, Utah, for constructing the Bingham & Garfield Ry., extending from Bingham Canyon, Utah, to Garfield, a distance of 17 miles; and George Webster, Winnipeg, Man., for the remaining 140 miles of the Tofield-Calgary branch of the Grand Trunk Pacific.—Bids for the first piece of work in connection with extensive levee and drainage improvements at East St. Louis, Ill., are being asked by the East Side Levee and Sanitary District, of that city. The contract, bids for which will be opened May 16, calls for the construction of a drainage channel for Cahokia Creek and includes 1,427,900 cu. yds. of excavation.—The Senate Committee on Commerce concluded its work on the river and harbor bill on April 8. The total amount of appropriations carried by the bill is $52,566,419, an increase of nearly $10,000,000 over the House bill. The more important additions which assisted in increasing the appropriations $10,000,000 were: The Ohio river, $1,000,000; the Hudson river, $1,000,000; North Carolina projects, $7,869,525; James river and other Virginia projects, $664,700; Texas rivers and channels, $350,000; Kentucky, $249,000; upper Mississippi river, all in Minnesota, $83,755; upper Missouri, $125,000.

Increased Cost of Railroad Building.

The greatly increased cost of materials and labor is held by many to be responsible for the fact that the railroads of the country are not undertaking greater amounts of new construction work at the present time. Some interesting figures on this increased cost of labor and materials were recently given by W. O. Winston of Winston Bros., railroad contractors, in an interview in a western paper. Mr. Winston stated that the increased cost was most apparent in the wages paid to labor. He stated that ten years ago the cost of building roads was 50 per cent less than it is today. At that time labor received from $1.50 to $1.75 per day and now receives from $2.25 to $2.50. Not only that, but with the increase in wages the efficiency of the men employed has decreased at an almost inverse ratio. At least the ratio of efficiency is 40 per cent less than it was 10 years ago. This is easily accounted for. When wages are high jobs are correspondingly plentiful and the men, knowing that they can hold their places with a minimum of effort, act accordingly.

Material of all kinds used in the construction of railroads has increased about 50 per cent, Mr. Winston stated. A team of heavy horses such as are used in grading is now valued at $600, where the team used to sell at $300. Their maintenance has proportionately increased, hay and grain of all kinds has nearly doubled in cost, as have many of the miscellaneous supplies. These things taken together have operated to advance the price of grading in level or prairie country from 12 to 18 cents per yard. In mountainous or hilly country, where steam shovels and other big machinery is used, the increase in ultimate cost has not been so large owing to the higher efficiency of the machines now in use over those of the last decade.

When's A Land Surveyor.

There has always been more or less ambiguity in the use of the term surveyor. Webster defines a surveyor as "one who measures land, or practices the art of surveying"; and he defines surveying as "that branch of applied mathematics which teaches the art of determining the area of any portion of the earth's surface, the lengths and directions of the bounding lines, the contours of the surfaces, etc., with an accurate delineation of the whole on paper." However, if there is any difficulty in defining the general term "surveyor," there should be none as regards the specific term "land surveyor," if the definition of the latter, which was formally adopted by the English Land Surveyors' Club in 1845, still holds good. The definition was as follows: "One who has learned the art of admeasuring and Delineating the Surface of a Country, is capable of Dividing, Allotting and Arranging for Inclosures, Commons or Waste Lands; or of Dividing or Allotting the Interest of those holding as Joint Tenants, Coparceners, or Tenants in Common, versed in the knowledge of the various products of Agriculture, their Values and Comparative Advantages, either as between Landlord and Tenant, Lord and Copyholder, Rector and Tithe paper, and in the relative Uses, Values and Mensuration of Standing or Fallen Timber, having at the same time a perfect knowledge of all that appertains to the Value, Contracts and Arrangement of Property in the character of Land Agent." If only as an example of anxious inclusiveness and a prodigal use of capital letters this definition is worthy of remembrance.

Big Doings in New York.

In New York city, where money talks louder than a megaphoned shrew fishwife, they are planning extensive construction work for the next few years. According to present plans, some of which are already under way, improvements involving the expenditure of $1,000,000,000 are to be made within the next 15 years. These plans include betterments and enlargements in nearly every field of municipal endeavor. Included in these plans is the construction of an adequate harbor at a cost of something like $100,000,000. This will be obtained by the conversion of the shallow and marsh lands of Jamaica Bay into a sheltered harbor having an area of 25 miles and affording hundreds of miles of wharfage. This new harbor, according to present plans, will also be made the terminal of the barge canal now being dug across the state to connect the Hudson River with the great lakes. New subways to cost about $200,000,000 are also proposed and the Board of Estimate has already authorized $60,000,000 to be spent at once on this work. Another improvement planned in connection with the city's means of transportation is the elevation or depression of intersecting streets at some of the busier points. Traffic on certain of the streets has now become so great that at certain busier points it will not be feasible much longer to have the streets cross each other at grade.

Blasting Damages.

Contractors engaged in construction in cities on which blasting is required are familiar with the many claims for damages to property along the work resulting from the use of the explosives. But it is seldom that they receive a more heartfelt appeal than the following, which Harper's Weekly asserts is an exact copy of a letter sent the claim agent of the Pennsylvania Railroad after the blasting for the tunnels leading to the new New York terminal had been finished. The writer was a Slav, who lived in one of the tenements on Thirty-first street:

"Dere Mr. P:—The panick is over. I want them sellar steps fixt rite off. My wife nere fell down last nite and like to broke her dam nec. Please send plumb and fix our bath tub. It soon be time for us to use him again."

The Western Pacific Ry. will probably build a branch to Reno, Nev., if present plans are carried out. A company has been formed to build a line from Reno to Verdi, where a connection will be made with the Verdi Lumber Co.'s road. It is then proposed to extend this road a distance of five miles to connect with the Boco & Loyalton R. R., which is controlled by the Western Pacific. The organizing company will in course of time, it is said, be taken over by the Western Pacific. Rights of way along the south side of the Truckee River have already been secured.

Confirmed Reports by Engineers and Contractors

RAILROADS, POWER DEVELOPMENTS, LEVEES, DRAINAGE AND IRRIGATION WORKS.

Railroads—Steam and Electric.

CALIFORNIA.

The San Diego, El Cajon & Escondido Ry. Co., which projects a 60-mile line from San Diego through El Cajon to Escondido, has completed surveys and has partly secured the capital for the construction of its line. The time for awarding the contract has not been determined but it may possibly be let within the next 60 days. A. C. Riordan, San Diego, Cal., is President and G. W. Pursell, San Diego, is General Manager and Chief Engineer.

IDAHO.

The Western Engineering Co., Emmett, Idaho, has been awarded the contract for grading for the 19 mile extension of the Payette Valley Extension R. R. Co., of which H. E. Dunn, Payette, Idaho, is general manager.

MONTANA.

Albert Walker, Missoula, Mont., has about 4½ miles of North Pacific double track work between Missoula and DeSmet. This is light work and involves about 29,000 cu. yds. of earth excavation.

NEW MEXICO.

Dalton & Whyman, Amarillo, Tex., have been awarded the contract for constructing two miles of street railway in the Highland section of Albuquerque, N. Mex., for the Citizens Traction & Power Co., of which A. W. Hayden, Albuquerque, is President.

NORTH DAKOTA.

A. Guthrie & Co., St. Paul, Minn., have the contract for grading the Great Northern Ry. line from Fargo to Surrey, S. Dak., a distance of about 225 miles.

H. A. Whittier, Norwich, N. Dak., has taken 100 miles of Great Northern Ry. team work for A. Guthrie & Co., St. Paul, Minn. This work begins at Surrey, N. Dak., and runs southeast to a point 12 miles southeast of New Rockford. There is a lot of first class machine work and Mr. Whittier can use a few good machine outfits. The work runs about 25,000 cu. yds. to the mile. Contractors wishing to figure on the work can get transportation of A. Guthrie & Co., St. Paul, Minn.

OHIO.

The Cincinnati, Portsmouth, Pomeroy & Pittsburg Traction Co., which purposes the construction of a 466 mile electric railway along the Ohio River Valley from Cincinnati, O., to Pittsburg, Pa., will not take up the matter of letting contracts for at least 90 days. Surveys are well under way as noted in previous issues of this paper. C. P. Sanborn, Huntington, W. Va., is Chief Engineer.

TEXAS.

The Nueces River Valley R. R. has completed preliminary surveys and has partially received the capital for the construction of its proposed line. The company is projecting a line 175 miles long by way of Oatville, Tilden, Cotula and Eagle Pass. Construction contracts are to be let within 60 or 90 days. John Andrawatha, Austin, Tex., is Chief Engineer. Wm. A. Frisby, Beeville, Tex., is President.

The Pecos Valley Southern Ry. has completed surveys from Pecos, Tex., to a point on the Southern Pacific Ry., and construction capital has been secured for 45 miles of line. Contracts were let on March 1, 1910, to T. N. Brigance, Pecos, Tex. About ten miles of line have been graded and five miles of steel laid. The total projected length of this road is 95 miles and it is to extend from Pecos southwest passing through Saragosa and Balmorhea. W. L. Cawile, Pecos, Tex., is President, and L. W. Anderson, Pecos, Tex., is Chief Engineer.

VIRGINIA.

Rinehart & Dennis Co., Evans Bldg., Washington, D. C., has just been awarded six miles of work on the Carolina, Clinchfield & Ohio Ry. in Russell county, Va., the contract amounting to about $100,000.

WASHINGTON.

The J. H. Flick Construction Co., Chicago, Ill., is beginning work on its contract filling in bridges on the line of the Chicago, Milwaukee & Puget Sound Ry. The work involves about 1,000,000 cu. yds. of filling, as previously noted in these columns. The equipment used on the work consists of a new 70-ton Bucyrus shovel and a 65-ton Bucyrus shovel, 50 new 12-yd. Western air dump cars and four consolidation locomotives, 60 ton on drivers. The company is getting its camps up and already has one shovel installed and the other on the road. Conditions are good for construction work, but labor is somewhat scarce, although $2.25 per 10 hours is being paid. Wm. B. Michel, Kittitas, Wash., is superintendent of construction for the contractors.

WYOMING.

John Burke, Shoshoni, Wyo., has nine miles of especially good Fresno wheeler and machine work to let; free transportation for men and outfits over the Burlington lines. Mr. Burke also wants "three up" teams and will pay $8 per day for them.

Power Developments, Levees, Drainage and Irragition Works.

ILLINOIS.

Plans are being made for the construction of 12 miles of ditches for the Kishwaukee Drainage District in McHenry County. The estimated cost of the work is $40,000. Hugh M. Price, 1207 Hartford Bldg., Chicago, Ill., is the engineer.

Bids are asked by the Board of Trustees of the East Side Levee and Sanitary District, H. D. Sexton, President, Sexton Bldg., East St. Louis, Ill., until noon, May 16, for the construction of a diversion channel for Cahokia Creek and necessary levees and embankments and other auxiliary or incidental improvements, the work including 1,427,900 cu. yds. of channel excavation, 60 ft. of 30 in. cast iron pipe, 96 lin. ft. of 24 in. cast iron pipe, 70 cu. yds. of reinforced concrete, 22 cu. yds. of concrete at pipe ends, and 2 acres of grubbing. The diversion channel will have a bottom width of 100 feet, with side slopes of 1 on 2 on the land portion of the channel. Below this, will be excavated a low water channel 30 ft. wide on bottom and 2 ft. below the grade of the channel proper. The material excavated from the channel will be deposited in the levees on each side thereof, leaving a berm of not less than 50 ft between the toe of slope of the levees and the channel. The levees on each side of the channel will have a top width of 10 ft., slopes on the channel side of 1 on 2 and on the land sides 1 on 3. The proposed work is located in Edwardsville and Chouteau Townships, near Poag Station, Madison County, Illinois, on the Wabash Railroad and Edwardsville line of the Alton, Granite and St. Louis Traction Company, and Klinke Station on the Alton line of the Alton, Granite and St. Louis Traction Company, and is convenient to switch tracks of the Wabash C. & A., C. C. C. & St. L., C. & E. I. and C. P. & St. L. Railroads. The official advertisement will be found elsewhere in this issue.

INDIANA.

Gust. Strom, Miller, Ind., has been awarded the contract at $11,849 for constructing a drainage system for the town of Miller, the work consisting of 15,000 cu. yds. excavation, open ditch work, and 2,100 lin. ft. 36-in. reinforced concrete pipe.

LOUISIANA.

The Upper Terrebonne Drainage District is dredging a canal between Houma, La., and Schriever, La., some 12 miles. This will be a very important canal and will open up a large and fertile cane area. Bonds were issued and placed locally. It will take some 8 to 10 months to complete the work. The adjoining Parish of Lafourche is considering continuing this canal into Bayou Lafourche at Thibodaux, La. Charles V. Moore, Schriever, La., is Secretary of the Upper Terrebonne Drainage District Commission.

MASSACHUSETTS.

As previously stated in this paper bids are being asked by Lt. Col. J. C. Sandford, U. S. Engineer, Newport, R. I., for dredging in New Bedford at Fairhaven Harbors, Mass. The work to be done consists of dredging a channel between the wharf fronts of New Bedford and Fish Island for a distance of about 550 ft. below and 300 ft. above the New Bedford and Fairhaven Bridge, also the removal of any shoal spots that may be found in the waterway for an additional distance of 450 ft. above the area described. The work includes the dredging of about 36,000 sq. yds. of material.

MICHIGAN.

Bids are asked by Major C. S. Riche, U. S. Engineer, Grand Rapids, Mich., until 3 p. m., April 29, for repair of south revetment at Grand Haven, as previously mentioned in this paper. The work includes the removal of the old superstructure, the cutting down of the front row of old piles to the level of 1.0 ft. below zero of gage, the strengthening of the front wall by a new row of piles, the driving of a new row of rear piles, the connecting the front and rear walls by means of wales and tie rods and the building of a new superstructure. The following materials will be required: Oak piles, 73,518 lin. ft.; oak timber, 32,639 ft. B. M.; pine or Douglas fir timber 389,645 ft. B. M.; pine or Douglas fir plants for sheet piles, 4,460 ft., B. M.; pine or Douglas fir planks for walks, 26,514 ft., B. M.; drift bolts, 59,608 lbs.; screw bolts, 55,232 lbs.; angle irons, 51,610 lbs.; tie rods, 33,521 lbs.; spikes 1,178 lbs.; carriage bolts, 127 lbs.; pile shoes, 1,350 lbs.

NEBRASKA.

Contracts for the drainage work in District No. 2, Humboldt, Neb., mentioned in our issue of March 16, have been let to Callahan Bros., Munn & Reise, Canon City, Colo., and Omaha Neb., at $73,966. The contract includes the construction of 11 miles of new channel for the Nemaha River, requiring 810,000 cu. yds. excavation, 14,000 cu. yds. excavations in Long Branch Creek, 6,327 cu. yds. of levee and 2,640 squares of river cleaning. The contract for the three steel bridges was let to the Standard Bridge Co., Omaha, Neb., for $4,932. Bids for the work were opened April 4, and all work is to be completed by April 1, 1911.

NEW YORK.

James Stewart & Co., 30 Church St., New York city, have been awarded Contract No. 39 for dredging work on the New York State Barge Canal. The work is located on the

Oswego River between Three Rivers and Fulton, N. Y., and includes 1,226,000 cu. yds. of excavation, 11,072 cu. yds. of stone masonry and 6,000 lbs. of iron castings.

Lane Bros. Co., Altavista, Va., have been awarded Barge Canal Contract No. 21, which is located west of the Genessee River near Rochester, N. Y. The contract includes about 1,490,000 cu. yds. of earth excavation, 860,000 cu. ft. rock excavation and 6,500 cu. yds. of concrete masonry. It has not been decided as to whether any of the work is to be sub-let.

OHIO.

The Great Lakes Dredge & Dock Co., Cleveland and Chicago, Ill., was the low bidder April 2, for the dredging in the Cuyahoga River in the city of Cleveland. As mentioned in our March 30 issue this work is divided into two contracts, known as Section No. 1 and Section No. 2. No. 1 includes the lower portion of the river and No. 2 the upper portion. Bids were received based upon the approximate quantities of 225,000 cu. yds. in Section No. 1 and 300,000 cu. yds. in Section No. 2. The dredged material is to be dumped upon a dump established by the government in Lake Erie, a distance of five miles from the mouth of the river. The portion of the river to be dredged is about five miles in length.

WASHINGTON.

Geo. Cooke & Sons, Spokane, Wash., were on March 31, awarded the contract for constructing the Cowiche-Yakima laterals for the Tieton project of the U. S. Reclamation Service. The work includes 36 miles of laterals and involves 385,000 cu. yds. of excavation. Bids were opened March 15 at North Yakima.

WYOMING.

Bids will close April 20 for constructing the Covey Canal near Cokeville, Wyo., for S. M. Covey, of Cokeville. The work includes approximately 100,000 cu. yds. of earth excavation, 2,000 cu. yds. rock excavation and 4,000 cu. yds. embankment. The canal parallels the Oregon Short Line R. R., and is about two miles distant. It is to be 25 miles long, 15 ft. wide, and 2 ft. deep. Labor conditions in the vicinity are fair. This work was noted in our March 23 issue, the date for closing bids being given as April 15.

The West Jersey & Seashore R. R. Co., a Pennsylvania line, is planning to build a freight yard covering at least half a block at Atlantic City, N. J.

The South Carolina Western Ry. Co., of Hartsville, S. C., has been chartered and proposes to construct a 40 mile line connecting Florence and McBee. W. R. Bonsal, Hamlet, N. C., President of the North & South Carolina Ry., is also President of the new company.

About $600,000 of bonds are reported to have been sold by the Paradise Valley R. R., which proposes to contract a standard gage line from Winnemuca, Nev., to Paradise Valley, a distance of 42 miles. J. G. Jacobs, President of the American Safety Railroad Switch Co., of Salt Lake City, Utah, is interested.

The Bonnie Clare & Gold Mountains R. R. Co., has been incorporated with a capital stock of $150,000 and propose to build a line, some 14 miles in length, from Bonnie Clare, Nev., to Gold Mountain in Esmeralda County, Nevada.

Surveys have been completed and maps made for the projected line of the Aroyelles, Palmetto & Gulf R. R., which proposes the construction of a line from Marksville to Opelousas, La. Hollier & Neff, Opelousas, La., are the engineers.

The Board of Aldermen of Worcester, Mass., has granted the Providence & Worcester Street Ry Co. the right to use certain streets of the city. The company was denied the right to lay rails in other streets and will have to arrange with the company now operating in that city to use its rails. The company is reported as ready to begin construction this year and will pass through Milbury, Sutton, Manchaug, Douglas, Burrillville to Mohegan, and will then follow the Douglas pike to Providence, R. I. The line will be 45 miles in length.

The Pennsylvania R. R. has made a proposition to the city of Trenton, N. J., to abolish the present grade crossings at State and Perry Sts. One plan proposes to elevate the railroad tracks from a point near Greenwood Avenue to a point some distance north of Perry Street. It is proposed that the tracks be laid on a base of masonry about 12 feet above the level of the street. The company also proposes, as a part of this plan to remove the present canal lock at State Street to a point also north of Perry Street, materially reducing the time of present traffic interference.

The Buckhannon & Clarksburg Electric Ry. Co., of Buckhannon, W. Va., has been chartered with a capital stock of $250,000 and proposes to build an electric line from Buckhannon, through the counties of Upshur, Barbour and Harrison to the city of Clarksburg; over the streets of Buckhannon and South Buckhannon and through the counties of Upshur and Lewis to the town of Weston. The incorporators are E. W. Martin, G. O. Young, R. I. Perine, W. H. Fisher and U. G. Young, all of Buckhannon, W. Va.

The Public Service Corporation of New Jersey, Jersey City, N. J., has secured control of the Camden & Trenton Ry. Co., which went into receivers' hands about two years ago. The management is said to have devised a plan whereby it will be possible to make the run from Camden to the heart of New York City in five hours and fifteen minutes, against nearly ten hours, the present schedule. The plan calls for connection being made through the Newark terminal of the McAdoo Tunnel system.

The Chamber of Commerce of Pensacola, Fla., is considering building a line of road from the proposed line of the Pensacola, Mobile & New Orleans Ry. at Millview across into Baldwin County, thus giving rail connection with that section. The road would be about eight miles in length. It would be leased to the Pensacola, Mobile & New Orleans, which has already been constructed to a point a few miles north of Millview.

Committees have been appointed at Superior, Neb., and Deshler, Neb., to secure the construction of a railroad between the two places. Negotiations have been opened with the Rock Island. John Rodenberg, Deshler, is a member of the committee.

J. Hugh Walker has been awarded the contract for constructing the 15 mile line of the Kinder & Northwestern Ry., which is to extend from Kinder, La., across the Calcasieu River.

Berwick, La., has voted a 5-mill tax for the proposed Iberia, St. Mary and Eastern R. R. Berwick is to be the terminal of the road.

The Chicago & Northwestern Ry. will have active construction work started May 1 on a number of extensions, contracts for which are reported to have already been let. These include the extension from Belle Fourche, S. D., north to the Moreau River, which will mean about 40 miles of new road; from Pierre, S. Dak., to Gettysburg, about 40 miles, and also on the longer branch that is to run from Iroquois across to the Pierre-Gettysburg branch, a distance of about 112 miles.

The International Elevated Railroad Co. of Washington, a monorail concern, has been chartered at Dover, Del., with capital of $50,000,000. At the same time the Universal Motor Co. of Washington was incorporated with a capital of $5,000,000. It will build equipment for the proposed single rail systems. The incorporators named in both companies are George G. Schroeder, of Washington, and Charles G. Guyer and S. E. Becker, of Wilmington. The real interests in the two concerns have not been announced. It is stated that the company will build its first line in Brooklyn, N. Y.

The Pecos Development Co., of Estancia, N. Mex., recently organized, proposes to develop 6,000 H. P. from the falls of the Pecos River. A conduit will carry the total flow of the river nine miles and drop it though a penstock for a fall of 766 ft. This power will be transmitted to the Estancia Valley and Albuquerque. The company proposes to utilize this power for operating pumping plants for irrigating lands. The incorporators of the Pecos Development Co. are M. H. Fisher, Alamogordo, an electrical engineer; C. L. Cory, dean of engineering, University of California; H. F. Cory, general manager of the Southern California Development Co., and F. H. Fisher, a civil and hydraulic engineer, who has been connected with several large irrigation schemes in New Mexico, and has large power fillings in New Mexico.

The City Council of New Orleans, La., has adopted both the ordinances providing for the sale of a franchise for an extension of the West End Railroad to Spanish Fort and Milneburg and for a new franchise in Algiers, from the head of Morgan and Patterson Streets to a point below town on the river. The latter will probably be a start on the new Grand Isle line.

The Mexican Government has granted a concession to the Southern Pacific Ry. Co. to build a branch to the main line from Quila to Dorado. Ten kilometers of the branch must be built in one year and the remainder in the year following. The company has made a deposit of $3,000, in bonds of the Public Debt, guaranteeing the fulfillment of the contract.

The Mayoch Drainage Commissioners of Mayoch, N. C., have awarded a contract to the American Steel Dredge Co., Fort Wayne, Ind., for constructing drainage canals, requiring 733,000 cu. yds. of dredge work.

The Missouri Valley Engineering Co., of Vermillion, S. Dak., is preparing plans for a hydro-electric development to be constructed in the Black Hills near Rapid City, S. Dak., for the Dakota Power Co. The estimated cost is about $250,000.

A bill is before the Massachusetts Legislature to allow the New York, New Haven & Hartford R. R. to take over the Berkshire street railway system and to improve trolley facilities in the Berkshire District.

The Minneapolis & St. Louis R. R. is reported to have acquired the South Dakota Central R. R. and is said to be planning to remove the shops of the latter road from Sioux Falls to Watertown, S. Dak. This is said to be part of the plan for important extensions which will be carried out by the Minneapolis & St. Louis as the controlling interest in the South Dakota Central.

A. Guthrie & Co., St. Paul, Minn., who have the contract for grading the Great Northern line from Fargo to Surrey, N. Dak., have sublet 25 miles of the work to Edward Swerington of New Salem and James Tobin. Mr. Tobin has been working on Great Northern contracts near Culbertson, Mont. Contractor Swerington has a force of 65 teams which have been wintering at New Salem and was engaged in grading on the N. P. extension west of the river last year.

The taxpayers in the Eighth ward of St. Mary Parish, in which is the town of Berwick, for the purpose of voting a 5-mill tax for a period of ten years in favor of the Iberia, St. Mary & Eastern R. R.

Items Concerning Contractors and Their Work

RAILROADS. POWER DEVELOPMENTS. LEVEES. DRAINAGE AND IRRIGATION WORKS

Alabama Notes.

FROM CORRESPONDENTS AND OTHER SOURCES.

The construction of an electric railroad from Decatur to Russellville, a distance of about 50 miles, is proposed and it is believed that there is a possibility of the line being built at an early date. It is proposed to have the line start at the union depot in Decatur and run westward to Curtis Wells, a summer watering resort a few miles from Decatur, then on to Neal, Danville, Jesseton, Needmore, Moulton, Landersville, Mt. Hope, Neburg and to Court square in Russellville. W. J. Cottingham, New Decatur, Ala., is interested.

Charles W. Eckert of Lancaster, Pa., President of the Gold Ridge Company of Alabama, and others are reported to have purchased the railroad of the Vanderbilt Timber & Mining Co., between Tallapoosa, Ga., and Hopewell, Ala., and may extend the line to Wedowee and Montgomery.

The Chattahoochee Valley R. R. is reported to have engineers in the field making surveys for an extension of the line down the Chattahoochee River to Phenix City. It is also said that instead of going to Phenix the road will reach Motts on the Central of Georgia.

Arkansas Notes.

FROM CORRESPONDENTS AND OTHER SOURCES.

The Prescott, Reader & Fordyce R. R., now operating nine miles of standard gage line between Reader and Lyda, has decided to build from both ends of the line and to connect with the Iron Mountain at Prescott and with the Cotton Belt at Fordyce. W. B. Ferguson, Little Rock, Ark., is president.

The St. Louis, Iron Mountain & Southern Ry. (Missouri Pacific system) is reported to be planning to build an extension from Womble, the present northern terminus of the Gurdon and Fort Smith Northern railroads, to Greenwood, the present southern terminus of the Greenwood branch of the Iron Mountain. E. F. Mitchell, St. Louis, Mo., is engineer of construction, Missouri Pacific Ry.

The McCrory Transportation Co. has been organized at McCrory, Ark., and the company proposes to build a railroad from there 16 miles north into Jackson county. The officers of the company are: President, B. Hailey; vice president, E. A. Hamilton; secretary and treasurer, Bruce Keating.

The Pike County Water Power Co. has engineering work under way for its proposed electric power development at Murfreesboro, Pike county. About 10,000 h. p. will be developed. W. A. Fuller, St. Louis, Mo., is engineer.

The State Board of Railroad Incorporators has granted the Hot Springs, Glenwood & Western R. R. Co. a charter. The road is capitalized at $350,000 and will be 35 miles long extending from Glenwood, Pike County, to Hot Springs. The incorporators are A. L. Clarke, J. A. Bonner, W. E. Mayber, C. T. Crosby, and S. W. Pryor.

California Notes.

FROM CORRESPONDENTS AND OTHER SOURCES.

The Boca & Loyalton R. R., A. H. Otis, manager, Loyalton, Cal., is reported to be securing right of way from Reno to Boca along the Truckee with a view to extending its line to Reno to a connection with the main line of the Western Pacific.

A company has been formed for the construction of an electric railroad from a point near Hemet, through the San Jacinto and a portion of the Perris valleys and to Moreno, a distance of about 20 miles. The line will be the first part of a road that later will connect either with Redlands or Riverside. A. G. Hubbard, Redlands, and E. H. Grigsby, Santa Monica, are interested. The latter has recently filed upon about 300,000 ins. of water on the north slope of the San Jacinto mountains and will build a power house at Florence, a town about seven miles from Hemet, to furnish power for the electric line and other enterprises in that section.

The Oakland Dock & Warehouse Co. has begun work in the reconstruction of nearly a third of a mile of its wharves between Alice and Fallon Sts. at Oakland. Similar work is being done by the Pacific Steel & Wire Co., the Hogan and Sunset lumber companies and other private corporations having frontages on the estuary.

Francis B. Smith, superintendent of the Scofield Construction Co., which has just completed the Mare Island dry dock, left Vallejo for Washington, D. C., where he held a conference with the naval officials relative to the dock at Pearl Harbor, Hawaii, the construction of which he is to superintend for the contractors.

The Santa Monica Harbor & Improvement Co., which is planning extensive lumber improvements at Santa Monica, is said to be ready to receive plans and estimates from engineers and contractors for the initial portion of the work. There is to be constructed a breakwater of some 4,000 ft. long, bulkheads of about 5,000 ft., also wharves, etc.

The Consolidated Reservoir & Power Co. has begun work on its project for the diversion of the Whitewater river in the San Bernardino mountains, northeast of Banning. W. E. Pedley, Riverside, is engineer in charge.

A project is under consideration for the construction of a railroad from Red Bluff to Eureka by way of Camp Wrigley on Tom Head Mountain, in the western part of Tehama County. William Wrigley, Jr., of Chicago, Ill., owner of the copper mines at Camp Wrigley, for which the road would furnish an outlet, is reported to be interested.

Marin County Citizens have begun an active campaign to construct a street railway from Corte Madera, through Ross Valley towns and San Rafael, to McNears point. Frederick Butterfield has been delegated by the San Francisco interests to look over the field. It is estimated that the road would cost $125,000 and an effort is being made to raise $65,000 in order to float bonds for the balance.

The Vallejo & Northern R. R., which proposes the construction of a railroad from Sacramento to Vallejo, has secured all right-of-way and is reported to have placed the bonds for the construction of the road. The road between the terminals Vallejo and Sacramento is to be double tracked and will cost $6,000,000. Construction will be commenced at Suisun. P. H. Haviland, Oakland, Cal., is Chief Engineer.

Klippel & McLain are making excellent progress with the grading work between French Creek and Stanwood for the Truckee Lumber Co's. railroad. Grading is now under way beyond Stanwood and it is understood that ten miles of the road beyond that place will be constructed this year.

Erickson & Peterson are making good progress with their work on the Southern Pacific cutoff near Bowman, and will complete one-half of the job within the next four months.

Bids were opened Apr. 10 at Marysville for the construction of the canal for the Hallwood Irrigation District. The water is to be diverted from the Yuba River at a point just above Daguerre point. The area that is thus benefited will be some 10,000 acres. The canal will be 8 ft. on the top and 6 ft. on the bottom and 3 ft. in depth. L. B. Crook, Room 14, Empire Block, Marysville, is the engineer.

Nearly 16 miles of grade on the Sacramento & Sierra Ry., which is building an electric railway from Sacramento, is completed, and grading work is being rushed in the vicinity of Orangevale. Surveys have been completed and practically all right of way has been secured.

Charles W. Corboley, Los Angeles, has the contract for constructing nine miles of levee along the Santa Maria River from Fulgers Point to the Pacific Ocean. The contract amounts to about $40,000.

Colorado Notes.

FROM CORRESPONDENTS AND OTHER SOURCES.

The directors of the Kansas-Colorado R. R. Co., Pueblo, have authorized an issue of $3,000,000 of bonds, with a view to at once starting work on the completion of the line from Pueblo to Canon City.

Grading work on the Laramie, Hahn's Peak & Pacific from Fox Park, Wyo., to Walden, Colo., has been resumed, and it is expected that the road will be completed to Walden this year.

The Colorado & Southern Ry., H. W. Cowan, chief engineer, will during the next 12 months reballast and lay heavy steel rails between Greeley and Fort Collins, involving an expenditure of $200,000. Decision will also be reached this month on the question as to whether the Colorado & Southern will build from Fort Collins to Cheyenne. There is little doubt but what this will be done. The road then will be extended to Orin Junction, Wyo.

The Union Pacific started work on April 4 on its branch line which is to connect Lasalle and Dacona. This new branch, which is to be known as the Denver-Lasalle line, when complete, is being started at Lasalle and will be constructed toward Dacona, a distance of 25 miles. The section from Denver to Dacona is already under construction, the work starting at Sand Creek on the Denver end and going toward Dacona. This branch will also be part of the new Denver-Fort Collins line, which is to be constructed in the future. The extension to Fort Collins will start at a point about ten miles from Lasalle.

The Denver & Colorado Springs Electric Ry. Co., R. E. Van Duesan, secretary, has asked the commissioners of El Paso county for permission to cross county roads three times in the vicinity of Table Rock. More than 20 miles of this road will be built within the limits of El Paso county.

J. H. Williamson has been awarded the contract for constructing a dam at the Lone Starr reservoir, about six miles northwest of Delta. The contract amounts to about $22,000 and calls for a dam 150 ft. long by 30 ft. high.

The Boyd Lake Reservoir & Irrigation Co., recently incorporated with a capital stock of $4,000,000, proposes to utilize Boyd Lake for its irrigation scheme. It is planned to form an irrigation district and lift the water 90 ft. by pumps and water a big territory. The water is available by a system of transfer for use on hand on the Platte and wherever used it is probable that irrigation districts will be formed to handle it. It is said that one of the first steps of the company will be to issue $200,000 in bonds. B. D. Sanborn, Greely, is interested.

Advices from Idaho Springs state that John McColl, Superintendent of the Lucania Tunnel & Mining Co., will at once let a contract for driving the mining tunnel. The present plans call for 500 ft., and it is almost a certainty that a larger contract will be let when this is completed. The breast of the tunnel is 4,209 feet into Bellevue mountain, and 47 veins have been intersected. These have been developed by about 1,500 feet of laterals.

The Antero Land & Irrigation Co., of Denver, has commenced work upon the extension of the High Line canal. The company intends to provide water for a large area of farm land north of Denver. The canal, when completed will be almost 20 miles in length

and with laterals aggregating many miles will supply water in all directions north and east of Denver. The company is preparing to survey a line for the canal that will make possible the distribution of water over a vastly larger area than is possible to serve at the present time. The main ditch or canal is being enlarged as far as Plum Creek to permit the transportation of a larger flow of water and laterals will soon be started.

The Desert Ditch & Colt Reservoir Co., A. W. Colt, President, is said to be ready to expend about $2,000,000 on the project of reclamation just as soon as the state will throw the land open to settlers, so that there may be buyers for the water the company proposes to offer. The enterprise includes reservoir near the west end of Otero County and several ditches and laterals covering the great tract of land below. Water to fill the reservoir is to be taken from the Arkansas River in Pueblo County and carried to the reservoir through the Desert ditch.

The U. S. Reclamation will construct by force account the necessary distribution system of canals on the west side of the Uncompahgre River, on the Uncompahgre irrigation project, Colorado. The work in this connection will be scattered over a considerable area and consists principally of the construction of small ditches and structures necessary for the operation thereof. It is estimated that the work will cost about $50,000.

Georgia Notes.

FROM CORRESPONDENTS AND OTHER SOURCES.

The Louisville & Nashville, Atlanta & West Point and the Georgia railroads will build at once an elevated driveway the entire length of the south side of the Louisville & Nashville freight depot at Atlanta, Ga. The roadway will be 800 ft. long and will cost about $50,000. C. A. Wickersham, Atlanta, Ga., is general manager of the Atlanta & West Point R. R.

The Athens Railway & Electric Co., with a capital stock of $1,050,000, has been chartered and proposes to construct an electric plant and operate street cars on the streets of Athens. The incorporators are John R. White of Whitehall, Ga., J. Y. Carithers, W. S. Holman, A. H. Hodgson, C. D. Flanigan, Billups Phinizy, James White, J. M. Hodgson, J. W. Morton and W. T. Bryan, all of Athens.

The Florida Central R. R., J. L. Philips, President, Thomasville, Ga., according to reports, is planning to construct a 10-mile extension.

Idaho Notes.

FROM CORRESPONDENTS AND OTHER SOURCES.

Work on the Burley-Oakley extension of the Oregon Short Line has been resumed after a layoff by the force of several months during the winter. If the weather continues favorable, it is expected that trains will be running from Burley, Idaho, to Oakley inside of three months.

The Utah Construction Co., of Ogden, Utah, is making good progress with its double-track work on the Oregon Short Line between Pocatello and McCammon. The double track has been completed between Pocatello and Inkom and a large force of men and a great deal of material are on the ground east of Inkom rushing the work between that town and McCammon.

Advices from Lewiston state that the Northern Pacific will have engineers placed on the North Fork early next month to complete the survey into the timber belt. E. L. Dorset, Ahsahka, is in charge of the surveys. Other Northern Pacific engineers are now engaged in making a permanent location into the Weippe section for a distance of 30 miles.

The owners of the Monitor mine at Adair in Shoshone County are to run a long tunnel from Adair about 5,500 ft., giving a working depth of 2,200 ft. N. Samuels, Wallace, Idaho, is interested.

The Oregon Short Line Ry. officials are stated to have announced that they will complete the extension of the Minidoka & Southwestern Ry. from Buhl to Nyssa upon the assurance of the construction of the Owyhee high line project. Similar assurances have been made to the promoters of the Twin Falls-Bruneau project, upon the same conditions.

The Oregon Short Line has purchased considerable land at Glenns Ferry and residents of that place think the railroad is to increase its present facilities at Glenns Ferry by the construction of additional shops.

Surveys for the Gilmore & Pittsburg Ry. extension will be completed to Lewiston, about June 1. The survey follows the Idaho side of the Snake River from the mouth of the Salmon River into Lewiston. Sometime ago it was reported that the railroad had awarded the contract for the construction of 40 miles of line down to Salmon River from the present terminus at Salmon City.

The Payette Valley extension R. R. Co., of Payette, opened bids April 5, for the grading of about 19 miles of roadbed between New Plymouth and Emmett, Idaho.

Illinois Notes.

FROM CORRESPONDENTS AND OTHER SOURCES.

The Peoria & Galesburg Interurban Ry. Co., S. F. Atwood, President, has for the second time applied to the city council of Peoria for a franchise allowing it to enter the city of Peoria. The company asks for rights on Hamilton from Jefferson down to Washington, thence south to Cherry, to Oakland, thence to Starr and to the western city limits.

The Cleveland, Cincinnati, Chicago & St. Louis Ry., has made plans and blue prints for enlarging its yards at Mattoon.

The Rock Island Southern Ry., which has been under construction for about three years is now practically completed and a branch from Aledo Junction to Aledo, about 10 miles, will be completed by July 1. The road which is about 100 miles long, connects Moline, Rock Island and Davenport on the Mississippi river with Monmouth and Galesburg. The line was built by E. C. and M. A. Walsh, bankers of Clinton, Ia., and its headquarters are to be in Chicago where an office has been opened in the Monadnock Building with E. C. Walsh as president and J. A. Hanley, formerly freight traffic manager of the Santa Fe and later of the Kansas City Southern, as vice president in charge of traffic.

The Tri-City & Northeastern Interurban R. Co., is having surveys made of two new routes for its projected line from Albany south. One of the surveys will be from Hampton across to Silvis and into Moline and the other from a point one and a half miles above Hampton to Silvis and into Moline. Wallace Treichler, Rock Island, Ill., is the engineer.

The Cairo & Thebes R. R. has been granted a connection with the Thebes bridge by the Railroad Commission. This company was formed in 1905 by Cairo shippers to build a road connecting Cairo with the railroads centering at the Thebes bridge. It was financed in Louisville, Ky., and it is generally reported that the Louisville & Nashville furnished the money. The sum of $2,000,000 was appropriated to build the road, half of which was for a terminal in Cairo. Grading work is under way, the contract being held by S. R. H. Robinson & Son Contracting Co., of St. Louis, Mo., as stated in our March 23 issue.

A proposition is under consideration for the construction of an electric railway from Freeport to Dixon. It is planned to have $200,000 in stock subscribed before starting work in securing the right of way. Of this sum over one-half is reported to have been subscribed. A. Merrill and J. Wilson, of Chicago, are interested.

Construction work on the Springfield-Jacksonville interurban line is now under way. The contractor for this road is J. H. Farland, Jacksonville, Ill., as previously mentioned in this paper. The company has been recently reorganized and the following officers elected: President, O. J. Lucas, Latham; Vice President, D. T. Torrence, Decatur; Treasurer and Secretary, D. H. Sims, Latham; Chief Engineer, T. S. Davy, Lincoln; General Manager, J. H. Farland, Jacksonville; Attorney, Albert Salzenstein, Springfield; Assistant Engineer, A. C. Brown, Columbia City, Ind.

A court decision has been handed down in the Spring Lake drainage case, sustaining the commissioners who seek to drain the lake and the widely known tract will be eventually converted into farming land.

The Freeport Railway, Light & Power Co., of Freeport, is preparing to at once extend its tracks from the present terminal on North Galena Avenue to a point on the west side of Whistler Street.

G. E. Hixon of the Egyptian Traction Co., has applied to the Board of Trustees of Carrier Mills for a franchise to operate an electric line at that place. A similar application has been made at Eldorado. The line as already surveyed is approximately 100 miles long, and will connect the McKinley lines in Illinois and the McCullough lines in Indiana.

The Chicago, Milwaukee & St. Paul R. R. will shortly begin work on the installation of the Hall safety signal system. Several months ago the surveys for these were made, and in addition to the wells for the support of the uprights, all material is being shipped to the different stations.

Indiana Notes.

FROM CORRESPONDENTS AND OTHER SOURCES.

The Fort Wayne & Springfield Traction Co., W. H. Fledderjohann, President, Decatur, has accepted the franchise granted the road from Portland to the Adams county line. It is said that work will soon be begun on the extension of the line southward and that it will be completed from Decatur to Portland by Sept. 1.

The Lake Shore & Michigan Southern Ry., is to expend $50,000 for a new freight house and yards at Goshen.

The Evansville Ry. Co., Evansville, is to extend its electric line to Grandview, six miles east of Rockport, and residents of Chrisney have raised a bonus of $20,000 for an extension to that place.

Right of way is being secured between Crawfordsville and Terre Haute, by Samuel D. Symmes, a real estate dealer of Crawfordsville, acting for a New York syndicate, which proposes to build a new traction line for Crawfordsville to St. Louis, by way of the Shades of Death and Terre Haute.

The Toledo & Indiana R. R. recently purchased from the receiver has been reorganized and will hereafter be operated under the name of the Toledo & Indiana Traction Co. Several improvements are planned, including the purchase of new rolling stock and the extension of the road from Bryan to Fort Wayne, Indiana, in the near future. In making the improvement the company will follow the right-of-way paralleling the Lake Shore & Michigan Southern and passing through Butler, Ind. The officers of the company are: President, S. C. Schenck; vice president, S. D. Carr; secretary, C. F. Chapman, Jr.; treasurer, D. D. Schenck; directors, S. C. Schenck, S. D. Carr, Thomas H. Tracy, D. D. Schenck and C. F. Chapman, Jr., all of Toledo, O.

Preliminary arrangements are said to have been made for the extension of the Kokomo & Marion Traction line from Kokomo to Frankfort, work to commence at once, the line ultimately to extend to Terre Haute.

The Beech Grove Traction Co., Ætna Bldg., Indianapolis, has awarded a contract to the Alan Construction Co., for the construction of its traction line between Indianapolis and Beech Grove. Orders have been placed for rails, ties and cars. The officers of the traction company are as follows: W. H. Ogan, president; John Wocher, vice-president; C. Frederick Schmidt, secretary; Morton S. Hawkins, treasurer.

The Erie R. R., is to enlarge its yards at Kent this season, and will also double track the division from Kent to Galion.

Work has started on the construction of the fourth track of the Lake Shore & Michigan Southern Ry. from LaPorte to Pinola.

Residents of Grandview have subscribed for $30,000 of bonds thus securing the extension of the electric railroad from Rockport to

Grandview. The road will be extended by the Tennis Construction Co., of Philadelphia, Pa.

The city of Hammond has granted the Eastern Illinois Traction Co., a subsidiary to the Consolidated Railways Co. of Chicago, a 50-year franchise in West Hammond. A line will be built to Dolton and Harvey within four months and a new territory opened up between Hammond and South Chicago. This is the line destined, according to Ira M. Cobe of the Consolidated Railways Co. to become an interurban inlet from Indiana to Chicago.

The Indianapolis & Cincinnati Traction Co., now in the hands of a receiver, is to be reorganized and will build an extension from Connersville to Hamilton, O. The extension will be about 30 miles long. Charles L. Henry, Indianapolis, is receiver.

Iowa Notes.

FROM CORRESPONDENTS AND OTHER SOURCES.

The Iowa & Dakota Interurban R. R. Co., has been incorporated with a capital stock of $500,000 and headquarters at Yankton, S. Dak. The company proposes a line from Sioux City to Mitchell, a distance of 125 miles, at an estimated cost of $20,000 a mile. It crosses the counties of Woodbury and Plymouth in Iowa, Union, Clay, Turner, Yankton, Hutchinson, Hanson and Davidson, in South Dakota. L. F. Phillips and W. G. Kirkpatrick of Wagner, S. Dak., and Albert Amundson, Lake Andes, S. Dak., are interested.

The St. Paul & Des Moines R. R., H. L. Jackson, chief engineer, Iowa Falls, Ia., is said to be considering extending its lines southward from Des Moines to connect with the Milwaukee and Rock Island Kansas City lines at Seymour in Wayne county. Such a line would involve building about 80 miles of road.

The citizens of Waverly will vote on April 12 upon the question of extending a franchise to the Waterloo Cedar Falls & Northern Railway Co. to extend its line from Denver into Waverly. In case the people of that city vote the proposition down the railroad company then will run its line into New Hampton instead of Waverly. In case they go to New Hampton they will pass through two towns, Tripoli and Fredericka. Harrington Bros., St. Louis, Mo., have the grading contracts.

The Federal Construction Co., of Muscatine, Ia., has been organized with a capital stock of $10,000 to further the construction of the waterway connecting the Cedar river with the Mississippi at Muscatine. Eastern capital is reported to be interested and it is said that the construction company has been formed to take care of preliminary matters. N. Barry, Jr., S. G. Stein, B. Layton, J. S. Blackwell, and J. M. Kemble are incorporators. Preliminary surveys were made under the direction of B. Layton of Chicago.

The Davenport Water Power Co., of Davenport, has started preliminary work in its water power dam to be erected in the Mississippi river. Charles Francis is engineer in charge.

The Chicago & Great Western Ry. has been unloading steel ties and other material along its line between Belmond and Mason City, preparatory to putting in heavier rails.

The stockholders of the Des Moines & Sioux City Electric Ry. Co., C. E. Russell, Auditor, Adel, are to hold a meeting at Des Moines on April 14, to act up on the proposition of changing the articles of incorporation of the company with the view of re-location of the proposed line of road.

The Chicago, Burlington & Quincy R. R. is to make extensive additions to its yards at Burlington.

Dennis McCarthy, aged 64 years, formerly one of Sioux City's prominent grading contractors died April 3 in that city. He was stricken by an attack of pneumonia a few days ago. During the old days in Sioux City Mr. McCarthy was one of its prominent men and had many large contracts for grading and other work of this nature. He was a member of the old contracting firm of McCarthy & McMahon of the boom days. In recent years he has been employed by the city.

Kansas Notes.

FROM CORRESPONDENTS AND OTHER SOURCES.

The MacArthur Bros Construction Co., Chicago, Ill., is reported to have purchased the rights and franchises of the Topeka Southwestern Ry. the proposed line from Topeka to Council Grove, the grading of about twelve miles of which has been completed. It is said that MacArthur Bros. intend to begin the construction of the line in about 90 days and expect to complete it by the end of this year.

The Kansas Union Traction Co., has permanent surveys under way for its line from Coffeyville to Parsons. In addition this company is figuring on a line from Cherryvale to Oswego to cross the Coffeyville-Parsons line near Altamont where the power station will be located. Barney McDaniel, Altamont, is Secretary.

The Union Pacific R. R., R. L. Huntley, Chief Engineer, Omaha, Neb., is planning to ballast this year over 200 miles of its branches in Kansas. Information has also been received by the State Railroad Board that the Union Pacific will complete its Topeka-Marysville line this year. The road now runs as far as Onaga about half way and it is said that money is forthcoming to build the rest of the line and also to ballast the whole branch.

Maryland Notes.

FROM CORRESPONDENTS AND OTHER SOURCES.

The Cumberland & Westernport Traction Co., of Cumberland, Md., is to have surveys made for an extension of its line from Westernport to Keyser, W. Va.

The directors of the Frederick Railroad Company, of Frederick, formed by the merging of the Frederick and Middletown and Braddock and Jefferson trolley systems and the Washington, Frederick & Gettysburg steam road, are considering electrifying the latter road. The directors have authorized the purchase of the right-of-way from the Baltimore turnpike at the end of East Patrick Street, through the property of the Frederick Improvement Co., to connect the Frederick and Middletown trolley line with the Washington, Frederick and Gettysburg road. A car barn and repair shops will be erected near the connecting point. George S. Anderson is manager.

The Elkton, Fairhill & Oxford Electric Railway & Power Co., of Elkton, Md., recently incorporated with a capital stock of $50,000, proposes to build a line from Elkton to Cherry Hill and Fair Hill, and thence to the Pennsylvania boundary, whence it may extend to Oxford, Pa. The incorporators include Geo. E. L. Hess, Heister Hess, C. P. Canriet, and John Lungren.

Michigan Notes.

FROM CORRESPONDENTS AND OTHER SOURCES.

The Port Huron Southern Ry., Otto Huette, General Manager, Port Huron, is to build a spur to a salt mine which the Port Huron Salt Co. is to establish in the vicinity of Rattle Run in Columbus Township. The railway is also said to be considering extending its line to Detroit.

Grading between Morrice and Shaftsburg, on the Lansing, Owosso & Flint Electric line is about completed and the Northern Construction Co., of Lansing, which has charge of the work, expect to have cars in operation between Lansing and Durand by Oct. 1.

L. W. Anderson, formerly city engineer of Grand Rapids, and Charles J. Carpenter of Grand Rapids, have formed a partnership and will conduct a general contracting and engineering business under the firm name of Carpenter & Anderson. The firm will devote itself largely to municipal contract work. In addition to the contracting it is expected engineering work along the consulting line will be handled with Mr. Anderson directly in charge of this department.

Minnesota Notes.

FROM CORRESPONDENTS AND OTHER SOURCES.

The Duluth & Iron Range R. R. has let a contract to G. H. Spurbeck for building a 300-foot addition to the coal dock at Two Harbors, which will increase its storage capacity to 174,000 tons and a pocket capacity of 3,700 tons. Work has been started.

John and Will Gross, of Pipestone, have begun work on their $3,500 contract for changes in Pipestone Creek.

Missouri Notes.

FROM CORRESPONDENTS AND OTHER SOURCES.

H. G. Horton, City Engineer of Springfield, is to make surveys of the Jordan through Springfield preparatory to making plans and specifications and estimates of cost of improvements with a view of making the creek as sanitary as possible. The plans will provide for widening the bed of the creek and deepening the channel.

Contracts are reported to have been let for grading for the interurban line between St. Joseph and Savannah. The town council of the latter place has just granted a franchise to the new road for the use of Maine and 1st Streets. It is planned to have the line in operation by Aug. 15. J. H. Van Brunt, St. Joseph, Mo., is General Manager.

The tragic death of John Mahoney in a motor car accident in Kansas City, Jan. 24 last, removes from the contracting profession a widely known and highly respected railroad contractor. Mr. Mahoney had been in the contracting business for many years and had several large grading and crusher plants in Kansas City, Kan., and Kansas City, Mo. He started in a poor boy, but at the time of his death he was currently reported to be worth $500,000. He had worked hard all his life, taking very little time for rest or recreation. He was a plain, unassuming man and was especially popular with his employees. He maintained five camps and personally looked after them and the welfare of his men. Mr. Mahoney's wife and his foreman, Thos. McGuine were also killed in the accident.

L. D. Keeler, of Kansas City, has applied to the Park Board of that city for a franchise for a 4-mile 22-in. gage railroad in Swope Park. The line would be operated by steam or electricity and would be used to transport visitors to the park from the entrance to various places of interest.

Montana Notes.

FROM CORRESPONDENTS AND OTHER SOURCES.

Preliminary surveys have been made for the construction of the projected electric railway of the Virginia City Southern Electric Ry. Co., from Virginia City, Mont., to Adler. Luther H. Leber, New York City, vice president of the company was authorized to sell the bond issue for $200,000, and he was also awarded the contract to construct the line and supply the equipment. He guarantees to have the road completed and in operation by Sept. 1, 1910. Karl Elling, Virginia City, Mont., is President.

The Gallatin Valley Electric Ry., C. B. Anderson, General Manager, Bozeman, Mont., is stated to have awarded grading contracts for its proposed extension to Three Forks. The line will extend from the Bozeman Hot Springs for a distance down the West Gallatin river and then across country to Three Forks, a total of 27 miles. The sidings and switches will make a total of 30 miles of rails to be laid this summer. It is planned to have the road complete and freight and passenger service installed by Oct. 1.

Residents of Townsend have had surveys made and have pledged much money for building an electric railway between that city and Radersburg. It is now proposed to build this line down the east side of the Missouri River Canyon Ferry.

Clifton & Applegate, Bonner, are making good progress with their contract on the Big Blackfort Ry. This road starts at Bonner and crosses the river just above the Big Blackfoot mill from the east side to the west. It runs

along the west side for the entire distance, which is about 12 miles, until it reaches McNamara's landing, where it recrosses to the eastern bank. The bridge work is being done by the Bates & Rogers Construction Co., of Chicago, who are now working on the new bridge on the Big Blackfoot. The bridge is to be a steel and concrete structure, with about 400 feet base line. The foundation will be entirely of concrete, while the superstructure, which is about 240 feet in length, is to be of steel.

The Northern Pacific Ry., is said to be planning in expenditure this year of about $1,000,000 for repairs, renewals and improvements on what is known as the lines west of Trout Creek, Mont. About half the sum will be spent for new steel for the main line which is to be renewed with 90-lb. rails throughout the entire district. The company is also said to be considering widening the cuts through the mountains. This will cost a large sum because of the heavy work that will be necessary.

The Chamber of Commerce of White Sulphur Springs is taking steps to raise loans to secure the construction of a branch line of the Chicago, Milwaukee & St. Paul Ry., from Dorsey to White Sulphur Springs.

New York Notes.

FROM CORRESPONDENTS AND OTHER SOURCES.

The Westchester Northern R. R. Co., Leverett S. Miller, President, 63 Beaver St., New York City, is planning to call for bids for construction work, as soon as the State Railroad Commission grants permission to construct a proposed line from White Plains north to the Connecticut state line. The company is anxious to get at work upon the line between White Plains and Danbury as quickly as possible and it is thought that contractors will have operations under way by early summer —perhaps sooner. The Westchester Northern is a part of the New York, Westchester & Boston R. R. enterprise.

Cunningham & Woodward, of Hudson Falls, have been awarded Barge Canal contract No. 78, calling for the construction of a dike in the Oswego River near Fulton. The contract price was $47,721. Barge Canal Contract No. 39, for dredging the Oswego River between Three Rivers and Fulton was let to James Stewart & Co., of New York. The contract price of the work is $1,048,674.

The City & Suburban Ry Co., has been incorporated with a capital stock of $230,000 and proposes to operate a line between Ridgewood, Brooklyn and Amityville, a distance of 23 miles. The directors are William W. Burroughs, I. T. Flatto, L. C. Neuberger, all of New York City.

The receivers of the Metropolitan Street Ry. Co., of New York City, have been authorized to spend approximately $510,000 for restoring the Eighth Avenue Railroad Co., a leased line, to good working order.

Ohio Notes.

FROM CORRESPONDENTS AND OTHER SOURCES.

All details for financing the proposed Canton-Youngstown Electric railroad are reported to have been completed and it is said that grading work will be started next month. Milton Shaeffer, Canton, is interested.

The Pennsylvania R. R. will soon begin work on the construction of new yards just below those already situated at Stark Siding, at Canton. Some material is already on the ground.

The Cleveland Ry. Co., of Cleveland, has purchased 8,000 steel ties and 1,000 tons of 103-lb. girder groove rails from the Lorain steel works. The ties and rails are to be used in renewing worn out tracks at Cleveland.

The Pennsylvania R. R. is to improve its yards at Crestline, the work involving the expenditure of about $125,000.

The Baltimore & Ohio Rv., will at once proceed with the improvements on the river north of the Erie Ave. viaduct at Lorain. The improvements to the docks at this point will involve an expenditure of $1,000,000 at present and a greatly larger sum ultimately. Later a boat slip approximately 600 ft. long will be built at a point opposite the life saving station. The unloading machinery will be built by the Brown Hoisting Machine Co., of Cleveland, and will include two fast clamshell plants with necessary conveyors. The contract for the whole improvement has been awarded to P. Farrell, Cincinnati. A brick and concrete power plant 75 by 125 ft. and 45 ft. high is included in the plans and a concrete dock 1,000 feet long will be built along the line of the river. The work of tearing out the old docks and machinery will be begun as soon as all of the subcontracts are awarded.

The Ohio Electric Ry. Co., will shortly commence work on its proposed improvement at Dayton, which includes the relaying of the South Main St. tracks and the extension of the suburban service.

The Chesapeake & Ohio R. R. will probably soon announce plans for the contemplated improvements on the Hocking Valley. Among these will be the enlargement and improvement of the Hocking Valley terminal facilities at Toledo, at a cost of approximately $275,000, and the construction of a connecting link of railway between the Hocking Valley at Wellston and the Chesapeake & Ohio at Huntington. A new bridge will be built at Huntington and the C. & O. will thus secure a northern outlet. The new line will tap the virgin coal fields of Symmes Creek and Waterloo, in Ohio, and will open up a large territory to development. The surveys for the new line have been made and it is said that work will be started on it during this year.

Efforts are being made to have the Cleveland Electric Ry. Co., Cleveland, extend the Superior Ave. car line to a point considerably east of its present terminus at E. 117th St. It is planned to make an extensive loop through unoccupied property and connect Superior Ave. N. E. with the Euclid line at Hayden Ave. N. E., for the purpose of sending through cars to Euclid Beach.

As briefly noted in our last issue, J. C. Carland & Co., of Toledo, O., has been awarded the contract for the last section of the Cleveland Belt Line at Cleveland. The contract covers the line between the Erie R. R. and the final section and amounts to about $1,000,000. J. C. Carland & Co. were also awarded the contract for double track work on the Big Four between Middletown and Miamisburg, O., this contract amounting to about $800,000.

The Big Miami Valley Development Co., Morgan Wamsley, President, Clevis, O., has started preliminary surveys to ascertain the amount of power that can be developed from the falls of the Big Miami River between Clevis and North Bend.

Preliminary surveys between Washington C. H. and Xenia along the proposed route of the Dayton and Xenia extension have been completed and it is believed that it will be only a short time before work is started. The construction of this extension will give another outlet for Springfield, as the Springfield & Xenia traction line is controlled by the same company that owns the Dayton & Xenia line, and when the extension of that road is finished direct cars may be run from Washington C. H.

Oklahoma Notes.

FROM CORRESPONDENTS AND OTHER SOURCES.

The Oklahoma City & Suburban Ry Co., which proposed to build several suburban lines around Oklahoma City has filed amended articles of incorporation, increasing its capital stock from $250,000 to $400,000. The directors include Charles W. Ford, J. J. Johnson, Fred S. Combs, W. A. Haley and Richard Durrett, all of Oklahoma City.

L. J. Lampke, of New York City, has made a proposition to the business men of Perkins looking to the construction of an interurban line between Perks, Stillwater, Yale and Perry.

The Cherokee Belt & Interurban R. R. organized some two years ago has secured right-of-way and terminal facilities, and the necessary capital for construction. This road is to be 43 miles in length, connecting the Missouri, Kansas & Texas, Iron Mountain, Frisco, Santa Fe and Midland Valley, and building from Pryor Creek via Claremore and Collinsville to Skiastook. This is a belt line with interurban service. The freight is to be handled by steam locomotives, while for passenger traffic gasoline motor cars like those now used on several branches of the Missouri Pacific will be employed.

According to a statement of W. M. Bushnell, of Fort Smith, Ark., general manager of the Fort Smith & Western R. R., President Crane will be in Oklahoma within a month, and will take an overland trip over the proposed extension of the Fort Smith & Western, southwest from El Reno toward the Texas boundary. After this trip has been made the company hopes to be in a position to push the road to the southwest without any further delay.

The city of Walters has let the contract for its portion of the Wichita Falls-Oklahoma City Ry. This section of it is 10 miles long and will bring the line from Walters to the bank of Red River. The contract for the eighteen miles from Wichita Falls to Red River will be let soon.

The Lawton & Fort Sill Electric Ry. Co. is reported to have location surveys under way for its projected line through the Fort Sill Government Reservation. The company proposes to build from Lawton to Fort Sill, via Medicine Park. The line will be about 14 miles long. W. H. Pattie, Lawton, Okla., is General Manager.

Oregon Notes.

FROM CORRESPONDENTS AND OTHER SOURCES.

The Lane County Asset Co., of Eugene, has started surveys for its projected electric railway between Eugene and Springfield. The company is also planning several other lines for Eugene and vicinity.

Engineers are in the field and right of way is being cleared for the projected electric railway between Marshfield and North Bend. According to a statement of Major L. D. Kinney of North Bend, who is interested in the project, the line will be completed in four months.

Right-of-way is being secured by the Oregon Trunk line along its surveys south of Bend, Ore. It is understood that for approximately 30 miles land has been purchased in a 100-foot width along the Upper Deschutes, close to which river the survey follows before branching from it in a southerly direction toward Klamath.

Advices from Laidlaw state that work on the new survey for the irrigation canals, ditches and reservoir of the Oregon, Washington & Idaho Finance Company, the concern which has taken over the holdings and contracts of the Columbia Southern Irrigating Company, has begun, and will be prosecuted as fast as possible. The survey for the reservoir site will first be taken up. Sixteen hundred acres of land in the Wimer flat will be used for the reservoir site to conserve the flood waters of Tumalo creek. It is proposed to build a dam 70 ft. high and 450 ft. long. It is also proposed to construct a new feed canal to the reservoir and most of the canals and ditches will have to be reconstructed and put on proper grades. The total cost of the project will be about $450,000.

The Oregon Trunk line R. R., John F. Stevens, President, Portland, according to reports is to shortly let contracts for the extension of the line from Madras to Bend. The first 109 miles of the road are now being constructed by the Porter brothers, and the work is progressing as rapidly as men can be secured for it.

The State Desert Land Board is framing up a contract with the Evans Almirall Co., for the reclamation of 73,376 acres of land in the Lower Powder River Valley, 14 miles northeast of Baker City. The total cost of this project is estimated at $3,943,000, or about $69 per acre. The land is divided into two units, there being in one 33,800 acres to be irrigated with water from the Powder River and stored in the Thief Valley. The other

will be watered by the construction of a reservoir on Balm Creek, the supply to be diverted through a long feed canal from Eagle Creek. There will be two dams, one in the Thief Valley 110 ft. high, and the other at the Balm Creek reservoir 150 ft. high. These dams will be of concrete and earth construction. The feed canal tunnel will be over two miles long. The entire system will be constructed of concrete and steel. No open ditches will be used, these being replaced by modern reinforced concrete pipes. This is the first project under the new law and the Evans-Almirall Co. has made maps, plans and surveys that have required an expenditure of over $30,000.

The City of Portland will probably shortly take up the matter of constructing municipal docks. A bond issue of $500,000 for this purpose was authorized in 1907, but nothing has been done.

Location surveys have been started from Albany for the projected line of the Albany & Interurban Ry. to Sweet Home by way of Lebanon and the valley of the South Santiam River. It is planned to construct two electric lines to Sweet Home, one by way of Lebanon and the South Santiam Valley and the other by way of Brownsville and the Calapooia River Valley. Hugh G. Fisher, Albany, is engineer in charge of surveys.

The Oregon Trunk Line, John F. Stevens, President, Portland, Ore., now building from a point on the Columbia River, near the mouth of the Des Chutes River, south into Central Oregon, is reported to be asking for bids for the construction of a number of bridges, the most important of which will be over the Columbia River, the Celilo Canal, the Oregon Railroad & Navigation Co.'s main line and the Portage Railroad. It is said the work will cost between $1,000,000 and $1,500,000. The plans provide for a swing bridge over the canal on several fixed spans. There will be three other bridges over the Des Chutes River, one of which will be at Horseshoe Bend and another at Oxbow.

Surveys have been made through the Malheur River Valley for the Boise & Western R. R., which is to extend from Boise, Idaho, across the state of Oregon to Coos Bay. Col. C. E. S. Wood, Portland, Ore., is President.

Pennsylvania Notes.

FROM CORRESPONDENTS AND OTHER SOURCES

The Juniata Valley Construction Co., mentioned in our last issue, has been incorporated to engage in construction work in Pennsylvania, making a specialty of the construction of electric, steam and gasoline electric railroads. A. J. Starr, H. E. Stael and B. F Godard, Huntington, Pa., are interested.

The Pittsburg & Lake Erie R. R., J. A. Atwood, Chief Engineer, Pittsburg, has been making surveys for a route from Stoneboro, Pa., to Ellwood City, via Poterville, for a cutoff and to tap the coal fields of that district.

The Borough officials of Catasauqua, have granted the Delaware, Lackawanna & Western R. R. a franchise to enter that place. To enter Catasauqua the railway would only have to build from Bath, a few miles distant. Surveys are also said to have been made for building to Allentown, three miles from Catasauqua. G. J. Ray, Hoboken, N. J., is Chief Engineer, D. L. & W. R. R.

The Reading Transit Co., Harry G. Louser, President, Lebanon, will this summer replace the 40 lb. rails on the Lebanon & Annville Street Ry., with 80 lb. rails. The line is five miles long.

The Receivers of the West Side Belt R. R. Co., of Pittsburg, are to expend $15,000 for additional yard tracks at Clairton. Henry W. McMaster is Receiver.

The Scranton Ry Co., of Scranton, proposes to lay additional tracks on Luzerne St. in that city.

Texas Notes.

FROM CORRESPONDENTS AND OTHER SOURCES

Grading work has been started five miles from Walnut Springs on the line of the Walnut Springs & Glen Rose R. R. The line will be completed to Walnut Springs and will then be built east across the Brazos River, to connect with the Santa Fe. J. H. Farr is General Manager.

The promoters of the projected interurban line from Dallas eastward have awarded the contract for grading the first four or five mile sections of Buckner Orphans' Home to E. L. Horalson, of Dallas. Dr. R. C. Buckner, Dallas, is interested.

B. F. Yoakum is reported to be negotiating for the purchase of the Texas Midland R. R. at present in operation between Paris and Ennis, with a view to making it a part of the Frisco and Trinity & Brazos Valley lines in Texas.

Surveys have been started from Gainesville for the projected line of the Gainesville, Oklahoma & Western R. R., from Gainesville to Bridgeport and thence north to points in Oklahoma. At a recent meeting of the directors in Gainesville the following officers were elected: J. C. Whaley, president; H. W. Stark, first vice president; O. F. Scott, second vice president; R. E. Thomason, secretary, and S. M. King, treasurer. F. B. Truax is the engineer.

Arrangements are under way for the beginning of construction work on the proposed line of the Penn City Terminal Ry. Co., which is to extend from Houston to Penn City, a distance of ten miles. The road is to be operated by steam with motor cars for passenger traffic. John G. Tod, Houston, is interested.

The Southern Lumber Co., of Texarkana, Tex., is said to have plans under way for the construction of a new railway line between Caddo Parish and Jefferson, Tex.

The Dimmick Construction Co., of Kansas City Mo., has been awarded the contract by the Lobo Land & Irrigation Co., for sinking 500 wells on 60,000 acres of land in El Paso County, known as the Van Horn Valley. The price of the wells depends on the depth, but it is estimated that the 500 wells will cost between $200,000 and $250,000. The 60,000 acres is to be opened for colonization. It will be divided into 20-acre tracts and on each tract will be sunk an artesian well.

The City of Austin, by a vote of 2187 to 38, has declared in favor of rebuilding the dam in the Colorado River destroyed some years ago. This work was mentioned in these columns in our March 30 and April 6 issues.

The A. M. Blodgett Construction Co., of Kansas City, Mo., is making good progress with its contract for the construction of the Galveston causeway and by the end of this month it is expected that all of the 8,500 concrete piles for the protected roadway will be finished at the end of March 2,500 of these piles had been placed. As soon as one side of the protected roadway piling is in place, the North American Dredging Co., will be ready to go ahead with its filling work, the pipe line for that purpose being now distributed over the line.

The properties of the Belton-Temple Traction Co., are to be sold at a receivers' sale at Belton on May 3, by W. G. Haag, Receiver, Temple. Arrangements for financing the line on a new and firmer basis have been made effective as soon as the receivership ends. It is probable that the bondholders will bid in the property. Street car service in Temple is to be extended to outlying territory that has built up almost solidly since the line was built and serious consideration is to be given extension of the line to Austin or Waco.

The County Commissioners at Galveston have been petitioned for the establishment of a drainage district between Dickinson and Texas City Junction on both sides of the Galveston, Houston & Henderson R. R.; about 16,000 acres of land would be affected.

The Memphis, Paris & Gulf R. R., H. C. McCluer, Chief Engineer, Nashville, Ark., is reported to have practically completed final arrangements for its extension to Texas. The whole line has been surveyed from Memphis, Tenn., via Helena, Ark., to Terrell, Tex., and cash bonuses amounted to $1,095,000 are said to have been secured, in addition to right of way and terminals. The projected line will be about 350 miles in length and will penetrate some of the richest undeveloped territory in the South. It will cross five navigable streams.

The Crosbyton & South Plains Ry. has filed its articles of incorporation at Austin. The company proposes to build a line from Spur, Tex., to Lubrock, Tex., 68 miles, and from Crosbyton to Plainview, Tex., 52 miles. Its chief stockholders are: O. L. Spencer, H. W. Coonley, J. S. Coonley, Edmund H. Bailey of Chicago, and Avery Coonley and Edward Coonley of Riverside, Ill., all of whom have large ranch interests in the territory.

J. H. Collins, Constructing Engineer, Chicago, Ill., has made a proposition to the citizens of Smithville, to build a railroad from Aransas Pass to that city. He is interested in the Aransas Pass & Northern R. R., which proposes to build from Aransas Pass to Smithville via Gonzales, Cureo, Goliad and Refugio.

D. J. Grigsley, of Dallas, who has the contract for the construction of the Temple Northwestern Ry., has opened permanent offices in the Willcox block on Avenue A at Temple. He will give personal supervision to the work, which is under full headway since the weather settled. Seventy teams are now employed on the dump and others are on the way to Temple, Gatesville and Comanche.

The Asherton & Gulf R. R., which at present extends from Artesia to Asherton, a distance of 32 miles has made a proposition to the citizens of Eagle Pass to build to that place. The road would connect Eagle Pass with the International & Great Northern and give that railroad another connection in Mexico.

Utah Notes.

FROM CORRESPONDENTS AND OTHER SOURCES

A. J. Evans of Lehi has applied to the city council of Lehi for a transfer to him of the Jesse Knight franchise for an interurban road. Mr. Knight has relinquished all applications for a franchise.

P. B. McKeon of Milford and W. H. Althoff of Salt Lake have interested Los Angeles and Eastern capitalists in a project to acquire an old reservoir site near Milford and about 10,000 acres of land. The reservoir is a part of a system constructed 18 years ago. The land reverted to the government, and the present owners believe that they can repair the reservoir for $5,000.

The Gunnison City Canal Co., of Gunnison, has been organized with a capital stock of $7,500.

The Utah Construction Co., Ogden, Utah, has been awarded the contract for constructing the railroad from Bingham Canyon to the smelters at Garfield, mentioned in our last issue. The road will be known as the Bingham & Garfield Ry., and its officials and stockholders are connected with the Utah Copper Co. The survey calls for a line of railroad 17 miles long from the mines of the Utah Copper Company at and near Bingham to the concentrating mill at Garfield, and thence to the smelter at Garfield. The maximum grade will be 2½ per cent, the maximum curvature, 6 degrees, with a small number of curves. The construction will be heavy. Three tunnels will have to be bored through the hills, each one to be of considerable length.

Virginia Notes.

FROM CORRESPONDENTS AND OTHER SOURCES.

The Virginia & Southwestern Ry., has engineers in the field surveying from Keaker, Va., through the Cumberland Mountains into Clover Fork, making possible an extension to Harlan, Ky. J. H. McCue, Bristol, Tenn., is General Manager.

Location surveys have been completed for the 34 miles of the route of the Roanoke & Bent Mountain Ry. from Roanoke to Floyd. The remaining 13 miles are between Roanoke and Poague's Mill. The cost of the line is estimated at $1,000,000.

The Dumps Creek extension of the Carolina-Clinchfield & Ohio Ry. has been practically completed and will be opened for traffic shortly. The extension will traverse 6 mines

that are being developed by the Clinchfield Coal Corporation, at Dumps Creek, Va., which is a few miles from Dante.

Washington Notes.

FROM CORRESPONDENTS AND OTHER SOURCES.

The Copper River & Northwestern Ry., S. C. Hawkins, Chief Engineer, Cordova, Alaska, is to put surveying parties in the field this summer to locate a route for an extension from Chitina, Alaska, to Fairbanks, a distance of 250 miles.

The Hewes Contracting Co., has grading work well along on the interurban line which is to connect Chehalis and Centralia. Rails and other equipment have already arrived at Chehalis.

W. P. Tierney & Co., Nelson, B. C., have been awarded a contract for construction of a ten miles' extension of the Kettle Valley Lines railway (Spokane & British Columbia Ry.) up the north fork of the Kettle River. The line is now built to Lyon creek, about 30 miles from Grand Forks.

Plans are under consideration for a car line from a point near Bellevue to Redmond by way of Kirkland, a distance of approximately eight miles. The route of the road, provided suitable grades can be obtained, will be through the farming districts lying back of Bellevue, thence northward to near Northrup's Landing, thence near the shore of Lake Washington to Kirkland, and from there to Redmond. Gasoline cars will be used at first, although the plans include the ultimate electrification of the line. Surveys have been under way for some time. Capt. J. L. Anderson, Manager of the Anderson Steamboat Co., Seattle, Wash., is interested.

The Boulevard Park Ry. Co., of Spokane, has been incorporated with a capital stock of $12,000, the incorporators being Samuel Glasgow, H. W. Allen, and J. W. Oakes.

M. J. Heney, Seattle, who has the contract for the construction of the Copper River & Northwestern R. R., from Cordova to the interior of Alaska, is now using about 1,800 men in the work and by May 1 expects to have 4,000 men employed. The contract time for the completion of the road is Nov. 30.

Right-of-way being secured for the extension of the Northern Pacific from Grandview to Gibbon. This covers twelve miles through the heart of the irrigated country west and north of Prosser. It is understood the Northern Pacific intends to build a double track from Gibbon to North Yakima, making the latter point the terminus of the old Sunnyside branch instead of Toppenish Junction.

The Seattle-Tacoma Short Line Ry. Co., has filed a map of the route of its projected interurban line with the County Commissioners and made application for a new franchise to replace the one already held, which is for a different route and which expires this month. It is believed that if the new route is satisfactory to the board, another franchise will be granted and construction work commenced early in May.

The Seattle-Tacoma Short Line has been granted a 50-year franchise to operate an electric railway within the King County limits. E. J. Felt and H. A. Eastman, of Tacoma, have been awarded the contract for building the line. Practically all right of way has been secured. The line will be 29 miles long.

Residents of Charleston have voted to rebuild the city wharf at a cost of $3,500.

Bids are to be opened Apr. 22 at the office of the Project Engineer, U. S. Reclamation Service, North Yakima, for the excavation of about 40 miles of sub-laterals, in the Tieton unit of the Yakima irrigation project, Washington. These ditches, the capacity of which is less than ten second-feet, will be used for the watering of the so-called second unit of the Tieton projects, embracing 8,200 acres of land. The work has been divided in seven schedules of approximately equal value in order to make it attractive to small local contractors. The estimated cost of the entire work is about $15,000.

The Western Washington Railway & Navigation Co., C. C. Quackenbush, President, Aberdeen, has about completed the survey of the 78 miles of the road between Aberdeen and Colby, on Puget Sound, 10 miles southwest of Seattle. Most of the right of way has been secured. The road will cost $2,000,000, it is said, and will be equipped with gasoline motors for passengers cars and steam engines for freight trains. Work upon building the road may be started in the near future.

Wisconsin Notes.

FROM CORRESPONDENTS AND OTHER SOURCES.

Schmidt Bros & Hill, Superior, have been awarded the contract by the Great Northern Ry. for the construction of new buildings to be erected this spring in connection with the road's big terminal project at Allouez. Included in the contract are the following: Eleven stall engine and power house; mechanical coal chute; fireproof power house; gasoline tank; seventy foot double cinder pit; storehouse and scrap bin, 30x70, 100,000 gallon water tank, and steel tower; icehouse, 20x26 feet; water piping, sewer system and fire protection system including standpipe, etc.

In addition to the McIntosh Bros. contract, mentioned in our last issue, for reconstructing the old tunnel at Tunnel City for the Chicago, Milwaukee & St. Paul, these constructors have the work of completing about 40 miles of double track on the Mississippi River Division. Both jobs are under way and are to be completed this fall. McIntosh Bros. have their offices in the Pabst Bldg., Milwaukee.

The Plum Valley R. R. Co., which surveyed a route from Plum City to Pepin and to the mouth of the Chippewa River in 1906, is taking options on a right of way for a proposed trolley line to be built in the near future over one of two routes: from Spring Valley via Eau Galle and Arkansaw to Pepin, or from Spring Valley via Rock Elm, Exile, Plum City to Pepin. The company would build over the route offering the best inducements in a financial way. H. A. Plath, Minneapolis, Minn., is interested.

The Wausau Street Ry Co., of Wausau, has purchased enough property on the Wisconsin river at Mosinee to give it the flowage rights for the development of a 21-foot head. This would give about 6,000 H. P. It is believed that steps for the development of the power will probably be taken soon.

The LaCrosse Water Power Co., W. J. Ferris, President, LaCrosse, has completed plans and submitted them to contractors for bids on the new east fork dam which is to create a 5,000,000,000 cu. ft. lake north of Hatfield, and which will help the operations of the Hatfield water power. The new dam is to be 33 feet high, 350 feet long, with six 5x6 gates in the bottom, and on a sloping side will have a dike 4,000 feet long and 33 feet high where it connects with the dam.

Canadian Notes.

FROM CORRESPONDENTS AND OTHER SOURCES.

The Board of Control of Toronto has decided to suport a council committee report that an engineer be engaged to assist the City Engineer in the preparation of a general plan for a subway railway service, and also that the Mayor and the City Engineer should visit several of the cities in the States, which have subway or tube railways, for the purpose of securing information as to their cost, and to endeavor to secure the services of an expert engineer, who has had charge of the construction of a subway railway.

The City of Londan, Ont., owning the London & Port Stanley Ry., is said to be considering electrifying it. At present the road is leased to the Pere Marquette.

Location work on the Alberta & Great Waterways Ry. has been practically suspended pending the hearings before the Canadian Legislature. Construction work, however, is to be proceeded with on the first 50 miles of line south of Edmonton, and contracts for clearing the way have been let. F. S. Darling, formerly with the C. P. is engineer in charge of construction.

The contract for the construction of the second line of the double track of the Canadian Pacific from Winnipeg to Portage la Prairie has been awarded to J. Hargrave & Co., of Winnipeg. This is a section 56 miles and it is the intention of the C. P. R. to have it ready for handling the wheat crop next fall. The work will entail the handling of approximately 350,000 cu. yds. of material.

M. H. MacLeod, General Manager of the Canadian Northern Ry., Winnipeg, Man., has submitted a proposition to the City Officials of Brandon, Man., by which the Canadian Northern will build a transfer track from the C. P. R. lines to its own tracks over which it will be allowed to operate a street railway. The proposition also includes the building of an industrial spur from McTavish Avenue to the C. N. R. station at the corner of Ninth and Princess Streets.

The company which is to build the two new dry docks in Canada has taken out registration papers with the State Department. The docks will be not less than 900 ft. long and 100 ft. wide, and will have a depth of 35 ft. on the sill. As previously mentioned in these columns, one of these docks will be located at Levis and the other at St. John, N. B. Both docks will be supplemented by adequate facilities for the repairing of vessels of the largest size, and it is probable that in connection with the St. John dock there will be a first-class steel shipbuilding plant. The company is composed of Harland & Wolf, of England, represented by Lord Pirrie, the Canadian Pacific by Sir Thomas Shaughnessy, the Allen Steamship Co., and McArthur, Perks & Co.

George Webster, Winnipeg, Man., has been awarded the contract for the 140 remaining miles of the Tofield-Colgary branch of the Grand Trunk Pacific. He will have his headquarters at Alix. The line is to be finished to Colgary this year.

The Canadian Pacific Ry., J. G. Sullivan, Assistant Chief Engineer, Montreal, Que., began work April 1 on its new terminals in the eastern part of Montreal near the Place Viger Station. The improvements will involve the expenditure of many millions before they are completed. They include an immense enlargement of the yards in the east end; additional trackage all the way from Dalhousie Square to Hochleaga; the construction of a continuous series of subways under Notre Dame Street, which will form a tunnel from Berry Street to Sohmer Park, and the construction of a new wing to the Place Viger Hotel, also the rearrangement and partial reconstruction of the station buildings and the construction of new freight sheds and warehouses in the vicinity of Dalhousie Square.

The Canadian Pacific Ry. will expend about $175,000 for improving its local yard at Kamloops, B. C. It is proposed to move the new station back 100 ft. from its present position and straighten out the main track. This will enable the company to lay several additional tracks, and thus provide more accommodation for cars.

The Grand Trunk R. R. has asked the city of Stratford, Ont., to build a subway, and if this is done the railway will construct a new station and shops.

The Niagara, Saint Catherines & Toronto Ry. Co., is meeting with good success in its promotion work and it is believed construction work will be started soon on its electric railroad from Saint Catherines, Ont., to Niagara-on-the-Lake, and from there to Fort Erie.

The Clyde Steamship Terminals, is planning to erect new terminals on its property in East Bay, between Market and Liberty Sts., at Jacksonville, Fla.

The supervisors of Black Bayou Drainage District of Greenville, Miss., are considering expending $8,000 to $10,000 to complete the drainage of lands along Black Bayou, in Washington County, Miss.

The Yellow Pine Mining Co. has bought the material for the narrow guage road from Jean, Nev., on the Salt Lake Route to Good Springs mining regions, and will begin building at once.

BIDS ASKED.

Bridges.

Bids are asked on following work, the notes being arranged alphabetically by states:

Denver, Colo.—Until April 16, by Charles W. Comstock, State Engineer, Denver, for the construction of a steel bridge over Blue River, 1½ miles north of Dillon.

Danville, Ind.—Until 10 a. m., April 19, by W. H. Nichols, County Auditor, for the construction of ten bridges.

Baltimore, Md.—Until 11 a. m., April 20, by B. T. Fendall, City Engineer, for constructing steel bridge over Gwynn's Falls on the Franklin Road.

Clay Center, Neb.—Until 10 a. m., April 14, by Ward K. Newcomb, County Clerk, for material and labor necessary for the construction and completion of all bridges that may be ordered in the county for one year from date of contract.

Cohasset, Minn.—Until 2 p. m., May 3, by the Town Clerk, for the construction of a steel and concrete bridge.

Meridian, Miss.—Until 8 p. m., April 15, by C. W. O'Leary, City Clerk, for constructing a concrete bridge containing 198.7 cu. yds. of concrete. W. G. Wetmore, City Engineer.

Chillicothe, O.—Until April 25, by Robert D. Alexandred, County Auditor, for labor and materials for building a reinforced concrete arch bridge over Bulls Run, about two miles from Hallsville in Colerain Township. Certified check for $100 required with bid.

Cincinnati, O.—Until noon, April 15, by the County Commissioners, Fred Dreihs, Clerk, for the following county work: Under Specification No. 19—For concrete bridge on and relocation of West Chester road south of Crescentville, Sycamore Township. Bond for $500 required with bids.

Cleveland, O.—Until noon, April 18, by A. B. Lea, Director of Public Service, 104 City Hall, for steel rods and beams for strengthening Superior viaduct.

Hamilton, O.—Until April 16, by the County Commissioners, for improving the Highman St. bridge at Hamilton by constructing new pipe railing, a protection for the lower portion of the bridge and side rails. The estimated cost is $800. L. A. Dillon is County Engineer.

Jefferson, O.—Until 1 p. m., April 19, by J. S. Matson, County Surveyor, for the construction of concrete abutments for a bridge over Rock Creek on the East and West Center Road in Rome Township.

Lima, O.—Until noon, April 14, by the Board of Control, Glen O. Wallace, Secretary, for the following work: (1) For furnishing all the labor, material and erecting a concrete bridge across the Ottawa river at the intersection of Collet St. and Shawnee Road. (2) For furnishing all labor, tools, etc., necessary for the straightening of the Ottawa river channel in the immediate neighborhood where the above bridge is to be erected.

Mt. Vernon, O.—Until 1 p. m., April 23, by Irvin Young, County Auditor, for the construction of the substructure and superstructure of the Balcom bridge in College Township.

Easton, Pa.—Until 10 a. m., April 22 by County Commissioners, for cleaning, scraping and painting county bridges.

York, Pa.—Until May 2, by the County Commissioners, for a general overhauling of the 27 iron bridges in the county, the work including two coats of paint.

Greenville, S. C.—Until April 15, by J. P. Goodman, County Supervisor, for construction of two bridges over Reedy River.

Newberry, S. C.—Until April 15, by County Commissioners, H. C. Holloway, Clerk, for constructing a steel or iron bridge to cost $3,500 over Saluda River between Kempson's Ferry and Bonknight's Ferry.

Elkins, W. Va.—Until 3 p. m., May 6, by F. A. Rowan, Clerk County Court, for the construction of a bridge over Cheat River, either at site near Bowden or near Faulkner. Bids will be received on a reinforced concrete arch or bridge, on a steel bridge with concrete or stone abutments, or a steel bridge to be placed on abutments provided by the county.

Winnipeg, Man.—Until noon, Apr. 14, by Frank Lee, Division Engineer, Canadian Pacific Ry., Winnipeg, for constructing abutments for bridge 24.4, Souris Section.

Buildings.

Bids are asked on following work, the notes being arranged alphabetically by states:

Cyrene, Ga.—Until April 15, by Rev. Z. J. Edge, president of Cyrene Institute, Cyrene, Ga., for mason, carpenter and painters' labor for a 50-room girls' dormitory; an 8-room addition to school building, and dining hall and kitchen—all frame construction. Plans may be seen at the office of the president, and may be had from the architect. Alexander Blair, Marion, Ga.

Belleville, Ill.—Until 3 p. m., May 16, by James Knox Taylor, Supervising Architect, Washington, D. C., for a plumbing and drainage system at the United States Post Office, Belleville, Ill.

Centralia, Ill.—Until 3 p. m., May 18, by James Knox Taylor, Supervising Architect, Washington, D. C., for the construction, complete (including plumbing, gas piping, heating apparatus, electric conduits and wiring) of the U. S. Post Office at Centralia, Ill.

Ottumwa, Ia.—Until 8 p. m., May 13, by James Knox Taylor, Supervising Architect, Washington, D. C., for the construction (including plumbing, gas piping, heating apparatus, electric conduits and wiring and standard clock system) of the U. S. Post Office and Court House at Ottumwa, Ia.

Fort Riley, Kan.—Until 10 a. m., April 15, by Capt. W. M. Whitman, Constructing Q. M., Fort Riley, for reconstruction of artillery stable No. 76, at Fort Riley. Bid will also be entertained for the installation of the electrical work.

Catlettsburg, Ky.—Until 3 p. m., May 19, by James Knox Taylor, Supervising Architect, Washington, D. C., for the construction (including plumbing, gas piping, heating apparatus, electric conduits and wiring), of the U. S. Post Office and Court House at Catlettsburg, Ky.

Shreveport, La.—Until 3 p. m., May 16, by James Knox Taylor, Supervising Architect, Washington, D. C., for the construction (including plumbing, gas piping, heating apparatus electric conduits and wiring and standard clock system), of the U. S. Post Office and Court House at Shreveport, La.

Fort Caswell, N. C.—Until 3 p. m., May 6, by Lieut. Wm. R. McCleary, Constructing Q. M., for construction, plumbing, heating and wiring, with fixtures, two double sets officers' quarters and one ordnance shop at this post.

Brooklyn, N. Y.—Until 11 a. m., April 18, by C. B. J. Snyder, Superintendent of School Buildings, Park Ave. and 59th St., New York, for alterations, repairs, etc., at public schools, 24, 26, 36, 43, 52, 53, 55, 68, 74, 75, 86 and 116, Borough of Brooklyn.

Brooklyn, N. Y.—Until 2:30 p. m., April 18, by Michael J. Drummond, Commissioner of Charities, foot of E. 26th St., New York, for furnishing all the labor and materials required for doing certain roofing on the Cumberland St. Hospital, Borough of Brooklyn, the City of New York. Surety required is $500.

Fort H. G. Wright, N. Y.—Until 10 a. m., May 6, by Capt. F. T. Arnold, Constructing Q. M., New London, Conn., for the construction, plumbing, heating, electric wiring and fixtures, of one double and two single company officers' quarters, one guardhouse, one ordnance shop, one coal shed, and one wagon shed, at Fort H. G. Wright, N. Y.

New York, N. Y.—Until 11 a. m., April 18, by C. B. J. Snyder, Superintendent of School Buildings, Park Ave. and 59th St., for alterations, repairs, etc., at public schools 1, 3, 8, 16, 21, 23, 29, 38, 41, 44, 106, 107, 108, 113 and 124, Borough of Manhattan, and also for alterations, repairs, etc., at Bryant High School, and public schools 1, 2, 4, 13, 14, 17, 19, 20, 72 and 76, Borough of Queens.

New York, N. Y.—Until 2:30 p. m., April 18, by Michael J. Drummond, Commissioner of Charities, foot of E. 26th St., for furnishing all the labor and materials required for alterations and repairs to building located on the Westerly end of pier at the foot of East 26th St., the City of New York. Security required is $1,000.

New York, N. Y.—Until 11 a. m., Apr. 26, by Board of Water Supply, 299 Broadway, for Contract 81—For the construction of four field office buildings and five horse sheds, in the Croton, White Plains and Hill View Divisions of the Catskill Aqueduct, in the towns of Mount Pleasant and Greenburg and the city of Yonkers, Westchester County, N. Y.

Oswego, N. Y.—Until 3 p. m., April 26, by Dr. Andrew S. Draper, Commissioner of Education, Capitol, Albany, N. Y., for construction complete, including heating, plumbing, electric work and gas-piping, for new building for State Normal School at Oswego, N. Y. Certified check for $15,600 required with bid. Franklin B. Ware, State Architect, Albany.

Rensselaer, N. Y.—Until noon, April 14, by F. A. McNeely, Secretary of the State Armory Commission at the Capitol, Albany, N. Y., for the construction of a 1-story tile and concrete house to be erected at the State Rifle Range, Rensselaer.

Ward's Island, N. Y.—Until 3 p. m., April 20, by the State Commission in Lunacy, T. E. McGarr, Secretary, Albany, N. Y., for additional medical quarters, construction, including heating, plumbing and electric work, at the Manhattan State Hospital, Ward's Island. Certified check for $1,500 required with bid. Franklin B. Ware, State Architect, Albany, N. Y.

Willard, N. Y.—Until 3 p. m., April 20, by T. E. McGarr, Secretary State Commission in Lunacy, Albany, N. Y., for water tower and piping for fire protection at the Willard State Hospital, Willard. Plans, etc., at the hospital and at office of Franklin B. Ware, State Architect, Albany. Certified check for $200 required with bid.

Warrensville, O.—Until noon, May 6, by W. H. Bubna, Clerk of the Board of Education of East View Village School District, Cuyahoga County, Ohio, at his residence on Kinsman Road in said District, or addressed to him at Warrensville, Ohio, R. F. D. No. 1, for furnishing the labor and material necessary for erecting a 4-room brick school building. George F. Hammond, Architect, at 409 Lennox Bldg., Cleveland, O.

Sewickley, Pa.—Until 3 p. m., May 14, by James Knox Taylor, Supervising Architect, Washington, D. C., for the construction, complete (including plumbing, gas piping, heating apparatus, electric conduits and wiring), of the U. S. Post Office at Sewickley, Pa.

Fort Moultrie, S. C.—Until 11 a. m., April 28, by the Constructing Q. M., Fort Moultrie, for constructing one frame artillery engineer's office and storeroom, one brick or reinforced concrete, ordnance shop, and one brick, or reinforced concrete quartermaster's storehouse at Fort Moultrie.

Beaumont, Tex.—Until noon, April 21, by Guy W. Junker, President City School Board, for the erection and completion of three brick school buildings: Millard, South End White and Averill addition, separately or collectively, including plumbing, heating, wiring and fire escapes each. Waller, Shaw & Field, Architects, Fort Worth.

Fort Bliss, Tex.—Until noon, May 4, by Capt. W. H. Waldron, Constructing Q. M., for the construction, plumbing, heating and electric wiring of field officers quarters.

Barrie, Ont.—Until noon, Apr. 18, by F. S. Baker, Architect, Traders Bank Bldg., Toronto, Ont., for all the work and material required in the erection of a new wing to be added to the Royal Victoria Hospital, Barrie.

Roads and Streets.

Bids are asked on following work, the notes being arranged alphabetically by states:

Attalla, Ala.—Until noon, April 27, by the Town Council, for the construction of 5,100 sq. yds. of artificial stone sidewalk, and 7,800 lin. ft. of combined curb and gutter of artificial stone. Certified check for $500 must accompany each bid. Hill & Campbell, Engineers, Gadsden, Ala.

Bridgeport, Conn.—Until 8 p. m., Apr. 14, by the Paving and Sewer Commission, Bernard Keating Secretary, for constructing about 1,580 sq. yds. wood block paving on Elm St., and 695 sq. yds. of brick paving on Broad St. M. F. McKenna is City Engineer.

Lake City, Fla.—Until 7:30 p. m., Apr. 25, by Board of Public Works, for constructing about five miles of cement sidewalks.

Atlanta, Ga.—Until noon, April 15, by H. L. Collier, Commissioner of Public Works, for the construction of chert or macadam pavement on portions of Waddell St., Hightower St., Wells St., Robbins St., McAfee St. and Randolph St. Certified check for $500 required with bid.

Macon, Ga.—Until noon, April 19, by Bridges Smith, Clerk of Council, for constructing 47,570 sq. yds. of pavement. Samples of paving material must accompany bid. C. C. Anderson, City Engineer.

Amboy, Ill.—Until 2 p. m., Apr. 20, by J. M. Egan, Jr., for brick paving and concrete curbing for two different improvements. Official advertisement will be found elsewhere in this issue.

Freeport, Ill.—Until 2 p. m., Apr. 21, by Board Local Improvements, for constructing 30,200 sq. yds. of brick paving, 19,890 ft. of cement curb, and 7,225 sq. yds. of macadam. J. A. R. Daniels, City Engineer. Official advertisement will be found elsewhere in this issue.

Crown Point, Ind.—Until 12 m., May 2, by Commissioners of Lake County, C. A. Johnson, Auditor, for the construction of three gravel roads in North Township.

Greencastle, Ind.—Until 11 a. m., May 2, by D. V. Moffett, County Auditor, for the improvement of 9,165 ft. of gravel road in Jackson and Floyd Townships.

Jeffersonville, Ind.—Until 11 a. m., May 23, by Commissioners of Clark, Scott and Jeffersonville Counties, Peter Nachand, Auditor of Clark County, for the construction of a gravel road.

Kokomo, Ind.—Until 2 p. m., May 3, by Commissioners of Howard County, A. B. Easterling, Auditor, for the construction of gravel roads, in Harrison and Liberty Townships.

Marion, Ind.—Until May 3, by A. G. Stout, County Auditor, for the construction of two stone roads.

Mishawaka, Ind.—Until May 2, by this city, J. W. Haverly, City Engineer, for constructing 4,750 sq. yds. of pavement on 5-in. concrete foundation on Mill St., from 2d St. to Lake Shore and Michigan Southern Ry. Bids will be received on brick, asphalt bitulithic and creosoted wood block.

Wabash, Ind.—Until 10 a. m., May 3, by J. P. Noftzger, County Auditor, for the construction of two macadamized roads in Noble Township

Wabash, Ind.—Until 10 a. m., May 3, by J. P. Noftzger, County Auditor, for the construction of a gravel road in Waltz Township.

Wabash, Ind.—Until 10 a. m., May 3, by J. P. Noftzger, County Auditor, for the construction of two gravel roads in Lagro Township.

Wabash, Ind.—Until 1 p. m., Apr. 23, by J. P. Noftzger, County Auditor, for construction of a gravel road on line between Wabash and Grant Counties.

Havre, Mont.—Until May 2, by James Holland, City Clerk, for constructing about 37,900 sq. ft. of cement walks.

Sikeston, Mo.—Until 7 p. m., May 3, for macadamizing one mile of the Benton and Sikeston Road at Sikeston. M. S. Murray, Sikeston, is the Engineer.

ENGINEERING-CONTRACTING

A Weekly "Methods and Cost" Journal for Civil Engineers and Contractors,
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CHAS. S. HILL
C. T. MURRAY
F. A. SMITH
} EDITORS

MYRON C. CLARK . . . PUBLISHER
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CONTENTS.

EDITORIAL: Page
Should Contractors Be Required to Guarantee Standard Pavements?.....351
Maintenance Work on the New York State Highway by the Patrol System.....352
CONCRETE SECTION:
Special Forms for and Methods of Constructing Weber Concrete Chimneys.....352
Cost of an Abutment, Masonry and Slope Paving for Highway Bridge Foundations, Illinois & Mississippi Canal.....354
Forms of Concrete Pile Construction and a Statement of the Advantages and Disadvantages of Concrete Piles.....354
EARTH AND ROCK SECTION:
Method of Reconstructing the Washington Street Tunnel of the Chicago Railways Co., a New and Economical Way of Constructing Tunnels.....356
Cost of Excavating 1,850 cu. yds. of Granite in Trench for Sewer Construction.....360
ROADS AND STREETS SECTION:
Method of Constructing Sand-Clay Roads in the Middle West and Cost Data on the Construction of Four Roads of This Type.362
RAILWAY SECTION:
Traffic Conditions Influencing Subway Construction in Chicago, Ill.....366
Cost of Operating the Manhattan Elevated Railway.....369
Valuation of the Railways of Texas.....370
Method and Cost of Constructing Street Railway Track With Grouted Crushed Stone Foundation.....370
GENERAL SECTION:
A Discussion of the Supporting Power of Piles.....371
LETTERS TO THE EDITOR.....373
CATALOGS WORTH HAVING.....374

Should Contractors Be Required to Guarantee Standard Pavements? Is Not "Mill Inspection" of Paving Materials a Preferable Solution of the Problem.

The first question is not novel, for a good many city engineers have come to the conclusion that most classes of pavements require no guarantee. However, the question is again raised by the action of a committee of the Organization of City Officials for Standardizing Paving Specifications. The report of this committee appeared in our issue of March 23 and we note that a guarantee clause is recommended for all classes of pavements.

The committee divides pavements into two general classes, the first being composed in part of "materials of a perishable nature" or pavements requiring special equipment to lay and maintain, or pavements of a proprietary nature; the second class is composed of "materials more durable in character," such as stone block, brick, or "well established Portland cement concrete pavements."

In passing it might well be asked what is meant by a "well established" concrete pavement. Certainly nearly every other class of city pavement is better established than concrete, for the latter is comparatively new in this country, and except on streets of light traffic can hardly be said to be "established" at all.

It is not our purpose at present to discuss this recommended division of pavements into two more or less arbitrary classes, the first of which is to have a five year guarantee, and the second, a one year guarantee. The question that overshadows any such classification of pavements is whether any guarantee at all should be required. It is our opinion that a much more economic method of securing a durable pavement is available than exists in the method of exacting a contractor's guarantee. We are speaking now not of new types of pavements but of what may be termed the standard types—asphalt, bitulithic or bituminous macadam, brick, stone block, creosoted wood block, and macadam.

Few engineers will contend that the original reason for requiring a guarantee on any of these forms of pavement exists now—namely: ignorance on the part of engineers as to satisfactory methods of testing and inspecting. Although it may be true that most engineers have no deep knowledge of the chemical technology of asphalts and bitumens, still it can be no longer contended that consulting experts are not available. It follows therefore that highway engineers can employ such experts to test bitumens, just as railway engineers employ steel experts to inspect steel rails. In like manner creosoting can and should be tested by "mill inspection"—to draw a term from structural engineering.

The chief reason for requiring a pavement guarantee is the present high cost of maintaining a corps of expert inspectors and testers to pass upon the suitability of the materials. In small cities this is almost out of the question, and even in comparatively large cities it is often doubtful whether it pays to have such a staff of experts unless the amount of pavement laid annually is very large. We have indicated above what we believe to be the economic solution of this problem—namely: "mill inspection." In brief, our plan is this: Let this new organization of city engineers agree to act as a body in selecting experts to inspect and test paving materials, such experts to be permanently located at all the larger centers of production or distribution of paving materials. For example, at any large plant engaged in the manufacture of creosoted wood block one or more testing experts would be permanently located. These experts would determine whether the blocks were being treated with the specified amount and quality of creosote and whether the wood was of the kind required. Payment for such inspection services could be made on the basis of the square yard, precisely as mill inspection of steel is paid for by the ton.

In a similar manner bitumens, brick, etc., could be inspected at or near the points of production or distribution, and at a cost that would be nominal.

We can conceive of no other plan that would so speedily lead to standardization of paving materials as this plan of "mill inspection." It has worked wonders in the realm of steel and it will evolve equal wonders in the realms of paving materials.

We believe that few engineers will doubt their ability to secure a durable pavement by proper engineering inspection in the city where it is laid, if they can be sure of receiving suitable materials for the pavement. The questions of proper mixtures and of proper manipulation of materials are relatively simple and can be easily inspected in any city. The great bugbear is and always has been the inspection of the materials. Give any engineer a rock equal to the traps found on the Hudson River and he will make you a durable macadam road. Give any engineer an asphaltic oil equal to that from the Sunset district of California and he will make you a durable dust proof coat for your macadam. Give any engineer a wood block uniformly impregnated with sufficient creosote and he will have no trouble in securing a wood pavement of lasting quality. Why then not strike at the very root of the difficulty? Should it be answered that human knowledge of asphalts, for example, is still too incomplete to enable us to specify and test them properly, our reply is that we are then asking the blind to lead the blind when we require a contractor's guarantee of an asphalt pavement. No, we are convinced that it is not a lack of knowledge of the subject that is now perpetuating the precedent of requiring guarantees, but rather the cost of maintaining laboratories and experts in each city to test the materials. If this is the fundamental reason, then it behooves us to consider the plan of "mill inspection."

As the aim of all engineering is economy of production and operation, let us consider for a moment whether it does not cost far more to secure proper street materials by requiring contractors' guarantees than it would cost to secure them by "mill inspection."

A five year guarantee must usually be accompanied by a bond. Latterly, however, engineers have come to regard such bonds as being the sources of so many law suits that they have pretty generally recommended retaing 10 per cent of the contract price of the pavement during the guarantee period. The effect has unquestionably been to increase the contract price of pavements by 5 to 10 per cent. Asking a small contractor to wait five years for his 10 per cent is practically equivalent to asking him to wait forever. It represents all or nearly all of his ordinary profits—his salary for superintendence. Let us who are engineers ask ourselves what we would do if required to wait five years for our salaries. We simply could not do it at all, and that is precisely the position of the small contractor. He is either driven out of business by the firms of large means or he increases his price on the pavement. If he is driven out, then the large firms, finding little competition, raise their prices accordingly. In any event the result is the same.

Steel rails are inspected for less than 1 per cent of their mill price. We see no reason why paving materials may not be inspected and tested for considerably less than 1 per cent of their first cost, provided the work is done at the "mill," according to the plan above outlined. The cost of testing cement in small field laboratories is about 3 cts. per barrel, say 2 per cent of its first cost. In mill laboratories it is considerably lower, probably not more than 1 per cent of the first cost for both physical and chemical tests.

Clearly then the present system of guaranteeing pavements is far more expensive to the community than a system of "mill inspection" would be, and, in the end, the result is not at all satisfactory. Only the other day we received a letter from a highway engineer in charge of work in one of our large cities, in which he stated that one of the reasons why he advocated a municipally operated repair plant was because contractors failed to maintain their pavements properly under their guarantees. While we fail to see soundness in this reason for a municipally operated plant, we do know that the conditions confronting this city engineer are precisely as stated by him—namely: that the guarantee clauses are practically worthless. If no such clauses existed, then separate contracts for maintenance could be and should be let.

Finally, out of the experience of one of the editors of this journal in the paving contracting field, another serious objection to the guarantee system may be cited. It is this: No contractor can be sure that a change of city administration may not bring in a swarm of grafting politicians who dispossess an honest city engineer and appoint in his place a man who will "take the hide off" every contractor who has pavements under guarantee, unless a contribution to the graft fund is forthcoming. This is one of the potent reasons why many paving contractors fear to put

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in any bid at all in a strange city, if guarantees are required. It is also one of the reasons for high bids in many cities where grafting now exists. We need scarcely more than mention this phase of the matter, for every city engineer is aware of the extreme difficulty of drawing a maintenance clause that can not be used as a club over a contractor's head, if an unscrupulous person should have the power so to use it.

We strongly urge the Organization of City Engineers to take up the subject of "mill inspection," or central cooperative inspection of paving materials as offering the truly economic solution of this important problem.

Maintenance Work on the New York State Highways by the Patrol System.

The work of maintaining and repairing New York highways which have been improved under state aid is in charge of a special bureau of the State Highway Commission. This bureau conducts the work of maintenance and repair in three ways: by contract, where the work is of sufficient size; through the county and town superintendents, in cases where the repairs are of such a nature that it is impracticable to provide a contract for the work; and by a system of patrol which is provided for every road which has been improved by state aid.

The organization of the bureau of maintenance and repairs consists of a first deputy, who reports directly to the commission. Under the first deputy are six assistants or superintendents of repair who have charge of the maintenance and repair work in the six divisions into which the state has been divided. Under these superintendents are highway inspectors who have charge of certain sections covering one or two counties, each inspector having the supervision of from 60 to 100 miles of improved highway. Next under the inspector come the patrolmen, who have the care of approximately five miles of highway. The highway inspectors make regular visits to these patrolmen, instructing them in the matter of maintaining the highways, see that they are provided with material, and superintend and direct their work. The work of the patrolmen under the highway inspector not only includes the repairing of small holes, cleaning of ditches and waterways, etc., but also the elimination of ruts and the preventing of ravel by the application of a wearing coat on the roads from time to time. The patrolmen supply themselves with a horse and cart and necessary small tools for their work, and are constantly on their patrols from 8 a. m. until 5 p. m. This allows them an hour for coming to and going from their work. Under the direction of the highway inspector they are constantly employed between these hours doing such work as may be necessary to preserve and care for the highways under their charge. There is no question, states the last annual report of the Highway Commission, from which these notes have been taken, but what this constant care and supervision and attention to the small things greatly increases the life of macadamized highways. It is also intended to apply this system to the asphalt macadam roads constructed in 1909, and it is believed that the patrolmen will be able to cover a greater length of roadway so improved. It is proposed to outfit these patrolmen with a small portable heating outfit in which asphaltic oils can be heated, and it will be his duty to cover his patrol with this outfit and clean out any holes and depressions that may occur, fill them with the oil and three-quarter stone or screenings, and that any ruts which may occur from time to time in the same manner. In the spring and fall of the year, when macadam does not need as much attention as during the dry months of the summer, patrolmen are employed advantageously in the construction or renewal of guard rail or painting of the same. The patrolmen are employed practically nine months in the year, and the highway inspectors in charge of sections are employed for twelve months in the year.

Concrete and Reinforced Concrete Section

Note: This section is devoted to methods and cost of constructing concrete and reinforced concrete structures. It will cover the selection, testing and proportioning of concrete materials; laboratory tests of concrete; concrete mixing, transportation and placing; fabrication and placing of reinforcement, and form construction and erection. It will also contain articles on new and interesting developments in the design of reinforced concrete.

Special Forms for and Methods of Constructing Weber Concrete Chimneys.*

We are now building two different types of chimneys, which, though identical in principle, differ greatly in details of construction and appearance. Both types are equally well adapted for their purpose, but each has certain advantages over the other which makes it preferable under special conditions.

The "cylindrical" chimney is built with vertical outlines and a uniform inside diameter throughout. This chimney as a rule has double walls for the lower part of the shaft, with a 4-in. air space between the walls. The upper part, from two-thirds to one-half of the entire height of the shaft, is built with a single wall of uniform thickness throughout. Where the two parts connect a collar or offset is visible on the outside of the chimney.

The "coniform" chimney is the latest type of construction. The coniform chimney is built with tapering outlines, and because of its greater initial stability and the resultant saving in reinforcing steel can be built at a somewhat reduced cost. The standard taper for the chimney is 1:56 and therefore the outside diameter increases 1 ft. for every 28 ft. of height. The thickness of the wall at the top is 4 ins. for chimneys up to 8 ft. inside diameter. Chimneys over 8 ft. and up to 12 ft. inside diameter have a wall thickness of 5 ins. at the top; chimneys over 12 ft. and up to 18 ft. 6 ins. and chimneys over 18 ft. have 7 ins. of wall thickness at the top. The thickness of wall increases 1 in. for every 28 ft. in height and therefore the center of gravity of the chimney is considerably lower than the cylindrical chimney.

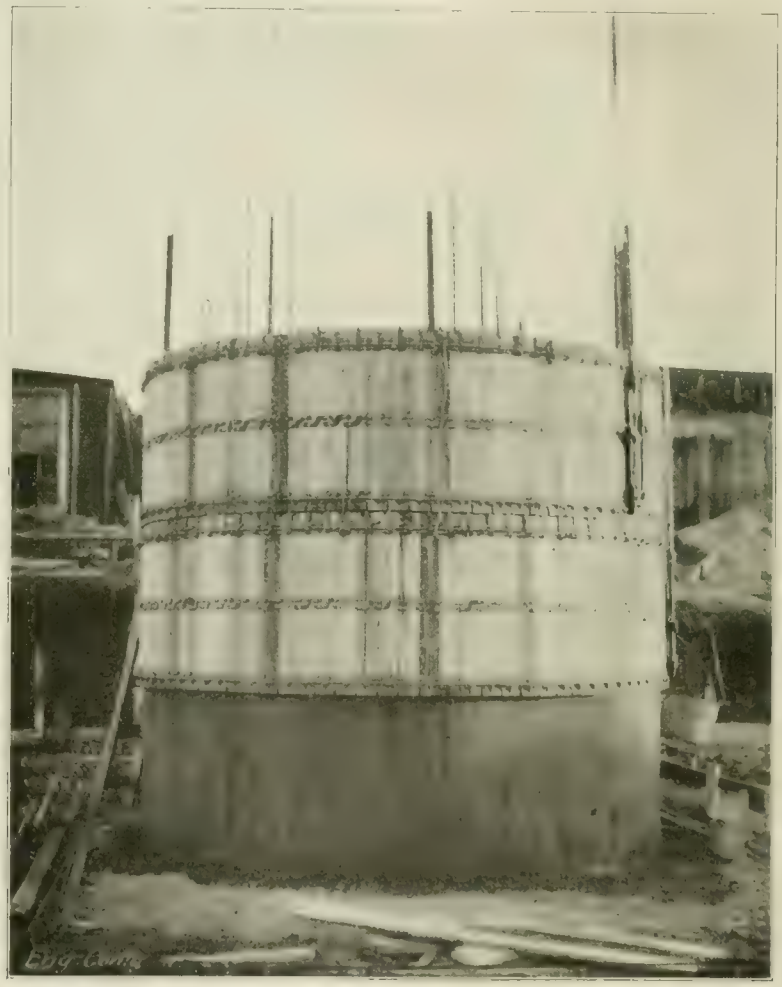


Fig. 1—View Showing Special Forms for Constructing Concrete Chimneys.

Each system has decided advantages of its own, and the conditions that have to be met will determine which is to be preferred.

The cylindrical chimney is almost exclusively used where the greatest possible saving of space is necessary, as, for instance, in places where the chimney is built inside of a building, between batteries of boilers or in congested city districts.

The coniform chimney is to be desired wherever the necessary space can be obtained. This chimney is somewhat cheaper than a cylindrical one, and also has the advantage of a more pleasing appearance. For high temperatures the chimney is partly lined with firebrick. Although concrete lining is undoubtedly better than firebrick lining, the cost of the former is made too expensive by the difficulty of hand-

*Rearranged from a paper by Carl Weber before the American Society of Engineering Contractors.

ling the complicated air space forms in a tapering chimney.

Materials of Construction and Forms.—The materials of construction are Portland cement, sand, and crushed stone or gravel, as for any other reinforced concrete work. The nature of the materials and the proportions of the concrete must naturally differ greatly to satisfy the varied purposes for which chimneys are erected, and it is hardly possible to give any strict rules for he composition of the concrete. Before deciding on the concrete mixture for a chimney, I always obtain samples of the local sand, stone, and gravel; and after carefully determining the percentage of voids in these materials I specify the proportions in accordance with the design and purpose of the chimney.

Tall and slender chimneys, with a diameter of about 1/25 to 1/40 of the total height, are subject to high bending stresses, and therefore a tough concrete of high crushing resistance is needed, while in sort and stubby chimneys, with a diameter of 1/10 to 1/20 of the height, a leaner concrete will be preferable. Chimneys which are subject to excessive heat must be built of very porous concrete, especially if they are subject also to sudden changes of temperature, while chimneys for chemical works, smelters, and so on require at least a very dense inside coating. Chimneys for copper and lead smelters require special protection against the actions of the sulphuric and arsenic gases and acids; and very often a chimney will require a special outside treatment for local reasons.

For chimneys built near the ocean, where the damp salt air is a factor to be considered, it is advisable to place the reinforcement well in the center of the wall, in order to prevent any possibility of rust streaks which mar the appearance and are very undesirable. Chimneys which are within the zone of other chimneys emitting poisonous gases will often require outside acid proofing. The kind of fuel used, whether hard or soft coal, wood, peat, oil, or local refuse, is frequently a very important factor to be reckoned with, and climatic conditions must not be overlooked.

If several flues enter into one chimney the necessary baffle walls must be provided for, and these walls must also be properly reinforced. Very often dust collectors, economizers, and so on have to be built in connection with the chimney, and care must be taken to have the necessary expansion joints supplied in these structures.

There is no other branch of reinforced concrete construction that requires such a varied and practical knowledge of the materials and the chemical and physical factors entering into the problem as chimney construction. There is no guess work in chimney construction and every failure can be traced directly and surely to ignorance or carelessness.

The method of construction of concrete chimneys is interesting and unique. The forms consist of a number of loosely connected wooden units provided with cast iron lugs which interlock and automatically secure the forms perfectly alined in a true circle.

The form units are held together by means of light steel ropes, which, acting like the hoops of a barrel, are uniformly tightened by a rope stretcher attached to one of the standard units. By means of these rope stretchers the forms can be set and released, tightened and loosened, from the working platform inside of the chimney without the use of an outside scaffold.

Figures 1 and 2 show details of the unit form system and the construction of the outside forms can clearly be seen in these pictures. The units are preferably all of even width, each representing a multiple of the figure π (3.1416), and the addition or removal of one of the units changes the diameter of the form correspondingly. Therefore any desired diameter can be built with these forms. For tapering structures a certain number of reducer units are placed evenly around in the form (see the dark staves in the pictures). These reducers are slightly tapered and together they reduce the upper diameter of the form ring, so that in the next ring above a smaller number of units are required. Of course any desired taper can be made.

The proportion of the taper is fixed in the reducer units, and therefore no reducers must be removed from the form by resetting the same, as otherwise a change in the taper would be the result.

This form system is equally valuable for any other kind of continuous construction, and is much used for the construction of water and oil reservoirs, tanks, towers, grain elevators, silos, and so on. Frequently a set of forms is rented to other contractors, but of course, on account of the patent questions involved they cannot be sold.

In chimney construction the forms are raised each day with the progress of the work. The single units are light and are so arranged that they cannot slip after the forms are opened. They are easily lifted piece by piece and as easily set again for concreting. The working platform, on which the workmen stand, forms a part of the inner forms, and all work, with the exception of the mixing of the concrete, which is done at the base of the chimney, is carried on from these working platforms just as safely several hundred feet up in the air as it possibly could be done on the level ground. The forms are extremely strong, in spite of their lightness, and there has never been a single case of an accident resulting from their use.

A light scaffolding is erected inside of the chimney merely for the purpose of carrying a ladder to the working platform. For chimneys up to 100 ft. high, scaffold and ladder have frequently been omitted, the workmen using a hoist rope to go up and down.

The same set of forms can be used for chimneys of all sizes, from 2 ft. 6 ins. in diameter up to 50 ft., and although a new set of forms is very expensive, the cost per chimney is reduced to a minimum. Because of the great care with which these forms are made, and the attention given to their preservation, an absolutely even surface of the concrete is produced, and any special outside finishing is resorted to only in very rare instances. Another important feature of these forms is that they can be used without any change on straight or tapered work and also on square, octagonal, and round structures with equally good results.

Steel forms have also been tried for chimney construction, but they have proved an absolute failure. The concrete adheres to the forms and the work produced is very rough. Greasing or oiling the forms is of no avail, because the first bucket full of concrete put into forms or the slightest tamping or spading destroys the film of oil or grease, causes unsightly streaks of oil, rust, or efflorescence to appear, and produces a weakening of the outer surface of the concrete. In frosty weather, the use of steel forms is an impossibility. Another serious objection is that these forms are easily buckled by handling and shipping and can never be adjusted again to a true circle. Every time the metal forms are raised an offset is visible in the work and these offsets can never be removed satisfactorily. A poor quality of work is the inevitable result of the use of steel forms and although large sums have been spent on experiments and schemes to perfect them, they must be abandoned for chimney construction.

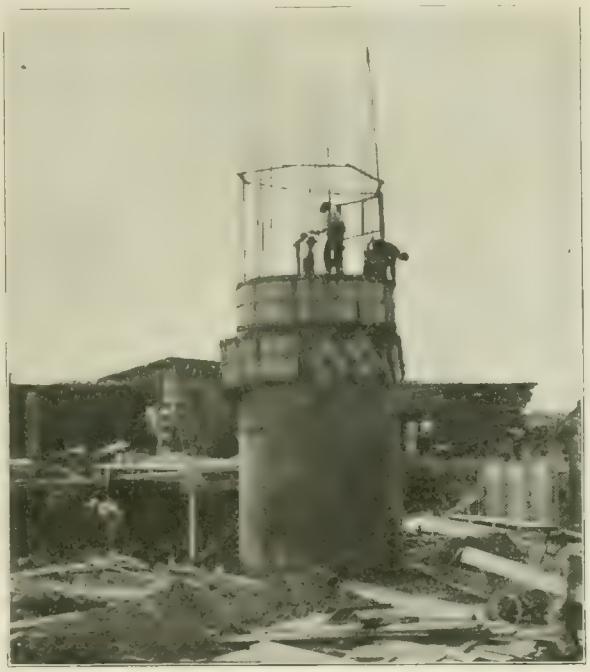


Fig. 2—View Showing Methods of Handling Forms for Concrete Chimney Construction.

The mixing of the concrete for chimney work is, as a rule, done by hand. Only a small amount of concrete is needed each day, and only a few hours of concrete mixing are required. The concrete must be mixed immediately before using, and all concrete which has been mixed over 30 mins. before being put into the forms should be thrown away.

The concrete is hoisted to the working platform in small quantities, and common water buckets are generally used for this purpose. On smaller chimneys the men who mix the concrete do the hoisting by hand, while on larger structures horse hoists or engines are used for this purpose.

There is very seldom any special outside finish required for the concrete walls. The perfect alinement which is at all times maintained in the unit forms produces very slight form marks, and as these are absolutely uniform they add to rather than detract from the beauty of the work. Patch work should never be permitted on a chimney; it only lasts a short time and the structure afterwards looks worse than before. A cement wash is often applied to the outside surfaces and although in a carefully constructed chimney there is no necessity for it, such cement wash, if carefully used on a moist concrete surface, will produce a uniform color. Whether, however, an absolutely uniform color on a large chimney is desirable or not from an artistic standpoint is another question. I believe that the only real objectionable feature in concrete work is the monotony of the gray color that characterizes the work and that the presence of correct form marks and a slight variation in the color scheme greatly increases the artistic effect. I am opposed to patching and painting concrete structures, especially as a means to cover up poor workmanship. The forms should leave the concrete surface without blemish, and if occasionally here and there a rough spot needs to be retouched to harmonize with the general

appearance of the structure, the experienced builder will certainly know what to do without using plaster or paint.

Advantages and Cost of Concrete Chimneys.—The general advances of the concrete chimney over any other type of construction are the following:

(1) It is monolithic; one solid single piece of concrete stone from bottom to top. The atmosphere, which in course of time disintegrates brick or natural stone, only adds to the strength and beauty of good concrete.

(2) It is absolutely air tight; the flue is almost perfectly smooth and therefore the chimney has a higher working capacity than any other.

(3) It can be erected in a shorter time than a brick or steel chimney. The materials used in its construction—cement, sand, and steel bars—are obtainable in any locality upon short notice and work can be started almost immediately after receipt of order.

(4) It can be built on a much smaller area than a brick or self supporting steel chimney—a point of the highest importance to a modern steam plant. A concrete chimney needs about one-half the area of a self supporting steel chimney and from one-third to one-fourth the area of a brick chimney of the same diameter and height.

(5) It is light, even lighter than a self supporting steel chimney, including lining and foundation. This is of the highest importance where the natural ground has a limited carrying capacity. The weight of a concrete chimney is from one-third to one-fifth that of a brick chimney, and therefore a good deal of money can be saved in many cases for pile driving and other foundation work.

(6) It resists the influences of the chimney gases and heat better than all others. Selected materials, strong steel reinforcement, and the monolithic nature of the chimney make it capable of resisting a continuous heat up to 1,500 degrees Fahrenheit, without injury. Concrete is one of the best fire resisting building materials known. Cement stands the test where brick and steel are completely destroyed.

(7) It is more attractive in appearance than either a brick or steel chimney. The light gray color, in connection with the elegant and graceful outlines, produces an artistic effect wholly foreign to a brick or steel chimney.

The cost depends of course almost entirely upon local conditions, local prices for cement, steel, sand, and so on, and therefore any rough and ready rules for making estimates would be worthless.

As compared with others, the concrete chimney will as a rule show a generous saving in cost, in all construction over 75 ft. high and over 3 ft. inside diameter. Even on smaller sizes this will very often hold true.

Cost of Abutment Masonry and Slope Paving for Highway Bridge Foundations Illinois and Mississippi Canal.*

To carry highways across the Illinois & Mississippi Canal required 67 bridges. Except for one swing bridge, three lift bridges and two special bridges at locks, these bridges are fixed truss bridges on concrete abutments. Three types of structure were employed.

(1) On the eastern section generally the abutments were U shaped and the superstructures were pony Warren trusses of 100-ft. spans and 14-ft. clear roadway.

(2) On the western section generally the abutments were wing abutments and the superstructures were 110-ft. Pratt trusses. The wing abutments were 23 ft. long and 16 ft. high, with 18-ft. wings at an angle of 30°.

(3) On the feeder canal a three-span structure carried on straight abutments and two-tower piers was employed. The main 75-ft. spans were pony Pratt trusses and the two approaches were stringer spans of 21 ft.

On the main canal the bridges had a clearance of 17 ft. over the water. On the feeder canal the clearance was reduced to 12 ft. The following data relate to the structures used on the western section of the main canal.

The wing abutments contain for each bridge (two abutments) 190 cu. yds. of natural cement concrete in the footings and 248 cu. yds. of Portland cement concrete in the abutments proper. The parapets are oak timbers 12 ins. wide and 22 ft. long. The slopes of the canal in front of each abutment for a distance of from 60 to 120 ft. are paved with hand laid rubble for the first bridges built and with concrete about 10 ins. thick for the bridges built later.

The steel superstructures were designed to carry a live load of 100 lbs. per sq. ft. or an engine load of 8 tons on axles 7 ft. c. to c. The trusses are 110-ft. spans, 20 ft. high and spaced 19 ft. 1 in c. to c., having a clearance of 16½ ft. between guards. These guards are 6x8 in. pine raised 3 ins. above the floor and having on the wearing side 3x3x¼-in. angles.

The embankment approaches are 21 ft. wide on top, with side slopes of 1 on 1½ and with grades running from 3 to 6 per cent. The roadways are surfaced with gravel or crushed rock and have board railings extending from bridges to foot of slope.

The costs given here relate to the substructure, that is, the concrete abutments and footings and the adjacent slope paving. The forms for the abutments were simple, consisting of opposite posts tied through the walls at bottom and mid height with bolts and at the top above the wall with 3x12-in. plank with short knee braces. The concrete was mixed in a Smith mixer charged by one-horse dump carts and was hauled to the work in cars and hoisted by horse elevator and dumped into the forms.

The following is the detailed cost of the substructure for highway bridge No. 34. Excavation and back fill cost as follows:

	Total	Per cu. yd
Excavation (576.6 cu. yds.):		
Labor	$151.52	.....
Stakes	3.00	.....
Total	$154.52	$0.268
Back fill (256.4 cu. yds.):		
Labor	$ 55.88	$0.220

There were 190 cu. yds. of natural cement concrete in the footings which cost as follows:

	Total.	Per cu. yd.
Concrete Materials:		
Cement	$ 208.80	$1.099
Crushed stone	289.02	1.521
Sand	113.00	0.594
Total	$ 610.82	$3.214
Receiving Concrete Materials:		
Hauling cement	$ 23.50	$0.124
Unloading cement	2.65	0.014
Hauling crushed stone	94.98	0.499
Freight on gravel	7.50	0.039
Total	$ 128.58	$0.676
Labor mixing and placing	218.39	1.149
Grand total	$ 955.79	$5.039
Form Materials:		
Lumber	$ 28.50	$0.150
Stakes	3.00	0.016
Hardware	1.65	0.008
Total	$ 33.15	$0.174
Form Labor:		
Hauling and unloading lumber	$ 3.70	$0.019
Labor constructing	17.16	0.090
Labor wrecking	2.00	0.011
Total	$ 22.86	$0.120
Grand total	56.01	0.294
Miscellaneous:		
Labor receiving materials	$ 15.48	$0.081
Miscellaneous labor	8.72	0.046
Total	$ 24.20	$0.127
Grand total	1,038.00	5.460

The cost of 248 cu. yds. of Portland cement concrete in the abutments proper was as follows:

	Total.	Per cu. yd.
Concrete Materials:		
Cement	$ [illegible]	$ [illegible]
Crushed stone	378.00	1.524
Sand	[illegible]	[illegible]
Total	$ [illegible]	$ [illegible]
Receiving Concrete Materials:		
Hauling cement	$ [illegible]	$ [illegible]
Unloading cement	3.40	0.013
Testing cement	29.50	0.118
Hauling crushed stone	114.78	0.462
Freight on gravel	9.50	0.033
Total	$ 181.05	$0.727
Concrete labor	265.67	1.071
Running mixer labor	22.00	0.081
Total	$ [illegible]	$ [illegible]
Grand total	$1,478.56	$5.952
Form Materials:		
Lumber	$ 59.50	$0.239
Hardware	11.35	0.045
Total	$ 70.58	$0.284
Form Labor:		
Hauling and unloading lumber	$ 50.82	$0.205
Labor constructing	119.86	0.483
Labor wrecking	15.75	0.063
Total	$ 186.43	$0.751
Grand total, forms	257.28	1.035
Miscellaneous:		
Labor receiving materials	$ 19.39	$0.078
Miscellaneous labor	15.42	0.062
Coal	19.19	0.076
Total	$ 54.00	$0.216
Grand total	$1,789.84	$7.217

The cost of 313 sq. yds. of rubble stone paving was as follows:

Item.	Total.	Per sq. yd.
Rubble stone	$406.78	$1.299
Hauling rubble stone	83.44	0.266
Labor paving	180.32	0.576
Labor receiving material	13.94	0.044
Miscellaneous labor	7.86	0.025
Total	$692.34	$2.210

The following expenses were charged against the whole work:

Engineering and inspection	$153.43
Traveling	4.08
Chicago office expenses	69.84
Total	$227.35

The grand total cost of the whole work was $3,957.93.

The work described was done by day labor and the wages paid were about as follows:

Carpenters, per day	$2.50
Laborers, per day	1.75
Teamsters with team	3.00

An 8-hour day was worked.

In the following Table I are given the masonry and slope paving costs of 20 other bridges of the same type as that described.

TABLE I.

	National cement. Concrete.		Portland cement. Concrete.		Slope Paving.	
No. of bridge.	No. cu. yds.	Per cu. yd.	No. cu. yds.	Per cu. yd.	No. sq. yds.	Per sq. yd.
17A	200	$7.10	248	$8.97	.....	.....
18A	200	6.20	248	8.64	.....	.....
20	224	5.99	248	8.24	.....	.....
21	252	6.54	248	8.73	340	$2.04
22	304	6.39	248	8.86	.....	.....
23	200	5.38	248	7.52	340	1.95
24	156	6.31	248	7.93	340	1.82
25	190	5.85	248	7.59	340	2.39
26	201	5.66	248	8.21	340	2.32
27	156	6.05	248	7.71	348	1.94
28	190	5.41	248	7.94	343	1.92
29	156	5.93	248	7.39	339	1.94
30	156	5.89	248	8.21	339	1.92
31	190	5.18	248	7.40	313	1.94
32	190	5.62	248	7.83	313	2.28
33	200	5.90	248	8.12	313	2.20
35	190	5.11	248	6.96	304	2.31
37	190	4.98	248	7.21	345	1.91
38	133	6.32	248	7.07	276	2.63
39	.....	....	248	7.05	270	2.36

Forms of Concrete Pile Construction and a Statement of the Advantages and Disadvantages of Concrete Piles.*

Historical.—Concrete piles may be divided into two general classes, "cast and driven" and "cast in place." The "cast and driven" type are always of reinforced concrete, are molded prior to being placed in the ground, and are driven like wooden piles. "Cast in place" piles are usually, though not necessarily, without reinforcement, and the pile hole is made artificially and afterward filled with concrete.

The first concrete piles were made in France by Mr. Hennebique in 1896, and were made of the cast and driven type. During the following decade this general type was developed by different engineers, and is now more generally used in Europe than any other. In the United States the Gilbreth (patented in 1908), Chenoweth (patented in 1904), and Raymond (patented in 1896) are the best known varieties of cast and driven piles.

In 1890 A. A. Raymond of Chicago, Ill., conceived the idea of a cast in place concrete pile, a further development of the caisson principle. His first patents were issued in 1896, and the first piles driven in 1901. The

*Compiled from data collected by Fred W. Honens, M. Am. Soc. C. E., U. S. Engineer's Office, Kansas City, Mo.

*Extracted from the report of the Committee on Wooden Bridges and Trestles, American Railway Engineering and Maintenance of Way Association.

Simplex pile, patented in the United States in 1903, is of the cast in place type, though differing from the Raymond in method of construction. These two systems have thus far been used in this country to a much greater extent than cast and driven piles, though owing to our comparatively recent development in concrete construction, our total use of concrete piles is less than the European. Prior to 1900 practically no concrete piles had been used in the United States .

Cast and Driven Types.—The chief objection to cast and driven concrete piles has been based upon the possibility of injury to the reinforced concrete during driving. Most of the systems in vogue care for this by jetting the piles or by the use of a special driving cap designed to protect the head of the piles. The patents covering these various systems refer principally to the driving caps, the arrangement of the reinforcement, provision for jetting, method of molding, and the shape of the pile itself. All of the items entering into the manufacture and placing of cast and driven piles may be varied to suit the local conditions.

The Gilbreth pile is a corrugated, tapering concrete pile, reinforced with Clinton electrically welded fabric of ⅜-in. wires 3 ins. on centers longitudinally, and ⅛-in. wires 12 ins. on centers transversely, or other enforcement of suitable design. The piles are made of any shape desired, but are usually octagonal, tapering from 16 ins. in diameter at the butt to 11 ins. at the tip, with corrugations running the entire length. In case the piles are intended to project above the ground, the corrugations may be stopped at the ground level. The taper is designed to develop the bearing power of the soil throughout the entire length and the corrugations are added to form outlets for the water from the jet. A hole is made through the center of the pile for jetting. The piles are cast horizontally in wooden forms and allowed to set for various periods; in some instances they have been driven after 7 days. They are handled by an ordinary pile driver and jetted into place, using a 2-in. jet, flowing through the hole in the center of the pile. The weight of the hammer resting on the driving cap helps to force the pile into place. The special driving cay consists of a steel shell with wooden blocks at each end, between which are pieces of hose and rope to form a cushion. When the pile has been jetted nearly into place the hammer and cushion cap may be hoisted, the jet removed, the cushion cap replaced, and the pile driven to the desired penetration per blow.

The Chenoweth pile is round and is made without forms by a special machine. It is reinforced with a coiled sheet of wire netting and longitudinal steel rods placed near the surface, at equal distances apart. The apparatus for rolling the pile consists of a traveling platform and the roller between which the pile is formed. The winding rod in the center is set in line with the shaft of the large spur wheel shown in In operation the steel wire netting, with the longitudinal rods attached, is spread on the platform and covered with a layer of concrete. One edge of the netting is attached to the edge of the platform and the other to the winding pipe or mandrel. The mandrel is then rotated and the netting and its covering of concrete is wound or coiled up. At the same time and as fast as the netting and concrete are coiled, the platform moves under the roll and the roll itself rotates, thus pressing the pile into shape.

To bind the roll of concrete, wires are wound around it at intervals of 6 ins. and tied. The wires are placed upon the platform beneath the mesh so that when the pile reaches the lower edge of the platform and is entirely rolled, they can be tied about the pile. The spools containing the wires are placed 4 ins. apart for the first 6 ft. of the pile from the driving end and 6 ins. apart for the remainder of its length. The pile is removed from the machine and rolled upon a car, by which it is transported to a platform, where the point is formed, and on which it is allowed to remain until hardened.

The driving cap is a steel cylinder, with a diaphragm in the center. The lower end of the cylinder fits on the head of the pile, and the upper end receives the wooden driving block. A cushion of rope is used between the head of the pile and the diaphragm, while a cushion of sawdust is placed between the diaphragm and the driving block.

The piles are driven with an ordinary pile driver and an extra heavy hammer. The concrete used is generally a 1:2:3 mixture of Portland cement, sand, and screenings or broken stone.

Cast in Place Piles.—The Raymond system is an economic way of placing caissons. A heavy mandrel, called a core, is surrounded by a casing of sheet steel and the whole is driven into the ground by means of a steam hammer. When the desired depth is reached the core is collapsed and withdrawn from the hole, leaving the steel shell in the ground as a form for the pile; the concrete is then shoveled into the hole and the pile is complete. The sheet steel shell is made havy enough to withstand the pressure of the earth along the sides of the hole, and protects the concrete from mixture with the surrounding earth. These shells are usually made in 8-ft. sections, and each section laps the other 6 ins. The point section is first placed on the core, then the next above, etc., until the core is covered. This brings the lap on the outside and each section is pushed into place as the driving proceeds.

After the core is withdrawn and before placing the concrete, the interior of the shell can be inspected, by means of an electric light, by reflected light from a mirror, or by the light reflected from the surface of water thrown into the hole. The 20-ft., 25-ft., and 30-ft. cores taper from a 6-in. point to a 20-in. head, the 35-ft. from an 8-in. point to a 20-in. head, and the 40-ft. from a 10-in. point to an 18-in. head. This is a greater taper than is found in any other type of concrete pile and is as great as practical limitations will permit. The diameter of the head and the taper are designed to provide a large bearing surface for the concrete footings, a large surface area for frictional bearing, and a maximum compression of the earth surrounding the pile. While the Raymond pile is rarely reinforced, reinforcement may be added by lowering a fabricated skeleton into the shell before the concrete is placed. Rods may also be placed by churning them through the concrete after the shell has been filled.

The Simplex system consists in driving an extra heavy iron pipe into the ground with a special point to exclude the dirt; when this pipe is driven to the proper bearing, a drop bottom bucket, filled with concrete, is lowered to the bottom of the pipe and dumped. The bucket is then removed, a heavy weight lowered into the pipe, and the pipe raised nearly to the top of the concrete, the weight being repeatedly dropped on the concrete, thus forcing it out of the end of the pipe. Another bucket of concrete is then placed in the pipe and the operation repeated until the pile is formed.

Two kinds of points are used, depending upon the character of soil through which pipe is driven. If in soft soil, a cast iron point closes the end of the pipe, while in stiff clay a pair of jaws are used. These jaws are attached by hinges to the bottom of the pipe, and automatically open to permit the concrete to flow through them as the pipe is raised. The pipes used are extra heavy steel, banded where necessary, and are made up in sections of varying lengths to suit the length of pile required.

The pipes are cylindrical and are usually 16 ins. in diameter. The only limit to the length of pile which can be driven by this method is the ability to drive and pull the pipe. In stiff, non-water bearing or clay soils, where the ground has no tendency to flow, this is the cheapest system of installing concrete piles.

Estimated Commercial Use.—After careful inquiry it is estimated that about 2,500,000 lin. ft. of cast-in-place piles are now in use in this country. No definite data in regard to the use of cast-and-driven piles could be obtained, but the quantity is believed to be less than 250,000 lin. ft.

Advantages of Concrete Piles.—Wooden piles are loaded to about 15 tons, and while many engineers think they are capable of carrying greater loads, this load represents conservative practice. The loads allowed on concrete piles vary from 25 to 50 tons each, depending upon the nature of the ground and the system used; in European practice they are loaded to 40 or 50 tons each, and there are records of piles loaded to 80 tons; the best American practice, however, limits the load to 35 tons.

To prevent decay wooden piles are cut off at low water and the foundations must be carried down to this level. The tops of concrete piles may be at any elevation desired and the depth of the footing course will be governed by the spacing of the piles and the weight of the superstructure. In this way the expensive excavation for deep footings, as well as the cost of the additional depth of footings, is saved.

Concrete piles cannot be driven as rapidly as wooden piles, but since the load per pile is greater, their use may result in a saving of both time and cost. If concrete piles are used, no delay is occasioned by waiting for the arrival of the piles; wooden piles are difficult to obtain in certain parts of the country, but sand, stone and cement are generally available. There is no reason why concrete should vary in quality, while it is becoming more and more difficult to obtain wooden piles of a standard grade.

A wooden pile rots if alternately wet and dry and is subject to attack by the teredo and other wood borers when placed in salt water. The elevation of ground water fixes the point of cut off, but the building of deeper sewers in the neighborhood may lower the ground water level, and when this occurs wooden piles are subject to decay.

Possible Disadvantages of Concrete Piles.—The argument most frequently urged against concrete piles is their cost. The cost per linear foot is certainly greater for a concrete pile than for one of wood, but when the saving in excavation, size of footings, number of piles and time of completion are taken into consideration, this additional cost per foot is discounted. Generally when these items of cost are considered, they should show a decided advantage in favor of concrete piles.

The length of cast in place piles is limited, but piles cast and driven may be of any length. When driven with a core or pipe, the maximum length thus far attained is 45 ft.; no cores have been made longer than this, while the difficulty experienced in pulling the pipe renders a greater length impracticable.

Cast and driven piles require careful handling if made in long lengths as cracks cannot be readily detected, and the piles should preferably be allowed to set several weeks before using. If made on the job this delays the work, while if made in distant yards, the exact lengths are hard to gage, and the piles may be either too short or too long. As the operations of lengthening or shortening cause delay and expense, it is very desirable that the penetration be determined before the piles are brought to the site.

If shells are used, they should be made of steel heavy enough to withstand the side pressures of soft ground or the shearing effect of boulders or gravel. Some objection has been made to dropping concrete through the longer lengths of a cast in place pile. As a wet mixture is used and the concrete is deposited by shovels, it should be properly graded when the pile form is full.

The driving of an adjacent pile tends to settle the concrete in the pile just filled, thus forcing out the air bubbles, and while distortion may occur, particularly in the case of piles driven without a shell, this danger has not been manifest in actual practice.

In cast in place piles, unprotected by a shell, it is impossible to inspect the integrity of the pile. After the concrete leaves the end of the pile, it is subjected to the action of the surrounding ground without protection. Soils bearing running water may carry off a part of the cement, leaving the coarser aggregates; very dry, porous soils may absorb the water needed in setting; in either case the bearing power of the pile would be affected.

As in the case of peeled wooden piles, a smooth exterior offers less resistance to movement than a rough one. However, when the

attempt is made to increase the skin friction by cementing the pile to the earth in which it is cast, a question arises as to how much the pile itself is weakened by an admixture of earth. The necessity of reinforcing concrete piles in certain soils is apparent, and the greater the dependence placed upon point bearing, the greater the necessity for reinforcing.

The bearing power of all piles is dependent upon a combination of two elements—viz.: point bearing and skin friction. Point bearing depends upon the class of material upon which the pile rests, the area of the point, and the material of which the pile is made. Skin friction depends upon the compression of the earth through which the pile is driven, and all the earth, from the top to the bottom of the pile, adds to its bearing power if subject to compression.

Probably the bearing power of every pile driven is dependent upon both the above factors, the percentage of each varying with the character of the soil and the shape of the pile. The larger the point and the less the taper of the pile, the more point bearing is depended upon, and vice versa. A pile depending upon point bearing acts as a column, supported more or less at the sides, and any pile acting as a column should be reinforced. When subjected to bending stresses or placed in semi-liquid or shifting soil, piles should be reinforced. Piles whose method of manufacture precludes the insertion of reinforcement are not adapted to use in service which requires action as a column.

Prices of Water for Building.—The prices charged for water used in building and trenching at Little Falls, N. Y., are as follows:

Per 1,000 brick laid	1 cts.
Per 100 sq. yds. plastering	20 cts.
Per cu. yd. stone masonry	3 cts.
Trench 2 ft. wide per lin. ft. per ft. depth	¼ ct.
Trench 2 to 3 ft. wide per lin ft. per ft. depth	⅜ ct.
Trench 3 to 4 ft. wide per lin. ft. per ft. depth	½ ct.

E. W. Gayman, Ogden, Utah, has been awarded the contract for constructing nine miles of the Portneuf March Valley Irrigation Co.'s canals near Downey, Idaho.

Earth and Rock Section

Note: This section is devoted to methods and costs of excavating earth and rock and building embankments. It will cover the grading of roads and railroads, diking and canal work, dredging, building reservoirs and earth dams, sewer and water pipe trenching, quarrying, etc.

Method of Reconstructing the Washington Street Tunnel of the Chicago Railways Company; a New and Economical Method of Constructing Tunnels.

The Washington street tunnel of the Chicago Railways Co., abandoned several years ago, is now under reconstruction by Geo. W. Jackson, Inc., of Chicago. The former tunnel was condemned by the U. S. government engineers in 1906 because its roof had been weakened by contact with heavily laden freight vessels, which had at different times become lodged upon it and because of the requirements of navigation, which called for a deeper channel in the river. Accordingly, in 1908, the river section of the tunnel, which is about 200 ft. long, was bulkheaded off and pile drivers in the river battered down the roof and the material was removed by dredges. Before this was done, however, the roof of the proposed new tunnel was built. This roof is slightly above the floor of the old tunnel. It is a flat roof and is constructed of 36-in. steel girders imbedded in concrete 4 ft. thick. The roof is at a depth of 26½ ft. below the water surface of the river.

The present reconstruction calls for the completion of the tunnel and is being carried out under two separate contracts, both contracts, however, being held by the Jackson company. The entire work under both contracts extends from Clinton St. on the west to Franklin St. on the east, a distance of 1,544 ft. When completed, the work will provide twin tubes for the proposed Chicago subway between the streets mentioned. Until the subway is built, the surface cars will pass under the river through this tunnel. Provision has been made, by the construction of a temporary timber trestle, for the surface cars to enter the west end of the tunnel at Clinton St. and the east end at Franklin St. This arrangement is shown in profile by Fig. 1.

SECTION I.

The west end of the work for one block, between Clinton and Canal streets, is being carried on by the open cut method. This work is called Section I and is covered by a separate contract.

The new Chicago & Northwestern Ry. terminal passenger station is being erected simultaneously with the construction of the tunnel, and the steel work for the elevated train shed of the station passes directly over the entire work. On account of this the work has been difficult and complicated. Steel columns supporting the frame work of the train shed extend down inside the tunnel walls on both sides of the tunnel to circular concrete footings just below the level of the tunnel floor. These footings were put in before the tunnel work was commenced and were carried down to solid rock, some 90 or 100 ft. below the street level. The columns resting on these footings were concreted in with the tunnel walls and give the appearance of pilasters on the tunnel walls.

The steel sheeting used for this work consisted of 15-in. I-beams, with clips bolted to the flanges. These clips were made to fit over the flange of the adjacent I-beam. This is not water-tight sheeting, and is used by the company on dry work. Two portable pile-driver outfits, equipped with No. 2 Vulcan

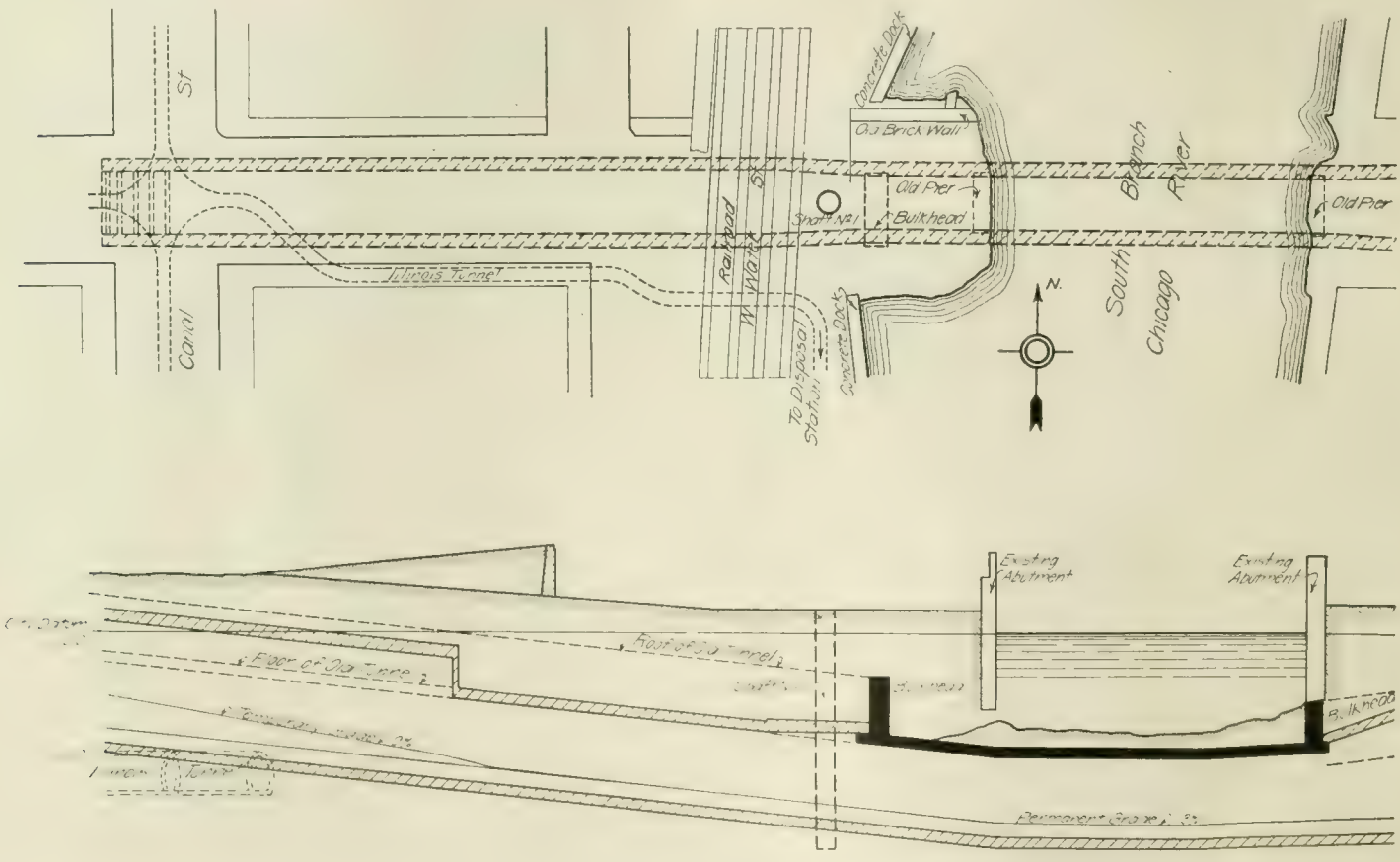


Fig. 1—Plan and Profile of the Reconstructed Washington

steam hammers, operated along opposite sides of the work in advance of the excavation. The rate of driving sheeting was from 15 to 18 pieces per shift of 8 hours, the record being 29 pieces.

The excavation was carried on by hand. The material—blue clay—was shoveled into cars running on narrow-gage tracks. The disposal of the material was greatly facilitated by connections made with the Illinois freight tunnel, which passes only a few feet below the work at this point. The narrow-gage cars operated from the points where the digging was in progress to the chutes, where the cars were dumped directly into the cars in the tunnel below. In these cars the spoil was taken to the Geo. W. Jackson disposal station on the west back of the Chicago River at Madison St. and was then dumped into barges to be towed out into Lake Michigan. The completed cut was 338 ft. in length, 42 ft. wide, and from 38 to 42 ft. deep.

The bracing consisted of 12x12-in. timbers placed transversely 8 ft. apart and in 4 tiers, the top tier being 1 ft. below the top of the sheeting and each tier 6 ft. below the one above it. In each tier 12x12-in. timbers were used as lateral bracing and vertical posts were placed between tiers.

The mixer was located at the east end and was placed so that the hopper was at street level. This permitted dumping the materials directly from the street into the mixer. A Lidgerwood 450-ft. span cableway was used to carry concrete to the west end of the work. After the completion of that part involving a long haul, the cableway was taken down and cars were used for transporting the concrete from the mixer to chutes placed conveniently for filling the forms. The forms nearest the mixer were filled by placing chutes directly under the mixer discharge.

An 8-in. waterproofing course was laid, consisting of brick laid in asphalt. The specifications called for 1 in. of asphalt between bricks and 1 in. of asphalt on the exterior surface. This waterproofing course is adjacent to the exterior face of the main tunnel wall and was built in sections of 6 ft. After a section of waterproofing had been laid, an outer protection course of 8 ins. of concrete was added. This concrete was kept separated from the steel sheet piling by light forms. Sand was poured between these forms and the sheet piling to prevent any settlement when the piling was removed.

The work for Section I is about half completed, the side walls and invert having been finished. It is estimated that it will be ready for use about Aug. 1, 1910.

SECTION II.

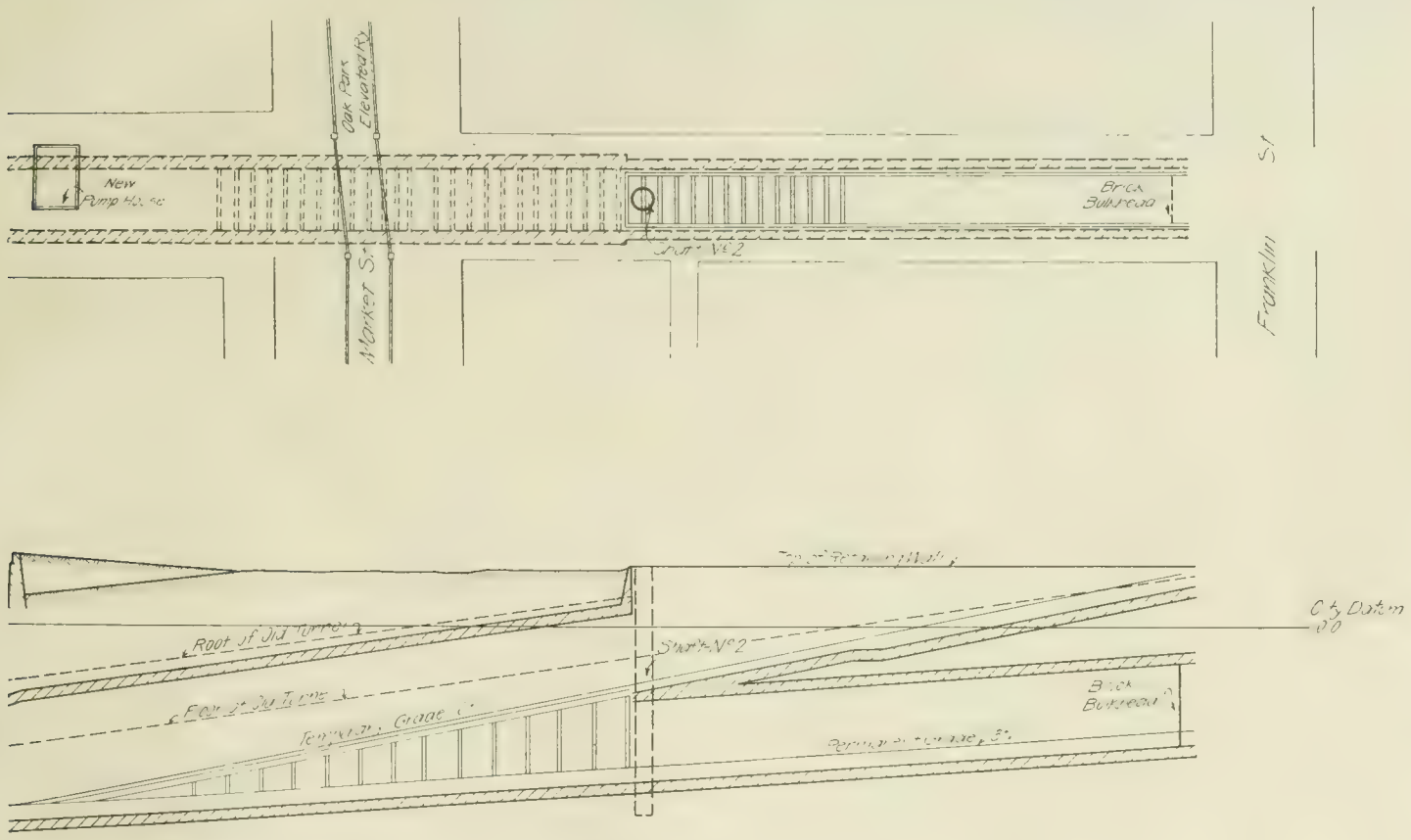
This section of the tunnel extends 1,204 ft. from the west line of Canal St. under the river to the west line of Franklin St. This includes all of the work east of Section I.

The original intention in handling the work on Section II was to use the open cut method. Mr. Jackson, however, having had a great deal of experience in tunnel work, devised a much better way. His plan was agreed to by the engineers representing the Chicago Railways Co. and has been so far carried out. The new method is safe and economical and has caused no obstruction to street traffic or navigation. Mr. Jackson has had the method patented. The method may be clearly understood by reference to the accompanying sketch, Fig. 2, showing a cross section of the river section of the tunnel. The sections of wall marked 1 on the sketch were excavated and timbered the entire length, under compressed air, and then concreted, leaving key for sections marked 2; then sections 2 were excavated complete, under compressed air, the lagging floor removed, and the section concreted. This completed the side walls in the river section, and, as previously described, the roof had already been placed. The work is now this far completed. It remains to excavate the tunnel between the side walls and to put in the invert, which will be put in in sections of 3 ft.

The work under contract for Section II is being carried on in two distinct parts, each part being about 600 ft. long and operated from a shaft located about the center of the work which it handles. These shafts are shown by the profile, Fig. 1. Shaft 1 is located about 100 ft. from the west bank of the river and handles all the work from Canal St. to the east bank of the river, including the river section of the tunnel. Shaft 2 is located at Market St. and handles all the work east of the river to Franklin St.

A separate plant has been established at each shaft so that they are operated independently. Each power plant consists of two compressors and tanks, and a hoisting engine for the operation of the shaft elevator. At Shaft 1 a battery of three 80-h.p. boilers is installed to supply power for the machinery. At Shaft 2 electric power is used, the machines being belted to 25-h.p. moto s and current being obtained from the Commonwealth Edison Co. At each shaft is an office, power house, and cement shed. The work is under direction of a superintendent of construction, whose office force consists of a clerk and time keeper, besides the civil engineer, who divides his time between the work at both shafts. Three shifts of 8 hours are worked, beginning at 8 a. m., 4 p. m., and midnight.

The shafts are of similar construction, each being about 7½ ft. in diameter and braced with steel rings. After the shafts were sunk a 10-in. wall of concrete was built up as far as the old tunnel floor, but the elevator guides are continued up so that the elevator may rise to a point about 15 ft. above the street. The depth of Shaft 1 is 68 ft. below ground level and Shaft 2 is 59 ft. deep. At the bottom of each shaft drifts were made each way on the center



St. Tunnel of the Chicago Railways Co., Chicago, Ill.

line for a distance of about 30 ft. from the shaft. At the ends of these drifts are doors, large enough to admit the cars. These doors lead into the air locks. Each air lock is about 18 ft. long by about 6 ft. high and 5 ft. wide, and is lined with concrete. A 4-in. Worthington pump is placed in a small compartment at the side of one of the air locks at each shaft. These pumps take care of the seepage in the sump. As the work is comparatively dry, as underground work goes, the pumps have been operated only a portion of the time. Beyond the air locks the main drift extends about 30 ft. and there diverges in two directions leading to either side wall of the tunnel. These branches leading to the headings in the side walls were made level with the bottom section of the wall and the first 9 ft. of the wall was excavated as described in explaining the general method. After the first section of the wall was completed the branches from the main drift were raised on a steep grade to a point on top of the completed section of the wall and the excavation was carried ahead at this level. A 5-h.p. motor is located at the sum-

mit of each grade, and is attached to a drum and cable, which are used to haul cars of material up the grade.

As fast as the excavation progressed, the drifts were timbered and the wall forms were placed. The wall forms were made of 3x8-in. lagging. The lagging was held in place by the pressure of the earth from without and was braced on the inside by steel frames 3 ft. apart. The frames consisted of two 5-in. channels placed vertically against the inside face of the lagging and adjusted to the batter of the wall. Two 4-in. I-beams were used to brace the channels apart. One I-beam was placed 6 ft. from the bottom and the other at the top of the section.

The excavated material was disposed of by means of a timber trestle, the floor of which is about 15 ft. above ground level, and which leads from the shaft to the river. Cars of spoil were brought up through the shaft to the trestle level and they were pushed by hand to the river end of the trestle, where they were dumped into barges. The trestle is double tracked and is wide enough to permit the storage of small piles of lumber and various materials used in mining. The spoil from both shafts was thus delivered to barges in the river in much the same way, the only difference being that the trestle from shaft 1 is about 75 ft. long and from Shaft 2 is about 350 ft. long.

The concrete for the work at Shaft 1 was mixed in a Chicago Improved cube mixer of ½ cu. yd. capacity. The mixer was placed about 50 ft. from the shaft. As the space for unloading material for this mixer was limited, a part of the material was brought by water on barges. The concrete was handled from the mixer in the same cars used for the excavation. The cars are of steel frame and wood bodies of ½ cu. yd. capacity, and are made so that the ends of the boxes may be removed for convenience in handling timbers. The

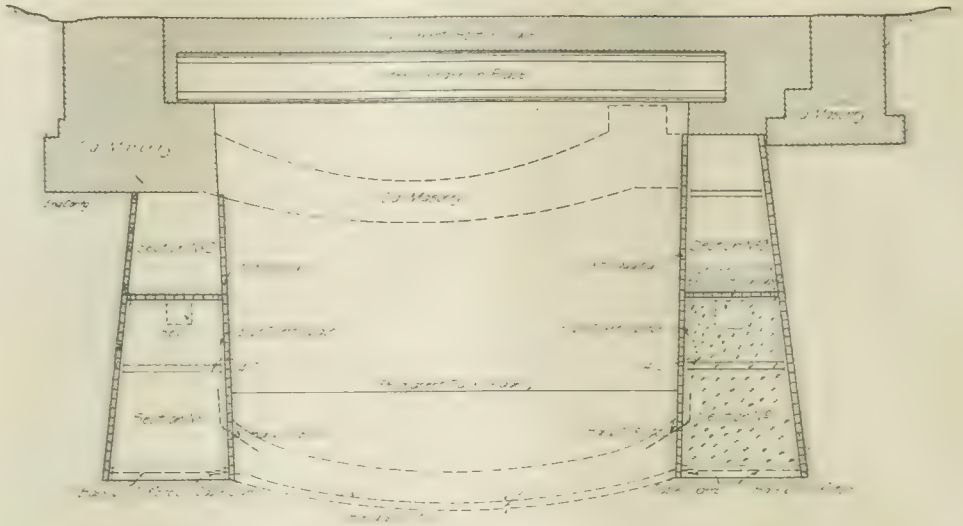


Fig. 2—Cross Section of Washington St. Tunnel.

Shift No. . HOURLY REPORT—MINING Contract No. .....

Shaft No. . Date .1910

Time.	Cars to Scow.	Speed of Compressor	Air Pressure at Compressor	Headings.	Feet Driven and Lagged	Feet Driven and Lagged Before	Total	Forms Set Up.	Miners	Number of Men.	Nature of Ground.	Remarks.
				No. 1								
				No. 2								
				No. 3..								
				No. 4								
				No.								
				No.								
Total												

Accidents . Foreman.

..Timekeeper.

	Yesterday.	This Date.	Increase.	Decrease.
Total No. of Men - - - - - -				
Total No. of Cars Delivered Scow				
Total No. of Feet Driven and Lagged				

Miscellaneous

Scow No.

Scow No..

Scow No.

Weather

Recapitulation of Employes.

Foreman	..
Timekeeper	....
Elevator Men	....
Lock Tenders	.....
Engineers, Civil	.....
Skinners	..
Car Pushers	.....
Miners	....
Muckers	....
Dumpmen -	....
Engineers -	...
Carpenters -	....
Laborers	..
Miscellaneous	...
Electricians	.....
Total No. of Men	.....

Signed .....

Form for Hourly Report of Mining.

concrete was mixed medium wet, so as to be easily tamped back into place in the wall forms.

The concrete plant for Shaft 2 was located in the open part of the old tunnel, as shown by the profile, about 50 ft. east of the shaft. The mixer is a ½ cu. yd. capacity Ransome mixer. The material is dumped by wagons from the street level into this old tunnel approach at a

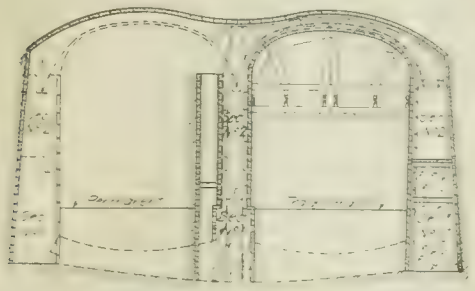


Fig. 3—Cross Section Showing Method of Constructing Washington St. Tunnel.

point just above the location of the mixer. This arrangement has been very convenient. The approach of the old tunnel contains ample space for the storage of stone and sand. The cars are loaded from the mixer and enter the shaft at the level of the old tunnel floor.

The waterproofing of the walls of the tunnel will be accomplished by piping the waterproofing material in 2-in. pipes under high air pressure. Pipes have been inserted in the walls 4 ft. apart at the top of the lower section and 2 ft. apart at the top of the upper section. Through this system of pipes the waterproofing will be forced into the voids between the outside lagging and the earth.

Fig. 4—View Showing East Bulkhead Washington St. Tunnel.

Weather .. Contract No.

Shift No.. HOURLY REPORT—CONCRETING

Shaft No. Date 1910

Time.	Cars of Concrete.	Speed of Compressor	Air Pressure at Compressor	Material Used: Gravel.	Cement.	Sand.	Headings.	Cars of Concrete.	Feet Concreted.	Feet Concreted Before.	Total Concreted.	Number of Men.	Remarks
							No. 1						
							No. 2						
							No. 3						
							No. 4						
							No.						
							No.						
Total .													

Accidents .

.. Foreman

.. ..

During the progress of the work hourly reports have been made out and telephoned to the main office. Two sets of reports, one for the excavation and one for the concreting, have been kept. These reports have assisted the contractor greatly in directing the entire work and have enabled him to solve difficulties as fast as they arose. Fac-similes of these reports are shown by Figs. 3 and 4.

Fig. 5—View Showing Hydraulic Jack Device for Pulling Steel Sheet Piles.

About the same number of men has been employed at each shaft, there being on each shift 10 miners, 4 muckers, 2 dump men, 2 air-lock tenders, and 1 stationary engineer, besides the office force. The miners do the excavating, put in the timber and forms, and handle the concrete in the headings. With this number of men four headings are handled. The scale of wages paid by the contractor is posted on the job and is as follows per 8-hour shift:

Miners	$3.25
Muckers	2.60
Car pushers	2.35
Air lock tenders	2.80
Elevator men	2.60
Dump men	2.25

The progress made in excavation in each heading has varied from 6 to 9 ft. per shift. This would be on an average about 14 cu. yds. per heading per shift. The amount of concrete placed per shift in each heading was also about 14 cu. yds., but the rate of lineal progress was from 9 to 12 ft. because of the smaller cross section.

The time necessary to do the work was originally estimated at about a year, but the work was commenced on Jan. 11, 1910, and is now—about half completed, and it is estimated by the contractor that it will be completed some time in August.

This work has been especially interesting to engineers and contractors because of the successful working of this special method of building tunnels in soft material. Credit is not only due to the contractor merely because the work has so far been accomplished, but it is due also because it has been accomplished by a unique method which has proved very economical, and has not interfered with street traffic or with navigation. By the open cut method one-half of the river would have been occupied at a time for a period of over a year, and the streets would have been closed to traffic continuously. During this work there have been no coffer dams to build, maintain, and pump out, and the cost of construction has been greatly reduced. Perhaps the greatest saving of all is effected by the manner of excavating the bore and putting in the invert. The excavation in the bore amounts to over one-half the total amount of excavation for the tunnel. This work, and putting in the invert, may now be accomplished without air pressure, and the slow and expensive handling of materials through the air locks will be avoided.

Fig. 6—View Showing Method of Excavating Headings for Side Walls.

Cost of Excavating 1,850 Cu. Yds. of Granite in Trench for Sewer Construction.

The excavation was for an 18-in. sewer built at Muskaka, Ont. This sewer had a total length of some 1,300 ft., but only the 550 ft. in rock trench is referred to here. The rock was Laurentian granite and the trench was 9 ft. deep. The excavation was by drilling and blasting, the rock being hoisted by horse derricks and skips and deposited in horse drawn cars operating on track. The haul was some 1,500 ft. for about two-thirds of the spoil and less than 300 ft. for the remainder. The total amount of rock excavation was 1,850 cu. yds., and the itemized cost of excavation was as follows:

Superintending.	Total.	Per cu. yd.
Walking boss, at 60c per hour	$ 222.45	$0.12
Clerk and timekeeper, at 37½c per hour	158.60	0.085
Foreman, at 45c per hour	608.15	0.328
Total for superintending	$ 989.20	.....
Labor Mucking, Loading, Hauling and Dumping:		
Laborers, at 20c per hour	$2,877.00	$1.555
Teamsters, at 21c per hour	499.70	.270
Teams, at 40c per hour	1,010.60	.545
Cars, at 5c per hour	117.00	.063
Carts, at 5c per hour	65.50	.035
Derricks and power, at 15c per hour	175.50	.095
Handy men, at 27½c per hour	125.15	.067
Total labor	$4,870.45	$2.630
Drilling Rock:		
Foot drilling, at 30c per ft.	$1,245.00	$0.673
Sharpening drills, at 27½c per hour	250.80	.135
Nippers, at 17½c per hour	382.20	.206
Coal, at $10 per ton	29.00	.157
Total	$1,907.00	$1.171

Explosives:		
Electric fuses	$ 95.95	.....
Caps and fuses	23.20	.....
Batteries, rent	38.00	.....
60% dynamite, at $10 per box	1,020.00	.....
Total	$1,117.15	$0.636
Grand total		4.97

Fig. 7—View Showing Method of Timbering Headings.

To the above total must be added $9.30 for depreciation of plant or 50 cts. per cu. yd., making a total cost per cubic yard of $5.47. In studying this cost it must be noted that the trench was narrow, and small shots had to be used, making the amount of drilling large; 1 ft. of hole was drilled per 4.5 cu. yds. excavated.

The above data are arranged from a paper by E. A. James in *Applied Science* for March, 1910.

Panama Canal Dynamite Records.—The records of the office of the Division Engineer of the Central Division show that 473,965 lbs. of dynamite were used during the month of January, 1910, as compared with 578,000 lbs. in January, 1909, although in the former month, 1,132,576 cu. yds. of rock were excavated, as compared with 1,032,016 cu. yds. in Janary, 1909. The comparison shows further that 2.39 cu. yds. of rock were excavated per pound of explosive used in January, 1910, as compared with 1.79 cu, yds. for January, 1909, a gain of over 33 per cent in rock excavated per pound of explosive used. The showing is still more pronounced in the February comparison. The total dynamite consumed in February, 1910, was but 375,000 lbs., as compared with 625,150 lbs. in February, 1909, while the amount of rock excavated in February, 1910, was 1,133,136 cu. yds., as compared with 1,037,645 cu. yds. in February, 1909. This shows that 3.02 cu. yds. of rock were excavated per pound of explosive used in February, 1910, as compared with 1.66 cu. yds. for February, 1909, a gain of 82 per cent in rock excavated per pound of explosive used. While accurate for the amount of dynamite use, and for the amount of material excavated, the figures relative to the quantity of material removed per pound of explosive used, are not cited as absolutely accurate, for the reason that during the dry season the steam shovels gain on the mining, but as the rate of gain so far as can be ascertained, was about the same in February, 1910, as in February, 1909, the comparative ratio would differ but little for the months in question. The figures show clearly that the amount of dynamite used in the Central Division has decreased, and that the decrease is more marked when the quantity of material excavated is taken into consideration. This in premature is taken from the Canal Record.

Cost of a Record Steam Shovel Run—On March 22, 1910, steam shovel No. 213 in the Culebra District of the Central Division of the Panama Canal broke all records by excavating 4.823 cu. yds. of rock and earth, place measurement. This material was loaded on 235 Lidgerwood cars. The time was divided as follows:

	Minutes.
Time loading	320
Moving up 20 times, 5 minutes each	100
Waiting for cars	55
Coaling shovel	5
Total	*480

*Or eight hours

The following employes comprised the crew of this shovel: J. L. Davies, steam shovel engineer; T. J. Scoville, steam shovel craneman; Edward Ward, pit foreman; Leon de Silva, Daniel Fitzgerald, Norman Austin, Manuel Shoy, Eli Titus, Albert Best, William Quash, James Bailey, pitmen; Alfred Dickson, Percy McCollen, firemen. The cost for labor for running the shovel on this day was $30.21 and the cost for supplies was $24.59, making a total expense of $54.80, itemized as follows:

Labor—	
1 engineer, one day at $7.56	$ 7.56
1 craneman, one day at $6.48	6.48
1 foreman, one day at $2.83	2.83
2 firemen, one day each at $1.67	3.34
1 laborer, 8 hours at 13 cents	1.04
7 laborers, 8 hours each at 16 cents	8.96
	$30.21
Supplies—	
5¼ tons of coal at $4.41	$23.15
3 gallons of car oil at 18 cents	.54
2 gallons of valve oil at 31 cents	.62
2 pounds of cup grease at 10 cents	.20
1 pound of gear grease at 8 cents	.08
	$24.59
Grand total	*$54.80

*This gives a cost of 1.14 cts. per cu. yd.

The Boston & Maine R. R., J. P. Snow, Chief Engineer, Boston, Mass., has had surveys made for a proposed branch line between Brattleboro and Hinsdale, N. H., to connect the Connecticut & Passumpsic division with the Ashuelot branch of the Boston & Maine, operating between South Vernon and Keene, N. H. If this line is constructed it will do away entirely with the 10-mile strip of track on the Vermont side of the river between Brattleboro and South Vernon, owned and operated by the Central Vermont and Grand Trunk railroads, in so far as it concerns the Boston & Maine interests. The Boston & Maine has also had engineers in the field to locate a line from Windsor to West Lebanon, N. H., doing away with the trackage of the Central Vermont between Windsor and White River Junction.

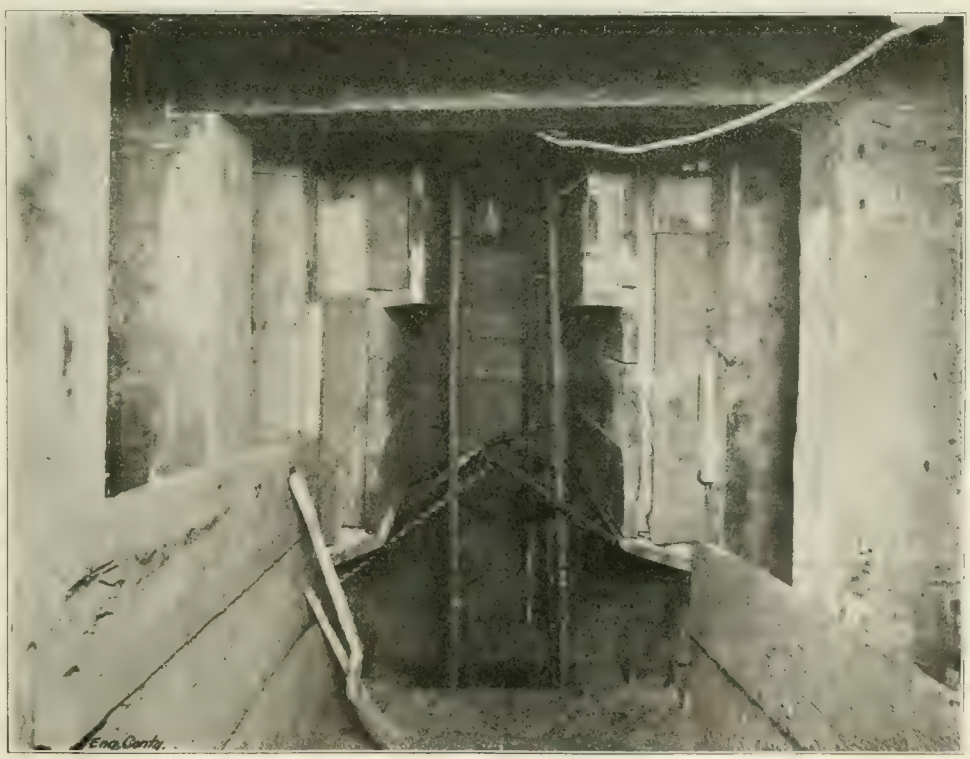


Fig. 8—View Showing Central Wall of Washington St. Tunnel.

Bidding Prices on New York State Road Work.—The following table, taken from the last annual report of the New York State Commission of Highways, shows a summary of the average, the high and the low bidding prices on 212 state roads. These bidding prices were submitted prior to Jan. 1, 1909:

Unit.	Items	Averages.	High.	Low
Acre.	Grubbing & clearing.	$84.00	$800.00	$10.00
Cu.Yd.	Earth excavation ...	.47	.85	.20
Cu.Yd.	Rock excavation ...	1.42	3.00	.50
Cu.Yd.	Embankm't furnished	.56	1.50	.10
Cu.Yd.	Sub base course.....	1.71	5.48	.50
Cu.Yd.	Bottom course macadam	3.39	5.08	1.50
Cu.Yd.	Top course macadam	4.37	7.50	2.00
Cu.Yd.	No. 2 maintenance stone	2.15	5.50	1.25
Cu.Yd.	Gravel or shale surfacing	1.60	2.50	1.00
Cu.Yd.	Second class concrete	8.08	12.00	4.50
Cu.Yd.	Third class concrete	6.89	9.00	4.00
Cu.Yd.	Third class masonry in cement	4.50	6.50	4.25
Cu.Yd.	Third class masonry, dry	4.07	10.00	2.00
Sq.Yd.	Repointing old masonry	.63	2.00	.10
Cu.Yd.	Rip rap	2.01	6.00	1.00
Cu.Yd.	Stone fill	1.09	2.25	1.50
Sq.Yd.	Telford base	.94	3.00	.25
Sq.Yd.	Stone filling	.98	3.00	.50
Sq.Yd.	Cobble gutter	.75	1.50	.50
Sq.Ft.	Expanded metal	.09	.20	.04
Lin.Ft.	Guard rail	.33	.75	.15
Lin.Ft.	Rustic guard rail....	.85	1.50	.20
Lin.Ft.	2-in. pipe rail.....	1.32	2.50	.30
Lin.Ft.	12-in. cast iron pipe.	2.06	5.00	.75
Lin.Ft.	18-in. cast iron pipe.	3.03	5.00	1.00
Lin.Ft.	6-in. vitrified pipe...	.43	1.50	.20
Lin.Ft.	12-in. vitrified pipe..	.70	2.00	.30
Lin.Ft.	18-in. vitrified pipe..	1.52	6.00	.50
Lin.Ft.	24-in. vitrified pipe..	2.71	6.00	1.50
Lin.Ft.	Relaying old pipe....	.31	.75	.05
Lbs.	Steel	.05	.10	.03
Ft.bm.	Oak	55.00	75.00	45.00
Ft.bm.	Hemlock	39.00	60.00	25.00
	Posts and signs.. ...	5.78	12.00	1.00
	Road signs	4.04	11.00	1.00
	Extra guide boards.....	3.21	11.00	1.00
Lin.Ft.	Piles	.26	.30	.22
Cu.Yd.	No. 4 stone on intersections	2.42	6.25	1.25

The White Pass & Yukon, R. R., V. I. Hahn, Superintendent, Skaguay, Alaska, is to lay four miles of track this summer and complete its spur line to the Pueblo copper mine at Skaguay.

Roads and Streets Section

Note: This section is devoted to methods and costs of road and street construction. It will cover road building in all its details, the construction of pavements, sidewalks and gutters, the testing and use of paving materials and the machinery and tools used in road building and paving.

Method of Constructing Sand-Clay Roads in the Middle West and Cost Data on the Construction of Four Roads of This Type.

Although the sand-clay method of road construction has been extensively and successfully used for many years throughout the southern states, it is only recently that an attempt has been made to use this method in the West. In 1908 the U. S. Office of Public Roads began a systematic investigation and study of the road problem and the conditions bearing thereon throughout the Middle West, particular attention being given to the possibilities for the construction of sand-clay roads. The general character of the formation of that section was studied and experimental roads were constructed by the sand-clay method in various sections with the materials which were to be had locally or within permissible hauling distance. The results of this investigation have been set forth by Mr. W. L. Spoon, superintendent of road construction, U. S. Office of Public Roads, in a circular recently issued by the U. S. Department of Agriculture, and the matter that follows has been taken from this circular.

Fig. 9—View Showing Reinforcement for Side Walls Washington St. Tunnel.

GENERAL METHODS OF CONSTRUCTION.

Sand-Clay Construction in the Gumbo or Plastic Soil Sections—In these sections the one primary consideration is the selection of sand. Since in many cases it must be hauled quite a distance, great care should be exercised in the selection in order to procure the sharpest and coarsest sand possible. After the sand is selected it is a good plan to haul it, in advance, alongside the road which is to be improved. When the road softens, a quantity of sand should be spread broadcast over the traveled roadway for the desired width—about 14 to 18 ft.—until the softened clay surface of the road is saturated with the sand. In this way the advantages of hauling the sand on a firm, dry clay road are obtained and it is ready for use when the road is softened by rain and slightly cut by travel. The amount of sand to be used is determined by the character of the road. If the road is taken before it is deeply cut by travel less sand will be required to give it a hard surface than would be the case were it delayed until deeply cut and full of mud holes. No ultimate harm would come from allowing it to become deep mud, but an unnecessarily large quantity of sand would be required to effect a remedy and would entail needless expense for surface material. For the first application of sand from 5 to 8 ins. should be sufficient to give a hard surface to almost any well-drained road, however plastic it may be. If, however, the surface is deeply cut, it may require twice as much sand to form a good road. This caution is given for the sake of economy both in hauling the sand to the road and in using it afterwards, rather than in the final effect to be obtained. However deep the mud hole may be, sand can fill it and make it permanently firm for travel. Although this is effective in improving the worst mud, still it is expensive and great economy will result by applying sand when the clay is softened, to a depth of about 3 or 4 ins. An excellent state of preparation can be had by driving a herd of cattle over the road when wet and at the same time adding the sand. By this simple method a thorough mixture of the surface clay and sand is formed, and, as it dries somewhat, a split-log drag may be used to produce the crown and maintain it until the road is hard and smooth under travel. Should any place in the road fail and become muddy, more sand must be added each time such a failure is noticed. If this direction is followed the result will be quite satisfactory, notwithstanding its simplicity. In the absence of the herd of cattle an excellent surface condition preparatory for the sand can be obtained by using a disk or tooth harrow to loosen the surface of the clay.

While it has not been specifically stated, it is assumed that the road to be improved has been properly laid out, drained, and graded to the desired crown before being prepared for the application of the sand. The subsequent dragging is merely to even inequalities while the road is settling under traffic. If a coarse sand is not available any clean sand available may be used. It is often a matter of using, not what one judges best, but such as can be had within the means of the supervisor. Any sand will improve a clay road.

Simple as this method is, it is nevertheless applicable to the whole plastic clay belt. Roads which are now almost impassible in rainy weather, may be rendered practically firm for all travel and even well suited for automobiles. The depth of the sand-clay mixture must be in proportion to the burden of travel. If the road is to withstand very heavy travel and extreme weather conditions, a deep sand-clay composition will be necessary, and there should be only clay enough in the composition to fill the voids in the sand and to act as a binder.

From a careful study of conditions it is believed that the application of sand, as above described, will prove a practical solution of the road problem for the plastic clay soils. Where sand is not available locally it may be transported by rail, delivered in chutes, loaded therefrom by gravity into wagons, and hauled

to the roadside for less cost than macadam, and in most cases it will prove equal, if not superior, to the more expensive macadam road. But no half-hearted effort should be attempted. A steam shovel should be used to load cars of the ballast type, and they should be unloaded into chutes by gravity at the desired station. The sand may then be dropped into dump wagons, hauled to the place of use, and dropped in sufficient quantity in regular order along the road to be improved. This is a practical and economical method by which much may be accomplished.

Improving Loam and Alkali Soil Roads.—Usually the loams have a very good degree of fine sand intermixed, and careful attention to drainage and the crown often proves sufficient to make a good road, if dragged occasionally when wet. Especial care should be given to drainage if the body of the road is to be of loam. The traveled roadway should be at least 18 ins. above the level of ditch water. It is also important to provide against either of two extremes—water standing in the side ditch or flowing too great a distance down a slope in the ditch. Both are disastrous to the road. The one saturates and softens the road bed, causing it to fail, and the other forms a gully of the ditch and washes the road away. A good maxim is "Ditch the side ditches." This is of great importance and well worth remembering. It not only applies to a loam soil, but to all kinds of soils and conditions with one exception, viz., where the sand subsoil is several feet deep and sufficiently porous to absorb any rainfall no side ditch is required and no attention need be given to the drainage of the road beyond crowning the sand-clay surface. Such deep sand is found only in the sand hills. In all cases where the sand is under 10 ins. deep or underlaid with clay or hardpan of any kind, well-constructed side ditches must be provided.

All forms of hard roads should have a good crown, varying from side to center. The slope of the crown should be greatest at the sides and flattened as it approaches the center. Only a sand road requires no crown at all. Where nothing but deep sand prevails, the surface should be concave for the purpose of conserving, as far as possible, the moisture. Sand alone is improved by water.

The same directions given for loam constructions may be followed in the case of alkali soil. A difference, however, usually exists in the case of alkali soils. They are more sticky and are flat and low. The one thing, therefore, of prime importance is drainage. To effect this it is often necessary to build up the road above the adjacent land. It is more important usually to build up an alkali soil road than one of loam soil because the alkali is more liable to failure where imperfect drainage exists. For this reason it is important that the road should have a width of not less than 30 ft., in order to give permanency and utility to the traveled way, and a sodded shoulder on either side to prevent washing.

If the construction of the road in alkali soil is followed with systematic and faithful dragging a very satisfactory road will be obtained. Should a muck-like condition continue after each rain and the road fail to harden satisfactorily it should be treated with an application of sand as outlined for gumbo.

Use of Sand-Clay on Sand-Hill Roads.—Perhaps the sandy roads in the sand-hill regions of the Middle West are the worst stretches of road to be found in this country. They often lie as impassable barriers between fertile lands and vary from a few hundred yards to several miles in width. To haul a load across a mile of such sand costs ten times as much as on a hard, smooth surface. It is, then, a most vital matter for the people living in the vicinity and having occasion to use these roads to build hard-surface roads through the sand. Many experiments have been made with varying results, but so far it appears that the sand-clay road is the practical road, and particularly so in the semiarid regions. Indeed, it appears that here the sand-clay road is capable of yielding the most satisfactory results both as to service and durability. Because of the dryness of the climate the clay rarely becomes oversaturated; on the other hand, however, the sand always contains enough moisture to keep the base of the clay in a state of sufficient moisture to prevent cracking at the bottom of the clay. This percentage of moisture, while small, is sufficient to strengthen the road surface greatly; but while this factor is important, there is another equally as advantageous in the porous character of the sandy base. It allows the excess of moisture to percolate, however hard it rains; there is therefore an interesting principle disclosed in this deep sand. It may be compared to a governor regulating the moisture admitted to the clay from beneath. According to this principle, one would expect to find the best sand-clay roads where the sand is deepest, and such is the case. The sand furnishes a perfect underdrainage and yet capillarity supplies the right amount of moisture to maintain the bond in the clay and prevent its becoming thoroughly dry, in which case it would crumble to dust and be dissipated either by the wind or in the deep sand. Again, this principle makes it possible and even practicable to have a satisfactory clay road on deep sand when the clay is largely in excess. Such a road would utterly fail on a clay foundation. Here, again, this principle is of great advantage, because the clay can be left in excess in the body and sand added to the surface only after the clay has been applied.

The importance of a careful location is not always as seriously considered as the nature of the case justifies. It too often happens that an effort is made to follow the section line. Normally, in lands valuable for cultivation, this may be justified, but in grazing lands, where the roads should be located with a view to an economic maintenance and an economic haul over the road, both of which require low grades, the case is not the same. Again, to build a sand-clay road over the top of a sand hill is to invite the winds to destroy it. It is therefore of importance that the location be as free from grades as possible and protected from drift sand or "blows."

After the location has been selected a roadway not less than 30 ft. wide should be laid out. All inequalities should be graded out so as to give a smooth road with a uniform cross section. When this has been done stakes should be set for the center line of the road, and for this purpose plaster laths serve excellently. With a turning plow a furrow should be run up one side of the row of stakes and back on the other side, throwing the dirt toward the stakes. In this way a ridge is made exactly in the center of the road. Then a roadbed should be thrown up to the width to be clayed by backfurrowing to this ridge. A drag or harrow should be used to smooth this bed and the crown should be carefully made to conform to the proposed finished road. A good practical width for this bed is 14 ft. After the central section has thus been prepared and smoothed with a harrow or drag the shoulders should be backfurrowed on both sides of this clay bed with the turning plow. To do this the plow should be set so that it will discharge the material in a ridge just outside of the last furrow made in forming the bed. Thus by several rounds with the plow the shoulder is raised sufficiently to form a protection to the sides of the clay when placed in the prepared bed. Usually five such furrows on either side complete a 30 ft. road to the ditch line. When this is done the sand bed is ready for the clay to be hauled upon it.

If in the foregoing operation any stakes have been misplaced from the center they should now be restored in order to maintain the center line of the road definitely. The first six or eight loads of clay should be dropped exactly in line with these center stakes. The next loads are dropped on one side of the center loads, inside of the shoulder, but only about half as many should be dropped on the side as were dropped in the center. Clay should then be dropped on the other side in the same manner. This work should be done in such a way that the center line is some 50 ft. in advance of one side line and the first side line about the same distance in advance of the other—an arrangement by which three loads can be unloaded at once. With this plan the teams will not be blocked in hauling, and, furthermore, by keeping the center line well in advance of the sides it is an easy matter to keep the road true and even.

After 200 lin. yds. of the road have been covered the clay should be spread. It is important not to begin to spread the material immediately after being dropped upon the road. The reason for this will appear later. Nothing is better for the purpose of spreading the clay than a 2-horse 2-wheel grader. The spreading is begun by pushing the side loads toward the center to fill in the space between the center and the side loads which has already been rolled by the wheels of the loaded wagons. After this has been done the hauling should be continued until the material has been thoroughly packed by the wheels of the loaded wagons passing over it. The center may then be brought toward the sides with the grader and the entire road smoothed. Travel may now be freely allowed on any part of the surface of the road. If the loads of clay average 1 cu. yd. each they should be dropped touching each other in the row, but if less than 1 cu. yd. they should be slightly lapped. The person in charge of this part of the work should exercise his judgment in the matter of dropping the loads according to the size in order to secure the desired depth of clay, which should not be less than 6 ins., while it may be as much as 12 ins. when very heavy loads, such as traction engines, are to pass over it.

The side loads should be pulled toward the center first for the purpose of preserving the crown and keeping the material well toward the center, since it is easier to cut down the crown later, if too high, than to build it up. This is also important for the reason that the teaming must be depended on to do the rolling, since it is not expected that a roller will be used. Moreover, if the center is left undisturbed the teams will naturally follow on each side of the crown and, in consequence, the wheels of the loaded wagons will roll in the proper place to give the greatest rolling effect to that part of the road which will afterwards bear the heaviest burden of travel, leaving the material of the center loads in condition to be handled by the grader when the center is to be dressed. Then, last of all, the surface is finished with the grader. Especial care has been taken to make this detail clear, for upon careful attention to it depends the smoothness of the road when completed. Perhaps no part of the construction is as important as the matter of providing an even texture and a surface in the outset free from small depressions. For the semiarid sand hills this is especially important, because it is not the purpose ever to break the bed of clay up entirely in the application of the sand. If by neglect or other cause the clay has been dropped improperly, causing a thin place, the necessary repair should be made at once and all the material should receive the same rolling in construction. It is quite important in the semiarid territory to have the clay fairly well compacted before the sand is added, and to add sand only on top of the clay, in the manner described above for sticky soils. Indeed, the construction is identically the same, after the clay has been placed on the deep sand, as that described for gumbo or any other clay district, with this exception—the sand, in the case of the sand-hill road, will not have to enter as deeply into the clay or form as large a percentage in the composition, except for the upper inch or two of the surface. The greater part of the clay remains undisturbed as when placed on the sand. It is expedient and proper, however, to have at all times a coating of sand on the road. After the road has been properly smoothed the grader may be reversed with good effect to bring a covering of sand from the sides of the road, which have been previously plowed up for the shoulders during the preparation of the roadbed. It may happen that by hauling over it the clay will be pulverized to such an extent that an inch or more of dust may form on the surface. In this case the fine, mechanical separation can be used to advantage by incorporating an abundance of sand with the dust. Sufficient sand, fully twice as much as the amount of

dust, if gumbo, should be added and thoroughly mixed by means of a tooth harrow. When the rains come only mucking and settling remain to complete the composition.

There is one important thing to avoid in this dry climate. The clay should not be disturbed deeper than there is moisture to reunite it at the time that sand is added. The road should be built of clay, covered with sand, and left to the rains to soften the clay so that it can absorb the sand. The clay should never be pierced to the sand base, for the reason that, if it should be continuously dry for a long time the loose sand would work up from below and cause sandy pockets and sandy places in the road, not unlike mud holes in a clay road in effect. This is quite important in drift and very fine sand.

After the clay has been placed upon the road, sanded, and treated as above described, the turning plow should again be used to build up the sandy shoulders until nearly level with the clayed part. In this way a trap will be set for all the clay that blows or washes to the sides. This is not only permissible in a sand-clay road, with deep sand, but desirable. It is not so in a road entirely of clay, and this distinction should be noted. Another reason for lifting the sand shoulders so high is to conserve moisture, the opposite of what is necessary in the case of sand-clay construction on a clay subsoil. It must be carefully observed that this last suggestion applies to deep sand only and never to shallow sand, where the rain is not at once absorbed. Every effort should be made to conserve moisture in deep sand and a dry climate, because the moisture prevents dust and the consequent blowing away of the road. It is therefore a matter of necessity, if the greatest success is to be attained, that these local conditions be carefully considered in every detail of the construction. The building up of the shoulders is of advantage to the road when it is to be dragged, because then it is an easy matter to get from the shoulders the sand needed on the softened sand-clay roadway.

While it is customary to use the sand along the road, yet if it is very fine and there is coarse sand near by it will often pay to haul a slight covering of the coarse quality upon the clay. This is particularly advantageous where the winds are very strong, because the coarse sand is far more resistant to the winds and far less disposed to break up the clay bond. It acts in the same way that coarse sand does with cement. The shoulders should be plowed out to the ditch line and, as far as possible, vegetation of some kind should be encouraged to grow on the sandy berm. All these points should be observed to prevent the sand from blowing away and leaving the sand-clay road unprotected. If much rain should come and the clay should soften as much sand should be added as the softened clay will mix with well and the sanding should be followed with a drag until the road is again dry and firm.

The maintenance of the road is of the utmost importance for one or two years after construction. Proper care at the right time often saves a whole road from failure. There is nothing permanent about a road except its location, and nowhere is that saying truer than in the sand hills. Even the location is often in jeopardy.

Nothing has been said so far about the choice of the material to be used as the clay part of the sand-clay road in the sand hills. The choice is usually limited to gypsum, alkali soil or gumbo. Sometimes only one is available, but when more than one can be had it is important to know how to select the best. Gypsum varies from a chalklike, nonbinding, easily pulverized mass to a composition of semiplastic gypsum and clay, which, under travel, hardens on the road like cement. This latter is quite useful as a road material, while the former is practically worthless, because it lacks binding power. The binding power is one of the properties to be sought for most carefully. If the material packs readily and pulverizes slowly when dry, or softens slowly when wet, it may be safely accepted as a suitable material for making the surface of a sand road hard. This characteristic alone can be relied upon. Color has little or no significance as to its value.

The alkali soils are more or less variable in composition, usually containing a certain proportion of sand, silt, clay, and organic matter. In some respects they are very much like the loams, but they contain verying percentages of different soluble salts. As a rule, very little sand need be added to an alkali hard surface material. The best results come from spreading it on rather heavily and dragging thoroughly afterwards. Gumbo is one of the materials sometimes met with and, if it is free from grit, a large amount of sand will have to be added. This material has the peculiarity of cracking in every direction when it thoroughly dries out. This makes it necessary to add more sand after each rain and also when the gumbo dries and cracks. These cracks should be filled with sand as often as they appear and this should be continued until sufficient sand is incorporated to stop the cracking completely. This characteristic of the gumbo of splitting up into thousands of little pieces is of immense advantage for introducing sand, but it is of serious consequence in periods of extended drought, because it may cause the complete failure of the road before the necessary sand can be incorporated with the gumbo. If once the sand and gumbo are mixed and compacted by travel, little is to be feared thereafter. It is clear, therefore, that, when gumbo is used, it is important to utilize to the fullest extent every rain, in order to puddle the surface and to do everything possible to conserve the moisture in the gumbo by keeping the sand shoulders high, even above the level of the clay portion of the road. It is better to do this, for the additional reason that it will help to keep the rain water on the gumbo and soften it to a greater depth, and thereby allow a more thorough intermixing of the sand with the gumbo. It should always be kept covered with a little sand. Whatever the variety of gumbo, whether from a lake bottom, the overflow of a river, or an irrigation ditch, its characteristics are practically the same. and it will be valuable as a road material in proportion to its binding power and ability to resist washing or pulverizing and consequent blowing away.

An occasional deposit of pipe clay may be encountered in certain sandy sections, as at Hutchinson, Kans. The treatment of this material differs somewhat from that given to the other types of clay mentioned above. It should be placed upon the road and covered with sand, as described for gumbo, but the difference consists chiefly in the difficulty experienced in the endeavor to incorporate sand with clay. It has a remarkable tendency to remain in lumps and to resist all efforts to pulverize it or to puddle sand into it. It usually requires a great deal of time and labor to mix sand with pipe clay to the proper point of combination. A dozen herds of cattle driven over the road are needed to effect a proper combination; perhaps a thousand sheep would effect the proper puddling of pipe clay more easily. Aside from this difference there is one other point well worth noting regarding pipe clay. It shows this tendency to form lumps when dug or plowed up in the pit. If these lumps are not broken before they are dropped on the road it is very difficult to produce a proper clay bed with an even and uniform thickness overlaying the sand. Eventually these lumps will cause inequalities in the surface. Considerable care should be exercised to have the pipe clay as finely divided as possible when placed on the road, so that it can be spread evenly.

It should not be forgotten that sand is needed in considerable quantities for pipe clay and that the proper time to add it is when the clay is in a muddy state and being puddled.

Sand-Oil Covering for a Sand-Clay Road.—At Garden City Kans., oil was tried on a section of a very sandy road, and it had been planned to parallel the oil with gypsum sand-clay. The suggestion was made that this oiled sand might with advantage be spread evenly over the finished part of gypsum sand-clay. So far this is an untried experiment and results are not known, but the object is to provide a dustless covering to the gypsum road, resisting both wind and rain. It might possibly have the additional effect of providing a cushionlike protection to the hard surface below. Thus the three things which might result in the betterment of the road are a dust preventive, a wind and water resistant, and a cushionlike effect to relieve the impact of travel and thereby prolong the life of the road. At Garden City, Kans., the sand is already saturated with the oil, and the experiment may be tried with little or no cost.

It is well known that the successful use of oil in road building depends largely upon the nature of the materials used. Natural oils vary widely in their characteristics and the same may be said in regard to tars. The possible use of bituminous materials in connection with sand-clay construction must be worked out experimentally before definite instruction in regard to it can be given.

SPECIFIC EXAMPLES OF SAND-CLAY CONSTRUCTION AND COST DATA.

Experimental sand-clay roads were constructed under the direction of the U. S. Office of Public Roads at Garden City Kans., Dodge City, Kans., Bucklin, Kans., and Ford, Kans., and the following is a brief description of the methods employed in the construction of these roads:

Garden City, Kans.—The road selected at Garden City was a part of the Santa Fe road leading south from the station. The work was begun at the foot of the sand hills on the southern side of the Arkansas river. From the starting point the grade rose about 6 per cent, or perhaps a little more, for a distance of about 500 ft., and then ran level for some distance. To give this heavy grade a hard surface was of the utmost importance, because it was impossible with the funds available to reduce the grade, and a change of location was out of the question.

About 300 yds. east of the road a deposit of gypsum clay was found and uncovered, and from this pit were taken 68 cu. yds. It was abandoned because of the heavy sand between the pit and the road, and for the additional reason that the sand could be stripped from a gypsum deposit near the road and material obtained there more cheaply. This pit was immediately on the roadside and promised sufficient material for the completion of the contemplated section. It proved a wise decision to use this pit, for it was found that it improved in quality as the excavation became deeper. It showed greater tenacity and bonded much better than that from the first pit.

Because the road was practically level in the cross section, no preparation at all was made in the subgrade, except to stake out the center and side lines in order to guide the teamsters in hauling. The proposed width was 12 ft. of clay, and for this width a full load was dropped on either side of the center and a half load in the middle between the side loads. The whole was spread as evenly as possible by hand and hauled over as fast as it was spread. All weak and defective places were reinforced as soon as they appeared, and the proper crown was formed as the work proceeded. An effort was made to add the clay to a depth of about 9 ins. and a width of 12 ft., but, since there were no shoulders and since 12 ft. made too narrow a road, the material was allowed to spread to 14 ft., so that the clay tapered off 12 ins. on the sides. In this simple manner the entire section of 765 ft. was constructed. The operation so far consisted simply in hauling gypsum clay and spreading it evenly on the road in a straight line and to an even depth and width. During this time the public was allowed undisturbed use of the road and was even invited to use it for the purpose of packing the surface.

After this packing was accomplished, fortunately a very heavy rain fell and effectually saturated the clay and the sand beneath it. The road was then harrowed with a toothed harrow to break all the lumps on the surface and to prepare it for the sand which was next to be added. For the sanding a heavy 2-horse turning plow was used, and the sand was backfurrowed up to the clay on both sides. A common drag was then used to pull the sand

upon the clay and the harrow was used to mix them. Finally, after several draggings and harrowings, the road was left for travel. After one year the same road was visited and was found to be as firm and hard as macadam. The people are so well pleased that they have continued the construction entirely across the sand southward for a distance of seven miles. A summary of the data regarding this and ten other roads will be found in Table I.

Dodge City, Kans.—At Dodge City a part of the Minneola road was selected. This road, like the one at Garden City, was south of the Arkansas river in the sand hills. The sand here made so serious an obstacle that the road was little used, and travelers preferred to go a mile or more out of the way to avoid it. A search for clay revealed, near the middle of the section to be improved, a deposit of sediment from an irrigation ditch. This deposit was about 18 to 20 ins. thick and extended over an area of 3 or 4 acres. It was decided to use this material, because it was the only thing at hand. Accordingly it was plowed as deep as two horses could pull the plow. It was then found to be dry enough to granulate perfectly, and consequently it was in fine condition for loading into wagons and spreading on the road. The loading was done by hand and common farm wagons were used. For the wagon boxes the material used was 2 by

This method proved the most satisfactory of all. By this means all high places on the roadside were graded, and the sand thus obtained was used to cover the clay. The use of the drag scraper was found far more expeditious than hand work. No roller was used on this work, but the travel was so distributed as to roll every portion of the road evenly.

The road has shown its ability to withstand travel and has converted what was formerly a little-used road into one of the most heavily traveled roads leading into Dodge City. It has clearly demonstrated the value of a good road. Formerly the farmers who had to travel along it were seriously considering the advisability of selling their farms and going where the roads were better. Now they easily haul 60 bushels of wheat with a 2-horse team.

Bucklin, Kans.—Simultaneously with the work at Dodge City, a section of an experimental road, five miles north of Bucklin, was constructed. The section laid out was supposed to be 1½ miles long, and the plan of construction was identical with the work at Dodge City. For the material for giving a hard surface there was no artificial lake of sedimentary clay as at Dodge City. At first it was thought that it would be necessary to haul all the material from the river valley up the hill, but the inspection of a basin on the summit of the hill, near the south end of the

of this condition, the gumbo-clay found in the river valley was plowed up in the afternoon when it had thawed out. The next morning the clay plowed the previous afternoon would be in frozen lumps as hard as stone. The men used gloves and threw these frozen lumps into the wagon by hand, as they would have done stones. In this rough state it was hauled upon the road and spread as well as possible. It was impossible to give a surface to the road until it had thawed in the afternoon. Then it was smoothed to some extent and the clay was covered with sharp sand 3 ins. deep. Certainly no more crude form of construction could have been followed but conditions were such as to prevent the use of any other method. This section was only a short approach to a bridge. The approach was a heavy sand bar, and had to be raised with sand 2 ft. or more in places in order to make the grade easy.

These four experimental roads were constructed with local material and local conditions were met at the least possible cost. The cost figures for each of these roads will be found in Table I. It is believed that a careful study of local conditions in any community will reveal many possibilities for improving the roads at a comparatively small cost. Where work of this kind is undertaken it may be well to make several experiments and tests and to

TABLE 1.—COMPARATIVE COSTS OF FOUR SAND-CLAY ROADS CONSTRUCTED IN 1908.

Place.	Garden City, Santa Fe Road. Oct. 12 to 20.		Dodge City, Minnesota Road. Oct. 22 to Dec. 10.					Bucklin, Spearville Road, Nov. 21 to Dec. 24.			Ford, Spearville Road, Dec. 17 to 21.		
Length, ft.	765		9,750					4,271†			350		
Width, including ditches, ft.	30		30					30			30		
Width of part clayed, ft.	12		14					14			16		
Depth of clay, ins.	9		11*					12			13		
Clay hauled, cu. yds.	256		3,703					1,883			179		
Surface clayed, sq. yds.	1,020		15,167					6,644			622		
	Unit cost per cu. yd.	Total cost.	Per sq. yd. clayed.	Unit cost per cu. yd.	Tot. cost.	Per sq. yd. clayed.	Unit cost per cu. yd.	Tot. cost.	Per sq. yd. clayed.	Unit cost per cu. yd.	Tot. cost.	Per sq. yd. clayed.	
Foreman for work					$ 51.50	$0.003		$ 50.00	$0.007				
Filling from barrow grit					9.00	0.001							
Excavation				$0.153	387.69	0.025	$0.141	224.07	0.034				
Filling in and widening road										0.069	17.25	$0.028	
Shaping subgrades					70.00	0.005		32.37	0.005				
Stripping clay in pit	$0.028	$ 7.17	$0.007										
Plowing up clay	0.041	10.50	0.010	0.015	54.87	0.004	0.039	16.75	0.002	0.059**	10.50	0.017	
Loading clay by hand	0.129	33.00	0.032	0.127	470.00	0.031	0.125	235.75	0.035		60.00	0.096	
Hauling clay to road	0.154	39.50	0.039	0.164	608.38	0.041	0.162	304.87	0.046	0.335	60.00	0.096	
Spreading clay on road	0.039	10.00	0.010	0.025	93.00	0.006	0.024	44.62	0.007	0.044	8.00	0.013	
Harrowing and mixing clay and sand	0.009	2.33	0.002	0.002	6.00								
Sanding road and building shoulders					107.68	0.007					8.00	0.013	
Dressing road with grader					27.00	0.002					.50		
Work in bridge, timber, etc.					59.53	0.004							
Repairs, water boy and sundries					3.75			5.67					
Livery for expert					49.00	0.003		35.25	0.005				
Miscellaneous					100.00	0.004		9.00					
Cost of road per sq. yd., clayed			$0.10			$0.138			$0.141				$0.167
Rate per mile		$707.45			$1,135.83			$1,183 64			$1,557.60		

*Depth of clay and sand composition. †Length clayed; road was laid off for length of 8,121 ft. **Plowing and loading clay. ‡Sanding clay.

4 in. scantling for the bottom and 1½ by 10 in. planks for the sides; all were 11 ft. long. Two by 6 in. scantling is perhaps better for the bottoms than the dimensions given above, because this size requires less handling.

The preparation of the subgrade was made in advance of the clay hauling and was done in the following manner: Unlike the work at Garden City, a subgrade of definite form and width was prepared. The center line was first laid out and backfurrowed in the manner previously described. The specifications previously noted were also followed in dropping and spreading the clay. During the construction there was no rain and dust formed an inch or more deep. Into this a large amount of sand was harrowed, and the road was finally covered with a layer of sand in preparation for rain. When the rain came the sand was completely absorbed by the clay and an additional application was required to overcome the tendency to stick. This was added after each rain and worked in as opportunity allowed. The clay also cracked quite deeply when it dried out, and to meet this contingency more sand was added and worked into the cracks with the drag. Shoulders were plowed up on either side in the same manner as at Garden City, and sand was pulled upon the clay with a two-horse grader. A large grader was also used to dress the road and to pull sand upon the clay; but still better was the drag scraper for sanding the clay.

section, indicated the possibility of a fairly good material, which, if it should have the necessary binding power, might mean a great saving in the cost of construction. From this point a haul downhill could be obtained, and from the importance of this matter it was deemed worthy of trial. Some of this material was plowed up and put on the road. This surface material at first showed a tendency to blister, and its binding power seemed very slight, but as the depth of the pit increased a decided improvement was apparent and excellent material was found beneath the surface soil. A great saving in the cost of construction, well worth the experiment, was thus accomplished.

At the south end of the road, 3,276 ft. of road were clayed from the clay pit described above. This was a haul down hill, and the material was spread on heavier than is usually done because it seemed likely that it would not support the travel. The work was then stopped at the south end and begun at the north end of the section. At this end 995 ft. were clayed and, when a bed for clay in the intervening space, which was about 2,500 ft. long, had been prepared, it was left for the community to clay according to the plan given them.

Ford, Kans.—The construction at this place was quite peculiar, because of the weather conditions. During the night the road would freeze hard, and, in order to take advantage

note the difference in the results. In all forms of sand-clay construction the process requires the final mixing to be in the wet state, as otherwise there can be no bond. It is also of the utmost importance to use the drag frequently on the road during the first year, and as often as any part shows a tendency to stick or pick up it should have a surface coating of sand to prevent the clay from being carried off. It is necessary to study the needs of the road by actual observation rather than to endeavor to learn them from printed rules. Local conditions must be studied and overcome on their own ground.

The Turkish Government has granted a concession to Americans for building a railway from Sivas to Dvarbekir, Betlis and Van, in Turkey, a distance of 1,500 miles. Manning, Maxwell & Moore, 85 Liberty St., New York City, are reported to have the contract for constructing the line.

The Legislature of Rhode Island has passed the bill chartering the Southern New England Ry. This is the road backed by the Grand Trunk Ry., and by means of it the latter will secure an entrance to Providence, R. I. Surveys for the line are to be made at once, it is said. H. G. Kelley, Montreal, Que., is Chief Engineer.

Railway Section

Note: This section is devoted to methods and costs of constructing railways. It will cover road-bed and track construction, contractor's plant and organization, surveying methods and permanent way structures.

Traffic Conditions Influencing Passenger Subway Construction in Chicago, Ill.

Final studies and perfected plans for the construction of passenger subways in Chicago are being made under the direction of Mr. Bion J. Arnold as chief engineer. It is too early to do more than surmise what these plans will be or to assert that they will be followed by immediate construction; we only know that the necessity is too pressing to permit of long postponement of definite action toward a comprehensive improvement of passenger transportation facilities to and from the business center of the city. It is with this idea that we propose in this and a succeeding article to present in outline, first, what the traffic conditions are that influence passenger subway construction in Chicago, and, second, the various plans that have been so far proposed for locating and constructing passenger subways.

Present Transportation Facilities.—The present passenger transportation facilities to and from the business district of Chicago consist of surface and elevated railways. The surface railways are all electric overhead trolley lines and the elevated railways are third rail electric lines. Figure 1 is a skeleton map of the city showing these lines. It will be noted that all the elevated lines converge into a loop line. The route of this loop line, starting from an arbitrarily selected point at the intersection of Van Buren St. and Wabash Ave., is west along Van Buren St., north along Fifth Ave., east along Lake St. and south along Wabash Ave. to the starting point. It is roughly 7 full city blocks from north to south and 5 city blocks from east to west. The 35 or more city blocks within the loop and those skirting its outer perimeter constitute what will be designated here the business district or loop district of the city; they contain most of the large office buildings, retail stores, hotels, theaters, etc. Practically all the surface railways as well as the elevated roads converge in the loop district; it will be seen therefore that the conditions here for congestion of traffic are exceptional. As a matter of fact such congestion exists to a marked degree, as will be shown further on. First, however, it is instructive to examine the character and amount of traffic which comes into the loop district from the surface and elevated lines and which has to be handled there.

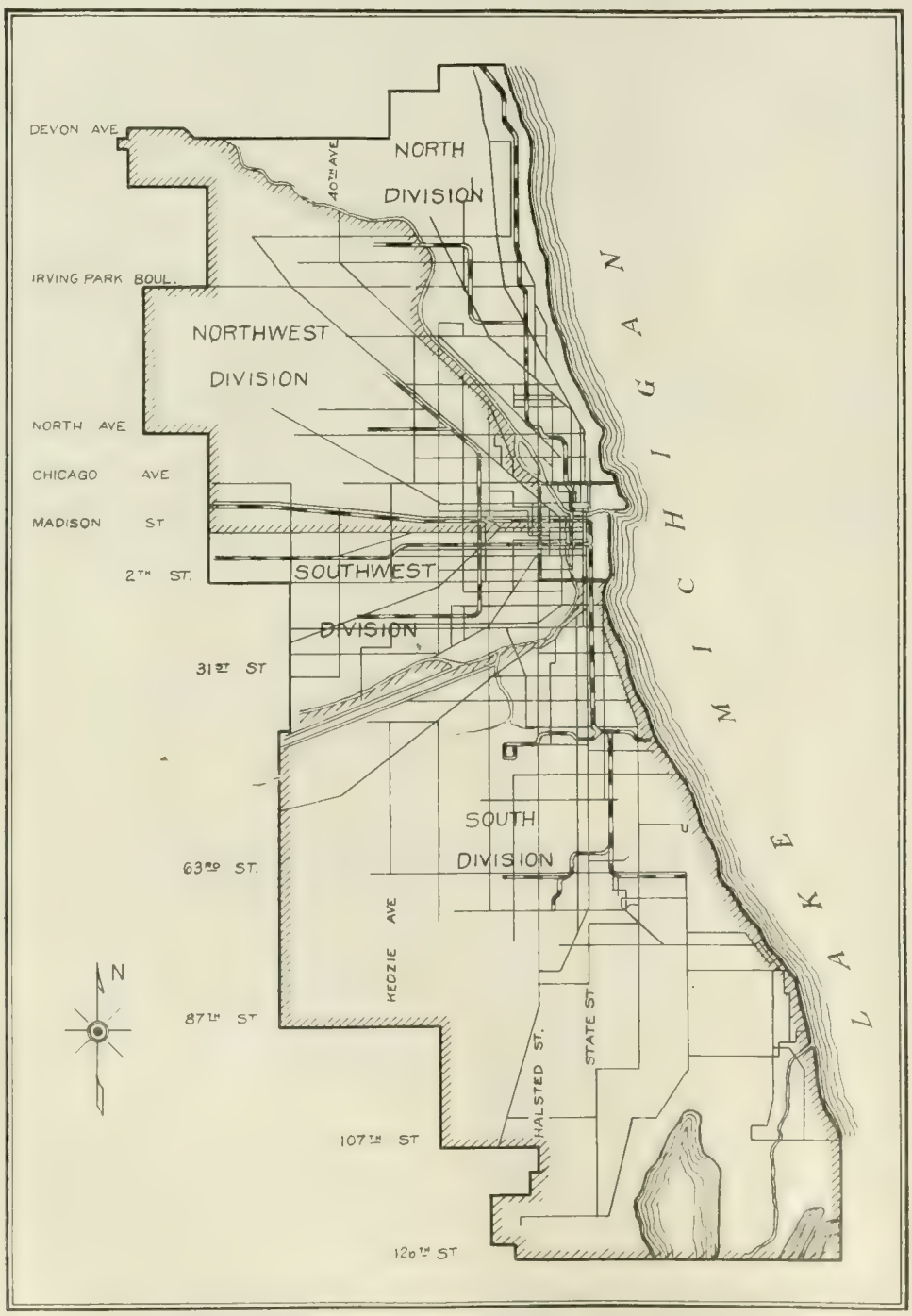


Fig. 1—Diagram Map Showing Surface and Elevated Railways of Chicago, Ill.

Elevated Railway Traffic Into Loop District.—The elevated railway lines of Chicago are shown by the map, Fig. 1. To simplify the study of the traffic of these lines the city is divided into four divisions as indicated. These divisions show as clearly as may be the distinctive traffic territories tributary to the different lines. A traffic census of elevated railway traffic into and out of the loop district for 24 hours was made in February, 1909, and the results are shown by diagram in Fig. 2 and in the following text. The observations were taken at the boundaries of the business district assumed as within the area bounded by Twelfth St., Halsted St., Chicago Ave. and Lake Michigan.

The total elevated railway traffic during the 24 hours recorded was as follows:

Line.	Inbound No. Pass.	Outbound. No. Pass.
Metropolitan	61,896	57,415
Northwestern	54,247	50,606
South Side	51,478	47,207
Oak Park	20,421	19,662
Total	188,042	174,890

Arranging this traffic according to the maximum ¼ hour and 1 hour periods the results were as follows:

Line.	Inbound. ¼-hr.	Inbound. 1-hr.	Outbound. ¼-hr.	Outbound. 1-hr.
Metropolitan	7,730	25,667	8,062	23,056
Northwestern	5,486	17,090	5,245	17,279
South Side	3,961	12,657	4,685	15,137
Oak Park	2,280	6,663	2,546	7,312
Totals	19,466	62,077	20,538	62,784

It will be observed from Fig. 2 that the inbound period of heavy traffic was between 6:30 and 9:45 a. m., and the outbound period was between 4 p. m. and 7 p. m.

The number of trains handling the elevated railway traffic for 24 hours and for the maximum hour of the 24 was as follows:

Item.	Inbound.	Outbound.
For 24 hours	2,187	2,201
For maximum hour	215	194

To illustrate the accommodations afforded passengers, records were taken of the number of passengers standing; the totals were as follows:

Standing in 24 hours (both directions)....48,371
Maximum standing during one hour.....19,664

Surface Line Traffic Into Loop District.—In studying the traffic on surface lines the same divisions of the city into traffic territories was assumed as in studying the elevated railway traffic, Fig. 1. A traffic census of the surface lines was made in March, 1909, to determine the number of passengers brought into the loop district for 24 hours. The results of this census are shown by the diagram, Fig. 3, and in the following text.

The total traffic for 24 hours was as follows:

Division.	Inbound. No. Pass.	Outbound. No. Pass.
North	54,401	58,014
Northwest	69,177	71,987
Southwest	37,236	48,235
South	92,387	103,458
Total	214,201	280,794

The maximum traffic periods of the ¼-hour and 1-hour were recorded and gave the following figures:

Division.	Inbound. ¼-hr.	Inbound. 1-hr.	Outbound. ¼-hr.	Outbound. 1-hr.
North	2,989	10,330	4,026	15,215
Northwest	4,150	12,893	5,468	18,834
Southwest	2,533	8,831	3,958	14,018
South	5,359	17,410	6,689	23,644
Total	14,870	50,074	19,443	69,919

The period of heaviest inbound traffic was

between 7 and 9 a. m. and of heaviest outbound traffic between 5 and 6:30 p. m.

The number of cars handling this traffic was for the 24 hours and for the hour of maximum traffic as follows:

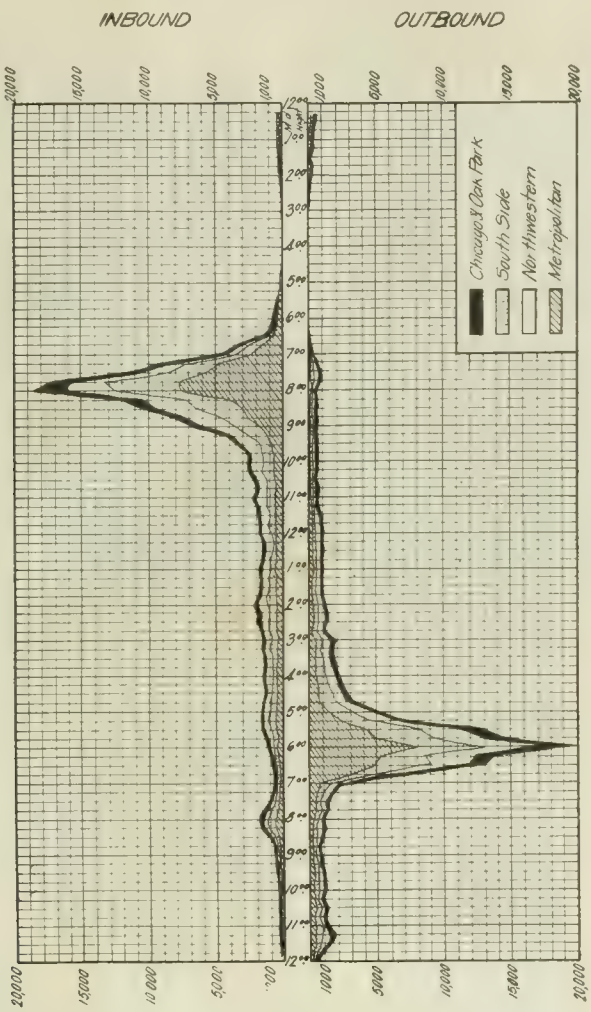


Fig. 2—Diagram Showing Fluctuation of Traffic on Elevated Railways for 24 Hours.

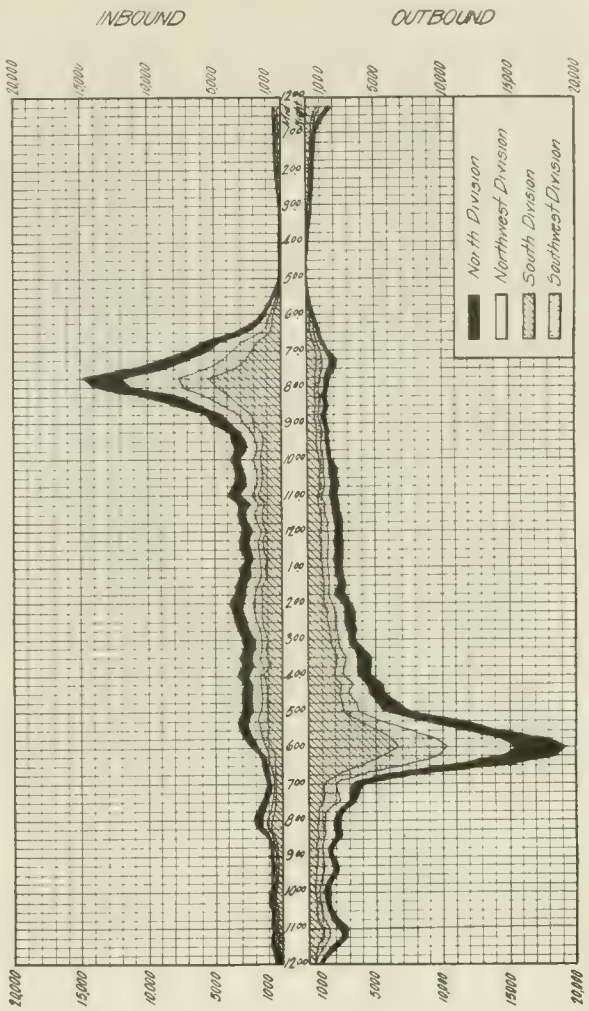


Fig. 3—Diagram Showing Fluctuation of Street Railway Traffic for 24 Hours.

Item.	Inbound.	Outbound.
For 24 hours	12,015	12,152
For maximum hour	909	959

The number of passengers standing for the 24 hours and for the maximum hour was as follows:

For 24 hours (both directions)	88,490
For maximum hour	35,526

Congestion Within the Loop District.—The preceding data indicate the amount, distribution and intensity of traffic entering the loop district and having to be cared for there. It will be observed that we say these data indicate—not that they show definitely. They were closely accurate at the time they were recorded a year ago, but the traffic has increased during that year and is constantly increasing. Remembering this we may study now the conditions of congestion which resulted from the traffic as recorded.

First in order is the elevated railway traffic. Practically all the elevated trains pass around the loop which is a two-track line. The South Side and the Metropolitan trains use one track and the other is used by the Northwestern and the Oak Park lines. There are 11 station stops on the loop. The total length of the loop is miles. Then on this miles of double track there must be handled some 2,000 trains every 24 hours and for short periods twice a day some 200 trains per hour, these trains nominally making all station stops. The condition of traffic congestion on the elevated loop is obvious from these general figures without further analysis.

Turning now to the surface car traffic within the loop district, it is evident that this traffic must be considered from the point of view of its congestion in connection with the vehicular traffic of the district. It is also

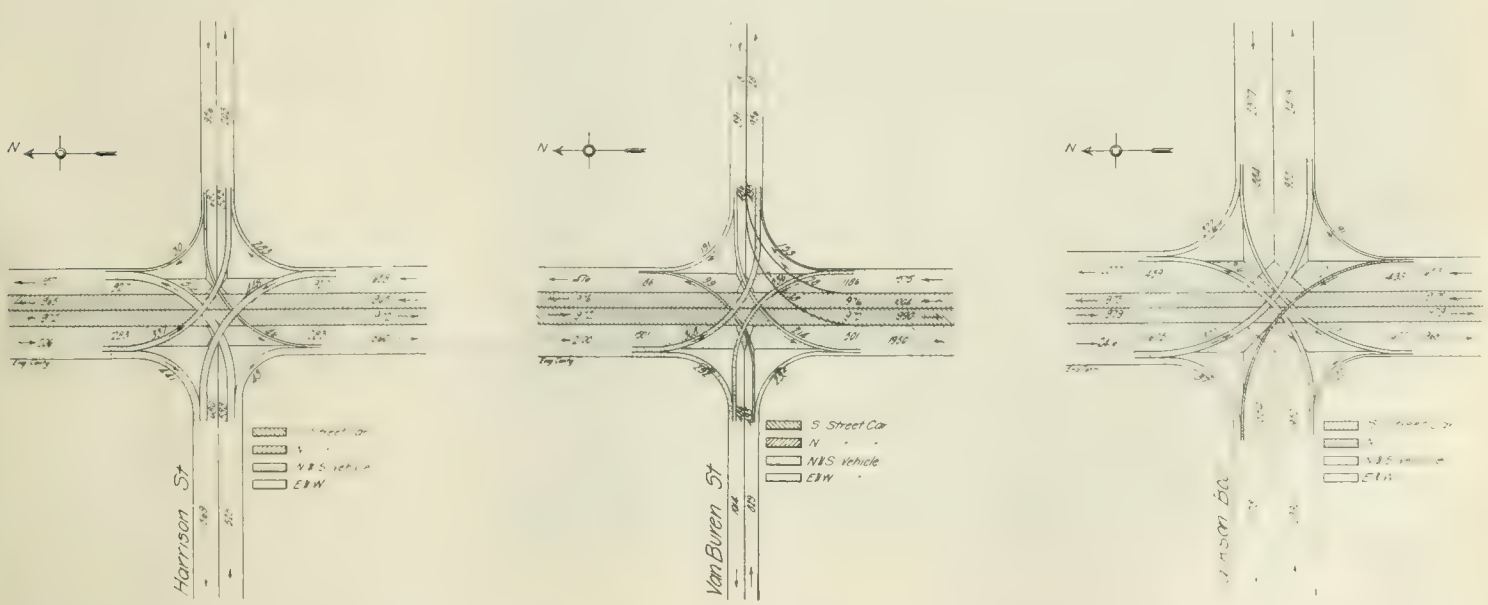


Fig. 4—Diagram Showing Direction, Character and Density of Surface Traffic in the Loop District.

evident that complete statistics of traffic by vehicles and cars within the loop district are nearly impossible to obtain. An idea of its intensity may be gained, however, by selecting certain points and recording this traffic movement at those points for a definite period of time. Selection has been made of State street, where it is crossed by various east and west streets and the vehicle and car traffic recorded for 12 hours from 7 a. m. to 7 p. m. for seven days in April, 1909. The results of this traffic census are shown by the accompanying diagrams, Fig. 4. In studying these diagrams it is to be noted that the points selected were ones at which the crossing streets had no car lines so that they would show the maximum congestion.

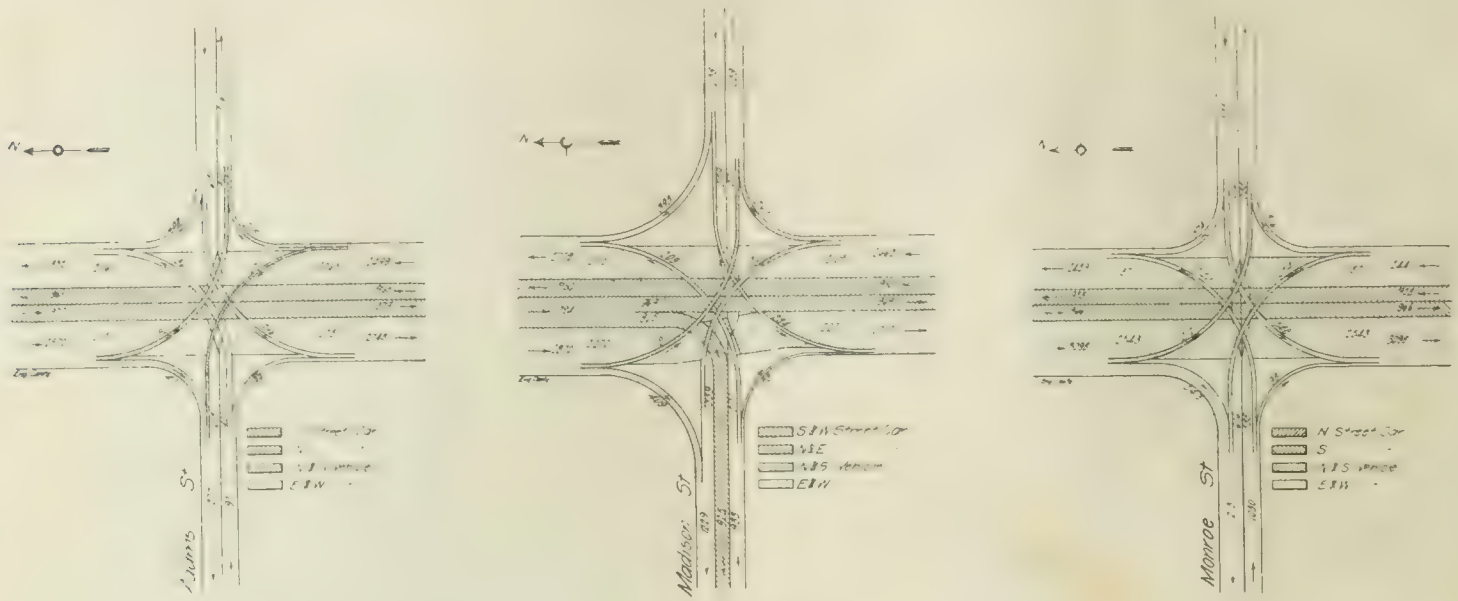


Fig. 4—Diagram Showing Direction, Character and Density of Surface Traffic in the Loop District.

At all the crossings shown by the diagrams of Fig. 4 the traffic is regulated by the police. This is the practice at all of the busier street crossings in the loop district. Broadly, the method of procedure is to close the crossing alternately against north and south and east and west travel. The time interval for which the crossing is closed in either direction of travel is determined by the police officer in charge depending on the relative pressure of traffic in the two directions. The diagram Fig. 5 shows the sum of intervals during 12 hours when traffic was permitted to pass without regulation at night, and under regulation the effect of such accident there are shown the pictures taken at the crossing of Randolph and Dearborn streets during the busy part of the day. Figure 6 shows the crossing under normal conditions with traffic under regulation. To obtain Fig 7 the police officers were instructed to disappear for 5 minutes, allowing traffic to take its own course; the view shows the conditions at the end of the 5-minute interval.

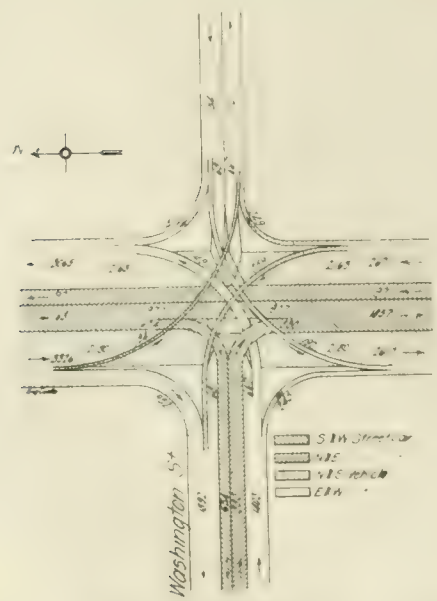


Fig. 4—Diagram Showing Direction, Character Density of Surface Traffic in the Loop District.

Washington St
Madison St.
Monroe St.
Adams St.
Jackson Boul.
Van Buren St.
Harrison St.
1 2 3 4 5 6 7 8 9 10 11 12
Time in Hours
Sum of intervals of North and South Traffic.
" " " East " West "
Total time when there was no Police Regulation

Fig. 5—Diagram Showing Movement of Traffice Crossing State St., Chicago, During 24 Hours.

Conclusions and Discussion.—The preceding records of traffic conditions are instructive first as demonstrating the necessity for substructure and by revising the methods of operation to improve conditions somewhat, but the possible improvement is so small that it does not satisfy the demand. The only other possible resort is elevated stub terminals, but they serve only those passengers whose destinations are near them. In respect to the surface lines there is still less hope of improvement. It is not lack of track facilities in the loop district that accounts for the slow movement of cars through the district; it is the delays to which they are subjected by vehicle traffic, by open bridges, etc. This vehicle

The foregoing statistics relate to the movement of traffic during normal conditions when it is not retarded by accident. To illustrate

way lines. They show that the capacity of the elevated lines entering the loop district is limited by the capacity of the loop and the capacity of the loop has been reached. It may be possible by physical changes of the loop

traffic is increasing and as it increases the interruptions to surface car traffic increases. The necessity for subway construction is imminent.

A second point of interest in the traffic records given above is the information they give of the relation between total traffic and rush-hour traffic. This relation is somewhat different than has been found in other cities. In most cities it has been found that the traffic of the heaviest hour is roughly one-sixth of the total traffic of one day. This is slightly more than 16 per cent. From the figures given above it will be found that in Chicago the corresponding percentages are as follows:

	Inbound. Traffic.	Outbound Traffic.
Elevated lines	33%	36%
Surface lines	20%	25%

The influence of variations such as this upon questions of subway capacity is evident.

In conclusion, we wish to note that the records given above are not necessarily those which will be used in working out the plans for a Chicago subway system that the city's engineer now has in hand. They are presented simply as a review of the work previously done in this respect to indicate the character of the traffic conditions which influence subway construction. In a succeeding article we shall review briefly the several plans that have been worked out during the last few years for subway routes and structures.

View of Corner of Washington and Dearborn Sts., Showing Condition of Traffic Under Regulation of Police.

Cost of Operating the Manhattan Elevated Railways.

The Interborough Rapid Transit Co. operates both the New York City Subway and the Manhattan Elevated Railway. The latter is operated under a lease. The first cost of the subway and the cost of operating it were given in our issue of April 13. In this article we give the cost of operating the Manhattan Elevated, for the fiscal year ending June 30, 1908.

The road extends from South Ferry to 159th St. on the west side and to Bronx Park on the east side. The mileage is as follows:

	Miles.
1st track	37.68
2d track	37.68
3d track	15.30
Other tracks	27.39
Total tracks	**118.05**

The first cost of this railway is not exactly ascertainable, but it can be approximated with considerable accuracy from actual detailed costs of many miles of elevated railways in New York and Brooklyn, given in the 1910 edition of Gillette's "Handbook of Cost Data."

This elevated line was originally operated by steam locomotives.

In 1901 an order was placed for an electric power plant to operate the elevated railways on Manhattan. There were 8 engines ordered, rated at 8,000 HP. each, total 64,000 HP., to operate generators having a total rated power of 40,000 K. W. The rolling stock ordered was 800 motor cars and 400 trailer cars, and the electric equipment for these 800 motor cars was reported to have cost $3,000,000, or $3,750 per motor cars, which does not include car bodies and trucks.

In 1908 the Manhattan Ry. Co. built and equipped 84 motor cars at a cost of $10,110 each, and 116 trailer cars at a cost of $5,240 each. In its report for June 30, 1907, the company stated that it had 836 motor cars, 669 trailer cars without motors, and 50 service cars (without motors), or 1,555 cars. The 50 service cars were reported to have cost $1,322 each, and the 1,505 remaining cars were reported to have cost $6,732 each, on the average. It would appear that some of the trailer cars were retired in 1908, for the total reported June 30, 1908, was 916 motor cars and 675 non-motor cars. From these data it appears that the rolling stock must have cost but little more than $11,000,000. Since 64,584,609 passenger car miles were reported for the year, we see that the first cost of the equipment was about 17 cts. per annual million car miles, which is considerably less than the corresponding cost of equipment for the Subway.

If we assume that this elevated system could be reproduced for $150,000 per mile of single track (see Gillette's "Handbook of Cost Data"), the total first cost of construction (not including power plant or rolling stock) would be less than $18,000,000. The company reports real estate to the amount of $2,776,724, but its report does not give the cost of the power plant. Exclusive of the power plant, the land and the electric transmission line, the total cost of reproduction would be about $29,000,000 or $30,000,000.

The company reports its "cost of road and equipment" at $95,443,757, but this, in common with all other similar reports, really represents capitalized value, and does not indicate in the remotest degree what was the actual cost of construction and equipment.

The Interborough Rapid Transit Co. reports electric generators having a total of 85,000 K. W., plus 10,250 K. W. for turbo-generators. This power includes both that used for the Subway and for the Manhattan Elevated Railway. Since a 55,000 K. W. plant was provided for the Subway, it would appear that about 40,000 K. W. are required for the Manhattan Elevated, in spite of the fact that nearly 50 per cent more car miles are required on the Elevated than on the Subway. However, the report shows that the cost of fuel was less than 7 per cent more to operate the Elevated lines than the Subway. Unfortunately the Interborough Co.'s report does not give the number of K. W. hrs. used by each, but only the grand total, which was 391,904,000 for both the Elevated and the Subway. There were required 2,385 lbs. of bituminous coal per K. W. hr.

The cost of operating the Elevated was as follows for the year 1908:

	Maintenance of Way and Structures:	
1.	Track and roadway	$ 560,312
2.	Electric line	68,517
3.	Buildings and fixtures	117,841
4.	Undistributed expense	44,926
	Total maintenance of way	$ 791,596
	Maintenance of Equipment:	
5.	Steam plant	$ 101,267
6.	Electric plant	32,929
7.	Cars	341,854
8.	Electric equipment of cars	220,645
9.	Miscellaneous equipment	314
10.	Shop expenses	133,453
11.	Undistributed expense	24,697
	Total maintenance of equipment	$ 855,158
	Operation of power plant:	
12.	Wages	$ 209,672
13.	Fuel	729,992
14.	Water	62,078
15.	Lubricants and waste	14,432

Fig. 7—View of Corner of Dearborn and Washington, Showing the Results Due to Non-regulation of Traffic for Five Minutes.

16.	Miscel. expenses and supplies.....	51,920
17.	Undistributed expense	44,194
	Total operation of power plant....	$1,112,288
	Operation of Cars:	
18.	Superintendence of transportation.	$ 31,511
19.	Wages of conductors	1,080,236
20.	Wages of motormen	414,433
21.	Wages of miscel. car service men.	262,410
22.	Wages of car house men.....	68,714
23.	Car service supplies.....	32,453
24.	Miscel. car service expense.....	59,336
25.	Hired equipment	749,736
	Total operation of cars	$2,728,828
	General Expense:	
26.	Salaries of general officers and clerks	$ 275,442
27.	Printing and stationery	15,450
28.	Miscel. office expense	33,249
29.	Miscel. general expense.....	65,294
30.	Damages	222,784
31.	Legal expense due to damages	49,341
32.	Miscel. legal expense	107,016
33.	Insurance	42,934
	Total general expense	$ 811,510
	Grand total	$6,299,381

Since this expense applies to 64,584,600 car miles, the cost per car mile is closely ascertained, in cents per mile, for any of the above items of operating cost by multiplying the cost (expressed in millions of dollars) by 1.55. This gives us the following summary of cost:

	Per car mile, etc.
Maintenance of way and structures.....	1.22
Maintenance of equipment and power plant	1.33
Operation of power plant	1.72
Operation of cars	4.23
General expense	1.26
Grand total	9.76

There were 547,095 car miles per mile of all-tracks, or 712,000 car miles per mile "tracking" (1st, 2d and 3d track). The average speed of cars was 14.91 miles. Each passenger averaged 43,050 miles during the year.

Maintenance of cars and electrical equipment on cars cost $562,499, but this does not include $158,150 of "shop expense" and "undistributed expense," about 70 per cent of which should apparently be charged to maintenance of rolling stock. It would seem, therefore, that maintenance of rolling stock cost about $675,000, which is only about 6 per cent of its first cost. This percentage will unquestionably increase greatly as the equipment grows older.

Item 25, "Hired Equipment," is an unexplained item, and is astonishingly large. Since no rolling stock other than that above described was in use, this Item 25 seems to be a matter of bookkeeping rather than of actual operating expense.

The very great cost of damages and legal expense is noteworthy.

Item 1, "Maintenance of Track and Roadway," amounts to $560,312, which is equivalent to $4,745 per mile of all-tracks. This seems, at first sight, like an exceedingly high cost. It should be remembered, however, that rail renewals under this enormous traffic must necessarily be very heavy. What rail renewals amounted to in 1908 is not reported, but in 1907 there were 21.4 miles of rails relaid in repairs, which is 23½ per cent of the operated "trackway" (1st, 2d and 3d track). If this were a fair average, it would indicate a life of rail equivalent to about 4¼ years, under a traffic of 712,000 car miles per mile of "trackway," or a total life of about 3,000,000 cars over each rail. If, however, we take all track (118 miles), the renewals were about 18 per cent, under a traffic of 547,095 car miles per mile of all-track. It is to be hoped that future reports will give the miles of rails in track relaid annually, so that accurate statistics as to rail wear under these conditions will be available.

The deduction is made in Gillette's "Handbook of Cost Data" that the average life of rails on steam roads in America is 1,600,000 cars, counting an engine and tender as equivalent to two cars.

Valuation of the Railways of Texas.

According to the report of the Railroad Commission of Texas for 1909, the total railway mileage was 12,373 miles of roadbed (or line) as of Oct. 31, 1909. The cost of reproduction new was estimated to be:

TABLE I.—VALUATION OF THE BEAUMONT & GREAT NORTHERN RAILROAD.
Trinity to Livingston, 33.45 miles.

Class Items.	Value.	Total value.	Value per mile of line.	Per cent.
Real estate—				
Right of way	$ 14,958.40			
Depot grounds	6,791.00			
Gravel lands	563.00	$ 22,312.40	$ 667.42	3.4
Graduation—				
Clearing and grubbing	18,318.15			
Earthwork	85,394.14			
Loose rock	1,948.00			
Solid rock	6,072.00			
Hauled embankment	2,600.00	114,332.29	3,420.05	17.9
Bridging—				
Foundation piling	270.00			
Cylinder piers	4,488.00			
Masonry in piers	2,937.00			
Steel trusses	21,255.75			
Trestle bridging	70,690.00			
Box drains	5,448.00			
Pipe drains	360.00	105,448.75	3,154.30	16.5
Main track—				
Ties	54,202.50			
Steel rails	91,525.24			
Joints, complete	9,591.25			
Spikes	5,764.50			
Laying and surfacing	16,713.00			
Railroad crossings	275.00	178,071.49	5,326.65	27.9
Sidings—				
Track	30,162.00			
Switches	3,450.00	33,612.00	1,005.40	5.3
Ballast—				
Gravel ballast and extra surfacing	41,145.00	41,145.00	1,230.70	6.4
Telegraph line (33 miles)	1,650.00	1,650.00	50.00	.3
Buildings—				
Passenger depots	2,250.00			
Freight depots	2,400.00			
Cotton platforms	150.00			
Section house	1,600.00			
Water stations	2,750.00			
Stock pens	400.00			
Coal chutes	500.00			
Tool house	35.00	10,085.00	301.60	1.6
Miscellaneous structures—				
Track scales	1,750.00			
Cattle guards	615.00			
Fencing	315.00			
Road crossings	262.00			
Signs	137.00	3,079.00	92.00	.5
Rolling stock and equipment	65,195.00	65,195.00	1,950.10	10.2
General property (sheet "C")	64,209.14	64,209.14	1,920.70	10.0
Totals	$639,145.57	$639,145.57	$19,118.92	100.0

	Per mile of line.
Roadbed, etc.	$13,044
General property	2,430
Equipment (rolling stock)	1,751
Total	$17,198

On June 30, 1909, the total track mileage was as follows:

	Miles.
Main line, branches and spurs	13,110.35
Yard track, sidings, etc.	3,231.15
Total	16,341.50

Unfortunately the report does not contain a summary of the detailed cost of reproduction. It is the practice of the Commission merely to report the detailed costs of lines valued during the preceding year.

Table I is fairly typical of the lines appraised, as of June 30, 1909. This line was 33.45 miles long, with 3.50 miles of yard track and sidings, making a total of 36.95 miles of track.

It will be noted that the appraised value of Texas railways is very low. (For comparison with the values of railways in other states, see the 1910 edition of Gillette's "Handbook of Cost Data.") Even the value of the rolling stock is abnormally low, being only $1,751 per mile of line. It is true that the traffic on Texas railways is light, but not as light as might be inferred from the low value placed on the rolling stock. For the year ending June 30, 1909, there were 426,931 ton-miles of freight per mile of line, which is about 45 per cent of the average for the whole United States. There were 3,220 train-miles per mile of line, which is equivalent to 8.8 trains per day both ways, or 4.4 trains each way, and this is about 75 per cent as many as the average for the United States. Therefore the value placed on the rolling stock appears to be considerably below half its cost of reproduction new, if the criteria furnished by valuations in other states are at all applicable.

Preliminary surveys have been started from Caldwell, Idaho, by Harold Williams, City Engineer of that place, for an electric railway to Roswell.

Method and Cost of Constructing Street Railway Track with Grouted Crushed Stone Foundation.

The following data are given by Mr. H. L. Weber, Chief Engineer, Columbus, Marion & Bucyrus Ry., Marion, O., in a paper presented to the Central Electric Railway Association, March 24, 1910:

A section of reconstructed track with a grouted, crushed-stone foundation was laid on Taylor St., Fort Wayne, Ind., in 1908, and I am informed by Frank M. Randall, city civil engineer, that the work is holding up well. The track was a single line, laid with 73-lb., 6-in. rail. During reconstruction it was necessary to excavate the street from 1 ft. to 3 ft., remove the old ties and rails and install the new material. During this work 50-ton interurban cars used the track under a 1½-hour schedule. There were also extra limited and express cars and a small city car service under a 15-minute headway. The city car service was at times delayed a few minutes, but the interurban cars had simply to operate under a slow order. A sufficient number of the old ties were removed so the excavation could be expeditiously done, and enough new ties were added to hold the rails to gage and make it safe under slow running. The tracks were then let down to the subgrade.

A trunk sewer had previously been constructed through a portion of the street. This portion was sub-drained with a 3-in. tile. All trenches were examined and if soft places were found or developed after a rain, they were filled with suitable material and rammed with the ordinary 45-lb. paver's rammer, manipulated by two laborers.

The outside of the rail, against the web, was filled in advance of the paving with a stiff concrete in the proportions of 1 part cement and 4 of sand. The 8 ins. of stone were put under the track in two 4-in. lifts. When the stone was in place, all the old ties were removed and the new ones were put in position. New rails were then laid. The track

was then thoroughly tamped to grade four times. The men commenced at one end and continued through the entire length of the line, and a close watch was kept on all portions for apparently soft places. When the tamping was completed the crushed-stone foundation was thoroughly grouted for a distance of 15 ins. on each side of each rail with a Portland cement grout of 1 part cement and 4 parts good sharp sand.

Over the sewer trench 6 x 8-in. x 8-ft. ties were used, for the rest of the track 6 x 8-in. x 7-ft. ties. At the suspended joints the ties were placed 20 in. centers. There were 30 ties to each 60-ft. rail, making the spacing practically 24 ins. It will be noticed that one-third more ties, but less concrete, are required by this method of construction. The space between the ties, from the base of the rail to the bottom of the ties, was filled with a very soft concrete, consisting of 1 part Portland cement, 2½ parts sand, 2½ parts gravel, the gravel containing the sand and 5 parts crushed stone. The concrete was thoroughly puddled so as to fill under the base of the rails and around the ties, thus giving a bearing surface equal to twice that of the ties. The space between the rails and for a distance of 1 ft. outside the rails was paved with brick, with a special block on the inside of the rail to form the flangeway. The itemized cost of the work is given in Table I.

TABLE I.—COST OF STREET RAILWAY TRACK.

Track work and material—	Per lin ft. of track.
Labor laying track and one-half excavation	$0.413
Ties	0.274
6-in., 73-lb. steel rails	0.700
Rail and cross bonds (compressed)	0.012
Bolts	0.004
Spikes	0.004
Splice bars	0.055
Total cost of track work per linear foot	$1.462
Track foundation, 8-in. crushed stone, grouted -	
Labor	$0.129
Stone delivered	0.231
Drain tile	0.011
Cement and sand for grouting	0.035
Total cost of foundation per linear foot	$0.406
Concrete foundation for paving—	
Labor, including one-half of the excavation	$0.336
Stone delivered	0.114
Cement	0.114
Sand	0.028
For use of tools	0.013
Total cost of paving foundation, per linear ft.	$0.605
Brick pavement—	
Labor	$0.111
Metropolitan paving block	0.505
Metropolitan special shapes	0.180
Cement	0.028
Sand	0.021
Track drains	0.005
Mixing boxes, etc	0.004
Total cost of pavement per linear ft.	$0.857
Grand total cost per linear foot	$3.328

Cost of concrete per cu. yd., $4.34.
Cost per sq. yd. of brick paving, including foundation complete, $1.946.
Length of track constructed, 2,332 lin. ft.
Brick pavement, 1,794 sq. yds.

Good Roads Convention in Montana.—A State Good Roads Convention is to be held at Billings, Mont., about June 15-20. Delegates are now being appointed from different sections of the state. The program of the convention has not as yet been completed, but it is expected that speakers of National repute will be present. It is also probable that short stretches of experimental highway will be built during the convention. As a result of this convention it is expected that the next session of the State Legislature will take up the matter of good roads. W. B. George, Billings, Mont., is Chairman of the Arrangement Committee and Mr. E. B. Camp, Billings, Mont., is chairman of the Program and Invitation Committee.

The city of Montclair, N. J., will vote on the expenditure of $1,500,000 for parks and playgrounds. This expenditure is to be spread over the next 10 years.

Unclassified and General Articles

Note: This section is devoted to methods and cost articles on construction work not properly coming under any of the preceding classifications.

A Discussion of the Supporting Power of Piles.*

Piles, whether of timber, concrete, steel or other material, sustain the superimposed load by acting either (a) as columns, more or less restrained; (b) as floats; or (c) as combinations of these two. Their supporting power, in each instance, is due to an entirely different series of phenomena, each of which must be separately considered in any endeavor to predetermine the ultimate supporting power of the pile.

Piles Acting as Columns.—A method of design has sometimes been employed where the bed of a waterway has been found to consist of solid rock, of drilling shallow holes a foot or more in depth, and placing blunt piles in these recesses with their tops carefully swaybraced and capped. The weight of the structure prevents damage from a certain variety of wave or tidal action, while the swaybracing is depended upon to prevent lateral motion and collapse of the structure as a whole. In this instance each pile acts entirely as a column, more or less restrained at or near the head, while the foot is practically free to turn and more nearly approaches the condition of a so-called "round-ended" strut.

In case the rock happens to be overlaid with a thin stratum of comparatively dense material, it is sometimes unnecessary to drill holes into the rock, dependence being placed upon the overlying stratum of soil to prevent lateral motion of the foot of each pile. Where the rock is of a shelving nature, this type of design must be studied with special care, as the slipping of the bottoms of the piles has been known to wreck the structure entirely. In an endeavor to prevent such action taking place, riprap has sometimes been deposited among the piles after they have been driven, but the added weight upon the material overlying the rock has been the probable cause of a subsequent sliding which moved the bottoms of the piles.

Where a stratum of hardpan exists, it serves in practically the same capacity as a rock bottom, so far as affording sufficient support for the piles is concerned. Because the latter are usually made to penetrate the hardpan to a limited extent, they receive some lateral restraint at the lower ends, and need no longer to be computed as "round-ended" members, but may be considered as struts with square ends.

In this connection, attention is called to the fact that the greatest care should be employed in driving piles, which are expected to rest on bed rock or penetrate slightly a stratum of hardpan, in order to prevent shattering or crushing the bottom of wooden or concrete piles, or the permanent bending or curling of the lower ends of metal piles. Otherwise, the supporting power of the member may be seriously impaired. More damage has probably been done by "overdriving" under such conditions than has been caused by settlement or other trouble from underdriving.

When, as is usually the case, the soil is composed of strata of different consistencies, it is customary to endeavor to drive the piles so that their points will penetrate a stratum which is firmer and offers more resistance to driving than those which lie above it. Under such circumstances, the lower end of each pile receives a considerable restraint, varying with the consistency of the soil, and it has been found that wooden piles driven in such soft material as Hudson River silt will break off, in case of trouble, approximately at the mud line. It is evident that such piles may be considered as fully restrained members, so far as the bottom of the pile is concerned, whenever they penetrate a sufficient distance into a firm stratum. Experiments can well be made and experience recited to determine the necessary penetration required to produce full restraint in different soils under different degrees of saturation. Experience with telegraph poles, and the few reported examples of pile failures of this type seem to show that only a relatively short length of penetration is necessary. It would be a very easy matter, where piles are being driven for a trestle across a swamp, with varying degrees of consistency and humidity of the soil, ranging from the firm material on the bank to the soft material at the center, to use a block and fall for actual tests of a number of piles to ascertain the resistance offered in the way above mentioned. The amount of this resistance should be measured, from time to time, over a period of several days, together with the deflection produced at several points along the pile, so as to ascertain the shape of the bent member and deduce its curve at the bottom for each penetration, kind of soil and lateral force.

The amount, stiffness and other characteristics of the swaybracing required near the top of a pile, when driven under each of the conditions above described, has a very great influence on its supporting power, and must therefore always be considered in computing this factor. The usual rules of diagonal bracing for bridge portals are entirely applicable to such conditions. The amount of natural curvature in the pile is also a factor which must be considered, together with the amount of flexure produced after the pile is driven by forcibly drawing the heads over out of their natural locations, to properly line poorly driven piles for capping or other similar purposes. Two-inch new hemp rope in a four-part tackle has been broken in such an effort, and the resulting bending stresses produced in the pile must have been correspondingly large.

Where dependence for the supporting power of a pile is placed upon a deep-lying firm stratum, both theory and experience have shown that the depth of the stratum below the surface has an appreciable effect on the actual supporting power afforded the bottom of the pile. A thorough investigation of the literature on the subject discloses so few experiments and so little information relating to this important topic, that accurate tests are exceedingly desirable, and every opportunity of securing accurate data should be embraced. In order to prevent complications arising through the action of friction on the sides of piles, the tests can probably best be made by first carefully sinking a large pipe, and, after the soil has resumed its natural condition, inserting through this pipe a heavy timber with a blunt cap just large enough to pass through to the earth to be tested. A platform at the upper end of the timber can then be loaded and accurate observations made to determine the compressibility of the soil in amount and rate under different loads. The latter should be alternately increased and decreased to ascertain whether any elasticity exists, and the experiment should be continued over several days or weeks, in order to ascertain whether the special soil under examination possesses any characteristic comparable with the viscosity of certain materials. Pipes and plungers of several sizes should also be employed. The few experiments which have been made, and a study of the records of load tests of piles, seems to show that soils possess each of the three qualities previously mentioned, viz., compressibility, elasticity and viscosity; and it is only after accurate information is obtained regarding each of these three items that the actual supporting power and the amount of settlement, which is to be expected in any given instance, can be computed.

*A paper by E. P. Goodrich, before the American Railway Engineering and Maintenance of Way Association.

The pipe should be sunk by dry methods, and accurate data secured of the weight per cubic foot, amount of humidity, and internal friction coefficient peculiar to each varying depth and kind of soil. Having ascertained these items, a further examination of them by methods similar, for example, to those used by the writer,[2] should be made, with varying amounts of water in combination, to investigate the possible effects which may be expected with changes in the amount of ground water present under any foundation. Piles which were considered entirely satisfactory, driven into a stratum of firm clay, have been known to become displaced to the extent of several feet even after some years of satisfactory service, because of a change in the amount of water in the clay stratum, which caused a marked reduction in its friction coefficient, so that the clay acted as a lubricant, the superimposed strata squeezing it aside and sliding upon it, carrying the piles downward and sideways to varying distances.

Since a pile must displace the soil through which it is driven, the latter must either become considerably compressed or actually move aside to allow the pile to take its proper position. This compression in itself changes the nature of the soil in many instances to such an extent that while piles which have been driven with a large spacing have been found to settle badly, other piles under the same conditions with a closer spacing have been found entirely satisfactory. Reference is now made solely to the action near the point of the pile with regard to the supporting power afforded, and has no relation to the shape of the pile above this point, whether the member be straight or tapered.

For piles which act as columns under any of the conditions above described, the cylinder is probably the most efficient shape which can be employed for separate piles, while square or rectangular sections are best for sheet piling of timber or concrete. In the case of sheet piles, special metal shapes may be employed advantageously, because the supporting power is not involved then to any appreciable extent.

Piles Acting as Floats.—Where a pile is placed so that its tip does not rest upon nor penetrate a supporting stratum, the resistance which it offers to superimposed loads is due to the frictional resistance between the surface of the pile and the surrounding soil. In any endeavor to ascertain the amount of this frictional resistance through other than experimental methods which involve the piles themselves and which are very difficult of execution, the general conditions involved in the problem of earth pressures must be studied.

The cohesion which characterizes solid bodies from the point of view of the physicist exists in soils under ordinary conditions only to a limited extent. Few investigators have given this subject any study, but the best discussion in English is contained in Prelini's book on Earth Slopes, Retaining Walls and Dams. While a rigorous discussion must include the effect of cohesion, it has been the usual practice to ignore this element in the problem, both because of the mathematical difficulties introduced by its inclusion in formulas and because of its widely varying nature due to changes in the degree of saturation and in the compression produced by driving adjacent piles or by similar causes. Rankine's celebrated discussions consider earth only as a granular mass, and his deductions are open to criticism since the results obtained differ from those of actual experiment, the difference being due to his omission of cohesion and because most engineers employ in his formulas the angles of surface slope, which the writer's experiments[3] have shown are quite different from those of the internal friction of the material. The latter should obviously be used for all earth pressure computations and give results by using Rankin's formulas, which are very closely in accord with the results of properly conducted experiments. When the angle of internal friction is employed, the effect of cohesion seems to be automatically included, so that complicated mathematical conditions are not necessary.

Under relatively heavy pressures and a varying degree of saturation depending upon the material, almost every variety of soil discloses phenomena, which can be most easily explained on the assumption of the existence of a sort of viscosity, such as is observed even in solids of high cohesive strength.[4]

Tests of the compressibility of earths show a certain amount of elastic deformation, of course always in combination with a large amount of permanent set, the elastic reaction being very small in dry sand and relatively very large in garden soil. In a purely granular mass devoid of cohesion and disclosing no elastic reaction, a pile could be driven only by an absolute displacement of material, and the resulting pressures against the displacing body would be purely those due to the weight of the material above any given area of the displacing body. Where the material, however, is compressible and exhibits any elastic properties it is possible that the pressures exerted against the displacing mass may be greater than under the conditions above mentioned. Finally any material which is of a viscous nature will tend to shift, so that the pressures which might have been produced against the surface of such a displacing body as a pile would be entirely altered with lapse of time, in some cases increasing and in others decreasing. For example, a pile of slightly irregular surface would displace the material, so that voids would be left adjoining the hollows in the surface of the solid into which the viscous material would ultimately flow and exert a greatly increased resistance to subsequent motion. This is the usual phenomenon observed under most conditions with regard to piles. On the other hand, where considerable elasticity exists in a soil, in combination with a large compressibility, the lateral pressures immediately after the displacement of the material by the solid are actually greater than exist at later periods after the surrounding material has had an opportunity to flow slightly away from the penetrating body, so as to readjust and equalize the stresses throughout the whole mass. Occasionally phenomena which are traceable to this condition have been encountered in connection with pile driving observations in which a pile showed a large resistance to driving and subsequently settled through the surrounding soil. This phenomenon is not to be confused with that often observed in which settlement takes place, due to the compression of deeply underlying strata, into which the pile and its surrounding earth settle en masse.

Similar changes of the lateral friction and attending lateral pressure may also be due to vibration, which may produce effects similar to those observed when a pile of irregular shape is driven and voids are produced, thus reducing the actual area of contact. Vibration may also expedite the viscous action, the readjustment in pressures taking place more rapidly and to a greater extent, causing the resulting frictional resistance to fall below the necessary requirements. Changes in the humidity of the soil are also apt to produce changes in the lateral pressures. This is sometimes caused by actual changes in the coefficient of sliding friction between the solid mass and the soil. Again it may be due to the fact that the lateral pressure will vary with the coefficient of internal friction, as indicated by the writer's experiments. In the last paragraph it was explained how a reduction in pressure may be produced through viscous action. An actual increase in pressure may also be developed through a readjustment of stresses caused by the displacement of soil by driving other piles in the vicinity.

While considering increases of pressure, the well known arch action must not be overlooked, especially with non-viscous materials. This arch action serves to prevent the full theoretical lateral stresses, which will only be produced where a marked viscosity exists. Arch action also influences the upward pressure against the bottom of a pile and is indirectly the cause of carrying down of a group of piles by a single overloaded one.

Every one familiar with the phenomena of pile driving is aware of the considerable changes which take place, especially in the interval immediately after the driving of the pile. The writer has observed increases of resistance amounting to over 1,000 per cent within twenty-four hours. His investigations have discovered practically no data in regard to this phenomenon, which is universal in effect and which absolutely governs the ultimate supporting power of a pile, but is ignored in every pile formula with which he is acquainted. It seems to be possible to collect data from a comprehensive series of experiments with different kinds of soils, and at very little cost, by simply measuring the resistance offered by several piles, in terms of any pile formula, where the soil conditions had been previously ascertained. Comparisons between individual cases will be much more difficult to reduce to any proper basis upon which to draw conclusions with regard to different soils than is the case with regard to the time rate of change of pressure for any special pile in a known soil, which can be even more easily determined and is of equally great value. It is strongly recommended that such data be collected.

Piles as Combined Columns and Floats.—In making computations of pile resistance, the course is often pursued of computing independently the supporting power of the soil at the point of the pile and the frictional resistance offered by the sides. This is done on the assumption that the two elements which correspond to the coefficients of elasticity are equal. It is needless to say that this is rarely the case. Other investigators treat the problem as if the bottom of the pile were provided with a long tapering point, so that the whole phenomenon is one of frictional resistance, which later may vary from point to point along the pile surface due to variation in the strata penetrated. That a compressed earth point actually exists under the bottom of a blunt pile has been practically demonstrated to the writer's satisfaction by his observations not only in the case of the model with a glass side,[5] but also in the case of full sized models driven in boxes of earth, and from excavation made under the points of actual piles. Theoretically each change in the slope of the pile surface, as well as each change in the character of the surrounding soil, produces a variation in the unit resistance. That the theoretical conditions approximate very closely to those actually existing in nature has been demonstrated in several instances, notably in the experiments of Stern, described in "Das Problem der Pfahbelastung."

The Forces Acting on Piles.—Under any conditions in which piles act as columns, both the unit compressive strength of the material and its bending strength are involved. Every pile driving specification should give the maximum unit compressive stress to be allowed and the load whch may be carried, whenever the pile acts as a column. For this information it is necessary only to turn to the experiments made by engineering laboratories. It is a difficult matter to arrange any pile driving formula to take account of these items, but manifestly an ideal formula should do so. The only trouble with laboratory experiments is in their wide difference from practical conditions. In the laboratory an effort is usually made to simplify conditions to the utmost, so as to be able to change but a single condition at a time and thus measure its effect upon the general problem. In the field innumerable extraneous conditions enter to complicate matters, so that laboratory data are to be employed with this point constantly in mind. However, with a properly equipped laboratory it would be possible to make actual tests with a large number of stock piles, one end of the piles to be bedded in earth to varying depths, so as to afford varying degrees of restraint or the tests might be made with square ends and the restraint provided by means of steel springs or other equivalent devices. A very large number of such experiments would be

[2]Lateral Earth Pressures and Related Phenomena, by E. P. Goodrich, Trans. Am. Soc. C. E., Vol. 53, p. 272, Dec., 1904.

[3]See preceding footnote.

[4]See article by Ira H. Woolson, Eng. News, Vol. 54, p. 459, Nov. 2, 1905.

[5]The Supporting Power of Piles, by E. P. Goodrich, Trans. Am. Soc. C. E., Vol. 48, p. 180, Aug., 1902.

necessary to ascertain true averages under different conditions or what is even more important the extreme range of strength secured and the average variation from the mean. It is only from a number of results that the measure of their accuracy can be determined either theoretically or practically. On the basis of such laboratory tests only a very few comparative field tests would be needed to determine actual conditions and hence what sort of a formula is required and its method of application.

A close approach can doubtless be made to the laboratory work above described by means of indirect experimental evidence and its application in purely theoretical mathematical formulas. For example, the writer always makes use of his experiments concerning the compressibility and elasticity of various soils with various degrees of saturation to determine in any special case whether the earth pressure initially developed will increase or decrease with the lapse of time. The actual lateral pressures to be expected are computed by the writer on the basis of his experiments with the shallow cylinder described in "Lateral Earth Pressures and Related Phenomena." These results are checked as far as possible in individual cases by making the described experiments to determine the internal friction of the earth. With this data available, results can be predicted with a fair degree of precision except for the influence of the factor of viscosity. The writer knows of no experiments on viscosity except his own, which were performed only on clay and hence are too meager to obtain accurate results. This field is one in which the testing laboratory can be of material service to the engineer who has to do with the effects of lateral pressure in the design of pile foundations, masonry footings, retaining walls, earth embankments, etc.

A more elaborate experiment, which is sometimes performed and which gives results combining the effects of compressibility and viscosity, is the one described above for ascertaining the carrying capacity of the earth at varying depths. Information of this character is of considerable value because it often happens that the driving of a cluster of piles simply serves to consolidate the soil throughout a given region. The latter, in its turn, rests on underlying and supporting strata, which may actually be incapable of resisting the stresses developed, and hence settlement of the whole mass may occur. The result is often attributed to improper piling or pile driving, whereas the true causes are entirely different. This difficulty is often encountered where the piles are too short. On the other hand in the effort to overcome this particular source of trouble, needlessly long piles are employed. The aim should be to discover the proper length of pile to consolidate the soil to a depth at which the resistance is sufficient to support the superimposed loads, and where the character of the material is such that no viscous action will take place in any of the underlying strata.

Indirect Methods of Test.—The usual procedure, which was followed by those who desired to secure some measure of the forces which resisted the load upon a pile, has been by a theoretical consideration of the phenomena observed during the sinking or driving of the pile, especially of its action under the blows of a hammer. At best, however, such information will afford data which is applicable only at the time of driving, since it ignores entirely the subsequent changes in the condition of the earth, which have been shown to modify materially the supporting power of the pile. In the mathematical development of the subject, the general theory of impact is employed. With regard to the theoretical phenomena which would be expected during the impact of perfectly elastic materials, with perfect freedom of motion, there is no question; and even when the masses are not perfectly elastic with known coefficients of restitution the matter still remains comparatively simple. In the case of a hammer falling upon the head of a pile and of the pile moving under the effect of this blow, perfect freedom of motion is impossible. The hammer, if of the gravity type, is restrained from falling freely by the friction of the guides, that of the rope through the sheaves by the stiffness of the rope, by the friction of the drum of the hoisting engine, etc. It may be possible in any given case to determine the influence of each of these factors, and thus to ascertain the exact velocity and hence the corresponding momentum with which the hammer strikes the head of the pile. By assigning proper coefficients applicable to the size, shape and material of the hammer and of the pile, it is possible to determine the velocity of the latter at each instant during the impact, provided, however, that the actual masses moved by the hammer are known. Besides the pile itself, these masses must include an absolutely unknowable mass of soil. Granting, however, the possibility of assuming a proper value for the mass acted upon by the hammer and the further possibility of computing accurately its initial velocity, the problem again immediately enters the region of the unknown, because the real item concerning which knowledge is desired is the measure of the force which brings the pile to rest. If this force is assumed constant and the initial velocity and mass of the pile are known, as well as the distance which it travels, before it is brought to rest, then the measure of the force can be computed. There is every reason to believe, however, that this force is not a constant during the motion of the pile, and that it should vary in character and strength at different depths, with different degrees of compactness of soil, with the shape of pile and the velocity of its motion, is to be expected from the general theory of earth pressures. It was in an endeavor to solve some of the problems arising with regard to the kind of force acting that the writer devised his graphical method of indicating the action of a pile during the blow of the hammer.[6] In connection with this work amount of variation encountered in the several phenomena investigated and the limits of accuracy for the several devices employed.

As a result of his investigations, the writer is of the opinion that, as far as the phenomena connected with the driving of a pile are concerned, a very simple formula may be employed in connection with a coefficient, which may be determined for a special set of conditions with a fair degree of accuracy, but which must vary widely, in order to cover the great variety of conditions actually met in practice. This simple formula might be employed as the basis around which to arrange a number of dependent functions or coefficients, which should take account of the soil conditions, the length of pile acting as a column, etc. For a number of years the writer has been working intermittently toward the construction of such a formula, but so much experimental data yet remains to be obtained that no definite form has yet been decided upon. With the co-operation of your society, it might be possible to secure the necessary information which would then go far to settle a point which has been in controversy among engineers for a century or more, viz.: the actual supporting power of a pile under known conditions.

Factors Theoretically Essential to a Complete Pile Formula.—The following items should be known and included in a theoretically complete pile formula to be used for piles supported only by friction, the formula being based on data obtainable from the effect of the hammer on the pile and the subsequent action of the earth around the pile: (1) Weight of pile. (2) Weight of hammer. (3) Fall of hammer. (4) Coefficient of friction during fall. (5) Penetration of pile. (6) Spacing of piles. (7) Coefficient and factor for the compressibility of the soil and the effect of spacing. (8) Coefficient for the effect of the shape of the pile on the compression of the earth, etc. (9) Length of pile below ground surface. (10) Coefficients and factors to allow for subsequent changes in lateral pressure throughout the length of the pile. (11) Length of pile above ground. (12) Area of pile. (13) Coefficient and factors to govern column action and unit compressive stress on pile .

[6]The Supporting Power of Piles, by E. P. Goodrich, Trans. Am. Soc. C. E., Vol. 48, p. 180, Aug., 1902.

Tests Required.—The following items should receive attention and special tests be made with regard to them: (1) Lateral restraint afforded by soils of different kinds and degrees of saturation. (2) Lateral pressures exerted by different soils, etc. (3) Compressibility of different soils. (4) Elastic reaction produced by different soils. (5) Viscosity exhibited by different soils. (6) Effects of jar on each of these characteristics. (7) Effect of lapse of time on these characteristics.

LETTERS TO THE EDITOR.

Paving Bonds and Guarantees.

Sirs: At the recent meeting at Chicago of the "Convention for Standardizing Paving Specifications," the "Committee on Bonds, Guarantees and Uniform Bidding Blanks" made some excellent recommendations, but the writer feels that in some important particulars the tentative report, which was necessarily hastily drawn, suggests plans which are not to the best interests of municipalities.

The report suggests a rather arbitrary classification of the several different forms of pavements into different periods of guaranty. The report in this respect provided that "asphalt, bitulithic or bituminous macadam and wood block or other pavement, requiring special equipment to lay and maintain, and also such pavements as are of a patent or proprietary nature, new or more or less experimental in character, shall be required to be maintained for a period of five (5) years from the first day of July next following completion," while "Pavements composed of materials more durable in character, among which we would include stone blocks, vitrified brick and well established Portland cement concrete pavement, shall be required to be maintained for a period of one (1) year from the first day of July next following the completion."

The reference to "well established Portland cement concrete pavement" is ambiguous and contradictory. Under this classification provision is made for guaranty period of one year, while, the writer believes, all forms of Portland cement concrete street pavements, wearing surfaces, are presented as "of a patent or proprietary nature," under which the report suggests a guaranty term of five years. Surely this class of pavements has not been in sufficiently general or uniformly successful use for a sufficiently long term to put them on a more favorable basis than creosoted blocks, asphalt or bitulithic. In fact the modern Portland cement concrete pavement construction has been in vogue scarcely more than two years, and reports of pavements of this class laid within this period show that many of them, at least, have required heavy repairs in that short period.

On the other hand creosoted wood block pavements are pointed to, for instance, on Tremont street, Boston, which have been in successful use without repairs for nine years. There are hundreds of miles of asphalt pavement more than five years old, which are in perfect condition. Official reports from the cities of Pawtucket, R. I., and Cambridge, Mass., show that the bitulithic pavements which were first laid in those cities nine years ago have never needed nor required repairs and are still in perfect condition.

Doubtless pavements of all these classes laid more recently have required repairs, from one cause or another, and to a greater or less extent, but this may be said of any and every other form of engineering construction, pavement or otherwise.

The many cities which have found brick pavement to require extensive repairs in two or three years bear witness that, although pavements of this kind can be shown in good condition after ten years or more use, it is not a kind of pavement which should be treated more favorably, as to guaranty period, than other forms of pavement, with the exception of first-class granite or Medina sandstone blocks laid on concrete foundation.

There is a general and rapidly growing sentiment among municipal officials in favor of shortening ior eliminating the term of guaranty on all classes of pavement, which have been in use a sufficient term and have proven sufficiently successful to warrant classifying them as "standard."

As municipal engineers are becoming more and more efficient in the art of street paving, taken in connection with the fact that the services of consulting engineers, chemists and experts in the several paving fields are procurable on reasonable terms, it is a very serious question, if the time has not arrived when the guarantee on all standard pavements should not be reduced to one year, if not entirely eliminated and a fraction of the money now being expended for guarantees, surety company bonds, reserves and insurance be expended in improved construction and more rigid, intelligent and scientific inspection and the balance remain in the pockets of the taxpayers.

We believe that in the aggregate but a small per cent of the increased price paid the contractors, which they must exact on account of the guarantee, is expended in repairs to the pavements guaranteed. If this is correct, then the guaranty is not to the interest of the taxpayer.

Finally, whatever the guaranty period, the writer fails to see any justification for the arbitrary suggestion that it begin "the first day of July next following completion." If a contract is completed on July 2, why should a guaranty be arbitrarily required for a year longer than if completed two days before? Why not have the guaranty period begin in all cases with the completion of the work? This brings up a question, which should be, but seldom is, fairly and clearly stated in specifications, to-wit: "What is the date of completion and consequent beginning of the guaranty period, if any?" This is often fixed at the "date of final acceptance," and under this we have known of cases where the contract period has been extended for months because the city engineer or City Council were dilatory in "officially accepting" the work, although during all this period it has been in use by the public. In other cases we have known of the greater portion of the pavement having been laid, but a small portion deferred for a year or even two years because some underground work, out of the control of the paving contractors, has not been completed, and consequently "final acceptance" deferred. This is an unwarranted and unfair hardship on the contractor. The writer suggests the following for the careful consideration of municipal officials:

The date of completion shall be considered to mean the date that the completed pavement on the entire contract is opened to traffic and public use; and in cases where construction of a portion of the work is, for any cause, deferred later than the 31st of December of any year, the guaranty period on that portion, completed and opened to traffic and public use prior to December 31st, shall begin with the date the whole of the portion of the work constructed prior to December 31st was opened to public use, and on the portion on which the construction was deferred until the following year, the guaranty period shall date from the date such deferred construction is opened to such public use.

The committee's report suggests that in lieu of surety company bonds covering the guaranty period that 10 per cent of the contract price per square yard for pavement laid be retained by the city in cash covering the guaranty period. There are several serious objections to this.

First: Generally speaking, it must be admitted that paving contracts are being let at a very low margin of profit, so that such an onerous provision as the retaining of 10 per cent of the contract price for a term of five years would surely result either in the advance of contract prices in an amount nearly, if not entirely, equal to the cash retained, or in limiting competition to the very few paving contractors who are sufficiently strong to get financial credit to enable them to carry the obligation.

Second: Such a provision seriously raises the question of legality of assessments generally issued in payment of the work, the general conclusions of the courts having been that when the cost of maintenance is to be paid by the city at large, which is the general law on the subject, the charging of any part of the cost of maintenance into the special assessment levied to cover the cost of the construction renders the assessment void and uncollectable. Surely maintenance requirements which are so onerous in their provisions as to increase the contractor's price necessitate a direct charge in the assessment on account of maintenance which the law provides is to be paid for by the city at large and not assessed on the abutters. It hardly seems possible for any one seriously to claim that any contractor will be willing to take contracts with 10 per cent of his money held by the city for five years at as low a price as if he were able to use that capital in his business.

If a contractor lays an aggregate of 500,000 sq. yds. of pavement per year at an average price of $2.25 per sq. yd., the retaining of 10 per cent of the contract price would amount to $110,000 per annum, and in five years the aggregate cash retained by cities from his contracts would be $550,000. Ordinarily when cash has been retained by cities in the past they have allowed the contractor from 3 to 4 per cent interest, or approximately half the interest the contractor has to pay for the use of money, on which basis the loss of interest alone to the contractor, after he has been doing business on the above basis for five years, would be approximately $20,000 per annum. We believe there is no contractor who is to-day making a margin of net profit, after paying discount on municipal securities, interest on borrowed money, and other necessary general expenses, which would make it possible for him to stand this tax and loss in interest without a material increase in contract prices.

In the past a few cities, including New York, have retained a percentage of the contract price as security for pavement guaranty. We believe that such cities have almost, if not universally, paid much more for their pavement than other cities which accept a surety company's bond or exact no guaranty, have paid for the same kinds of pavement.

The writer believes if cities are unable to get satisfactory results under surety company's bond for the guaranty period, without making the bond so onerous as to itself increase the cost to the contractor, and consequently necessitating higher pavement prices, that they can most economically overcome the difficulty by engaging the very best expert service obtainable and giving close inspection of construction and provide no guarantee or a guarantee for a period of one year, which is sufficient time for imperfections in construction to develop.

It is a serious question if maintenance guaranties are not against public interest, even under the present generally adopted provision of surety company bond covering the guaranty period. Surely, the premiums on those bonds and the reserves which the prudent contractor must make to cover the contingent liability cost the contractor a very considerable amount which he must, and doubtless does, include in his contract price.

The committee's report develops that City Engineer Fendall of Baltimore has recommended the elimination of maintenance guaranties. This has already been adopted by a number of cities and officials of many others are seriously considering it. We have noticed that in cases where maintenance guaranties have been eliminated the contract prices have materially dropped. About two years ago the Supreme Court of the state of Alabama decided that any form of maintenance guaranty is illegal, following which Alabama cities adopted specifications eliminating the guarantee, the result being a material universal reduction in price for all classes of pavement..

If a system of no guaranty is adopted the city can protect itself in the case of proprietary or patented pavements by requiring the contractor to furnish the materials or wearing surface necessary for repairs at a certain price per square yard of repairs required including cuts made to reach underground service pipes for such term as the city may elect.

Very truly,
"PAVING CONTRACTOR."

Chicago, Ill., April 12, 1910.

The Minneapolis, St. Paul & Sault Ste Marie Ry. has had surveyors at work between Medford, Walsh County, North Dakota, and Drake, McHenry County, North Dakota, on a line which would bring about the direct shipment of grain from the central west portions of North Dakota to Duluth. As proposed this line will be about 160 miles in length and will pass through Devil's Lake. It goes through portions of Walsh, Nelson, Ramsey, Benson, Pierce and McHenry Counties.

Personals.

Mr. H. R. Safford has resigned his position as Chief Engineer of Maintenance of Way of the Illinois Central R. R. to go into the railway supply business.

Mr. James A. Brown has resigned his position as a Constructing Engineer in the Ordnance Department, U. S. Army, and will henceforth devote his time to general plant engineering, making a specialty of sloop equipment work.

Mr. Robert J. Potts, Assistant Professor of Civil Engineering at the Agricultural & Mechanical College of Texas, has been appointed Professor of Highway Engineering, a newly established branch of the Department of Civil Engineering at that college.

Mr. C. S. Davidson, a specialist in hydraulic and concrete work, has become associate with Mr. E. C. Crum, Civil Engineer and Constructor, Frederick, Md. They will continue to do all classes of municipal and railway engineering and constructing work under the firm name of Crum & Davidson, at the present offices of Mr. Crum in Frederick, Md.

Mr. A. W. Thompson, heretofore Chief Engineer of Maintenance of Way, Baltimore & Ohio R. R., has been promoted to Chief Engineer, inclusive of the Baltimore & Ohio Southwestern, succeeding Mr. A. M. Kinsman, who is relieved at his own request and appointed Consulting Engineer. Mr. Earl Stimson, heretofore Chief Engineer of Maintenance of Way at Cincinnati, O., succeeds Mr. Thompson.

Mr. Horace S. Baker, 1727 Chase Ave., Chicago, Ill., has been appointed Engineer of the Track Elevation Department of Chicago, to succeed Morris K. Trumbull, who resigned March 31, after holding the position ever since it was created three years ago. Mr. Trumbull returns to the Chicago & Western Indiana R. R., where he was formerly assistant to H. S. Lee, Chief Engineer. Mr. Baker until placed in the new position, was chief designer for Chicago city water works bureau. He has also been in the track elevation departments of the Western Indiana and of the Chicago & Northwestern Ry. He is a graduate of the Massachusetts Institute of Technology.

Catalogs Worth Having.

Engineers and contractors should have on file the latest catalogs of machines, tools and supplies that they use. In sending for catalogs reviewed or advertised in this paper, you will confer a favor on us if you will write directly to the advertisers and state that you saw the catalog mentioned in ENGINEERING-CONTRACTING. If you are in the market for tools, machinery or supplies, tell us and we will notify promptly the leading manufacturers.

American Concrete Systems.—Paper folder, 3½ x6¼ ins., 6 pp. American Concrete Co., 80 William St., New York, N. Y.

A folder telling of the adaptability of the various monolithic, steel, reinforced concrete products and systems owned and used by this company.

Hydraulic Mining Cartridge. — Paper, 6x6½ ins., 16 pp. The Hydraulic Mining Cartridge Co., 42 Broadway, New York, N. Y.

Gives a good description of a new substitute for explosives in coal mining.

Eclipse Concrete Mixer.—Paper, 6x9 ins., 16 pp. The Standard Scale & Supply Co., 23 N. Canal St., Chicago.

This booklet is gotten out by the company named to show their 1910 models with the latest improvements. The catalog is well illustrated and contains, besides the mixer, illustrations and descriptions of various types of steam and gasoline engines.

Pumps.—Paper, 3½x6 ins., 4 pp. The Barnes Mfg. Co., Mansfield, O.

This is a circular recently issued by the company. It shows their line of diaphram pumps, which consist of three sizes, namely, 2½-in., 3-in. and 4-in.

Cement.—Paper, 3½x6½ ins., 36 pp. The Superior Portland Cement Co., 1503-1513 Union Trust Bldg., Cincinnati, O.

A booklet which contains a good detailed description of the manufacture of Portland cement by this company.

Cement.—Paper, 3½x6¼ ins., 8 pp. Lehigh Portland Cement Co.

"The Future's Past" is the title of the booklet sent in by this company, and is a short argument, purposing to have been published in the indefinite future, regarding present day use of concrete.

Power From Coal.—Paper, 3½x6¼ ins., 12 pp. Electrical Testing Laboratories, 80th St. and East End Ave., New York City.

A booklet describing the measure of the value of coal to the manufacturer of power.

Hydrolithic Waterproofing.—Paper, 6x8¼ ins., 32 pp. The Waterproofing Co., 150 E. 36th St., New York.

A very good description of the application and advantages of hydrolithic cement, with illustrations, specifications and data interesting to engineers, contractors and architects.

Contract News Section

of

ENGINEERING-CONTRACTING

A Consolidation of ENGINEERING-CONTRACTING—CONTRACT NEWS—ENGINEERING WORLD—THE DIRT MOVER.

Containing Items of Interest to Railroad, Public Works and Other Contractors.

The Doings of the Week.

The principal railway construction contract of the week and the largest that has been let in the East for some time, has been secured by the Carter Construction Co., 184 La Salle Street, Chicago, Ill. This contract calls for the construction of the extension of the Western Maryland R. R. from Cumberland, Md., to Connellsville, Pa., a distance of 83 miles. Other railroad contracts of the week include the following: D. B. Lacy, Anniston, Ala., for 100,000 cu. yds. of grading for the Louisville & Nashville R. R. yards at Paris, Ky.; Kilpatrick Bros., Beatrice, Neb., for constructing a branch of the Union Pacific from Wamsutter, Wyo., to Craig, Colo.; Porter Bros., Spokane, Wash., for constructing a 3,400-ft. tunnel for the United Rys. of Portland, Ore.; W. J. Oliver, Knoxville, Tenn., for constructing the electric railway from Greenville to Spartanburg, S. C., for the Greenville & Spartanburg Electric Ry. Co., the contract amounting to about $750,000; and Kahmann & McMurry, 709 Sharp Bldg., Kansas City, Mo., for the grading work on the Menard end of the Frisco.—It looks now as though there was to be considerable new railroad construction work in New England in the near future. The Rhode Island Legislature has granted a charter to the Southern New England Ry., a subsidiary company of the Grand Trunk System, by which the latter will secure an entrance to Providence, R. I. As a result possibly of this, announcement has been made that the New York, New Haven & Hartford R. R. will at once proceed with plans to double-track the Air Line from New Haven to Boston and to construct the through route from New York to Sherbrooke, Que. In the meantime the Boston & Maine R. R. has had engineers in the field to look over a route for a branch line from Brattleboro, Vt., to Hinsdale, N. H., connecting two divisions of the road, and also to look over a route for a line from Windsor, Vt., to West Lebanon, N. H.—A fair sized dredging contract has just been let by the Water Commissioners of St. Paul, Minn. The contract calls for dredging about 1,500,000 cu. yds. mostly vegetation and peat from Vadnais Lake, and was awarded to the La Crosse Dredging Co., of Minneapolis, Minn.—The construction of 1,500-mile railway in Turkey is proposed by Americans who have recently been granted a concession by the Turkish Government. Manning, Maxwell & Moore, 85 Liberty St., New York City, are said to have the contract.—Senator Burton, Chairman of the National Waterways Commission, on Apr. 14 presented a minority report on the pending Senate bill which would appropriate about $52,000,000 for the improvement of rivers and harbors. His opposition to the bill related rather to the system than to the amount involved. He did not consider the sum large, but he felt that under present methods many injudicious and wasteful projects were sure to be included with many that are meritorious.—An association comprising 12 companies holding 22 contracts for over $55,000,000 worth of work on the New York State Barge Canal has been formed. The primary objects of the association are to take action on such legislation affecting barge canal construction work as shall in the opinion of the contractors, appear unwise; to properly discuss and consider work of such magnitude as the construction of this canal affords and to enable the heads of the various companies to visit the work being done by other companies and gain ideas as to management and methods.

New Water Power Bill.

One of the pet projects of the preceding and present government administrations has been legislation regarding water power sites. A bill regarding this, which seems to give the government powers wide enough to satisfy the most carping critic of the vested interests, has just been given favorable action by the House Committee on Interstate Commerce. As now framed the measure would give the federal government full control over the plans as well as the construction, maintenance of all such works and revocation of such contracts. It would make the approval of the War department a condition precedent to the building of all dams authorized to be constructed across a navigable stream. The bill would impose stringent restrictions upon dam privileges, including discretionary authority of the War department to require dam owners to maintain locks or similar structures. The owners would have to convey to the United States free of cost title for necessary land for the construction of locks and approaches and free use of water power.

Vote Dry and Get Water Works.

Virtue may be its own reward, but nevertheless a little town down in Ohio has also been rewarded with waterworks, a sewer system and electric lights as a result of its virtue. It seems that a wealthy resident of the town a year or so ago offered to install waterworks, sewerage and electric lights without cost to the town provided the citizens would vote out the saloons. This they did, and at the recent election the town again went dry by a vote of 162 to 97. The terms of the gift provide that the town shall continue dry for the next 50 years or the improvements will become the property of the heirs of the donor. According to press reports the offer also provides that all the houses in the town shall be painted white and shall have red tile roofs. It is further provided that all fences shall be replaced by hedges and that all trees shall be planted equal distances apart. Prohibitionists claim that the only reason the benighted 97 voted for saloons was due to the fact that they didn't want to paint their houses.

A New Central American Railroad.

A new railroad for Central America is proposed, and the interesting point about it is that it is to be built by the United States government. The road will be 274.4 miles long and will connect the city of Panama with David, a city on the Pacific coast in the province of Chiriquaz, Panama. Already the secretary of war has authorized the Panama R. R. Co., which is controlled by the U. S. government, to enter into a contract with the government of Panama for preliminary and location surveys. These will be made by the engineering force of the Panama R. R. In general the routes recommended by the Intercontinental Railroad Commission in 1893 will be followed. The surveys are to be completed in time so that when the next national assembly meets at Panama the United States will be ready to submit a proposition for the construction of this line as an extension of the present government owned Panama R. R. English, French and German capitalists stand ready to build this road, and the primary reason assigned for the taking up of the venture by the United States is that it will prevent the entrance of undue foreign influence into Panama, which would make necessary additional fortifications for the canal.

Railroad Construction in Oklahoma.

When Oklahoma became a state it adopted a constitution which contained a number of restrictions regarding the construction of new railroads in the state. As a result the active period of railroad building which had prevailed ceased, owing to the fact that outside capital could not be induced to invest because when the railroads were built they could not be sold. The Oklahoma Federated Commercial Clubs is making a determined effort to remedy these conditions and has taken steps toward having an election called to vote on amending the constitution to remove the restrictions regarding railroad building. It is stated that if the amendment carries 3,000 miles of railroad now projected will be constructed, and that within two years the state will benefit by the introduction of $75,000,000 of taxable railroad property. In the meantime the Farmers' Educational and Co-operative Union and the State Federation of Labor of Oklahoma are claiming that the railroads now operating in the state are out of reach of the people or the powers of the court of the state and will submit a petition to the voters proposing that a vote be taken at the November election to amend the constitution so as to provide a new commission of six members with power to construct and operate railroads in the name of the state.

Location surveys are now underway near the Cumberland River at Gainesboro, Tenn., for the projected line of the Tennessee, Alabama & Kentucky R. R., and it is said that construction work will be first started on that portion of the line. The road will be about 230 miles in length, 100 miles shorter than the shortest line from Louisville to Chattanooga. It will pass through Dunlap, Spencer, Sparta, Cookeville, Gainesboro, Tompkinsville, Edmonton and Hodgenville.

The Electric Light Co. of Pittsfield, Mass., has just made arrangements with the Stone & Webster Engineering Corporation of Boston, for an addition to the plant at Silver Lake in Pittsfield.

The Otis Co. of Ware, Mass., is preparing to blow up its old dam in the Chicopee River just above Three Rivers, Mass. This will be replaced with a new dam, located farther up stream, to avoid interference by the head water of the Ludlow associate dam.

Confirmed Reports by Engineers and Contractors

RAILROADS, POWER DEVELOPMENTS, LEVEES, DRAINAGE AND IRRIGATION WORKS.

Railroads—Steam and Electric.

ARKANSAS.

The Prescott, Reader & Fordyce R. R., which now has nine miles of standard gage line in operation, has had surveys made for 75 miles of additional line. The capital for construction has not been secured as yet, and the time for letting construction contracts is indefinite. W. B. Ferguson, Little Rock, Ark., is President.

GEORGIA.

The location work for the projected extension of the Rome & Northern R. R., from Gore to Tunnel Hill, Ga., has not been completed as yet. Construction contracts will probably be let in the next 30 days. The extension will be about 32 miles long. H. M. Smith, Rome, Ga., is Chief Engineer.

INDIANA.

The Alan Construction Co., Indianapolis, Ind., has the contract for constructing the road bed of the Beech Grove Traction Co., from the Maine County line, City of Indianapolis, to Beech Grove. The contract includes 10,000 cu. yds. of earth excavation and a small I-beam bridge 28 ft. long.

The Capital Circuit Traction Co. has made surveys for its projected line. The projected length is 170 miles and the route is through Greenfield, Noblesville, Lebanon, Danville, Martinsville, Franklin and Shelbyville, Ind., forming a circle. The capital for construction has not been secured as yet. John A. Shafer, 3725 North Illinois St., Indianapolis, Ind., is Chief Engineer, and J. N. Crabb, 926 Law Bldg., Indianapolis, Ind., is President.

KANSAS.

The Kansas Union Traction Co. has completed surveys for its projected 40-mile line from Parsons, Kan., to Coffeyville, Kan., passing through Altamont and Edna. The capital for construction has not been secured as yet and no date for awarding construction contracts has been determined on. Archer, Rollins & Co., Kansas City, Mo., are the engineers. Wm. A. Jones, Altamont, Kan., is President and Barney McDaniel, Altamont, is Secretary.

KENTUCKY.

Jas. Ward, Carbondale, Ill., has taken a subcontract from the Walsh Construction Co., Davenport, Ia., for work on the Louisville & Nashville R. R. near Madisonville, Ky. The work includes 100,000 cu. yds. earth excavation, and 40,000 cu. yds. rock excavation.

MARYLAND.

The Carter Construction Co., 184 LaSalle St., Chicago, Ill., has been awarded the contract for the construction of the extension of the Western Maryland R. R., from Cumberland, Md., to Connellsville, Pa., a distance of 83 miles.

OHIO.

J. C. Carland & Co., Toledo, O., as previously noted, have been awarded contracts by the Big Four Ry. for work at Miami and Middletown and for work at Cleveland for the Lake Shore Ry. for the Cleveland Belt Line. The work at Middletown for the Big Four Ry. includes 800,000 cu. yds. of earth excavation and the work at Cleveland requires a like amount. In addition the Cleveland work includes 20,000 cu. yds. of concrete masonry. Sub-contracts have been let to Carland & Monarty, Cleveland, A. S. Hecker, Cleveland, and George Maxfield, Middletown, O.

TEXAS.

The Texas Building Co., F. & M. Bank Bldg., Fort Worth, Tex., which has the contract for grading for the Brownwood North & South R. R., has 300,000 to 400,000 cu. yds. both way work between Brownwood and May, Texas to let; 75 per cent of this work is in the fields and can be handled with fresnos.

Harty & Ford, 307 Ecanlon Bldg., Houston, Tex., as previously mentioned in this paper, have the contract for constructing the Galveston & Houston Electric Ry. from Clear Creek to Brays Bayou, a distance of 18.6 miles. The contract includes 200,000 cu. yds. of earth excavation and a like amount of embankment. The contract is for the north section of this road and includes grading, fencing, clearing, grubbing and drain boxes, to be completed by Sept. 1st, 1910. The lower section (16.1 miles) of this road is contracted to J. C. Kelso of Galveston. The yardage for this section is about the same as on the Harty & Ford contract.

WISCONSIN.

The Prairie Farm & Southwestern Railway Co., which is projecting a railway from Prairie Farm, Wis., has adopted the name of "Badger Short Line," as the short name for the company. J. H. Thomas, formerly Chief Engineer of the Twin City & Lake Superior Ry. Co., has been put in charge of the engineering and has recently, with his corps, completed the survey. In a short time application will be made to the State Railway Commission for a permit, and soon after, actual construction will commence. The work possibly may be let out to contractors. J. De Wilde, Prairie Farm, Wis., is Secretary and Treasurer.

CANADA.

J. S. Hargrave Co., Ltd., Winnipeg, Man., as previously announced in this paper, has the contract for double tracking on the Canadian Pacific Ry. from Winnipeg, Man., to Portage La Prairie, Man. The contract includes 500,000 cu. yds. earth excavation, 300 cu. yds. of concrete masonry and 10,000 lin. ft. of piling.

The limit of time for submitting bids for the clearing, grading and bridge work on the extension of 31 miles (more or less) of the Algoma Central & Hudson Bay Ry., between Hawk, Lake Junction, A. C. & H. B. Ry., and Hobon, C. P. R., has been extended to noon, April 30th. Profile, specifications and form of tender may be seen at office of N. Coburn, Chief Engineer, A. C. & H. B. Ry., Sault Ste. Marie, Ont., to whom all tenders should be addressed.

Power Developments, Levees, Drainage and Irragition Works.

COLORADO.

The Lucania Tunnel & Mines Co., John McColl, Superintendent, Idaho Springs, Colo., will let a contract Apr. 20, for driving a rock tunnel 500 ft. long 8 ft. 8 in. in clear, 2½ miles north of Idaho Springs.

We are advised that the Boyd Lake Reservoir & Irrigation Co. has not as yet decided on full plans for its proposed work. The reservoir was built by B. D. Sanborn of Greeley, and turned over to the company nearly complete, and cement riprapping of the banks is all the work that will be undertaken at present. This work is estimated at $10,000 and will be done by the company's own force locally and bids will not be advertised for. The reservoir is a natural one, nearly four miles long, one mile wide and 60 ft. deep and does not require much artificial work. B. D. Sanborn, Greeley, is interested.

MASSACHUSETTS.

Coleman Bros., Boston, Mass., have been awarded the contract at $28,446 for surfacing the main portion of the Charles River Dam at Cambridge for the Charles River Basin Commission. Bids for this work were opened April 4 and the itemized bids received will be found under Contracts Let in this issue.

MINNESOTA.

Contracts for State ditch work, bids for which were opened April 15 at St. Paul, have been let as follows: No. 89, located in St. Louis County, Minn., contains 112,757 cu. yds. suitable dredge work, O. F. Doyle, at 8.9 cts. per cu. yd.; No. 93, located in Aitkin County, Minn., contains 65,569 cu. yds. suitable dredge work, Kohler Contracting Co., at 7.88 cts. per cu. yd.

Bids were opened April 11 by the Board of Water Commissioners of St. Paul, Minn., for dredging the West Arm of Vadnais Lake, situated about seven miles from the City of St. Paul, the work consisting of about 1,500,000 cu. yds., the material being mostly vegetation and peat. The La Crosse Dredging Co., 2103 Colfax ave., Minneapolis, Minn., was the low bidder at 13½ cts. per cu. yd.

NEW JERSEY.

The Newburgh Dredging Co., Newburgh, N. Y., was awarded the contract for dredging in the Shrewsbury River, N. J., at 26 cts. per cu. yd. The work is to be done for the U. S. Government and includes about 15,000 cu. yds. of earth excavation. The bids of 85 cts. and 97 cts. per cu. yd., received at the same time for dredging in the Passaic River were rejected as excessive.

OHIO.

Bids are asked by the Director of Public Service, Ashtabula, O., until noon, Apr. 27, for improving Ashtabula Creek at Ashtabula, according to the plans and specifications on file in his office. The work includes, approximately, 360,327 cu. yds. of earth excavation; 136,487 cu. yds. of rock excavation; 2,160 lin. ft. of "I" beam bulkhead. A. J. Richardson, Ashtabula, O., is Clerk Public Service Department.

TEXAS.

The J. W. Maxcy Co., H. de B. Forbes, General Superintendent, 301 West Broad St., Texarkana, Tex., has started work on its Bowie County road contract, which comprises the construction of about 50 miles of county road and about 10 miles of city streets. The J. W. Maxcy Co. want teams for slip and wheeler scraper work and might consider subletting a portion of the grading.

Bids are asked until noon, May 10, by the Commissioners of Brazoria County Drainage District No. 3, F. M. Ragland, Chairman, at office of County Judge, Angleton, Tex., for following work: Ditch No. 1, 497,394 cu. yds.; Ditch No. 2, 31,241 cu. yds.; Ditch No. 3, 20,788 cu. yds.; Ditch No. 4, 26,300 cu. yds.; Ditch No. 5, 35,228 cu. yds.; Ditch No. 6, 51,093 cu. yds.; Ditch No. 7, 104,327 cu. yds.; Ditch No. 8, 11,850 cu. yds.; No. 9, 17,001 cu. yds.; No. 10, 38,142 cu. yds.; cut-offs on slough, 26,660 cu. yds. Also for seven miles of slough to be cleared, wet excavation, 122,000 cu. yds. Plans and specifications may be seen at office of A. R. Leckie, Engineer in Charge, Bay City, Tex., and with T. W. Carlton, Alvin, Tex., and County Judge, Angleton, Tex. Bids will be received for whole work complete or for any division. Official advertisement will be found elsewhere in this issue.

ONTARIO.

Bids are asked until noon, April 27, by A. McArthur, Clerk of Council, 31 King St., Chatham, Ont., for constructing an outlet drainage work. The drainage work begins at the Chenal Ecarte in the Township of Dover, and continues in the bed or course of

Items Concerning Contractors and Their Work

RAILROADS, POWER DEVELOPMENTS, LEVEES, DRAINAGE AND IRRIGATION WORKS

(Confirmed Reports Continued.)

what is commonly known as Maxwell Creek, through parts of Dover and Chatham Township. The engineer's estimate (exclusive of bridges and incidental expenses) for excavating by dredge work, is about $31,400.

Bids are being asked by L. K. Jones, Secretary Department of Railways and canals, Ottawa, Ont., for two contracts for work on the Trent Canal. One of these contracts calls for the construction of works connected with Sec. 6 of the Ontario-Rice Lake Division and bids for it will be opened April 26. The contract calls for the construction of Sec. 4 of the Ontario-Rice Lake Division. Bids for this latter work will be opened May 5. Plans, specifications and the form of contract can be seen at the office of the Chief Engineer of the Department of Railways and Canals, Ottawa, and at the office of the Superintending Engineer, Trent Canal, Peterboro, Ont.

Alabama Notes.

FROM CORRESPONDENTS AND OTHER SOURCES.

The Birmingham Railway, Light & Power Co., of Birmingham, has applied to the City Council of that city for a franchise to build its Corey extension, connecting the lines at Ensley with the new city of Corey. The company will build a single or double track with overhead trolley wire, the work to be started immediately and completed within twelve months. The line is to extend from 27th street and Avenue E in a southwesterly direction to 34th street and Avenue C.

Residents of Attalla have applied to the City Council of Gadsden for a franchise from the city limits for a street car line. As proposed the line will connect Attalla and the new plants of the Southern Iron & Steel Co. at the city of Gadsden. It is estimated that the road will cost $100,000.

D. B. Lacy, Anniston, has been awarded the contract for grading the new Louisville & Nashville R. R. yards at Paris, Ky. The contract calls for 100,000 cu. yds. grading and amounts to about $55,000. Work is to be started at once.

Out of town capitalists have applied to the City Council of Gadsden for a franchise and propose to build a street car line to the top of Lookout mountain. It is the intention to connect the mountain with the steel plant, and make it possible for those employed at the big industry to have homes on the mountain.

Arkansas Notes.

FROM CORRESPONDENTS AND OTHER SOURCES.

The Ouachita Power Co. has an application before the State Board of Railroad Incorporators for permission to build a dam across the Ouachita river at or near Ross Ford.

The Marianna, Aubrey & Western R. R. Co. has been granted 18 months' additional time in which to complete its lines. The road is to extend from Marianna and intersect with the Missouri and North Arkansas R. R.

The project for extending the Arkansas, Louisiana & Gulf Ry. north from Hamburg to Hazen on Devalls Bluff, via Pine Bluff, has been revived and it is possible that construction work will be begun this summer. J. M. Parker, Hamburg, Ark., is Chief Engineer.

The Fort Smith & Van Buren Ry. Co. of Fort Smith, has been chartered with a capital stock of $250,000, the incorporators being Samuel McLoud, R. S. Robertson, W. D. Pratt, John C. Gardner and J. B. McDonough. The road will extend from Fort Smith to Van Buren on the opposite side of the Arkansas River.

California Notes.

FROM CORRESPONDENTS AND OTHER SOURCES.

All right of way has been secured for the proposed Modesto-Stockton electric line, and it is reported that the promoter, Morris Brackett, has secured the necessary construction capital in New York. O. B. Parkinson, Stockton, is attorney for Br. Brackett.

The Atchison, Topeka & Santa Fe Ry., H. C. Phillips, Chief Engineer, Los Angeles, is to establish a new division point at Riverbank in Stanislaus County. It is understood that this company will establish yards there capable of accommodating 2,000 cars. About $300,000 will be expended.

The Grant Brothers Construction Co., Los Angeles, is to resume work on the construction of the Southern Pacific branch line along the west coast of Mexico, which was discontinued some time ago. The road will run through a section of Mexico which at present has no railroad facilities, and will open this domain up to the trade of the United States, particularly California.

The Southern Pacific Ry. has commenced preliminary work on laying out new yards and building new depots at Stockton. The work will involve the expenditure of $500,000.

Erickson & Petterson, who have the Southern Pacific cut-off contract between Rocklin and Clipper Gap, have let the sub-contract to build the Dutch Ravine road to Joseph Correa, Jr. The road is about two miles long and the estimated cost is $15,000.

Plans have been completed for an electric railway connecting Hemet, San Jacinto and Moreno, and applications have been made to the towns of Hemet and San Jacinto and the Supervisors of Riverside County for franchises. The line is to be 35 miles long, and it is intended to operate it with storage battery cars. J. S. Jackson, of San Jacinto; H. E. Munn, R. J. Waters, of Los Angeles; H. E. Hubbard, of Redlands, are interested.

The Northern Electric Co., whose electric railway runs two miles from Gridley, is said to be considering building into that city. The plan proposed is to build from the main line at a point near Ord ranch, in a southwesterly direction, to the northern limits of the town near the Southern Pacific track.

Advices from Sacramento state that work is progressing all along the line of the Central California Traction Co. Track laying from the Sacramento end has begun and will continue until the line is completed. The grading crews are now in the vicinity of the Cosunnes River.

George West, of San Bernardino, has begun work at Fairview, Ariz., on his contract for double tracking the Santa Fe from that city to Ash Fork. This is the second Santa Fe contract he now is working on; the first extending from Barstow to Cottonwood, will be completed soon.

Colorado Notes.

FROM CORRESPONDENTS AND OTHER SOURCES.

Kilpatrick Bros., Beatrice, Neb., are reported to have the contract for constructing a branch of the Union Pacific from Wamsutter, Wyo., to Craig, Colo. It is said that the branch will be built this summer, and that some of the work has already been sublet to Reinhardt Bros.

C. A. Hull, of Salida, General Manager of the O. J. Mining & Development Co., has started excavation on the 3,000 ft. mining tunnel through Big Four mountain in the Cleora district, situated about three miles east of Salida. The amount of money to be spent in this enterprise is $100,000. The tunnel will pierce the base of the mountain, which is 1,000 feet high.

The Arbuckle Reservoir Co. has filed its articles of incorporation at Boulder. The company has a capital stock of $25,000, and its directors are: C. P. Howard, T. N. Callahan, A. L. Gibson, Joe Lee and J. D. Bashor, all of Longmont. The company was organized to acquire a system of reservoirs in Boulder County near the base of Long's Peak.

W. H. Everle, Denver, is planning to construct the Comanche-Kiowa irrigation system in Adams and Weld Counties. It will include the Wolfe and Baker reservoirs, Wolfe, Kiowa and Comanche ditches and irrigate 20,000 acres.

Construction work is under way on the Union Pacific branch line, which is to extend from LaSalle to Dacona, a distance of 25 miles.

The Kenefick, Quigley, Hoffman Co., who have the contract for constructing the De Weese irrigation project, as previously mentioned in these columns, have awarded a subcontract to Charles Dittmer & Co., of Pueblo, for the construction of a tunnel for the main canal through a mountain ridge near Grape Creek, four miles south of Canon City. This tunnel will be 1,600 ft. in length, and work has already been started.

The Denver, Laramie & Northwestern R. R. has completed the road bed for its extension from Milliken to Greeley, a distance of 12 miles. The steel is now on its way and track laying will be started by the company at once.

Final surveys are reported to have been started by the Arnold Co., Chicago, Ill., for the Paradox Valley R. R. The Pacific Construction Co., Carmon Layton, President, Montrose, is to construct the line.

The Denver Tramway Co. of Denver, through the Denver Realty Co. and others, is said to be purchasing considerable land along the terminals of the Moffat road, with the intention of ultimately extending its lines to Utah Junction.

Advices from Greeley state that the Farmers' Reservoir & Irrigation Co. will build the Speer canal, to become part of the Standley Lake system, to water 30,000 acres south of Greeley and cost $175,000.

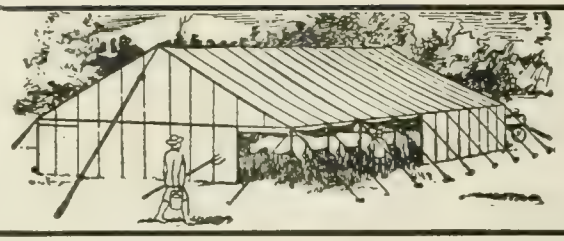
Fox & Smith, Florence, Colo., are working a large force on the construction of the Schaeffer dam and reservoir for the Beaver Land and Irrigation Co. and the work is progressing rapidly. A night shift has recently been put on.

The directors of the Greeley-Poudre Irrigation District have selected Louis R. Stockman, the Government Engineer who built the Shoshone dam, to superintend the building of Stove-Prairie dam. This will be a concrete dam; it will be 220 feet high and will cost $600,000.

Advices from Idaho Springs state that after a suspension of three months driving has been resumed in the breast of the Newhouse mining tunnel. The tunnel heading, which is now directly under the north slope of Nevadaville gulch above Central City, is 20,987 ft. in from the portal at Idaho Springs, and is 1,200 ft. below the surface.

The Argentine Tunnel Ry. Co. has been organized at Denver, with a capital stock of $50,000, for the purpose, it is said, of constructing a tunnel railroad from beneath the peak of Mount McClellan to Gray's peak, a distance of about four miles. The Argentine Central Ry., E. J. Tuttle, General Manager, Denver, Colo., is said to be back of the project.

Eastern capitalists are considering the construction of a railroad from Montrose through the Uncompahgre Valley, and have secured freight statistics from O. C. Skinner, President of the Chamber of Commerce of Montrose.



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MORRISON TENT & AWNING CO., 115-117 OLIVE STREET ST. LOUIS, MO.

Georgia Notes.

FROM CORRESPONDENTS AND OTHER SOURCES.

Surveys have been started by George Harris for a railroad to be built through the western portion of Carroll County, joining the Central of Georgia at Carrollton and extending twelve miles out to Bowdon.

The Bowdon R. R. Co. of Bowdon, has been incorporated with a capital stock of $60,000, and proposes to build a line to run in an easterly direction to some point on the Central of Georgia Railway in Carrol County or to some point on the Southern in Haralson County. The length is to be approximately 15 miles. The incorporators are: J. L. Lovvarn, H. J. Reaves, J. M. Barrow, R. M. Lovvarn, O. P. Bennett, John W. Eason, W. T. Bech, J. B. Fowler and W. T. Johnson, of Carroll County, and J. M. Terrell, of Merriwether, and Thomas J. Lovvarn and G. W. Taylor of Randolph County, Alabama.

Idaho Notes.

FROM CORRESPONDENTS AND OTHER SOURCES.

The Oregon Short Line R. R., Wm. Ashton, Chief Engineer, Salt Lake City, Utah, will probably start construction work about June 1 on a line from Ashton, Idaho to Driggs, a distance of 40 miles. Ashton, from where the branch is to be built, is fifty-one miles from Idaho Falls and 56 miles from Yellowstone Park station. It is the intention to begin work upon this branch, in so far as the grading is concerned, early this summer, and this part of the work will be completed this year ready for the ties and steel.

Illinois Notes.

FROM CORRESPONDENTS AND OTHER SOURCES.

The Wabash R. R., A. O. Cunningham, Chief Engineer, St. Louis, Mo., is said to be planning to rebuild the Shumway-Effingham line, abandoned for several years, and put it into use. It is also planned to improve the shops at Decatur, and to build new ones.

Track laying on the Woodstock-Sycamore Traction Co.'s line between Sycamore and Woodstock has been started at Sycamore. Over four miles of grading toward Genoa has been completed by the contractor, John Seymour, and it is expected to have the line in operation to Genoa before July 1.

The directors of the East St. Louis, Columbia & Waterloo Ry. have increased the capital stock of the company from $10,000 to $1,000,000, and have moved the offices of the company from Columbia to East St. Louis. It has been decided to begin work on the proposed electric road as soon as matters can be arranged. The work is to begin at East St. Louis, and the contracts for grading are to be let at once, it is said.

The Chicago, Rock Island & Pacific Ry., J. B. Berry, Chief Engineer, Chicago, Ill., is to expend $4,000,000 this year for laying new track, renewing old track, for ballasting roadbed, for steel ties and for enlargement of terminal facilities. The company has ordered 35,000 tons of steel rails, which will cost close to $1,000,000. This will lay over 260 miles of main line, and the rail which it supplants will be laid on the lighter divisions and on branch lines. About 100 miles of the main line from Chicago south will be laid with steel rails weighing 100 pounds to the yard. Up to date the company has decided upon the reballasting of the main line tracks, which will cost approximately $800,000.

Plans are in progress it is said for extending the Alton, Jacksonville & Peoria Ry. so that an entrance into St. Louis can be secured over the Alton bridge and the Burlington R. R. tracks. W. R. Heagler, Alton, is Chief Engineer.

Indiana Notes.

FROM CORRESPONDENTS AND OTHER SOURCES.

The Indianapolis, Newcastle & Toledo Traction Co. has applied to the Board of Public Works of Indianapolis for permission to enter the city by way of 19th St. and Parker Ave. to the end of the Brookside Ave. car line at Brookside Ave. and 18th St. The company expects to build tracks through a subway under Sherman drive and the Belt railroad track, then follow 19th St. and Parker Ave. to the Brookside Ave. line.

The construction of an electric line to connect Bremen and Mishawaka is proposed Omar E. Neff, Milford, Ind., is interested.

The Walsh Construction Co., Davenport, Ia., has six steam shovels at work on its contract for constructing the Evansville-Mt. Carmel line for the Big Four. Two shovels are working at Cynthiana, two at Evansville and two at Mt. Carmel. It is expected to have the work completed by November.

The Foulkes Contracting Co., of Terre Haute, has been incorporated with a capital stock of $25,000, and will engage in a general contracting business. The directors are: G. C. Foulkes, P. G. Lindeman and C. L. Foulkes.

The promoters of the proposed interurban line from Charleston to Paris by way of Ashmore have been making good progress with the preliminary work, and it is hoped to have the line in operation by July 1, next year. Charles H. Cox, Mattoon, is General Manager.

Connell Bros., Jamesville, Wis., have started work on their contract for erecting a new round house and machine shop at Nelson for the Chicago & Northwestern Ry. The contract amounts to about $65,000.

Active work securing the necessary right of way for the Illinois Traction system line from Morris to Joliet has been started, and it is hoped to get this done in season so that grading can be started by June 15. The line will parallel the Rock Island tracks, going from Morris through Minooka and then on to Joliet.

The Taylorville Street Ry. Co. of Taylorville, is to at once extend its line south to the Christian County Coal Co.'s mine.

Surveys for the foundation of the new Lake Shore & Michigan Southern Ry. tracks which are to be erected in Elkhart are reported to have been started. These shops will cost about $3,000,000 it is said. S. H. Scharschmidt is Resident Engineer at Elkhart.

The business men of Lynnville have formed an organization for the purpose of getting a traction line for the town. Lynnville is an inland town ten miles from Boonville, Ind., which is on the Southern R. R. and the terminus of the Evansville & Boonville traction line, and seven miles from Lynn station, on the Evansville and Indianapolis R. R. The Lynnville merchants hope to induce the Evansville & Boonville Co. to extend the traction line on to Lynnvillle.

Iowa Notes.

FROM CORRESPONDENTS AND OTHER SOURCES.

Harrington Bros., St. Louis, Mo., have started work near Denver Junction on the contract for grading on the extension of the Waterloo, Cedar Falls & Northern electric line.

The Chicago, Rock Island & Pacific Ry. is preparing to relay 88 miles of track on the Iowa division with 90-pound steel rails, which will be substituted for the ones of lighter weight now in use. The portions of the track to be relaid are between Davenport and West Liberty, and Van Meter and Adair. This is the first step in relaying the entire line in Iowa with 90-pound steel, which will be followed next year by building a second track from Iowa City, the present terminus of the double line, to Altoona, where connection will be made with the Keokuk line for Des Moines and Valley Junction. Mexican laborers will be used for the work.

The Chicago, Burlington & Quincy R. R. is to build a subway at North Main St. in Albia.

The Chicago Great Western Ry. is said to be planning to expend $2,000,000 the coming summer in improving its lines and service in Iowa, the improvements to consist of double tracks, new rails and motive power.

The Cedar Rapids Construction Co., E. J. C. Bealer, President, Cedar Rapids, has a number of contracts on the Iowa, Minnesota and Dakota Divisions of the Chicago, Rock Island & Pacific Ry.

Surveys for the extension of the Muscatine North & South Ry. have been completed and final estimates are now being made in the company's offices at Davenport. It is said that as soon as these are completed active construction work will be started.

Kansas Notes.

FROM CORRESPONDENTS AND OTHER SOURCES.

Residents of McCormick Camp, Fuller, Curranville and other towns lying between Frontenac and Mulberry, have asked the Pittsburg Electric Ry. Co., of Pittsburg, Kan., to extend its line from Frontenac to Mulberry.

The city of Wichita has voted to construct a $25,000 concrete dam across the Little Arkansas river at Central Ave.

The Arkansas Valley Interurban R. R., C. D. Bell, Chief Engineer, Wichita, is now considering plans for building the line northward from Wichita to Belle Plaine and other towns. Preliminary surveys have been made for such a line and steps are now being taken to secure bonuses along the route.

The Missouri Pacific Ry. as part of its improvement plans in Kansas, will put in sidings every five miles on its line between Atchison and Kansas City, every siding to be 6,000 ft. long. Eventually similar improvements will be made between Atchison and Omaha to accomomodate increased traffic.

Louisiana Notes.

FROM CORRESPONDENTS AND OTHER SOURCES.

The New Orleans Drainage Co., Warren B. Read, President, New Orleans, La., is reported to have purchased a 34,000 acre tract of land below Gentilly Terrace, near Lee Station, and ranging between five and seven miles from the heart of New Orleans. Part of the acreage was a sugar plantation at one time and all of it is high-class tillable land, although needing to be drained as a whole.

The Police Jury of Arcadia Parish, La., has adopted an ordinance creating a new drainage district to be known as the Crowley and Sixth Police Jury Ward Drainage District of Arcadia Parish. The new drainage district extends from Bayous Plaquemine, Brulee and Wikoff on the north to Bayou Quene de Tortus on the south, and includes within its limits the Ebenezer drainage district. P. S. Lovell, P. L. Lawrence, H. E. Lewis, Edmer Faulk and Clebert Simon are the commissioners.

Among those interested in a proposed electric railway in Algiers, La., franchise for which is to be sold shortly to the City of

New Orleans, are the following: Peter Lawton, ex-Governor Warmoth, J. J. Manson and J. B. Esnard, of New Orleans, La. The new line is to be operated in Algiers beginning at the ferry landing and running out Morgan and Patterson Sts. to the site of the immigration station to the cut-off at the parish line. It is intended to extend the line eventually to Grand Isle.

Michigan Notes.

FROM CORRESPONDENTS AND OTHER SOURCES.

The Detroit United Rys. Co., F. W. Brooks, General Manager, Detroit, Mich., is planning the expenditure of about $400,000 for constructing five miles of track for its new cross-town lines at Flint.

The construction of an electric railway from Ann Arbor to Flint by way of Fenton is being advocated by Father David L. Dillon of Fenton, and it is believed that the line will be constructed.

Minnesota Notes.

FROM CORRESPONDENTS AND OTHER SOURCES.

Application has been made to the Village Council of Hibbing for a franchise for a street railway line in Hibbing, running south on Second and Third Aves. to the village of Alice. The line will be operated with a gasoline motor car, and will cost in the neighborhood of $30,000. G. N. Butchard, John Sheehy and Frank Lavell are interested.

Duluth and the Ranges.

BY PETER E. MEAGHER.

C. J. A. Morris of the firm of Morris & Shepard, Railroad Contractors, was a caller at the office this week, and reported that they had their 85 miles on the Great Northern fairly well covered with sub-contractors, but, still, they could use two or three more outfits, if they could get them.

Arthur Mitchell, General Superintendent for MacArthur Brothers Co. in this section of the country, was a caller and reported everything in a very nice condition on their two large stripping jobs on the Iron Range near Duluth.

E. P. Arsneau, one of the old time contractors, spent a few days with us here recently. He was on his way home to Spokane, where he is going to rest up for a week or two. He then will look around for a steam shovel contract to keep him busy.

A. Nelson, the team contractor, was a caller here last week, and we secured him a subcontract from Morris & Shepard on the Great Northern Railroad in North Dakota, and he shipped out there with his outfit.

Andrew Perrin of the firm of Carl Hall & Co., contractors, was a visitor with us last week. They have two or three small jobs on the Duluth & Iron Range R. R. near Duluth.

All the mining companies and stripping Contractors in this vicinity made their laborers quite happy recently by declaring a voluntary increase of 10 per cent in their wages, same to take effect April 1. They have also cut out all Sunday work, and there will not be a shovel working, or a yard of stripping, or a ton of coal mined on that day. This was a very nice thing for these people to do, and will be appreciated not only by the men it directly affects, but also by those who do not have any interest in this question whatever, because we all know that a man who puts in six days hard work a week, is certainly entitled to one day of rest.

Michael Murphy and J. E. Erickson of the contracting firm of Murphy Brothers & Erickson were callers at this office recently. They are getting along very nicely on their subcontract from Foley, Welch & Stewart on the Soo Line, and expect to have the same completed about Aug. 1 this year.

Will Philips, representing the Taylor Iron & Steel Co., High Bridge N. J., manufacturers of Tisco manganese dipper teeth, was a visitor with us recently. He reported business in his line very good.

G. A. Jones of the contracting firm of Jones Bros. spent a day with us here last week. He came up from their large contract at Middletown, Ohio, to look over their contract of stripping the Crosby Mine at Nashwauk, Minn. He said that their work in the different sections of the country was in a very nice shape, and that the outlook for new work was very good.

J. H. Rooney of the Pastoret-Lawrence Co., contractors of this city, was a caller and reported that they had just been awarded a water works contract by the City of Eveleth, Minn., and would start on the same immediately.

Edward Kimball of Kimball Brothers, contractors, spent a couple of days with us last week, and reported that he had taken 150,000 yds. of work for Morris & Shepard on the Great Northern Railroad in North Dakota. He shipped two carloads of horses from this point, and will start on this work immediately.

R. S. Bloome & Co., paving contractors, were awarded a contract for street paving by the city of Eveleth last week, and will start on the same immediately.

P. W. Jones, equipment man from Minneapolis was a caller here the other day. The writer did not see him, as he was out of the city. Mr. Jones reported business very good in his line.

Hagstrom Brothers, contractors, were callers recently, and we shipped a carload of their horses to Morris & Shepard's work on the Great Northern Railroad in North Dakota.

The Northern Pacific and Great Northern Railroads are doing a great deal of construction and maintenance work in this vicinity, and in North Dakota. The G. N. Road are retieing its roadbed from Duluth to the Twin Cities, and the N. P. is laying heavier steel the same distance. The G. N. Railroad last week let a contract to A. Guthrie & Company, for about two hundred and ten miles of new work in the vicinity of Minot, N. Dak. The N. P. Railway Co. also let this same firm quite a bit of work in the same vicinity. This work is to be started on at once.

Winston-Dear Co., stripping contractors on the Iron Range near Duluth, recently purchased 100 12-yd. standard gauge dump cars used on their contract of stripping the Buffalo & Susquehanna Mine near Hibbing, Minn.

The writer has just returned from a trip to the Twin Cities and while there, called on most of the large contracting firms, and found practically all of them loaded with bunches of work, and figuring on quite a bit more. If there are any sub-contractors that are looking for steam shovel, rock, team or concrete work by addressing this office, we will be glad to put them in touch with people who can give them all the work that they will be able to take care of for this season at least.

The labor situation at Duluth and vicinity at the present time is in a very prosperous condition. There are a large number of men here, and there is also quite a demand for them. The wages offered are very good, and no man in this vicinity need be without work. The demand for men here is going to be very good all the coming season, as there is lots of work under way now, and more coming up.

Contractors and others, when in this vicinity are cordially invited to make the Labor and Equipment Office of Peter E. Meagher, 409 West Michigan street, their headquarters.

Missouri Notes.

FROM CORRESPONDENTS AND OTHER SOURCES.

The Springfield Traction Co., of Springfield, is planning a number of improvements for this year. These will include the construction of the north end cross-town line which will connect the Springfield Ave. and Doling Park car lines, and the construction of a subway under the north side Frisco tracks on Grant St., and the laying of new steel along the new route to be followed by Park and Atlantic St. line cars.

Officials of the St. Louis-Kansas City Electric Ry. Co., which was incorporated some time ago under the laws of Missouri, have announced that the engineering corps in the field has finished the final locating of 75 per cent of the road. The company proposes to construct a double track air line between St. Louis and Kansas City at the shortest distance possible, estimated at 250 miles. The line is to be in operation inside of two years, according to its promoters. D. C. Nevins, Kansas City, is President and E. D. Cauthorn is Chief Engineer.

The route has been secured and it is expected that active work will be started shortly on the projected electric railway from Springfield to Nixa, Christian County, surveys for which have been made by W. H. Schreiber, of Springfield.

Three-fourths of the right of way for the proposed motor line of the Springfield, Mt. Vernon & Southwestern Ry. is said to have been secured. This line is being promoted by F. C. Yentsch, of Mt. Vernon, Mo., and the route as now proposed includes Springfield, Halltown, Paris Springs, Mt. Vernon, Hoburg, Friestatt, Monett, Pierce City, Clarkson and Sarcoxie.

The City Council of St. Joseph has passed an ordinance granting the St. Joseph Street Ry. Co. a franchise to build a line on Third St., from Francis to Michel.

The Metropolitan Street Ry. Co., of Kansas City, has at work at present 500 men repairing tracks, roadways and paving, and this force will be kept steadily at work throughout the year, until all the track, roadways and paving are in first class condition. The company has also begun the construction of an extension to its Westport line from its 45th St. terminus to 55th St. at Kansas City.

St. Louis Items.

BY A. B. KOENIG.

The L. J. Smith Construction Co. have added two more 110-ton locomotives and one 85-ton steam shovel to their outfit in Kansas and Colorado.

J. J. Fitzgerald, Whitham, Mo., was in town the other day looking for work for his 16-team outfit.

H. C. Cass is in the market for work for his 17-team outfit. Leavenworth, Kas., or Carrollton, Mo., will catch him.

Costello Bros., who are doing the double track work on the Big Four R. R. between Shelby and Greenwich, Ohio, also 40 miles of double track work between Anderson and Indianapolis, Ind., have some nice team work to let on this job. They also have 6,000 yds. of work on the Missouri Pacific R. R. near Kirkwood, Mo., to let at elegant prices. Clay Pool bldg., Indianapolis, is where they are making their headquarters at present.

Burke & Joseph, Cape Girardeau, Mo., have 40,000 yds. of spur track on the Kansas City Southern at DuQueen, Ark., to let. One-third of this is earth, one-third loose rock and one-third solid rock. Write them to Cape Girardeau, Mo., or Ft. Smith, Ark.

J. J. McInerney writes us from Washington, Ia., that his 15-team outfit is idle at that place.

The Missouri Pacific R. R. Co. are going to let quite a lot of double track and betterment work in Missouri and Northern Arkansas on April 20th. E. F. Mitchell is Chief Engineer of Construction.

J. R. Morris, superintendent McArthur Bros.' Construction Co., came in from Chicago looking for some team outfits to put on their Shoshoni, Kirby extension of the Burlington R. R. in Wyoming.

John Marsch has resumed work on the Northwestern R. R. in Illinois.

Ransom & Cook, Ottawa, Kas., have two or three jobs on about 10,000 to 12,000 yds. each to let.

R. L. Whitney, bookkeeper for the L. J. Smith Construction Co. of Kansas City, spent last Saturday in St. Louis, and returned to Kansas City.

Foley Bros. bought five carloads of big mules here last Saturday and shipped them to their Grand Trunk Pacific work in Canada.

J. H. McFarlin, who is building the Springfield and Jacksonville Electric line,

has 387,000 yds. of fine team work to let on this line, also have one piece of steam shovel work. Address McFarlin at Jacksonville or Springfield, Ill.

Montana Notes.

FROM CORRESPONDENTS AND OTHER SOURCES.

Land agents of the Northern Pacific have been closing deals for right of way for the proposed N. P. line from Bridges into the Bear Creek coal fields. The Northern Pacific has had a crew of civil engineers in the Bear Creek fields and the Clarke Fork canyon over the bench into the Cooke City mining district.

Applications as follows have been filed with the Carey Land Act Board at Helena, for the creation of two Carey projects: R. A. Carnochan, of Butte, for the withdrawal of 23,000 acres in Madison and Beaverhead Counties for the Ruby river project, and Walter Winnett, of Lewistown, for the withdrawal of 17,500 acres in the Flatwillow country in Fergus County.

Grading has been begun on the extension of the Bozeman Interurban road from the Springs to Three Forks. Three outfits of graders are located between the Springs and Manhattan, and another, which will do the heaviest work on the line, has commenced at Logan. Besides these, there is a party engaged in clearing the roadway along the West Gallatin. It is hoped the grading will be completed by Aug. 15. With this extension the company is preparing to improve its terminal facilities at Bozeman and will build a spur to the Bozeman Milling Co.'s plant.

The Chambers of Commerce of Hamilton and Stevensville, Mont., are continuing their efforts to secure the construction of an electric railway between the two cities and it is believed that announcement giving definite plans for the work will be made soon. John Dowling and John McLaughlin, Stevensville, are interested.

The City of Kalispell has voted a franchise for the proposed Whitefish-Polson Electric Ry. Co.

New York Notes.

FROM CORRESPONDENTS AND OTHER SOURCES

The Elmira Water, Light & R. R. Co., of Elmira, has had surveys made with a view to extending the present Pennsylvania Ave. line to Southport Corners during the coming summer. The company is also said to be considering the construction of a belt line connecting the Franklin St. line and the Pennsylvania Ave. line.

Surveys have been started for the proposed electric railway from Bolivar to Wellsville, a distance of 15 miles. The proposed line will follow the route of the old B. & E. C. R. R. most of the way. The line is to start from the Shawmut R. R. station in Bolivar and end at the fairgrounds in Wellsville. E. M. Bedford, Portville, is engineer.

The Northern Central R. R., J. H. Nichol, Principal Assistant Engineer, Williamsport, Pa., is said to be planning to make extensive improvements to its yards at Penn Yan.

The directors of the Catskill Traction Co., W. C. Wood, President, Catskill, have decided that immediate steps should be taken for the construction of an extension to Cairo.

The Fonda, Johnstown & Gloversville R. R., F. A. Bagg, Chief Engineer, Gloversville, is to erect an addition to its shops in Gloversville. The electrifying of a portion of the steam road and also of the adoption of a gasoline motor car on the branch line between Gloversville and Broadalbin has been postponed for this year. The board of directors has decided to defer electrifying the steam road between Johnstown and Gloversville, and will spend the money increasing the facilities of the Gloversville shops.

Ohio Notes.

FROM CORRESPONDENTS AND OTHER SOURCES.

Committees have been appointed at Mt. Gilead, Mansfield and Marion to secure subscriptions for the surveys and reports on three proposed electric lines through Mt. Gilead. The attempt is being made to raise $5,000 for a comprehensive report on the possibility of constructing three roads: Mansfield, Mt. Gilead and Delaware; Galion, Mt. Gilead and Delaware; Marion, Mt. Gilead and Mt. Vernon. A. A. Whitney, Mt. Gilead; Benj. Waddell, Marion, and Charles Bechtel, Galion, O., are on the committee.

Capitalists of Campbell County, Ky., are reported to have offered a bonus to the Louisville, Lexington & Maysville Traction Co. to bring its line through the county, reaching Cincinnati by way of Newport.

The construction of an electric railway from Bellefontaine to Sidney, a distance of 22 miles, is proposed there. The line is also to be extended from Bellefontaine via West Mansfield and Marysville into Columbus. It is stated that the company has purchased the right of way between Bellefontaine and Sidney from the old Bellefontaine & Sidney Electric railway promoters, and that the work of constructing the road will start next month. H. F. Houghton, Indianapolis, Ind., General Superintendent of the Big Four Ry., and E. M. Costin, Cleveland, O., Division Superintendent, are reported to be interested.

The Toledo & Ohio Central Ry., D. C. Holtsberry, Division Engineer, Columbus, has had surveys made for a grade-crossing at Kenton. This will require about 1,500 ft. of new track and some line changes.

The Akron, Canton & Youngstown R. R., T. Z. Davie, President, Akron, has secured right of way between Akron and Magadore for its projected line, which is to be a steam road.

Surveys are underway for the proposed railroad from Jackson to Portsmouth. The proposed route leaves Jackson in the direction of Cove and passes near that point. It bears toward Mabee and passes near if not through Meldick's farm in Hamilton township, thence in the direction of Jackson Furnace to Sciotoville. W. H. Monahan, Jr., Jackson, O., is interested.

The Columbus, Urbana & Western Traction Co. of Columbus, is securing right of way for an extension of its line from Fishinger's Bridge, 8½ miles north of Columbus, to Dublin. The proposed extension is five miles long. Construction work may be started this fall.

Plans are under way for the extension of the Shaker Heights St. car line of the Cleveland Rys. Co., of Cleveland, two miles further out on the heights. The plan is to extend the line out Coventry Rd. from the intersection of Fairmount boulevard, as far as Attleboro Rd. This would call for four miles of new double track at an approximate cost of $150,000.

Oklahoma Notes.

FROM CORRESPONDENTS AND OTHER SOURCES.

The Business Men's Association of Perkins has accepted the proposition of L. J. Lampke, of New York City, mentioned in our last issue, to build an interurban railroad through that city. The association will give 40 acres of land and a $10,000 bonus.

The City Engineer's Department of Oklahoma City, as previously noted, is drafting plans and making drawings for a system of elevated railroad tracks in compliance with a recent request from the railroads entering Oklahoma City that a method whereby surface crossings may be eliminated be devised.

The Beaver Valley & Northwestern R. R., chartered in Oklahoma three years ago, to build a line from Oklahoma City to the Colorado coal fields, is reported to have made such progress with its promotion work that active construction will be started in Oklahoma this spring. A proposition has been made to the Commercial Club of Liberal, Kan., to locate a terminal at that city. J. M. Kerns, Sunset, Okla., is General Manager.

The Oklahoma City Junction Ry. Co., of Oklahoma City, which proposes to build a belt line in that city, connecting with the proposed packing house districts with the Katy and Rock Island lines, has filed amended articles of incorporation providing that offices shall be maintained in Oklahoma City and Chicago and fixing the capital stock at $1,000,000. The directors are: P. E. Wilson, C. C. McFarlane and E. F. Bisbee, of Chicago; D. T. Flynn, C. B. Ames and J. S. Agnew, of Oklahoma City.

The Okmulgee & Coalton R. R. Co., with principal offices at Okmulgee, has been chartered to build from Okmulgee to Coalton, at an estimated cost of $150,000. The company has a capital stock of $50,000, and the directors are: W. J. Cook, of Muskogee; C. S. Dawley, N. D. Boyd, T. J. Baker, Walter W. Martin, E. W. Gill, A. F. Seidler, Lee O. Voorhis, G. W. Mecklin, A. D. Kennedy, John A. Belford and R. D. Carpenter, of Okmulgee.

The Muskogee Transit Co. of Muskogee, recently organized by Muskogee and St. Louis capitalists, proposes the building and operating of a second electric street railway in Muskogee and constructing interurban lines to Tulsa, Sapulpa and intervening towns. It is planned to have the line in operation in the fall of 1911.

Engineers of the American Central Construction Co., F. P. Reed, President, are working between Olustee, Tex., and Vernon, Tex., on the proposed railroad to be built through Olustee.

The Chicago, Rock Island & Pacific Ry., A. B. Warner, District Engineer, Fort Worth, Tex., is to double the capacity of its yards in Oklahoma City. The additional tracks are to be placed in the eastern section of the city near the junction of the Rock Island and Missouri, Kansas & Texas lines and will extend for more than a mile to the east. The cost will aggregate $100,000.

Oregon Notes.

FROM CORRESPONDENTS AND OTHER SOURCES.

Porter Bros., Spokane, Wash., have been awarded the contract by the United Rys. Co., of Portland, for the construction of a tunnel through the ridge of hills separating Willamette and Tualatin, three miles beyond Burlington. The tunnel will be 3,400 ft. long.

The Oregon Trunk Line Ry., John F. Stevens, President, Portland, will, it is said, let contracts May 1 for the construction of 130 miles of the new road penetrating central and southern Oregon. The contract will involve construction to cost between $4,000,000 and $5,000,000.

Porter Bros., Spokane, Wash., have the contract for the first 110 miles of the Oregon Trunk Line Ry., which has its beginning near Deschutes, on the south bank of the Columbia river. The contract runs to a point midway between Madras and Bend, Oregon. The next division mapped out calls for 130 miles of road which takes the system into the Klamath Lake country in southern Oregon.

The City Council of Springfield has accepted the bonds of the Lane County Asset Co., of Eugene, to build its electric line into the city within 24 months. Work is to start at once.

Citizens of Fossil have appointed a committee with James S. Stewart, Fossil, as chairman, to secure the construction of a railroad south from Condon, via Mayville to Fossil, a distance of 20 miles. Efforts will be made to have the Harriman officials extend the line from Condon to Fossil, and if this plan fails the citizens will build the line themselves.

The Portland Railway, Light & Power Co. is considering extending its Woodlawn car line at Portland from its present terminal at East 8th and Dekum to East 27th St.

Twohy Bros., Portland, Ore., have started work on their contract for constructing the Pendleton-Yoakum line, and have construction camps established along the 14 miles of road. The work will take about six or eight months to complete.

Pennsylvania Notes.

FROM CORRESPONDENTS AND OTHER SOURCES.

John A. Kelly Co., Philadelphia, Pa., have work well under way on the contract for the Lehigh Valley R. R. to construct the roadway for four tracks between the lower Cata-

sauqua bridge and the Hokendauqua bridge. They will widen and build new abutments for the bridges, face the river with concrete walls and widen the roadbed between the two points requiring the entire summer to complete. The contract from the Gap bluff to the lower bridge is almost completed, a month's work of blasting at the bluff finishing the work. The four-track roadway along the river, from Allentown to Catasauqua is in place, and track laying will be done by the company.

The Somerset Street Ry. Co. has completed surveys and is arranging for the construction of its line connecting Somerset and Rockwood. The company is composed of Somerset capitalists.

The Allentown & Reading Transit Co. will rebuild its tracks on Walnut St., at Allentown from 12th to 17th Sts., as that street is to be paved.

Advices from Hanover state that construction work will probably be started at once on the projected electric railway between that place and Reisterstown, Md. The company has recently been chartered by the Maryland legislature and has a capital stock of $6,000,000. The construction of the line will require no heavy grading and there is only a few small bridges to be built. The incorporators named in the charter include James H. Wilson, Jacob A. Frederick Newton, S. Watts, John P. Bruce, Frank L. Hancock, Daniel F. Reiseweber and William L. Dietrich. The proposed route of the line is around or through Hampstead and Manchester, in Carroll County, and through Carroll County, in the state of Maryland, to the Maryland and Pennsylvania state line, and then in the state of Pennsylvania, to such points as its directors may determine.

A petition has been presented to councils of Williamsport asking that a franchise be granted the Williamsport Passenger Ry. Co. for an extension of its tracks on West Third St. to the West End for the accommodation, primarily, of the employes of the Sweets Steel Co.

The West Penn Rys. Co. is to expend $10,000 for straightening its Scottdale-Greensburg line at a point about three miles south of Mt. Pleasant. The road is also planning a line from Graham's crossing, Dunbar Township to Uniontown. Right of way for the greater part of the distance has been secured.

The Huntingdon, Lewistown & Juniata Valley Traction Co. has awarded contracts for the construction of its line from Mill Creek to Huntingdon and grading work is to be started at once. The contractors have erected shanties at Mill Creek for their laborers.

The York Rys. Co., of York, is considering the construction of a belt line in order to improve the service in the northwestern part of the city of York. It is proposed to build an extension to the Linden Ave. line on Carlisle Ave. and connect with the West York Ave., via Pennsylvania Ave. The improvement would require about one mile of new line.

The Blue Ridge Co. has been organized at Waynesboro with a capital stock of $15,000 for the purpose of building an extension of the Chambersburg, Greencastle & Waynesboro street railway from Pen-Mar to Blue Ridge Summit, a distance of four miles. The directors and officers are as follows: President, George B. Beaver; secretary, John G. Benedict; treasurer, W. B. Stottlemeyer; W. L. Minick, J. W. Wareheim, I. D. Sefton and J. C. Lane.

Construction work on the trolley line from Grove City to Slippery Rock is to be started shortly; the construction force for the work is reported as having been already secured by General Manager S. L. McClure of Grove City.

The New York Central & Hudson River R. R. has been rushing its third survey for its line from Franklin to Ellwood City.

Efforts are being made to interest capitalists of Blair and Huntingdon counties in the project of building a trolley line between Hollidaysburg and Huntingdon. The most desirable route between the capitals of the two counties seems to be by way of Frankstown, Canoe Creek, Point View, Williamsburg, Cove Forge, Carlim, Blair Four, Shaversville, Waterstreet, Alfarata Park, Alexandria, Petersburg and Shaver's Creek, a total distance of about 40 miles.

Texas Notes.

FROM CORRESPONDENTS AND OTHER SOURCES.

Indiana capitalists represented by E. L. Derryberry, of Dallas, are considering the construction of an interurban line between Dallas and Waco, which would pass through Waxahachie, Hillsboro and other towns on the most direct route.

The Texas & Pacific Ry., D. S. Wathen, Chief Engineer, Dallas, Texas, is to improve its roadbed and will, it is said, place several steam shovels at work on its eastern division.

Construction work is to be started this month on the projected line of the Quanah, Seymour, Dublin & Rockport R. R. The company is said to have been promised bonuses of over $1,000,000 for the new line which is to extend from North Texas to the coast, a distance of 700 miles. As projected the line will traverse the following counties: Hardeman, Wilbarger, Foard, Baylor, Throckmorton, Young, Stevens, Travis, Hamilton, Coryell, Burnet, Williamson, Caldwell, Conzales, DeWitt, Victoria and Calhoun. L. E. Walker, Austin, is President.

The North American Dredging Co., Galveston, has been awarded the contract by Galveston County for filling the causeway road from the Galveston city limits to the island end of the causeway site to 10 ft. The filling of the interurban right of way strip adjoining the county road is now under way by the same contractor and both jobs will be pushed to an early completion.

The Business League of Austin is considering a proposition of W. H. Caton, a railroad constructing engineer of Vinita, Okla., for the building of a railroad from Austin to Fredericksburg. According to preliminary plans it is proposed to form a construction company from people along the line to build the road, which will cost between $17,000 and $18,000 per mile.

The Dumont-Holmes Steel Concrete Co., of Chicago, Ill., whose propositions to replace the old dâm in the Colorado river with a new concrete structure, was accepted at a recent election, is planning to start work within 60 days. The proposed improvement will cost about $1,000,000.

The Stephenville, North & South Texas Ry. has been purchased by the St. Louis Southwestern Ry., and the line of the latter road will be extended to Gatesville, where a connection will be made. M. L. Lynch, Tyler, Texas, is Chief Engineer of the St. Louis Southwestern Ry.

A meeting of the stockholders of the Quanah, Acme & Pacific Ry., which at present has 43 miles of line, was held April 19 to take formal action on the plans to extend the line from Paducah southwest to El Paso, a distance of 425 miles. C. E. Ensminger, Quanah, is General Manager.

According to a statement at Austin of Edwin Hawley, chairman of the Board of Directors of the Missouri, Kansas & Texas Ry., plans have been adopted for double-tracking the main line between Dallas and Parsons, Kan., 380 miles. It is reported that the Missouri, Kansas and Texas will extend its San Antonio line south to Kingsville, about 160 miles, to connect with the Frisco's new line to Mexico. A. M. Acheson, Dallas, Tex., is Chief Engineer.

The Southern Lumber Co. is obtaining right of way for a road from a point in Caddo Parish, La., to Jefferson, Tex. While this road will be constructed primarily for the purpose of utilizing a large tract of timber which it will penetrate, it will also perform a regular freight and passenger service, it is stated.

The Charles Clarke Co., Galveston, has completed over 1,500 ft. of the base of the seawall being built at Fort Travis. This seawall is being built for the U. S. government and when complete will be 2,563 ft. in length, resting on round and sheet piling and in addition there will be a retaining wall to protect the filling of the reservation which will be 4,310 ft. in length.

The St. Louis, Brownsville & Mexico Ry. will extend the Buckeye spur seven miles, making a total length of sixteen miles for the spur, from the Tres Palacio's Rice and Irrigation Co. to Collegeport. E. C. Burgess, Kingsville is Engineer of Construction, S. L. B. & M. Ry.

The Atchison, Topeka & Santa Fe has started track laying on its line from San Angelo to Sterling City, 47 miles. It is stated that this line will be extended northwest from Sterling City to a connection with the Lubbock line of the Santa Fe.

The State Railroad Commission has authorized the Gulf Coast & Provident City Ry., Emil Reinbold, President, Kansas City, Mo., to issue $721,000 of stock and bonds. The line extends from Pierce to Waterhouse and thence to Provident City, a distance of 30¼ miles. The company is also planning 20 miles of extensions.

Advices from San Benito state that final contracts have been signed by the company that has undertaken to build an interurban railroad running from San Benito to the river below San Benito, a distance of about 17 miles, and Judge Campbell of Palestine, Tex., representing the firm that will furnish the rails and other equipment. The right of way for this road has already been cleared and men are now at work with scrapers building the grade. Surveyors are also busy staking off a right of way north of town to the sugar plantation of the San Benito Sugar Company, a distance of 14 miles. This extension will in all probability also be made, four-fifths of the bonus asked for the extension having already been subscribed.

The Missouri, Kansas & Texas Ry. will, it is said, have its own terminals in San Antonio within two years, when the contract with the Galveston, Harrisburg & San Antonio R. R. for the use of its tracks will expire. It is also said that the directors of the Missouri, Kansas & Texas will consider a proposition to extend the railroad south to connect with the St. Louis, Brownsville & Mexico R. R.

F. B. Truax, Chief Engineer of the Gainsville, Oklahoma & Western R. R., started surveys from Gainesville early this month on the projected line which is to be built from that city to Bridgeport in Wise county, via Decatur.

Eight men were instantly killed and three men badly injured on April 10 by the premature explosion of a heavy charge of dynamite in a construction camp on the Texico extension of the Santa Fe, 22 miles northwest of Coleman. The accident occurred at a point 2 miles from Novice on a road the Santa Fe is building from Coleman to Lubbock. The men were working in a deep cut right at the Jim Ned creek. Only blasting work is done on Sunday and most of the workmen, numbering more than 200, were in camp, 200 yards distant from the mine of powder. The workmen were just finishing their midday meal and only fourteen had returned to the cutoff when the explosion occurred. The cut is 34 ft. deep and required the removal of 110,000 yds. of solid rock. It is thought that one of the workmen in tamping a charge struck a dynamite cap, which touched off the 1800 lbs. of explosive.

The Texas North & South Ry. has surveyors in the field working north and south from Coleman for the projected line through Throckmorton, Shackelford, Callahan, Coleman, McCulloch, Mason, Gillespie and Comal counties. The line is to be constructed from Vernon, on the Fort Worth & Denver, to San Antonio, a distance of 360 miles. J. E. Boog-Scott, Coleman, is interested.

The following have been elected officers of the San Antonio, Rio Grande & Tampico R. R., now building from San Antonio to Brownsville, with an ultimate terminus at Tampico, Mexico: George W. Nock, New York, chairman of the board of directors; A. B. Hedden, New York, president; H. H. Aubrey, San Antonio, first vice president; W. H. Cullen, San Antonio, second vice president; A. L. Matlock, San Antonio, third vice presi-

dent; H. C. King, Jr., secretary; J. H. Hale, treasurer.

Kahmann & McMurry, 709 Sharp Bldg., Kansas City, Mo., have been awarded the contract for the grading work on the Menard end of the Frisco and will start work this month. **The Frisco is pushing the building** of bridges and culverts on the first 17 miles out of Brady and will begin laying steel about June 1. It is the intention to have the road in operation to Menardville by Jan. 1.

The charter of the Quanah, Seymour, Dublin & Rockport Ry. Co. was approved on April 13. This line is to commence at or near the northwestern corner of Hardeman county, on the south bank of the Red River, to proceed thence through Hardeman, Foard, Wilbarger, Baylor, Throckmorton, Young, Stephens, Palo, Pinto, Eastland, Erath, Comanche, Hamilton, Coryell, Bell, Williamson, Travis, Bastrop, Caldwell, Gonzales, Lavaca, De Witt, Victoria, Goliad, Refugio and Aransas counties and through the cities of Quanah, Seymour, Dublin and Austin terminating in Rockport. The home office is to be in Austin, and the capital stock is $500,000. The incorporators are: L. E. Walker, W. R. Davie, H. P. Faefflin, F. P. McLaughlin, Charles Rogan, George Mendell, Jr., H. E. Ford, Harry Koch, P. A. Whaley, Will L. Vining and A. J. Eilers.

Utah Notes.

FROM CORRESPONDENTS AND OTHER SOURCES.

The Ogden Rapid Transit Co., Ogden, has applied to the County Commissioners for a franchise for a change of its line from North Ogden to Hot Springs. The company intends to reconstruct a portion of its Hot Springs line to avoid a number of heavy grades between North Ogden and the resort.

A considerable amount of work has been secured by Springville contractors and over 300 men and teams will leave that place this spring to engage in railroad and canal building. Among those who have secured contracts are: H. T. Reynolds & Co., Crandall Bros., R. Palfreyman, Nephi Straw & Co., Deal Bros. and the Ely Construction Co.

The Tooele Valley R. R. Co., of Tooele, has petitioned the City Council for an extension of one year in which to electrify the road to the Salt Lake Route tracks.

Such progress has been made in reconstructing the track of the Salt Lake R. R. in the washed out section in Nevada, that it has been announced that the line would be open to through traffic on July 1. From the western end the track has been relaid to a point beyond Galt, while the eastern construction force has passed Caliente.

Virginia Notes.

FROM CORRESPONDENTS AND OTHER SOURCES.

Surveys for the route for the projected electric railway from Fredericksburg, Va., to Washington, D. C., have been completed to a point 12 or 14 miles north of Stafford Courthouse. The line is to be built in connection with the Richmond & Chesapeake Bay Ry., of which Wm. Northrop, Richmond, Va., is General Manager.

The Norfolk & Portsmouth Belt Line R. R., L. E. Johnson, Vice President, Norfolk, Va., is reported to be planning to extend the line across the Eastern Branch of the Elizabeth River into Norfolk proper, and continue it to Sewells Point, terminal of the Virginian Ry.

The Old Dominion Development Co., coal producers, Mutual Bldg., Richmond, Va., have purchased the old Clyde line wharf in Fulton, and will spend $100,000 in putting the wharf in shape for the purpose of handling coal from railway cars to river steamers and barges. Joseph W. Woolfolk is President of the Old Dominion Development Co.

Washington Notes.

FROM CORRESPONDENTS AND OTHER SOURCES.

The City Council of Snohomish has granted a 25-year franchise to the Seattle, Snohomish & Everett Ry. Co., to build, equip and operate an electric railway over the streets and avenues of that city. The franchise provides that actual construction shall be begun within one year, and that the road shall be in actual operation within two years.

The Stone & Webster Engineering Corporation will have work started shortly on the proposed Bellingham-Skagit County Interurban Ry. The corporation is also planning a number of improvements in Bellingham and vicinity, to include an auxiliary power plant. S. L. Shuffleton, Sunset Block, Bellingham, is Constructing Engineer.

The North Coast R. R., F. L. Pitman, Chief Engineer, Spokane, Wash., is securing right of way and, it is believed, that active construction work on the line through Walla Walla will be started soon.

H. C. Henry, Seattle, has begun work near Moncton on the construction of the first six miles of track on the branch line of the Chicago, Milwaukee & Puget Sound, between Moncton and Everett. Right of way for the remaining distance of the branch has been over 60 per cent secured.

The H. M. Byllesby Co., of Chicago, Ill., is reported to have started surveys for its projected interurban line from Walla Walla to Pendleton. After the survey between Walla Walla and Pendleton is completed, it is said the line will be projected through to La Grande.

Construction work on the North Coast Ry. in Washington has been making good progress although the contractors are somewhat handicapped by the scarcity of labor. Tribble & Anderson, who have the first 8 miles out of Cheney have been working between 600 and 700 men in three general camps and in three camps under sub-contractors. They are also employing station men. Washtok & Chew, who have the next 12 miles of line, have been working between 900 and 1,000 men. They also have a contract at Silver Hill for the North Coast, and are working two camps of men, and have there 150 men in these two camps, called camps 5 and 7. Carlson & Chindahl, contractors for the North Coast out of Sprague, are working 500 men and have other contracts to start as soon as they can get the laborers. They have also had to resort to subletting and station work in order to hasten their job. They are just finishing a large job on the Northern Pacific cutoff at Adrian, Wash., and just as soon as this is finished, about May 1, intend to move their entire force to Sprague on the North Coast work.

The Tacoma Railway & Power Co., L. H. Bean, General Manager, Tacoma, will expend about $200,000 this year for improvements underway or ordered. Of this sum $65,000 will be expended for raising the trestle which runs along Puyallup Ave. on the interurban line at Tacoma.

The Northern Pacific Ry., W. L. Darling, Chief Engineer, St. Paul, Minn., has given notice to agents of all property along the south end of Lake Union in Seattle to remove buildings and obstructions in order that work may be started at once on construction of the four-track belt line around the lake. Under three franchises granted to the Northern Pacific, covering the territory between Ballard and Fremont, around the south end of Lake Union from Fremont to Hamlin St. and on Terry Ave., between Valley St. and Denny Way, the company is required to finish work on the Lake Union section within twelve months after Westlake Ave. has been improved by Seattle. Bids for this improvement have been called for and will be opened within three weeks. It now looks as though the Northern Pacific will not wait for this improvement to be finished, but will pursue its work coincident with that of the city, in order to place tracks in position by the time municipal operations are completed.

Wisconsin Notes.

FROM CORRESPONDENTS AND OTHER SOURCES.

The Chippewa Valley & Northern Ry., J. Z. Arpin, Manager, Atlanta, Wis., has started surveys for an extension which, according to reports, will be built from Bruce, Atlanta and Exeland in a northeasterly direction to Radisson. Motor car passenger service has already been inaugurated between Bruce and Exeland and work of grading will be started at Exeland.

The Common Council of Oconomowoc has granted the Milwaukee Light, Heat & Traction Co. a franchise for an electric railway in the city. The road will be an extension of the line planned from Milwaukee.

Surveys have been made and work will soon be started on the dam which the Arpin Hardwood Lumber Co., D. J. Arpin, President, Grand Rapids, Wis., will put in on the Chippewa River north of Bruce. The company has several franchises along the river and expect to put in several mills and dams.

The Minneapolis, St. Paul & Salt Ste. Marie Ry., Thos. Green, Chief Engineer, Minneapolis, Minn., will spend $1,000,000 this season in completing its terminal improvements at Superior. These will include a new ore dock on St. Louis Bay, contract for which will be let shortly, and the enlargement of the car yards.

Work is to be started immediately on the building of the projected roads of the Sparta-Melrose Electric R. R. Co. A St. Paul financier has agreed with the officers of the company to build the road and lease it to the Chicago, Milwaukee & St. Paul Co. The first eleven of the 28 miles will be built this summer.

Wyoming Notes.

FROM CORRESPONDENTS AND OTHER SOURCES.

The Chicago & Northwestern Ry., E. C. Carter, Chief Engineer, Chicago, Ill., is reported to be planning to have work started this summer on a branch railroad from Whaba, near Riverton, up the Wind River Valley to Crowhart. The proposed line is about 75 miles long up a fertile valley with water grade.

Construction work on the dam of the Park Reservoir Co., 25 miles southwest of Sheridan, Wyo., has been in progress all winter and the work is about 75 per cent completed. The dam will create a reservoir that will cover 260 acres, which will be covered with water to an average depth of 29 feet. E. C. Bowman, Sheridan, Wyo., is Superintendent of the Park Reservoir Co.

Canadian Notes.

FROM CORRESPONDENTS AND OTHER SOURCES.

The House of Commons Railway Committee has passed the bill to incorporate the Montreal Kapitachuan & Rupert's Bay Ry. Co., which proposes to build a line from Montreal to Rupert's Bay, on Hudson's Bay, a distance of 450 miles.

The Railway Committee of the House of Commons has passed the Ottawa, Rideau Valley & Brockville Railway bill. The company owns mines near Ironsides and proposes a line down to Hull. From there it would use the interprovincial bridge and the Grand Trunk out to Graham's Bay, branching off thence and running as an air line through Carleton, Grenville and a part of Leeds Counties to Brockville.

The Canadian Northern Ry. has awarded contracts for extensions in Saskatchewan and Alberta totalling 230 miles. Half of the contract on the Maryfield extension and the Moose Jaw extension was awarded to the Cowan Construction Co. Winnipeg, the balance of the work at the Maryfield extension being awarded to the Northern Construction Co., who also secured the work for grading on the Vegreville extension to Calgary and on the Goose Lake line extension.

Financial aid has been asked from the Provincial Government of New Brunswick for the proposed extension of York & Carleton (Stanley Branch) Ry. from Ryan's Brook to meet the Grand Trunk Pacific at Nappadogan Lake, the divisional point. This proposed extension is about nine miles in length, and it is understood that financial arrangements have been made for carrying on the work if certain assistance is given. Dominion subsidies will lapse in July next, and a bond guarantee

of $10,000 per mile is asked from the Provincial Government. It is stated that arrangements which have been in progress for some time for taking over of the York & Carleton Ry. by the Dominion Government as a branch of the Intercolonial or Transcontinental Ry. are about completed.

The Montreal Harbor Commissioners, Montreal, have ordered a new plant, costing about $250,000. This plant consists of a twin-screw tug, a land excavator built by the Browning Co. of Cleveland, O., and the hull and boiler for a dredge. This is the first expenditure from a $6,000,000 loan. F. W. W. Cowie, Montreal, Que., is Harbor Engineer.

The Temiskaming & Northern Ontario Ry., S. B. Clement, Chief Engineer, North Bay, Ont., has perfected plans for a number of improvements and extensions. Contracts are also to be let shortly for the construction of new steel bridges. The double tracking of an additional portion of the road, as well as the erection of several new stations is also proposed.

The Canadian Northern Ry. has completed the survey of its route to Niagara Falls, Ont. The route runs along the right-of-way of the Toronto & Niagara Power Co. to the city line, through the heart of the city, crossing the river on a bridge to be built 300 ft. north of the upper steel arch bridge.

The Niagara, St. Catharines & Toronto Ry., owned by Mackenzie & Mann interests, will build a line to Fort Erie during the coming summer, forming a belt line through the Niagara district as a feeder for the Canadian Northern.

The Essex Terminal Ry. Co. is planning to build a spur at Windsor, Ont., from its interswitching line to tap the district along McDougall St., which the city proposes to lay out in factory sites this year. William Woollett is General Manager.

A bill has been before the House of Commons to incorporate a company with power to construct a canal from 7 to 9 ft. deep and 40 ft. wide connecting Lake Superior with Lake Winnipeg. The proposed waterway will cost, it is estimated, about $20,000,000 and will develop 1,000,000 H.P., part of which will be available for consumers in Michigan and Wisconsin. The promoters are said to have $20,000,000 available for the enterprise and as soon as the bill is passed engineers will be sent out to make a survey preparatory to construction. J. H. Horne, Fort William, Ont., is interested.

City Engineer Rust of Toronto, Ont., has made a report on the question of requesting the Toronto Ry. Co. to build lines to the North, Northwest and Northeast sections of the city.

Mexican Notes.

FROM CORRESPONDENTS AND OTHER SOURCES.

The United Railways of Yucatan has obtained a loan from the Banco Nacional de Mexico of Mexico City for $4,000,000 gold. The money will be used to build an extension and to improve the physical condition of the existing property.

Among the concessions covering the use of river waters for the generation of power and for irrigation purposes recently asked of the Department of Formento, of the Mexican Government, are the following: 10,000 liters, per second, from the arroya de Mimbre, in the state of Coahuila, have been requested by Messrs. Gil and Franco, for irrigation purposes; Manuel Miravet has asked for the use of a portion of the waters of the Rio Quiotepec, in the state of Oaxaca, also for irrigation; Guadalupe Gonzalez has an irrigation project in the territory of Tepic, which will require the use of several thousand liters of water per second, from the Rio Acaponta; a large power proposition, in the state of Michoacan, which will require 20,000 liters, per second, is the basis of a concession asked for by George Pinson, the water to come from the Zitacuaro, San Francisco and Enandio rivers.

The National Railways of Mexico has given the Monterey Steel & Iron Co. another large order for steel rails and bridge material, aggregating about $2,000,000. Part of the rails will be used to construct the extension which the National is building from Durango southwest toward Mazatlan. The extension already under contract is 65 miles long.

W. J. Irwin & Son, Roswell, N. Mex., have about completed work on their contract for constructing a concrete dam for the Acme Irrigation Co., one mile north of Hagerman, N. Mex. Plans for the dam were made by Reed & Wilson, Roswell, N. Mex., and construction work was started Jan. 25 and will be completed by Apr. 25. The dam is 174 ft. long and contains 1,120 cu. yds. of concrete.

As originally planned in the minority report of the International Board of Engineers which was adopted by Congress the construction of the Panama Canal required a total excavation of 103,795,000 cu. yds. Changes in the plan made subsequently by order of the President added 70,871,594 cu. yds., making the total excavation required 174,666,594 cu. yds. At the end of March the grand total of excavation accomplished amounted to 103,205,666 cu. yds. or within 590,004 cu. yds. of the total excavation required by the original plan. The amounts excavated and remaining to be excavated at the beginning of April were as follows:

	Amount Excavated cu. yds.	To be Excavated cu. yds.
Atlantic Division:		
Dry excavation....	6,791,280	2,770,631
Dredges	17,574,566	15,940,831
Central Division:		
Culebra Cut.....	45,624,605	32,417,690
All other points...	8,655,533	3,096,665
Pacific Division:		
Dry excavation....	2,714,211	3,216,369
Dredges	21,845,469	14,018,742
Grand totals.....	103,205,666	71,460,928

City Engineer Wagner of Sioux Falls, S. Dak., has been granted a 30 days leave of absence by that city in order to run the preliminary line for the Sioux Falls & Western Ry. Co., which proposes constructing a railroad from Sioux Falls to Wheeler, on the Missouri river in Charles Mix county. The line probably will strike Parker or Marion Junction on its route toward the southwest.

The engineering force on the Pingree-Wilton extension of the Northern Pacific has established its headquarters at Pingree and is setting the grade stakes preparatory to having grading started.

The Iowa & Dakota Interurban R. R. Co., of Yankton, S. Dak., the incorporation of which was mentioned in these columns recently, is reported to have secured considerable capital for the undertaking. As proposed the line will extend northwest from Sioux City through Woodbury and Plymouth counties, Iowa, and then passes through Union, Clay, Yankton, Turner, Hutchinson, Hanson and Davidson counties, into Mitchell. The board of directors of this company are as follows: B. E. Wells, E. E. Mamford and H. E. Valentine of Centerville; L. F. Phillips and W. G. Kirkpatrick of Wagner, and Albert Abundson of Lake Andes.

The City Council of Clarksville, Tenn., has granted a franchise to the Clarksville & New Providence Street Ry. Co., giving it the right of way over North Second st., to the city limits. It is the purpose of the company to connect Clarksville and New Providence with a car line.

The White Mountain Paper Co. is preparing to expend $1,500,000 on its plant at Portsmouth, N. H.

It is reported that parties connected with the Carnegie Steel Co., will this summer, start the development of a hydro-electric project in the neighborhood of Indian Lake, Me. The plan contemplates the building of a dam below Indian Lake, which will raise the level of the lake 125 feet, flood 56,000 acres of land, and develop 90,000 H. P. The estimated cost is about $9,000,000.

The Sanford Traction Co., of Sanford, Fla., which now has seven miles of line in operation, will extend its road so as to belt the city and take in the West Side.

The construction of a railroad from Loup City to Broken Bow, Neb., is proposed. Walt George and Frank M. Currie, of Broken Bow, Neb., are interested.

The City of McComb, Miss., has granted a franchise to W. M. White and J. J. White, of McComb, owners of the Liberty White Steam R. R., to put in a complete electric street car line, covering the principal business streets of the city, starting from the Liberty-White depot in South McComb, and traversing the west, northern and central portions of McComb.

The Memphis Street Ry. Co., Memphis, Tenn., has asked the County Court for permission to extend its Main St. line, New Raleigh road division, from the present terminus on the New Raleigh road, to a point 7,500 ft. farther east.

W. J. Oliver & Co., Knoxville, Tenn., has been awarded the contract for constructing the electric railway of the Greenville & Spartanburg Electric Ry. Co. The line is to extend from Greenville to Spartanburg, S. C., and the contract just let is said to amount to $750,000. H. H. Prince, Greenville, S. C., is General Manager.

Dominick Rich, Clarksburg, W. Va., has begun work on his contract for extending the West Virginia Midland R. R. up Black Fork and Elk river through the Camden and Johnson lands, the timber on which is being operated by the Belle-Meade Lumber Co., a distance of five miles to Skelt, W. Va.

The J. T. Stevens Contracting Co., Beatrice, Neb., has started work straightening the channel of Indian creek, west of town, for the Chicago, Burlington & Quincy Ry. A 50-ft. channel will be cut, shortening the course of the creek about a half a mile. This is done to stop damage by high water.

Samuel Ferguson has begun work at Marston's Corner, Me., on his contract for constructing the Portland, Gray & Lewiston Electric Ry., of which W. Scott Libby, Lewiston, Me., is President. The construction of the road will be continued from this point towards Portland, and it is expected that the roadbed, bridges and culverts will be all built this year, and the road will be running by a year from next June.

The New York, New Haven & Hartford R. R., Edw. Gagel, Chief Engineer, New Haven, Conn., has decided to proceed with plans to double-track the Air Line from New Haven to Boston and to construct the through route from New York to Sherbrooke in the Province of Quebec. The proposed new route from New York to Sherbrooke, Canada, is to be made possible by closing two gaps. One is between Brattleboro, Vt., and South Vernon, Vt., and the other between Windsor, Vt., and White River Junction, Vt. The proposed route lies over the New Haven road from New York to Springfield, and then over the Boston & Maine from Springfield through Brattleboro and White River Junction.

The Baltimore & Ohio R. R. is reported to have decided to build an extension from Lost Creek to West Milford, W. Va., in Harrison County. The extension will be about 15 miles long and will open extensive coal lands. It will connect with the West Virginia & Pittsburg Division of the Baltimore & Ohio.

BIDS ASKED.

Bridges.

Bids are asked on following work, the notes being arranged alphabetically by states:

Ft. Morgan, Colo.—Until noon, April 30, by Charles W. Comstock, state engineer, Denver, Colo., for the fabrication and construction of a pile-trestle highway bridge across the Platte River at or near the point where division line between ranges 58 and 59 crosses the river, in Morgan county, Colorado. Certified check for $300 required with bid.

Highland Park, Ill.—Until 8 p. m., April 21, by Board Local Improvements, for constructing reinforced concrete bridge.

Indianapolis, Ind.—Until 10 a. m., April 23, by Albert Sahm, county auditor, for the construction of a culvert over ditch, north line Section 15-15-5, Warren township; culvert over Moore ditch, on Copeland Road, southeast quarter of Section 24-14-4, Franklin township, and a retaining wall at west end of bridge over Buck Creek, on north line of Section 15-15-5, Warren township.

Princeton, Ind.—Until 11 a. m., May 4, by W. T. Roberts, county auditor, for the construction of 11 steel bridges and 14 reinforced concrete bridges.

Kansas City, Kan.—Until 2 p. m., April 25, by Kaw Valley Drainage Board, W. H. Daniels, president, for furnishing materials and the construction along the Santa Fe ditch, Argentine, Kansas City, Kan., of about 460 lin. ft. of reinforced concrete culvert, of approximately 9 ft. sq. section, and containing about 830 cu. yds. of concrete.

Topeka, Kan.—Until noon, April 22, by S. G. Zimmerman, County Clerk, for constructing 188-ft. steel span on north end of bridge over the Kansas River, near Willard.

Ypsilanti, Mich.—Until noon, May 16, by S. Damon, city clerk, for the construction of a 3-arch reinforced concrete bridge over the Huron River. Bridge is to be 225 ft. long, with a 46-ft. width. Official advertisement will be found elsewhere in this issue.

Lexington, Miss.—Bids are being asked by Peckham Williams, clerk County Supervisors, for building a wooden bridge on Durant Turnpike leading to Big Black River.

Monticello, Miss.—Until May 2, by W. H. Speights, Clerk County Supervisors, for construction of a steel bridge over Silver Creek, on Mt. Carmel Road.

Winnemucca, Nev.—Until 2 p. m., May 3, by the County Clerk, for constructing reinforced concrete bridge over the Humboldt River in Winnemucca; also two reinforced concrete culverts in the same town.

Cleveland, O.—Until 11 a. m., May 14, by John F. Goldenbogen, clerk County Commissioners, for the construction of bridge work per report No. 2570, Embankment, Barrett Road, Olmsted township. Frank R. Lander, county surveyor.

Dayton, O.—Until noon, April 22, by Department Public Service, Wm. A. Budroe, secretary, for all labor and material necessary to build a hand-power lift bridge of steel construction, wooden floor, over the Miami and Erie basin extension canal at Webster St., Dayton, together with the necessary foundations therefor. Bridge is to provide a 40-ft. waterway and a 10-ft. towing path, and is to be 24 ft. wide. F. J. Cellarius, city civil engineer.

Sherman, Tex.—Until May 2, by Barney C. Kreager, city secretary, for constructing a concrete arch or steel span with concrete abutments. Bridge is to have minimum span of 40 ft. in clear and minimum width of 22 ft. in clear.

Elkins, W. Va.—Until May 6, by F. A. Rowan, Clerk, County Clerk, for constructing bridge over Cheat River.

New London, Wis.—Until 8 p. m., May 3, by N. R. Deming, City Clerk, for material and construction of a concrete bridge on the Embarrass River on St. Johns Pl. Part of plans and specifications are on file with City Clerk. Bidders are expected to furnish their own plans and specifications.

Ellice, Man.—Until May 7, by Henry Tillman, Secretary-Treasurer Ellice Municipality, for building a bridge over Assiniboine. Plans, etc., at office of Department of Public Works, Winnipeg.

Buildings.

Bids are asked on following work, the notes being arranged alphabetically by states:

Fort Logan, Colo.—Until 10 a. m., April 28, by Capt. Chase Doster, Quartermaster, U. S. A., for the material and labor required in the alterations and repairs to post hospital here. Work includes brickwork, plastering, painting, plumbing, etc.

Washington, D. C.—Until 2 p. m., April 21, by the District Commission, 427 District Bldg., for constructing an addition and making alterations to Bennings School No. 48, square 5053, Anacostia Road N. E.; constructing a 4-room addition to the Lovejoy School Building, No. 124, northwest corner 12th and D Sts. N. E., and for constructing a 2-room School Building, No. 161, on Bunker Hill Road, Brookland, D. C.

Perry, Fla.—Until 2 p. m., May 2, by John C. Calhoun, Clerk, County Commissioners, for erection of a new brick jail, complete, at Perry. Certified check for $500 required with bid.

Knoxville, Ia.—Until noon, April 23 by J. H. Power, for the erection of a 2-story brick business house, 20x120 ft.

Brookville, Ind.—Until 1 p. m., May 12, by the County Auditor, for the repair of court house; also bids for heating, plumbing and electric work.

Greensburg, Ind.—Until 10 a. m., April 30, by E. L. Meek, trustee Clinton Township, Decatur County, at law office of Wickens & Osborn, Greensburg, Ind., for the construction of a 2-story brick school house in Sandusky, Ind.

Kokomo, Ind.—Until 3 p. m., May 20, by James Knox Taylor, supervising architect, Washington, D. C., for the construction, complete (including plumbing, gas piping, heating apparatus, electric conduits and wiring), of the U. S. post office at Kokomo, Ind.

Seymour, Ind.—Until noon, May 3, by Board of School Trustees, W. J. Durham, president, for construction of a new High School Building, including plumbing, heating and electric wiring.

Lawrence, Kan.—Until 2:30 p. m., April 28, by Regents University of Kansas, Edw. E. Brown, secretary, for all labor and materials, and the erection of the first wing of an Administration Building and College of Liberal Arts and Sciences, on the campus of the University of Kansas, at Lawrence, also for the furnishing of all labor and materials for the complete installation of a system of heating and plumbing in said building. Plans with Charles H. Chandler, state architect, Capitol Bldg., Topeka, and at the office of M. P. McArdle, architect, Chemical Bldg., St. Louis, Mo.

High Point, N. C.—Until 3 p. m., May 17, by James Knox Taylor, supervising architect, Washington, D. C., for the construction complete (including plumbing, gas piping, heating apparatus and electric conduits and wiring) of the U. S. Post Office at High Point, N. C.

Wentworth, N. C.—Until noon, May 12, by J. T. Holland, Clerk County Commissioners, for furnishing the materials and erecting a jail in accordance with the plans and specifications prepared by Architects Wheeler & Stern, Charlotte, N. C.

Portsmouth, N. H.—Until 11 a. m., May 21, by the Bureau of Yards and Docks, Navy Department, Washington, D. C., for rebuilding and fireproofing building No. 20, U. S. navy yard, Portsmouth, N. H.

Brooklyn, N. Y.—Until 11 a. m., April 27, by Alfred E. Steers, Borough President, for furnishing all the labor and materials required for making repairs and alterations to the four free floating baths in the borough of Brooklyn. Security required is $1,400.

Brooklyn, N. Y.—Until 11 a. m., April 25, by C. B. J. Snyder, Superintendent of School Buildings, Park Ave. and 59th St., New York, for alterations, repairs, etc., at public schools 16, 19, annex 22, 23, 33, 37, 49, 50, 51, 59, 71, 122, 126 and Eastern District high school, borough of Brooklyn.

Fort Terry, N. Y.—Until 10 a. m., May 13, by Capt. F. T. Arnold, Constructing Quartermaster, New London, Conn., for the construction, plumbing, heating, electric wiring and fixtures of one guard house and one quartermaster's store house at Fort Terry. Official advertisement will be found elsewhere in this issue.

New York, N. Y.—Until 11 a. m., April 25, by C. B. J. Snyder, Superintendent of School Buildings, Park Ave. and 59th St., for alterations, repairs, etc., at Public Schools 6, 18, 49, 53, 59, 70, 73, 74, 76, 77, 82, 96, 116, 117, 135, 158, 183 and 190, borough of Manhattan; also for alterations, repairs, etc., at Curtis High School Athletic Field, Curtis High School, and Public Schools 1, 14, 17, 18, 20 and 23, borough of Richmond.

New York, N. Y.—Until noon, April 26, by Calvin Tomkins, Commissioner of Docks, for furnishing all the labor and materials required for reconstructing and repairing the ferry structures at the foot of East 23d street, East River, borough of Manhattan. Security required is $4,000.

West Point, N. Y.—Until noon May 16, by the Quartermaster, U. S. A., West Point, for supplying the U. S. Military Academy with building materials, plumbing materials, gas and steam fittings, hardware, paints, etc., during the fiscal year ending June 30, 1911.

Fort Crockett, Galveston, Tex.—Until 2 p. m., May 20, by Capt. P. Whitworth, Constructing Q. M., for the construction, plumbing, heating and electric wiring of eight sets of officers' quarters, the construction of two storehouses, two shops and a fire station, all of reinforced concrete, and the construction of a coal shed, frame.

Stamford, Tex.—Until noon, May 2, by Elliott & Meredith, supervising architects, Stamford, for the erection of M. E. Church, South, at Stamford, according to plans and specifications prepared by Flanders & Flanders, architects, Dallas, Tex.

Fort Monroe, Va.—Until 10 a. m., May 11, by Capt. Ernest R. Tilton, Constructing Quartermaster, for the construction, including plumbing and electric wiring and fixtures of a detachment barracks, at Fort Wool, near Fort Monroe.

Elkins, W. Va.—Until 3 p. m., May 9, by F. A. Rowan, Clerk of County Court, for erection of a jail building and jailer's residence. B. F. Smith, Architect, 817 14th St., Washington, D. C.

North Yakima, Wash.—Until 3 p. m., May 26, by James Knox Taylor, supervising architect, Washington, D. C., for the construction, complete (except elevator), including plumbing, gas piping, heating apparatus, electric conduits and wiring of the U. S. post office at North Yakima, Wash.

Milwaukee, Wis.—Until 10:30 a. m., April 23, by Board of Public Works, Charles J. Poetsch, chairman, for furnishing all the material and doing all the work necessary and required to do the work of installing new shower bath and toilet room partitions, tiling walls in first story and laying new cement floors in first story of natatorium in toilet rooms in the Northwest Side Natatorium on the corner of 16th St. and North Ave.

Roads and Streets.

Bids are asked on following work, the notes being arranged alphabetically by states:

Phoenix, Ariz.—Until April 25, by Robert A. Craig, Secretary Board of Control, for constructing 13 miles of territorial highway between Prescott and Phoenix.

Palatka, Fla.—Until Apr. 26, by Board of Trustees for Putnam County Bonds, S. Worden, Clerk, 722 Water St., Palatka, for the construction of hard-surfaced road from city limits of Palatka to Bostwick, Fla., a distance of 10 miles. R. F. Ensey, County Engineer, Palatka.

Fort Dodge, Ia.—Until 5 p. m., May 2, by Mayor S. J. Bennett, for the construction of about 70,000 sq. yds. of asphalt pavement on 5-in. concrete base (1 in. border and 1½ in. wearing surface) and about 35,000 lin. ft. of Portland cement combined curb and gutter. Official advertisement will be found elsewhere in this issue.

Anderson, Ind.—Until 10 a. m., May 3, by William T. Richards, county auditor, for grading and paving a road with brick.

Brookville, Ind.—Until noon, May 12, by the County Auditor, for constructing a public highway.

Bloomfield, Ind.—Until 2 p. m., May 3, by Peter M. Cook, county auditor, for constructing a gravel road in Center township.

Bloomington, Ind.—Until 2 p. m., May 4, by Horace Blakely, county auditor, for the construction of a pike in Bloomington township.

Brownstown, Ind.—Until 1:30 p. m., May 3, by H. W. Walker, county auditor, for constructing a gravel road in Washington township, 28,000 ft. in length.

Danville, Ind.—Until 10 a. m., May 2, by Wm. H. Nichols, county auditor, for constructing two roads, one 2,000 ft. long in Center township, and the other 10,605 ft. long in Liberty township.

Fairmount, Ind.—Until 2 p. m., May 3, by A. G. Stout, county auditor, Marion, for improvement of a street in the town of Fairmount by grading and paving with brick.

Jeffersonville, Ind.—Until 11 a. m., May 23, by Peter Narchand, county auditor, for constructing a gravel road 5.88 miles long.

Kentland, Ind.—Until 2 p. m., May 23, by E. R. Bringham, county auditor, for the construction of a system of macadam roads in Washington township.

Madison, Ind.—Until 1 p. m., May 3, by G. F. Crozier, county auditor, for constructing 6.64 miles long gravel road in Smyrna township.

Monticello, Ind.—Until noon, May 3, by A. G. Fisher, county auditor, for the construction of a stone and gravel road in Big Creek township.

Monticello, Ind.—Until noon, May 3, by A. G. Fisher, county auditor, for the construction of four gravel roads in Liberty township.

Salem, Ind.—Until 1:30 p. m., May 2, by Sam G. Ellis, county auditor, for constructing a road 4,000 ft. long in Madison township.

Sullivan, Ind.—Until noon, May 4, by Ben C. Crowder, County Auditor, for the construction of 7,939 ft. of stone road in Curry Township.

Terre Haute, Ind.—Until 11 a. m., April 23, by N. G. Wallace, county auditor, for the construction of one gravel road in Honey Creek township and three gravel roads in Fayette township.

Vincennes, Ind.—Until 2 p. m., May 3, by John T. Scott, county auditor, for the construction of 8,140 ft. of gravel roads in Vigo township, 8,050 ft. of gravel roads in Widner township and 9,383 ft. of gravel roads in Decker township.

Williamsport, Ind.—Until 1 p. m., May 6, by Robt. L. Winks, county auditor, for the construction of a gravel road in Steuben township.

Grand Forks, N. Dak.—Until 2 p. m., May 6, by Hans Anderson, county auditor, for grading and repairing about four miles of county road, running from Grand Forks city limits in a northwesterly direction toward Walsh county line, near Ardoch, N. Dak.

Bethlehem, N. H.—Until 10 a. m., April 29, by H. C. Hill, state engineer, Concord, N. H., for constructing one mile of road in this town, surfaced with native stone.

Cincinnati, O.—Until noon, April 29, by County Commissioners, Fred Dreihs, clerk, for the following county work: Under Specification No. 22, for improvement of the Hamilton Pike, from

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WITH WHICH ARE COMBINED

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CHAS. S. HILL
C. T. MURRAY
F. A. SMITH
} EDITORS

MYRON C. CLARK . . . . . PUBLISHER
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CONTENTS.

EDITORIAL: Page.

A Noteworthy Series of Articles on Electric Railway Operating Costs.....375
How Can Recognition Be Secured for the Civilian Assistant Engineer of the Army?.....376
Experimental Grouted Macadam Road....376
Results of Tests for Leakage Under Pressure of a Reinforced Concrete Pipe.....377
Method of Constructing Reinforced Concrete Trestles for Railway, With Some Costs.....377
Methods and Cost of Constructing a Concrete Lock on the Illinois & Mississippi Canal.....380
The North Shore Channel of the Sanitary District of Chicago; Methods and Some Costs on Sections Four and Six.....383
A New Type of Stone Crusher.....384
Methods of New York State Commission, of Highways in Testing Bituminous Materials Used in Road Work.....385
A Method of Preventing Sewer Flooding in Riverside Districts.....387
Some English Costs of Washing Filtering Material Using a Special Washing Machine.....387
The Results of Experiments on Pollution in Shallow Wells for Municipal Water Supply.....388
Cost of Constructing and Operating the Electric Street Railways of Long Island City—The New York and Queens County Railway.....390
Cost of Generating Electric Power for Operating the Elevated and Subway Cars in Manhattan, New York City.....391
Some Conditions, Methods and Cost of Construction Work, in Peru, South America.....392
Organization and Equipment of Survey Parties, Georgian Bay Ship Canal Survey, With Data on Allotment and Cost of Rations.....393
Character and Methods of English Ordinance Surveys With Data on Costs.....394
Example of the Relocation of Roads in Hilly Country.....395

A Noteworthy Series of Articles on Electric Railway Operating Costs.

Before the day of Wellington there were probably few civil engineers who fully appreciated the necessity of knowing in detail the cost of operating railways. The engineer who designs a structure or plant is rather prone to concentrate his attention upon the construction features to the neglect of the operating and maintenance costs. Wellington did much to change this tendency among railway engineers, but much yet remains to be done. The civil engineer who is called upon to locate and design an electric railway is still apt to approach the problem with a defective knowledge of the costs of operation. If the soundness of this statement is doubted, consult any of the books on street and electric railway design and construction. Even the one that makes the bravest attempt at introducing the economies of operation is full of blunders relating both to construction costs and to costs of operation. We refer to the work by Gotshall. Moreover, it is lamentably weak in data of operation.

Believing that the publication of costs of operating electric railways will prove of great assistance to engineers engaged in railway work, we have begun a series of articles on this subject, the first of which appeared in our issue of April 13, and gave the detailed cost of operating the New York Subway. In our issue of April 20 the cost of operating the elevated railways of Manhattan was given.

In this issue we give the cost of operating 69 miles of surface railways in Long Island City, and we shall follow with a series of similar articles relating to other lines and systems.

In comparing these actual costs with the estimated costs given in various books, one is struck with the large number of items that engineering authors have omitted entirely. Again, it frequently has happened that the actual data quoted by authors have been data of new lines, where the maintenance expenses have been far below normal expenses during a long term of years.

The steam railway engineer, who uses the train-mile as the unit in which to express operating costs, will find it necessary to adopt the car-mile as the unit for electric railway operation. Upon doing so, he may be curious to know what are the corresponding costs per car-mile on steam railways. The data given by the Interstate Commerce Commission do not permit of perfectly exact deduction of car-mile costs on steam railways, but a very close approximation is possible. Such an approximate estimate is made in the second edition of Gillette's "Handbook of Cost Data," where it is shown that the total operating expenses of American steam railways average 8.33 cts. per car mile. This is about half the average cost of operating electric street railways, and a study of the respective details is very instructive.

The civil engineer to whom electrical terms are somewhat foreign may not take kindly to the kilowatt (kw.) in place of the old horsepower (hp.), but since a kilowatt is only slightly more than a third greater than a horsepower, the relation is easily established at a glance. There are 8,760 hours in a year, hence each kw. of capacity possessed by an electric generator could deliver 8,760 kw. hrs. if the generator worked constantly for a year. The "load factor" is formed by dividing the actual number of kw. hrs. delivered from each kw. during the year by 8,760. A 30 to 50 per cent load factor may be said to be the ordinary range for most plants used to operate street railways.

Other electric terms—and they are few in number—are readily understandable by any engineer, so that a study of the costs of operating electric railways is a simple matter, provided the details are fully and clearly set forth. However, there are frequently missing links of information, which make it necessary at present to analyze the reports of several electric railway lines before one obtains a relatively complete knowledge of details.

We have undertaken to do for our readers what few of them are likely to undertake for themselves, namely, the critical analysis of the costs of operation of a considerable number of street railway reports. We shall also give the detailed cost of reproducing a large but typical street railway system, including its equipment and plant, also similar data for an interurban line. In this connection we may call attention to the fact that the word equipment is commonly used at present to include not only rolling stock but power plant. This is confusing to the steam railway engineer who is accustomed to confine the term equipment to rolling stock. It may well be asked whether it would not be better to adhere to this old practice, and reserve the word plant for all stationary equipment, like boilers, engines, generators, etc.

In analyzing maintenance costs of electric railways it is advisable to express many of the items in percentages of the first cost. This is particularly desirable as regards rolling stock and power plant. The car mile is not a satisfactory unit for either of these items. Maintenance of way costs should be expressed in dollars per mile of trackway. We use the term trackway to include all first, second, third, etc., track, excluding yard track, sidings, etc. Unfortunately no published reports give the cost of rail renewals on electric street railways. Rail wear is, therefore, a moot question. It is probably somewhat less per car mile than on steam railways; how much less, we are unable as yet to say.

We must caution our readers against drawing sweeping conclusions from the maintenance costs of one system for a single year. Wide fluctuations are apt to occur, as an article in our next issue will show.

However, the maintenance costs of a large number of street railway systems—those of Massachusetts, for example—are apt to vary little from year to year, unless a commercial panic results in a general curtailment of maintenance expenses.

With the certainty before us that public service corporations will be largely regulated in their operations by public service commissions, it behooves all railway engineers to master the details of operating costs. There is a grave danger that such commissions will underestimate maintenance costs and do irreparable injury. Engineers themselves have been the leaders in the past in underestimating maintenance expenses. No less a man than Wellington made the preposterous mistake of estimating the life of a steel rail at 300,000 to 500,000 trains. This would give an average life of about 100 years on the average American railway, or about five times the present average life. In the "South Dakota Rate Case," some years ago, Wellington's conclusions were quoted to prove a lower rail maintenance cost than was claimed by the Chicago, Milwaukee & St. Paul Ry. engineers and statisticians.

It is the custom on many of our American street railways to run open cars during the summer, while the closed cars are laid up, and thus nearly half the total equipment idle at any given period of the year. This custom is dying out, but, so long as it exists, engineers must interpret street car maintenance statistics with care. Obviously where half the rolling stock is idle, the maintenance cost per car will be almost half what it would be if all cars were in constant service.

It should also be noted that the size, weight and cost of street cars are increasing rapidly. Hence the present cost of our maintenance expressed in cents per car mile is likely to prove misleading in the future. By all odds the best way of expressing car maintenance is in percentage of the first cost of the car. Unfortunately most reports do not give the first cost of the equipment, nor even such a description of the equipment as to enable any one to estimate the first cost. The average first cost of street cars in the cities of Massachusetts was $4,000 per car in 1908, which is probably a fair average for the older cities where equal numbers of ancient $2,000 cars (7-ton) and modern $6,000 cars (20 ton) are in operation. The first cost of street cars, including their electrical equipment, is about $300 per ton. It would be well, therefore, if public service commissions were to require reports of the different classes of street cars and their weights.

How Can Recognition Be Secured for The Civilian Assistant Engineers of The Army?

There is under consideration by the Committee on Interstate Commerce of the United States House of Representatives a bill which contemplates the creation of a corps of civil engineers to have charge of all non-military engineering works of the Federal Government and to be a bureau of the Department of

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Commerce and Labor. What the decision on this bill in the committee will be cannot be predicted with certainty. Similar bills have in years past met with a very unkind fate, and justly so in the opinion of many engineers. There are, however, circumstances now existing which may reasonably be regarded as giving such a bill as has been indicated a greater claim for consideration than its predecessors. Like the bills that have gone before it, the present bill has its genesis in a condition which calls for improvement. It voices a need for justice in the treatment of an important body of engineers. But in addition, the present bill just now seems to offer a means of obtaining succor which has been denied by other legislation on which dependence had been placed. The circumstances are these.

The authorized strength of the Corps of Engineers U. S. A. is 188. Of this number only 48 engineers of all grades are available for non-military engineering work. These officers are supplemented by the employment of civilian engineers. These civilian engineers under present conditions cannot rise higher than the grade of assistant engineer. No matter what their age and experience may be or what responsibilities may be on their shoulders, they must be subordinates in rank, in pay and in public credit to the army engineers who alone have the right of responsible command of work. It is obvious that with so few army engineers to draw upon as heads of work, there must be in many cases young and inexperienced officers in charge of work calling for age and experience, and directing men as assistants who are really their superiors in engineering ability. The condition is not equitable nor is it a defensible one from an engineering or business standpoint. Naturally there has been protest against it by the civilian engineers.

Early during the present session of Congress a bill was introduced which promised recognition to the civilian engineer of the army. For the present purpose only three provisions of this bill need be mentioned. First it provided that vacancies should be filled so far as possible by graduates from West Point, but vacancies not filled in this way might be filled by the appointment of civilian engineers. Second, the bill provided that civilian assistant engineers already in the service might be detailed for duty in charge of river and harbor work. Third, there was the provision that no engineer should be detailed in charge of river and harbor districts until he had had at least eight years of experience in that class of work and had attained the age of 35 years. As originally drawn this bill was a decided step in advance in the recognition of the civilian engineer. It was, we believe, regarded favorably by the civilian engineers in general. Further than this, however, it gave some guarantee that none but engineers of considerable experience should direct large and responsible tasks of river and harbor work.

The bill as we have briefly outlined it originated in the River and Harbor Committee of the House of Representatives. It was ordered to the Committee on Military Affairs and was reported back to the House by this Committee late in March. The Committee had amended the bill, however, so that none of the meritorious provisions of the original bill remained. In a word the bill had been shorn of all usefulness for the purpose intended or for any other purpose unless it were to reassert the solid intrenchment of the army monopoly of river and harbor engineering work.

It is not a surprising outcome of the circumstances just described that there has been a resort on the part of many civilian engineers in the river and harbor service to the old idea of removing non-military engineering work of the Government from the army engineers and placing it in the hands of an engineering bureau independent of the army engineers and even of the War Department. The bill providing for this action to which we referred in an opening sentence has the support and confidence of a considerable number of civilian engineers as representing the only means of remedy of the conditions that confront them. This bill provides for a corps of civil engineers to have charge of all non-military engineering works of the Federal Government and to be a part or bureau of the Department of Commerce and Labor. It provides for the appointment of a chief of civil engineers, with the lower grades of assistant chief, department engineer, division engineer, resident engineer, etc. It provides also for the detailing for service in the corps of Civil Engineers of such engineer officers of the army as request it. This service is to continue for four years without prejudice to their rank or rate of advancement should they elect to return to the Corps of Military Engineers at the end of that time. Should they prefer to remain in the Civil Corps, they acquire corresponding rank there and their military connection ceases. Under this bill, it is argued, the experienced civilian assistant engineers of the corps would receive rank and authority such as their ability and service deserve, nor would the work of river and harbor improvement necessarily lose the services of a single one of the military engineers who have distinguished themselves in it.

At first glance it seems that there should be no hesitation in declaring the bill just outlined as by all odds better than the amended bill from the Committee on Military Affairs. Really it is an open question, not because the military bill is at all worthy but because it is doubtful if the removal of river and harbor work from the hands of the army engineer corps would be wise public policy. It cannot be denied that a body of engineers entirely free, as the army engineers are, from political interference, holding office for life and having a high standard of personal and professional integrity is a very strong and desirable guarantee of efficient and honest administration of public work. Neither can it be denied that the one bureau of civilian engineers that has been organized, the engineers of the Reclamation Service, has had its efficiency reduced and is almost in danger of disruption by such political influences. We do not believe that the Reclamation Service engineers are not as honest or that the civilian engineers of the proposed new corps would not be as honest and honorable as individuals in every way as are the engineers of the army, but they would not be free from danger of political interference nor would they command the public confidence in their integrity that the army engineers undeniably do command. For these reasons we are candid to acknowledge, we do not see a way clear to commend any general proposition to take the river and harbor work of the country out of the control of the army engineers.

There is just cause for all the complaints of the civilian assistant engineers of the army corps of inadequate recognition in rank and pay. We shall go even further and assert that we do not believe that it is the disposition at present of any large proportion of the army engineers to allow these civilian assistants to gain the opportunity for equal rank or pay or equal credit for their services. They will, we believe, exert their influence against any legislation like that proposed in the original bill of the River and Harbor Committee which will open the door through which civilian engineers may take equality with them. This is a feeling that can be overcome and which, we believe, is being overcome, at least to the extent that some action should be taken to secure for civilian assistant engineers something of the recognition to which their ability and responsibility entitles them. Is it not the wisest action of civil engineers as individuals and as organized bodies to work for improvement in this direction rather than toward securing an independent civil engineer corps such as is proposed in the bill which we have outlined?

Experimental Grouted Macadam Road.

During the past year a New York State Commission of Highways set aside $1,800 for an experimental piece of concrete road to be constructed according to ideas of the County Engineer of Westchester county. The piece of work was constructed on Road No. 52 last July under the direction of Eberhard J. Wulff, County Engineer, and the following matter has been taken from his report to the State Commission of Highways.

Crushed trap rock of a size usually employed in the top course of a macadam containing, by experiment, about 40 per cent voids was spread on the old macadam surface and rolled by a steam roller to a finished thickness of about 3 ins., the percentage of void being reduced by this rolling to about 25.

Screened sand and Atlas Portland cement were mixed in the proportions of one part cement to three parts sand, in the dry state on a mixing platform, spread upon the road surface and worked into the voids by sweeping about with brooms and continuous rolling with a steam roller until the voids were completely filled with the dry sand and cement mixture. Water was then spread freely on the road surface forming a fluid grout of the sand cement and water, the sweeping, watering and rolling being continued to assist a perfect penetration and filling of the voids between the adjoining particles of stone. More sand and cement mixture was spread wherever it was found necessary to completely fill all voids and to leave a very thin covering over the entire surface, which when completed was smooth and even but slightly gritty. The roadway was then permitted to harden for about seven days before being thrown open to traffic, the roadway being wet down frequently during that period. Expansion joints were placed about 25 ft. apart by pouring a thin line of heated asphalt across the roadway after the broken stone was compacted but before any sand and cement mixture was spread. A section of 100 ft. in length was placed without expansion joints but reinforcing the concrete slab with woven wire mesh.

The completed roadway states the report presents a smooth surface, equal to new macadam, is quite free from irregularities frequently formed in concrete roads and offers a good foothold to horses. Automobiles have no detrimental effect on the road. After five months of fairly heavy traffic over the road no serious defects have developed and the coming winter will prove the efficiency or the advantage of expansion joints or reinforcement.

The measured quantities of materials used were 88 bbls. of cement, about 40 cu. yds. of sand and 200 cu. yds. of 1½ in. trap rock (commercial size), the resulting concrete representing a mass of 150 cu. yds. in place. Expressed in the proportion of the completed concrete the mixture would be about 1-3-7½; if expressed in the proportions of the loose materials used in the mixture would be about 1-3-12½. It would be manifestly impossible to secure a dense mixture if the materials were mixed in the latter proportions in the loose state, and the resulting concrete would unquestionably be porous and full of cavities and lacking in resisting power for road purposes. The result of the dense concrete being obtained by the expediency of reducing the voids contained in the loose stone by rolling.

The cost of the improvement was very nearly $1 per square yard and was in excess of the preliminary estimate. This was largely due to the cost of labor and the cost of renting tools and machines, and should prove materially less if similar work is done on a larger scale. All sprinkling was done by hand sprinklers, as it was found impossible to use a sprinkling wagon. All sand and cement was mixed by hand when a mechanical mixture would have been more economical.

The detailed cost of the work was as follows:

	Total.	Per sq. yd.
200 cu. yds. trap rock at $2.47.	$ 493.29	$0.2774
88 bbls. Portland cement	148.20	0.0805
50 cu. yds. of sand	75.00	0.0422
1,600 sq. ft. wire reinforcement	52.10	0.0292
2 bbls. of asphalt	15.00	0.0080
Lumber	16.00	0.0090
Steam roller, 21 days	210.00	0.1182
Teaming	150.00	0.0856
Hire of tools and machinery	100.00	0.056
Labor	517.50	0.291
Total	$1,772.00	$0.996

Concrete and Reinforced Concrete Section

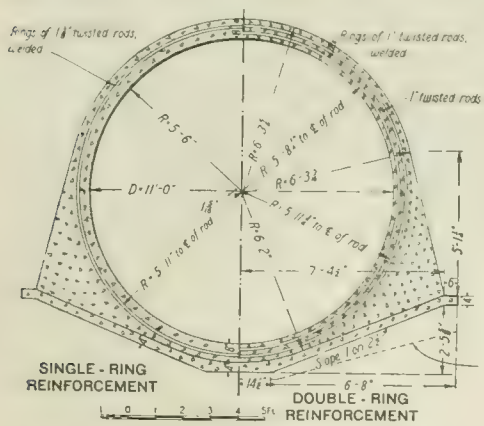
Note: This section is devoted to methods and cost of constructing concrete and reinforced concrete structures. It will cover the selection, testing and proportioning of concrete materials; laboratory tests of concrete; concrete mixing, transportation and placing; fabrication and placing of reinforcement, and form construction and erection. It will also contain articles on new and interesting developments in the design of reinforced concrete.

Results of Tests for Leakage Under Pressure of a Reinforced Concrete Pipe.

The reinforced concrete pipe shown in section by the accompanying cut was constructed for test purposes at Hunter's Brook on the Catskill Aqueduct of the New York water supply. The section 210 ft. long was built in place with the purpose of making it a part of the permanent construction should the tests prove satisfactory.

The principal features of this pipe are: Length 210 ft., made up of seven 30-ft. sections; inside diameter, 11 ft.; thickness, 8 ins.; reinforcement, welded rings of twisted square steel bars, about 1 sq. in. of cross-section for every 2½ ins. of pipe length. The concrete, consisting of 1 part Portland cement, 2 parts sand or stone screenings, and 3½ parts gravel or broken stone, was machine mixed, quite wet. Transverse tests made on samples of this material at 7 months —the average age of the pipe when tested— indicated an average tensile strength not less than 330 lbs. per sq. in., the so-called average transverse strength being 400 lbs. per sq. in.

When first tested under a head of 28 ft. the leakage from the pipe was at the rate of 560,000 gals. per mile per day, most of which was due to porous spots in the sides of the



Section of Reinforced Concrete Conduit Tested for Leakage.

pipe, especially where stone screenings had been used in the concrete instead of natural sand. After grouting and pointing the defective portions with cement mortar, the leakage was as follows:

Head feet.		Gals. per mile per day.
30	Leakage	55,000
62	Initial leakage	119,000
	Decreasing after 6 hours to	78,000
93	Initial leakage	215,000
	Decreasing after 2 days to	110,000
125	Initial leakage	465,000
	Increasing after 5 repetitions in 6 days to	816,000

After again pointing and painting the interior surface with cement grout, the leakage was as follows:

Head feet.		Gals. per mile per day.
34	Leakage	28,000
62	Leakage	36,000
92	Leakage	114,000
125	Initial leakage	240,000
	Increasing after 6 repetitions within 6 days to	497,000

The magnitude of the leakage in the first test was due mainly to imperfections in the concrete. Under a moderate head, less than 100 ft., the leakage decreased while the head remained constant, but when the head was increased the leakage increased at a somewhat higher ratio. On reaching a certain "critical head," in this case about 100 ft., the permeability of the pipe was radically changed, the leakage not only increasing at a much higher ratio than the head, but with each new application of pressure, indicating that the concrete begins to crack when the "critical head" is exceeded. A large number of longitudinal cracks were actually observed; most of them, however, were so fine as to be perceptible only by color differences while the concrete was still damp after the pipe was emptied. When the first cracks appeared the tensile stress in the concrete was estimated at 270 lbs. per sq. in., or 82 per cent of that derived from beam tests. The above results are for the pipe as a whole, although considerable portions of the pipe remained dust-dry under the maximum head of 125 ft.

Method of Constructing Reinforced Concrete Trestles for Railways, with Some Costs.*

In railroad construction in the West and South it was, and is still quite generally the practice to bridge unimportant streams, ravines carrying little or no drainage, bayous, and marshes, with pile or timber trestles. As the cost of timber increases and as the standards of railroad maintenance are raised, it is the practice on most roads to replace these structures, when they become ripe for replacement, with structures of a more permanent character. Where the drainage areas are small, pipes or masonry culverts are often built and the remaining portions of the bridges replaced by an embankment, and at such a low cost as to be economical. But there are, on most roads traversing the Mississippi valley, a great many pile trestles in river bottoms, and over bayous or swamps, which may not be filled and which, if replaced with steel bridges on permanent supports, would be extremely expensive, because of their great length.

These conditions are very familiar to all maintenance engineers on roads traversing this part of the country, and the necessity for retaining the entire existing opening is, in many cases, perfectly obvious. In most of these cases there is no need for spans of any great length, there being neither ice nor drift to catch upon supports placed closely together. For bridges having the characteristics described, many of them of lengths from 100 to 1,000 ft. or more, the writer has devised a construction which seems well fitted to replace the timber or wooden pile trestle bridge. As the wooden pile bridge is the cheapest wooden construction possible, it occurred to the writer when considering how best such structures might be made permanent to design a reinforced concrete construction, following the main features of the timber trestle.

An investigation of the reasons for the great economy of such a construction as the pile trestle shows that it is largely due to the small amount of work necessary to be done in the field. There are no cofferdams, foundation pits, or falseworks to be built. Very little raw material has to be unloaded and cared for. The members comprising both the substructure and superstructure are taken out and put in place, often largely by machinery and with a minimum of disturbance of the track and delay to traffic. It was evident that if a construction of permanent materials, having the characteristics mentioned, could be devised, the result would be what was wanted.

A structure embodying these features was built and tested, and with the experience gained, a standard plan was drawn up, which is shown by Fig. 1.

It should be emphasized that this construction is suited only for shallow openings, and it is the writer's practice to limit the height of concrete pile trestles to 16 ft. from ground line to base of rail. For greater heights it is his practice to substitute thin piers for the pile bents, although at considerably increased cost. Figure 2 is a view of a trestle built in accordance with the standard plan of Fig. 1.

The construction of these bridges in any great length requires some little organization, and the more thorough this is the less will be the unit cost and the better the construction.

In the bridges so far built, concrete piles of two kinds have been used—one being molded in horizontal forms and the other made by rolling in a machine, under the Chenoweth patents. The molded piles were used in the first of these bridges. They were sixteen inches square at the butt, had a 4-in. chamber at each corner, a taper of 4 ins. in 30 ft. on each face, and were pointed at the tip. The reinforcement consisted of four ¾-in. sq. corrugated bars, hooped with No. 12 gage steel wire, wound at close pitch near the butt and point, and at 3-in. pitch over the greater part of the length of the pile. The reinforcement was assembled on a mandrel and the spiral hooping wound around it by turning the mandrel. After the hooping was in place it was tied at frequent intervals with No 16 soft wire, and the complete reinforcement was then withdrawn from the mandrel.

The forms were of wood, unlined and made so that the sides could be removed as soon as the concrete was firm; the pile was left on the bottom boards until hard enough to stand handling. The reinforcement was hung in the forms by wires depending from the cross braces and concrete, composed of 1 part of cement to 4½ parts of gravel, mixed to a slushy consistency, poured in. The gravel was generally screened so that all the sand and pebbles ½ in. in diameter or less were retained and used, the coarser aggregate being rejected. The piles were allowed to harden at least 30 days before being shipped. This seems to be about the least time which can be allowed, as attempts to ship and drive piles of less age have not been successful. More extended seasoning is often easily obtained and is to be preferred.

The rolled piles are made in the machine shown by Fig. 3. This machine consists essentially of a movable platform, a shaft or mandrel, and means for moving and turning the piles, together with rolls for holding them in line during fabrication. The illustration shows some completed piles in the seasoning yard, where the piles are sprinkled frequently to assist the hardening of the concrete.

A somewhat incomplete comparison of the first year's costs of rolled and molded piling indicates that there is little difference in the cost of the two kinds. As the cost of making reinforcement for the molded piling was one of the principal items, it was decided to experiment with molded piling made without taper, the idea being to use a wire fabric, as reinforcement, which could be simply folded into a square and wired together at the lap, thus avoiding considerable labor. The cost of forms is also much reduced if they are not tapered. An efficient plant was designed and is shown in Fig. 4. On each side of each form a rail is placed. A pair of trucks has a short piece of track spiked to it at right angles to the track on which it runs, the level of the latter being such that a car can run off the upper track directly on to the rails between the forms. The car on the trucks is a hopper-bottom dump car and carries a half yard of concrete, Fig. 5. In operation the

*A paper read before the Western Society of Engineers, April 13, 1910, by C. H. Cartlidge, Chicago, Burlington & Quincy R. R.

mixer is placed high enough to dump into this hopper car standing on the trucks. This two-storied car is pushed over to the form and the dump car run off and dumped directly into the form. In spite of the economy of this arrangement no great difference in the cost has resulted, partly because of the difficulty of handling the square piles. On the whole, in the absence of definite comparative tests, the writer is inclined to favor the rolled pile. Tests to determine the relative strength of the two kinds will be made, however, for both compression and bending. It is probable that each form of pile will be found to have its own place and use.

As yet, no soil has been encountered in which wooden piles could be driven and in which it has not been possible to drive the concrete piles. In some soils it is expedient to employ a jet; in others, an ordinary drop hammer, a steam hammer, or a combination of the jet with one or the other forms of hammer. It is necessary to lift the drop hammer somewhat more slowly for the concrete pile than for the wooden pile, in order not to set the driver into vibration. A cushion of some elastic material must be placed between the hammer and the pile, and with this precaution very little damage to the head of the pile results, even after long continued driving. As a matter of fact, it is surprising how much punishment a well seasoned pile will stand. When it is necessary to drive the pile below the leads, as is generally the case, the follower is placed on top of the cushion. As the loads on these piles are great it is necessary to drive them to refusal, so that accurate knowledge of the required length is necessary. In case it is found that the piles so driven do not reach the elevation called for on the plans, the depth of the cap is increased accordingly. If it is found impossible or impractical to drive the piles to the depth anticipated, they can be cut off without difficulty. The cut need not be a smooth one, as the casting of the cap will take care of all irregularities of the head of the pile. Should settlement occur in a finished bent, the strength of the cap is important, so that the loads may be equalized and even settlement result. Experience has shown that the design of Fig. 1 provides sufficient strength. Slight settlement has taken place in two bridges but without causing cracks or damage. As the settlement was doubtless due to the fact that the piles had not been driven to refusal, a mass of concrete was placed about each settled bent, extending from just below the ground line to about three feet below; the slabs were jacked up to grade and a layer of concrete was placed between them and the caps.

The manufacture of the floor slabs is best accomplished in a convenient yard, where advantage can be taken of economical methods. Such a plant is shown by Fig. 6. It is necessary to provide a firm, unyielding bed. The sides and ends of the forms are removable, and as one span consists of two slabs, a temporary partition is placed in each form to be removed after a half span has been completed. A layer of paper is placed against the slab and the remaining half is cast. Drainage holes are also cast along the dividing line.

By referring again to Fig. 1 it will be seen that U-bolts or stirrups are set in the upper part of the slab to permit of its being easily handled. These are set at an angle so that there may be a direct pull when attached to a chain, thus obviating the necessity for a toggle-beam when lifting and placing the slabs.

After the slabs have remained in the forms for from two to four weeks, they are lifted by means of a locomotive crane and piled to one side until hard enough for service, the minimum time for seasoning being three months. When seasoned they are readily erected by the same locomotive crane, a mortar joint being placed between the bottom of the slab and the cap.

After being erected the slabs are painted on top with a waterproofing compound, and the joints over the caps are filled with a mastic of tar or asphalt and sand. It is better to fill these joints with such material than to allow them to fill with sand, as the former will admit of the slight expansion necessary. Thus far, the best material for waterproofing, with which experiments have been made on work under the direction of the writer, has been found to be a paint made of coal tar, Portland cement and kerosene, after a formula published in an engineering periodical a few years ago. This compound not only covers the surface but sinks into the bonds with it, so that two or three coats are sometimes re-

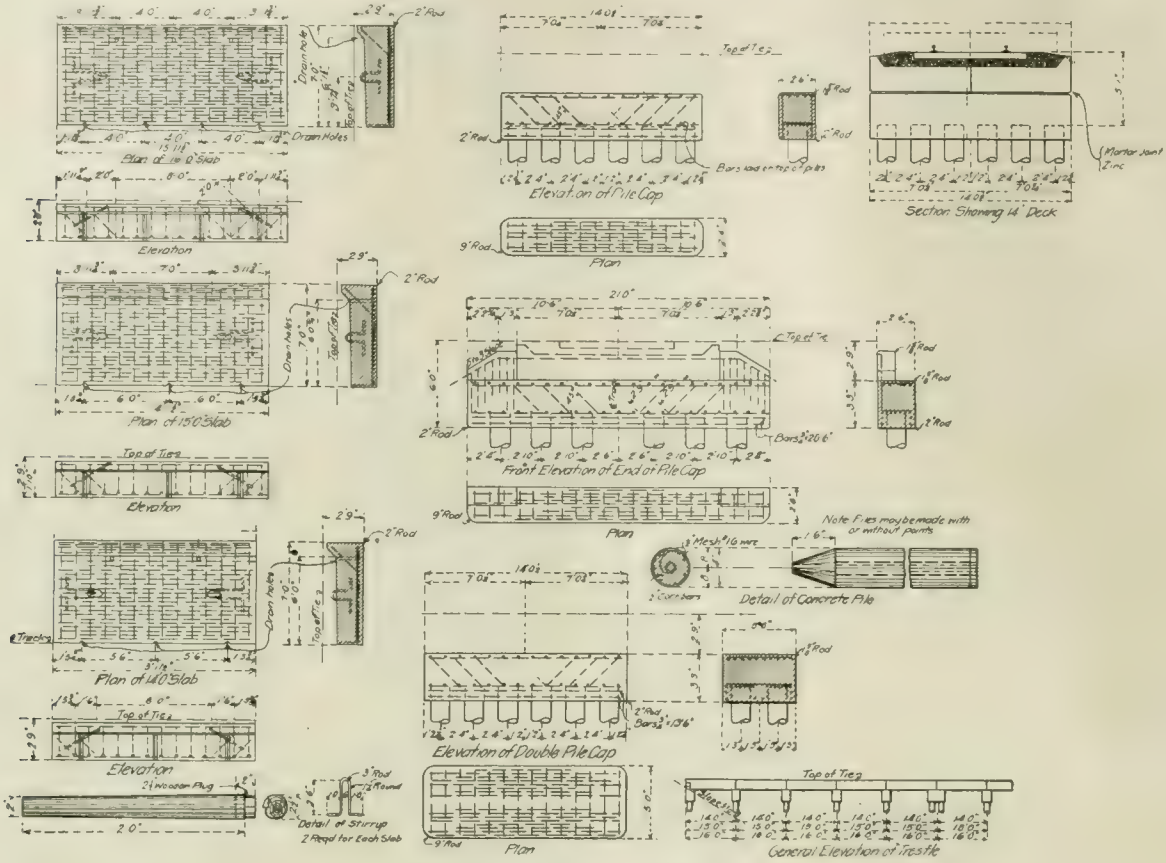


Fig. 1—Details of Reinforced Concrete Pile Trestle.

Fig. 2—View of Reinforced Concrete Pile Trestle.

Fig. 3—General Arrangement of Plant for Rolling Reinforced Concrete Piles.

quired. It is put on with paint brushes, in the same way as ordinary paint is applied. Another valuable attribute is its ability to adhere to moist or even wet concrete. Still another and not its least recommendation, is its very low cost.

It is evident that in a pile trestle the piling must be capable of transmitting the lateral and longitudinal stresses to the ground, so that considerable bending strength is required.

The double bents are designed to take up such longitudinal stresses as might be apt to place undue bending on the piling. As a matter of fact the stiffness and weight of the floor are such that it is somewhat questionable whether the double bents are necessary. It seems well to put them in, however, as an extra precaution.

As to cost, it is difficult to generalize, as conditions of traffic, length of structure, etc., have a very important bearing. With men experienced in this work, several bridges of lengths of from 80 to 250 ft. have been built at a total cost of from $20 to $26 per lin. ft. and on lines carrying heavy traffic, while in one or two short bridges of two or three spans, the cost has been as high as $45 per lin. ft. For the purpose of estimating, a cost of $30 per lin. ft. plus a constant of $300 will be ample for the design shown.

For bridges having a height above the ground line greater than 16 ft., a plan involving the use of thin piers is preferable. Such a structure is shown by Fig. 7. The piers are heavily reinforced and are generally founded upon wooden piles cut off 5 or 6 ft. below the ground line. Because of the greater cost of these piers, it is generally economical to make the spans longer than 16 ft., spans of 18 to 25 ft. being common. A great number of such bridges have been built and have so far developed no defects. When the spans are as long as 25 ft., however, it is impracticable to build the slabs in a plant away from the bridge, because of their great weight. In general, it has been found best to build them on false work adjoining their final position and to jack them into position.

The writer wishes to lay especial stress upon the necessity for the use of the best materials and the most skillful labor on such work. Not only should the cement be tested but also the sand to be used, unless its properties have already been thoroughly established. If the work of making piling or slabs is to be done by contract it should be done by experienced men, under proper specifications and under rigid inspection during every step of the process. If the work is done by company forces, the foreman must be one worthy of confidence, willing to obey instructions to the letter, and intelligent enough to realize the necessity for refinement of the work. The comparative novelty of reinforced concrete, and especially of such designs, makes necessary a most efficient organization for the work, and the placing of all possible safeguards to insure its integrity. Such organization and safeguards have been in effect in the case of steel construction for so long that they have become matters of course, and when reinforced concrete is carried on with similar care and scrupulous watchfulness, no fear need be felt as to its value as a material of construction. Without these, it is needless to say it is dangerous.

It is possible, under some specifications, to design short span steel bridges on concrete supports which will be as cheap as the designs described herein, but not, the writer believes, of equal strength to the bridges shown in these designs. Further, if the obvious advantages of ballasted, non-corrodible, fire-

Fig. 4—View of Yard for Molding Square Concrete Piles.

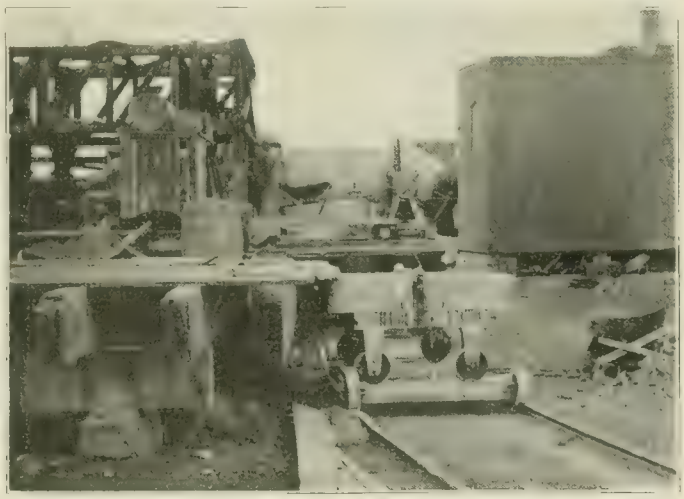


Fig. 5—View of Mixing Plant and Car for Transporting Concrete to Molding Yard.

Fig. 6—View of Floor Slab Forms and of Car for Transporting Concrete.

Fig. 7—View of Concrete Slab and Pier Construction for High Trestles.

proof bridges are considered, it will be seen that there is a preponderance of good qualities on the side of the reinforced concrete construction.

Methods and Cost of Constructing a Concrete Lock on the Illinois and Mississippi Canal.

The following data relate to the construction of what was known as the Feeder Guard Lock on the Illinois & Mississippi Canal. There were two guard locks on the canal, the one described here and one located at the head of the lower rapids of Rock River, near Moline, Ill., the costs of which are given in "Concrete Construction: Methods and Costs," by Gillette and Hill.

The Feeder Guard Lock was a combination structure. Its masonry work comprised, therefore, the foundations and walls of the lock proper; sills, pier and abutment for two sluice gates; foundations for a highway bridge and foundations for two small needle dams. All this masonry was concrete.

Foundations.—The lock was in rock cut which was excavated by drilling and blasting and loading into dump cars by steam shovel, bringing the bottom to grade with pick and shovel. Under the lock walls all rock that could be loosened by pick was taken out and the surface was brought to grade with natural cement concrete. Trenches were also excavated under the meter sills and at other points and filled to grade with Portland cement concrete.

Lock.—The lock is shown in plan by Fig. 1, and is 35x170 ft. inside chamber and 228 ft. long, with a retaining wall at each end, making a total length of 340 ft. The sections of the walls are indicated by Fig. 2. For convenience the stepped wall next the rock bank will be called the east wall and the other will be called the west wall.

Other Masonry.—The sluice gate abutment was 51½ ft. long, stepped down at both ends, and 18 ft. high and 4 ft. wide on top. The sluiceway pier is 31½x6 ft. and 21 ft. high. The sluice-way sills were 15½ ft. wide and 3 ft. thick.

METHODS OF CONSTRUCTION

The masonry work comprised 79.9 cu. yds. natural cement concrete and 2,404.7 cu. yds. of Portland cement concrete. Figure 1 shows the layout and general arrangement of the concrete construction plant.

Materials.—Gravel was taken from the river about one-half mile from the lock and required neither washing or sluicing. Sand for facing mortar was obtained by screening the gravel. The gravel was hauled and stored in a pile, as shown by Fig. 1. The cost of the 550.7 cu. yds. of gravel was as follows:

Item	Total.	Per cu. yd.
Loading, screening and hauling	$2,934.18	.....
Coal	31.33	.....
Miscellaneous	30.38	.....
Total	$2,995.89	$0.544

Rock for broken stone was taken from the lock excavation and adjacent canal prism, loaded into dump cars and hauled by a small construction engine to a No. 2 Gates crusher plant located as shown by Fig. 1. The stone was screened to sizes passing a 2-in. mesh and stopping on a No. 5 screen into a double bin holding about 40 cu. yds. The stone bin was elevated and wagons or cars passing underneath were loaded by chute and hauled to the storage pile, where a reserve of several hundred yards was kept; ordinarily the stone was crushed as needed for concrete. The cost of 1,875 cu. yds. of crushed stone was as follows:

Item	Total
Erecting crusher	$ 216.43
Laying track	34.00
Loading rock	617.59
Crushing	689.22
Coal	65.95
Engineering	7.00
Miscellaneous	30.38
Total	$1,641.81
Total per cubic yard	$0.876

Utica natural cement and Alpha Portland cement were used. About half of the cement was received and stored in a warehouse one mile from the lock and was trans-shipped to the lock; the other half was hauled direct to the lock and transferred to narrow-gage flat-cars which took it to the cement store house. These same narrow-gage cars brought cement from the warehouse to the cement stone house. The cement store house was 18x36 ft., and had a capacity of 150 barrels.

The shed was about 18 ft. wide and 36 ft. long, the long side being parallel to the center of the lock and had a capacity of about 150 bbls. of cement. The floor was built on a level with the top of the flat cars on which the cement was hauled, that part over the track being omitted so that a car could be pushed into the shed and its top form a part of the floor, leaving the car to be unloaded when desired. This was found to be very convenient as a supply of cement could be placed on the permanent floor and the car reloaded whenever time permitted. This was usually done after the section of the form for the day's work had been filled with concrete, and the top dressing was being put on the same. Two cars would be filled and brought to the shed, one car being unloaded on the platform, and the second car remaining unloaded in the shed. The second car was usually unloaded as the cement was used the following day by the regular cement handlers.

At the opposite end from the track entrance, the platform was built entirely across the shed and a bin was built on it for opening and mixing the cement, several barrels being opened at one time.

The cement was measured in a rocker and dumped into the material car. The rocker consisted of a box made of 1-in. lumber mounted on a pair of rockers cut from 2x12 in. lumber, and fastened together by pieces of wood 2x4 ins. One of these pieces served for a handle to raise and lower the rocker. The box was the shape of a scoop, having one closed end and the other a projecting end with a slide in it. A strip of wood was nailed around the inside of the box at a proper height to measure the required amount of cement for one batch of concrete.

Mixing Plant.—The general layout for the concrete work is shown by Fig. 1. For convenience we will designate the tracks from the crusher and material piles to the material hoppers as the "supply tracks," the track from the material hoppers to the mixer, as the "material track;" and the tracks from the mixer to the hoist and the hoist to and on the forms, as the upper and lower "concrete tracks," respectively. All of the concrete, except that portion in the foundations, was mixed with a No. 2 Smith concrete mixer.

The materials were dumped into the mixer through a specially constructed extension chute, which was permanently attached to the mixer, raising and lowering with the drum as the concrete was dumped and the machine again righted.

The mixer, engine and a vertical boiler were furnished on a single frame mounted on trucks, and cost the United States $887, housed and delivered at Rock Falls, Ill. The extension chute was made in a local shop and cost about $30.

The mixer was placed in the bottom of the lock pit, about 60 ft. above and on line with the east wall of the lock. The wheels were removed from the truck and the mixer set up on a crib high enough to allow the concrete to be dumped into a car.

Tracks.—The lower concrete track was parallel to the center line of the lock. Over the mixer, at a height sufficient to clear the machine, and at right angles to the lower concrete track was the material track carried on a trestle to the towpath. On this track the dry materials for the concrete were hauled to the mixer from the material hoppers in a car similar to those used for carrying the concrete. The car will be described in a succeeding paragraph. The materials were emptied into the mixer by opening a slide in the bottom of the car and allowing it to pass into the mixer below, through the extension chute. The ties above the mixer on the material track were omitted on account of the chute.

Water Supply.—The water used in mixing concrete was supplied through a small pipe line from the water tank belonging to the narrow gage railroad. A barrel was placed on the trestle above the mixer from which the water was dipped in a pail and poured into the mixer through the extension chute.

Material Hoppers.—The material hoppers consisted of a pair of hoppers, one for gravel and one for crushed rock, located on the material track at one end of the cement shed, about 50 ft. from the mixer.

The hoppers were about 8 ft. square on top, 2 ft. square on the bottom, 4 ft. deep, and were about 12 ft. between centers, thus allowing an opening between them for putting the cement in the material car. Each bottom was fitted with a cast iron chute with a steel slide having a lever arranged for opening and closing the same. The chutes were identical with those used on the bottom of the concrete cars. The bottoms of the hoppers were high enough to allow the material cars to pass under them to be filled and the top was low enough to allow the material from the crusher and the piles to be dumped into them from dump cars running on the supply tracks which were laid on the natural surface.

The cement shed was set on the towpath with its long side parallel to the canal. The hopper next to the canal prism was used for gravel, the track to it being parallel to the short end of the cement shed and was carried over the tow path on a short trestle. The other hopper was used for the crushed rock and the track to it was carried on the natural surface parallel to the long side of the cement shed terminating at the side of the other track.

Concrete Cars.—On all previous work on locks, the side dump cars were used for carrying the concrete from the mixer to the forms and it was necessary to build a special runway at the side of the forms for the track. On the abutments for bridges, on the Feeder and Western Section, it was found that this car was objectionable and a car was designed with a bottom dump. Castings were made in a local foundry and the car was built by the carpenters on the work.

It consisted essentially of a wooden hopper lined with sheet steel and mounted on two pairs of trucks, 36-in. gage, having a casting in the bottom with a slide made of ¼-in. steel plate. The opening in the casting was 12 ins. by 18 ins. The cross section 2 ft. above the casting, and from there to the top of the car, was 3 ft. x 3 ft. 6 ins. The total height was 3 ft., and when level full the car held about 22 cu. ft. The slide was operated by a lever attached to the side of the car. The car proved to be far superior to the side dump car as it did not require a special runway and the concrete could be distributed along the entire length of the pit and only a part of the concrete used if desired. A set of trucks for one car cost the United States $12.90, and one chute $10 at the foundry.

The Hoisting Plant.—All of the concrete was raised from the canal bottom to the top of the forms. An elevator was constructed of 6x8-in. timbers, and a single drum Lidgerwood hoisting engine was used for hoisting. The frame of the elevator was mortised and fastened with wooden pins, the leads being made of 3x8-in. pine.

In order to provide a passageway for cars without using switches, a track just long enough to hold one concrete car was constructed, at the same elevation as, and on the opposite side of the elevator, from the track leading to the forms. Two cars were used for carrying the concrete, one car being at the mixer when the other was on the upper concrete track. The cage of the elevator would be left at the top making a continuous track over the elevator and the car from above would be run over it to the passageway. The cage would then descend, the car of concrete be placed thereon, and raised to the upper track. As soon as the loaded car was pushed off, the empty one was pulled on and lowered to the mixer, and the operation

repeated. For every load of concrete taken to the forms, it was necessary to raise the cage twice. This would seem to be a waste of both time and power. However, the facing or "fine stuff" was mixed near the foot of the elevator, and it was necessary to hoist it. Also it was loaded into wheelbarrows and hoisted on the second trip of the cage, thus making a load for nearly every ascent of the cage. The scheme worked very nicely and very little time was lost at the elevator.

Forms.—Figure 2 shows the general plan of forming at the Feeder Guard Lock. The posts were 8x10-in. timbers, the sills and braces were 6x8-in. timbers, the facing lumber was 3x12-in. pine, surfaced on four sides, and the spreaders were made from 2x4-in. and 4x4-in. materials.

Anchor bolts ¾ in. diameter and 2 ft. long were set, with Portland cement, in the rock on the center line of the lock at intervals of 4 ft. and 8x10-in. timbers were bolted thereto. Sills were laid from this timber to the bottom of each post and the braces were placed from the sill at an angle of about 45° to the post at a point near the top of the wall. The braces were cut to fit on top of the sills and against the posts, leaving shoulders of about 2 ins. to abut against blocks of 2-in. lumber, which had been securely nailed to the sill and to the post.

Wedges were placed between the shoulder and block on the sill, with which to plumb the walls and between the sill and central longitudinal timber, to bring the face of the form to the exact line of the wall.

Posts were set opposite each other on the front and back of the wall. The foot of the braces at the back of the wall were set against the rock on the side of the ditch for draining the pit.

East Wall.—Spreaders 2x4 ins. were cut the exact length of the width of the wall and on the low wall one was placed about 3 ft. below the top of the wall, and one about 1 ft. above the bottom. A ⅝-in. rod connected the two posts at about one-half of the height of the wall, the protruding ends being cut off a little under the face after the form had been removed, and the surface repaired with mortar of the same consistency as the facing. The posts on the low wall were 16 ft. long, and were tied at the top with a 3x12-in. plank, which was bolted at the top of the post and had a block under it nailed to the post. This was done so that the track for the concrete cars might be fastened thereon. On the higher wall, the posts were 20 ft. long and three 4x4-in. spreaders and two ⅝-in. rods were used. The facing lumber was put on with 40-penny wire nails.

West Wall.—The west wall having been built against the natural rock, and in a number of places having the rock extend into the wall section, the forming was different from the east wall. Where the rock projected into the section, the posts on the back were set upon the rock and braced back to the rock slope. Where the excavation had been made wide enough for the regular section, the posts were set on the bottom, concrete deposited around them, and the posts cut off when the forming was removed, leaving the ends embedded in the concrete.

The inside of the form was built the same as the east wall form except that the ⅝-in. rod was omitted and a short secondary brace used in its stead.

Sections.—The forms for each wall were divided into sections by bulkheads made of 2x12-in. lumber for facing and 6x8-in. timbers for posts, and braces. The bulkheads were so placed that alternate sections were filled with concrete, the bulkheads then removed and the intervening sections filled. A 3x12-in. plank with sides and ends beveled was nailed on the inside of the bulkhead and removed with it after the concrete had been deposited to form a bond between the adjacent sections. Each wall was divided into ten sections, of which two were 20 ft. long, two were 22 ft. long, and six were 24 ft. long. The smallest section contained 50 cu. yds. and the largest 148 cu. yds.

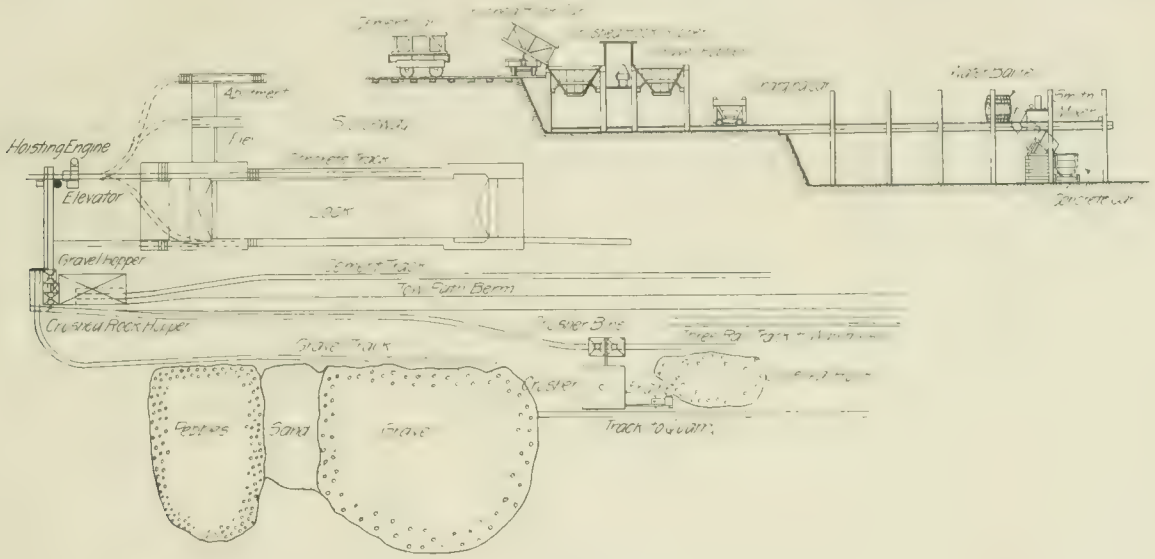


Fig. 1—Lay-Out of Concrete Construction Plant for Canal Lock Work.

Hollow Quoin Casings.—The hollow quoin casing is made up of several sections about 5 or 6 ft. in length. Each section has lugs cast upon them through which the adjoining sections are connected with short steel pins. The form for the wall at this place is built the same as at other places, especial care being taken to make the walls plumb. The quoin casting is then temporarily fastened against the form and the section filled, the temporary fastenings being removed and the anchor bolts carefully set as the concrete is filled up to them.

Lumber.—The lumber for the forms was purchased with the expectation that it would be used for forming for the Guard Lock, and subsequently used in the construction of the apron for a movable dam. If this had not been the case, smaller sized timbers could have been used. The dam has not been constructed as yet, but the lumber has been used for forming at the Guard Lock and at Aqueduct No. 9, on the Feeder. About 131,000 ft. B. M. of lumber was purchased at a cost of $2,590.69, of which a charge of $813.34 was made to the lock.

Mixing and Placing.—As soon as the form for the end of the east wall was ready, a trestle was built of 6x8-in. timbers, and a track laid from the hoist to the form, and work begun depositing concrete in the end section.

Mixing.—At the beginning of the work, the material hoppers were filled, one with gravel and the other with crushed rock, and as the work progressed the hoppers were kept supplied with 2½ yard dump cars, one car being used for each material.

The dump car was pushed under the bin of the crusher, the chute opened, the car filled with crushed rock, and drawn by a single horse from the crusher to the hopper. The track was a little up-grade from the crusher so that the car returned by gravity.

The gravel was shoveled into a car on another track by a number of men and it was hauled by the same horse to the gravel hopper, where it was dumped. One horse with a driver attended to all of the hauling. The material hoppers acted as a governor to the mixing plant.

All of the dry materials were carried to the mixer in a single material car, one batch at a time. A batch consisted of 9 cu. ft. of crushed rock, 9 cu. ft. of gravel, and 2 cu. ft. of Alpha Portland cement.

The car was first pushed under the hopper containing crushed rock, where it received the proper amount of that material. It was next pushed ahead to the opening between the hoppers where the cement was dumped into it from the rocker above. It was then pushed under the gravel hopper, where the proportion of gravel was obtained. The car was then pushed over the extension chute of the concrete mixer and the material dumped into the mixer. The cement being between the crushed rock and the gravel, a partial mixing was obtained when the materials were dumped into the mixer. It was found when the rock was put in the bottom of the car that it did not arch over like the gravel, and the car was dumped much easier than when the gravel was placed in first. Some trouble was experienced in getting the material through the extension chute on the mixer and it was found necessary to keep a man at this position all of the time. This attendant also attended to the wetting of the concrete.

A bucket of water was placed in the mixer before the materials were dumped and enough added afterwards to give the concrete the proper consistency. The concrete for this lock would be considered a rather dry mixture, there being just enough water used to flush to the surface after the concrete had been thoroughly tamped.

A batch would be placed in the mixer as soon as one was taken out, allowing it to remain mixing as long as possible without delaying the work. About 20 batches were mixed per hour. However, we crowded the capacity somewhat, using 20 cu. ft. of loose material instead of 13½ cu. ft., the rated capacity. A small amount of the concrete would be spilled out of the mixer, but was easily thrown back into the next batch by one of the attendants.

The conical shape of the mixer, and the wings attached to the inside of it, threw the materials together and turned them in such manner as to give a first-class job of mixing. The machine was eminently satisfactory. By

tilting the machine, the contents of the mixer was dumped into one of the concrete cars. The car was pushed to the hoist, elevated, and taken to the section which was being filled.

Depositing.—The bottom of the section having been washed with a wire broom and a mortar consisting of 1 part Portland cement and 2 parts of sand about ½ in. thick spread over the entire bottom surface, the concrete was dumped into the pit. Considerable of the labor of spreading was saved by opening the slide in the bottom when the car was at one end of the pit, and pushing it along, distributing the concrete the entire length of the pit. The concrete was deposited in layers about 6 ins. thick and thoroughly tamped.

Surfacing.—All of the exposed surfaces and copings of the walls were finished with a mortar consisting of 1 part of Portland cement and 2 parts of torpedo sand. The materials were first thoroughly mixed dry and then water was added as the mixture was turned over, five or six turns being given. The mixing board was placed at the foot of the hoist and the facing was carried to the top of the form in a wheelbarrow, where it was dumped into a box in the pit, through a galvanized iron tube.

The box had a capacity of about 2 cu. ft. and had handles on its ends so that it could be easily carried about in the pit.

The tube was made in sections having different diameters, increasing from the top so that the second would telescope the first, and the third over the second. The first section was about 6 ins. in diameter, and was permanently attached to a wooden hopper which was fastened to the form or runway over the form, to be filled. The second and third sections had ears attached near the upper ends by which they were suspended in position from the top by light ropes. When working in the bottom of the pit the tube was extended its full length, and as the form was filled the sections were pulled up out of the way. This proved to be a very satisfactory method, very little of the facing being lost, as was done when it was dumped into the pit from the top.

The facing was put up against the surface with the back of a shovel or a trowel in the shape of a wedge, which was about 1½ ins. thick at base, and about 1 ft. high. When tamped, this would give about 1½ ins. of facing. A board was placed in front of this wedge of mortar to protect it from the rocks and pebbles that scattered from the concrete as it was being dumped into the pit.

The concrete having been deposited, the protection was removed, the concrete leveled off and tamped together with the facing. Care was taken to keep the coarse rocks away from the face, the finer part being placed next to the fine stuff. This operation was repeated for each course until the form was filled to within ½-in. of the top, when the coping was given a side-walk finish. The edge was struck off with an edging tool having a radius of about 1 in. The coping was given a crown of about ¼ in., and as the cement was taking its initial set, the surface was rubbed down with a float, giving a sand finish.

In order to give a more finished appearance at the joints between two adjacent sections, a triangular moulding or "bead" ¾ in. on each side, was nailed in the corner formed by the bulkhead and the front of the form. When the first section was completed, and the bulkhead torn out, the bead was left in position and a second one was fastened next to it. In the finished wall this gave a vertical mark ¾ in. deep and 1½ in. wide on the face, half being on each section.

Beads were placed at all small corners where the edges would be seen in the completed work, such as treads and risers of step, recesses, etc. At the more important corners such as at the ends of the lock walls, a large bead or "corner board" was placed. It had a face of 12 ins. and was placed at an angle of 45° with the face of the wall.

Force Employed.—The following is a list showing the average number of men of the various classes employed per day of 8 hours, and the part of the work performed by each:

Hauling lumber, building and wrecking forms and other miscellaneous carpenter work	1 Foreman. 8 Carpenters 1 Laborer.
Painting	1 Engineman.
Screening sand	1 Laborer. 1 Laborer.
Hauling cement	1 Teamster with team.
Hauling coal, etc	1 Engine crew
Carrying water	1 Water boy.
Miscellaneous work	1 Laborer
Mixing and Placing Concrete	
General overseeing	1 Foreman.
Filling and tending crusher rock car	1 Laborer
Shoveling gravel	5 Laborers.
Hauling crushed rock and gravel	1 Teamster with team.
Handling and measuring cement	2 Laborers.
Pushing charging car	2 Laborers.
Wetting concrete	1 Laborer.
Running mixer	1 Engineman.
Tending mixer	1 Laborer
Pushing concrete cars	3 Laborers.
Mixing facing	2 Laborers.
Hoisting concrete	1 Engineman.
Wheeling facing	1 Laborer.
Putting on facing in pit	2 Laborers.
Distributing concrete	3 Laborers.
Tamping concrete	7 Laborers.

Total, 1 Foreman, 2 Enginemen, 1 Team and 30 Laborers.

Foremen were paid	$100.00 month.
Enginemen were paid	60.00 month.
Carpenters were paid	2.50 day.
Laborers were paid	1.75 day.
Water boys were paid	.75 day.
Teamsters with teams were paid	3.00 day.

Program and Progress of Work.—The first concrete in the walls was deposited in the north end of the east wall of the lock. Those portions of the walls 17 ft. high were first built, with the exception of the bridge seats, the construction of which was deferred until after the low walls were built. The concrete tracks were then lowered and the rails laid on 3x12-in. plank on top of the finished walls and extended onto the forms for the lower walls.

On the low part of the east wall the sections averaged about 70 cu. yds. Work on one of these sections began promptly at 8 o'clock A. M., and the section was usually filled by half past two, allowing 30 minutes for dinner. This made an average of about 11½ cu. yds. per hour. The organization was then broken up, part of the men put on the top dressing of the section just filled, part cleaned the form for the following day, some hauled cement, others excavated for foundations of sluice gates, loaded rock on cars for crushing, and did other miscellaneous work. On the west wall the sections averaged about 55 cu. yds. and as the miscellaneous work had been about finished, the concrete work was continued throughout the day. One section was completed and as much deposited in the second as possible. In this way about three sections were completed in two days. Two days were used in filling the larger sections. The largest day's work was 105.5 cu. yds., which required nine hours to complete.

Concrete work was begun on September 29, 1902, and was finished November 10, 1902. Three days were lost on account of rain and three days were used for excavating rock.

Quantities and Cost.—The total amount of Portland cement concrete, including the part in mitre sills which was mixed by hand, was 2404.7 cu. yds., and the total cost was $15,584.80, which would be $6.48 per cu. yd. The above price does not include the cost of engineering and plant, which would be about 10 cts. per cu. yd. for each item. Following is a table showing the various items of cost:

COST OF PORTLAND CONCRETE MASONRY AT GUARD LOCK, FEEDER.

Labor—	
Erecting and wrecking forms	$1,434.63
Building trestles	85.14
Building cement shed	49.26
Constructing concrete cars	42.00
Unloading and hauling lumber	177.28
Track work	178.43
Mixing and placing concrete	2,557.89
Setting up and dismantling machinery	200.49
Unloading and hauling cement	137.03
Setting up pump and pumping	147.34
Miscellaneous work	48.95
Bills—	
Coal	$ 102.00
1,553 cu. yds. crushed rock at 87.6c per cu. yd.	1,360.43
1,600 cu. yds. gravel at 54.4c per cu. yd.	870.40
2,571.3 bbls. Alpha Portland cement at $2.79 per bbl.	7,173.90
Lumber, 33⅓% of original cost	813.34
Miscellaneous bills	141.94
Total cost of 2,404.7 cu. yds. concrete	$15,584.00
Cost per cu. yd.	$6.48
No. bbls. Portland cement concrete per cu. yd.	$1.07

The Portland cement was purchased at a time when cement was exceedingly high. It cost the United States $2.79 delivered at Rock Falls, Ill. The following year cement was bought at almost half the above price.

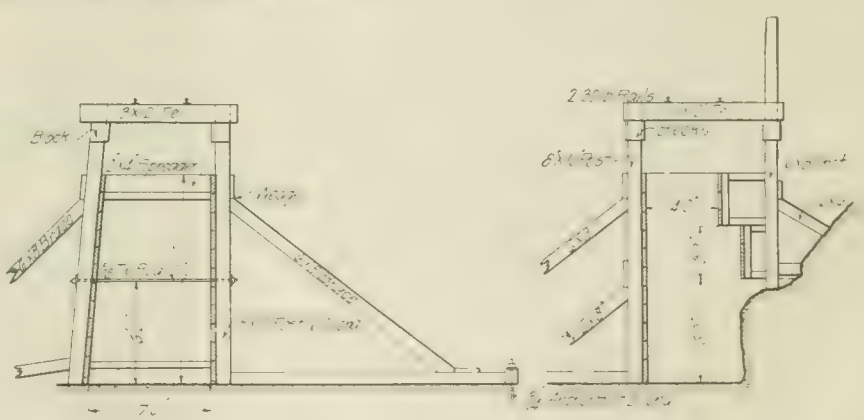
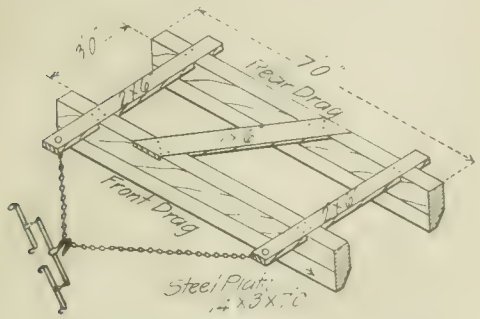


Fig. 2—Sections of Forms for Concrete Lock Walls.

The 79.9 cu. yds. of natural cement concrete cost $403.21, or $5.05 per cu. yd. The above article is compiled from data furnished by F. W. Honens, U. S. Engineer Office, Kansas City.

"Home-made" Road Drag.—There are several types of "home-made" road drags now in use in the maintenance of certain roads. The most commonly used of these are the split log drag, the plank drag and the lap plank drag. Many drags are dodged so that when pulled at an angle they will exactly track, but when drag is made in that manner it can be used only to go one way on one side of the road. In a recent bulletin of the Southern Appalachian Good Roads Association, Mr. W. L. Spoon, Highway Engineer, North Carolina Geological and Economic Survey, describes a drag which can be used up and down and back and forth on either side of the road. His description of the method of constructing and using this drag follows: After the pieces are set up as shown in sketch, a piece may be tacked across the ends to hold them in place while sawing and fitting in the tie pieces. To fit in the tie pieces, lay them on the drags 8 ins. from the ends and mark the drags carefully so that when the places are sawed and chipped out for the ties, they will fit in tightly. It is a good plan to make them so tight that they must be driven in with a hammer, for then the nails will hold much better. After the two drags have thus been joined, and the two ties set in as shown in the cut, nail them securely with five 40-penny nails at each place, as indicated. These ties should project 12 ins. over in front and 6 ins. in the rear. A 2-in. hole should then

be bored in the front end of the tie, as indicated. This hole is for the chain to pass through a hitch. Next lay the brace piece on and mark carefully, as shown, then cut and fit the brace in tightly and nail securely with 20-penny nails. If the directions have been followed carefully, it is now ready to turn upside down. When turned, hew the back bevel on the drags with an axe, as shown in the cut, leaving the front edge of each drag one inch thick. While it is still in this posi-



Construction of Road Drag Used on North Carolina Road Work.

tion, nail securely the two steel plates so that they will extend about ⅛ in. lower than the face of the drag. This is done for the reason that the steel will have a better chance to get hold of the road and move material than it would if it were placed flush. When this has been done, turn the drag right side up and it is ready for the chain and to be put to use. To put the chain on, pass it around the tie as indicated, and down through the hole in the end of the tie, then up through the hole in the end of the second tie and around it, behind the drag, as shown in the cut. The stretcher hook may be hitched in at any place desired to give the angle to the drag that is desired. This drag will work either end forward, simply by a change in the hitch. All that is necessary is to move the hook on the chain. A little practice will soon make any one proficient in the use of this drag. To operate it, throw a board 6 ft. long and 10 or 12 in. broad on the ties and brace, about midway between the drags. This is for the driver to stand on. It will be interesting to notice the effect of the driver changing his position on the drag. Step one foot on the front of the drag, and it will cut and carry material until the weight is removed; step back on the rear drag and the front one will drop its load and the rear one catch it. Step forward again and the latter drag will drop its load. In this way a little practice on the part of the driver will enable him to become very proficient in filling up holes. If it is desired to crown the road up, stand with superior weight on the front and a little to the ditch end of the drag and let the drag have an angle of about 45 degrees.

Stone for Road Repair Work.—For several years the State Highway Department of Connecticut has caused to be furnished at the completion of every state road contract a supply of crushed stone of ½ to ¾ in. size, for top dressing, to be used as required in repairing the road. On all contracts now in force, the amount of stone named in each contract for future repairs is arranged for on the basis of 100 tons per mile of road constructed, and before any contract is accepted, the contractor is obliged to furnish and stack this amount of stone where directed by the Town Selectmen. The contractor is required to place this extra stone in a neat formation not exceeding 5 ft. high with the stone trimmed up neatly into a compact form.

The Long Branch Pier & Land Co. has awarded the contract for the superstructure of its pier at Long Branch, N. J., to Jesse A. Howland, Seabright, N. J., at $158,000. John B. White, of Long Branch, was given the contract for erecting the buildings on the Ocean Park grounds.

Earth and Rock Section

Note: This section is devoted to methods and costs of excavating earth and rock and building embankments. It will cover the grading of roads and railroads, diking and canal work, dredging, building reservoirs and earth dams, sewer and water pipe trenching, quarrying, etc.

The North Shore Channel of the Sanitary District of Chicago; Methods and Some Costs On Sections Four and Six.

The North Shore Drainage Channel, which has been under construction for about two years, is scheduled to be in operation by the end of the year. This canal was described in ENGINEERING-CONTRACTING of Aug. 4, 1909, and the methods and costs of constructing Section 1 of the canal were then given.

The channel is 8¼ miles long and extends from Lake Michigan, at Willmette, southwardly and westwardly to the North Branch of the Chicago River, at Lawrence Ave. The average cross-section is about 140 ft. wide on top, 26 ft. wide at the bottom and 28 ft. in depth. The water area will be 720 sq. ft. and about 13.6 ft. deep. The entire sewage from the district bordering the north shore of Lake Michigan from Lawrence Ave. to Willmette, will be turned into the channel when completed.

For construction purposes the channel was divided into twelve sections. Number 1 being at the north end and Number 12 at the south end of the channel. At the beginning of the work, only a part of the right-of-way had been secured, and also during the second year operations were handicapped by the excessive rainfall. In spite of these and other troubles, however, the work has now been about two-thirds completed, and is well organized for the balance of the construction to be done.

Sections Numbers 4 and 5, under contract to James O. Heyworth of Chicago, have been completed. The top-soil on both these sections was excavated with team and drag scrapers. In this way 47,000 cu. yds. were removed from Section 4, and 21,000 cu. yds. were removed from Section 5. The balance of the cut was made with Heyworth-Newman excavators, one machine working on each section. These machines are designed and operated by Jas. O. Heyworth, who has patented the machine and bucket and is manufacturing them.

This machine is built to operate from the bank. Its whole weight is balanced upon a portable turntable. As shown in the accompanying views, Figs. 1 and 2, of the machine, the boiler and engine are housed on the turntable so as to balance the 100 ft. steel boom, which handles a three-yard bucket. When in operation the entire machine revolves on the turntable and is able to handle anything within a radius of 110 ft. The manner of filling the bucket differs from the method of filling most buckets in the fact that this bucket is made to dig up, or, in a direction toward the machine, instead of down and away from the machine. The bucket is placed with its nose toward the machine and the drag-line wound in on the drum until the bucket is filled. This forward motion is continued by raising the bucket on the load line. Simultaneously with the raising of the bucket, the boom is set in motion by the revolution of the machine on the turntable, and the bucket is dumped when the boom is over the spoil bank without stopping the revolution of the machine. When running steadily, on dry work, about 800 to 850 revolutions are made in 24 hours.

The advantage of using a bucket which digs in an upward direction is shown in the view, Fig. 2, of one of these machines excavating in 14 ft. of water. This picture was taken on Section 12, at the junction of the canal with the North branch of the Chicago River. Any bucket which digs in a downward direction would be impractical here as the action of the water, and the reversal of motion would tend to loosen the load before the bucket had attained an upright position. It requires, however, an experienced operator to get a smooth finish on the slope of the cut, and also, to be able to place the bucket under water so as to get a bucket-full of material.

The records of the work on Sections 4 and 5, according to the estimates of the engineers, are given here. These sections were in dry excavation, all material being stiff blue clay.

Section 4.

1908.	Cu. yds.
Sept.	34,350
Oct.	29,481
Nov.	25,543
Dec.	24,168
1909.	
Jan.	19,776
Feb.	27,878
March	52,163
April	13,224
May	16,647
June	48,151
July	26,683
Aug.	39,341
Sept.	36,410
Oct.	30,020
Nov.-Dec.	29,693
Dec.	15,513
	499,062

Section 5.

1908.	Cu. yds.
May	35,685
June	35,830
July	26,089
Aug.	19,954
Sept.	29,201
Oct.	38,080
Nov.-Dec.	1,000
Dec.	15,890
	201,712

Fig. 1—Heyworth-Newman Drag Line Excavator Excavating Dry.

These figures are the engineer's estimates and show the amounts allowed on the monthly estimates to the contractor. The figures may vary a little from the actual number of cubic yards taken out by the machine in any one month, because of the variation of time of

taking cross sections, but the average yardage per month for the 16 months' work on Section 4, and 8 months' work on Section 5, may be considered as nearly correct for the capacity of the machines. This would be, on Section 4, an average of 31,191 cu. yds. per month, and on Section 5, an average of 25,214 cu. yds. per month.

Section 4.

	Cost per cu.yd.
Labor	0.061
3 tons coal per day	0.010
Repairs and miscellaneous supplies	0.048
15% annual interest on $15,000 plant	0.006
50% annual depreciation on $15,000 plant	0.02
Total cost per cu. yd.	$0.145

Fig. 2—Heyworth-Newman Drag Line Excavator Excavating Under Water.

An estimate of the cost of labor for one machine is as follows: No consideration is taken of interest on contractors' bond, insurance, or of general office expense. The work is divided into three shifts of 8 hrs. each for the operators, and two shifts of 12 hrs. each for the balance of the crew. The work is carried on 6 days a week or 25 days a month. The figures were obtained by the editor while going over the work and are given according to the information furnished him. He believes, however, that the crew given for each machine is too large. It would be more nearly correct to eliminate the items of mechanic, blacksmith's helper and oiler; and to

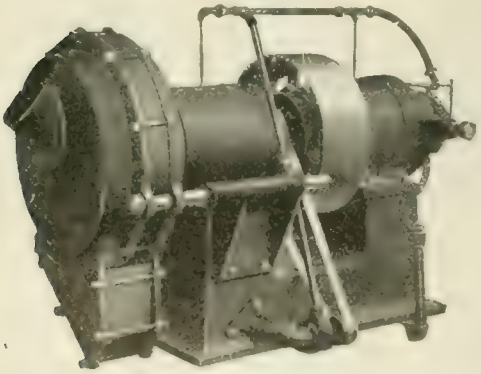


Fig. 1—View of Symons Disc Crusher: a New Type of Stone Crusher.

divide the blacksmith's time between three machines.

12 laborers at 20c per hr., per month	$ 720.00
3 operators at $150 per month	450.00
2 firemen at $90 per month	180.00
1 man and team at	125.00
1 supt. to 2 machines at $200 per month	100.00
1 [illegible] engineer and [illegible] per month, 2 machines	67.50
1 [illegible] 3 machines at $150	[illegible]
1 [illegible] per month	[illegible]
1 blacksmiths' helper, per month	50.00
1 oiler, per month	60.00
Total	$1,892.50

Using 31,191 cu. yds. excavated for Section 4 and 25,214 cu. yds. excavated for Section 5, the costs per cubic yard are estimated as follows:

Section 5.

	Cost per cu. yd.
Labor	$0.076
3 tons coal per day	0.012
Repairs and miscellaneous supplies	0.059
15% annual interest on $15,000 plant	0.007
50% annual depreciation on $15,000 plant	0.030
Total cost per cu. yd.	$0.184

The labor item includes all work done, such as repairs, moving machine, and actual excavation.

The repair and miscellaneous supplies item is large. It contains new cable, oil, renewals and 2 miles of 2-in. pipe to supply water to the boilers. The strains and work demanded of large drag-line machines are heavier than that of steam shovels. The average repair and maintenance bill has been $1,500 per month.

The work on the remainder of the canal is being rushed. The two machines described above and one other of the same type, are now at work on Sections 8, 9 and 12, and it is expected that the work on these sections will be completed by Sept. 1, 1910.

A New Type of Stone Crusher.

The accompanying cuts show the general appearance and the main operating parts of a new type of stone crusher that has recently been tried out with successful results. This crusher is styled a disc crusher and its operating principle is distinctly novel. Briefly, the crushing parts consist of two saucer-shaped discs of manganese steel, set at a slight angle to each other and rotating at the same speed, in the same direction. A stone is fed in between the discs and drops until it lodges near the bottom, where it is caught and revolves with the discs. As the discs revolve, opposite points approach each other on the upward part of the revolution and recede from each other on the downward part of the revolution. This approaching together and receding apart of the space between discs is due entirely to their being set at an angle; the discs themselves do not vibrate or move sideways. It is plain that the stone revolving with the discs will be crushed as they approach on the upward part of the revolution and that the fragments will, as the discs recede on the downward part of the revolution, drop still farther into the wedge-shaped space and be again crushed as the space contracts on the next upward part of the revolution. This process is repeated until the fragments are small enough to pass the open space between the edges of the discs. It will be seen also that the fragments of stone are not acted on by gravity alone in passing out from between the discs; they are hurled out by the centrifugal force due to rotation. As shown by Fig. 1, a hood envelopes the crushing discs and catches the fragments as they escape from the discs. This hood is stationary and has a spout at the bottom to deliver the stone.

The construction by which the operation described above is obtained is best understood by referring to Fig. 2, which shows the operating parts of the crusher. In Fig. 2, *A* is a hollow shaft, mounted in two bearings, *BB*. One end of shaft *A* is enlarged and threaded and to it is screwed the cap *C;* this cap has cross-arms, *D*, between which the material escapes. Inside the cap, *C*, is fastened one of the crushing discs *E;* this disc is fixed to the shaft and revolves with it. Inside the hollow shaft, *A*, is a solid shaft, *G*, which has a half-ball enlargement supporting the crushing disc, *F*, and fitting into the enlarged socket end of the hollow shaft, *A*. The tail end of shaft *G* extends out beyond the end of shaft *A* and has an independent bearing, *H*, which is provided with screws to alter the alinement of shaft *G* and so vary the angle between crushing discs. Now when power is applied to the belt pulley, *I*, the hollow shaft *A*, its cap, *C*, and the attached disc, *E*, will revolve. The inner shaft, *G*, and disc, *F*, tend to revolve due to the friction of the ball head with the socket of shaft *A*, but they are not driven positively when the machine is running idle. Immediately stone is fed between the discs, the crushing action already described increases the friction between ball and socket and the two shafts and their attached parts revolve together.

These crushers are built in three sizes having 48-in., 24-in. and 13-in. discs. The 48-in. machine will take 7-in. stone and reduce it to any size between 3 ins. and ⅝ in. Its rated output of 1-in. stone is 50 to 90 tons per hour. These crushers have been used successfully in a number of places. They are made by Symons Brothers, Old Colony Building, Chicago, Ill.

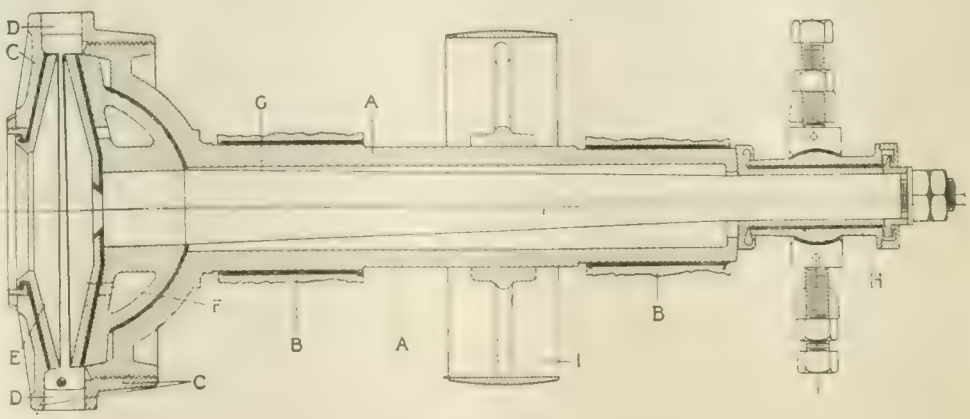


Fig. 2—Operating Parts of Symons Disc Crusher.

Roads and Streets Section

Note: This section is devoted to methods and costs of road and street construction. It will cover road building in all its details, the construction of pavements, sidewalks and gutters, the testing and use of paving materials and the machinery and tools used in road building and paving.

Methods of a New York State Commission of Highways in Testing Bituminous Materials Used in Road Work.

The testing of all materials submitted for use in the construction of state highways in New York is done under the direction of the Bureau of Research of the State Commission of Highways. In 1909 there were tested in the laboratory of the Bureau 330 samples of stone proposed for use on 110 separate roads, aggregating approximately 600 miles. This material was from all parts of the state and of many different classes of stone. The cost of stone sampling was $8.55 per sample, this including the cost of collecting each sample. The average time necessary for making tests was five days. The bureau also sampled and tested 2,003 samples representing 20,003 bbls. of cement from a total of 163 lots, the cement was used on 95 roads throughout the state. Forty-eight samples were rejected. The cost of the testing averaged 5 cts. per barrel of cement used. In addition 2,640 samples of bituminous material comprising 721 lots were tested; 496 of these lots were of asphalt and road oil representing 2,900,000 galls., while 225 lots were of rock asphalt taken from 205 carloads, approximately 8,100 tons. The cost of this sampling was at the rate of $8.05 per lot or approximately 7¾ cts. per barrel of material represented by the test. The cost of this sampling was at the rate of $8.05 per lot or approximately 7¾ cts. per barrel of material represented by the test. Of this 4 cts. was laboratory work and 3¾ cts. represented the cost of factory sampling and office expenses properly chargeable to this test. In the last annual report of the State Commis- of Highways the methods of making the above test are described, and we have abstracted from this report the following matter relative to the testing of bituminous material:

Sampling.—Samples of bituminous material for use on construction work were sampled either before shipment from the plant or immediately upon the arrival of the material at the road. When material was sampled from a car upon its arrival at or near the road one sample was taken by the engineer on the road for approximately every twenty barrels of material received. These samples were shipped to the Bureau of Research in standard pint cans furnished for the purpose, together with the information shown in specimen Form 1. In this and the other forms the matter in black is given to show the method of filling out the forms:

Rd. No. 795.

State of New York,
DEPARTMENT OF HIGHWAYS.

To the Engineer in Charge, Jeffersonville, N. Y.
Bureau of Research, Albany, N. Y. August 11, 1909.

Dear Sir:—I have this day shipped 3 carefully and securely wrapped samples (Nos. 22 to 24) representing 65 Bbls. of Texaco Macadam Binder for Rd. No. 795.
Sampled From L. V. Car No. 32425 at Collicoon.
on August 11, 1909, by C. B. Smith, Asst. Eng.

FORM I.

Samples shipped from the oil plants were secured by inspectors of the bureau stationed there for that purpose. The samples were taken as the material was run from the stills into the barrels, tank cars, or other receptacles in which it was to be shipped or stored. A pint sample was sent in for approximately every 20 bbls. of material as was done on the sampling at the road. Shipments were made from some plants directly after sampling. In such cases notification of the acceptance or rejection of the material was mailed direct to the division engineer in whose division the material was to be used. In other cases material was held at the plants until receipt of notification of acceptance, after which shipment of the accepted material was made. This material was ready for immediate use upon its arrival at the road. Notification of each shipment of such material was made by the inspector at the plant on Form I, which, upon receipt at the Bureau of Research was approved and forwarded to the division engineer in whose division the material was to be used.

B. R. Sample No. 732.

State of New York,
DEPARTMENT OF HIGHWAYS.
Bureau of Research, Albany.

Mr. Guy H. Miller,
Engineer, Division No. 3.
Watertown, N. Y.

Bayonne, N. J.,
August 11, 1909.

Dear Sir

There has this day been shipped 2 Cars of N. Y. State Road Binder Spec. No. 1.
The designation of this material is Utica, County of Oneida.
It is consigned to Smith & Green Construction Co.
For Use on the Utica-Bridgewater Road, Road No. 599.
This material is from Tank No. 532, Plant of Standard Oil Co.
This material has passed the required test and was accepted by the Commission August 9, 1909.
This material has been shipped in officially sealed cars which should arrive at their destination in good condition. The seal shall be broken and the car opened only in the presence of the engineer in charge of the road on which the material is to be used.
R. R. Name on car is L. V. No. of car is 32,453. No. of bbls. in car is 65.
R. R. Name on car is N. Y. C. & H. R. R. No. of car is 42,211. No. of bbls. in car is 65.
Approved. A. F. Armstrong,
Engineer in charge Bureau of Research, August 12, 1909.
Chas. B. Smith, Inspector.

FORM II.

Laboratory Equipment.—The oil testing laboratory in the basement of the building used by the Highway Commission at Albany, is fitted up with modern equipment for four workmen. This equipment consists in general of work tables; three analytical balances; three scales, with capacity of from 0.1 gram to 500 grams, 0.5 gram to 2 kilograms, and ½ oz. to 240 lbs., respectively; 2 heating ovens; 1 N. Y. pentrometer; 1 hot plate; 1 Wespath balance; 5 iron retorts, ½ pt. to 4 pt. capacities; 1 Engler viscosimeter; 1 Saybolt viscosimeter; 1 float sink; thermometers ranging in temperature recorded from —25° F. to +1050° F.; set of 8 hydrometers, giving the degree Beaume from 10 to 90; extraction apparatus; hot water bath; closed flash Tester (New York State pattern); freezing apparatus; water still; distilling apparatus for other liquids; nest of 12 sieves for the mechanical analysis of sands in natural and artificial mineral bitumens. Besides these larger pieces of apparatus are the smaller things necessary in a chemical laboratory, such as platinum and porcelain crucibles; funnels; beakers; graduates; pipettes; burettes; flasks, etc.

Bituminous Material Used.—There were five different specifications governing the bituminous materials used as road binders during the season. Specification No. 1 called for material to be applied on the broken stone top course of the road under construction at temperatures between 250 and 300° F. Material passing specification No. 2 was generally used in the same manner as the above mentioned material. It was, however, a heavier, denser material than that passing specification No. 1, and was generally applied at somewhat higher temperatures. The temperature at which any oil is applied depends considerably on the temperature of the weather at time of application. Specification No. 3 called for a heavy asphaltic oil, somewhat lighter than that specified in specification No. 1, which when heated to 200° F. was applied by sprinkling or other means, to the surface of roads being constructed or repaired. For satisfactory use of this material it was essential that the road surface be thoroughly cleaned and that the application be made in warm summer weather. Specification No. 4 called for a lighter oil than any of those above mentioned, which was applied by sprinkling to the cleanly swept surface of the road at air temperature. The cleaner the road surface and the warmer the air temperature the more satisfactory the application. The fifth specification was for a natural rock asphalt and stated that the material should contain not less than 7 per cent of bitumen.

Testing.—In each of the four first mentioned specifications there are 12 distinct tests which the material is required to pass. These tests are determinations of (1) water present, (2) homogenity, (3) specific gravity, (4) penetration at 77° F., (5) penetration at 77° F. on a certain per cent of residue, this per cent of residue varying for the different specifications, (6) loss on heating for five

hours at 325° F., (7) loss on heating for five hours at 400° F., (8) per cent soluble in carbon disulphide, (9) per cent soluble in 76° naphtha, (10) amount fixed carbon present, (11) closed flash point, (12) per cent of paraffine scale present. Besides these required tests, some of all of the following named tests were made on the greater part of the material used. Tests for viscosity, time of float tests at various temperatures, penetration at various temperatures, solubility in carbon tetrachloride, fire point, open flash, percentage of coke left upon destructive distillation, etc., etc.

Briefly, the amount of work required for one set of tests might be stated as follows: Twenty-one weighings made to the accuracy of 0.0001 gram, 11 weighings made to the accuracy of 0.1 gram, observations of the character of the material made at seven different temperatures, viz.: 0° F., 77° F., 212° F., 325° F., 400° F., 500° F., and the unknown temperature required for flash. The temperature of 0° F. is obtained by using an intimate mixture of finely cracked ice and salt in water. Variations in the proportion of water, salt and ice give various temperatures from 30° F. to —3° F. A mixture of ½ gal. of water, 15 lb. of finely cracked ice and 5 lb. of common dry salt will give a temperature of 0° F. On the lighter oils the fire point is usually noted. Three filtrations are necessary. The average time of testing a sample is 2.2 days as computed from the records of tests which show that

127	tests were completed in	1	day.
354	tests were completed in	2	days.
98	tests were completed in	3	days.
38	tests were completed in	4	days.
26	tests were completed in	5	days.
1	test was completed in	6	days.
5	tests were completed in	7	days.
1	test was completed in	10	days.

The tests that were completed in one day were principally those of Kentucky Rock asphalt. The tests completed in two days were chiefly material submitted for specification No. 2. Tests on material submitted to meet specification Nos. 3 and 4 frequently required a longer time than two days. A sample received at the close of work on one day and reported at the beginning of work the second day following has been figured as two days in the test, although it was actually in the laboratory but one working day, and as the above given figures make no deductions for material held in the laboratory over Sundays and holidays it may be seen that the actual working time taken for testing a sample was generally between one and two days. The length of time that expired from the time that the different lots of material were sampled until the samples were received at the laboratory was as follows:

83	lots received 1 day after sampling.
253	lots received 2 days after sampling.
145	lots received 3 days after sampling.
54	lots received 4 days after sampling.
19	lots received 5 days after sampling.
9	lots received 6 days after sampling.
2	lots received 7 days after sampling.

The average time elapsing between the sampling of this material and its receipt at the laboratory being 2.5 days. This material was sampled in various parts of New York State, at Philadelphia, Pa., at Bayonne and Maurer, N. J., and at Chicago, Ill. It may be seen from the above figures, for time necessary for receiving and testing samples, that the results of tests are on the average obtainable from the laboratory in 4.7 days from the time the samples are shipped, but at least a period of 6 days should be allowed from the time of taking samples at nearby points until report is received, and a day or two longer for samples taken at distant points.

Upon completion of tests the results thereof are submitted to the Commission. The proper party is then notified of the action taken regarding the use of the material, and the results of tests filed in the bureau on Form II which contains specimen information.

Road Surface Treatment With Oil in 1909 by the New York State Commission of Highways.

Early in the spring of 1909 the New York State Highway Commission realized that something must be done to preserve and hold the macadam roads which had been constructed and which were in comparatively good condition but were subject to extremely heavy automobile traffic and which were already beginning to show rapid deterioration. After considerable study and some experimenting it was decided to use an asphaltic oil, and accordingly approximately 380 miles on macadam highways were given a surface treatment with oil during the year.

Sample No. 902.

State of New York,

DEPARTMENT OF HIGHWAYS.

Bureau of Research, Albany.

Taken August 11, 1909. Received August 13, 1909. Road No. 795.

Taken by C. B. Smith, Asst. Eng., at Callicoon marked his sample Nos 22-24.

LV car No. 32,425.

Trade name Texas Macadam Binder,

Manufactured by Texas Company.

Address of manufacturers 17 Battery Place, N. Y. City.

RESULTS OF TESTS.

1	Water present	None.	7 Per cent loss, 5 hrs. 400° F.	1.8	12 Per cent of paraffine 0.5
2	Homogeneous	Yes.			13 Sol in CC1 99.8
3	Specific gravity	13.0	8 Per cent soluble in CS_2	99.80	14 Float at 150 F. 130 sec
4	Penetration at 77 F	240	9 Per cent soluble in naphtha	80.00	15 Pen at 41° F 80
5	Pen. of 94 per cent residue	98	10 Per cent fixed carbon	8.00	16 Flash pt. open 450°
6	Per cent loss, 5 hrs. 325° F.	0.8	11 Flash point Closed	400°	17 Fire pt. 500°
					18

Remarks The figures given above are merely specimen figures and do not pertain to any particular make of material.

Tests made by

Report made August 15, 1909, by X X X X

Chemist in Charge of Tests.

Material —— approved for Spec. No. 1, August, 15, 1909, by X X X

Engr. in Charge of Bureau.

FORM III.

The oil was applied at the rate of from 3/10 to ½ gal. to the square yard and was covered after allowing for a period of three to four hours' penetration with from ½ to ¾ in. of screenings with the dust removed, ¾ in. stone, Lyon mountain tailings or the best grade of gravel obtainable in that vicinity. Experience has demonstrated that it is very necessary to obtain a high grade of covering for the oil after this application. In many cases the gravel has not proved entirely satisfactory. The use of stone screenings with the dust removed and ¾ in. stone has given very satisfactory results. The use of Lyon mountain tailings which are the refuse produce of the ore mines situated on the D. & H. railway in the northeastern part of the state has also proved very satisfactory. The material to be suitable for this purpose should be gritty. It is not essential that material should have any particular binding qualities. The success of the oil treatment depends largely upon the skill of the application. It is, of course, important to have first class materials, but the manner of application is also just as important. The use of asphaltic oil and cushion preserves the road from rapid deterioration and eleminates the dust nuisance.

According to the last annual report of the State Commission of Highways, from which these notes have been taken, the work throughout the state, which has been distributed in almost every country in the state, has been generally satisfactory and as a method of preserving macadam roads which have already been constructed and which are in comparatively good condition may be said to be a very successful treatment. Roads which would have been entirely destroyed by the end of the season are preserved and will go into the winter in good condition. The use of oil and covering is especially effective in preventing raveling. Many of the roads in the state of New York have been constructed with stone which has no special binding qualities and which have heretofore raveled badly during the hot months of the summer. A number of these roads were treated with asphaltic oil during the past summer and have given absolutely no trouble in this respect since the application. In most cases the oil was applied cold during the hot months. In some cases it was found necessary, especially in the fall of the year, to heat this oil. The oil was delivered in tank cars and pumped into oilers which were especially constructed for the purpose of distributing oil. A portion of road No. 241, running from Ballston Springs to Saratoga Springs in Saratoga county, was treated with this oil early in June. The remaining portion of the road was treated with a heavier oil, viz., New York state binder No. 1. and covered with gravel to a depth of about ¾ in. Both portions of this highway have been subject to extremely heavy automobile traffic during the year and both sections were in exceptionally good condition this fall. While the portion covered by the heavy binder perhaps had little penetration, a surface coat was formed over the macadam which protected the roadway. The treatment with the heavier grade of asphaltic oil and covering is considerably more expensive than the treatment with the oil which can be applied cold. Time will demonstrate whether or not this form of repair work will or will not be the cheapest in the long run. One of the principal reasons for the selection of the treatment of the roads with a grade of oil which could be applied cold was the fact that this treatment was about the only treatment which would come within the appropriations available. It has been generally considered that the macadam surface to be treated should be absolutely dry. In a number of instances very good results have been obtained where the oil was applied when the road was damp, but not wet or muddy. (In some cases this condition occurred after rain; in one or two a sprinkler was used before the oil was applied). Greater penetration was obtained and less cover was needed and the final results were even better than many cases where the oil was applied to a dry surface. One of the most important points to be ob-

served in this surface treatment or so-called painting method is that the surface should be swept as clean as possible. This can best be done by the use of a rotary horse sweeper.

The cost of this treatment varies greatly with cost and amount of material used, freight rates, etc. Experience has shown that for a 16-ft. roadway approximately 3,700 gals. of oil should be used to the mile or about 4/10 gal. per sq. yd. This amount will depend somewhat upon the character of the stone in the roadway, some stone affording better penetration than others. The above figure of 3,700 gals. to the mile on a 16-ft. roadway may be said to be a fair average. If an excess quantity of oil is used it will require more covering material, which will unite with the oil, forming a thick cover which is inclined to rut and become sloppy in bad weather. The cost is also greatly increased and no advantage gained. It will require approximately 75 to 100 cu. yds. of covering for the above application. The following may be considered an average estimate of the cost of the oil treatment upon one mile of 16-ft. roadway:

3,700 gallons oil at 4 cts. f. o. b. station	$148.00
Applying 3,700 gals. of oil at 1½ cts. per gallon	55.00
100 cu. yds. covering (gravel, screenings or three-quarter stone at $1.75 delivered on the road)	175.00
Sweeping	14.00
Sanding after oiling	30.00
Total	$422.00

This equals a cost of 4½ cts. per sq. yd.

The covering selected for this class of treatment should be of a gritty nature, free from dust. If gravel is used it should be of a superior quality, free from loam or dust. Gravels containing shale or slate should particularly be avoided. A very large portion of the gravels of New York state are unsuited for this work.

The oil used in the surface treatment work was furnished by the Standard Oil Co., Indian Refining Co., Gulf Refining Co., and the Texas Oil Co. Approximately 1,400,000 gals. of this grade of oil have been applied to roads during the season.

The Consumers' Power Co., with a capitalization of $20,000 000, has been incorporated under the laws of Maine. The company was organized at Portland to manufacture, produce, generate, transmit, distribute and supply electricity for lighting, fuel or other purposes. The incorporators are James R. Parsons, William M. Bradlev and A. G. McPherson, all of Portland.

A Shaft Sinking Record.—Starting at a depth of 365 ft. on March 3, 1910, the No. 1 shaft on the Moodna siphon of the Catskill Aqueduct was deepened 177 ft. to April 3, 1910. This shaft is circular, with a minimum allowable radius of 7 ft. 11 ins. The average diameter is about 16 ft. 8 ins. The shaft was sunk with two 8-hour mucking shifts and one 8-hour drilling shift daily. Nineteen shifts were worked per week, two being lost on Sunday. The rock penetrated was hard Hudson River shale. A liberal bonus contributed to the progress. The work was done by the Mason & Hanger Company, contractors to the city.

Engine Foundation of Concrete Blocks.—In a foundation recently built for the outboard pillow block of an engine the blocks were made in two machines, one making 8 x 12 x 24-in. blocks, and the other, 8 x 8 x 16-in. blocks. Odd size blocks were made by putting fillers into the block machines. The foundation had six courses, the top one measuring 16 x 32 in. in plan, and the bottom one 28 x 44 in. The stepping was done in three 2-in. steps. The holes in the blocks were filled with grout and 2-in. pebbles, and in four of them anchor bolts were placed. Joints in successive courses were broken in all directions, both by odd-sized blocks and different methods of laying the courses, so that the entire mass was well bonded. The blocks were mixed with 1:5 proportions, using gravel having a maximum size of 1 in.

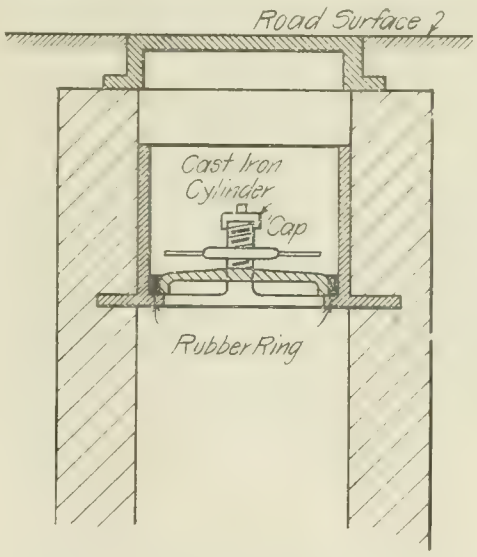
Water-works and Sewer Section

Note: This section is devoted to methods and costs of constructing sewers and water-works. It will cover the construction work for all details of water supply and sewerage, including sewage purification and water filtration.

A Method of Preventing Sewer Flooding in Riverside Districts.

An interesting method has been put into use at Sunbury, England, to prevent sewer flooding. The city has a long river frontage, on which are five or ten intakes of the Metropolitan Water Board of London, so extreme care is necessary to prevent pollution. The difference in level between the riverside road and the Thames is also very small, and the sewers gravitating to the ejectors at this point come from much higher levels. It, therefore, became very important to guard against any overflow of sewage in case of a stoppage of the ejectors, and to prevent river water entering the sewers through the manhole covers when the Thames was in flood. The manner in which this has been accomplished is described in a recent issue of the Surveyor as follows:

In the shaft of each manhole on the river frontage has been built a cast iron cylinder, 21 ins. diameter by about 18 ins. long, with a square flange at the bottom. On the inside of the cylinder, also at the bottom, a small rebate or fillet is cast. Within the cylinder is



Device for Preventing Sewer Flooding in Riverside Districts.

fixed a 21-in. drain stopper, tightening up with a screw and having an India rubber external ring after the usual pattern. This rests on the small rebate of the cylinder, and is therefore always horizontal and easily tightened, or it may be left slack and lifted out to give access to the manhole below. The stopper is provided with a by-pass and screwed cap, so that if the sewage is up and exerting a pressure on the under side of the stopper, the removal of the cap will at once show the position of affairs, and the cap being of small diameter can be replaced without difficulty or harm having been done. The manhole cover should be slightly larger than the cylinder—22 ins. clear opening being a convenient size—for the removal of the stopper when necessary. The flange of the cylinder should be built in at such a level as to give a sufficient weight of brickwork or concrete above it, so that the cylinder cannot be lifted by the upward pressure; this does not, however, mean a great depth, the frictional resistance on the exterior of the shaft being so high; it is 2 ft. 6 ins. from the surface at Sunbury.

This arrangement has proved equally useful in excluding river water from the sewers in time of flood, and has enabled the ejectors to continue work and clear the sewers; though in the last flood had they stopped they could not have been restarted, as the road was submerged to a depth of 2 ft. The low lying house drains on the riverside are provided with 6-in. sluice valves between the intercepting chambers and the sewer, these valves only being shut when the flood water is actually on the point of entering the house gulleys, etc., and being reopened directly the river subsides below their level. In this way the drainage of the remainder of the district has not been interfered with, and there has been no flooding from river water. Existing manholes have been fitted with the stoppers by removing the shafts to the necessary depth, setting the cylinders and then rebuilding.

Some English Costs of Washing Filtering Material Using a Special Washing Machine.*

For washing of contact clinker beds after being in use for about five years, the washing plant used may be briefly described as follows: It consists of a movable washing tray and riddle, with inclined screens for grading the material, and which is actuated by steam. The ashes are brought from the beds, and are tipped on an elevated platform approached by an inclined roadway or may be elevated by other means and tipped into the jigging riddle (actuated by a vertical eccentric shaft) which has the first part so made as to retain the ashes and water. The water is applied here until the jigging or shaking motion, assisted by bafflers, removes the undesirable matter which the medium contained and which becomes of the same consistency as very liquid sludge. As the material passes on and over a perforated portion so constructed to suit the sizes of media required, water is sprayed on, and so rinses or thoroughly swills away the sludge along with the material which can pass through the size of mesh. This sludge and water immediately drops on to another inclined plane of corrugated iron, and then on to a smaller mesh wire gauze which retains the smaller particles, say ⅛ in., and by a mechanical contrivance carried into a wagon ready for removal. The larger material which has had the sludge and fine media removed, which passing, say, a ¼-in. mesh, passes on to an inclined grating formed by parallel bars, say, 2 in. apart, or whatever size is required, the larger material passing on, and the smaller (say less than 2 in.) passing through into a wagon ready for removal, as before described. The fouled media is therefore not only washed, but graded into three different sizes, each size being placed into a different wagon. The sludge and fouled washing water passes from the washer into a wagon which retains the heavier matter which it contains, while the water and light sludge overflows and passes away by means of channels into specially constructed pits or tanks, where the sludge readily settles, and can be drawn away without disturbing the working of the tanks. The sludge, on being drawn away by means of valves, is conducted to the ordinary sludge channel, and is of the consistency of sewage sludge. This sludge, I may say, readily presses. The water may be used over and over again (if required) after passing the tanks.

The machines are made by Messrs. Ran-

*Extracted from a paper by A. B. Ogden, read before the Institute of Sanitary Engineers, and published in the "Surveyor" for April 8, 1910.

some, Ver Mehr Machinery Co., Caxton House, Westminster, who describe it as a machine for washing and simultaneously grading all classes of material used in the various districts for sewage filtration.

Cost of Working.—Having explained the machine, let me now give you the cost of working. Media which has been in use for, say, five years, can be removed from the bed, washed and returned, including all labor, locomotion, coal, oil, etc., for 12.5d per cu. yd. Ordinary unscreened or crude clinker ashes can be purchased in the Manchester district at 2s. per ton, and in some districts they may be procured even cheaper. Taking the first cost as 2s. per ton:

	£	s	d
Say 100 tons at 2s. material	10	0	0
Add 26 tons for loss in washing, material	2	12	0
Washing 126 tons at 4.26d	2	13	0
Total for 100 tons washed and graded ashes	£15	5	0

Thus we get 100 tons of washed and graded material for £15 5s., or 3.05s. per ton. I therefore consider that it is much cheaper to purchase the clinker ashes in their crude state and prepare them as suggested, as it is obvious that material which is similar and clean, purchased ready for the bed, would cost considerably more than 3s. per ton, which, by the way, is equal to 1.51 cu. yds. This material can be employed for four or five years (perhaps longer), at which time it may be so fouled as to require washing again.

The following is a detailed account of cost, etc., for taking out, washing, refilling the bed, etc. This bed was ½ acre in extent and 3 ft. 6 in. deep, containing 2,823 cu. yds.:

	£	s	d
Emptying the bed	46	10	8
Washing the media	43	19	8
Refilling bed	15	17	10
Locomotives, wagons, etc.	22	12	7
Platelayers (removing roads, etc.)	7	0	8
Repairs (wagons, locomotives, etc.)	5	16	1
Total	£151	17	6

The above figures include tipping and removal of the refuse and general labor in cleaning up, etc.

Now let us consider what we have as a material. We must admit that if any soft or otherwise undesirable material was first employed by taking the crude clinker ashes, after working for four or five years this material must have broken down, so that after washing all undesirable material must have been eliminated, and the material which is returned to the bed must necessarily be a media which has withstood a lengthened test, and therefore must be more suitable than any so-called picked or selected material offered on the market.

Regarding the cost, the original cost of the crude washed clinker is 3.05s. per ton, and the cost for washing and remaking the bed after the same has been in use for four to five years (£151 17s. 6d. for 2,823 cu. yds.) is 1.07s. per cu. yd.

In detail we get a bed containing 2,823 cu. yds, costing £711 10s. 10d., made up as follows.

	£	s	d
Original cost 2,823 cu. yds. at 3.05s.	430	10	0
Cost washing after five years' working	151	17	6
Making good loss of material, 30 per cent	129	3	4
Total	£711	10	10

It may here be noted that the 30 per cent taken as loss on the second washing is a very high figure and would not occur if the crude clinker ashes were taken only from such works as are known to contain a small percentage of soft or undesirable material.

Now we see that after washing, five years' work, and washing again we get 2,823 cu. yds. of what must be excellent filtering media at a cost of £711 10s. 10d., or 5s. .0½d. per cu. yd.

For comparison I give the detailed cost of washing another ½-acre contact bed, the material dealt with being similar to the one before quoted:

	£	s	d
Emptying bed (2,823 cu. yds.)	41	8	11
Washing medium	59	1	6
Filling bed with washed ashes	10	5	10
Locomotion	18	11	8
Platelayers (putting in roads, etc.)	5	13	3
Repairs (superintendence, etc.)	3	9	5
Greasing wagons	1	8	4
Coal for locomotives	3	7	4
Coal for working washer	2	15	5
Engine oil (locomotives)	0	17	0
Cylinder oil (locomotives)	0	5	5
Engine oil (washer)	0	2	6
Cylinder oil (washer)	0	2	6
Wagon grease	1	8	4
Total	£139	17	5

This washer is therefore capable of thoroughly cleansing filtering material at a cost of 4.26d. per cu. yd., and, including the taking out—removing to the washer, washing, returning same to and remaking the bed—cost 11.98d., or, say, 1s. per cu. yd.

This was one of the beds cleaned in favorable weather, which somewhat accounts for the lower cost, but you will see that the cost of this work varies little.

The following is the actual cost in washing the whole of 46 acres of similar beds taken over a lengthened period:

	£	s	d
The labor on 46 acres cost	11,960	0	0
Repairs (locomotives, etc.)	828	0	0
Coals, oils, etc.	782	0	0
Total	£13.570	0	0

The 46 acres, 3 ft. 6 ins. deep, is equal to 259,746 cu. yds. This works out at 12½d. per cu. yd. The time occupied by the washing plant in dealing with one ½-acre bed, or 2,823 cu. yds., was 137¾ hours, but in the foregoing accounts 157½ hours were charged in the labor account, the difference—19¾ hours— being time taken up by the men employed on the washer in tipping and storing the very fine rejected ashes for other purposes. This applies practically to each and every bed. The time charged to the washing account, which is actually outside the cost of washing proper, is about 12.53 per cent of the whole cost for the time the washer worked. The cost does not include interest on capital or depreciation, but does include all cost for repairs and maintenance of plant.

The Results of Experiments on Pollution in Shallow Wells for Municipal Water-Supply.*

This paper presents some notes and observations bearing upon the sanitary character of water of wells used in municipal supplies, referring particularly to so-called shallow wells, or wells deriving their supply from the sands and gravels overlying bed rock. Reference will not be made to accidental sources of pollution, such as defective pipes, although this source is probably more frequent and fraught with more danger than any other. The notes deal particularly with the chances of pollution to travel through the interstices of the water-bearing materials.

It is well known that soils, particularly sands, possess the ability to purify water passing through them to a surprising degree. Ground water in its natural state, necessarily flows from the land to the nearest watercourse, and therefore where this condition of nature is undisturbed, the rainfall, in passinig from its course to the stream, is subjected to a very thorough filtration. Its travel is extremely slow—usually not more than a few inches per day; close to the stream and the ground, depending upon the rapidity of the fluctuations in the stream level.

In the development of a municipal supply, a site is usually selected close to the stream, for the reason that it is at this place that the most favorable deposits generally lie. Further, at this place the ground-water level is most stable, and the elevation of the ground is usually such that the minimum depths and lifts are involved. The operating conditions largely change the state of nature close to the wells. The ground-water plane is commonly depressed considerably below the stream for some distance from the wells, varying with the character of the material, and in such situations a large part of the supply is frequently derived by infiltration from the stream. The writer has observed many situations where the supplying capacity of the inland drainage area and the sub-strata were incapable of furnishing a small part of the supply drawn from wells, and the larger part of this water must have found its source in infiltration from the river bed, although this infiltration may have occurred at a considerable distance from the well.

It is doubtless a fact, where a new well is first drilled close to a stream, that this infiltration is always most rapid where the distance of travel is least, and if this travel is greater than is desirable for filtration purposes the full beneficial effect of the filtration is not secured. It is found to be true, however, in artificial filtration that the effect of use is the clogging of the bed, and the diminution of the supply, rather than a decrease in efficiency. The tendency, therefore, is for a short path to clog most rapidly, and this, by a change in the character of the interstices, automatically reduce the rate so that it is probable that the infiltration from stream beds which reaches the well upon the bank is much more uniform over the area of the stream bottom than would be ordinarily supposed. The natural filter thus formed necessarily possesses the defect that the manner of its operations is in some doubt, and although the filtration rate is not uniform over the entire surface at any particular place, the filtration rate at any one place is possibly as uniform as that of our artificial filters. Owing to the distances traversed by such waters, the results of the process are doubtless less subject to quick change than any system of artificial filtration, and uniformity of results is an important matter in water purification.

Brooklyn Investigation.—The Burr-Hering-Freeman commission, for its report upon the water-supply of Greater New York, conducted an experiment upon the travel of pollution at Elmont, Long Island, at a laborers' camp where between 200 and 300 Italians were housed. The experiment consisted in construcing a cesspool, used by the entire camp, and noting the quality of ground water at varying distances therefrom. The cesspool was 11x2½ ft., and 6 ft. deep. The soil was sand, having an effective size of 0.26 mm. and a uniformity coefficient of 2.71. The original bacterial content of the soil at various depths was as follows: 615,000 per cc. at 4 ins. depth, 1,750 at 15 ins. and 800 at 27 ins., with zero at depths of 33 ins. to 72 ins. The tests for B. coli were negative at all depths.

The bottom of the cesspool was about 8 ft. above the ground-water plane. Test wells were sunk at a distance of 10 ft. from the side of the pit, drawing water respectively 2 ft., 7 ft. and 17 ft. below the ground-water line. About a week after the cesspool was placed in use, analysis from these test wells were begun, and continued for about a month, showing that the water from all of the test wells was highly polluted. The degree of pollution apparently varied considerably (as would be expected) with the rainfall. The total bacterial count varied from 10,000 to 400,000 per cc. In 60 observations at the various depths stated, the colon bacillus was found once in 0.1 cc., six times in 1 cc. and 17 times in 10 cc. A similar experiment upon an old cesspool, whose bottom was located about 2 ft. above the ground water plane, showed similar results.

Tests were also made on wells at distances of 50 to 300 ft. All these wells beyond 50 ft. showed absence of B. coli in 1 cc. and less, and all except the wells at 130 and 160 ft. showed B. coli absent in 10 cc. The nitrates were, however, very high, and indicated that the organic matter was actively undergoing decomposiaion. As a result of this investigation and others, the commission concluded:

With low velocities, polluted water passing though the finer sands that exist on Long Island, for a distance of 25 ft. may be considered as practically safe for use, and it is probable that in most cases a distance less than this would serve as an efficient safeguard.

German Experiment.—A recent experiment in connection with the water-supply of Berlin

*Abstract of a paper by C. B. Burdick, of Alvord & Burdick, Hydraulic and Sanitary Engineers, Hartford Bldg., Chicago, presented at the annual meeting of the Illinois Water Supply Association, at the University of Illinois, March 8, 9, 1910.

has been reported in the "Gesundheit-Ingenieur." The object was to ascertain how near a well a broken sewer pipe would contaminate the supply. The experiments were made by supplying water inoculated with B. prodigiosus to the soil at a certain distance from a well at which water was drawn at a constant rate. Tests were made by delivering the inoculated water to the soil both below and above the ground water line. The water-bearing material was sand and gravel of average coarseness.

In the first experiment the well tested was 177 ft. deep, the top of the strainer 121 ft. deep, and water was drawn from the well continuously for 30 days at the rate of 380,000 gals. per day. The inoculated water was introduced 69 ft. horizontally from the well through a special well point, the inoculated water therein being kept at a constant level of from 3 to 4½ ft. above the ground-water level, requiring about 1,000 gals. of inoculated water per hour. Tests of the well water were made with extreme care, and the test bacillus was first detected in the well water nine days after the test started and at several times thereafter. As the result of the test it was concluded that 1 in 40,000 of the bacilli reached the well, and inasmuch as dangerous bacteria are more sensitive to cold water, they would be less likely to survive under the circumstances than the bacillus used in the test.

The second experiment was made upon a well 140 ft. deep, the top of the strainer being 92 ft. below the ground surface and 76 ft. below the ground-water level, which was 16 ft. below the ground surface. The inoculated water was introduced 58 ft. from the well and 4 ft. above the ground water level. The test occupied a period of 1½ months. Water was drawn from the test well at the rate of 85,000 gals. per 24 hours. In this test no trace of bacteria was found in the well, although 8,240,000 millions of the bacillus were poured into the germ pipe.

It will perhaps be of some use to the cause of sanitation to set down some facts noted by the writer in the investigation of two public water-supplies that have recently come under his observation in the course of professional practice.

Winona, Minn.—The situation at Winona, Minn., is interesting from a sanitary standpoint, in that for many years the municipal supply has been drawn from a system of wells immediately adjoining the business center of the city. At Winona the ancient Mississippi River excavated a channel in the native rocks three miles wide and more than 500 ft. deep, and, with the gradual recession of the water, refilled its channel to a depth of 200 ft., mostly with coarse sand and gravel.

The city occupies one of the huge sandbars left by the receding river, with the present Mississippi on its front, and a lagoon paralleling the river close to the rocky cliffs on its rear. The water-works plant is located on the river front at the end of one of the principal business streets, and immediately adjoining the business center. At the present time the city has a population of 21,000, and is consuming water at the average rate of 1,750,000 gals. per day, with a maximum rate of 3,000,000 gals. The hourly pumpage rate during sprinkling hours frequently reaches a 7,000,000-gal rate, no storage being provided, either elevated or otherwise.

The supply is drawn from two circular masonry wells about 50 ft. diameter, the well shoes being from 11 to 18 ft. below datum, or low water. The ground surface stands at 18 ft. above datum. The north well is about 25 ft. and the west well 175 ft. from the edge of the river. There are numerous sources of pollution, vaults, etc., within 200 ft. of the wells. A private sewer passes through the grounds about 150 ft. distant. The sewage of the city is discharged several blocks below the pumping station. The ordinary draft or depression of the ground-water level in the wells is about 5 ft., although the pumps are capable of reducing it about 15 ft. The static water level when the wells are shut down corresponds closely with the stage of the river, which ordinarily varies 10 or 15 ft. during the year. The underlying material is principally coarse sand to a depth of 175 ft. below the ground surface, having an effective size of from 0.35 to 0.45 m.m., and a uniformity coefficient of about 3.5. The supply under the well shoes is supplemented to a slight extent by numerous drive-well points in the bottoms of the open wells to a total depth of 60 or 70 ft. below the ground surface. The supply from these points is said to be inconsiderable owing to the corroded condition of the strainers. A small amount of water leaches through the masonry of the wells, but the major portion of it comes under the well shoes. In regard to the character of this water, the Minnesota State Board of Health concluded:

No wells could be recommended which receive surface water in relatively thickly-settled portions of the town, and situated as close to a badly polluted water as that of the Mississippi River water at Winona. . . . These dug wells cannot be endorsed by any sanitary authority, not that they have constituted a source of danger as evidenced by typhoid and digestive disturbances, but that they may, if excreta from patients should find its way into the wells.

The total bacterial count in the water is extremely low, running from 3 to 50 per c.c. It is noteworthy, however, that B. coli were found present in four out of ten observations in 1 c.c. Upon the whole, however, it is surprising that water as favorable in character is obtained under circumstances apparently so detrimental to the sanitary supply. The typhoid death rate per 100,000 in 15 years has never exceeded 40, has exceeded 30 only twice, has exceeded 20 eight times, and has been less than 10, eight times, or over 50 per cent of the time.

Manistee, Mich.—The situation is in many respects similar to that of Winona. The water-supply is derived from the sands and gravels of the ancient Manistee River terrace. The ancient river cut through a bank of clay to a depth of about 200 ft., and a width of about 1½ miles, afterwards refilling its channel with the sands and gravels from which the present supply is derived. This material below the ground-water plane is fairly homogeneous. The sand has an effective size of about 0.35 m.m., and a uniformity coefficient of from 2 to 2.5.

As at Winona, the water-works plant closely adjoins the inhabited part of the city; in fact, occupies the ground that was first settled. The business part of the city, however, is at some distance from the plant. There are a number of vaults at present in use, 250 to 500 ft. distant from the wells forming the source of supply. A 9-in. pipe sewer at a depth of 10 ft. passes within 29 ft. of well No. 3, and a similar sewer 6 ft. deep within 37 ft. of well No. 4.

The site of the water-works is 25 ft. above river and lake level. The ground-water plane in a state of rest is about 2 ft. above the same plane of reference, and, when the wells are pumped, is drawn down at the rate of about 1 ft. for each 250,000 gals. of pumpage.

The present population is about 14,000. The average daily consumption for the past year has been 951,000 gals. The maximum 24-hour consumption is 1,500,000 gals. and the maximum rate during the sprinkling hours of a hot summer day, between 6 and 8 p. m., is from 3,000,000 to 4,000,000 gals.

The supply is derived from four masonry-curbed wells, from 30 to 45 ft. diameter, and 34 to 44 ft. in depth below the ground surface. The supply is largely supplemented by three 8-in. pipe wells, driven one each in the bottom of the three principal open wells. These pipe wells penetrate an additional depth of 60 ft., and are packed in an ingenious manner with gravel. They have no strainers, the water being admitted through perforations in the pipes. The supply is therefore drawn at two places: (1) Under the well shoes from 8 to 20 ft. below the ground-water plane, and (2) from the pipe wells 40 to 60 ft. deeper.

The total bacterial count was usually less than 50, but it varied from day to day, occasionally exceeding 500 c.c. In about 140 observations the presumptive test for the B. coli was negative in all tests on 0.1 c.c.; in 1 c.c. it was positive once, and in 10 c.c. 13 times. In a 10-year record the typhoid death rate has exceeded 40 (per 100,000) once, 30 once, 20 three times, 10 six times, and has been less than 10 four times, or 40 per cent of the time. The average death rate is less than 15.

In the light of all these data, it cannot be successfully maintained that the character of the water-supply has had a detrimental effect in the matter of local typhoid. In view, however, of the environment of the wells, the possibilities for contamination, and the occasional evidences of sewage pollution during the period of the examination, it was concluded that the water was not safe for continued use without treatment.

Discussion of Data.—The writer must confess some surprise that the continued public use of water from such sources as these has apparently done so little harm, and the explanation is doubtless to be found in the fact that the bacilli of disease are apparently eliminated by processes less effective upon other forms of bacterial life, sufficiently easy of recognition to be useful in practical water examinations.

There is an important work for our university experiment stations in the study of this subject, and in the endeavor to formulate methods of investigation more certain than we have at present in the separation of the bad from the good. The sanitary determinations often govern considerable expenditures, and while the wise analyst will always condemn in case of doubt, it is very important that the realm of doubt be confined to limits as narrow as possible, for to unjustly condemn tends to the detriment of sanitation generally.

Shade Trees.—The following regarding the furnishing and planting of shade trees in connection with the construction of state highways, is taken from the specifications of the State Highway Department of Connecticut: The contractor will be obliged to furnish and plant where indicated ....., or as near as it is practicable ..... shade trees, the preference being given to hard maple trees in the selection, no swamp trees allowed. The calibre of these trees 1 ft. from the crown of the root shall be 2 in. in diameter. Good straight trees shall be selected with natural tops, neatly trimmed, not too much, care being taken to properly shape the tree, no bean poles will do. In taking up the trees care shall be used by the contractor to see that the roots are not defaced or cut off, so as to injure the trees, preserving the fibrous roots as far as possible. No trees shall be planted in less dimensions of home for the tree than 4 ft. in width and 3 ft. in depth. Good loam or soil suitable for planting said trees shall be used. All sand and rock and material that would be injurious to the growth of the tree shall be removed, and only good, dark, rich soil used in making a home for the roots of the trees to rest. Care shall be taken in planting the tree to properly spread the roots and place them as near as possible in their natural position. The earth shall be tamped in good and solid and the tree well shaken as the earth is being put around the roots, to properly bed them. A sufficient amount of water shall be added so that the tree may have an opportunity to receive all of the nourishment necessary to assist its growth. Two or more stakes shall be furnished and the tree properly tied so as to prevent any possibility of the roots being disturbed. If, when the road has been completed, it is not the proper season for planting trees, the contractor shall leave on deposit with the town the sum of $10 per tree, and if he neglects to plant them the following season, the commissioner is hereby given the right to plant whatever trees are required without further notice, and pay for the same out of any money that may be due the contractor. Whatever the season of the year in which the tree is planted it shall be protected by a 6-in. mulch of hay or grass extending 2 ft. in all directions from the tree trunk.

Railway Section

Note: This section is devoted to methods and costs of constructing railways. It will cover road-bed and track construction, contractor's plant and organization, surveying methods and permanent way structures.

Cost of Constructing and Operating the Electric Street Railways of Long Island City—The New York and Queens County Railway.

All the street railways of Long Island City and vicinity are owned by the New York & Queens County Ry. Co. This company was incorporated in 1896 and absorbed the various street railways of Long Island City. Most of its stock is now owned by the Interborough Rapid Transit Co.

The following data relate to the fiscal year ending June 30, 1908. The track mileage was as follows:

	Miles.
Road, main track	40.24
Second track	28.96
Total track operated	69.20
Siding, storage track, etc.	5.27
Total, all tracks	74.47

The lines are all surface railways, electrically operated by the overhead trolley system.

The rolling stock was as follows on June 30, 1908:

101 closed motor cars.
15 closed non-motor cars.
118 open motor cars.
40 semi-convertible motor cars.
1 parlor car.

275 passenger cars.
7 snow plows (motor).
4 sweepers (motor).
15 work cars (9 being motor cars).
1 wrecking car (motor).
5 other service cars (motor).

The cost of this passenger car equipment was as follows:

41 closed motor cars, 15 tons, 27 ft. long, at $5,000.
36 closed cars (15 non-motor), 7 tons, 18 ft., at $800.
100 open motor cars, 7 tons, 31 ft., at $2,000.
30 semi-convertible motor cars, 19 tons, 31 ft., $6,000.
50 closed motor cars (steel), $13,257.

275 total.

These 275 cars cost $1,228,753, or $4,440 per car. The 50 steel cars were purchased during the year 1908.

The average age of the rails was 12½ years; of tires, 4 years.

The ballast was sand for 35 miles, and cinders and stone for 4 miles.

The rails whose sizes were reported were:

	Miles.
6-in. girder	14.00
7-in. girder	8.56
9-in. girder	20.94
9-in. trilby	2.83
[illegible]	1.29
[illegible]	5.94
Total	53.56

The company had laid 195,620 sq. yds. of paving, nearly all of which was bluestone and granite blocks.

The electric line construction consisted of 38.40 miles of overhead trolley span wire, and 1.84 miles side bracket. There were 40.24 miles of iron poles, 42 to the mile. There were 50.33 miles of vitrified ducts, occupying 3.39 miles of street.

There were two timber trestles, with total length of 5,808 ft.; no other bridges.

The power plant had 5 generators with a total rated capacity of 2,100 kw. This plant was inadequate, and was withdrawn from service April 28, 1908, so it was in operation only eight months of the year.

There were two substations whose equipment was:

[illegible] kw.
[illegible] kw.
60 storage battery cells..... 80 amp. hrs.
1 motor generator set..... 100 kw.

The reported cost of the road and its equipment was:

1. Right of way	$ 27,748
2. Real estate used in operation	53,587
3. Track and roadway construction	972,021
4. Electric line construction	566,071
5. Buildings and fixtures used in operation	387,720
6. Power plant equipment	345,428
7. Shop tools and machinery	19,873
8. Cars and electric equip. of cars	1,228,753
9. Miscellaneous equipment	3,287
10. Organization	10,667
11. Miscellaneous	10,865
Total	$3,626,020
12. Purchase of constructed roads	4,696,563
Grand total	$8,322,583

Dividing each of these 12 items by 69.2, the miles of operated trackway, we have the following cost per mile of trackway (not of track):

	Per mile.
1. Right of way	$ 402
2. Real estate	774
3. Track and roadway	14,046
4. Electric line construction	8,180
5. Buildings	5,604
6. Power plant equipment	4,991
7. Shop tools and machinery	287
8. Cars and electric equipment of cars	17,757
9. Miscellaneous equipment	48
10. Organization	154
11. Miscellaneous	157
Total	$ 52,400
12. Purchase of constructed roads	66,280
Grand total	$118,680

It needs little engineering knowledge to perceive that Item 12 represents very little but promoter's profits.

Since there were 1.076 miles of track per mile of trackway, divide each of the above items by 1.076 to get the cost per mile of track.

The power plant equipment (Item 6) cost $165 per kw. of generator capacity, but it should be remembered that the substation equipment not only provided for the 2,100 kw. station generators but for a large amount of purchased power.

The traffic statistics were as follows:

Mean number of passenger cars in use	251
Passenger car miles	1,533,172
Same per mile of all track	60,872
Same per passenger car in use	18,060
Same per passenger	0.243
Freight, mail and express car miles	None
Service car miles	No record
Passenger car hours	507,295
Passenger car miles per hr. (speed)	8.94
Car trips	397,626
Car miles per trip	11.40
Passengers, at 5 cts.	18,631,339
Passengers in chartered cars	33,760
Passengers per car mile	4.12

The employes and wages were as follows:

General Office Staff:	
1 general officer	
2 other officers	$18,000
40 employes	29,920
43 total general office	$ 47,920
Transportation:	
22 inspectors.	
3 train clerks and dispatchers.	
1 superintendent.	
156 conductors.	
161 motormen.	
2 drivers (horse car).	
4 switchmen and yardmen.	
124 road and trackmen.	
5 hostlers, stablemen, etc.	
480 total transportation	$298,543
Power (largely purchased):	
1 engineer.	
7 boiler cleaners.	
1 electrician.	
30 linemen.	
39 total power	$ [illegible]
Car Houses and Shops:	
24 car cleaners.	
2 car oilers.	
3 lamp trimmers.	
26 car house repairers.	
9 other car house men	
16 carpenters	
12 blacksmiths.	
2 machinists.	
2 brass moulders.	
3 armature winders.	
2 electrical helpers.	
6 painters.	
5 other men.	
111 total car house and shops	$ 75,461
673 grand total	467,547

Conductors and motormen received 20 cts. per hr. for the first and second years, 21 cts. for 3d year, and 22 cts. after 5th year.

The cost of operation was as follows:

Maintenance of Way and Structures:	
1. Track and roadway	$ 45,037
2. Electric line	13,999
3. Buildings and fixtures	1,720
Total maintenance of way	$ 60,756
Maintenance of Equipment:	
4. Steam plant	$ 7,334
5. Electric plant	438
6. Cars	36,981
7. Electric equip. of cars	31,896
8. Miscellaneous equipment	831
9. Shop expenses	4,253
Total maintenance of equipment	$ 81,733
Operation of Power Plant:	
10. Wages	$ 16,456
11. Fuel	32,432
12. Water	2,690
13. Lubricants and waste	1,114
14. Miscellaneous supplies and expenses	6,137
15. Hired power	86,911
Total operation of power plant	$165,740
Operation of Cars:	
16. Superintendence of transportation	$ 1,556
17. Wages of conductors	108,473
18. Wages of motormen	110,009
19. Wages of miscel, car service men	15,927
20. Wages of car house men	2,753
21. Car service supplies	7,380
22. Miscellaneous car service expense	19,604
23. Cleaning and sanding track	4,080
24. Removal of snow and ice	3,975
Total operation of cars	$273,757
General expenses:	
25. Salaries of general officers	$ 10,164
26. Salaries of clerks	8,717
27. Printing and stationery	3,600
28. Miscellaneous office expense	2,982
29. Stores expenses	1,716
30. Stable expenses	4,467
31. Advertising and attractions	75
32. Miscellaneous general expense	6,467
33. Damages	131,640
34. Legal expense incident to damages	32,413
35. Miscellaneous legal expenses	12,651
36. Rent of land and buildings	301
37. Rent of track and terminals	544
38. Insurance	12,089
Total general expense	$227,828
Grand total operating expense	809,815
Taxes assessed for the year	50,492

The cost of operation was as follows per car mile:

	Cents per car mile.
Maintenance of Way and Structures:	
1. Track and roadway	0.994
2. Electric line	0.308
3. Buildings and fixtures	0.038
Total maintenance of way	1.340
Maintenance of Equipment:	
4. Steam plant	0.161
5. Electric plant	0.010
6. Cars	0.817
7. Electric equipment of cars	0.703
8. Miscellaneous equipment	0.018
9. Shop expense	0.094
Total maintenance of equipment	1.803
Operation of Power Plant:	
10. Wages	0.363
11. Fuel	1.157
12. Water	0.059
13. Lubricants and waste	0.024
14. Miscellaneous supplies and expense	0.136
15. Hired power	1.917
Total operation of power plant	3.656
Operation of Cars:	
16. Superintendence of transportation	0.034
17. Wages of conductors	2.393
18. Wages of motormen	2.427
19. Wages of miscellaneous car service men	0.351
20. Wages of car house men	0.061
21. Car service supplies	0.163
22. Miscellaneous car service expense	0.432
23. Cleaning and sanding track	0.090
24. Removal of snow and ice	0.088
Total operation of cars	6.039
General expense:	
25. Salaries of general officers	0.223
26. Salaries of clerks	0.192
27. Printing and stationery	0.079
28. Miscellaneous office expense	0.066
29. Stores expenses	0.037
30. Stable expenses	0.098
31. Advertising and attractions	0.002
32. Miscellaneous general expense	0.142
33. Damages	2.906
34. Legal expense incident to damages	0.717
35. Miscellaneous legal expense	0.279
36. Rent of land and buildings	0.007
37. Rent of electric subway	0.012
38. Insurance	0.266
Total general expense	5.026
Grand total	17.864
Taxes assessed for the year	1.110

The maintenance of track and roadway (Item 1) cost $650 per mile of trackway

(69.2 miles), as compared with $688 for the preceding year.

The maintenance of electric line (Item 2) cost $203 per mile of trackway, as compared with $263 for the preceding year.

The maintenance of power plant cost as follows for the fiscal years 1907 and 1908:

Year.	Per kw. 1907.	1908.
Steam plant (item 4)	$5.95	$3.50
Electric plant (item 5)	0.64	0.20
Total	$6.59	$3.70

It must be remembered that the generating power plant was abandoned after 10 mos.' use in 1908.

In determining the cost of maintenance of passenger cars, we shall not consider the 50 new steel cars purchased during 1908; but shall assume that all the maintenance costs were due to the 225 old cars whose total first cost was $566,000, or $2,510 per car. The maintenance of these cars (Items 6 and 7) was as follows for the fiscal years of 1907 and 1908 per car:

Year.	Per car. 1907.	1908.
Maintenance of car (body and truck)	$181	$164
Maintenance of electric equipment	235	141
Total	$416	$305

About $360 is the average for these two years, so that the annual maintenance expense was 14 per cent of the first cost of the cars; nor does this include shop expense (Item 9) which should evidently be prorated among Items 4 to 8.

In considering the cost of street car maintenance, sight should not be lost of the fact that the open cars are used only during the summer months, and that during such periods few of the closed cars are used. Hence if half the passenger cars were constantly idle, the wear and tear on the total car equipment would be about half what would occur if all cars were constantly in use. This company reports 250 cars in constant use, but we doubt the accuracy of the statement, for 40 per cent of the total equipment of 275 cars consisted of open cars. Moreover, there were only 160 motormen employed, and the number of motormen is never less than the number of cars in active use; often the number of motormen is 40 per cent in excess of the number of cars in active use.

The cost of operating the power plant (Items 10 to 14) was $78,829 for 10 months, during which it produced 9,356,128 kw. hrs., or 0.84 ct. per kw. hr. Since the plant had 2,100 kw. capacity, each kw. generated 4,455 kw. hrs. Since there are 8,760 hrs. in a year, the load factor was 4,455÷8,760= 51 per cent. It required 4.71 lbs. of anthracite (at $2.38 per ton of 2,000 lbs.) per kw. hr., which indicates a poor quality of fuel. There were purchased 6,614,322 kw. hrs., at 1.3 cts. per kw. hr. The total energy was, therefore, 15,970,500 kw. hrs., which is equivalent to 3.52 kw. hrs. per passenger car mile.

The cost of accidents (Items 33 and 34) was exceptionally high, being 3.6 cts. per car mile, or nearly 20 per cent of the total operating expense. During the same year the total cost of accidents on surface railways in New York city was about 10 per cent of the total operating expense. On all the street railways in Massachusetts, during the same year, damages amounted to 1.04 cts. per car mile, and all legal expense amounted to 0.36 cts. per car mile, a total of 1.40 cts. The legal expense also included other legal expenses than those arising from damages. This 1.40 cts. is 8 per cent of the total operating expense of 17.56 cts. per car mile (See page 1,450 of the second edition of Gillette's "Handbook of Cost Data").

The operating income was:

Passengers	$935,000
Advertising	2,500
Rents	300
Total	$937,800

For study in connection with the above statistics readers may advantageously consult the costs of operating the New York subway lines given in our issue of April 6, 1910, and the costs of operating the Manhattan Elevated lines, given in our issue of April 20, 1910.

Cost of Generating Electric Power for Operating the Elevated and Subway Cars in Manhattan New York City.

In our issue of April 13 the first cost and cost of operating the New York subway were given. In our issue of April 20 the cost of operating the Manhattan Elevated was given, also the first cost of the equipment.

The Interborough Rapid Transit Co. operates both the subway and the Manhattan elevated, and generates some four hundred million kilowatt hours of electricity annually. The following data as to the cost of producing this power have been deduced from their annual report for 1908. There are two power plants, and the following is their total equipment and rated capacity:

Station Equipment:	
Boilers, 130 units	72,880 HP.
Superheaters, 12 units	9,744 HP.
Economizers, 36 units	261,040 HP.
Steam engines, 17 units	131,500 HP.
Turbo-generators, 4 units	10,250 KW.
Generators (direct A. C.), 17 units.	85,000 KW.
Station transformers, 12 units	2,625 KW.
Storage battery cells, 240 units	2,000 amp. hrs.
Rotaries, 3 units	2,400 KW.
Exciters, 9 units	2,250 KW.
Substation Equipment:	
Rotary converters, 84 units	126,000 KW.
Transformers, 252 units	138,600 KW.
Miscellaneous, 39 units	2,109 KW.

The cost of maintaining and operating this plant and the electric transmission lines was as follows for the year ending June 30, 1908:

Maintenance:	
1. Electric line	$ 148,104
2. Buildings and fixtures	192,071
3. Steam plant	291,645
4. Electric plant	53,983
5. Shop expense (prorated)	78,000
6. Undistributed expense (prorated)	16,000
Total maintenance	$ 689,804
Operation of Power Plant:	
7. Wages	$ 420,173
8. Fuel, 479,435 short tons (soft), at $2.95	1,413,907
9. Water	120,781
10. Lubricants and waste	35,278
11. Miscel. supplies and expenses	81,811
12. Undistributed expenses	86,560
Total operation of power plant	$2,167,510
Grand total	2,857,314

There were 402,084,635 kw. hrs. produced, of which all was used to operate the subway and elevated railways except 10,181,000 kw. hrs. which were sold. The selling price ranged from 1¼ to 2½ cts. per kw. hr., depending on the amount consumed.

Item 5, "Shop Expense," and Item 6, "Undistributed Expense," are charged to maintenance of rolling stock as well as power plant, so we have roughly prorated these items to the power plant maintenance, although it is by no means certain exactly how they should be charged.

Item 2, "Buildings and Fixtures," probably includes a considerable sum spent on buildings other than power plant buildings, and this should be borne in mind when considering the following unit costs:

Maintenance:	Cents per kw. hr.
1. Electric line	0.037
2. Buildings and fixtures	0.048
3. Steam plant	0.050
4. Electric plant	0.013
5. Shop expense	0.019
6. Undistributed expense	0.004
Total maintenance	0.171
Operation of Power Plant:	
7. Wages	0.105
8. Fuel, 2,835 lbs. at $2.95 per ton	0.353
9. Water	0.032
10. Lubricants and waste	0.009
11. Miscel. supplies and expenses	0.020
12. Undistributed expense	0.021
Total operation of power plant	0.540
Total maintenance and operation.	0.711
13. General expense (5½%)	0.039
Grand total	0.750

Although the item of "General Expense" amounted to 10.7 per cent of the total operating expenses of the Interborough Rapid Transit Co., nearly half this general expense was due to damages and legal expenses. Eliminating these, the general expense would not amount to more than 5½ per cent, so we have estimated Item 13 on that basis.

In our issue of April 13 it was shown that the cost of the power plant (55,000 kw.) and transmission line of the subway is reported to have cost as follows:

	Per kw.
Electric transmission lines	$ 83
Buildings and fixtures	35
Power plant equipment	112
Real estate	25
Total	$255

This is a high unit cost for the transmission lines and the buildings. Since the 95,000 kw. plant (subway and elevated) produced 402,084,000 kw. hrs., each kw. produced 4,243 kw. hrs. during the year. Since there are 8,700 hrs. in a year, the plant operated under an average load factor of 4,243÷8,760=48½ per cent.

Assuming, for illustration, that the first cost of each kw. of plant was $300, and that interest was 6 per cent, we should have $18 interest. This divided by 4,243 kw. hrs. gives 0.42 ct. per kw. hr. to be charged to interest on investment, which, added to the 0.75 ct. maintenance and plant operation, gives a grand total of 1.17 ct. per kw. hr. The maintenance of plant and transmission line (Items 1 to 6) cost 0.17 ct. per kw. hr., which is equivalent to only 2½ per cent on a plant whose first cost is $300 per kw.

If we consider only the power plant equipment ($112 per kw.), the maintenance (Items 3 to 6) was 0.086 ct. per kw. hr. Since each kw. produced 4,240 kw. hrs., this is equivalent to 4,240×0.086 ct. = $3.65 per kw. for power plant equipment maintenance. Since this is less than 3.3 per cent of $112, the first cost, it is evident that these maintenance costs are far below what they will be a few years hence, when the plant is older. The elevated railway power plant was put in operation in 1904, and the subway in 1905.

There were 2,385 lb. of bituminous coal used per kw. hr., and the price was $2.95 per ton of 2,000 lbs.

For comparison of unit costs of generating electricity, the reader is referred to the costs of the Edison Electric Illuminating Co. of Brooklyn, in our issue of April 6.

The Interborough Rapid Transit Co. had the following number of employes operating both the subway and the elevated during the year ending June 30, 1908:

General Office Staff:	
467 employes general office staff	$657,923
Transportation:	
106 Train clerks and dispatchers.	
21 Starters.	
11 Depot masters.	
686 Ticket agents.	
740 Gatemen and platform men.	
2,173 Guards.	
530 Conductors.	
595 Motormen.	
358 Switchmen, flagmen and yardmen.	
1,198 Road and track men.	
302 Station porters and watchmen.	
2 Other employes.	
6,722 Total transportation	$4,517,304
Power:	
32 Engineers.	
104 Oilers.	
19 Wipers.	
122 Firemen (stoker operators).	
22 Coal passers.	
30 Water tenders.	
25 Ashmen.	
32 Boiler cleaners.	
89 Dynamo and switchboard men.	
30 Electricians.	
23 Linemen.	
246 Other power plant employes.	
722 Total power	$578,493
Car Houses and Shops:	
189 Car cleaners.	
22 Lamp trimmers.	
169 Car house men.	
48 Other car house employes.	
210 Carpenters.	
38 Blacksmiths.	
94 Machinists.	
114 Machinists' helpers.	
3 Brass moulders.	
208 Electrical helpers.	
155 Painters.	
310 Other shop employes.	
1,560 Total car house and shops	$ 77,900
9,521 Grand total	6,610,722

This is equivalent to an average of $13.40 per employe per week.

The total car mileage was:

Rapid Transit Subway	44,005,213
Manhattan Ry. Co. (Elevated)	64,584,609
Total, Interborough Rapid Tr. Co.	108,589,822

Since 391,900,000 kw. hrs. were generated for 108,589,822 car miles, it required 3.6 kw. hrs. per car mile, at an average speed of 16.08 miles per hr. (including stops). There were 4.45 passengers per car mile, or 71.57 passengers per car hour.

Unclassified and General Articles

Note: This section is devoted to methods and cost articles on construction work not properly coming under any of the preceding classifications.

Some Conditions, Methods and Costs of Construction Work, In Peru, South America.

In the past ten years numbers of engineers and contractors have gone to South America with the purpose of locating there in business or to look after construction work in different capacities representing American firms. The writer has had two years residence in Peru,

Fig. 1—View of Plant of the Peruvian Mining, Smelting & Refining Co., Showing Mountainous Country.

and has picked up various items of interest at first hand as an engineer (during construction) of a copper smelter, which was built in the Andes at an elevation of 11,500 ft. above sea level. He has found many engineers and contractors curious to know the conditions met with and the ideas of some of them are so entirely wrong and their knowledge of the country is so limited that it is worth while telling of a few things which will help anyone who may contemplate going there.

Peru is on the western coast of the continent and extends along the Pacific for a distance of 1,500 miles. The country is from 200 to 1,500 miles wide, east and west, and although Peru claims the right of domain over many hundreds of thousands of square miles of land east of the Andes mountains, and in the valleys of branches of the Amazon, yet the greater part of this land has never been explored. This land is inhabited by different tribes, some of which are cannibals, who know nothing about Peru's claim to the land on which they live. The territory over which stable government is actually in force is a strip along the coast about 200 miles wide extending from Equador to Chili. The main seaport, Callao, is 7 miles from Lima, the capitol, and is 1,500 miles south of Panama. The flat strip of land along the coast is only a few miles wide, 25 to 50 miles, and the balance of the inhabited country is very mountainous. The chief resources of the country are in mining, though the sugar and coffee plantations have been, in the past, the foremost resources.

Peru has had her wars and revolutions as well as other South American republics, but has for some time been on a sound money basis and much American capital is invested there. The attitude of the government and people is quite friendly to Americans, more so, perhaps, than that of any other South American country, unless it be Argentina. The conditions and quality of labor will vary in different localities, and especially in different South American countries, but wherever Spanish is the language of the country, the customs of the people are also apt to be Spanish. The condition of the labor will generally vary according to the stability of the respective governments. Skilled labor is not plentiful nor is it to be classed with skilled labor in United States. In Peru a man may choose his trade to suit the opportunity—he may be a bricklayer today and a carpenter tomorrow, and as a result the skilled labor consists of "jacks of all trades—and masters of none." The average rate of wages paid for carpenters, masons and mechanics is from $2 to $3 per day, according to the man. The common labor, especially in the mountains, consists of the original Indian inhabitants of Peru whose blood has mixed with Spanish blood for some 400 years. These people have an appearance much like that of the original Indian inhabitants of our northwestern states. The excessive use of cocaine by these Indians, who chew the coca leaves, and their drink, pisco, which is nearly pure alcohol,—has made them shiftless and without the necessary strength of body or mind to be worth much at common labor. Even at the rate of wages paid them, which averages from 30 cts. to $1.20 per 9-hour day, the labor item is more expensive than labor in this country at twice the wage.

Local conditions always effect costs of construction to a certain extent but it is not usual that every local condition will raise costs. However, in the rugged country of the Andes, at 11,500 ft. above the sea, with atmospheric pressure only 9 lbs. per sq. in., and labor conditions as described above, it will be seen that local conditions control costs in every respect.

Most of the building material for the smelter above referred to was shipped from New York around the Horn to Callao and after passing that port, came by railroad direct to the site. Transportation of freight from New York took 6 months on the average, although mail came from the States by way of Panama in from 19 to 26 days. It may be noted here that freight and mail will both go by way of the Panama canal, when it is completed, which will greatly reduce the time required.

The site of the construction was in a narrow valley with steep slopes, as shown by Fig. 1. The costs given here were obtained during construction on jobs in connection with the plant. One large retaining wall about 20 ft. high, 11½ ft. wide at the base and 3 ft. at the top was representative of the costs of rubble masonry during the construction of the plant. The wall was 350 ft. long and is shown by Fig. 2 in cross-section. The wall may seem to be of a larger cross section than necessary for a retaining wall, but in its design, consideration was taken of the quality of the labor building it and it was made heavy on that account more than for any other reason. The labor of laying the stone in the wall was let by contract at $1.26 (U. S. currency), per cu. yd. All material was furnished by the company and placed conveniently on the site for the contractor. The rock was quarried at different points near the site of the work and hauled in ½ cu. yd. cars on narrow gauge tracks. The lime was made by the company at kilns two miles below the plant and brought to the work on the backs of llamas, in bags of 100 lbs. each. This transportation was let by contract at 7 cts. per 100 lbs. The cost of lime was found to be very high, as shown by this item in the cost of the wall. This was due to the fact that no costs on burning lime had been figured up to this time and as the kilns were some distance away no special attention had been paid to them. It was discovered that the company's coal and tools were being stolen by the laborers. After a responsible

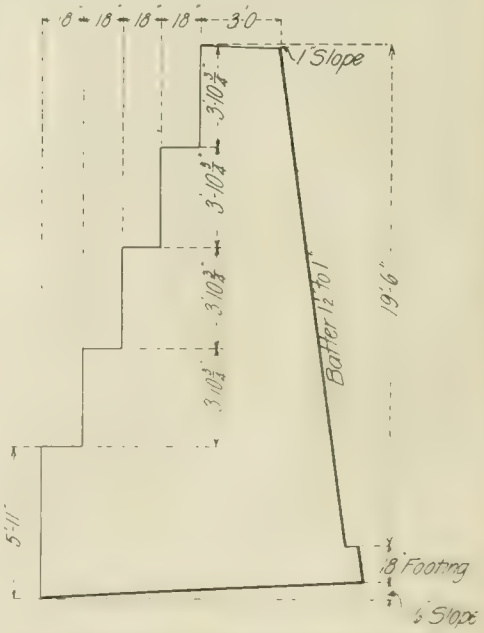


Fig. 2—Section of Rubble Masonry Retaining Wall.

man was put in charge, the cost of lime was reduced about one half.

The sand for mortar and for concrete also had to be brought by llamas a distance of 3½ miles. This work was let by contract at 6 to 9 cts. for 100 lbs., the price varying at different seasons of the year according to the general demands for llamas. These animals carried 100 lbs. and knew perfectly when more was added. If the weight was increased they would be quite likely to refuse to carry it, and they are so stubborn at such times as to take any amount of punishment

rather than give in. They are faster than burros and are handled in trains of about 30 or 40 animals. The value of one llama is not over $5. The llamas work two weeks and lay off one, because they cannot stand steady work and become very balky if worked steadily. An excellent photograph of one of the llamas carrying a bag of sand is shown by Fig. 3.

Fig. 3—Llama Loaded With 100-lb. Sack of Sand; Method of Transporting Sand for Mortar and Concrete.

The cement was shipped from New York around The Horn to Callao and from there by rail to the plant. The cost of the cement—Atlas cement was used—including freight, was $5.82 per bbl.

The following estimate for the cost of the wall is transferred into U. S. currency using 48½ cts. as the U. S. equivalent for one Peruvian sole:

Time—May, 1907—Dry Season
9 hour day.

Quarry Supplies.	
13 sticks dynamite per day at $0.004	$0.520
18 caps per day at $0.007	0.130
8/11 roll of fuse per day at $0.14	0.102
20 lbs. coal for forge per day at $18.43	0.184
4.65 lbs. drill steel per day at $0.11	0.511
Cost of quarry supplies per day	$1.447
Or for 26.16 cu. yds. rock produced per day, $0.055, per cu. yd.	
Labor for Quarry:	
34 men per day at $0.75, average	$25.50
3 foremen per day at $1.58⅓, average	4.75
1 mule per day at $0.75	.75
Total cost per day of quarry labor	$31.00
	Per cu. yd. rock.
Or for 26.16 cu. yds. rock per day	$1.19
Add quarry supplies	0.055
Total quarry cost per cu. yd.	$1.245
Cost of Mortar:	
	Per cu. yd. of wall.
Lime at $1.17 per 100 lbs., 62.2 lbs. per cu. yd.	$0.73
Cement at $5.82 per bbl., 16 bbls. per cu. yd.	.93
Sand at $0.07 per 100 lbs., 549 lbs. per cu. yd.	.38
Total cost of mortar per cu. yd. of wall.	$2.04
Contract price for laying per cu. yd.	1.26
Cost of rock	1.25
Total cost of wall per cu. yd.	$4.55

The cost of excavating 449 cu. yds. for the above wall was as follows: Material consisted of earth and boulders of small size. The work was done in 6½ days and ½ the material had to be handled twice, average haul 100 yds.:

23 men at $0.75 per day	$ 17.25
1 foreman at $1.50 per day	1.50
Total per day	$ 18.75
Total for 6½ days	121.88
449 cu. yds. cost $121.88.	
1 cu. yd. cost $0.271.	
Cost of masonry per cu. yd.	$4.55
Cost of excavation per cu. yd.	0.27
Total cost of wall and excav. per cu. yd.	$4.82

Note—Contractors cost for laying wall was $0.93 per cu. yd.

The proportions of mortar used in the above wall were 1 cement, 2 lime and 9 sand. The volume of mortar in this wall was 28 per cent of the volume of the wall. This is high for masonry walls and is attributed to the quality of the labor. A continuous attempt to reduce this percentage, resulted only in a moderate success after a year of hammering it into the heads of the mason foremen.

In making concrete we were fortunate in having plenty of stone within a short distance. The stone used was taken from the spoil bank of one of the railroad tunnels and was of various sizes. No stone, however, which larger than 4 ins. in greatest diameter, was used in mixing a batch of concrete, but larger stones were thrown in the wall forms with the concrete. The stone was brought to the site by ½ cu. yd. cars making a 100 yd. haul and the sand was brought by llamas at 6 cts. per 100 lbs. All sand weighed 95 lbs. per cu. ft. The concrete was hand mixed with labor averaging 75 cts. per 9-hour day and placed in forms for the power house wall foundations. These walls averaged 16 ins. in thickness and were 5 ft. in height.

Fig. 4—View of Dam and Upper Pipe Line Showing Rubble Masonry Supports.

Time—October, 1907—Dry Season.
Proportions concrete 1:3:5. Loose material calculated to be 1½ the volume of material in place.

111 cu. yds., cost for labor	$209.52
Cement, 4 cu. ft. to bbl.	
1¼ bbl. cement per cu. yd. concrete, at $5.82	$6.55
13.5 cu. ft. sand per cu. yd. concrete at ¾ cts. per 100 lbs.	0.77
22.5 cu. ft. stone per cu. yd. concrete, no cost, except that included in labor	...
40.5 cu. ft. loose material; total cost	$7.32
Cost per cu. yd. labor	1.89
Cost (excluding forms) per cu. yd. concrete.	$9.21

The labor on forms for this work cost about $1 per cu. yd. of concrete. The forms were used several times on other jobs.

It was found cheaper to manufacture our own brick than to pay the railroad freight. In wet seasons, however, it was impossible to dry the brick economically. The cost of making the brick was about $12 per thousand.

The contract price for riveting and placing a 40-in. power pipe line containing about 35,000 rivets of ⅝ in. diameter, was 4½ cts. a rivet. The accompying view (Fig. 4) shows a portion of this pipe line and also gives a good idea of some of the rubble masonry.

Some illustrations as to the difficulties encountered may be noted in conclusion. The railroad rates per M. ft. B. M. of lumber, shipped from the coast, 85 miles, raised the cost of the lumber $30. Other things were in proportion. Another annoying thing was the fact that some of the machinery, rope, etc., was held up in the customs until after the construction work was nearly completed. This was partly due to congestion at the port of Callao. This congestion can not be remedied until better facilities are provided for the increasing commerce of the country. The delays were due also to the well known slow business methods of Spanish countries.

Another little item of interest which comes to mind is a statement made by an American contractor in Lima. He said that he never made a bid for a public works contract without adding the amount of the cash bond furnished at the time of bidding, for the successful bidder never got his money back. This is, of course, a deplorable state of affairs, but it illustrates one of the many little things contractors are "up against" in South America.

Organization and Equipment of Survey Parties, Georgian Bay Ship Canal Survey, with Data on Allotment and Cost of Rations.

The surveys for the Georgian Bay Ship Canal, 440 miles, from Georgian Bay on Lake Huron to Montreal, were conducted by nine regular survey parties, one precise leveling party, three test boring parties, one hydraulic investigating party and one party for canal feeder surveys. The territory to be surveyed was divided into three districts, each in charge of a district engineer with headquarters at Ottawa. Each district was subdivided

TABLE I.—SHOWING QUANTITY AND COST OF RATIONS FOR 100 MEN FOR ONE DAY, GEORGIAN BAY SHIP CANAL SURVEY.

Articles	Quantity.	Cost.	Total Cost.
Fresh meat	100 lbs.	$0.12 per lb	$12.00
Cured meat	35 lbs.	0.17 per lb.	5.95
Canned meat	10 lbs.	0.14 per lb.	1.40
Cheese	5 lbs.	0.12½ per lb.	0.62½
Lard	15 lbs.	0.11 per lb.	1.65
Flour	75 lbs.	2.80 per cwt.	2.10
Crackers	5 lbs.	0.11 per lb. (average)	0.55
Corn meal	15 lbs.	0.04¾ per lb. (average)	0.72
Cereals	15 lbs.	0.04¾ per lb. (average)	0.72
Macaroni	15 lbs.	0.04¾ per lb. (average)	0.72
Sago or corn starch	15 lbs	0.04¾ per lb. (average)	0.72
Baking powder or yeast cakes	5 lbs.	0.05½ per lb.	0.27½
Granulated sugar	40 lbs.	0.04¾ per lb.	1.90
Molasses	1 gallon.	0.45 per gal.	0.45
Coffee	12 lbs.	0.30 per lb.	3.60
Tea, chocolate or cocoa	2 lbs.	0.35 per lb.	0.70
Condensed milk	10 cans.	0.13¾ per can.	1.37½
Butter	10 lbs.	0.20 per lb.	2.00
Dried fruit	20 lbs.	0.12⅔ per lb. (average)	2.53⅓
Rice	10 lbs.	0.05 per lb.	0.50
Beans	10 lbs.	0.03⅓ per lb.	0.33⅓
Potatoes or other vegetables	100 lbs.	0.50 per bush.	0.83⅓
Canned vegetables	20 cans.	1.15 per doz.	1.53⅓
Canned fruit	10 cans.	2.00 per doz.	1.66⅔
Spices	4 ozs.	0.03 per oz.	0.12
Flavoring extracts	4 ozs.	0.10 per oz.	0.40
Pepper	¼ lb.	0.28 per lb.	0.07
Mustard	¼ lb.	0.50 per lb.	0.12½
Pickles	6 bottles.	0.25 per bottle.	1.50
Vinegar	1 quart.	0.12½ per quart.	0.12½
Table salt	10½ lbs.	0.01⅓ per lb.	0.15
Total cost of rations for 100 men for 1			$45.18
Total cost of rations for 1 man 1 day			0.45 1-6

TABLE II.—SHOWING COST OF RATIONS FOR SURVEY PARTIES, GEORGIAN BAY SHIP CANAL SURVEY.

Name of Party.	Date of Field Work.	No. of Days.	Cost of Provisions.	Rate.
French River	May 13, '06-July 31, '06	1,352	$ 740.00	$0.54¾
Lake Nipissing	Dec. 21, '04-Mar. 31, '06	5,027	3,161.31	0.63
Section No. 1	Sept. 27, '04-Dec. 31, '05	7,227	3,568.90	0.49⅓
Section No. 2	Sept. 27, '04-Dec. 31, '05	7,676	3,615.54	0.47
Section No. 3	Sept. 27, '04-Dec. 31, '05	8,157½	3,823.09	0.47
Section No. 4	Sept. 27, '04-Jan. 31, '06	9,946	3,691.83	0.37
Section No. 4A	Sept. 1, '05-Jan. 31, '06	2,507	1,181.33	0.47
Section No. 5	Sept. 27, '04-Jan. 31, '06	9,183	2,358.33	0.25⅔
Section No. 6	Sept. 27, '04-Jan. 31, '06	8,697½	3,344.27	0.38½
Section No. 7	Sept. 27, '04-Sept. 30, '05	7,032½	3,324.35	0.47¼
Section No. 8	Sept. 27, '04-Aug. 31, '05	6,241½	3,209.21	0.51⅓
Section No. 9	Sept. 27, '04-Oct. 31, '05	7,100	3,264.75	0.46
Totals		80,147	$35,282.91	.....
Averages		6,679	$ 2,940 24	$0.44

into three or more sections, each in charge of a sectional engineer, who generally had under his control two assistant engineers, two rodmen, two chainmen, one foreman and seven or more laborers, according to the requirements of the work. The salaries paid were as follows:

Sectional engineers, per month	$200 to $225
First assistant engineers, per month	150 to 175
Second assistant engineers, per month	110 to 135
Rodmen, per month	75 to 90
Chain men, per month	60 to 75
Foreman, per day	2.00
Cooks, per day	2.00
Laborers, per day	1.50

While the length of canal surveyed was as stated 440 miles, the distance covered by surveys was some 600 miles by reason of the several branches of the Ottawa River which had to be developed and the several alternate routes that had to be inspected. As work had frequently to be performed on rough and dangerous waters, in order to reduce accidents the principle was adopted at the start of the work that all equipment should be new and the best available. It may be noted that there were only two drowning accidents during the work.

Equipment.—Each party was provided with 2 lumberman's boats 36 ft. long, 1 punt 24 ft. long, 1 skiff, 1 large Peterborough canoe, and 1 light canoe for portaging. On some sections where relatively large bodies of water existed it was found advantageous to have small gasoline launches; these saved much time when the work was several miles from the camping place. They were also used to transport supplies, to tow the smaller boats, etc. These launches were very strongly built, were 24 ft. long and 6 ft. beam and could carry 15 men.

The instruments supplied each party comprised 2 transits with stadia and other attachments, 1 Y level, 1 Dumpy level, 2 field glasses, 2 box sextants, 1 prismatic compass, 1 hand level, rods, chains, sounding wires, and all necessary articles of stationery.

The camp equipment generally consisted of 1 engineer's tent, 1 tent for rodmen and chainmen, 2 large tents for the men, 1 dining tent, 1 small tent for provisions and 1 small tent for the cook. All these were supplied with fly, tarpaulin, folding tables, stoves, etc. In many cases an extra tent was issued to be used as a drafting office. There was a full supply of camp beds, blankets, cooking utensils, etc.

The purchase and cost of provisions was realized from the outset to be an important item in connection with the survey and caution was exercised to control extravagance of any kind either in the matter of prices or in the purchase of fancy articles. A circular was issued giving quantities and prices for a ration for 100 men for one day, the amounts stated being maximum amounts and not to be exceeded. This ration list is shown by Table I. It was provided that articles of food not mentioned in the list, such as eggs, could be purchased instead of articles of a similar nature which were quoted. As will be seen from the list, the total cost of rations for 1 man for 1 day was 46 1/6 cts., and this cost was not exceeded, as is shown by Table II, giving the actual cost. In this table the differences in the averages were mainly due to transportation cost, when camps were a long distance from towns or villages.

Character and Methods of English Ordnance Surveys with Data on Costs.*

It is generally admitted that the art of surveying is practically a lost one in this country. This is undoubtedly due to the existence of the Ordnance Survey maps on various scales. It may be also said that very few people have any knowledge of what a survey should cost, and it is intended in this article to give data whereby the cost of any survey on any scale can be estimated. This will be of special interest to municipal surveyors who require to revise or extend their large scale plans. The necessity for the information is the greater owing to the Ordnance Survey having arbitrarily fixed upon the price of £45 per 1/500 plan, "revision or extension," which is a prohibitive price to local authorities who now have to pay for their large scale surveys if they require them.

A committee on the Ordnance Survey, appointed by Parliament in 1893, recommended that no scale work larger than the 1/2500 should be carried out at the expense of the National Exchequer, but that the Ordnance Survey Department might, at their convenience, revise or extend large scale areas on prepayment of the estimated cost of the same by local authorities. These maps, with certain reservations, become the property of the town which pays for them, and a certain amount may be recovered by the sale of the plans. The average sale of the plans of fourteen large towns in sixteen years was at the rate of 3s. per plan per annum (*vide* committee's report), so that it would take 300 years to recover the charge now made. The Ordnance Survey are now charged with the revision of all scale plans up to 1/2500 scale in a certain cycle of years, the period of town vicinities being less than that of country districts. A Parliamentary grant is made for the purpose, therefore in carrying out revisions or extensions at the cost of local authorities it seems only equitable that the charge should be based upon reduced rates to what an entirely new survey would cost, as these partial revisions or extensions aid the general revision. That this is not the case will be shown.

The cost of surveys depends on the difficulties encountered in the work. For instance, two plans may exist, each containing the same number of area parcels. On one plan all area boundaries are straight, ground level, and no obstruction to an uninterrupted view over the whole; on the other all boundaries are crooked, ground hilly, and view restricted by trees, etc. The latter might cost double the price of the former. It would be obviously unfair to class both alike, or according to area of parcels. It is therefore necessary in estimating the cost of surveys to classify according to the difficulties existing, and experience is needed to carry this out.

On the Ordnance Survey work is classed and priced at about the following rates for 1/500 work, and includes everything up to the completion of the manuscript plans in pence per acre. A 1/500 plan measures 1,584 ft. by 1,056 ft., and contains 38.4 acres:

Operation.	Very open. d.	Open. d.	Medium. d.	Close. d.	Very close. d.
Triangulation	2.5	3.5	5.0	7.5	10.0
Surveying	9.0	18.0	30.0	48.0	72.0
Plotting	2.0	4.0	9.0	14.0	21.0
Tracing for examination	0.75	1.5	2.0	3.0	5.0
Examination	9.0	18.0	30.0	48.0	72.0
Drawing	1.5	4.0	8.0	12.0	18.0
Coloring	0.5	2.0	5.0	8.0	11.0
Leveling	1.5	2.25	3.0	4.0	5.0
Tot. per acre	26.75	33.25	92.0	144.5	214.0
Total per plan	£4.2621	£8.5248	£14.7072	£23.1168	£34.2528

Cost of Revision Work.—It is obvious, if a town when surveyed was revised one year afterwards, that the cost of the revision would be very small in comparison with that of the original cost. If left many years a great deal of work on the plans, especially on outside areas of towns, would be obsolete, although generally the inside areas would not have altered much. To estimate the cost of revision work it becomes necessary to fix the average life of a survey—that is, to state a period when the cost of revision would equal the cost of a new survey. This period we will assume as 30 years, and the law for the cost of a revision can now be stated in terms of cost of an original survey—that is, that it is fractionally proportionate to the number of elapsed years since the original survey, making 30 the denominator of the fraction. Thus if a revision was made in ten years it would cost 10/30 of its original class cost.

In Departmental Committee's Report 584 square miles of 1/500 work in England, not

*A paper by J. J. Amos in the "Surveyor" for April 1, 1910. For conversion of English costs into American money, in round figures, the following equivalents may be used: £ = $5; s = 25 cts.; d = 2 cts.

including Lancashire and Yorkshire, are stated to have cost an average of 15s per acre, and 178 square miles of 1/500 work in the latter counties averaged 20s per acre; 1/2500 work in town vicinities in the remainder of England averaged 4s per acre, and in Lancashire and Yorkshire averaged 5s per acre. The town work in these two counties was a patchwork survey, partly replotted from original survey books compiled over forty years previously, and revised, and partly new survey, a process of compiling a cadastral survey most unsatisfactory. However, it will serve to prove the assumption of the thirty-year period as the life of a survey.

Cost of original 1/500 survey remainder of England 15s per acre; Lancashire and Yorkshire $40/30 \times 15/1 = 20$s per acre.

Cost of original 1/2500 survey remainder of England town vicinities, 4s per acre; Lancashire and Yorkshire 1/2500 survey town vicinities $40/30 \times 4/1 = 5.3$s per acre. This practical illustration goes far to prove the assumption made, and that it would have been more economical to have made an entirely new survey of these counties as far as the towns were concerned.

Publishing and Printing—If the zincographic process is used, the two chief items are the preparation of tracing and cost of zinc plate, the latter about 16s each; and putting the cost of tracing as equal to drawing cost, and taking the mean between close and very close, we have £2 16s for average cost per plan for tracing, or a total of £3 12s per plan. The statement that the average cost of printing per plan was £5 (*vide* committee's report) may, therefore, be accepted as a price which would allow of thorough supervision, and a fair quantity of prints being pulled.

The cost of a town actually revised and extended by Ordnance Survey will now be analyzed, first by accepting the average cost at 15s per acre, secondly by the writer having carefully classed the work, both on ground and on plans, no niggardly class being awarded.

FIRST ANALYSIS.

	£	s.	d.
21 plans, new survey, at 15s. per acre =	892	16	0
36 plans, revised (17 year period), $17/30 \times 15/1$ per acre =	587	10	5
67 plans, printing and publishing at £5 per plan	335	0	0
	£1,815	6	5
Deduction for 2572.6 acres, at 2s. per acre, for this survey, helping the general revision	257	5	7
	£1,558	0	10
Allow Ordinance Survey 5 per cent for incidentals	77	18	0
Total cost	£1,635	18	10
The town paid	3,000	0	0
Overcharge	£1,364	1	2

SECOND ANALYSIS.

	£	s.	d.
13 plans, new survey, close, at £23 1168 per plan	300	10	5
10¾ plans, new survey, medium, at £14.7972 per plan	158	2	1
7¼ plans, new survey, open, at £8.521s per plan	61	16	1
16 plans, revision, very close, at $17/30 \times £24.3528$	311	2	0
20 plans, revision, close, at $17/30 \times £23\ 1168$	261	13	8
67 plans, printing and publishing at £5 per plan	335	0	0
	£1,428	4	3
Deduct as in the first case	257	5	7
	£1,170	18	8
Allow Ordinance Survey 25 per cent for administration, as this work has been classed at piece-work rates	292	14	8
Total cost	£1,463	13	4
Paid	3,000	0	0
Overcharge	£1,536	6	8

In a written memorandum Colonel Sir C. Wilson, Director-General, Ordnance Survey, to the Departmental Committee, says: "The charge of 15s per acre is not excessive, including as it does triangulation, levelling, surveying, and the drawing of the finished plan. Considering that these partial revisions and extensions will aid the general revision, they might be carried out at somewhat reduced rates." And yet within about ten years of a director-general feeling himself called upon to defend a charge of 15s per acre for a new survey, a case occurs in which the same department make a charge of £1 3s 4d per acre, and that for revision as well as for new survey.

The following prices, suitable for any 1/500 survey, the writer has proved by experience to be perfectly just. The saving is from about 27 per cent in very open to about 55 per cent in very close work on Ordnance Survey prices. The cost of manuscript plans on any other scale can be found from these prices by the ratio the denominators of the representative fractions of the scale have to each other. Thus if an acre, very close work, costs 155d on 1/500 scale, what would it cost on 1/2500, and 1/250 scales, $500/2500 \times 155/1d = 31d$, and $500/250 \times 155/1d = 310d$ per acre? It seems unnecessary to give details of prices of the different operations.

	Very open.	Open.	Medium	Close.	Very close.
Per acre.	19.5d	38.04	67.5d	105.5d	155.0d
Per plan of 38.4 acres	£3.1104	£6.0791	£10.7904	£16,8960	£24.8064

An analysis of the cost of the survey as in the second case with these prices gives cost as	£1,067	15	5
Paid	3,000	0	0
Overcharge	£1,932	4	7

Comments on Ordnance Survey Procedure.—Their system necessitates for the completion of a portion of work the visit of at least six different persons to the ground, and the plans in the office routine pass through quite as many different hands. Generally speaking, the employes are only trained in two or three of the duties, and only a few years ago it was no uncommon case to see men who had been chain-surveying all their lives, and could not plot, etc. This system has been somewhat modified of late years. A rule-of-thumb method existed for each particular duty, and was adhered to with red-tape impartiality. In the system of one man one duty a certain number of field hands lose a good deal of time by weather conditions, and the expense of moving them about and superintending them is heavy and adds greatly to the cost of the survey.

The surveyor who completes all his work can so arrange office and field work that he obtains the best weather for the latter. By a few additional measurements and check bookings when surveying he may materially reduce the cost of plan examination. Tracing for examination can be altogether saved, as he may take his plotted plan on to the ground for examination before being drawn; moreover, the man who completes everything takes a more intelligent interest in the work than the routine man who only perhaps understands a portion of the complete processes.

Process of Revision.—A few prints are cut into convenient sized cards and handed to a reviser, who checks the work on the ground, erasing and supplying everything necessary. A final examiner checks the work on the ground; a zincographic tracing is compiled of each plan from the cards. This tracing is transferred to a zinc plate, and the revised edition printed therefrom. This zincographic tracing takes the place of the original manuscript plan, and it should be remembered that a revised plan is burdened with the errors inseparable from the various processes leading to two reproductions. The Ordnance Survey plans do not now bear the high reputation for accuracy among those using them they formerly did.

Data Obtainable from Ordnance Survey.—When extensions are required the following data should be requisitioned for from the Director-General, Ordnance Survey Office, Southampton:

(1) Co-ordinates and sheet-line distances of all trigonometrical points required.

(2) Descriptions, with measurements for refinding a few selected points.

(3) Latitudes and longitudes of the respective origin points of co-ordinates.

The latter is needed where the work concerned is projected on more than one meridian, as happens in districts around London, Newcastle-on-Tyne, etc. The above data is all computed, and the public are entitled to be supplied with it at the departmental price of copying the same. Before making the requisition the ground should be visited with a 6-in. map, and all trigonometrical stations which are required for the extension should be encircled, those of which descriptions are required being represented by a double circle. Generally a series of points outside the extension area, and all prominent points inside, such as church spires, etc., will be sufficient.

Surveyors' Qualifications.—That great care is needed in selecting surveyors for carrying on a survey, even when assisted by Ordnance Survey triangulation, the following incidents will show: A town in the North of England obtained the triangulation, and carried out a large extension, working from extreme sides of their extension and meeting in the center, where their work, although relatively correct in itself, failed to agree to 10 ft. on the plans, this result being due to want of knowledge of the methods and processes that should have been used to hold the work together. In another case the writer put a trigonometrical test on some work lately which had been extended by a system of production from internal 1/500 detail points combined with a system of chaining from three fixed points in the 1/500 work into another point, and scoring its position by the length of the lines; the work was up to 18 ft. out of position, and the money spent in obtaining it wasted.

For purely revision work a man who can chain accurately and draw neatly will suffice, but for extension work good trigonometrical experience is needed, and the method of polar and cartesian co-ordinates and the adjustment of co-ordinate traverse should be thoroughly understood. In districts where the existing maps are projected on different meridians, the calculation of geodetic latitudes and longitudes is a necessary qualification, so as to be able to calculate the projection of plan lines on to the common plans projected on another meridian. Up to 1893 about £478,000 had been paid in the United Kingdom for 1/500 survey alone, and it seems a pity that the result of such an expenditure should be allowed to deteriorate to such an extent as to become useless by lapse of time, although it is clearly evident that the expense of keeping it up should fall on the community who benefit by the map, and not on the general public.

A block survey on 1/500 scale, showing all roads, streets and frontages, etc., "the filling up being carried out only when absolutely required," could be carried out at about half the rates last quoted, and would probably meet all requirements of municipal engineers in extending towns.

Example of The Relocation of Roads in Hilly Country.*

The causes leading up to and which, at the present day, demand relocation of improved roads, date back to the very early history of our country, when our forefathers began to settle here and there in what was then an unbroken wilderness, and when it became of the utmost importance to have communication between the different settlements for their mutual protection against the invasion of the Red Man of the forest. Then it was that mere foot paths were blazed through the forest and opened up from one settlement to another, regardless of any feasible route. These soon became bridle paths, later to become cart paths and highways. Many of such roads that to-day are our public highways were never surveyed or legally laid out and recorded upon our county records. As time passed and it became the custom to have the roads legally laid out, but little more attention was paid to the location in order to eliminate grades. When John Jones believed it would be to his interest to have a public highway laid out, passing his door and extending through his brother Hiram's place, they made application to the court of the county asking for the appointment of highway surveyors to lay out a public road, begin-

*From a paper by A. H. Konkle, County Engineer of Sussex County, N. J., read before the Association of County Engineers, and printed in the Annual Report of the State Department of Public Roads.

ning at a certain well-defined point and running in a certain direction to another well-defined point, the place of ending. You will see that the route was generally defined in the application, regardless of hills and grades that might be encountered, before ever the surveyors went upon the ground, so that if the surveyors were at all inclined to select the best route, their hands were virtually tied as to the best location and most feasible route. The writer well knows from long years of experience, as both practical surveyor and highway surveyor, wherein he has been an unwilling party, and, in more than one instance, where he has utterly refused to lay out a road over the ground selected by the applicants. To-day these are some of the roads that we are called upon to improve.

I have now briefly outlined the causes that made it imperative for modern road improvement to relocate in part, or in the whole, the road to be improved, in order to meet two requirements—first, to bring the grades within the maximum limits required by the State authorities; and second, to reduce the expense of such improvement to a minimum.

Sussex county was one of the last counties in the State to commence the improvement of its highways and has progressed slowly, there now being only about 30 miles of improved roads finished and in process of completion, five miles of which have been built without State aid, and upon that portion the grades were not kept down to the State's requirements. The roads so improved have all been under the writer's supervision and have generally been the main roads leading over the mountains, the most difficult sections to improve, as to question of grading. To reduce grades, running anywhere from 12 to 18 per cent, down to 5 per cent, and, at the same time, keep down the expense of such improvement, is no easy problem.

In 1903 there were improved 1¾ miles of road leading over the Blue Mountain. This road was a portion of an old turnpike having grades reaching 12½ per cent, climbing a hill, dropping into a valley, again climbing another hill, and so on to the top of the mountain. It was relocated its entire length, and, in relocating, the contours of the mountain were followed up a ravine and no grade exceeded 5½ per cent, and in no place in the entire length was any reverse grade encountered. The cost of the road was far less than it would have been had the line of the old road been followed, even though with a far greater per cent of grade, and by such change the length was increased but 600 ft.

Within the past year another portion of the same turnpike has been improved from the summit of the mountain down the same, and through the foot hills to the borough of Branchville, a distance of 3½ miles. The old road showed grades of 14 per cent, while the improved road was constructed on a maximum grade of 4½ per cent by relocating two sections at a greatly reduced cost from that required to grade the old road with an additional length of only 390 ft. over that of the old road.

A portion of the Morris turnpike, leading from Newton to Stanhope, a distance of 9¾ miles, is now in process of improvement. This road also crosses a mountain, and, as originally laid out, showed grades of 15 per cent, with no possible way to cut them down to the requirements without a heavy expense, but by relocation in five separate short sections, at a nominal expense, the grades were brought down to a maximum of 5 per cent, and by the several changes the length was increased only 164 ft. over that of the old road.

Another road under the writer's charge, leading from the celebrated mining town of Franklin Furnace over the Stockholm mountain to the Passaic county line, a distance of 5¾ miles, was surveyed last year and is now under construction. This has been one of the most difficult problems the writer has had to contend with. The grades of the old road reaching 17 per cent, about two-thirds of the entire distance was relocated, mostly through the forest and at a maximum grade of 6 per cent. This relocation cut out several very dangerous railroad crossings and required the building of one bridge 210 ft. in length, crossing a ravine and the railroad. This bridge will cost about $10,000, which the railroad company has agreed to build in consideration of the elimination of the several grade crossings, which elimination was possible only by relocation of road. The improved road will be three-eighths of a mile shorter than the old road.

Technical Society Meetings.

The list following names those technical societies in which engineers and contractors are most interested, whose meetings are to be held within three months of the date of this issue. There are given for each society listed the date and place of meeting and the name and address of the secretary, to whom all communications and inquiries should be addressed.

American Electrochemical Society.—May 5-7. Annual meeting at Pittsburg, Pa. Secy., Jos. W. Richards, South Bethlehem, Pa.

Appalachian Engineering Association.—May 6-7. Annual meeting at Winston-Salem, N. C. Secy., Henry M. Payne, Morgantown, W. Va.

National Fire Protection Association.—May 17-19. Annual meeting at Chicago, Ill. Secy., Franklin H. Wentworth, 87 Milk St., Boston, Mass.

American Railway Association.—May 18. Annual meeting at New York City. Secy., W. F. Allen, 24 Park Pl., New York City.

International Railway Fuel Association.—May 23-26. Annual meeting at Chicago, Ill. Secy., D. B. Sebastian, 327 La Salle Station, Chicago, Ill.

National Electric Light Association.—May 23-28. Annual meeting at St. Louis, Mo. Secy., T. C. Martin, 29 West 39th St., New York City.

American Society of Mechanical Engineers.—May 31-June 3. Spring meeting at Atlantic City, N. J. Secy., Calvin W. Rice, 29 West 39th St., New York City.

Engineers' Society of Pennsylvania.—June 1-3. Annual convention at Harrisburg, Pa. Secy., E. R. Dasher, Gilbert Bldg., Harrisburg, Pa.

Personals.

The General Contracting & Engineering Co. has removed its offices to 29 Broadway, New York City.

Henry H. Heinemann, a contractor of Chicago, Ill., died suddenly Apr. 22 at St. Louis, Mo., from apoplexy.

T. C. Lea, Deputy County Surveyor of Jackson County, Mo., died last week at his home in Independence, Mo., aged 71 years.

Messrs. C. A. Edel and W. D. Janney have resigned their positions as Assistant Engineers to the Harbor Board of Baltimore, Md.

Mr. Manton Hannah of Austin, Tex., has been appointed Consulting Engineer in the matter of sanitation to the Texas State Board of Health.

Mr. F. J. Angier has resigned his position as Superintendent of the Wood Preserving Department of the Chicago, Burlington & Quincy R. R. to accept a position with the Kettle River Treating Co.

Mr. A. S. Kent has been appointed Engineer of Maintenance of Way for the Monon road, with headquarters in Chicago, and Mr. Anton Anderson has been appointed Division Engineer of the first and second divisions, with headquarters at Lafayette.

Alexander McDonald, a well known Civil Engineer of Schenectady, N. Y., died Apr. 20. He was 44 years of age and had lived in Schenectady all his life. He was graduated from Union University with the class of 1890 and was formerly Assistant City Engineer of Schenectady.

Mr. J. B. Carothers, formerly Superintendent of the Illinois division of the Baltimore & Ohio Southwestern R. R. at Washington, Ind., has been appointed Chief Engineer of Maintenance of Way to succeed Mr. Earl Stimson, who has been appointed Chief Engineer of Maintenance of Way for the Baltimore & Ohio R. R.

Mr. Geo. W. Arnold, who has been Engineer in Charge for the construction of a number of large tunnels within the past few years, has been appointed Division Engineer for the Western Maryland Ry. on the construction of several tunnels and heavy grading in Pennsylvania. Mr. Arnold will establish offices at Meyendale, Pa.

Mr. J. Edward McDonald, Attorney, of Winnsboro; Mr. William H. Riggs, Director of the Department of Engineering in Clemson College, and Mr. Thomas N. Raysor have been appointed members of the recently authorized State Public Service Commission of South Carolina. The commission will have general supervision of public service and charges therefor throughout the state except in the counties of Charleston, Marion, Spartanburg, Sumter, Union and Horry, which are expressly exempted.

Mr. John A. Byrne has been appointed Engineer in Charge of the Queens Borough Water Department of New York City to succeed Mr. Leonard C. L. Smith. Mr. Byrne, whose home is in Yonkers, some years ago was connected with the Water Department, under George Creed. His present appointment will not include the charge of the Water Register Department, which usually has been given over to the Engineer, as it has been decided to appoint a man to care for that branch.

Catalogs Worth Having.

Engineers and contractors should have on file the latest catalogs of machines, tools and supplies that they use. In sending for catalogs reviewed or advertised in this paper, you will confer a favor on us if you will write directly to the advertisers and state that you saw the catalog mentioned in ENGINEERING-CONTRACTING. If you are in the market for tools, machinery or supplies, tell us and we will notify promptly the leading manufacturers.

Manganese Steel.—Manganese Steel Rail Co., Paterson, N. J.

This company sends out reprints, in pamplet form, of articles published in different engineering periodicals as follows: The Manufacture of Manganese steel products 8½ x 12½ ins., 3½ pp., "The Iron Age" of Sept. 30, 1909. Rolled Manganese Steel Rails, 8 x 6½ ins., 7 pp.; giving life of rails and comparative tests, "Railway and Engineering Review" of Mar. 13, 1909. Physical Properties of Manganese Steel, 6 x 9 ins., 31 pp.; "Journal of the Western Society of Engineers." Life of Manganese Steel Rail on Curves, 6 x 9 ins.; 7 pp.; "Electric Ry. Journal," Oct. 17, 1908, being tests for wear on the elevated division of the Boston Elevated Ry. Co.

I-Beam Trolleys and Chain Block Traveling Cranes.—Paper 6 x 9 ins.; 12 pp.; Pawling & Harnischfeger Co., Milwaukee, Wis.

Steel Piles.—Folder 4 x 9 ins.; 8 pp.; The Underpinning Co., 290 Broadway, New York, N. Y.

Illustrative and descriptive pamphlet.

Water Works Specialties.—Paper 6 x 9 ins.; circulars Nos. 1 to 5 of 10, 11, 11, 6, and 4 pp., respectively. The Simplex Valve & Meter Co. 112 N. Broad Street, Philadelphia, Pa.

These circulars contain good illustrations and descriptions together with tables of the various devices manufactured by the company.

Oil and Gas Engines.—The De La Vergne Machine Co., New York City; paper 9 x 6 ins.; 84 pp.

Complete of oil engines; also folders 4 x 8¾ ins. of two cycle engines, four cycle gas engines and heating lamps; also Bulletins No. 98 and 101, paper 8 x 10½ ins.; 12 pp. each, being descriptive of oil engines of two types manufactured by this company.

Climax Road Machines.—Paper, 8x10¾ ins., 16 pp. Climax Road Machinery Co., Marathon, Cortland County, New York.

An illustrated catalog of various kinds of machinery for making and maintaining of roads.

Supplies and Machinery.—Cloth, 7x9⅝ ins., 952 pp. Catalog No. 50. H. Channon Co., Market and Randolph Sts., Chicago.

This is the last published general catalog of this company.

A concise and comprehensive catalog containing the descriptions, lists, tables, illustrations and prices of machinery and supplies for railroads, factories, mines and all kinds of construction work.

Cement Workers' Tools.—Paper, 3⅛x6¼ ins. 48 pp. The Contractors' Tool Co. Philadelphia, Pa.

This is a very complete pamphlet of tools for cement work. It is illustrated throughout, showing cuts of high grade tools made of bronze and also with cuts of the cheaper grades of tools. It also gives prices.

Pipes for Hydraulic Dredges.—Paper, 9½x6¼ ins., 8 pp. The Norborn Engineering Co., 11th and Market Streets, Philadelphia, Pa.

This is a catalog of land and pontoon pipes for hydraulic dredging. It gives cuts of the pipe, valves, etc., and illustrations of work being done. The catalog also contains tables of size, thickness, weight and price per lineal foot of pipe.

Dumping Wagons.—Paper, 9x6 ins., 24 pp. Watson Wagon Co., Castanova, New York.

This is a well gotten up catalog containing cuts of dump wagons of from 1 to 3 cu. yds. capacity. A good description of each wagon is given, including dimensions of parts, weights, etc.

Metal Hose.—Paper, 3½x6½ ins., 12 pp. Pennsylvania Flexible Metallic Tubing Co., 1305 Arch St., Philadelphia, Pa.

A catalog of cuts and prices of high pressure hose for steam, hydraulic, and pneumatic use.

Sectional Concrete Piles.—Paper, 4½x7 ins., 16 pp. The Holmes Caseless Sectional Concrete Pile Co., Real Estate Trust Bldg., Philadelphia, Pa.

A description of a method of making and placing concrete piles in sections by the use of a jet, and without the use of a pile driver.

Contract News Section

of

ENGINEERING-CONTRACTING

A Consolidation of Engineering-Contracting—Contract News—Engineering World—The Dirt Mover.

Containing Items of Interest to Railroad, Public Works and Other Contractors.

The Doings of the Week.

The directors of the Atchison, Topeka & Santa Fe Ry. have approved a budget for improvements calling for an expenditure of $31,000,000.—The latest development in railroad construction work in Texas is that the Southwestern railroads have served notice upon the Texas Railroad Commission that they will be compelled to cut the planned improvements and extensions for the next two years aggregating $25,000,000, to not exceeding $10,000,000, if the farmers get the reduction in cotton rates asked for. The expenditures contemplated by the railroads include the construction of about 150 miles of new road, building of several extensions, and new equipment, in addition to maintenance, and the usual renewals and repairs. The railroads claim the proposed reduction in the cotton tariff will reduce the earnings of the Texas lines a little over $1,300,000 annually.—An interesting development in the northwest is the report that ex-Senator William A. Clark, of Montana, and James J. Hill, have joined hands with a view to a combined railroad invasion of Washington, Idaho, Oregon, Montana and California. It is stated that a considerable portion of the Clark millions will be invested during the next few years in railroad ventures in the Northwest, which will be planned with a view to occupation of all territory that promises to become tonnage producers. Just now Senator Clark is said to be interested with Mr. Hill in the construction of the Gilmore and Pittsburg Railroad and in the North Coast line which Robert Strathorn of Spokane is promoting.—The municipal government of the Port of Vera Cruz, Mexico, has applied to the Mexican government for permission to make a loan of $2,000,000 for the construction of a water supply scheme for the city.—Bids are now being asked by George C. Ralph, State Drainage Engineer of Minnesota, at St. Paul, Minn., for the construction of several large ditches. The ditches will be over 200 miles long, will drain 200,000 acres and will require the moving of 3,500,000 cu. yds. of dirt.—Among the railway construction contracts recently let are the following: Timothy Burke, Scranton, Pa., for change of alignment for the D. L. & W. Ry. between Analominch and Henryville, Pa., the work including 20,500 cu. yds. concrete masonry, 54,000 cu. yds. rock excavation and 198,500 cu. yds. earth excavation; Felt & Eastman, Tacoma, Wash., for constructing a portion of the projected interurban line of the Seattle-Tacoma Short Line Ry.; Newkirk-Powers Construction Co., Joliet, Ill., for replacing 20 small bridges on the line of the Elgin, Joliet & Eastern R. R., which is to be double tracked; C. M. McConnico and J. S. Moore, of Lufkin, Tex., for grading from Temple, Tex. to Hamilton, for the Temple Northwestern R. R.; Taylor Bros. Construction Co., Bingham, Utah, sub-contract for work on the railroad now being built from Bingham, the contract including 150,000 cu. yds. of rock excavation and 15,000 cu. yds. of tunnel work; O'Boyle Bros. Construction Co., Sault Ste. Marie, Mich., for grading for nine miles of line for the Algoma Central R. R.; Smith Bros., Memphis, Tenn., according to reports, for constructing the Joplin, Oklahoma & Western R. R. from Joplin, Mo., to Bartlesville, Okla.; Walsh Construction Co., Davenport Ia., for grading second track on St. Louis, Iron Mountain & Southern Ry., between Bald Knob and McAlmont, Ark.; Ball & Peters, Little Rock, Ark., for second track grading for the St. Louis, Iron Mountain & Southern between Diaz and White River Bridge, Ark., and between Poplar Bluff at Harviell, Mo.; Burke & Joseph, Cape Girardeau, Mo., for trestle bridging for the last two mentioned contracts; and T. B. Jones & Co., Louisville, Ky., for second track grading between Jefferson City and Cole Junction for the Missouri Pacific Ry.

A Railway Reconnaissance of 1910 and a Trip in 1870.

The inspection of the proposed route of a projected railway preliminary to ordering the starting of surveys is not nowadays, in most cases, the tiresome and often disagreeable task that it was when this country was young and unsettled. In a recent inspection of the proposed route of a railway to extend from Tucson, Ariz., to a terminus on the gulf of California the railway officials used automobiles for the greater part of the distance and could have covered the entire route had the supply of gasoline held out. The name of the railway is the Arizona, Mexico & Gulf of California R. R. and it is to be built from Tucson to a little bay between Point Lobos and Cape Tepoca, a distance of 210 miles. In a recent issue of the New York Sun Mr. V. L. Mason, vice president of the company, describes the inspection trip, and we have abstracted the following from his description:

"We left Tucson in four automobiles and a fifth came later with the surveyors' instruments. We used the autos for 150 miles, all the way to Caborca, the road that far being fairly good. In fact, we might have driven the automobiles all the way, only we found at Caborca there was no gasoline to be had, and that town is 90 miles from a railroad, so as the machines had just enough fuel to take them back to the next town where some gasoline was, we sent them back and went on in four horse wagons of the old prairie schooner type. We spent the first night at Sasabe, on the border, camping out in tents. The next night we stopped at the Desaeo ranch, where some of the party slept in the hayrick with their blankets wrapped around them, and some put up in a shed. We reached Caborca the third day. Caborca is a town of about 3,000 inhabitants typically Mexican in appearance, the houses being of one story and built of adobe and the streets dusty. One of the autos broke its gear when we reached Caborca and another had broken down the first day of the journey, so there were only three to be sent back. When we learned there was no gasoline to be had in Caborca we telegraphed to Altar and were informed that there was just 30 gallons in that town. We had 15 gallons in reserve on the running boards of the cars. The men who took the cars back to Altar reported later that somebody had sold them kerosene at a dollar a gallon and they had to empty out their tanks. They finally got the gasoline.

"We made the journey from Caborca to the gulf in about 24 hours, passing one night at a little hamlet called Pitaquita. There was no real road beyond Caborca, but somebody had driven over the country. In the latter part of the journey we passed through a region that was evidently rich in game. While we were going through a mountain pass we saw several antelope, and one of the party got out and killed one. Big horn seem to be numerous. We had ordered a steamer to come up from Guaymas to meet us. She was called the General Minas, and she was a wonder. However, she was useful making soundings in the harbor and to determine the best places for our wharves. We stayed at Port Lobos four nights, sleeping in tents. It was cool all the time, and at night I had to sleep in my regular clothes, a sweater and three blankets. That coast has a mountain range running along it almost at the water's edge for hundreds of miles, but at Port Lobos there is a large flat area. The waters of the harbor teem with fish. One day three men of the crew of the steamer caught 200 sea bass within three hours, and their average weight was six pounds. I fished one day for an hour, but lost two lines, one a brand new one, trying to catch a big bass. The last day I was there I caught a fish that weighed 50 pounds, but none of our party knew what it was. Our Chinese cook insisted it was a sturgeon and was dressing him to cook when some of the Mexicans came ashore and told him that the fish was nothing but a young shark. The cook was so disgusted he went and dug a hole and buried it."

The following item from the Pioneer Press of St. Paul, Minn., of April 17, 1870, describes a trip of a different kind, made under conditions more difficult than the one above mentioned. In passing it may be noted that the J. J. Hill mentioned in the item is the present head of the Great Northern Ry. and the other roads that go to make up the great Hill system of railroads:

"Mr. J. J. Hill, who left here for Fort Garry, is having a strenuous experience together with his stage companions in forcing their way through the huge snow drifts which have recently fallen in that district. At one place the driver, agent and passengers had to shovel their way for over 20 miles. Several nights they were obliged to lie out and they were obliged to send a man in on foot to bring back a fresh team, as the one they had was completely exhausted. At Old Crossing Mr. Hill bought a dog train and proceeded on his journey.

"Forty miles this side of the Grand Forks of the Red River and probably about 22 miles north of Georgetown, Mr. Hill, while in camp for the night, heard the barking of dogs some distance away. Upon reconnoitering he was pleasantly surprised to find encamped his old friend Judge Malmros, who was on his way to St. Paul. They moved their camps together and a most enjoyable evening was spent. Mr. Hill took this opportunity to deliver to Judge Malmros a box of cigars sent him by Hon. Charles Scheffer, and rarely were fine cigars more enjoyed than on that evening in the midst of long stretches of mountainous snow drifts. Judge Malmros, who is now in St. Paul, says he was compelled to camp six nights in the open. He says Mr. Hill has a splendid 'team' of dogs, the best that could be found anywhere, and was getting along capably. The dog sledges are flat bottomed, like a long slab, with the forward end curved upward, and 8 or 9 ft. long and from 12 to 14 ins. wide—being some 2 ins. narrower at the rear. He describes President Riel, the leader of the rebellion, as a young man of great daring, energy and perseverance, and in many respects fitted to take a lead in such a movement."

Confirmed Reports by Engineers and Contractors

RAILROADS, POWER DEVELOPMENTS, LEVEES, DRAINAGE AND IRRIGATION WORKS.

Railroads—Steam and Electric.

ARKANSAS.

Contracts for second track work on the Missouri Pacific Ry. system have been let as follows: Contract for grading second track on the St. Louis, Iron Mountain & Southern Ry. Co. between Bald Knob and McAlmont, Ark., was let to the Walsh Construction Co., Davenport, Ia.; for second track grading between Diaz and White River Bridge, Ark., and between Poplar Bluff and Harviell, Mo., contract was let to Ball & Peters of Little Rock, Ark.; contracts for trestle bridging for all of the above work was let to Burke & Joseph of Cape Girardeau, Mo.; contract for second track grading on the Missouri Pacific Ry., between Jefferson City and Cole Junction was let to T. B. Jones & Co., Louisville, Ky.

COLORADO.

We are advised that the contract for constructing a branch of the Union Pacific Ry. from Wamsutter, Wyo., to Craig, Colo., has not as yet been let. It was reported that this contract had been let to Kilpatrick Bros. & Collins Constructing Co., Beatrice, Neb.

ILLINOIS.

Ryan & Connell, Fulton or Nelson, Ill., have 140,000 cu. yds. machine work and 35,000 cu. yds. side work at Fulton, Ill., which they wish to sub-let.

E. E. Headley & Son have just moved their outfit from Cayuga, Ind., to Springfield, Ill., and have commenced work on the Interurban Line that runs west to Jacksonville. They could use a lot of their old Skinners if they should come that way.

INDIANA.

The Fort Wayne & Springfield Ry. Co. has completed surveys for its projected 28-mile extension to Portland, Ind., and has partly secured the construction capital. The company will do the construction work itself. A. W. Fishbaugh, Celina, O., is Chief Engineer, and W. H. Fledderjohn, Decatur, Ind., is President.

MARYLAND.

The Elkton, Fairhill & Oxford Ry. & Power Co., recently chartered with a capital stock of $50,000, proposes the construction of a 16-mile electric railway from Elkton, Md., through Cherryhill and Fairhill in Maryland and Lewisville in Chester County, Pa., to Oxford, Pa. Hiester Hess, Elkton, Md., is interested.

MICHIGAN.

Bids are asked by F. A. Bean, Chief Engineer, Detroit, Lansing & Grand Rapids Ry., 706 Union Trust Bldg., Detroit, Mich., until noon, May 14, for all necessary surveys and plans for an electric railway about 35 miles in length from Brighton, Mich., to a point near Detroit, Mich. The official advertisement will be found elsewhere in this issue.

MINNESOTA.

Contracts have not been let as yet for the construction of the Duluth, Winnipeg & Pacific Ry., but they probably will be soon so that the work can go ahead this season. This line is a Canadian Northern project and is to extend from Virginia, Minn., to Duluth, 75 miles. H. T. Hazen, 619 Lyceum Bldg., Duluth, is Chief Engineer.

MISSOURI.

The Springfield, Nixa & Southern Interurban Ry. & Power Co. has made surveys for its projected 18¾-mile line from Springfield to the James River. The capital for construction has not been secured as yet and the time for awarding construction contracts is indefinite. Jno. Owan, Springfield, Mo., is President, and W. H. Schreiber, Springfield, Mo., is Chief Engineer.

The Missouri Bridge Co., P. O. Box 785 Kansas City, Mo., has started work on some extensive dike work on the Missouri River near Kansas City, Kan. The company also has been awarded the contract for bridge work on the Kansas, Lawton & Gulf Ry. in Oklahoma, and likewise has the contract for all the bridge work for the Interstate Ry. for its projected line from Kansas City to St. Joseph, Mo. Actual construction work on the last named contract has not been started as yet, as only part of the railway project has been financed at the present writing.

NEW YORK.

The Southwestern New York Traction Co. is having surveys made for its projected 15 mile line from Bolivar to Wellsville, N. Y. The capital for construction has not been entirely secured as yet; construction contracts, however, are to be let soon. E. M. Bedford, Southwestern New York Traction Co., Bolivar, N. Y., is Chief Engineer, and C. M. Van Curen, Bolivar, N. Y., is President.

PENNSYLVANIA.

The Delaware, Lackawanna & Western Ry. has awarded the contract for change of alignment of its line between Analominck and Henryville, Pa., to Timothy Burke, Scranton, Pa. The contract includes 198,500 cu. yds. earth excavation, 54,000 cu. yds. rock excavation and 20,500 cu. yds. concrete masonry.

SOUTH CAROLINA.

Surveys for the projected 32-mile electric railway of the Greenville & Spartanburg Ry. Co., which is to extend from Greenville, S. C., to Spartanburg, S. C., line not as yet completed, and no decision has been reached as to when contracts will be let. In our last issue we erroneously reported that William J. Oliver, Knoxville, Tenn., had been awarded the contract for this line.

SOUTH DAKOTA.

Surveys have been partly made for the projected 140-mile line of the Iowa & Dakota Interurban R. R. Co., and construction contracts are to be let soon. This company was recently incorporated with a capital stock of $500,000 to construct a line from Sioux City to Mitchell. L. F. Phillips, Wagner, S. Dak., is President.

TEXAS.

The Gainesville, Oklahoma & Western Ry. has made preliminary surveys for its projected 54-mile line from Gainesville, Tex., to Bridgeport. It is proposed to let construction contracts some time the latter part of May. Jas. Whaley, Gainesville, Tex., is President, and F. B. Truax, Gainesville, is Chief Engineer.

UTAH.

The Taylor Bros. Construction Co., R. F. D. No. 2, Bingham, Utah, have taken a subcontract from the Utah Construction Co., Ogden, Utah, for work on the Copper Belt Ry., being built from Bingham. Taylor Bros. contract includes the excavation of 150,000 cu. yds. of solid rock, 15,000 cu. yds. of tunnel work and a large quantity of team work. The railroad is to be 17 to 20 miles long and will cost about $1,000,000.

WASHINGTON.

Preliminary surveys have been made for the projected 77-mile line of the Western Washington Ry. & Navigation Co. The road is to extend from Gray's Harbor to Seattle, and is to be a gasoline-electric line. The capital for construction has not been secured as yet. C. C. Quackenbush, Aberdeen, Wash., is President and W. B. Sammons, Aberdeen, Wash., is Chief Engineer.

Power Developments, Levees, Drainage and Irrigation Works.

ARKANSAS.

The Pike County Water Power Co., is having final surveys made for a hydro-electric development which will develop 10,000 H.P. Final plans and specifications have not as yet been prepared for the installation. It is proposed to construct a dam about 60 ft. in height which will back the water up the Little Missouri River about 3½ miles. The Pike County Water Power Co. has just completed arrangements for fully financing this proposition and it is probable that actual construction work will begin some time this coming summer. The Fuller-Coult Co., Chemical Bldg., St. Louis, Mo., are the engineers.

CALIFORNIA.

The Sacramento Valley Irrigation Co., Willows, Cal., is now calling for bids to be opened May 1 for the re-construction of 23 miles of main canal and five miles of new ditch, this five miles being gaps in the canal which were never completed. This canal is from 35 to 55 ft. wide on the bottom and is designed to carry 6 ft. of water. It is to be enlarged so as to carry 8 ft. The yardage involved is approximately 800,000 cu. yds.

COLORADO.

The Bent & Prowers Irrigation District propose the construction of three dams across Purgatoire River and the construction of ditches. The District expects to be in position to advertise for bids on construction work sometime in May. The District has authorized a bond issue of $4,000,000 to cover the cost of this work, and expects to irrigate some 100,000 acres of land by means of a storage reservoir of the Purgatoire River and a ditch line from it covering the lands lying thereunder. Brandby Hillyer, Lamar, Colo., is Secretary, and F. H. Whiting, Denver, Colo., is Engineer in charge.

Bids are asked by San Luis Valley Irrigation District, D. Miles, Secretary, Center, Colo., until 2 p. m., May 25, for the construction of a dam and spill-way at the Rio Grande Reservoir site, located about 30 miles west of Creed, in Hinsdale County, Colo. The dam is 450 ft. in length, 100 ft. high, 30 ft. wide on top, and involves the placing approximately of 68,000 cu. yds. of loose rock fill, 120,000 cu. yds. of earth fill, and 7,000 cu. yds. of rip-rap. Plans and specifications for dam and spillway can be seen at the office of district in the town of Center, or at 205 Boston Bldg., Denver, Colo.

IOWA.

Bids will be received at the office of C. W. Duke, auditor of Page County, Clarinda, Ia., until May 10, for the construction of the Coin-Blanchard drainage ditch. The ditch will be 28,000 ft. long and will require the moving of 233,000 cu. yds. of earth. It is to be constructed to straighten Tarkio Creek.

ILLINOIS.

Bids are asked by the commissioners of the Keithsburg Drainage Disrict, F. B. Wickett, commissioner, Keithsburg, Ill., for the construction of 182,000 cu. yds. of levee and 60,000 cu. yds. of main ditches. Harman En-

gineering Co., 120 Fredonia Ave., Peoria, Ill., is the engineer. Official advertisement will be found elsewhere in this issue.

KANSAS.

Burns & McDonnell, consulting engineers, Scarritt Bldg., Kansas City, Mo., are preparing plans and specifications for a concrete dam to be built across the Arkansas River at Wichita, Kas. Bids for the construction of the dam are to be taken as soon as the plans and specifications are completed. The dam will cost about $25,000.

MICHIGAN.

The city of Grand Rapids, Mich., has awarded the contract for excavating in Grand River and constructing embankments along the dock lines of Grand River, with cutoff embankments at lower ends south of Wealthy Ave., to Albert H. Prange, Grand Rapids, for the sum of $83,310.

MISSISSIPPI.

But one bid was received April 19 at the U. S. Engineer's Office, Vicksburg, Miss., for furnishing about 36,000 cords of brush and poles for revetment work in the Third District of the Mississippi River Commission. This bid was submitted by C. W. Hunter, Memphis, Tenn., and was $1.68 per cord of 128 cu. ft.

The following bids per cubic yard were received April 18 at the U. S. Engineers' Office, Vicksburg, Miss., for furnishing about 20,000 cu. yds. of stone: Guy Dickinson, 111 Center St., Little Rock, Ark., delivered by rail at Luna Landing, Ark., $2.50; F. W. Katterjohn, Paducah, Ky., by rail at Greenville, Miss., $2.16, by rail at Southern R. R. south of Greenville, Miss., $2.16; Oscar F. Barrett, Room 513, Chamber of Commerce, Bldg., Cincinnati, O., on barges at Greenville, Miss., $2.10; Foster-Creighton-Gould Co., No. 3 Berry Block, Nashville, Tenn., by rail at Greenville, Miss., Southern R. R. tipple, $1.99.

MONTANA.

Robert Russell, General Contractor, Valier, Mont., has been awarded the contract at Valier by the Conrad Land & Power Co. to build the irrigation system which consists of over 2,000,000 yards of work. At the present time the contractor has seven steam shovels, four drag lines and 200 teams at work.

SOUTH DAKOTA.

The Dakota Power Co., R. M. Fulweiber, Chief Engineer, Rapid City, S. Dak., is to install a plant of 1,500 K. W. generator capacity. The plant will include a pen-stock of 85 second feet capacity, 2,000 ft. long, with gates, etc., head 280 ft., water wheels, governing apparatus; generators of approximately 400 or 500 K.W. units; exciters, switch boards, switches, measurement, controlling and protection apparatus, transmission line approximately 12 miles long, transformers, sub-station, etc. Generator and line voltage will be 15,000 volts.

TEXAS.

C. H. Wier, Hempstead, Tex., wants bids for contracts for building of a pile-jetty about 400 ft. long in the Brazos River, near Hempstead.

Chas. A. Mangold and associates have retained F. H. Lancashire of Dallas, Texas, to do preliminary work and make designs for the construction of a dam, core wall and spillway at Lake Cliff, Tex.

As previously noted in this paper the City of Austin has voted to have the old dam in the Colorado River replaced with a new structure. The price to be paid is $1,000,000, in 40 installments, six months apart, $25,000 each. The structure is to be of reinforced concrete. The crest is to be 65 ft. above low water in the river. The structure will call for about 50,000 bbls. of cement and 180 tons of steel. J. C. Dumont, at present in Austin, is the contractor.

It is reported that grading will be finished in about 90 days on the branch of the Chicago, Milwaukee & Puget Sound Ry. from the main line at McLoughlin, S. Dak., about 25 miles west of the Missouri river, north to a crossing of the Cannon Ball river to the western boundary of the Hettinger county, at New England, 135 miles.

Frank E. Scharff of Lincoln, Neb., who purchased the right of way and all assets of the Omaha & Nebraska Central R. R. project at receiver's sale, has asked the Hastings City Council for a franchise giving the Omaha, Western & Lincoln R. R. Co. the right to use certain streets. The Omaha, Western & Lincoln has taken over the assets purchased by Mr. Scharff, and is said to have European capital available to construct the road as soon as complete right of way and terminal franchises are obtained. The plans prepared for the road contemplate construction and equipment complete that will cost $27,000 per mile. The route will be from Omaha to Hastings along the projected Nebraska Central line, with a branch from the Platte River to Lincoln.

The Louisville Traction Co., Louisville, Ky., has been petitioned to extend the Orell suburban line from its terminus at Orell to Kosmosdale, a distance of about three miles.

Col. T. Moore Jackson, Clarksburg, W. Va., who is promoting a project for the construction of an interurban line from Sisterville, W. Va., to Middlebourne and Clarksburg, has been over the proposed routes to decide on which will be the best one to follow.

The Nebraska Traction & Power Co. of Omaha, Neb., is to extend its line from Ralston to Papallion, Neb., and the work on the extension will begin in the near future. This interurban line now runs from Omaha to Ralston.

The Jacksonville Electric Co., Jacksonville, Fla., is reported to have secured the necessary material for the extension of the street car lines from their present termination at Phoenix Park to Cummer's Mill at Jacksonville.

C. E. James, Chattanooga, Tenn., has applied to the City Council of that city for a franchise for a new electric railway for that city and suburbs.

The St. Johns River Terminal Co., O. H. Grady, Superintendent, Macon, Ga., is said to be planning the expenditure of $200,000 for improving its facilities at Jacksonville, Fla.

The Laurel Forks Ry. Co., of Carter County, Tenn., has been incorporated with a capital stock of $50,000 and purposes to build a railroad from Hamilton to Gouge, both points being in Carter County. The incorporators are: A. R. Flinn, T. J. McMorrough, A. S. Britt, R. B. C. Howell and Thomas G. Henson.

The Territorial Engineer of New Mexico has approved two applications for power propositions on the Penasco River in Eddy County. One of these is from W. P. Turner, W. R. Kinney and W. R. Allison of Roswell, N. Mex., for 100 second feet to produce 1,000 H.P. at a cost of $25,000. The other from Will Benson of Artesia, N. M., is for 90 second feet to produce 10,980 H.P. at a cost of $150,000. The latter project is to have five power stations.

The Coal & Coke Ry., R. H. Pembroke, Chief Engineer, Elkins, W. Va., is stated to have surveys under way of a route between Elkins and Rowlesburg, W. Va. The object is to ascertain the cost and distance, as well as other information, of building an extension of the line from Elkins to Rowlesburg.

The Tennessee, Alabama & Kentucky R. R., will probably let contracts within two or three months for the construction of that portion of its line from the Cumberland River. The projected length of this road is 230 miles and it is to extend from Chattanooga, Tenn., to Louisville, Ky., passing through Dunlap, Spencer, Sparta, Cookeville and Gainesboro, Tenn.; Tompkinsville, Edmonton and Hodgenville, Ky. Rutledge Smith, Cookeville, Tenn., is President.

The new owners of the water power at Trenton, N. J., propose the erection of a power plant along the stream, either at a point in the rear of South Warrne St., Trenton, where the Assanpink flows under the Water Power, or on a tract of land the company owns at the junction of the Water Power and the Delaware River. The power plant will be for the purpose of supplying power to manufacturing establishments. David Wharton Pepper, Jr., 1201 Chestnut St., Philadelphia, Pa., is interested.

The Cumberland & Westernport Electric Ry. Co., J. E. Taylor, superintendent, Frostburg, Md., is considering extending its line from Westernport to Keyser, W. Va.

Advices from Pachuca, Mexico, state that the construction of a large reservoir for water storage is to be immediately commenced on the Hacienda of "Pitahayas" the property of the Hoyos family. The dam is to be built of solid masonry and will be 300 meters in length and will have a maximum height of 30 meters. The storage capacity will be sufficient for irrigating ten thousand acres of land. The designs and plans were provided by a Pachuca engineering firm. The work will cost in the neighborhood of $100,000.

Pennsylvania R. R., Geo. P. Miller, principal assistant engineer, Jersey City, N. J., will probably have work started this year on the addition of two tracks between Colonia, N. J., and Waverly and running through Elizabeth, and the straightening of all curves between Rahway and Newark, N. J.

The state of Durango has given a franchise to Francisco Neugebauer for the construction of a railroad from the terminus of the International at Tepehuanes to the Guanacevi. The concession grants the privilege of constructing a broad or narrow gage road and steam or electric power may be used. The principal offices will be located at first in the city of Durango, afterwards branches may be established in any part of the republic.

Albert Emanuel and William R. Sullivan, of Dayton, O., are to apply to the City Council of Sheridan, Wyo., for a franchise for an electric plant and an electric railway for that city. It is proposed to construct about 15 miles of track, three of which will be in the city, and the remainder will reach the Koot coal camps via Fort Mackenzie. The estimated cost of the project is $500,000.

As previously noted William P. Woods has been granted a concession by the Mexican Government to build a railroad from Santa Lucrecia, on the Veracruz and Pacific, to Campeche, a distance of 750 kilometers. The road will be known as Veracruz, Tabasco and Campeche Ry. At Campeche connection will be made with the United Railways of Yucatan. A subsidy of 12,500 pesos per kilometer was granted by the government along with the concession. This subsidy, it is estimated, will pay half the cost of the road's construction. The Veracruz, Tabasco & Campeche Railway Construction Co., S. A., has been organized to construct the railroad. Among those interested in the company are J. B. Body, Frederick Adams and T. J. Ryder, connected with the Sir Weetman Pearson interests in Mexico; D. Chapeaurouge and J. J. Lemmens, of the Banco Internacional é Hipotecario; F. W. Johnstone, A. L. Van Antwerp, H. C. Dinkins, M. S. McKay, C. T. Ambridge and C. S. Hartmann, railroad men; Lic. Emilio Pardo, Jr., Lic. Isidoro Sternfeld, E. T. Bailey, Charles L. Seegar, A. E. Warswick, Albert Pepper, Thomas L. Phillips, Carl Heynen, D. J. Bohan and Dr. Charles S. Dolley, all of the City of Mexico.

Items Concerning Contractors and Their Work

RAILROADS, POWER DEVELOPMENTS, LEVEES, DRAINAGE AND IRRIGATION WORKS.

Alabama Notes.

FROM CORRESPONDENTS AND OTHER SOURCES.

Thurston H. Allen, C. E. Florence, Ala., has completed a horseback survey of a proposed route for an electric railway from Huntsville to Florence, which is projected by eastern capitalists. The proposed route passes through a country that is rich in water power facilities and the road would open up a rich timber and agricultural section.

Steps are being taken at Tuscaloosa to build a mineral railroad to Brookwood, and a committee has been appointed to raise subscriptions for the work. A. S. Van de Graaff. Tuscaloosa, is interested.

Reports from Huntsville state that preparations are being made for the resumption of the work of construction of the Monte Sano Electric railway. The railroad was started last spring but suspended after half a mile of track had been laid and put in operation.

The Noccalula & Southwestern R. R., a new company, is asking a franchise at Gadsden to build an electric railway to Lookout mountain, the steel plant and Attalla, has engineers now in that city on the preliminary work.

A company has been organized at Guntersville, Ala., in Marshall county, to build an electric light plant at that place. D. C. Jordan is president, J. H. Carter, vice-president, and Alex Gilbreath, treasurer.

The Union Springs & Northern R. R. Co., W. M. Blount, President, Union Springs, Ala., is reported to have secured $500,000 for the extension of the road to Milstead and the purchase of the 9-mile road extending from Milstead to Tallassee. J. W. Wright, Jr., Union Springs, has the contract.

A company owning a 2,680 acre tract in Blue Cane township, Clay county, is to established a town site there and propose to build a branch line to a connection with the St. Louis, Kennett & Southeastern R. R. S. R. Simpson, Rector, Ark., and Frank Shelter, Kennett, Mo., are interested.

The Iron Mountain R. R. has commenced operations on the reconstruction of its branch from Fort Smith to Greenwood, and it is reported that as soon as the work is completed the line will be extended to Gurdon.

Arkansas Notes.

FROM CORRESPONDENTS AND OTHER SOURCES.

The Iron Mountain Ry. (Missouri Pacific system) is to rebuild its coal docks at Van Buren, which were recently destroyed by fire.

The Board of Trade of Pine Bluff has been advised that Pine Bluff must raise a bonus of $100,000 and right of way through the city and county in order to have the Memphis, Paris & Gulf R. R. build there from Murfreesboro via Arkadelphia. It is the purpose of the company to build from Pine Bluff to Helena, the latter city having already pledged a bonus and right of way.

Construction work was started at Rogers on April 18 on the Tontitown-Cave Springs Ry., the extension of the Arkansas, Oklahoma & Western. This road will extend from Cave Springs to Tontitown, the Italian colony, a distance of seven miles. The road will be finished in 90 days and will practically give Tontitown a Frisco connection.

The Red Cloud copper mine on Rush Creek, near Mountain Home, has awarded a contract for the contruction of an aerial cable from the mine to Buffalo, in Baxter county, a distance of six miles. The tram road will be used at first for handling only the ore of the Red Cloud mine, but will later be used for custom hauling for the Buffalo district to the railroad.

The Chicago, Rock Island & Pacific Ry. has already spent $300,000 on its yards and shops now under construction at Biddle near Little Rock, and will expend $150,000 on the work this year. Only about one-half of the track scheme has been carried out in the work done so far at Biddle and this represents practically all of the $300,000 expenditure. Before work is begun on the shops, a roundhouse with a capacity of 20 engines, drawpits and turntables of size proportionate to the yards contemplated will be built. Work on the shop will probably be started by the end of this year. The improvements will represent a total of about $1,250,000.

California Notes.

FROM CORRESPONDENTS AND OTHER SOURCES.

The Southern Pacific Ry., W. Hood, chief engineer, San Francisco, according to reports, will double track its Sierra Mountain division from Sacramento east to Colfax, from Truckee to Reno, and will build a 30,000-ft. tunnel for a second track over the mountains.

The Power, Transit & Light Co., Harry Jastro, manager, Bakersfield, is considering a plan for building an electric railway to connect Bakersfield and the West Side oil fields.

The Elmhurst Street Ry. Co. of Sacramento has been incorporated with a capital stock of $100,000, of which $10,000 is subscribed, and proposes to build, own and operate a street and interurban railroad of standard gage with the usual overhead trolley wire system between the present terminus of the Sacramento Electric, Gas & Railway Co. opposite the East Lawn cemetery and a point at the junction of Manzanita and Helvetia avenues, Elmhurst. The estimated length of the lines of the company as thus planned are less than a mile, but the articles state that branches and extensions are contemplated as fast as traffic will justify and franchises can be secured. H. J. Goeth, Sacramento, is president, and S. P. Beere, Sacramento, is secretary.

The Western Pacific Ry. has engineers in the field for a line from Gerlach, the division headquarters, into the Surprise valley and from there to Goose Lake valley, via the Fandango pass.

The board of engineers appointed by the federal circuit court to report on the condition of the Ocean Shore Ry. has estimated that it would cost $3,190,029 to complete the line. This estimate includes the following: Completing roadbed, $1,351,115; terminal facilities, $1,227,441.36; ballasting entire roadbed, $132,320; fully equipping the road, $479,153.65. J. B. Rogers, San Francisco, is chief engineer.

The Board of Trade of Pomona is to appoint a special committee to secure a right of way through Pomona on the proposed Pomona-Claremont electric railway.

The citizens of Los Angeles have voted to bond the city for $6,500,000 to improve the harbor and develop 120,000 HP along the Owens River aqueduct.

Morris L. Brackett, a New York promoter, is reported to have sold bonds to the extent of $700,000 for financing the San Joaquin Valley Electric Ry. Co. This company projects a line to Modesto via French Camp, Manteca, Ripon and Salida. Right of way for the entire 32 miles of line has been donated by farmers. The company has offices in the Stockton Savings & Loan Society Bank Bldg., Stockton. W. H. Wallace is chief engineer.

The Sacramento & Sierra Ry., F. A. Warner, manager, Sacramento, which projects 79-mile line from Sacramento to Lake Tahoe has a large force of laborers at work clearing off the rights of way purchased by the company on the grade between Orangevale and Rattlesnake Bar, installing piles and dry walls along the waterways and preparing to construct concrete culverts. It is planned to have construction work under way all along the line by July 1. The route of this road is as follows: From Sacramento the roadbed will run through Ben Ali, directly north of Sacramento, thence to Orangevale northeasterly, north to Rattlesnake Bar on the American river, thence to Pilot Hill and on to Cool, and thence directly east to Greenwood, Georgetown and so on to Jackson Spring and Lake Tahoe.

Colorado Notes.

FROM CORRESPONDENTS AND OTHER SOURCES.

The Secretary of the Interior has authorized the construction of the necessary distribution system of canals on the west side of the Uncompahgre River for the Uncompahgre project. C. T. Pease, Montrose, is project engineer.

Profiles of the Thatcher lake reservoir and canal system, which is to be built near Buttes, 22 miles southeast of Colorado Springs, have been filed with the county clerk at Colorado Springs by Samuel Brown, Jr., president of the Southern Colorado Irrigation Co. The reservoir will have a capacity of 6,250,000,000 gallons of water and will cover 1,280 acres of land. It will cost $750,000. The canal which will supply the reservoir will have its intake near Little Buttes on Fountain creek. It will be four miles long. The dam of the reservoir will be 75 ft. high. The system will irrigate 40,000 acres of land. Work will be started at once. The surveys were made by H. Q. Raschahn.

The Colorado & Southern R. R., according to reports, in order to reach the iron mines of Sunrise, Guernsey and other camps of Wyoming, will connect its lines at Cheyenne the present year. The terminus of the Colorado & Southern in Colorado is Wellington. The company also has a line in operation between Cheyenne and Orin Junction, Wyo., and it is proposed to connect these two at Cheyenne, through which the company has secured a franchise for building a railroad. The company has run three surveys, one from Wellington, one from Greeley and another from a point about half way between these two towns.

The Empire Construction Co. of Denver, is making good progress with its contract for constructing the dam of the Garden Park Land & Irrigation Co., 12 miles northeast of Cripple Creek, and will complete the work about June 1. Concreting on the upper surface of the dam is now well along.

The Atchison, Topeka & Santa Fe Ry. is said to have plans under consideration for improvements to its Colorado properties which will involve the expenditure of $5,000,000. The principal improvement contemplated is the double tracking of the road between Pueblo and Denver.

Georgia Notes.

FROM CORRESPONDENTS AND OTHER SOURCES.

The Griffin City & Suburban Ry. Co. of Griffin, Ga., has been chartered with a capital stock of $25,000 and proposes to construct four miles of street railway in Griffin and suburbs. The incorporators are H. H. Bass, J. P. Nichols, D. R. Blakeley, Frank Flynt, Joseph D. Boyd, Thomas J. Brooks, J. C. Brooks, R. R. Strickland, C. M. Preston, and A. B. Aikin.

The Seaboard Air Line Ry. is reported to be negotiating for the purchase of the Augusta-Aiken interurban line with a view to using the tracks to secure an entrance to Aiken, S. C. The plan proposes the construction of a line from Aiken to Columbia and the use of the interurban tracks from Aiken to Augusta, Ga.

The Merchants' & Manufacturers' Association of Rome, Wright Willingham, chairman of the Railway Committee, has begun work at Rome raising stock subscriptions for the

construction of a railroad from Kingston to Canton, a distance of 30 miles. It is planned to secure traffic arrangements with the N. C. and St. L. from Kingston to Rome, and thus have practically a through line from Rome to Canton.

Residents of Albany are taking preliminary steps for the construction of an electric railway for that place. The company will be backed by local parties and it is planned to have construction work started by Sept. 1.

Idaho Notes.

FROM CORRESPONDENTS AND OTHER SOURCES.

The Clear Lake Orchard Co., of which Capt. R. A. Hazzard, Buhl, Idaho, and Milwaukee, Wis., is president, has begun work on the development of a tract four miles south of Buhl at Clear Lake. A two-span steel bridge is to be built over the Snake River and it is also planned to develop the power at Clear Lake.

Surveys have been made and all right of way has been secured for an electric railway from Idaho Falls to Hizer's Hot Springs. George H. Lawrence, Salt Lake City, Utah, is reported to have secured the necessary capital for construction and it is said that work will be started by July 1.

A company has been organized at Caldwell for the construction and operation of an electric railway from Caldwell to Roswell, Idaho, a distance of 15 miles. It is planned later to extend the line to Big Bend and possibly to Greenlear and Notus. H. W. Dorman, Caldwell, Idaho, is president and H. S. Kneedler, Caldwell, is secretary.

Preliminary surveys have been completed for the Boise & Butte R. R. incorporated a short time ago by the Hill interests to build a steam line from Boise northwest through central Idaho to Butte. It is stated that arrangements have been entered into with European capitalists by which abundant capital will be furnished for the enterprise and that the surveying parties are to be put into the field within a few weeks to make the final surveys and location of the road. The preliminary locations show a route starting at Butte, thence to the Big Hole river to the summit of the Bitter Root range, thence to the town of Salmon and up the Salmon river through the Sawtooth range and thence to Boise, Idaho. From thence down the Boise valley via Caldwell to the Snake river and to the Owyhee, through to Jordan valley and on to Winnemucca, Nevada.

Advices from Boise state that Wm. G. Eagleson and Lewis L. Folsom, representing eastern capitalists, have filed upon water of the Salmon river and tributaries, south fork of the Payete and tributaries, amounting to 4,370 second feet, for an irrigation project which proposes the reclamation of over 300,000 acres of land near Boise.

Illinois Notes.

FROM CORRESPONDENTS AND OTHER SOURCES.

The Tri-City Ry. Co. of Davenport, Ia., and Rock Island has accepted the franchise granted by the city of Rock Island. The franchise, which is for 20 years, provides for the privilege of laying 37 additional blocks of street car lines. The construction of these lines will cost approximately $800,000 and work must be started within 60 days.

Reports from Galena, Ill., state that Surveyor J. Carson Scott has completed the survey of a proposed line of railroad from Patch Grove, Wis., to a point on the Burlington road a short distance south of Bagley. It is said that the new road is being planned and will be built by residents of southwestern Wisconsin. Residents of Bloomington have raised money to have the survey completed to that city.

The Gant-Gilbreath Construction Co. of Chester has been incorporated with a capital stock of $10,000 and will engage in a dredging and general contracting business. The incorporators are Elmer Gant, Whitney Gilbreath, Jesse Lee Gant, and W. L. Husband.

The directors of the Atchison, Topeka & Santa Fe Ry. have approved a budget for improvements calling for an expenditure of $31,000,000. Of this $2,000,000 will be set apart for a bridge at Kansas City.

The directors of the Baltimore & Ohio Chicago Terminal Ry. Co. have authorized an issue of $50,000,000 of bonds $30,000,000 of which will be put out soon. This is the last step necessary to make the Baltimore & Ohio distinctively a Chicago road, with ample terminal facilities in Chicago.

The Newkirk-Powers Construction Co., Joliet, has been awarded the contract for replacing 20 small bridges along the line of the Elgin, Joliet & Eastern R. R., which is to double track its line. The Newkirk-Powers Co. also has the contract for the laying of 14 switch tracks to accommodate 900 cars, in the Joliet switch yards. This latter contract was let some three months ago.

The incorporation papers of the St. Louis East Side Belt Terminal Ry. Co. have been filed for record at the court house at Edwardsville. The capital stock is placed at the nominal sum of $2,500. The principal office of the company is at East St. Louis and the incorporators are Wm. H. Haas, C. T. Smiley, F. W. Kraft, A. E. Meintz and F. L. Flannigan.

The Chicago & Northwestern Rv., according to reports, will make Fulton, Ill., the terminal point for the Galena and Iowa divisions, instead of Clinton, Ia.

The Elgin, Joliet & Eastern Ry., A. Montzheimer, chief engineer, Joliet, is planning improvements which will involve an expenditure of about $500,000 and will include the double tracking of the line from Joliet to South Chicago. About $80,000 will be spent at Waukegan in improvements, including a roundhouse. The Joliet yards will be enlarged and additional car shops, coal chutes and a modern concrete roundhouse will be erected there.

The Illinois Constructing Co., of Edwardsville, has been incorporated with a capital stock of $2,500 to engage in a general contracting and railroad equipping business, the incorporators being Charles W. Terry, Charles E. Gueltig and E. C. Crane.

O. S. Tippy, of Marion, has work well under way east of Marion putting in a switch which will lead from the Black Diamond road to the new mine shaft on the Tibbs farm.

Contracts for the excavation of 70,000 yards of dirt for the right of way of the Aledo Terminal Railway Company have been let to F. J. Petersen of Davenport, Ia., and the Marble & Greer and Cass Brothers Companies.

Indiana Notes.

FROM CORRESPONDENTS AND OTHER SOURCES.

A movement is under consideration at Utica for the construction of a trolley line to Jeffersonville, a distance of six miles. Dix Bros., Utica, are reported to be interested.

Announcement has been made that the Terre Haute, Indianapolis & Eastern Traction Co. has bought a majority of the stock of the Indianapolis Traction & Terminal Co. and that the system will be unified. The traction and the terminal company owns the Indianapolis city street railway system, including the traction terminal station, and its capitalization is something like $5,000,000. This purchase makes possible a unification of the system from Richmond to Indianapolis and thence to Terre Haute, including the lines to Lafayette, Crawfordsville, Lebanon, Danville and Martinsville and including the cities of Indianapolis, Terre Haute and Richmond, and the lines radiating from Terre Haute to Sullivan, Clinton and Paris.

The Evansville & Terre Haute R. R., J. W. Hunter, Division Engineer, Evansville, is to erect a shipping dock on the site of the old Hermann sawmill at the West Side in Evansville.

The Syracuse & Milford R. R., owned by the Sandusky Portland Cement Co., of Syracuse, which operates between its factory and Waubee Lake south of Milford, has purchased the materials for an extension into Milford.

Iowa Notes.

FROM CORRESPONDENTS AND OTHER SOURCES.

Petitions are being circulated at Manchester for the levying of a tax to aid in the construction of the Manchester-Davenport interurban railway. It is stated that as soon as $25,000 is raised at Manchester work will be started on the first section between that place and Monticello. The contract for the construction of the entire line has been let to F. J. Cross of Monticello, Ia., and the preliminary surveys have all been made. Lafe Matthews, Manchester, Ia., is interested.

The city council of Charles City has granted a franchise to the Charles City Western Ry. and the management has decided to run the line from Charles City to Marble Rock. A survey has been completed between these two points. Work will commence on the road at once, also on the car shops and sheds, for which plans are now being completed. H. E. Bennett, Charles City, is assistant general manager.

The Scott county supervisors have passed a resolution giving the Tri-City Railway Co. of Davenport the right of way over the road to Fairmount cemetery. A portion of the road on which the track would be built when the line is constructed is outside of the Davenport city limits and it was necessary for the supervisors to grant the right of way before the street car company could build the line.

R. C. Campbell of London, England, representing English capitalists, was in Iowa City recently looking over the data for the projected Iowa City-Ottumwa interurban line. It is stated that he will return in May or June with engineers to go over the proposed route.

The Waterloo, Cedar Falls & Northern Ry., T. E. Lust, chief engineer, Waterloo, Ia., has ordered materials for the extension of its street car service at Waterloo.

The Chicago, Anamosa & Northern Ry., J. L. Kelsey, general manager, Anamosa, Ia., is reported to be considering extending its line to Waterloo from Coggon, with the ultimate intention of building the road from Anamosa to Davenport by way of Olin.

The Chicago, Burlington & Quincy Ry. is said to be preparing to have work started soon on changing its road bed for a distance of 10 or 12 miles between Keokuk and Madison. The change of tracks is made necessary by the construction of the Keokuk and Hamilton power dam and will be paid for by the power company.

The Chicago, Great Western R. R., L. C. Fritch, chief engineer, Chicago, Ill., is reported to have plans under consideration for the location of a division terminal midway between Des Moines and St. Joseph, probably at Conception, Parnell or Ravenwood. The plan is to establish a freight division about 100 miles north of St. Joseph, where a roundhouse, turntables, supply houses, coal chutes and other accessories will be built.

The Iowa Supreme Court has handed down a decision sustaining the decision of the district court at Fort Dodge, granting to the Fort Dodge, Des Moines & Southern Interurban the right to cross the main line of the Illinois Central Ry. on a grade crossing at Gypsum near that city. The decision will doubtless hasten the taking over of the Crooked Creek line by the Interurban, on which they have held an option for some time.

Kansas Notes.

FROM CORRESPONDENTS AND OTHER SOURCES.

The Missouri, Kansas & Texas Ry. is to have work started by fall on a new round house to be erected at Junction City, Kan.

The southern tier of townships in Reno county has voted bonds for the Wichita, Kinsley, Scott City & Denver Air Line road, making a total for the county of $80,000. All but four townships in Stafford county have voted bonds and these towns will hold elections May 14. Construction of the road will be commenced at Turon June 1, it is said.

The Missouri Pacific Ry. has work under way at Hoisington on the improvement of its shops and yards. It is said that the princi-

pal division part in Kansas will be made at Hoisington, and that the improvements will involve the expenditure of $450,000.

The promoters of an electric railway to extend from Omaha to Kansas City, have offered to build the line from Falls City to Sabetha this summer if right of way and terminal grounds were furnished. E. V. Kauffman, Sabetha, is interested.

The Topeka Ry. Co., of Topeka, has accepted the franchise ordinance of the city council and will commence work on the extension of its lines about June 15. About $150,000 will be expended.

The Gulf & Northwestern Ry. Co., of Goodland, is planning to have actual construction work started shortly. Permanent surveys have been run south from Goodland and across the Smoky Hill River.

Permanent surveys for the Coffeyville-Parsons line of the Kansas Union Traction Co. have been completed and officers of the company are now in New York City taking steps to finance the proposition. O. C. Randall, Altamont, Kan., is interested.

Louisiana Notes.

FROM CORRESPONDENTS AND OTHER SOURCES.

At a recent meeting of the 5th Louisiana levee district at Delta, J. T. McClellan reported as follows regarding new work: Within the next one or two years the following new levees will have to be built on 20-year locations: Atherton, East Carroll parish, 260,000 cu. yds.; Mascot, East Carroll and Madison parishes, 400,000 cu. yds.; Morancy, Madison parish, 200,000 cu. yds.; Duckport, Madison parish, 225,000 cu. yds.; Reid-Biggs, Madison parish, 250,000 cu. yds.; Sycamore, Concordia parish, 300,000 cu. yds.; Kinmore, Concordia parish, 175,000 cu. yds.—making a total of 1,810,000 cu. yds. From the Arkansas state line to Bedford's Point in Madison parish there is needed to bring the levee 4 ft. above the 1903 water 1,840,000 cu. yds. and from Bedford's Point to Red river it will take 1,280,000 cu. yds. to bring the levees to commission grade.

The Lake Arthur, Jennings & Northern R. R., E. P. Fox, General Manager, Jennings, La., is reported to have secured the necessary capital for beginning construction on its proposed line which will give Jennings a northern outlet.

The Board of Port Commissioners of New Orleans, J. F. Coleman, Engineer, is calling for bids for new steel wharf sheds stretching all the way from Jackson to Louisiana Avenue, at New Orleans, with the exception of barely two open spaces of about 500 feet each. The new sheds will cover 3,700 ft. of space.

It is reported here in Lake Charles that a deal is pending whereby a Chicago land company will shortly acquire a large portion of the semi-swamp lands in Cameron Parish now owned by the North American Land & Timber Co. Several hundred thousand acres of land are involved, and if it is purchased the Chicago men will at once begin reclaiming it and placing it on the market. According to the report of an engineer who has just completed a survey of the land for the purchasers the problem of draining the land is simple.

Michigan Notes.

FROM CORRESPONDENTS AND OTHER SOURCES.

The Detroit, Lansing & Grand Rapids Ry. Co. has secured franchises on its projected route through every township and corporation except Williamston, East Lansing, Oneida and Grand Ledge. Negotiations are reported as well along for securing the capital needed for construction work and it is expected that at least part of the line will be built this year. Andrew Fyfe, Grand Rapids, Mich., is one of the promoters.

The Michigan Central and Pere Marquette Rys. are to abandon their joint use of tracks through Lansing and will lay separate tracks, to be followed by the erection of new freight houses. The Michigan Central will acquire all the tracks now in use jointly between Michigan Ave. and North Lansing, as well as add more trackage, and erect a freight station 400 ft. long just north of Michigan Ave. and east of the track. The Pere Marquette will lay new tracks and will cross the Michigan Central south of Michigan Ave. and run north through the city west of the union passenger station. Its freight house will be west of these tracks, between Michigan Ave. and Shiawassee St.

The Michigan United Rys. Co., A. R. Mann, superintendent, Lansing, is to double track the greater portion of Washington Ave. at Lansing this summer. About 3,500 ft. of new track will be built.

The Lake Superior & Ishpeming Ry. Co. has started a steam shovel cutting away the northern end of the old Lake Superior rock dump, at Ishpeming, in order to make room for a temporary track that will be used while the main line is being raised and connected with the structures that are to be built over the Chicago & Northwestern and South Shore tracks, also West Division St. This work is preliminary to the construction of the North Lakes branch, which is to be four miles long. Gust Fredin, Ishpeming has the contract, and Peter Nelson and Albert Lindberg have subcontracts.

The Detroit & Mackinac Ry. Co. has secured permission from the war department at Washington to cross Cheboygan River on the north side of the paper mill at Cheboygan, and is prepared to construct a bridge to span the stream, provided the city council of Cheboygan will permit them to cross Main St. with the proposed track. This is to be used for the handling of pulp wood by the Cheboygan Paper Co., the yards for the piling of pulp wood being on the east side of the river.

The O'Boyle Bros. Construction Co., Sault Ste Marie, Mich., has been awarded a contract by the Algoma Central Ry. for the construction of nine miles of line from Josephine to the Magpie mines. O'Boyle Bros. have 40 men and 15 teams at work on the contract, which they expect to complete this fall.

Minnesota Notes.

FROM CORRESPONDENTS AND OTHER SOURCES.

The State Drainage Commissioner, George A. Ralph, Engineer, St. Paul, Minn., is calling for bids for the digging of ditches Nos. 83, 90, 91 and 92. They will be among the largest ditches ever dug by the state. Their length will aggregate more than 200 miles. They will drain 200,000 acres and it will be necessary to move more than 3,500,000 cu. yds. of dirt.

Contractor Elzy, of St. Paul, Minn., has begun work on his double track contract with the Northern Pacific between St. Cloud and Rice.

Mississippi Notes.

FROM CORRESPONDENTS AND OTHER SOURCES.

The Newton Northwestern R. R. Co., has been organized by D. L. Ragland, W. A. Brown, H. C. Majure, W. V. Fant, J. C. McClinton, T. A. Baucum and W. A. Richardson, all of Newton, Miss. As proposed the road is to run from Newton in Newton county, northwesterly to Carthage in Leake county. The route covers 45 miles of road, and the privilege is given in the charter to make Carthage the northern terminal or to go to some point five or six miles distant from Carthage. The proposed line will make a junction with the Mobile, Jackson & Kansas City road and the Alabama & Vicksburg line at Newton, and will connect at Carthage or some neighboring point with the projected line of the Pearl River Valley road.

Preliminary plans have been agreed upon at a meeting of citizens to construct an interurban line between Itta Bena, Miss., and Greenwood. Eastern men are said to be behind the proposition.

Missouri Notes.

FROM CORRESPONDENTS AND OTHER SOURCES.

Advices from Osceola state that work is to begin July 1 on a dam across the Osage River there to develop power for manufacturing and lighting purposes. The dam will cost about $100,000. It is being promoted by a manufacturing company and Osceola citizens have subscribed $10,000 worth of stock. The work will be finished Nov. 1.

The St. Joseph Belt Ry. Co. has leased five miles of its right of way in St. Joseph to J. H. Van Brunt, general manager of the street railway company, which will build a line this summer to Savannah.

St. Louis Items.

BY A. E. KOENIG.

The Walsh Construction Co. of Davenport, Ia., were awarded the contract for double tracking 47 miles of the Iron Mountain R. R., from Argenta, Ark., north.

Ball and Peters, of Little Rock Ark., secured a part of the double track work from the Iron Mountain R. R. in Arkansas the other day.

Burke & Joseph were awarded the contract for bridging and pile driving on the new double track work on the Iron Mountain R. R. in southern Missouri and Arkansas.

Articles of incorporation for the East Side Belt Terminal Railway Company of East St. Louis have been filed in Recorder William Metzger's office in Bellville, Ill. The company is capitalized at $2,500, and the incorporators are W. H. Hauss, Charles T. Smiley, F. W. Kraft, Albert E. Meints and J. L. Flannigan. The company proposes to build a belt line from Venice to Cahokia around East St. Louis.

R. H. McWilliams, Mattoon, Ill., wants a small team outfit at Kampsville, Ill. Will either let the work or hire teams at $4 per day.

The Board of Public Improvements is to let contracts May 13 for the improvement of the following 16 streets: Asphalt—Laurel, between Ridge and Wells; Holly, between Penrose and Carter; High, from Franklin to Biddle. Brick—Coleman, from Montgomery to its intersection with Garrison; Penrose, between Grand and Prairie; Taylor, between Ashland and Margaretta; Palm, between Broadway and Fourteenth; Gravois, from Arsenal to Grand. Granite—Walnut, from Tenth to Twelfth. Bitulithic—Adelaide, from Florissant to Rosalie. Telford—King's Highway between Gravois and Nottingham; King's Highway between Nottingham and Arsenal. Wood Blocks—Washington, from Fourth to Twelfth; Fourth, from Chestnut to Washington; Washington from King's Highway to Union; Rauschenbach, from Benton to Hebert.

C. W. Prosser is building the depot, hotel and office building for the Kansas City Southern R. R. at Heavenor, Okla.

The Ryan Bros., Dick, Tim and Pat, passed through St. Louis on their way from Hot Springs, Ark., to Hawerden, Ia., where they have a job on the Chicago & Northwestern Ry.

The MacArthur Bros., Fisher Bldg., Chicago, Ill., have several pieces of nice team work to let on the Burlington extension in Wyoming. Contractors in the neighborhood of St. Louis or Kansas can see profile and get prices at Koenig's Labor Agency.

S. C. Hitchcock, Vice-President and General Manager of the MacArthur Bros. Co., spent a couple of days in St. Louis and left for Kansas City to show contractors what they had to offer for team outfits on their Powder River extension work on the Burlington R. R. in Wyoming.

Geo. H. Lawrence is going to be in charge of the Kenefick Quigley Hoffman Construction Co.'s irrigation work near Cannon City, Colo.

L. J. Smith of the L. J. Smith Construction Co. returned from Arizona. Took a flying trip to St. Louis and returned home to spend a day on his farm near Pleasant Hill, Mo. Smith reports his work on the Santa Fe in

Arizona as getting along fine and dandy; also all of his ballasting on the Missouri Pacific in Kansas, Colorado, Oklahoma and Arkansas.

Hannon & Hickey have started on their steam shovel work on the Big Four R. R., at Mt. Carmel, Ill.

Within a few days Speaker Rombauer of the House of Delegates will present to the Municipal Assembly a bill authorizing the submission of a bond issue of $2,500,000 with which to complete the free bridge. It is likely that the measure will provide for a special election in October to prevent, Speaker Rombauer says, the defeat of the proposition through its failure to obtain a sufficient number of votes. If submitted at the general election in November, the proposal would have to receive a two-thirds majority of all the votes cast on that day. As several constitutional amendments are to be referred to the people in November, it is thought that a large number of voters might ignore the bond issue and cause its defeat. The sum which the people are to be asked to vote—$2,500,000—is a million more than was indicated as necessary by Mayor Kreismann in his latest message to the Municipal Assembly. In that communication he gave $1,500,000 as the amount needed to complete the free bridge for both railroad and vehicular traffic. In his message last May Mayor Kreismann declared that $3,000,000 would be required in finishing the bridge, but there has thus far been a saving of about $200,000 compared with the engineers estimates of cost. With $2,500,000 added to the original appropriations, the city would be able to build the bridge with main eastern and western approaches, and north and south turnouts on the wharf.

Wm. Heman, Secretary of the Heman Construction Co., fell from a Market St. car here last Saturday morning and died an hour later.

Montana Notes.

FROM CORRESPONDENTS AND OTHER SOURCES.

Advices from Virginia City, Mont., state that George F. Douglass, chief engineer of the Virginia City Southern Electric Ry. Co., has located the permanent line of the road to Alder and that Robert J. Watson of the Leber-Watson Engineering Co., which has the contract to construct the road, has arrived from Kenyon City, from which point on the Northern Pacific the same company is to build an electric road to Cook City, a distance of about sixty-five miles, and will be in active charge of the work at Virginia City. It is hoped to have grading started by May 1.

It is reported in Missoula that ex-Senator W. A. Clark, New York City, is to acquire the power plant and water works at Hamilton, and is also to construct an electric line from Missoula to Hamilton.

The Commercial Club of Belgrade has raised $30,000 and has $20,000 more promised, for the construction of an electric railway line from Belgrade to the Dry Creek and East Flathead country north of there. The money subscribed is for the purpose of encouraging the construction of the proposed electric line, the route for which has already been surveyed and most of the right-of-way secured by options. It is proposed to connect with the Bozeman-Three Forks line now in course of construction.

The Northwestern Improvement Co., a subsidiary corporation of the Northern Pacific Ry., operating coal mines in the vicinity of Red Lodge, has increased its capital stock from $3,000,000 to $7,000,000.

Engineers of the Northern Pacific Ry. have arrived in Belgrade where they will make their headquarters for the construction of the new low grade line between Logan and Bozeman. It is said that the new line will be four or five miles longer than the present one and will be used exclusively for eastbound freight. Construction work will begin at once, most of the right-of-way having been secured.

It is reported that the Northern Pacific branch up the east side of the Bitter River from Missoula is to be constructed this summer.

New York Notes.

FROM CORRESPONDENTS AND OTHER SOURCES.

The Hicks-Johnson Construction Co., Long Island City, has work well under way on the constructing of the New York & North Shore Co.'s trolley extension from Flushing to Bayside. The company is to lay 3½ miles of track and is to have it laid and ready for use by the cars of the company on June 10.

The State Public Service Commission has taken under consideration the application of the Auburn & Syracuse and the Auburn & Northern companies for a rehearing on their joint petition to double track the State St. line in Auburn.

The state superintendent of public works has awarded Barge Canal Contract No. 90 to the D'Olier Engineering Co. of Philadelphia, Pa., for $178,197. This contract provides for furnishing and installing electrical equipment for lighting and operating locks on the Erie, Champlain and Oswego canals at Baldwinsville, Smith's Basin, Comstock's, Whitehall, Phœnix and Oswego. Another contract providing for the construction of a dike along the Oswego River for a mile and a quarter near Fulton was awarded to Cunningham & Woodard of Hudson Falls for $7,721.

The Battle Island Pulp Co. has purchased land to the south of the present Minetto dam at Oswego and has presented a proposition to the advisory board of engineers of the barge canal for the construction of a dam on the property acquired. The proposition as proposed by the Battle Island Pulp Co. provides that the high and Minetto dams be reconstructed with no change in the height of their crests and the raising of the lower, the first or lower dam in Oswego.

Lane Bros. Co., of Altavista, Va., who were recently awarded Barge Canal Contract No. 21, have opened offices in the Cutler Bldg., Rochester N. Y., and are planning to begin construction work May 1. Included in Contract No. 21, which extends from the west bank of the Genesee river about 2½ miles to the eastern limit of Contract No. 6, is some of the heaviest rock excavation on the line of the barge canal. At a point opposite Brooks avenue, Rochester, the bottom of the canal will be 62 ft. below the present surface. Besides the actual work of excavating the contract includes the construction of a guard-lock at the crossing of the Genesee river and the machinery for its operation, three bridges, with sub-structures and approaches, and the necessary highway changes and drains. It is proposed to use steam shovels largely in the excavating, the shovels, to be worked in succession, each machine working on a lower level than the preceding one. According to the tentative plans five of the shovels will be at work as soon as practicable. In addition, chamelers will be employed for rock cutting.

The Knight Construction Co., of Middletown, has been incorporated with a capital stock of $5,000 and purposes to engage in a general contracting business, including the building of roads, bridges, railroads, etc. The incorporators are: Samuel F. Knight, No. 14 Highland Ave., Lee M. Drake, No. 22 Roberts St.; Wm. E. Seymour, all of Middletown, N. Y.

The New York Central & Hudson River R. R. is said to be considering building a cut-off near Albany, similar to the one between Hoffman and Carman. In connection it is said that surveys and plans have been made for a new bridge over the Hudson River at New Baltimore.

The Bath Electric Light Co., of Bath, has applied to the State Public Service Commission for permission to issue $150,000 of bonds for extensions and improvements.

The State Public Service Commission will begin to hold hearings in New York City for the building of the new subways. The first hearing will be devoted to the form of contract for the construction, equipment and operation of the new lines. Further hearings will deal with the alternate form of contract whereby the city will build the subways section by section, spreading the cost over four or five years and then leasing out the operating right of the lines. The Board of Estimates and Apportionment of New York City has recently announced that it was ready to set aside for subway purposes $13,000,000 after July 1, 1910, and also the $47,000,000 which is hoped will be obtained as a result of the passing of the constitutional amendment at the last election authorizing the exemption of revenue producing bonds from computation in ascertaining the debt limit.

The Long Island R. R. has a large force of men at work in the vicinity of Springfield Junction, L. I., between the Laurelton and Rosedale stations. The tracks of the Montauk Division are being shifted so as to eliminate a bad curve there, and also to provide room for the laying of the additional track of the third rail line, which runs parallel to it at this junction point. When the work is finished the grade of the Montauk tracks will be about 3 feet higher than it is at present, and the distance between Laurelton and Rosedale will be considerably shortened. The raising of the tracks at the Laurelton station will be sufficient to allow for the depression of Cortland Boulevard, which passes through Laurelton and now crosses the track at grade, and will thus do away with one more bad crossing on the Long Island road.

The City & Suburban Ry. Co. of New York County has been incorporated with a capital stock of $230,000 and proposes to operate a street surface electric railway. The incorporators are: Wm. H. Burroughs, Louis J. Judgens, both of No. 74 Broadway, New York City; I. T. Flatto, No. 261 Broadway, New York City; Thomas F. Martin, 16 Court St., Brooklyn. The company has applied for a franchise to operate a railroad between Brooklyn and Amityville, and also to operate a spur from the Ridgewood Reservoir to Jamaica Bay.

The Brooklyn Rapid Transit Co. of Brooklyn, has applied to the Board of Estimates of New York City, for a franchise to operate a line over the Manhattan Bridge and through the Canal St. tunnel, Manhattan.

Ohio Notes.

FROM CORRESPONDENTS AND OTHER SOURCES.

The Hocking & Sunday Creek Traction Co. has had surveys completed for the extension to Athens and within a short time contracts will be let for its construction. Engineers have now started on surveys in the upper Sunday Creek and on Sugar Creek. The company is now operating part of its line with gasoline cars. It is said that the company expects to build to Logan and will connect there with an extension of the Scioto Valley Traction Co., which would give traction connection from Columbus throughout the Hocking Valley mining region.

Norwood, a suburb of Cincinnati, has voted in favor of granting the Cincinnati Traction Co. an extension franchise of 25 years to operate in Main Ave. and a 25 year franchise to extend a line down Sherman Ave.

The Board of Trade of New Lexington is securing right of way for a proposed extension of the Southeastern Ohio Ry. from Crooksville to New Lexington.

Engineers of the Big Four have been in Kenton surveying routes for the short spur which is to be built at Kenton to connect the lines of the Big Four Ry. and the Toledo & Ohio Central R. R.

The state house of representatives has passed the Swan bill, providing for the elimination of railroad grade crossings outside of municipalities on the initiative of the county commissioners. Not more than one crossing a year is to be abolished in any county and three-fourths of the expense is to be borne by the railroad.

Lane Bros. Co., Altavista, Va., have begun work on its recently awarded contract for double tracking the 17-mile stretch of the Chesapeake & Ohio Ry. between Greenup and South Portsmouth. They also have the contract for double tracking between South Portsmouth and St. Paul, Ky.

The Kanawha & Michigan Ry., F. B. Sheldon, Chief Engineer, Columbus, O., is reported to have awarded the contracts for the

work of changing the grades and doing other new work on the Kanawha & Michigan at Kanauga, just across the river from Pt. Pleasant. Grades will be cut down and curves cut out by the new construction, which will cost about $100,000.

Oklahoma Notes.

FROM CORRESPONDENTS AND OTHER SOURCES.

Extensive yard and track improvements in Oklahoma City, involving the expenditure of $400,000, are proposed by the Santa Fe and Frisco railways. The Santa Fe will build new yards south of the city to accommodate 2,000 additional cars. The Frisco will construct a system of terminals covering 80 acres northeast of the city.

The Commercial Club of Ardmore has been asked to co-operate in securing the building of the Red River Valley & Texas R. R. from Chillicothe, Tex., to Ardmore. F. L. Mercer, Frederick, Okla., is interested.

The Muskogee Transit Co. has been chartered with a capital stock and proposes to build a 225-mile electric interurban system through the counties of Muskogee, Wagoner, Tulsa, Creek, Okmulgee, McIntosh, Sequoyah and Cherokee. The system proposes to touch many towns in the territory including Muskogee, Corrette, Coweta, Broken Arrow, Tulsa, Sapulpa, Haskell, Boynton, Okmulgee, Checotah, Warner, Webber's Falls, Illinois Station, Braggs, Fort Gibson and Henryetta. Among the incorporators are: E. W. Mangson and Oliver J. Barwick of St. Louis, Mo.; Tams Bixby and T. P. Smith of Muskogee; O. D. Revell of Asheville, N. C.

The Anadarko Western Ry. Co. has been chartered with a capital stock of $50,000 and proposes to build a 50-mile line through Caddo County at a cost of $1,000,000. It is proposed to construct a line from near Alden through Anadarko to a point near the Caddo-Grady county line. The incorporators are C. H. Deford, G. D. Driskell, L. M. Swivey and W. F. McCracken, all of Anadarko, Okla.

The Oklahoma Electric Co. of Oklahoma City has brought proceedings to condemn a water power site on the Washita river near Ardmore. The company states an investment of $150,000 will create an 8,000 h.p. plant.

The Muskogee Electric Traction Co., of Muskogee, will soon begin the laying of a double track on the West Broadway line.

Smith Brothers, Memphis, Tenn., are reported to have been awarded the contract for the construction of the Joplin, Oklahoma & Western R. R., and it is said that construction work on the line between Joplin and Bartlesville will be started next month. F. O. Overlees, Bartlesville, Okla., is interested.

Oregon Notes.

FROM CORRESPONDENTS AND OTHER SOURCES.

The city council of Portland has granted a franchise to the King's Heights Trust Co. to construct a street car line from 23d and Washington sts. to King's Heights, via the Barnes road.

The Portland, Eugene & Eastern Ry. is to build a 5-mile loop line at Eugene.

Advices from Marshfield quote officials of the new Coos Bay Rapid Transit Co. recently organized to build an electric line from Marshfield to North Bend, as stating that the work of building the road will begin as soon as the franchises in the two cities are granted.

The Oregon Electric Co. has applied to the city council of Albany for a franchise through that city. The company plans to extend its line from Salem to Albany and proposes to have construction work started sometime next month.

The Union Central R. R., now in operation between Union and Cone, has surveys under way for an extension.

The Eschbach-Bruce Co., Seattle, Wash., has been awarded the contract for completing the Furnish-Coe dam in Umatilla County, Oregon. The dam will cost about $110,000 and the concrete core has already been completed from bed rock to the surface of the ground. The dam will be 50 ft. high, 1,170 ft. across, 270 ft. wide at the base and 20 ft. wide at the top. It will form a reservoir covering 240 acres and containing 8,000 acre ft. of water.

The Corvallis & Eastern R. R. Co. has let a contract to the Yaquina Bay Lumber Co., for 7,500 ties for the 3½ mile extension of the railway from Yaquina, the present terminus, to Newport.

Advices from Vale state that the Oregon & Eastern R. R., a Harriman subsidiary company, on April 15 started active work of construction over its survey, which extends westward across Oregon to a juncture in Western Oregon with the Klamath-Natron line of the Southern Pacific Company at Odell.

Pennsylvania Notes.

FROM CORRESPONDENTS AND OTHER SOURCES.

The Pittsburg & Allegheny Valley Street Ry. Co., according to advices from Connellsville, will advertise for bids for the construction of the road from New Kensington to Leechburg about May 1.

Timothy Burke, Scranton, has started work on his contract for building the new 4-mile cut-off of the Delaware, Lackawanna & Western R. R., at Analomink, near Stroudsburg.

The directors of the Lehigh Valley R. R. Co. have adopted a resolution recommending to the stockholders that the capital stock be increased from $40,334,000 to $80,000,000. A meeting of the stockholders has been called for June 22 to act on this resolution. If the stockholders approve, the directors propose to issue $20,167,400 of new stock, giving stockholders the right to subscribe at par for the new issue. Six millions of 7 per cent outstanding bonds and other obligations will be paid out of the stock and the money remaining will be used for betterments.

Grading work is under way on a new railroad from Brownstown to Millway.

An ordinance has been before the city council of Scranton to permit the Scranton Ry. Co. to lay a single track line on Lafayette St., between Main and Bromley Aves.

The Philadelphia & Reading Ry., Wm. Hunter, Chief Engineer, Philadelphia, is reported to be planning to construct a heavy freight line of tracks paralleling its New York Division from a point south of Wayne Junction to beyond Logan.

Texas Notes.

FROM CORRESPONDENTS AND OTHER SOURCES.

The Quanah, Seymour, Dublin & Rockport Ry. Co., mentioned in our last issue, has elected L. E. Walker, President; A. J. Elilers, Vice-President; Will L. Vining, Secretary; and H. Pfaefflin, Treasurer, all of Austin. Austin will be headquarters for the company. Engineers are already at work near Rockport and rails will soon be laid.

The Houston & Bay Shore Traction Co. has been formed by A. F. Irvin, Detroit, Mich., and it is stated in Houston that construction work will be started within the next 60 days on an interurban line between Houston and La Porte.

An amendment to the charter of the Stephenville, North & South Texas R. R., which was recently purchased by the Cotton Belt line and will be operated as a part of the Cotton Belt system, was filed on April 18. It provides for the construction of 83 miles of extensions. One is to run from Hamilton to Gatesville, 32 miles; another from Stephenville to Thurber, 26 miles, and another from Hamilton to Comanche, 35 miles. M. L. Lynch, Tyler, Tex., is chief engineer, Cotton Belt line.

Construction work is to be started shortly on the projected line on the Gulf Coast & Providence City R. R. The road is projected

The Galveston-Houston Interurban Ry Co., J. B. Townsend, engineer, 410 First National Bank bldg., Houston, has awarded a contract to the Peden Iron & Steel Co. of Houston for 350 miles of standard railroad barb wire fencing. Another large contract upon which bids will be received in a few days by the interurban company is the one covering about 120,000 cu. yds. of shell for ballasting. This contract will mean that about 50 miles of the right of way will be ballasted.

Crow Bros., civil engineers, Waco, Tex., are promoting a project for the construction of an interurban line from Hillsboro to Whitney, a distance of 10 miles.

from Glen Flora and Pierce City, Tex., with its western terminus at Provident City, a new town of 1,000 inhabitants. The contract for 60 miles of road has been let to C. L. Dwyer, Houston. Schlafli & Porter, Houston, Tex., are the engineers.

W. F. Barbour & Sons, who have the contract for building the first four miles of the Santa Fe east from Brady, Tex., have begun the grading work.

In connection with the construction of the Elephant Butte dam in New Mexico by the U. S. Reclamation Service, it will be necessary to build a 12-mile railroad from the dam site toward Engle on the Santa Fe to be used for hauling construction materials. Plans for this railroad have been prepared at the Reclamation office in El Paso. W. M. Reed, El Paso, is district engineer.

The Chicago, Rock Island & Pacific Ry. is to make a survey from Mangum, Okla., to Quanah, Tex., for the purpose of determining a line from the former point to Quanah. It is stated that the action of the Quanah, Acme & Pacific Ry. Co. in authorizing immediate extension of that line to Roswell and El Paso will cause the building of the Rock Island to Quanah in order that the latter road may shorten the distance to El Paso by use of the tracks of the former.

The Canadian Government has purchased the dredge, the Nereus, now at work in Galveston, and it is to be delivered in Halifax, N. S. The dredge was one of three that were built in Holland just prior to the Galveston tidal wave. Owing to the necessity of getting immediate help in rebuilding the city, the dredges were brought to America. The other two have been sold and the delivery to the Canadian Government of the Nereus takes away the last of them.

The Bartlett & Florence Ry., J. R. Graham, Chief Engineer, Bartlett, is reported to have completed financial arrangements for extending the line through to Lampasas, also to a point near Houston crossing the San Antonio & Aransas Pass, International & Great Northern and Houston & Texas Central on an air line to Brenham.

C. M. McConnico and J. S. Moore, of Lufkin, have been awarded the contract for the grading of the Temple & Northwestern railroad from Temple to Hamilton. It is proposed to complete the work in twelve months.

The grade of the Altus, Roswell & El Paso R. R. has been practically finished for 165 miles, from Altus, Okla., to Lubbock, Tex., via Hollis, Okla., and Wellington, Memphis, Lakeview, Silverton, Lockney and Petersburg, Texas. The iron on this road is now being laid out of Altus toward Wellington at a rapid rate. Work proceeds on the grade at unfinished places near Memphis, Silverton and Lakeview.

Utah Notes.

FROM CORRESPONDENTS AND OTHER SOURCES.

The Salt Lake County Commissioners have granted a franchise in favor of Le Grand Young, Salt Lake City, for the construction of an interurban road from Salt Lake City to Holliday. The road will run along 21st East St. from the southern limits of the city to 13th South St. thence east along that street to 28th East St., at Salt Lake City, thence south on that street to Holliday. Work must begin on the road within one year and be completed and in operation within two years.

The Oregon Short Line Ry. has engineers in the Cache Valley making surveys for the improvement and reconstruction of the Cache valley branch of that road. The engineers will run new lines where necessary, and will eliminate, as far as possible, the heavy

grades that are encountered on the present line. The original Cache valley line was constructed under the direction of Brigham Young, and was known as the Utah Central. The line has many heavy grades and curves. These grades will be overcome wherever possible, and the new line will eliminate many curves.

A company has been organized and has had surveys made for the construction of a reservoir on La Sal creek, at Rattlesnake Flat. The purpose is to build a large reservoir about 30 miles above Moab and store the water during the winter months, which will irrigate 20,000 acres of land. The dam will be about 75 ft. high. J. M. Cunningham, La Sal, Utah, and D. M. Cooper, Moab, are interested.

The reconstruction work on the 15 mile stretch of washed-out Salt Lake track between Guelph and Galt was completed April 19. This was the most difficult portion of the engineer's task. The stretch completed makes 32 miles of road rebuilt to date through the washed-out sections in Nevada and Utah. There remains about 64 miles to be reconstructed, but material is on hand and the work will be finished rapidly.

The Gunnison Valley Power Co., of Gunnison, has been incorporated with a capital stock of $50,000, the officers being as follows: M. D. Beauregard is president; S. M. Duggins, vice president and treasurer; L. W. Ransh, secretary.

Los Angeles capitalists are planning to expend $75,000 in rebuilding a mountain resort in the Wasatch Mountains east of Ogden. The plans include the construction of a cog railroad up the side of the mountain. Alexander Thorpe, Los Angeles, Cal., is interested.

Virginia Notes.

FROM CORRESPONDENTS AND OTHER SOURCES.

Efforts are being made by citizens of Chesterfield county to have the Virginia Railway & Power Co. of Manchester extend its street railway from the Cockade City to Matoaca. Most of the owners of land along the proposed line have agreed, it is said, to give a free right of way for the road.

J. P. Pettyjohn & Son, Lynchburg, Va., have been awarded the contract to build the repair shop and roundhouse for the Virginian at Victoria.

The Holston River R. R., a new line of the Southern Railway system, extending from Bullsgap, Tenn., to Moccasin Gap, Va., was completed on April 15. This line gives the Southern a direct entrance into the coal deposits of Southwest Virginia.

The town of Bedford City has sold $100,000 of bonds recently voted for an hydroelectric plant. The town purchased a water power site on the James River and 4,500 acres of mountain land for $32,500, and it is to develop this power plant that the bonds were issued. W. R. Abbott, Bedford City, is interested.

Washington Notes.

FROM CORRESPONDENTS AND OTHER SOURCES.

Felt & Eastman, Tacoma, have been awarded the contract for constructing a portion of the projected line of the Seattle-Tacoma Short Line Ry., which proposes an interurban line between Seattle and Tacoma. Work is to be started by May 15.

The Bellingham Eastern Logging & Railway Co. of Bellingham, has been incorporated and will build a new railroad for common carrier purposes. The terminal point of the road has not yet been determined. The road will be used principally in marketing timber. Thomas Waters and D. J. Cain, Bellingham, are interested.

The Mary Hill & Goldendale Ry. Co., with a capital stock of $10,000, has been incorporated and proposes to build a railroad between the points named. The incorporators are Samuel Hill and A. E. Hanford.

Location work for the Ellensburg-Ritzville cut-off of the Northern Pacific Ry. has been about completed. The route from the Columbia River to the top of the Columbia-Yakima River divide has practically been settled upon and the engineer's attention is now confined to the most feasible route from the divide to the present main line. It is said that the Northern Pacific engineers have succeeded in gaining the same maximum grade on both sides of the Columbia River divide as did the Milwaukee engineers.

The Northern Pacific Ry. is reported to be planning to let contracts shortly for the construction of the 4-track line around the Old Town waterfront by way of the Narrows and Nisqually flats to the connection with the main line at Tenino, a distance of about 40 miles.

Wisconsin Notes.

FROM CORRESPONDENTS AND OTHER SOURCES.

Foley, Welch & Stewart, St. Paul, Minn., have started work on their contract for constructing the new ore dock at St. Louis Bay, Superior, for the Soo Ry. The contract amounts to about $200,000. The ore dock is to be about 500 ft. long and will have a timber approach bringing the total length of the entire structure up to nearly 6,000 ft.

The Milwaukee Electric Railway & Light Co. will lay over 5,000 tons of new steel rails in Milwaukee this year. It will also lay 1,000,000 new granite blocks this year, direct from Wisconsin quarries.

B. W. Hicks, of Warren, Ill., has a subcontract for grading work on the Chicago & Northwestrn Ry. at Templeton, Wis.

The Chicago, Milwaukee & St. Paul Ry. is reported to be contemplating securing a new route from Milwaukee to Kansas City for a fast freight line. Such a line could be obtained by the construction of about 50 miles of track between Shullsburg, Wis., and Farley, Ia. When this is done the line will extend from Milwaukee to Janesville, thence to Shullsburg, Dubuque, Ia., Cedar Rapids, Ottumwa and Kansas City. The new line, if built, would have an approximate mileage of 540 miles. From Kansas City to Milwaukee via Chicago, the mileage is 583.

Canadian Notes.

FROM CORRESPONDENTS AND OTHER SOURCES.

The Canadian Pacific Ry. has appropriated $250,000 for spreading selected gravel and broken stone over the grade in order to reduce the amount of flying dust on the line between Fort William and Winnipeg.

The meeting of the stockholders of the Lake Superior Corporation will be held in Camden, N. J., May 6, to vote on a proposition to issue securities of the Algoma Central Ry. Co., a subsidiary of the Lake Superior Corporation, to the amount of about $3,500,000, to finance the completion of the railroad to a connection with the main line of the Canadian Pacific. It is planned to complete the Algoma & Central Railroad from Sault Ste. Marie to Josephine Junction and thence to Hobon, where it will connect with the Canadian Pacific. The greater part of the line along the extension proposed has already been graded. C. N. Coburn, Sault Ste. Marie, Ont., is chief engineer.

The Montreal Harbor Commissioners, F. W. W. Cowie, engineer, Montreal, are planning extensive development work in the harbor, which will involve the expenditure of from $12,000,000 to $18,000,000 in the next 12 years. The program for the present year includes the following: Grain elevator, No. 2. Capacity about 2,000,000 bus. Foundations to be permanent on reinforced concrete piles to rock. To be completed, ready for operating October, 1911. Appropriation for 1910, $800,000. High level railway tracks from the high level wharves above Victoria pier, up to Hochelaga, and Molson's Creek, available for winter and summer use. Three tracks and all crossings down as far as Hochelaga to be by subways. Appropriation for 1910, $200,000. New Victoria Pier and market basin. The upstream and outside wharves to be high level for ocean vessels, and all the inside to be low level for river craft, giving 2,700 lin. ft. of wharves having 35 ft. at low water for ocean vessels and 4,000 lin. ft. for river vessels. Appropriation for 1910 for 600 ft. of high level wharf and 800 ft. permanent low level, and other works, $400,000. The completion of the Dominion Coal Co. wharf at Hochelaga, length 291 ft. Appropriation for 1910, $100,000.

The Canadian Pacific Ry. has awarded the contract for the McPhillips St. subway at Winnipeg to John Gunn & Son, Winnipeg. The contract involves an expenditure of about $75,000 and calls for completion about July 15. The work will require the excavation of about 35,000 cu. yds. of earth and will need some 6,000 cu. yds. of concrete.

The Grand Trunk Pacific Ry. is planning to lay some 200 miles of steel this year on branch lines in the three prairie provinces. The contractors having grading contracts on this road in these provinces are as follows: 30 miles from Yorkton, on the Yorkton-Melville branch, Rigby, Hyland & Plummer, Winnipeg; from Watrous to Prince Albert, 130 miles, to J. D. McArthur & Co.; from Biggar to Battleford, 50 miles, the Goulin Contracting Co.; from Balcarres to Regina, the balance of the Melville-Regina branch, 75 miles, to J. D. McArthur & Co., and for 100 miles from Regina, south towards the boundary, with a view to swinging around later to Brandon, also to J. D. McArthur & Co.

Announcement has been made at Montreal that the Canadian Pacific Ry. will proceed at once with the construction of an air line between Mimico and Islington. By means of this cut-off the company will be able to get connections between Hamilton and the east without having to run over the Grand Trunk tracks along the waterfront in Toronto. It is also stated that the company will shortly build a line of its own from Toronto to Hamilton. In addition to this the work of double-tracking the line to Toronto, now partly carried out, is to be pushed ahead.

The Senate Committee on Railways has passed the Hamilton, Waterloo & Guelph Ry. bill, and the Toronto Eastern Ry. bill.

Supplemental estimates for the current fiscal year have been before the Canadian Parliament. The principal items in the supplemental estimates are as follows: To begin the construction of the Hudson Bay Railway, $500,000; further amount required for the construction of the Quebec Bridge, $500,000; surveys and borings for the proposed new or enlarged Welland Canal, $25,000; Port Colborne harbor improvements, $113,000; Port Arthur and Fort William harbor improvements, $100,000; Quebec harbor improvements, $100,000; Victoria harbor, B. C., $90,000. The main estimates of the Canadian Government for the fiscal year amount to $127,670,993.

The Canadian Northern R. R., M. H. MacLeod, General Manager, Winnipeg, Man., is said to be preparing to award a contract for the first 20 miles of its line on Vancouver Island. The Canadian Northern is now revising the survey made by the Barclay Sound Ry. Co., the charter of which the Canadian Northern took over. Within two weeks a contract will be awarded for the clearing of Canadian Northern townsite at Port Mann, and it is expected that construction will be commenced on its mainland line from New Westminster, B. C., about June 1.

City Engineer Rust, of Toronto, has recommended that the city officials apply to the Ontario Railway Board to compel the Toronto Street Ry. Co. to construct several new lines in Toronto. The city's share of the cost of the new railway lines will be $1,170,000. The city must pay for the substructure and necessary street widenings. The company's share would be only $500,000.

The Hudson Bay & Pacific Ry. Co. has sent out a second engineering party from Prince Albert, Sask. All the work so far has been done on the north side of the Saskatchewan and the indications are that the parties will survey direct from Prince Albert to Fort Churchill, and that the line will not go through The Pas, as had been reported formerly.

The Railway Committee of the Canadian Senate has reported the bill for the incorporation of the St. Lawrence & Ungava Ry. The company is given authority to build from the

St. Lawrence through Joliette, Berthier, Maskonge, St. Maurice and Champlain, to Ungava Bay.

Mexican Notes.

FROM CORRESPONDENTS AND OTHER SOURCES.

Engineers of the Southern Pacific R. R. of Mexico who are now locating the route of that road through the barrancas of the Sierra Madres between Orendain and Tepic, are said to have estimated it will cost not less than $8,000,000 to build one stretch of 20 miles of the road, owing to the fact that the line for the whole 20 miles will have to be one series of bridges and tunnels. L. H. Long, Tucson, Ariz., is chief engineer.

A commission representing the municipal government of the port of Veracruz has been in the City of Mexico for the purpose of arranging a loan for the introduction of a great water supply for their city. The commission wishes to contract a loan of $2,000,000 for the expense of the work.

Advices from the City of Mexico state that Edward L. Doheny, Charles L. Canfield, Lyman Stewart and other prominent California oil operators are projecting the formation of a $25,000,000 company to build a pipe line to carry California oil from the fields to points in Arizona and Sonora which are at present large consumers of California fuel oil. It is stated that the terminus of the pipe line will be at Cananea, in the state of Sonora where, by special concession, the Cananea Copper Co. has the right to import foreign fuel oil without the payment of any duty. The present consumption at the points to be reached by the pipe line, it is estimated, will exceed 300,000 bbls. per month.

BIDS ASKED.

Bridges.

Bids are asked on following work, the notes being arranged alphabetically by states:

Washington, D. C.—Until noon, May 14, by Bureau of Navigation, Navy Department, Washington, D. C., for the construction of a concrete arch bridge at North Chicago, Ill.

Wilmington, Del.—Until noon, May 3, by Levee Court, for the erection of a reinforced concrete girder bridge at Noxentown Mill Dam, St. Georges Hundred, Delaware. James Wilson is County Engineer.

Palatka, Fla.—Until 11 a. m., May 7, by Board of Trustees for County Bonds, for the construction of a hard surfaced road from the eastermost terminus of the highway bridge across the St. Johns River at Palatka, Fla., to the St. Johns county line, and from a point on this road to San Mateo, Fla., 10 miles. S. Worden is Secretary of the Board. Official advertisement will be found elsewhere in this issue.

Danville, Ind.—Until 10 a. m., May 17 (postponement of bids from April 19), by H. Nichols, County Auditor, for the construction of ten bridges.

Cohasset, Minn.—Until 2 p. m., May 3, by E. W. Windsor, town clerk, for the construction of a steel bridge with draw and with concrete abutments over the Mississippi River.

Carrollton, Miss. — Until May 2, by Samuel Hart, Clerk of County Board of Supervisors, for the reinforcement of pier at Iron Bridge over Big Sand Creek, on the Carrollton and Grenada Road.

Carrollton, Mo.—Until 1:30 p. m., May 3, by County Court, for the construction of the following work: Concrete culverts—1. Egypt township, between Sec. 17 and 18; 2. Carrollton township in Sec. 8; 3. Eugene township, between Sec. 9 and 10; 4. Fairfield township, between Sec. 21 and 22. Steel Bridges—1. Wakenda township, Sec. 5; 2. Ridge township, between Sec. 31 and 32; 3. Ridge township, between Sec. 1 and 2; 4. Trotter township, Sec. 19 and Prairie Sec. 24; 5. Trotter township, between Sec. 19 and 20; 6. Trotter township, between Sec. 3 and 10; 7. Eugene township in Sec. 12; 8. Eugene township in Sec. 18; 9. Carrollton township, between Sec. 19 and 30; 10. DeWitt township in Sec. 19; 11. DeWitt township in Sec. 12; 12. Hill township in Sec. 8. C. H. Faris is county highway engineer.

Springfield, Mo.—Until April 27, by Fred J. Marshall, highway engineer, for the construction of concrete girder bridge over the Sac River at Valley Water Mill.

Cleveland, O.—Until 11 a. m., May 11, by Board of County Commissioners for the construction of bridge work per Report No. 2398, concrete culvert and conduit, Bradley Road, Dover township; Report No. 2396, concrete bridge, Miles Ave. No. 3 road, Solon township. John F. Goldenberg is clerk of the Board of County Commissioners.

Cleveland, O.—Until 11 a. m., May 14, by Board of County Commissioners, for the construction of bridge work per report No. 2570, embankment, Barrett Road, Olmsted township. John F. Goldenbogen is clerk of the County Commissioners.

Eugene, Ore.—Until 2 p. m., May 9, by E. U. Lee, county clerk, for the construction and material necessary for the wooden bridge across Row River, about 2 miles east of Cottage Grove in Lane county.

Easton, Pa.—Until 10 a. m., April 29, by County Commissioners, for the construction of the proposed steel highway bridge, together with the extensions to the present masonry and the completion of the grading, etc., for the proposed highway bridge at Glendon, Pa.

Stroudsburg, Pa.—Until 11 a. m., May 2, by County Commissioners, for the construction of two double arch stone bridges—one over the McMichael Creek at Kellersville in Hamilton township, and the other over Poconto Creek at Tannersville in Poconto township, both in Monroe county. Joseph Overfield, Stroudsburg, Pa., is clerk of the Commissioners.

Buildings.

Bids are asked on following work, the notes being arranged alphabetically by states:

Gunnison, Colo.—Until noon, May 2, by Board of Trustees of the Colorado State Normal School, Gunnison, Colo., for the erection and completion of a building for the State Normal School and a detached boiler house for the same to be erected in this city. S. P. Spencer is President of the Board.

Washington, D. C.—Until May 18, by Bureau of Navigation, Navy Department, Washington, D. C., for the construction of a receiving guard house at North Chicago, Ill. The materials are brick, stone and terra cotta.

Atlanta, Ga.—Until noon, May 7, by Board of Fire Masters, for the erection and completion of Fire Station No. 12 and for the erection and completion of Fire Station No. 7.

Griffin, Ga.—Until 3 p. m., May 25, by James Knox Taylor, Supervising Architect, Treasury Department, Washington, D. C., for the construction complete, including plumbing, gas piping, heating apparatus, electric conduits and wiring of the United States Post Office at Griffin, Ga.

Brazil, Ind.—Until 11 a. m., June 7, by County Commissioners, for the construction of a county infirmary. James L. Burns is Auditor of Clay County.

New Orleans, La.—Until 1:30 p. m., May 20, by the Board of Commissioners of the Port of New Orleans, for the fabrication and erection of structural steel and cast iron for any and all of the following sheds: Eighth-Harmony Sts. Shed No. 2; Sixth St. Shed; Third St. Shed; Sopaparu St. Shed; Branch M. King Shed. Hugh McCloskey is president of the Board.

Grand Rapids, Mich.—Until 3 p. m., May 27, by James Knox Taylor, Supervising Architect, Treasury Department, Washington, D. C., for the construction of sidewalks, etc., at the United States postoffice and court house, Grand Rapids, Mich.

Fremont, Neb.—Until 3 p. m., June 6, by James Knox Taylor, Supervising Architect, Treasury Department, Washington, D. C., for the construction of an extension, remodeling, etc., including plumbing, gas piping, heating apparatus, electric conduits and wiring, of the United States postoffice at Fremont, Neb.

Keene, N. H.—Until 3 p. m., May 31, by James Knox Taylor, Supervising Architect, Treasury Department, Washington, D. C., for the construction complete, including plumbing, gas piping, heating apparatus, electric conduits and wiring of the United States Post Office at Keene, N. H.

Plattsburg Barracks, N. Y.—Until 11 a. m., May 13, by Capt. E. T. Hartmann, Constructing Quartermaster, for the construction of one double set N. C. quarters at Plattsburg Barracks, N. Y., including plumbing, heating and electric wiring and electric fixtures.

Cleveland, O.—Until noon, May 6, by Director of Public Safety, for tearing down and remodeling the middle house of the Infirmary Group on Scranton Road, S. W. E. G. Hogen is Director of Public Safety.

Delaware, O.—Until 3 p. m., May 23, by James Knox Taylor, Supervising Architect, Treasury Department, Washington, D. C., for the construction complete, including plumbing, gas piping, heating apparatus, electric conduits and wiring of the United States Post Office at Delaware, O.

Canistota, S. Dak.—Until May 9, by H. L. Myers, Secretary of the Board, for the construction of a school house in the town of Canistota.

Fort Crockett, Galveston, Tex.—Until 2 p. m., May 20, by Capt. P. Whitworth, Quartermaster, for the construction, plumbing, heating and electric wiring of 8 sets of officers' quarters, the construction of two store houses, two shops, and a fire station.

Stamford, Texas.—Until noon, May 2, by Elliott & Meredith, Supervising Architects, Stamford, Texas, for the erection of the M. E. Church, South, at Stamford, Texas.

Fort Douglas, Utah.—Until 10 a. m., May 12, by Kenneth P. Williams, Constucting Quartermaster, for the construction of one single set hospital corps sergeants' quarters, with plumbing, heating and electric wiring and fixtures complete at Fort Douglas, Utah.

Lake Superior Junction, Ont.—Until noon, May 2, by P. E. Ryan, secretary Commissioners of the Transcontinental Railway, Ottawa, Ont., for the construction and erection complete of a station building at Lake Superior Junction, Ont., District "F.",

Roads and Streets.

Bids are asked on following work, the notes being arranged alphabetically by states:

Oakland, Cal.—Until 11 a. m., by Board of Public Works, for furnishing the necessary labor and material for the construction of improvements at the crossings of 15th, 16th, 17th, 18th, 19th and 20th Aves. with East 14th St. Walter B. Fawcett is secretary.

Centerville, Ia.—Until May 2, by Hall & Adams, city engineers, for the construction of 25,930 sq. yds. of brick pavement on concrete foundation and cement filler and 20,910 lin. ft. of combined curb and gutter.

Batesville, Miss.—Until May 2, by Board of Supervisors, at the Court House, for the construction of a road from Camp Ground Church to McNeely Place. R. W. Draper is Clerk of the Board.

Omaha, Neb.—Until 3 p. m., April 28, by Constructing Quartermaster, for the resurfacing of certain macadam roads at Fort Des Moines, Ia. The work includes approximately 44,000 sq. yds. of paving.

Holderness, N. H.—Until 1 p. m., May 6, by H. C. Hill, Concord, N. H., state engineer, for improvement of 3 miles of state highway in Holderness, N. H., with native stone.

Wilton, N. H.—Until 10 p. m., May 6, by H. C. Hill, Concord, N. H., state engineer, for the improvement of 6 miles of state highway with native stone in Wilton, N. H.

Wilton, N. H.—Until 10 p. m., May 6, by H. C. Hill, Concord, N. H., state engineer, for the improvement of one mile of state highway with trap rock in Wilton, N. H.

Winchester, N. H.—Until 1 p. m., May 6, by H. C. Hill, state engineer, Concord, N. H., for the improvement of state highway in this city with native stone. The estimated cost of the work is $29,000.

Westfield, N. J.—Until 8:15 p. m., May 16, by Lloyd Thompson, Town Clerk, for the construction of street improvements including the following approximate quantities: 6,500 cu. yds. of excavation; 20,900 sq. yds. of 6-in. macadam; 20,100 sq. yds. of 4-in. macadam; 8,300 lin. ft. of combination concrete curb and gutter; 2,900 lin. ft. 6x18-in. concrete curb; 4,000 lin. ft. 3-in. underdrain; 800 lin. ft. 4x20-in. bluestone curb; 660 lin. ft. culverts.

Albany, N. Y.—Until 1 p. m., May 6, by Commission of Highways, Albany, N. Y., for the improvement of Goldens Bridge-Turk's Hill Road No. 770 a length of 3.85 miles in Lewisboro, Westchester County, N. Y.

Brooklyn, N. Y.—Until 11 a. m., April 27, by Alfred E. Steers, borough president, for the regulating, grading, curbing and laying of sidewalks on 56th St., from Sixth Ave. to Seventh Ave., with all work incidental thereto; for regulating, grading, curbing and laying sidewalks where not already done, on Ave. H., from Coney Island Ave. to the right of way of the Brighton Beach R. R. Co.; for fencing vacant lots on the north side of Grand St. extension between South First and Grand Sts., and on various other streets in the Borough of Brooklyn, with a wooden rail fence 6 ft. high.

Buffalo, N. Y.—Until 11 a. m., April 27, by Department of Public Works, for the paving of portions of Norman Ave., Dempster St., Faxon Ave., Pratt St., Tenth St., Columbia St., and Woodlawn Ave. Francis G. Ward is Commissioner.

Dunkirk, N. Y.—Until May 3, by Common Council, for paving Swan and Fox Sts.

Washington, N. C.—Until 7 p. m., May 12, by Board of Improvements, for the improvement of E. Main and E. Second Sts. between Harvey and Market Sts.; W. Main St. between Gladden and Bridge Sts.; W. Second St., between Market and Van Orden St.; Market St., between Main and Fourth Sts.; Water St., between Market and Union Alley. The work includes grading, curbs, gutters, bituminous macadam or brick pavement, catch basins and cement sidewalks. D. B. Packard is City Engineer. Official advertisement will be found elsewhere in this issue.

Cincinnati, O.—Until noon, April 29, by Board of County Commissioners, for the improvement of the Hamilton Pike from city corporation line to North Bend Road in Mill Creek township. Fred Dreihs is clerk.

Cleveland, O.—Until 11 a. m., May 14, by Board of County Commissioners, for the paving of Herbst Hill with common Medina Block stone in accordance with specifications furnished by Frank R. Lander, county surveyor. John F. Goldenbogen, clerk of the County Commissioners.

Cleveland, O.—Until noon, May 9, by A. B. Lea, director of public service, for the construction of paving on Cornell Road at Nickel Plate R. R. crossing.

Steubenville, O.—Until noon, May 9, by County Commissioners, for grading, sewering and macadamizing Bloomfield and Western Free Turnpike road and described as beginning at

the West end of the Bloomfield and Fair Play free turnpike road at or near the line between Sections 28 and 22 in Wayne Township and thence on Steubenville and Cadiz State Road to the line dividing Jefferson and Harrison Counties.

Toledo, O.—Macadam Materials.—Until 10 a. m., April 29, by Board of County Commissioners, for furnishing and delivering materials for the repair of stone road No. 26 in Washington and Adams Townships, including 1,080 lin. rds. more or less. C. J. Sazenbacher is County Auditor.

Youngstown, O.—Until May 15, by director of public service for the construction of 10,000 sq. yds. of brick pavement on concrete foundation with cement filler. The work includes 4,000 lin. ft. of curbing and 1,800 cu. yds. of excavation. F. M. Lillie, Youngstown, O., is engineer.

Aberdeen, S. Dak.—Until 8 p. m., May 9, by F. W. Raymond, City Auditor, for the construction of curbing on First Ave., southwest, Second Ave., southeast, Third Ave., southwest, and First St., south, with stone, granite or cement.

Redfield, S. D.—Until noon, May 14, by Board of County Supervisors, for the grading of 8 miles of road in Jefferson township. A. W. Young is clerk of the board.

Abilene, Tex.—Until May 10, by city clerk, for the construction of bitulithic, vitrified brick, granitoid or other pavement on several business streets.

Abilene, Tex.—Until 4 p. m., May 4, by City of Abilene, for $50,000 40-year 5 per cent ten-year option, street improvement bonds, dated Sept. 1, 1909, interest payable semi-annually on September 1 and March 1. B. K. Isaacs is City Attorney.

Port Arthur, Ont.—Until noon, April 30, by J. McTeigue, city clerk, for the construction of approximately 50,000 sq. yds. of sheet asphalt or asphalt block pavement on concrete foundation.

Sewers.

Bids are asked on following work, the notes being arranged alphabetically by states:

Atlanta, Ga.—Until 3 p. m., May 2, by city clerk, for the construction of approximately 24,000 ft. of trunk sewers varying in size from 6x9 to 24 in. The estimated quantities of material required is 6,000,000 brick and 65,000 cu. yds. of excavation from 5 to 25 ft. in depth, with necessary manholes, catch-basins, castings, vitrified pipe, etc.

Colfax, Ia.—Until 7 p. m., April 27, by city clerk, for necessary labor and material for the construction of a sanitary sewer system on a number of streets. The work includes the following approximate quantities: 1,320 lin. ft. 12-in. vitrified pipe; 880 lin. ft. of 10-in. vitrified pipe; 4,135 lin. ft. of 8-in. vitrified pipe; 1,420 ft. of 6-in. vitrified pipe; 21 manholes, 2 flush tanks, 3 lampholes, 46 lin. ft. of ¾-in. water pipes, 24 ft. of 12-in. standard cast iron water pipe. W. S. Cutter is city clerk of Colfax.

Hays City, Kan.—Until 2 p. m., May 5, by City Clerk, for the construction of a sanitary sewer system for Hays City, Kan., including the furnishing and installing of all appurtenances in accordance with drawings and specifications. W. K. Palmer Co., Dwight Bldg., Kansas City, Mo., are the Consulting Engineers.

Albert Lea, Minn.—Until May 5, by C. J. Dudley, city clerk, for the construction of sewers, bids for which were received and rejected April 15. William Barneck is city engineer.

Brainerd, Minn.—Until 8 p. m., May 16, by V. N. Roderick, city clerk, for the construction of lateral sewer "L" in sewer district No. 1, in Brainerd, Minn.

St. Louis, Mo.—Until May 31, by Board of Public Improvements, for the construction of the second section of the South Harlem Joint District Sewer.

St. Louis, Mo.—Until May 24, by Board of Public Improvements, for the construction of the first section of the South Harlem Joint District Sewer.

St. Louis, Mo.—Until May 17, by Board of Public Improvements, for the construction of the first section of the proposed Beden sewer. The work includes 475 ft. of 18½x38 ft.; 2,591 ft. of 17x23; 1,634 ft. of 13x18.

Belmar, N. J.—Until 7:30 p. m., May 3, by Charles O. Hudnut, Borough Clerk, for the construction of a sewage disposal works for this place. Each bid must be accompanied by a certified check for $1,500.

Westfield, N. J.—Until 8:15 p. m., by Lloyd Thompson, Town Clerk, for the construction of sanitary sewers and appurtenances in the town of Westfield. The work includes the following approximate quantities: 11,600 lin. ft. of 8-in. vitrified pipe sewer; 60 lin. ft. 8-in. cast-iron pipe sewer; 21 manholes; 460 branches; 10 combined flush tanks and manholes; 3 drop connections; 10 extension connections.

Mandan, N. Dak.—Until May 9, by Lee Nichols, city auditor, for the construction of a sewer system. The work includes the following approximate quantities: 5,300 ft. of 24-in. vitrified pipe, in place; 2,445 ft. of 18-in. vitrified pipe, in place; 11,400 ft. of 12-in. vitrified pipe, in place; 5,200 ft. of 10-in. vitrified pipe, in place; 700 ft. 8-in. vitrified pipe, in place; 800 ft. 6-in. vitrified pipe, in place; 8 brick catch-basins, in place; 83 brick manholes, in place; 1 pumping pit and building for motor, in place; 1 24-in. single gate valve, in place; 1 12-in. single gate valve, in place; 1 centrifugal pump with 12-in. intake; 10-in. discharge, in place; 1 15 kw. motor, in place.

Cleveland Heights, O.—Until noon, May 24, by H. H. Canfield, clerk of the village, at his office, 306 Beckman Bldg., Cleveland, O., for furnishing the necessary labor and material for the construction of sewers in Cedar Road, from Coventry Road to the Lee Road.

Cincinnati, O.—Until noon, April 28, by Director of Public Service, for necessary labor and material for the construction of main and lateral sewers and drains with their appurtenances in ravine west of Burnet Ave., from end of existing sewer south of Erkenbrecher Ave., southward.

Memphis, Tenn.—Until noon, May 3, by Board of City Commissioners, at the office of Ennis M. Douglass, City Clerk, for the construction of and furnishing labor, tools, hauling materials for sewers in the Klondyke District including 26,000 lin. ft. of 6, 8, 10 and 12-in. terra cotta pipe sewer; 27 manholes and 8 flush tanks, in district known as Mount Arlington, including 102,480 lin. ft. of terra cotta pipe sewer and 40 manholes. Official advertisement of this work will be found elsewhere in this issue.

Water Supply.

Bids are asked on following work, the notes being arranged alphabetically by states:

Colby, Kan.—Until May 3, by City Clerk, for the construction of a municipal water works and lighting plant. Burns & McDonnell, Scarritt Bldg., Kansas City, Mo., are the Engineers.

Fort Riley, Kan.—Until 10 a. m., May 18, by Capt. W. M. Whitman, Constructing Quartermaster, for furnishing all necessary labor and material for the taking up and relaying of 10,000 ft. of water pipe line and for furnishing and laying 5,000 ft. of new 6-in. cast iron water pipe and for making all connections at Maneuver Camp at Fort Riley, Kan.

Breaux Bridge, La.—Until May 3, by City Council, for the erection of a water works system for this place.

Manistee, Mich.—Until 2 p. m., May 5, by Board of Water Commissioners, T. J. Elton, Secretary, for furnishing and constructing ready for use a steel water tank, 45 ft. in diameter and 55 ft. in height. John W. Alvord and Charles B. Burdick, 1212 Hartford Bldg., Chicago, Ill., are the Engineers. Official advertisement of the work will be found elsewhere in this issue.

Fort Sill, Okla.—Until 10 a. m., May 10, by Capt. David Stone, Constructing Quartermaster, for the installation of a water distribution system.

Johnson City, Tenn.—Until 7 p. m., May 5, by Board of Mayor and City Aldermen, for the construction of a water supply system for this city. W. M. Dunlap is City Engineer and Commissioner.

Milwaukee, Wis.—Until noon, April 28, by Board of Park Commissioners, for furnishing the necessary labor and material for laying 4-in. water pipe from the eastern terminus of Kane place to the Lake Shore drive.

Milwaukee, Wis.—Until 10:30 a. m., April 29, by Board of Public Works, for furnishing necessary labor and material for laying a 36-in. cast iron water supply main in and along Milwaukee St., from Detroit St. to Chicago St., thence along Chicago St. to East Water St., thence along East Water St. to a connection with pipe in shaft of tunnel at Erie and East Water St.; also starting at shaft of tunnel in Ferry St., thence along Ferry St. to Lake St., thence along Lake St. to Clinton St., thence along Clinton St. to Scott St., thence along Scott St. to Greenbush St.; also a 30-in. cast iron water supply main in and along Greenbush St., from Scott St. to Lapham St., and a 20-in. cost iron water supply main in and along Scott St., from Greenbush St. to Eleventh Ave.

Milwaukee, Wis.—Until 10:30 a. m., April 27, by Board of Public Works, for furnishing all necessary materials and labor for the construction of house drains and water service connections on the following streets in the city of Milwaukee: Second Ave., from Mitchell St. to Windlake Ave., and Windlake Ave., from Second Ave to Eighth Ave.; 16th Ave., from Forest Home Ave. to Grant St.; Kerney Place, from Thirteenth Ave. to Fourteenth Ave.; Eighth Ave., from Grant St. to Cleveland Ave. Charles J. Poetsch is chairman of the board.

Miscellaneous.

Bids are asked on following work, the notes being arranged alphabetically by states:

Center, Colo.—Dam & Spillway—Until 2 p. m., May 25, by D. Miles, secretary of the Board of Directors of the San Luis Valley Irrigation District, Center, Colo., for the construction of a dam and spillway at the Rio Grande Reservoir site located about 30 miles west of Creed in Hinsdale county. The work is also noted under Confirmed Reports in this issue.

Washington, D. C.—Lock Gates.—Until 10:30 June 15, by Capt. F. C. Boggs, General Purchasing Officer, Isthmian Canal Commission, Washington, D. C., for furnishing and erecting 46 Mitering Lock Gates of two leaves each of certain fixed parts for same and for furnishing certain repair parts.

Fort Oglethorpe, Ga.—Cold Storage and Ice Plant.—Until 11 a. m., May 4, by Capt. George Vidmer, Constructing Quartermaster, for the enlargement and addition of boiler and pump house, including a cold storage and ice plant at this post.

Detroit, Mich.—Electric Railway Survey.—Until noon, May 14, by F. A. Bean, Chief Engineer, Detroit, Lansing & Grand Rapids Ry., for all necessary surveys and plans for an electric railway about 30 miles in length from Brighton, Mich., to a point near Detroit, Mich. Official advertisement will be found elsewhere in this issue. Also noted under confirmed reports.

Aberdeen, Wash.—Garbage Incinerator.—Until 5 p. m., May 18, by P. F. Clark, City Clerk, for one incinerator capable of taking care of 25 tons of garbage in one day. Official advertisement will be found elsewhere in this issue.

Winnipeg, Man.—Electrical Distribution System.—Until 11 a. m., May 16, by Board of Control, for the installation of an electrical distribution system including the following items: No. 51, Conduit; No. 52, Construction Conduit Runs, 1910; No. 53, Substation Transformers and Switching apparatus.

Excavation, Earth and Rock.

Bids are asked on following work, the notes being arranged alphabetically by states:

Washington, D. C.—Grading—Until May 11, by Bureau of Navigation, Navy Department, Washington, D. C., for grading site of sewage disposal plant, North Chicago, Ill. The work includes about 40,000 cu. yds. of excavation.

Washington, D. C.—Laundry Machinery—Until May 11, by Bureau of Navigation, Navy Department, Washington, D. C., for furnishing and erecting certain laundry machinery and apparatus in the receiving gallery and laundry building and furnishing and erecting driers in the basements of the four main dormitories in North Chicago, Ill.

Clarinda, Ia.—Drainage Ditch—Until May 10, by Clifford W. Duke, county auditor, for the Coin-Blanchard Drainage Ditch, 28,000 ft. long and including about 233,000 cu. yds. of earth excavation. Work is also noted under Confirmed Reports.

Clarinda, Ia.—Channel.—Until 3 p. m., May 10, by Board of Supervisors for the construction of a new channel for the Tarkio River in Drainage District No. 7. C. W. Duke is County Auditor, Clarinda, Ia. Official advertisement will be found elsewhere in this issue.

Keithsburg, Ill.—Levee and Ditches.—Until 2 p. m., May 7, by F. B. Wickett, Keithsburg, Ill., for the construction of 182,000 cu. yds. of levee and 60,000 cu. yds. of main ditches in the Keithsburg Drainage District. Harman Engineering Co., Peoria, Ill., are the Engineers. Official advertisement of the work will be found elsewhere in this issue.

Boston, Mass.—Jetty Work—Until 2 p. m., April 29, by Board of Harbor and Land Commissioners, State House, Boston, Mass., for the construction of an extension to the stone jetty at the entrance to Sesuit Harbor, East Dennis. The work will require about 4,000 tons of granite quarry grout.

Materials, Machines, Supplies, Etc.

Bids are asked on following work, the notes being arranged alphabetically by states:

Jeffersonville, Ind.—Machinist's Lathe, Etc.—Until 10 a. m., May 2, by Constructing Quartermaster, for the furnishing of the following: Lathe, machinist's, 12-in. swing, 8 ft. bed, fitted for screw cutting, with automatic cross feed, compound rest, counter shaft, large and small face plates, complete with all attachments.

Two Harbors, Minn.—Stone Crusher.—Until 8 p. m., May 2, by P. J. MacAlpine, City Clerk, for the furnishing of one gyratory rock crusher with total receiving opening of at least 12x60 in.

West Point, N. Y.—Gymnastic Apparatus—Until 2 p. m., May 6, by Quartermaster, West Point, for furnishing and installing gymnastic apparatus in the New Gymnasium, West Point, N. Y.

Watervliet Arsenal, N. Y.—Hardware, Etc.—Until 1 p. m., May 16, by Col. W. W. Gibson, for furnishing steel, hardware, forage, fuel, oils, etc.

Cleveland, O.—Fire Hose—Until noon, May 6, by Charles A. Marvin, secretary, director of public safety, for furnishing the city with 5,000 ft. more or less of 2½-in. internal measurement of cotton rubber lined fire hose.

Medford, Okla.—Water and Light Plant Materials.—Until May 26, by City Clerk, for the furnishing of the following materials for the water and light plant at this city: Item No. 3, 2 16-ft. by 66-in. R. T. boilers; 2 feed pumps; one heater. Item No. 7, one 100 K. W., Belted Generator A. C. 2,300 V.; Switchboard complete; Series Tungsten Regulator; Seven 5 K. W. Transformers; two 3 K. W. Transformers. Item No. 9, 100 30-ft. cedar poles; 300 25-ft. cedar poles; 5 40-ft. cedar polse. Bids for these materials received April 13 were rejected.

CONTRACT LET.

The following contracts have been let recently:

BRIDGES.

Montgomery, Ala.—Bridge. — Hugger Bros., city, at $8,100, for the construction of a concrete bridge in Capitol Heights. Bids were opened April 11.

Denver, Colo.—Bridge.—M. J. Patterson, Denver, at $6,297, for the construction of an 80-ft. span steel bridge over Blue River 1½ miles north of Dillon, Colo. Bids were opened April 16.

West Union, Ia.—Bridge—N. M. Stark Bridge Co., Des Moines, Ia., for the construction of the new cement bridge over Otter Creek at the foot of Vine St.

Weiser, Ida.—Bridges.—J. H. Forbes & Co., Caldwell, Ida., at $19,985, for the construction of three steel bridges for the County Commissioners. Bids were opened April 11.

Clinton, Ill.—Bridges.—Decatur Bridge Co., at $3,700, for the construction of the 23 road bridges to be constructed in the Nixon Special Drainage District. The bridges will have concrete abutments, oak floors and steel superstructure and will span the 10-mile drainage ditch at necessary points along its course.

Hardin, Ill.—Bridges.—John Cimmers & Son, Batchtown, Ill., at $330, for the construction of two arch bridges. Bids were opened April 11.

Alexandria, Ind.—Bridges—Mason & Sullivan, this city, for the construction of five new concrete bridges in Hamilton county.

Marysville, Mo.—Bridge—Canton Bridge Co., Canton, O., at $4,750, for building and repairing 12 bridges throughout the county.

Lewiston, Mont.—Bridge—Security Bridge Co., Minneapolis, at $8,000, for the construction of a steel and concrete bridge to go in at Fullerton. The new structure will be 150 ft. span.

Nelson, Neb.—Bridges.—Standard Bridge Co., Omaha, Neb., for the construction, completion and repairing of all steel bridges in the county during the year 1910. Bids were opened April 19.

Bridgetown, N. J. Bridge Hankins & Campbell, this city, at $6,842, for doing the additional work upon the Mauricetown bridge.

Cincinnati, O.—Bridge.—John Ryan, Lockland, O., at $3,707, for the construction of a concrete bridge on and relocation of West Chester road south of Crescentville, Sycamore Township. Bids were opened April 19.

Lima, O.—Bridge and Channel. — Hackedom Construction Co., Indianapolis, Ind., for the construction of a concrete bridge across the Ottawa River at the intersection of Collet St. and Shawnee Road, also for straightening Ottawa River channel in the immediate neighborhod where the above bridge is to be erected. Bids were opened April 14.

Syracuse, N. Y.—Bridge.—Samuel Bonn, city, at $6,561, for the construction of a reinforced concrete bridge on Dickerson St. Bids were opened April 11.

Castle Rock, Wash.—Bridge—International Contract Co., Seattle, Wash. at $22,987, for the construction of a steel bridge in Cowlitz county. The span is 308 ft. in length.

Colfax, Wash.—Bridges—Columbia Bridge Co., Walla Walla, Wash., at $6,660, for replacing five new steel bridges; at $3,990, for constructing the Fisher bridge; at $3,900, for the West Elberton bridge and at $1,990 for the Young bridge.

Toronto, Ont.—Bridge—Pete Nicholson, North Bay, Ont., for the construction of abutments to bridge at M. P. 48.91 and for construction of substructure of steel trestle for Wabis River, M. P. 119.13.

Winnipeg, Man.—Bridge.—Jas. Kelly, 380 Agnes St., city, for the construction of the abutments to bridge 24.4, Souris Section. Bids were opened April 14.

ROADS AND STREETS.

Oakland, Cal.—Road—Frank Rose, at $3,900, for the construction of a 14-ft. roadway in the Niles road district, near Spring Valley.

Auburn, Cal.—Road—J. T. Patrick, at $9,000, for the construction of a road from Gorge, a point on the railroad above Towle, right down to the Rawhide mine. The road will be a little less than four miles in length.

New Haven, Conn.—Roads—Highway Commissioner James H. McDonnald has awarded contracts for state road work in the towns of Woodstock, Tolland and Hampton, as follows: Woodstock—1,300 lin. ft. on the Quinnebaug turnpike, to A. Vito, Thompson, at $1.75 per lin. ft. for gravel and $2.50 per lin. ft. for the telford; also 8,500 lin. ft. gravel telford road on the Eastford Road at $1.65 for gravel and $2.40 for telford and $1.05 per lin. ft. for rubble drain; Tolland—O. T. Benedict, Pittsfield, Mass., at $2.99 for gravel and $3.50 for telford, for 1,200 ft. of gravel road on Sand Hill; Hampton—A. Vito, at $16,965, for grading, $0.60 per lin. ft. for telford and $1.25 per lin. ft. for rubble drain; 9,000 lin. ft. of graded road.

New Haven, Conn.—Grading—Frank Brazos, at $3,030, for grading Norton St. Other bids received were A. N. Farnham, $3,150, and C. W. Blakeslee & Sons, $3,300.

Mendota, Ill.—Paving—Keys & McNamara, La Salle, Ill., at $16,042, for the paving of North Main St., in this city.

Perry, Ia.—Bitulithic.—Bids as follows were opened April 15 by this city, Chas. Wilson, City Engineer, for constructing bitulithic pavement with a 2-in. wearing surface on 5-in. concrete base with concrete combined curb and gutter 6 ins. thick, the contract being let to Wm. Horrabin:

	Grading, 5,000 cu. yds.	Curb, 9,500 ft.	Pavement, 20,600 sq. yds.	Overhaul.
Wm. Horrabin, Iowa City	$0.40	$0.69	$2.08½	$0.02½
Kansas Bituminous Co., Kansas City	.44	.62	2.22	...
General Contracting Co., Minneapolis	.47	.75	2.09½	.02
Granite Bituminous Co., St. Louis	.48	.73	2.10	...

Perry, Ia.—Creosoted Wood Blocks.—The following bids were received April 15 by this city, Chas. Wilson, City Engineer, for creosoted wood block pavement, consisting of 3-in. long leaf southern pine wearing surface with a 16-lb. treatment and tar filler, laid on a 4-in. concrete base with a 6x20-in. curb, the contract being let to Wm. Horrabin:

	Grading, 11,455 cu. yds.	Curb, 18,850 ft.	Pavement, 33,700 sq. yds.	Overhaul.
Wm. Horrabin, Iowa City	$0.40	$0.43	$2.25	$0.02
Miracle Concrete Co., Minneapolis	.47	.46½	2.353	.02½
General Contracting Co., Minneapolis	.41	.46	2.29	.02½
Western Paving Co., Minneapolis	.48	.45	2.26	.02
	.49	.47	2.32	.03

Davenport, Ia.—Boulevard—Schaefer & Fey, by the Bettendorf Improvement Co., for excavating 30,000 cu. yds. of earth for the new boulevard extending from the western limits of the city through the center of the town to the eastern limits, to be known as the Washington Blvd. The roadway will be 80 ft. wide.

Lees, Mass.—Road—Lane Construction Co., Meriden, Conn., at $6,850, for the construction of the uncompleted portion of the east and west state highway in the town of Becker, extending from the Walker Brook bridge at Ephraim Palmer's, almost to the Chester line.

Peoria, Ill.—Paving—A. D. Thompson, at $102,000, for the Terminal Railway Co., for paving South Washington St.

Moline, Ill.—Paving—McCarthy Improvement Co., at $8,886, for the paving with asphalt of 21st St., between Third and Seventh Aves.

Belleville, Ill.—Paving—Following contracts have been let by the Board of Local Improvements: Hoeffken Bros., at $20,975, for paving Main St.; at $11,186, for paving Caseyville Ave.; at $8,128, for paving South Church St.; Reeb Bros., at $12,190, for paving Illinois St.; at $8,141, for paving High St.; at $4,878, for paving Jackson St.

Butler, Ind.—Paving—Neal Paving Co., at $64,732, for paving Main and Broadway, from one end of the city limits to the other. J. F. McDowell, Auburn, is consulting engineer.

Elkhart, Ind.—Paving—Andrews Asphalt Paving Co., at $1.06 per sq. yd., for paving one block in this city with macadam. The total bid is $1,782.

Rockville, Ind.—Road.—J. S. Harney, R. F. D. No. 3, Rockville, Ind., at $3,737, for the construction of a gravel road in Jackson Township.

Mt. Pleasant, Ia.—Paving—Burlington Construction Co., Burlington, Ia., at $2.095 per sq. yd. for the paving of about 40 blocks of streets in this city. The contract amounts to about $115,000.

Albany, N. Y.—State Road Work.—Bids were opened April 4, 6 and 8 by the State Commissioners of Highways for road work, contracts being let as follows:

Road No.	County.	Length, miles.
683	Tompkins	3.57
801	Alleghany	4.68
787	Otsego	.47
850	Steuben	6.14
5,047	Schuyler	1.64
5,048	Chemung	2.50
834	Broome	7.50
5,045	Delaware	3.04
5,046	Monroe	5.77
854	Wyoming	4.50
740	Niagara	2.75
715	Livingston	4.54
5,054	Erie	2
857	Chautauqua	1.62
852	Cayuga	.81
664	Chenango	4.33
811	Madison	2.39
5,041	Ontario	2.41
5,044	Oswego	3.50
5,043	Tompkins	2.59
5,037	Otsego	3.50
492	Monroe	5.75
856	Livingston	1.32
686	Cayuga	8.72
5,015	Ontario	1.19
746	Oswego	1.12
598	Chenango	.22
761	Oneida	6.32
5,036	Lewis	2.61
5,038	Hamilton	3
542	Fulton	2.69
5,039	Albany and Schoharie	4.01
5,051	Nassau	1.97
823	Sullivan	4.82
846	Suffolk	5.30
5,055	Warren	1.63
682	Tompkins	3.95
5,049	Tioga	2.58
786	Otsego	3.76
851	Monroe	1.11
729	Niagara	3.20
855	Livingston	47
5,053	Chautauqua	2.54
5,042	Seneca-Cayuga	3.33
665	Chenango	5.18
812	Madison	4.81
494	Monroe	4.43
661	Oswego	3.58
5,008	Suffolk	3.56
841	Lewis	5.74
5,052	Oneida	0.65
848	Hamilton	3.76
596	Chenango	0.34
755	Albany	4.25
5,040	Rensselaer	1.56
555	Onondaga	7.79
628	Dutchess	4.66

Albany, N. Y.—Sidewalks—Following contracts have been awarded for the construction of sidewalks along the Manning Blvd.: T. Henry Dumary, at $31,232, Myrtle Ave., from Partridge to West Lawrence St.; James S. Campion, at $13,358, Colonie St., from Broadway to Water St.; M. F. Dollard, at $4,112, Colonie St., from Broadway to North Pearl St.

New York, N. Y.—Repairing Pavement.—Barber Asphalt Paving Co., 30 Church St., city, at $8,300, for repairs to be made to asphalt pavements on bridges over the Harlem River during 1910. Bids were opened April 14.

Bellefontaine, O.—Paving.—Theodore Hill, E. Chillicothe St., city, for paving North Elm St. with brick and macadam. Bids were opened April 15.

Cleveland, O.—Road Improvement. — William S. Pace, 11207 Clifton Blvd., city, for grading, draining and improving Bradley Road from Lake Road to North Ridge Road, in Dover Township. Bids were opened April 16.

Contractor.	Price.
Joseph McCormick, East Providence, R. I.	$38,444
Northwestern Constr. Co., Franklin, Pa.	43,017
Chas. E. Townsend, Oneonta, N. Y.	5,700
Northwestern Constr. Co., Franklin, Pa.	61,263
McGuery, McGuigan & Baum, Elmira, N. Y.	22,503
McGuery, McGuigan & Baum, Elmira, N. Y.	34,050
T. H. Gill Co., Somerville, Boston, Mass.	75,676
Almahar Constr. Co., Albany, N. Y.	46,764
Monroe Roads Co., Pittsford, N. Y.	57,906
Greene Constr. Co., Rochester, N. Y.	54,925
Louis H. Gypp Co., Buffalo, N. Y.	26,956
Northwestern Constr. Co., Franklin, Pa.	55,792
Frederick J. Mumm, Buffalo, N. Y.	28,000
W. L. Notally, Findley Lake, N. Y.	32,486
Albert Gaffey, Syracuse, N. Y.	11,800
Joseph McCormick, East Providence, R. I.	43,188
Joseph McCormick, East Providence, R. I.	23,749
Charles O. McComb, Syracuse, N. Y.	54,500
Cunningham & Woodward, Hudson Falls, N. Y.	39,640
Morris Kantrowitz, Albany, N. Y.	32,800
Dorpian City Constr. Co., Schenectady, N. Y.	39,092
Frederick A. Brotsch, Rochester, N. Y.	40,500
Schroeder-Hicks Constr. Co., Rochester, N. Y.	16,900
Morris Kantrowitz, Albany, N. Y.	101,900
Clarence Alkenhead Co., Rochester, N. Y.	22,000
Parretti & Robertaccio, Utica, N. Y.	9,890
Newport Constr. Co., Newport, N. Y.	5,900
Conroy & Nixdorf, Oneida, N. Y.	63,013
Morris Kantrowitz, Albany, N. Y.	33,000
Flood & Van Wert, Hudson Falls, N. Y.	37,974
Flood & Van Wert, Hudson Falls, N. Y.	30,995
DeGraff & Hogeboom, Bloomington, N. Y.	61,989
H. J. Mullen, Jamaica, N. Y.	24,955
Bellew & Merritt Co., Tuckahoe, N. Y.	59,943
Dunbar Constr. Co., New York, N. Y.	62,300
Santonina Constr. Co., Albany, N. Y.	50,190
P. D. Conley, Ithaca, N. Y.	40,177
E. Whalen, Towanda, Pa.	31,307
Dorpian City Constr. Co., Schenectady, N. Y.	35,803
Clarence Alkenhead, Rochester, N. Y.	14,000
Frank L. Cohen, Buffalo, N. Y.	23,300
Schroeder-Hicks Constr. Co., Rochester, N. Y.	7,300
Northwestern Constr. Co., Franklin, Pa.	33,596
F. A. Brotsch, Rochester, N. Y.	55,500
John H. Gordon, Albany, N. Y.	54,900
P. H. Murray, Rochester, N. Y.	46,944
Greece Constr. Co., Rochester, N. Y.	48,800
Chambers & Grady, Rochester, N. Y.	33,688
Joseph Boyce, Long Island City, N. Y.	38,596
P. H. Murray, Rochester, N. Y.	62,558
E. J. Doyle, Albany, N. Y.	18,765
J. D. Moynihan, Herkimer, N. Y.	44,900
Newport Constr. Co., Newport, N. Y.	4,600
Ryan & Yale, Brewster, N. Y.	45,540
John B. Dower, Ballston, N. Y.	51,900
E. Brown Baker, Herkimer, N. Y.	85,741
Harper, Jovah & Kehoe, Inc., Newburgh, N. Y.	44,800

Toledo, O.—Paving—Asphalt Block Paving Co., this city, at $75,207, for paving Broadway, from Colburn St. to St. James Court, with asphalt.

Muskogee, Okla.—Sidewalks & Driveways—Hoff & Williams, at $1,100, for constructing sidewalks and driveways at the fire stations.

Harrisburg, Pa.—Paving—Central Construction & Supply Co., at $1.62 per sq. yd., and $0.75 per lin. ft., for paving and curbing Lawton St., from Calder to Reily.

New Castle, Pa.—Paving—Nelson Meredith & Co., at $6,927, for paving with brick West Washington St. bridge.

Aberdeen, S. D.—Paving—Flinn & Hanlan Construction Co., Sioux City, Ia., at $2.59 per sq. yd., for paving the following streets: First St., south from Railroad Ave., southwest to Third Ave. southwest; Third Ave., southwest from First St. to Sixth St., south; Second Ave. southeast from the east line of Lincoln St. to the east line of Pennsylvania St.

Salt Lake City, Utah.—Paving—P. J. Moran, at $23,435, for paving Third South St., from Third West St., to Rio Grande Ave., and Rio Grande Ave., from Second South to Fourth South Sts.

Aberdeen, Wash.—Road—Pinckney & Strohmer, this city, at $25,175, for building the new county road from South Aberdeen to Markham, a distance of five miles. This is a portion of a proposed highway from South Aberdeen to Westport, the entire cost of which will be about $127,000.

Tacoma, Wash.—Paving—Bertelson & Sons, at $7,344, for the construction of the Tacoma-Olympia Road to connect the old road leading to the Nisqually River with the new bridge.

SEWERS AND WATER SUPPLY.

Fort Collins, Colo.—Reservoir.—Joseph Finger, Fort Collins, Colo., at $42,800, for constructing a storage reservoir on Bingham Hill. It is to have concrete sides and bottom and either concrete or frame roof, and a capacity of 5,000,000 gals. Bids were opened April 14.

Hartford, Conn.—Sewers—Berardino, Silvesteri & Conti, Hartford, for the construction of the John and Howard St. sewers. The contract calls for about 1,600 ft.

Canton, Ill.—Sewer—E. R. Harding & Co., Racine, Wis., at $53,339, for constructing the sewer extension in this city.

Galesburg, Ill.—Sewer—Mart O'Connor, at $8,833, for the construction of the Kellogg-Cherry-Fifth and Seminary Sts. sewer. The specifications call for the supply and laying of 1,680 ft. of 24-in. pipe, 1,244 ft. of 18-in. pipe, 3,494 ft. of 15-in. pipe and 13 manholes and 24 catch-basins.

Boonville, Ind.—Reservoir and Pipe Line.—Foster & Raiser Construction Co., Union City, Ind., at $18,865, for the construction of a reservoir and pipe line in connection with the water works. The pipe line will be 4,200 ft. long and will be of 8-in. pipe. Bids were opened April 20.

Louisville, Ky.—Sewer.—C. T. McCracken & Co., 610 Lincoln Bank Bldg., city, for the construction of the Brook St. sewer, contract No. 62.

Guilford, Me.—Waterworks.—Chas. N. Taylor, Wellesley, Mass., at $65,000, by the Guilford Water Co., J. S. William, President, for the construction of a complete water system for this village. The source of supply is Bennitt Pond, Parkman, Me.

Jefferson Barracks, Mo.—Sewer — James E. Egan, 7321 S. Broadway, St. Louis, Mo., at $983, for water and sewer connections. Bids were opened March 23.

Trenton, N. J.—Sewers—City council has awarded the following contracts for the construction of sewers: Gibbs & Morgan, Exton Ave. and Hillcrest, Woodside and Mercer Aves.; Giuseppi Boscorella, Hewitt St.; Antonio De Lucia, Stuyvesant and East Stuyvesant Aves., and Prospect and Marlan Sts.

Charlotte, N. C.—Sewerage—Guild & Co., Chattanooga, Tenn., for the construction of a sewerage system in this city.

Lima, O.—Sewer.—Nelson F. Stedcke, Second St., Lima, O., for the construction of a sewer from Third St. to the south corporation line by way of Blaine Ave., Fourt and Metcalf Sts. Bids were opened April 14.

Youngstown, O.—Sewer. — Anthony O'Hore, city, at $944, for furnishing material for sewering Fairview and Hoffman Sts. Bids were opened March 28.

Medford, Okla.—Water and Light Plant.—Following contracts have been awarded for the construction of a water and light plant in this city, O'Bannon & Foster Co., Joplin, Mo., Engineers: E. J. Merkle, Kansas City, Mo., at $4,363, for 1,560 ft. of 6-in. cast iron pipe; 9,900 ft. of 4-in. cast iron pipe, 10,000 special castings; English Iron Works Co., Kansas City, Mo., at $309 for 9 4-in. hydrants, 5 4-in. gate valves, one 6-in. gate valve with box; H. H. Straight Mfg. Co., Kansas City, Mo., at $1,300, for one 75 h. p. Corliss engine, R. M. type; H. H. Straight Mfg. Co., at $1,500, for one 150 h. p. Corliss engine, R. M. type; Westinghouse Electric Mfg. Co., Kansas City, Mo., at $3,620, for one 50 K. W. belted generator, A. C. 2,300 V.

Indiana, Pa.—Sewer—P. J. McGovern, for the construction of the Normal sewer in this city.

Lebanon, Pa.—Water Main.—Bids were received March 25 by this city for building a new 20-in. cast iron water main, the contract being let to Jno. D. Kuhn, at $87,811. Bids were also received for improving the distribution system, the contract for this being let to W. M. Chisholm at $38,738. The bids received for building a 20-in. cast iron water main were as follows: (1) Jno. D. Kuhn, $87,811, 125 days; (2) W. D. Fritz & Bro., $89,314, 120 days; (3) United Ice & Coal Co., $90,686, 135 days; (4) United States Construction Co., $91,412, 150 days; (5) Pitt Construction Co., $91,556, 120 days, (6) Antonio Cocco, $98,636, 90 days; (7) Jas. Ferry & Son, $101,764, 150 days; (8) M. O'Herron, $107,989, 120 days; (9) B. F. Sweeten & Son, $114,641, 120 days; (10) Weaver Construction Co., $115,381, 250 days; (11) Jno. I. Dick, $118,250, 180 days; (12) Hawman Bros., $127,680, 250 days.

Bids Received March 25 at Lebanon, Pa., for building 20-in. cast iron main:

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
926 Cu. yds. Excavation through breast of Dam No. 1, including backfilling and shoring	$ 1.00	$ 0.90	$ 1.05	$ 1.00	$ 1.50	$ 1.25	$ 1.50	$ 1.50	$ 1.00	$ 0.90	$ 1.60	$ 1.05
100 Cu. yds. Excavation other than above but exclusive of pipe trenches	.60	1.60	1.05	1.00	1.00	1.00	2.00	1.50	1.00	1.30	2.40	.55
15 Cu. yds. Concrete, casing intake tower (if built)	9.00	15.00	10.50	8.50	10.00	15.00	12.00	12.00	15.00	10.00	14.50	16.00
45 Cu. yds. Concrete other than above for valve pits, cut off walls, etc	6.00	15.00	10.50	8.50	10.00	7.00	11.00	12.00	10.00	8.00	12.00	9.00
110 Sq. yds. Replacing old stone on dam breast with concrete filling	.30	1.00	1.10	1.00	1.00	2.00	1.00	2.00	1.00	1.30	3.70	1.10
84 Lin. ft. 6-in. cast iron pipe laid complete exclusive of valves and valve boxes	.80	.75	1.00	.89	1.00	1.00	1.00	.50	1.50	.78	1.85	.87
300 Lin. ft. 6-in. terra cotta pipe laid complete	.45	.40	.50	.35	.50	.70	.75	.60	.50	.30	.80	.42
15,486 Lin. ft. 20-in. pipe, class A, laid complete including trenching and backfilling	2.70	2.75	2.74	2.87	2.84	2.99	3.07	3.33	3.41	3.58	3.70	4.05
13,764 Lin. ft. 20-in. pipe, class B, laid complete, including trenching and backfilling	3.00	3.05	3.11	3.10	3.13	3.32	3.45	3.64	4.11	4.00	3.99	4.25
11,008 Lbs. Specials including Y's, tees, etc., complete in place	.03½	.04	.04	.04	.03½	.05	.06	.04	.04	.04	.05	.03½
7 6-in. gate valves (not geared) in place	14.00	12.00	14.00	11.00	13.00	15.00	19.00	12.00	12.50	15.75	12.00	13.75
9 20-in. gate valves geared, in place	133.00	120.00	115.00	110.00	110.00	111.00	140.00	120.00	115.00	142.00	126.00	115.00
7 Iron pit covers in place complete with locks, etc.	22.00	7.00	25.00	20.00	10.00	25.00	30.00	30.00	20.00	15.00	2.75	26.50
16 Air valves complete in place	17.00	20.00	15.00	12.00	20.00	15.00	18.00	20.00	15.00	25.00	13.50	15.00
21 Cast iron valve boxes	4.00	3.00	25.00	4.00	5.00	5.00	7.00	4.50	4.00	5.00	3.70	73.25
Erecting intake tower and bridge in place	90.00	50.00	250.00	150.00	100.00	1,200.00	400.00	700.00	300.00	100.00	125.00	80.00
Tower house and slope steps complete	650.00	450.00	450.00	275.00	200.00	700.00	800.00	500.00	700.00	500.00	485.00	800.00
25 Line markers	6.00	1.00	7.00	5.00	4.00	10.00	9.00	800.00	6.00	3.00	2.75	4.50

Evansville, Ind.—Sewers—John W. Newman, for the construction of sewers in this city, one on Fourth Ave. and the other through blocks 49 and 50, in Lamasco.

Centerville, Ia.—Sewer—Guy F. Smith, Indianola, at $3,021, for putting in 3,747 ft. of sewer in this city.

Hamburg, Ia.—Sewer—Dunnegan & Corey, Shenandoah, at $8,911, for the construction of the sewage system in this city.

Jamestown, Kan.—Waterworks and Lighting Plant.—Lund & Cunyon, Blackwell, Okla., at $15,000, for the construction of the waterworks and lighting plant in this city.

Junction City, Kan.—Waterworks—John Dalton & Sons, this city, for the construction of the new pumping plant at Fort Riley. W. W. Cook & Son, this city for the construction of the waterworks system.

Russell, Kan.—Dam.—Henry Bowman, Lawrence, Kan., at $17,176, for the construction of a reinforced concrete dam in connection with the waterworks.

Nashville, Tenn.—Sewers—Board of Public Works has awarded the following contracts: Quinn & Ellis, $281, sewer in alley 307, between Joseph St. and North Second St.; T. I. Curtis & Son, $895, sewers in alleys 612 and 611, between 12th Ave. and Quarry St.

Park R. Station, P. O. (Knoxville), Tenn.—Sewer—J. A. Ahler Plumbing Co., Knoxville, Tenn., at about $2,000, for the construction of a line of sewers on Washington Ave., 5,000 ft. in length.

Orange, Va.—Waterworks.—J. T. McMahon, Norfolk, Va., at $25,073, for the installation of a waterworks for this city. The work includes 100,000 gal. stand pipe, pipe line, all necessary to make a complete and perfect waterworks. April 22.

Saskatoon, Sask.—Excavating and Pipelaying.—Saskatoon Construction & Engineering Co., at $64,485, for three sections of the contract for furnishing necessary labor and material for laying water mains and sewer pipes and furnishing materials included. William Cooke, at $27,330, for one section of the above work. Bids were opened April 11.

EXCAVATION, MISCELLANEOUS, MATERIALS.

Oakland, Cal.—Cable.—The Waterbury Co., 45 California St., San Francisco, Cal., at $13,400, for furnishing the city with lead encased saturated core cable. Bids were opened April 13.

Troy, Kan.—Light & Power—Atchison Electric Light & Power Co., Atchison, Kan., at $25 per day, for supplying this city with light and power. City will build its own distributing line at a cost of $16,000.

Pittsfield, Mass.—Concrete Piles.—George W. Van Vranken, of the Raymond Concrete Pile Co. New York and Chicago, for the placing of Raymond concrete piles in the foundations of an addition to the power station of the Stanley Electric Co., this city. M. Thrane is Superintendent of Building and Construction.

Baltimore, Md.—Station—J. Henry Miller Co., Inc., this city, for the construction of the new Union Station of the Pennsylvania Railroad, on North Charles St. The station will be 277 ft. long and 63 ft. wide, with four stories, including the train platform. It is estimated that the building will cost $700,000.

Detroit, Mich.—Lumber.—Bids were opened April 14 by Col. C. McD. Townsend, U. S. Engineer, for furnishing and delivering at St. Mary's Falls Canal, Mich., about 2,630,000 ft. B. M. of timber, the following bids being recommended for acceptance. Lot II, White Star Lumber Co., Elma, Wash., 985,728 ft. B. M. of fir timber, at $11.25 per M. f. o. b. cars, Pacific Coast; Lot III, Emery D. Weimer, Ludington, Mich., 1,637,600 ft. B. M. Hemlock, at $18.94 per M. f. o. b. cars, Sault Ste. Marie, Mich. The other bids received, the prices being per M ft. B. M., were as follows: John Schroeder Lumber Co., Milwaukee, Wis., Lot III, $19.00; G. Elias & Bro., Buffalo, N. Y., Lot I, $12.50, Lot II, $12.50, Lot III, $19.00; Foster Lumber Co., Tacoma, Wash., Lot I, $11.75, Lot II, $11.40; G. W. Gates & Co., Portland, Ore., Lot I, $11.90, Lot II, $11.40; J. G. Newgegin, Tacoma, Wash., Lot I, $11.90, Lot II, $11.45; The Herron Co., Seattle, Wash., Lot I, $11.94, Lot 11, $11.94; Schwager & Nettleton, Seattle, Wash., Lot I, $12.15, Lot II, $11.99; R. J. Clark, Sault Ste. Marie, Mich., Lot. I, $13.25, Lot. II, $12.90, Lot III, $19.90; Day Lumber Co., Big Lake, Wash., Lot II, $12.00; J. R. Somerville, Napvine, Wash., Lot I, $12.40, Lot II, $12.25; James F. Abbot Co., Boston, Mass., Lot I, $12.40, Lot II $12.30; H. P. Waite Lumber Co., Minneapolis, Minn., Lot I, $12.50, Lot II, $12.50; Emery D. Weimer, Ludington, Mich.; Lot I, $12.95; Lot II, $12.94; McCormick Lumber Co., McCormick, Wash., Lot 1, 32 ft. and under, $12.00, Lot I, 34 and 36 ft., $14.00; C. M. McCoy, Minneapolis, Minn., Lot 1, $12.25; Lumber Manufacturers' Agency, Centralia, Wash., Lot. I, $12.35; Mercantile Lumber & Supply Co., Kansas City, Mo., Lot I, $13.88, Lot II, $13.50; Deatherage Lumber Co., Kansas City, Mo., Lot I, $14.40, Lot II, $14.40, Lot III, $37.50; Phillips & Seeley, Saginaw, Mich., Yellow pine, $25.00; Herzfeld Lumber Co., Alexander City, Ala., Lot III, Yellow pine, $28.50; Watkins-Gray Lumber Co., Hattiesburg, Miss., Lot III, $30.62; Rich Lbr. Mfg. Co., Hattiesburg, Miss., all yellow pine, Lot I, $35.97, Lot II, $34.34, Lot III, $32.92.

Pontiac, Mich.—Reservoir—A. J. Johnson, for the construction of a 2,000,000-gal. reservoir for the city water supply.

Brooklyn, N. Y.—Paints and Oils.—C. W. Keenan, Jay and Fulton Sts., city, for furnishing paints and oils to the Bureau of Sewers.

Brooklyn, N. Y.—Warehouse. — Turner Construction Co., 11 Broadway, New York City, for the erection of a 12-story reinforced concrete warehouse 175 ft. by 110 ft. for the Robert Gair Co., Washington St., city. William Higginson, Architect.

South Brooklyn, N. Y.—Factories. — Turner Construction Co., 11 Broadway, New York City, for constructing of Model Factories 5 and 6 for the Bush Terminal Co., this city. The buildings are to be reinforced concrete throughout and are each 700 ft. by 75 ft., six stories high, and have a connecting wing 250 ft. by 100 ft. six

stories high. Total floor area is 18 acres. William Higginson, Architect.

Boston, Mass.—Surfacing Dam. — Bids were opened April 4 by the Charles River Basin Commission for resurfacing the main portion of the Charles River Dam, the bids received being as follows: (1) standing for Coleman Bros., Boston, Mass. (awarded contract); (2) for F. D. Davis Co., Boston; (3) for Luke D. Mullen, Charlestown, Mass.; (4) for W. H. Ellis, Boston, Mass.; (5) for T. H. Gill Co., Boston, Mass.; (6) for John J. Falvey, Somerville, Mass.; (7) for McCarthy & Walsh, East Boston, Mass., and (8) for Wm. L. Miller, Boston.

BIDS RECEIVED AT BOSTON, MASS., APRIL 4, FOR RESURFACING MAIN PORTION OF CHARLES RIVER DAM.

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Earth excavated, 5,500 cu. yds.	$0.40	$0.35	$0.50	$0.87	$0.50	$0.80	$0.40	$0.55
Borrowed earth, 20 cu. yds.	0.60	0.50	2.00	1.00	1.00	1.00	0.50	0.75
Laying 8-in. vitrified pipe, 1,700 lin. ft.	0.25	0.40	0.30	0.40	0.35	0.60	0.25	0.45
Laying 10-in. vitrified pipe, 900 lin. ft.	0.30	0.40	0.32	0.50	0.40	0.70	0.30	0.45
Laying 4-in. cast iron pipe, 900 lin. ft.	0.25	0.30	0.28	0.35	0.50	0.40	0.28	0.40
Laying 1-in. lead pipe, 650 lin. ft.	0.25	0.30	0.20	0.25	0.16	0.30	0.25	0.30
Laying fibre conduits, 1,600 lin. ft.	0.12	0.20	0.10	0.20	0.25	0.30	0.20	0.25
Service boxes "A," 9 boxes	10.00	10.00	2.00	12.00	12.00	20.00	6.50	10.00
Service boxes "B," 4 boxes	10.00	15.00	2.00	15.00	12.00	20.00	15.00	10.00
Manholes "C," 2 manholes	50.00	65.00	50.00	50.00	60.00	50.00	60.00	50.00
Catch basins, 46 catch basins	20.00	20.00	15.00	18.00	25.00	20.00	16.00	15.00
Gravel in place in walks, 2,600 cu. yds.	1.40	1.50	1.25	1.50	1.25	1.40	1.90	2.00
Vitrified brick gutters, 200 sq. yds.	2.50	2.50	2.10	2.50	2.50	2.50	2.40	3.00
Surfacing gravel walk along basin wall, 2,700 sq. yds.	0.25	0.50	0.15	0.50	0.25	0.20	0.25	1.50
Removing a portion of the shut-off dam.	175.00	250.00	300.00	300.00	25.00	300.00	250.00	300.00
Loam surfacing in place, 14,000 cu. yds.	1.35	1.52	1.75	1.45	1.75	1.60	1.90	1.85
Totals	$28,446	$32,170	$33,721	$34,004	$34,955	$35,605	$37,479	$42,027

Cleveland, O.—Wire.—John A. Roebling Sons Co., Trenton, N. J., at $1.152, for furnishing and delivering f. o. b. Cleveland, 7,000 lbs. No. 12 triple braid hard drawn copper wire for the police signal system. April 14.

Hamilton, O.—Repairing Rail. — Oregonia Bridge Co., Lebanon, O., at $710, for repairs to rail of High and Main St. bridges. The work includes new 3-in. pipe for top of rail and ¼x 5-in. plate and two angles for lower part of rail. Bids were opened April 16.

Youngstown, O.—Water Pipe.—J. B. Clow & Sons, Chicago, Ill., at $25.15 per ton, for furnishing 515 tons of water pipe and specials. Bids were opened March 28.

Fort Sill, Okla.—Electric Light and Power Plant.—Following are the low bids received on electric light and power plant, electric lighting system, etc. Bids opened by David L. Stone, Constructing Quartermaster: Kraushaar Brass Mfg. Co., St. Louis, Mo., $7,780; McCay Engineering Co., Baltimore, Md., $10,997; General Electric Co. of Texas, Oklahoma City, $2,632; Ridgway Dynamo & Engine Co., Ridgway, Pa., $13,400; Westinghouse Elec. & Mfg. Co., Baltimore, Md., $3,863; E. C. D'Yarmett, Oklahoma City, Okla., $16,700; Urbauer-Atwood Heating Co., St. Louis, Mo., $2,450; Urbauer-Atwood Heating Co., St. Louis, Mo., $6,500; Evans, Almirall & Co., New York City, $1,754; Evans, Almirall & Co., New York City, $2,647.

Aberdeen, S. D.—Cement—McCaull-Webster Co., at $1.65 per barrel, for furnishing the city with 500 barrels of cement.

Milwaukee, Wis.—Repairing Crib.—W. H. Gillen, 902 Summit Ave., city, at $6,690, for repairing crib located in Lake Michigan, about 3,200 ft. east of the North Point Pumping Station. Bids were opened April 22.

Toronto, Ont.—Pipe—Following contracts have been awarded for furnishing cast iron pipe: National Iron Works, at $4.35 per length for 3-in. pipe; at $4.88 per length for 4-in. pipe; at $6.97 per length for 6-in. pipe; Canada Foundry Co., at $10.50 per length for 8-in. pipe; at $14.80 per length for 10-in. pipe; at $19.85 per length for 12-in. pipe.

Prince Albert, Sask.—Cement.—O. B. Manville, city, at $293, for furnishing the city with about 2,500 bbls. of cement for the year 1910. Bids were opened April 18.

Saskatoon, Sask.—Stand Pipe. — Western Bridge & Equipment Co., Chatham, Ont., at $6,478, for furnishing and erecting a steel stand pipe. Bids were opened April 4.

PROJECTED WORK.

Bridges.

Items Arranged Alphabetically by States.

Little Rock, Ark.—Plans for the proposed viaduct over the railroad crossing at 19th St. Pike were submitted to Joseph Asher, County Judge, by E. F. Mitchell, Engineer of Construction of the Iron Mountain R. R., and T. W. Fatherson, District Engineer of the Chicago, Rock Island & Pacific Ry. Work will begin in a very short time as the structure, according to the act passed at the last legislature, must be finished by Sept. 10, 1910.

Eureka, Cal.—County Commissioners have decided upon the construction of the proposed bridge over the Eel River at Ferndale and surveys are now being made and plans and specifications are being prepared.

Nevada City, Cal.—Board of County Supervisors and E. M. Miller, County Engineer, are taking up the matter of constructing a new bridge across the Truckee River with a span of 150 ft.

Sacramento, Cal.—Commissioners of Yolo and Sacramento Counties have passed separate resolutions and at a meeting in the near future will pass a joint resolution providing for a change in the present plans of the proposed Southern Pacific R. R. bridge across the Sacramento River at this place from draw to lift bridge type. The change as proposed is satisfactory to the railroad company.

Atlanta, Ga.—Committee of citizens are to confer with General Manager T. K. Scott of the Georgia R. R. at Augusta, Ga., regarding the construction of a bridge across its tracks at Jackson St., and an underpass at Whiteford Ave.

Cedar Rapids, Ia.—City Council has on file two sets of plans for the construction of the proposed reinforced concrete bridge across the river. As proposed the structure will consist of six 96-ft. spans resting on four piers and four abutments, the island dividing the bridge in two parts. The roadway will be 48 ft. in width and an 8-ft. sidewalk will be built on each side.

Des Moines, Ia.—Plans for the proposed Walnut St. bridge over the Des Moines River, calling for an ornamental concrete structure, were presented the council by City Engineer John W. Budd and referred to the Department of Streets.

Buhl, Idaho.—Capt. R. A. Hazzard, President of the Clear Lake Orchard Co., has decided upon the construction of two steel bridges across the Snake River about 4 miles north of this city.

Idaho Falls, Idaho.—The Oregon Short Line Ry. Co., in connection with improvements planned in this city, will construct a large bridge over the Snake River.

Chicago, Ill.—Hearings are to be held May 10 and 20 at the office of Maj. Thomas H. Rees, U. S. Engineer, 508 Federal Bldg., on the Jackson Blvd. and Metropolitan West Side Elevated Railway bridges, respectively. The structures are declared obstructions to navigation.

Colona, Ill.—According to advices from this city the proposition to construct a bridge has not been fully decided upon. Martin Coleman is village clerk.

Decatur, Ill.—According to reports the Wabash R. R. Co. has authorized the expenditure of about $50,000 for the construction of new bridges, ten being on the Bement-Tilton Line for single track; five between Bement and Tilton; two between Decatur and Edwardsville Junction. One structure over Mud Creek will be 160 ft. in length and is estimated to cost $10,000.

Fulton, Ill.—The completion of the Chicago & Northwestern R. R. Company's Fulton Cutoff will require the construction of a number of steel and concrete bridges. Temporary structures are now serving at the various points.

Fort Wayne, Ind.—Park Commissioners have asked the city council for an appropriation of $1,500 for repairing the floors of the foot bridges at Swinney Park and Lawton Park.

Rockville, Ind.—The wagon bridge across the Big Raccoon River was recently dynamited and destroyed by the fire which followed the explosion. The reconstruction of the bridge will require an expenditure of about $10,000 by the county.

Winfield, Kan.—Joint committee of Winfield and Arkansas City, Kan., decided at a recent meeting held at Arkansas City, to petition the Cowley County Commissioners to vote bonds amounting to the sum of $100,000 for the construction of concrete bridges.

Shreveport, La.—Bids received by the city council for the construction of the proposed Red River wagon bridge connecting the cities of Shreveport and Bossier, indicate the building of the proposed structure will necessitate an expenditure of $300,000 or more.

Winnfield, La.—The Winn Parish Police Jury has appropriated $2,500 for the erection of a steel bridge across Dudgemonia Bayou at Maxwell's Crossing.

Calumet, Mich.—Chairman of the bridge committee has taken up the matter with the Houghton County Traction Co. and the Copper Range R. R. Co. of repairing the county bridge.

Cheboygan, Mich.—Officials of the Detroit & Mackinac Ry. Co. have secured permission from the United States War Department to construct a bridge over the Cheboygan River north of the paper mill and construction work will be started soon, provided the city council will permit the crossing of Main St. with the proposed track. H. S. Waterman, East Tawas, Mich., is chief engineer of the railroad.

Grand Rapids, Mich.—City council has finally decided in favor of the improvement of the approach to the Ann St. Bridge. The work including the improvement of Victoria St. will necessitate an expenditure of $15,000.

Wadena, Minn.—Township Board of Huntersville has applied to the County Commissioners for assistance in erecting the proposed bridge across the Crow Wing River. The work as proposed is estimated to cost $5,000.

Missoula, Mont.—The proposed bridge of the Chicago, Milwaukee & Puget Sound Ry. Co. across Rattlesnake Creek at the east end of the Missoula yards will be constructed of sufficient width to lay three tracks.

Omaha, Neb.—Commissioners of Douglas and Saunders counties have ordered plans prepared for the construction of a bridge across the Platte River at Valley and bids for the construction work will be asked soon.

Jersey City, N. J.—The Street and Water Board at the last meeting passed a resolution applying to the Finance Board for funds for the repairs of the Mercer and 13th St. viaducts. The amount required for the necessary work is estimated to be $9,250.

Albany, N. Y.—Martin G. Saxe, representing the New York and New Jersey Interstate Bridge Commission, with representatives of commercial bodies in the borough of Bronx, have appeared before the Senate finance committee favoring the bill authorizing the commission to make borings for the proposed bridge over the Hudson River at 179th St. to the Jersey shore.

Albany, N. Y.—The New York Central R. R. Co. has surveys under way in the vicinity of North Pearl and Van Woert Sts. for the erection of a viaduct over the railroad.

Albany, N. Y.—The New York State Barge Canal Terminal Commission has passed a resolution requiring the construction of bascule or movable bridges across the canal at Tonawanda, thus effecting about six existing bridges, and the estimated cost of replacement will range from $500,000 to $750,000.

Conklin, N. Y.—According to advices from this place work has been started tearing down the old Kirkwood-Conklin bridge over the Susquehanna River and steps will soon be taken by the cities toward the construction of a new bridge to replace the old.

Fenton, N. Y.—City is soon to vote on proposition of borrowing $9,500 for the construction of a bridge over the Chenango River at Chenango Bridge.

New York, N. Y.—Plans for the proposed approaches to the Manhattan bridge at the intersection of Canal St. and the Bowery have been approved by the Municipal Art Commission. The work as proposed will involve an expenditure of about $700,000.

Syracuse, N. Y.—Board of Contract and Supply have received the following bids for the construction of a reinforced concrete arched bridge over Onondaga Creek at Dickerson St.: Samuel Bonn, $6,560.75; C. J. Sullivan, $8,055.25; Frank Sposata, $9,451; C. T. Hookway, $7,111.40; H. S. Moore, $10,999.70; John Young, $7,886.50; Walter Bradley, $8,280.50; Wells, Boughton & Co., $9,299.80.

Statesville, N. C.—According to reports from this place the Southern Ry. Company is planning the construction of a modern steel structure across Third Creek to take the place of the old wooden Kestler bridge two miles south of this city on the Charlotte and Taylorville Road. W. H. Wells, Washington, D. C., is chief engineer of construction of the Southern Ry.

Grand Forks, N. Dak.—Bridge committee of the County Commissioners are to investigate conditions at places where the construction of bridges have been petitioned for.

Sandusky, O.—Commissioners of Erie county are seeking advice from T. J. Loeffler concerning the plans and specifications for the construction of the bridge over the Huron River at Huron. Mr. Loeffler is bridge engineer of the Lake Shore & Michigan Southern Ry. Company.

Wooster, O.—County Commissioners have rejected all bids received for placing a new roadway in the bridge over Apple Creek.

Pryor Creek, Okla. An election is soon to be held to vote on issuing bonds amounting to $100,000 for the purpose of constructing bridges on the Grand River and other smaller streams.

Allentown, Pa.—County Commissioners have filed petitions with the grand jury for the construction of three bridges at Wanamaker's, Jacksonville and Ruchsville.

Beaver, Pa.—County Commissioners are planning an expenditure of about $8,000 for the improvement of the Ohio River bridge between Rochester and Monaca. The work will include the replacement of nearly an entire span.

Dunmore, Pa., Scranton, Pa.—Residents of Dunmore and City Improvement Association are petitioning the Erie R. R. Co. to construct the proposed new bridge on Monroe Ave., Dunmore, to conform with the width of the street at that point.

Johnstown, Pa.—Surveys have been made for the proposed bridge connecting Cambria City and Minersville by the Fetterman Engineering Co. Petitions are now being circulated among the citizens in order to secure the interest of the city councils and the County Commissioners.

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CONTENTS.

EDITORIAL: Page.

Two Popular Reasons for the Day Labor System of Construction and What They Amount To 397

CONCRETE SECTION:

Method and Cost of Lining an Open Channel with Concrete 398

Method and Cost of Constructing Concrete Lining for the Land Sections of the Hudson River Tunnels of the Pennsylvania Railroad 398

EARTH AND ROCK SECTION:

Methods and Costs of Operating Well Drilling Machines in Prospecting for Copper .. 401

ROADS AND STREETS SECTION:

Paving Roadways Having Steep Gradients. 403

Methods of the New York State Commission of Highways for Testing Stone Used in Road Construction 403

Notes on Road and Street Work 404

WATER WORKS AND SEWER SECTION:

Methods of Constructing the Western Avenue Sewer, Chicago, Illinois 405

The Los Angeles Aqueduct: Structural Details, Economic Studies, The Working Organization and Service Constructions .. 407

Method of Stream Gaging by Use of Rod Floats with an Outline of the Reductions. 411

RAILWAY SECTION:

Cost of Operating New York City Railway Company's Lines, 218 Miles of Electric Street Railways 413

Cost of Constructing, Equipping and Operating 36 Miles of Electric Suburban Railway, New York and Long Island Traction Company 414

Some Notes on the Florida East Coast Railway Work 415

GENERAL SECTION:

Cost of Power for Various Industries under Ordinary Conditions 416

Some Costs of tSadia Surveys for the New York State Water Supply Commission ... 419

COMING TECHNICAL MEETING 420

PERSONALS 420

CATALOGS WORTH HAVING 420

Two Popular Arguments in Favor of Day Labor Work and What They Amount To.

Of the various claims that have been urged in its favor by the exponents of the day labor system of doing construction work, there are two which are just now popular. The first is the difficulty of drawing contracts to cover unknown conditions and the second is the flexibility of the day labor system in allowing changes in plans, etc. Just to how much does either of these claims amount? If we may believe the advocates of the day labor system they amount to enough to warrant day labor construction in very many instances. Neglecting all other phases of the case between the day labor and the contract systems of doing construction work let us consider these two.

Stated briefly, the propositions we have to consider are: First, it is exceedingly difficult to draw contracts which will cover the multitude of unforeseen obstacles and contingencies to be met on certain classes of work. Second, plans can be modified or even radically changed after work is begun if the work is being done by day labor while a similar procedure under contract work is, customarily, expensive and difficult. If this is a fair presentation then these two statements are tantamount to saying either that engineers are not capable of determining and predicting the conditions of work with any degre of confidence, or that engineering and legal acumen are insufficient to devise contract requirements for meeting undetermined conditions or that the engineer has not given the work careful and competent investigation and must supply the deficiency by leaving the way open for changes in plan to meet the conditions as they become known, or that contractors as a class are not open to fair business propositions. To which of these alternatives do engineers wish to subscribe?

How frequently do we meet with indeterminate conditions in planning construction work? Undetermined conditions are common enough and occasionally without doubt circumstances arise which involve so much uncertainty as to conditions under which work is to be prosecuted as to make it difficult to prepare satisfactory specifications to cover them; but such occasions are rare. Take, for example, underground work, which as a class is commonly admitted to be particularly subject to uncertainties, how often has it been found impracticable to cover it satisfactorily by contracts and specifications. The Boston and New York subways, the Pennsylvania and other railway tunnels under the Hudson and East rivers, the water supply tunnels of the Metropolitan Water and Sewerage Board at Boston and the Catskill aqueduct work at New York were all constructed by contract and no unsurmountable difficulty was found in drawing satisfactory agreements and specifications. Other examples can be cited by scores of work quite as complex if one needs them. The truth is that we do not. There is not the slightest impossibility or even very serious difficulty in eliminating uncertainties to such an extent in practically any piece of construction work that the contract forms in common use will provide amply for all contingencies. In the rare case where they will not any reputable contractor will meet the engineer half way in an adjustment of differences. It is a popular notion, we know, to believe differently, but it is a callow notion.

Turning now to the argument of the flexibility of the day labor system in allowing for changes in plans, etc., we must credit it with some force. Conditions sometimes develop which make it desirable or even necessary materially to modify or radically change the plans upon which a contract has been based. Such changes are always unfortunate and usually expensive in contract work, the contractor being in the more advantageous position in the negotiations for the price to be paid for the work under the revised plan. If, on the other hand, the work is done by day labor, changes of any kind may be made, at any time, often without unduly increasing the cost of the work and sometimes even materially reducing it. Admitting these things we may well ask: How often are changes in plan actually the necessity of indeterminate conditions and how often are they merely the result of insufficient and perhaps inefficient study of the problem before the plans were prepared for its solution? It is a very common complaint of engineers that they are often prevented from making the thorough preliminary studies that are essential to developing the most efficient and economical plans. Will not the fact of the possible increase in the cost of construction, resulting from changes in the proposed plans after the letting of contracts lead to more careful and mature study and hence to an ultimate saving in cost and gain in efficiency? Conversely may the admitted greater flexibility in this respect of the day labor system of work not be a direct encouragement of hasty and careless preliminary studies? These are legitimate questions and we have not seen them answered convincingly from the day labor advocate's standpoint.

To sum up most favorably, while there may be an occasional piece of work in which the considerations stated may count for something, they furnish a very weak reason for employing generally a method of doing work which experience has proven to be excessively expensive. It is cost that determines the efficiency of a method of doing work and cost is so preponderantly in favor of the contract system as compared with the day labor system that the latter falls little short of economic absurdity.

Garbage Disposal in Paris.—Household refuse is set out in front of houses during the night in tin, zinc, or galvanized iron cans or boxes, whence it is collected in the early morning hours by large wagons belonging to the municipality. For this service an ordinary family living in a flat pays a tax of 56 francs, or $10.80 per year. The wagons carry the rubbish to quays along the river Seine, where it is dumped upon inclined shoots which carry it onto barges, which are towed to points where the material is to be landed. Both while in the boxes along the streets and on the quay the ordure is exposed to the operations of "chiffoniers," or rag pickers, who sort out and take away rags, paper, and other articles, from the sale of which a large number of men, women, and children gain a living in Paris. There are several private establishments in the neighborhood of Parish where the household rubbish is treated for the salvage of bottles, glass, crockery, tin cans, bones, etc., but by far the most important of them is at Bondy, about 8 miles east of Paris, on the Canal de l'Ourcq, which connects with the Seine. The establishment is owned and operated by a private company which was organized and took up the business after the government of Paris had failed in its attempt to destroy the city garbage by burning. The ordure being landed at the wharves in Bondy, is carefully picked over and all rags, bones, old paper, sardine and other cans, metal, glass, oyster shells, etc., which have escaped the hook of the "chiffonier" taken out and assorted for separate treatment. The sardine, fruit, meat, and vegetable cans are cut up for tin, which is used in making toys, for which large quantities of this scrap tin are sent to Germany. The rough bones are used as material for glue, the finer ones for making knife handles, buttons, dominoes, dice, and other articles. Oyster shells, which are rich in lime and phosphates, are ground into powder which is mixed with grain and other materials to make food for poultry. The remainder of the rubbish, which consists mainly of ashes and vegetable refuse, is pulverized and sold to farmers as a fertilizer. Owing to its high percentage of potash it is too strong to be used alone; it is therefore mixed with barn yard manure. A car load of these pulverized ashes (6 to 10 tons) is sold at $4 to $6—too low to justify its transportation to any great distance, so it is used mainly within a radius of 30 or 40 miles. The extent of the supply may be inferred from the fact that the establishment at Bondy sends out from 100 to 150 car loads per day.

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Concrete and Reinforced Concrete Section

Note: This section is devoted to methods and cost of constructing concrete and reinforced concrete structures. It will cover the selection, testing and proportioning of concrete materials; laboratory tests of concrete; concrete mixing, transportation and placing; fabrication and placing of reinforcement, and form construction and erection. It will also contain articles on new and interesting developments in the design of reinforced concrete.

Method and Cost of Lining Earthan Channel with Concrete.

The channel forms a part of the Los Angeles Aqueduct on the Mojave Division, and its approximate dimensions are shown by Fig. 1. This description relates to the construction and operation of the forms used and gives the cost of lining per 100 ft. of conduit; the lining requires 0.75 cu. yd. of concrete per lineal foot of aqueduct or 75 cu. yds. per 100-ft. section.

The illustration shows the form in cross section. This form is built in sections 8 ft. long; each section consists of four yokes spaced 2 ft. 8 ins. apart and made of 2x5-in. lumber. These yokes carry a side lagging of No. 12 steel or ⅞-in. surfaced boarding. The roof lagging is made up in sections 3 ft. wide and 8 ft. long and is No. 18 gage steel. Each section is made stiff by cleats. The yokes are collapsible: First the sides can be drawn inward horizontally by loosening the slot bolts in the horizontal braces; second, the lower 18 ins. of the sides are detachable by removing the bolts *a*, *b* and *c*. It is stated that the success of the forms depends largely upon these detachable sections. Briefly then, for handling each section consists of four parts, the detachable roof, the two detachable partitions of the sides and the main body of yokes and attached siding.

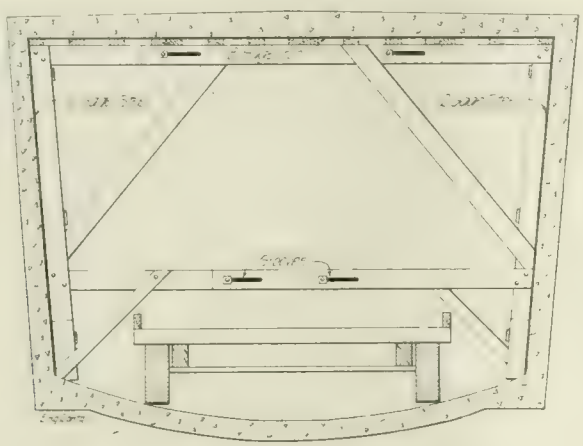

Fig. 1.—Section Showing Form for Lining Open Channel.

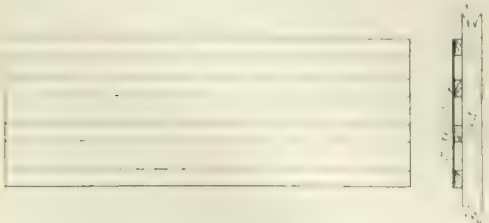

Fig. 2.—Roof Panel for Open Channel Forms.

The method of operation is as follows: Assume 600 ft. of forms as being used. Starting at a point 600 ft. ahead of the completed conduit the forms are erected a section at a time, working back toward the completed work. The concreting proceeds backward also. As soon as the finished work has been come up to, the forward section of forms is moved ahead another 600 ft. and succeeding sections are erected behind it. The sections of forms are hauled ahead on two-wheeled trucks, Fig. 3, four men handling a section readily. In erecting the forms they are set on previously cast 7x8x10-in. blocks of concrete which are placed 1 in. below grade, being adjusted to grade by wooden wedges on top of the concrete blocks.

In actual work it is aimed to line 100 ft. of channel per day using a gang of 43 men and 600 ft. of forms. This amount of forms requires, thus, to be moved every five days. The forms cost, closely, $1.50 per running foot.

The cost of lining 100 ft. of channel which requires 75 cu. yds. of concrete, runs as follows:

Gang on sides and bottom: one 11-ft. cube mixer:	
1 foreman at $3.50	$ 3.50
3 shovelers at $2.00	6.00
2 shovelers at $2.25	4.50
5 buggy men at $2.00	10.00
3 platform men at $2.25	6.75
1 engineer at $3.00	3.00
1 man at hopper at $2.00	2.00
Cover gang behind: one 6-ft. mixer:	
1 foreman at $3.50	3.50
3 laying steel, etc., at $2.00	6.00
3 buggy men at $2.25	6.75
1 engineer at $3.00	3.00
3 shovelers at $2.00	6.00
Gang on forms:	
1 carpenter boss at $4.00	4.00
3 carpenters at $3.00	9.00
12 helpers at $2.25	27.00
Materials:	
Gravel, very close, per yd., $0.75	75.00
Cement on ground, per bbl., $3.00	300.00
Total	$476.00

This gives a cost of about $6.50 per cu. yd. of concrete lining.

We are indebted to Mr. R. B. Kepner, 511 S. Boylston St., Los Angeles, Cal., one of the engineers on the work, for the information given above. Mr. Kepner states that the forms have even exceeded expectations as to convenience and economy. They are light and durable, make it possible to complete a section of lining in one operation, permit the use of one general gang instead of several independent ganges, and there is a clear ditch through which to move and in which to erect forms.

Method and Cost of Constructing Concrete Lining for the Land Sections of the Hudson River Tunnels of the Pennsylvania Railroad.*

The land tunnels of the North River Tunnels of the Pennsylvania R. R. at New York city consist of 1,207 lin. ft. of double tunnel, 977 ft. on the New York side and 230 ft. on the New Jersey side.

The general design of the cross-section consists of a semi-circular arch, vertical side-walls and a flat invert, as shown in diagram by Fig. 1. The tunnel is adapted for two lines of track, each being contained in its compartment or tunnel. The span of the arch is wider than is absolutely necessary to take the rolling stock, and the extra space is utilized by the provision of a sidewalk or "bench" forming by its upper surface a gangway, out of the way of traffic, for persons walking in the tunnels, while embedded in its mass are a number of vitrified earthenware ducts, for high and low-tension electric cables. The provision of this bench enables its vertical wall to be brought much nearer to the side of the rolling stock than is usually possible, thus minimizing the effects of a derailment or other accident. Refuge niches for trackmen, and ladders to the top of the bench, are provided at frequent intervals. In cases where a narrow street limits the width of the structure, as on the New York side, the two tunnels are separated by a medial wall of masonry, thus involving excavation over the entire width of both tunnels, and in such case the tunnels are spoken of as "Twin Tunnels"; where the exigencies of width are not so severe, the two tunnels are entirely distinct, and are separated by a wall of rock. This type is found on the Weehawken side. The arches are of brick, the remainder of the tunnel lining being of concrete.

The general sequence of building the masonry lining is shown in Fig. 1. The operations were as follows:

(1)—Laying concrete for the whole height of the sand-walls, and for the floor and foundations for walls and benches up to the level of the base of the conduits.

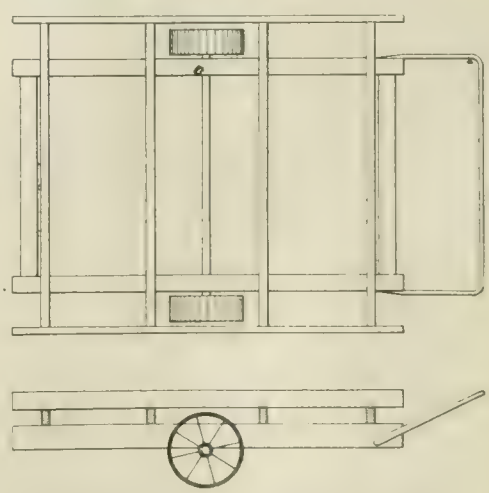

Fig. 3.—Cart for Transporting Forms.

(2)—Water-proofing the side-walls, and, where there was a middle trench containing subgrade conduits, laying and water-proofing these conduits.

(3)—Building concrete wall for conduits to be laid against, and where there was a middle trench, filling up with concrete between the conduits.

(4)—Laying conduits.

(5)—Laying concrete for benches and middle-wall.

(6)—Building haunches from top of bench to springing of brick arch.

*Extracted from a paper by B. H. M. Hewett and W. L. Brown, Proceedings American Society of Civil Engineers, Vol. xxxvi, p. 690.

(7)—Building brick arch and part of concrete back-filling.

(8)—Finishing back-filling.

The whole work will be generally described under the headings of Concrete, Brickwork, Water-proofing and Electric Conduits.

Concrete.—The number of types and the obstructions caused by the heavy posting of the timbering made it inadvisable to use built-up traveling forms at the Manhattan side, though they were used in the Weehawken Rock Tunnels.

The specifications required a facing mixture of mortar to be deposited against the forms simultaneously with the placing of the concrete. This facing mixture was dry, about 2 ins. thick, and was kept separate from the concrete during the placing by a steel diaphragm. The diaphragm was removed when the concrete reached the top of each successive layer, and the facing mixture and concrete were then tamped down together. This method was at first followed and gave good results, which was indeed a foregone conclusion, as the Weehawken shaft had been built in this way. However, it was found that as good results, in the way of smooth finish, were to be obtained without the facing mixture by spading the concrete back from the forms, so that the stone was forced back and the finer portion of the mixture came against the forms; this method was followed for the rest of the work. All corners were rounded off on a 1-in. radius by moldings tacked to the forms; this method was followed for the about four times, and were carefully scraped, planed, filled at open joints and oiled with soap grease each time they were set up. When too rough for face work they were used for sand-wall and other rough work.

The mixing was done by a No. 4 Ransome mixer, driven by 30-hp. electric motors. The mixer at Manhattan was set on an elevated platform at the north end of the intercepting arch; that at Weehawken was placed at the entrance to the tunnels. The sand and stone were stored in bins above the mixers, and were led to the hoppers of the mixers through chutes. The hoppers were divided into two sections, which gave the correct quantities of sand and stone, respectively, for one batch. The water was measured in a small tank alongside. A "four-bag" batch was the amount mixed at one time, that is, it consisted of 4 bags of cement, 8¾ cu. ft. of sand, and 17½ cu. ft. of broken stone, and was called a 1:2½:5 mixture. It measured when mixed about ¾ cu. yd.

The cement was furnished to the contractor by the railroad company, which undertook all the purchasing from the manufacturer, as well as the sampling, testing and storing until the contractor needed it. The railroad company charged the contractor $2 a barrel for this material.

The sand was required by the specifications to be coarse, sharp, and silicious, and to contain not more than 0.5 per cent of mica, loam, dirt or clay. All sand was carefully tested before being used. The stone was to be a sound trap or limestone, passing a 1½-in. mesh and being retained on 2⅜-in. mesh. The contractor was allowed to use a coarser stone than this, namely, one that had passed a 2-in. and was retained on a 1½-in. mesh.

The concrete was to be machine-mixed, except in cases of local necessity. The quantity of water used in the mixture was to be such that the concrete would quake on being deposited, but the engineer was to use his discretion on this point. Concrete was to be deposited in such a manner that the aggregates would not separate. It was to be laid in layers, not exceeding 9 ins. in thickness, and thoroughly rammed. When placing was suspended a joint was to be formed in a manner satisfactory to the engineer. Before depositing fresh concrete, the entire surface on which it was to be laid was to be cleaned, washed and brushed, and slushed over with neat cement grout. Concrete which had begun to set was not to be used, and retempering was not to be allowed. The forms were to be substantial and hold their shape until the concrete had set. The face forms were to be of matched and dressed planking, finished to true line and surfaces; adequate measures were to be taken to prevent concrete from adhering to the forms. Warped or distorted forms were to be replaced. Plastering the face was not allowed. Rock surfaces were to be thoroughly washed and cleaned before the concrete was deposited. These specifications were followed quite closely.

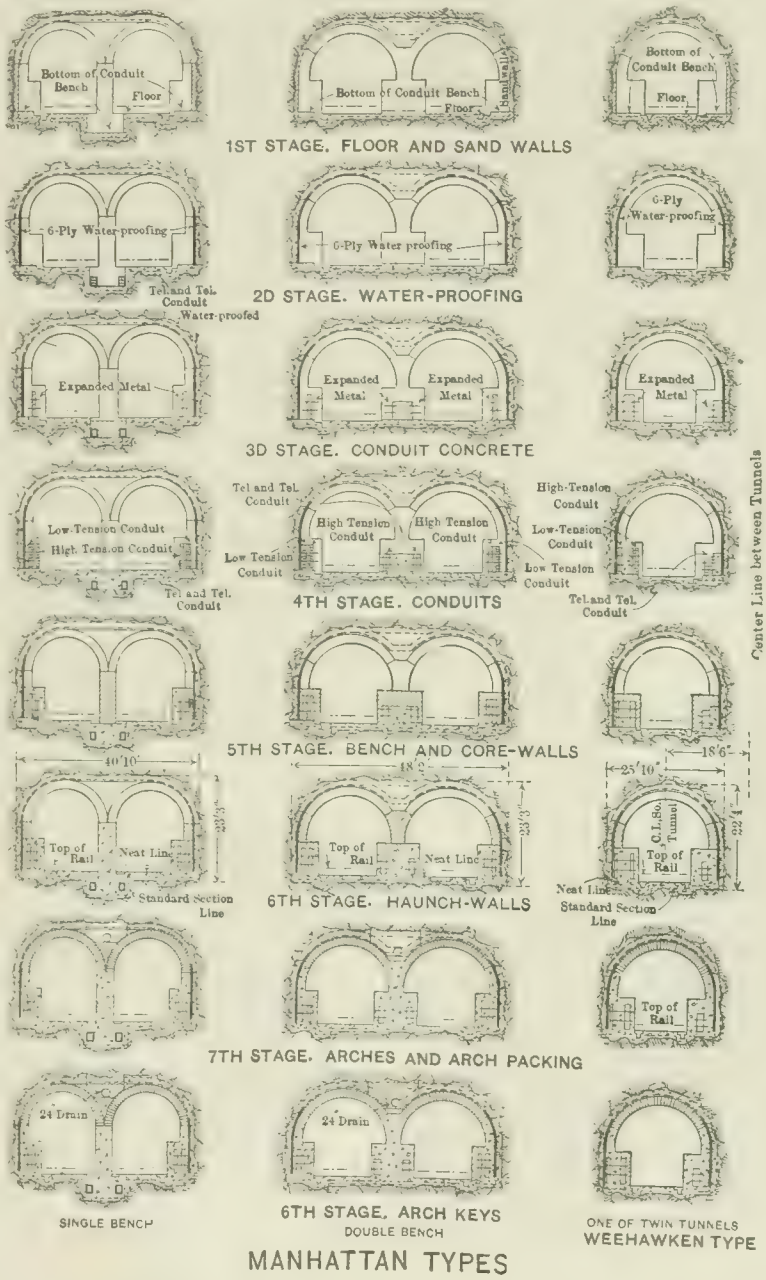

Fig. 1.—Sections Showing Sequence of Operations in Placing Concrete Tunnel Lining.

A typical working gang, as divided among the various operations, is shown below:

	Per month.
Superintendence:	
½ superintendent at	$250
½ assistant engineer at	150
1 assistant superintendent at	150
Surface Transport:	Per day.
1 foreman at	$2.50
1 engineer at	3.00
1 signalman at	2.00
16 laborers at	1.75
3 teams at	7.50
Laying:	
1 foreman at	$4.00
8 laborers at	2.00
Forms:	
1 foreman at	$4.50
4 carpenters at	3.25
5 helpers at	2.25
Tunnel Transport:	
¼ foreman at	$3.25
¼ engineer at	3.00
¼ signalman at	2.00
4 laborers at	1.75
Mixers:	
¼ foreman at	$3.25
2 laborers at	1.75

The superintendent and assistant engineer looked after the brickwork and other work as well as the concrete. The surface transport gang handled all the materials on the surface, including the fetching of the cement from the cement warehouses.

The tunnel transport gang handled all materials in the tunnel, but, when the haul became too long, the gang was reinforced with laborers from the laying gang. Of the laying gang, two generally did the spading, two the spreading and tamping, and the remaining force dumped the concrete. The general cost of this part of the work is shown in Table I.

The figures in Table I include the various items built into the concrete and some that are certificate extras in connection with the concrete, such as drains, ironwork and iron materials, rods and bars, expanded metal, doors, frames and fittings, etc.

Water-proofing.—According to the specifications, the water-proofing was to consist of seven layers of pitch and six layers of felt on the side-walls and a ½-in. layer of mastic, composed of coal-tar and Portland cement, to be plastered over the outside of the arches.

By the time the work was in hand, some distrust had arisen as to the efficiency of this mastic coating, and a great deal of study was devoted to the problem of how to apply a felt and pitch water-proofing to the arches. The difficulty was that there was no room between the rock and the arch or between the timber and the arch (as the case might be) in which

to work. Several ingenious schemes of putting the felt on in layers, or in small pieces like shingles, were proposed and discussed, and a full-sized model of the tunnel arch was even built on which to try experiments, but it was finally decided to overcome the difficulty by leaving out the arch water-proofing altogether and simply building in pipes for grouting through under pressure, in case it was found that the arch was wet.

As to the arch built through the length excavated by cut-and-cover on the New York side, it was resolved to water-proof that with felt and pitch exactly as the side-walls were done, the spandrel filling between the arches being raised in a slight ridge along the concrete line between tunnels in order to throw the water over to the sides. The portions of arch not water-proofed were rather wet, and grouting with a 1:1 mixture was done, but only with the effect of stopping large local leaks and distributing a general dampness over the whole surface of the arch.

TABLE I.—COST OF CONCRETE IN LAND TUNNELS, IN DOLLARS PER CUBIC YARD.

	Manhattan.	Weehawken.	Total yardage.
Cubic yards placed	14,706½	3,723	18,429½
Labor:			
Surface transport	$ 0.31	$ 1.43	$ 0.54
Superintendence and general labor at point of work	0.31	1.31	0.51
Mixing	0.52	0.56	0.53
Laying	1.38	1.45	1.39
Tunnel transport	1.30	1.47	1.34
Cleaning	0.21	....	0.17
Forms, erecting and removal	1.58	1.51	1.56
Total labor	$ 5.61	$ 7.73	$ 6.04
Material:			
Cement	$ 2.30	$ 2.22	$ 2.28
Sand	0.34	0.40	0.36
Stone	0.91	0.61	0.85
Lumber for forms	0.47	0.45	0.47
Sundry tunnel supplies	0.16	0.17	0.16
Total materials	$ 4.18	$ 3.85	$ 4.12
Plant running	$ 0.44	$ 0.44	$ 0.44
Surface labor, repairs and maintenance	0.25	1.24	0.44
Field office administration	0.50	1.72	0.75
Total field charges	$10.98	$14.98	$11.79
Plant depreciation	$ 0.62	$ 1.57	$ 0.81
Chief office administration	0.24	0.31	0.25
Total average cost per cubic yard	$11.84	$16.86	$12.85
Cost of Miscellaneous Items in Concrete:			
Amount, in dollars	$6,184.83	$1,756.79	$7,941.62
Unit cost	0.42	0.47	0.43

The 24-ft. 6-in. tunnel adjoining the Terminal Station-West was water-proofed by a surface-rendering method which, up to the present time, has been satisfactory. Generally speaking, the arches of the land tunnels, though not dripping with water, are the dampest parts of the whole structure from Tenth Ave. to Weehawken, and it would seem as if some form of water-proofing over these arches would have been a distinct advantage.

There was no difficulty in applying the water-proofing on the side-walls, after a little experience had been gained as to the best methods. The specifications required the sand-wall to be covered with alternate layers of coal-tar pitch and felt, seven layers of the former and six layers of the latter, the felt to be of Hydrex brand or other equally satisfactory to the engineer. The pitch was to be straight-run, coal-tar pitch which would soften at 60° F., and melt at 100° F., being a grade in which distillate oils, distilled from it, should have a specified gravity of 1.105. The pitch was to be mopped on the surface to a uniform thickness, of 1-16 in., and a covering of felt, previously mopped with pitch, was to be applied immediately. The sheets were to lap not less than 4 ins. on cross-joints and 12 ins. on longitudinal joints, and had to adhere firmly to the pitch-covered surface. This layer was then to be mopped, and another layer placed, and so on until all the layers were in place. This water-proofing was to extend from the bottom of the cable conduits to the springing of the brick arch. Where sub-track conduits were used, these were to be surrounded with their own water-proofing. The work was carried out as specified; the sand-walls were not rendered, but were built smooth enough to apply the water-proofing directly to them. They were dried with gasoline torches before the application of the pitch, and in very wet sections grooves were cut to lead the water away.

The first attempts were with the felt laid in horizontal strips. This ended very disastrously, as the pitch could not sustain the weight of the felt, and the whole arrangement slipped down the wall. The felt was then laid vertically, being tacked to a piece of horizontal scantlinig at the top of the sand-wall and also held by a row of planks braced against it at about half its height. A layer of porous brick was laid as a drain along the base of the water-proofing, covered by a single layer of felt to prevent it from becoming choked with concrete.

The water-proofing of the sub-track conduits was troublesome, as the numerous layers and the necessity for preserving the proper laps in both directions between adjacent layers made the whole thing a kind of Chinese puzzle. Various modifications, to suit local conditions, were made from time to time. Conduits outside the general outline of the tunnel are difficult to excavate, to lay, and to water-proof, and should be avoided wherever possible.

The usual force in water-proofing consisted of a foreman, at $3.50 per day, and nine laborers at $1.75 per day. These men not only laid the water-proofing, but transported the materials, heated the pitch, and cut up the rolls of felt. In general, two men transported material, one tended the heater, and the other six worked in pairs, two preparing the surface of the concrete sand-wall, two laying pitch, and two laying felt.

The cost of the water-proofing operation was about as shown in Table II.

TABLE II.—COST OF WATERPROOFING, IN DOLLARS PER SQUARE FOOT.

	Manhattan.	Weehawken.	Total.
Square feet covered	47,042	13,964	60,736
Labor	$ 0.07	$ 0.07	$ 0.07
Material	0.12	0.09	0.11
Total field charges	$ 0.19	$ 0.16	$ 0.18
Chief office and plant depreciation	0.01	0.03	0.02
Total average cost	$ 0.20	$ 0.19	$ 0.20

Brickwork in Arches.—Owing to the heavy timbering, the brickwork at Manhattan was interfered with to a considerable extent, and the gang was always kept at work at two or more places. The work was carried up to a point where it was necessary to back-fill, or prop or cut away encroaching timbers, and then the men were moved to another place while this was being done.

The centers were set up in sets of seven, spaced 4 ft. apart. Two 14-ft. lengths of 3 by 4-in. yellow pine lagging were used with each set of ribs, with 24x8-in. block lagging in the crown.

All centers were set ¼ in. high, to allow for settlement, except in the 24-ft. 6-in. span, in which they were set ½ in. high. This proved ample, the average settlement of the ribs being 0.01 ft. and of the masonry, 0.003 ft. In the 24-ft. 6-in. span the ribs were strengthened with 6x6-in. blocking and 12x12-in. posts to subgrade. Great trouble was here encountered with encroaching timbering, due to the settlement of the wide flat span. Grout pipes were built in, as previously mentioned.

Each mason laid an average of 0.535 cu. yd. of brickwork per hour, or 4.28 cu. yds. per day. The number of bricks laid per mason per hour was 218, or 1,744 per day.

The bricks were of the best quality of vitrified paving brick, and were obtained from the Jamestown Brick Co., of Jamestown, N. Y. The average size was 8¾x3 15-16x2 7-16 ins.; the average number per cubic yard of masonry was 408, the arches being from 19 ft. to 24 ft. 6 ins. in span and from 22 to 27 ins. thick. The joints were 3-16 in. at the face and averaged 9-16 in. through the arch.

The proportions for mortar were 1 of cement and 2½ of sand. One cubic yard of masonry was composed of 73.5 per cent brick and 26.5 per cent mortar. The volume of the ingredients in a four-bag batch was 12.12 cu. ft. and the resulting mixture was 9.54 cu. ft. The number of barrels of cement was 0.915 per cu. yd. of masonry, and about 17.7 per cent of the mortar made was wasted. The average force employed was:

Laying:	Per day
1 foreman at	$3.00
4 layers at	6.00
8 tenders at	2.00
2 mixers at	2.00
Forms:	
1 foreman at	$4.50
4 carpenters at	3.50
5 helpers at	2.25
Transport:	
¼ hoist engineer at	$3.00
¼ signalman at	2.00
4 laborers at	2.00

For materials, the following prices prevailed: Cement, $2.00 per bbl.; Sand, $0.90 to $1.00 per cu. yd.; Brick, $16 per thousand, delivered at yard; Centers, $26 each; Lagging, $45 per 1,000 ft. B. M. The cost of the brickwork is given in Table III.

TABLE III.—COST OF BRICKWORK.

	Manhattan.	Weehawken.	Total.
Cubic yards placed	4,137	790	4,927
Labor:			
Surface transport	$ 0.35	$ 1.19	$ 0.48
Superintendent and general labor at point of work	0.17	0.04	0.16
Laying and mixing	2.58	3.20	2.60
Forms: erection and removal	2.62	0.32	2.25
Tunnel transport	1.19	1.12	1.18
Total labor	$ 6.91	$ 5.87	$ 6.75
Material:			
Brick	$ 6.56	$ 6.56	$ 6.56
Cement	1.76	1.75	1.76
Sand	0.20	0.28	0.22
Forms	0.92	0.98	0.93
Overhead conductor pockets	0.15	0.09	0.11
Total material	$ 9.59	$ 9.66	$ 9.67
Plant running	$ 0.55	$ 0.30	$ 0.51
Surface labor, repairs and maintenance	0.36	1.30	0.51
Field office administration	0.55	0.88	0.60
Total field charges	$17.96	$18.01	$17.97
Chief office administration	$ 0.60	$ 0.66	$ 0.61
Plant depreciation	0.35	0.64	0.39
Total average cost per cubic yard	$18.91	$19.31	$18.97

In Table IV the cost of grout is expressed in terms of barrels of cement used, because that was in the schedule of prices attached to the contract as the unit of payment for grout.

TABLE IV.—COST OF GROUT OVER ARCHES IN LAND TUNNELS, IN DOLLARS PER BARREL OF CEMENT USED.

	Manhattan, (Gy-East only).	Weehawken.	Total.
Barrels used	3,000½	261½	3,262
Labor	$ 0.55	$ 0.46	$ 0.53
Material	2.30	2.25	2.28
Field office administration	0.08	0.06	0.08
Plant and supplies	0.10	0.07	0.09
Total field charges	$ 3.03	$ 2.84	$ 2.98
Chief office and plant depreciation	0.21	0.22	0.22
Total average cost	$ 3.24	$ 3.06	$ 3.20

Vitrified Earthenware Conduits for Electric Cables.—The general drawings will show how the ducts were arranged, and that manholes were provided at intervals. They were water-proofed, in the case of those embedded in the bench, by the general water-proofing of the tunnels, which was carried down to the level of the bottom of the banks of ducts; and in the case of those below subgrade, by a special water-proofing of felt and pitch wrapped around the ducts themselves.

The portion of wall in front of the ducts was bonded to that behind by bonds, mostly of expanded metal, passing between the ducts. Examples of the bonding will be seen in the drawings.

The joints between successive lengths of 4-way and 2-way ducts were wrapped with two thicknesses of cotton duck, 6 in. wide, those of single-way ducts were not wrapped, but plastered with cement mortar. The ducts were laid on beds of mortar, and were made to break joints at top and bottom, and side to side with the adjacent ducts. They were laid with a wooden mandrel; a square leather washer at the near end acted as a cleanser when the mandrel was pulled through.

The specifications required the ducts to be laid at the same time as the concrete and be carried up with it, but this was found to be a very awkward operation, as the tamping of the concrete and the walking of men disturbed the ducts, especially as the bonds lay across them. It was resolved, therefore, to build the portion of the wall behind the ducts first, with the bonds embedded in it at the proper heights and projecting from it, then to lay up the banks of ducts against this wall, bending the bonds down as they were reached, and finally, after all the ducts were in, to lay the concrete in front of and over the top of the ducts. Several detailed modifications of this general scheme were followed at one time or another when necessary or advisable.

The laying of ducts below subgrade was not complicated by the presence of bonds; the water-proofing caused the trouble here, as before described.

The specifications called for a final rodding after completion. Ordinary ¾-in. gas pipe was used for the rod, and a cutter with rectangular cross-section and rounded corners was run through ahead of the mandrel: following the cutter came a scraper consisting of several square leather washers, of the size of the ducts, spaced at intervals on a short rod. The mandrel itself was next put through, three or four men being used on the rods. All the ducts in a bank were thus rodded from manhole to manhole. When a duct was rodded it was plugged at each end with a wooden plug. A solid wooden paraffined plug was used at first, but afterward an expansion plug was used.

Very little trouble was met in rodding the power conduits, except for a few misplaced ducts, or a small mound of mortar or a laying mandrel left in. At such points a cut was made in the concrete and the duct replaced.

In the subgrade telephone and telegraph ducts east of the Manhattan Shaft, much trouble was caused by grout in the ducts. The mandrel and cutters were deflected and broke through the web of the ducts rather than remove this hard grout. Trenches had to be cut from the floor to the top of the water-proofing, the latter was then cut and folded back, and the ducts replaced. To do this, a number of ducts had to be taken out to replace the broken ones and get the proper laps. The water-proofing was then patched and the concrete replaced. This grout had not penetrated the water-proofing, but had got in through the ends of the ducts where they had not been properly plugged and protected. The duct gang, both for laying and rodding, generally consisted of 1 foreman, at $3.50 per day, and 9 laborers, at $1.75 per day. When laying: 4 men were laying, 2 men mixing and carrying mortar, and 3 were transporting material. When rodding: 4 men were rodding, 2 men at adjacent manholes were connecting and disconnecting cutters and mandrels, 1 was joining up rods, and 2 men assisting generally.

The cost of this work is shown in Table V.

TABLE V.—COST OF CONDUIT WORK.

	Manhattan.	Weehawken.	Total.
Duct feet	115,962	35,155	151,117
Labor	$0.035	$0.032	$0.034
Material	0.043	0.052	0.045
Total field charges	$0.078	$0.084	$0.079
Chief office and plant depreciation	0.005	0.008	0.006
Total average cost	$0.083	$0.092	$0.085

Cost of Making Sewer Connections.—Data on the construction of sewer connections in 1909 in the city of Waltham, Mass., are given in the annual report of the city engineer as follows:

Connections with sewer, 4 and 5-in	56
Total length of street work	1,328 ft.
Total length of lawn work	1,673 ft.
Average cost of street work	$ 9.51
Average cost of lawn work	12.63
Street Work:	
Average cost of labor per yd.	0.456
Average total cost	.618
Average cost per lin. ft.	.372
Lawn Work:	
Average cost of labor per yd.	.51
Average total cost	.72
Average cost per lin. ft.	.407

There were 89 stoppages in house connections and the average cost of repairing these was $1.92 for connection.

Earth and Rock Section

Note: This section is devoted to methods and costs of excavating earth and rock and building embankments. It will cover the grading of roads and railroads, diking and canal work, dredging, building reservoirs and earth dams, sewer and water pipe trenching, quarrying, etc.

Methods and Costs of Operating Well Drilling Machines in Prospecting for Copper.*

The ground to be prospected is divided into 200-ft. squares, each corner being marked as a drill hole location. Roads are then built to these locations, the road work being kept far enough in advance of the drills to avoid delays on this score. As the roads must be at least 9 ft. wide and substantially built, and as the surface of the ground prospected is almost invariably rough, these roads are quite an item of expense. Moreover, since they can seldom be used for any other purpose, they must usually be charged entirely to drilling. The roads should not exceed 15 per cent in grade. A drilling machine can pull up a steeper grade, but the team of horses hauling the coal and supplies must be considered.

Before drilling can be commenced an adequate water supply must be provided, and this is not always easy in the Miami district. Water is pumped from wells, springs, or underground workings, through pipe lines as much as 3 miles in length, to tanks placed at the highest points on the ground to be drilled, and thence through temporary lines to the machines. Between an actual shortage of water in periods of drought and the freezing and bursting of these temporary lines in cold weather, much time may be lost in the shut downs.

The machines now in use in Arizona are of the traction type. Both Keystone and Star outfits are in use. Drilling practice is practically the same in all cases, so the following description of Miami methods is applicable to all.

When a machine arrives at a location, it is blocked and leveled; the drive wheels are disconnected from the engine, and the spudding arm is attached to it. The mast is raised and steadied with wooden braces and with ⅝-in. steel guy wires. A floor, 14x18 or 20 ft., built of 2-in. plank, is laid in front of the machine; in the summer a simple roof of corrugated iron is built over this floor, sides and ends of the same material being added in winter. A longitudinal opening about 3 ft. wide is left in the roof to allow the handling of casing and tools. Water tanks and a portable coal box are also placed before drilling commences.

The string of tools for starting a hole, or "spudding in," usually consists of a 10-in. bit, 4 ins. x 20 ft. auger stem, and rope socket. The tools are strung up, a hole is cut in the floor where they will drop, and "spudding in" commences. When spudding, the cable passes direct from the tools over the crown pulley, down to the spudding wheel, and thence to the drum where the excess cable is wound. This spudding line is generally a section cut from a worn drilling cable; 1⅞ in. to 2 in. manila cable is used.

The spudding wheel is moved on an arm in such a way as alternately to raise and drop the tools in the hole. As the depth increases, cable is unwound from the drum, so that the tools may always strike a fair blow on the bottom. When about 5 ft. of progress has been made, the cable is thrown off the spudding wheel so that it passes direct from the crown pulley to the drum; it is then wound on the latter, pulling the tools out of the hole.

A bailer is then lowered into the hole on 7/16 in. steel line wound on a separate reel. The bailer is often made of casing pipe—4 ins. to 8 ins. in diameter, and 10 ft. to 20 ft. long. A dart valve on the bottom opens when the bottom of the hole is reached, thus admitting the sludge. The bailer is then hoisted to the surface and emptied into a trough which conducts the sludge to the sampling device. The bailer is run until the hole is dry, or all the cuttings have been removed. It is then swung back out of the way, the drilling tools are run back into the hole, and spudding is resumed.

A varying amount of water is needed in the hole to keep the tools cool and to take up the sludge. When the natural flow is not sufficient, this water is thrown in from the surface.

With a Keystone machine, spudding may be continued to a depth of several hundred feet. With a Star machine, however, the wear and tear on machine and cable are too great, and consequently the Star driller "hitches on" as soon as practicable, generally at a depth of from 100 to 125 ft. Then, instead of carrying the motion up over the crown pulley and back again, the rope is attached by clamps and a temper-screw to a beam extending out over the hole, and operated by a crank and pitman. That part of the cable above the clamps is not used while drilling is going on, but is pulled aside out of the way. In pulling out, the cable is unclamped, the pitman taken off the crank and the beam pulled up out of the way, as shown in the photo, and the cable is then wound on the drum just as when spudding. A pair of short-stroke jars is inserted in the string of drilling tools between the stem and the rope-socket.

A drilling crew consists of two men—a driller and a helper or "tool dresser." There are two crews to a machine, each working a 12-hour shift or "tower," changing at noon and at midnight. When moving or casing, both crews work in the daytime.

Holes are drilled on the average to a depth of 500 ft. or until below the limits of commercial ore. The rate of drilling is quite variable, depending on the rock encountered, the depth, and the amount of water flowing into the hole. With a 10 in. bit in average dry rock, which stands up well, 40 or 50 ft. per tower is not uncommon. On the other hand shattered and silicified schist which tend to cave and settle in the hole, and soft, sandy schist and granite which tend to run in at the bottom, are often encountered in the Miami district, and in such material, a drill may work a week or so and make little or no progress; in fact, the ground may come in faster than it can be drilled out. The presence of much water in a deep hole may also retard drilling, both by flotation of tools and cable, and by resisting the motion. In such cases it appears advisable to use a wire cable, with 100 to 150 ft. of manila cable, inserted immediately above the tools to absorb the shock and lessen the strain on the machine. Table I shows in a general way the variations in the rate of progress with respect to depth of hole and nature of work:

It is evident that in very shallow holes, the time required for moving and setting up may become a prominent factor in determination of the average rate of progress. Under delays are included shut-downs, redrilling bad holes, cleaning out after casing, and except in No. 2, time spent in fishing for tools lost in the hole. A drilling machine is expected to average 750 ft. a month, everything included.

Delays in drilling may be due to various causes, as noted above, some of the chief of these being briefly explained here.

*Condensed from a paper by Wm. G. Weber in the "Wisconsin Engineer" for April, 1910, describing practice in Arizona.

TABLE I.

	Time (Hours).									
	Drilling.	Repairs.	Delays.	Moving.	Casing.	Total.	Depth of hole (ft.)	Depth of permanent water level (ft.).	Rock.	Kind of drilling.	Ft. per 24 hrs.
1	7	11	12	41	..	136	103	...	Granite	Fair	18.2
[illegible]	17	12	60	45	14	303	252	...	Granite and Schist	Poor (Caving)	19.9
2	(Same as above + total time fishing.)					684	252	...	Granite and Schist	Poor (Caving)	8.8
3	...	...	...	...	...	336	340	(?)	Schist	Fair	24.3
4	...	...	..	..	...	456	421	290	Schist	Fair	22.1
[illegible]			..	..	..	420	427	(?)	Granite and Schist	Fair	24.5
6	369	8	113	47	43	580	468	320	Granite and Schist	Poor (Caving)	19.4
7	...	...	..	..	.	468	505	300	Schist	Fair	25.9
8	487	5	120	52	66	730	527	15	Schist and Granite	Poor (wet and Caving)	17.3
9	292	6	197	47	33	575	555	255	Granite	Poor (Caving)	23.3
10	481	37	11	40	34	636	608	465	Granite	Fair	22.9
11	...	...	..	..	...	588	635	380	Schist	Fair	25.5
12	376	32	86	35	...	529	645	(?)	Granite	Good	29.3

Crooked holes, and flat holes are sometimes encountered. Theoretically a drill hole should always be vertical, round and up to gage, but either through carelessness on the part of the driller or otherwise, variations from the ideal hole are many and troublesome. As a result the bit sticks or the tools lag and do not hit an effective blow. The common remedy is to fill the hole up above the bad place with fragments of quartz gathered on the surface, and then redrill it. Sometimes a four-winged star bit is used in place of the regular shaped bit and extra wide rope sockets are also used to reduce the play of the upper end of the tools in the hole. Shooting the hole with dynamite is occasionally attempted with rather indifferent success. In spite of all precautions few drill holes are vertical or straight, the tendency being to deflect a foot or two in a hundred.

Cavings, or pieces of rock falling from the sides of a hole may seriously delay drilling, as well as interfere with sampling. Large quantities of rock often fall suddenly on the tools and may wedge them in so tightly as to make it necessary to cut the cable, if indeed it does not break, and fish for them with a second string. Sands running in from below may produce the same effect. These cavings occasionally fill the hole as much as 50 ft. or even more above the bottom, and even if they do not catch the tools, much time is lost removing them. Usually casing the hole will stop the caving. Three sizes of casing are used in Miami, 7⅝ ins., 6¼ ins. and 4½ ins. in diameter, weighing 8 to 13 lbs. per foot. When a hole is cased, it is of course necessary to use smaller bits and tools. Four sizes of bits are used, 10 ins., 7⅝ ins., 6¼ ins. and 4½ ins., these figures representing the diameter when dressed to gage. With the last named bits, a smaller string of tools, 3¼ ins. in diameter, is used.

A hole may thus be cased several times if necessary. Each size of casing reaches to the top of the hole, and all are removed when the hole is finished. When casing is being handled, the drilling tools are lashed to the mast, and usually the manilla cable is unwound from the drum, a wire cable being put on in its place. With this line, the joints of casing, each 18 ft. to 20 ft. long, are hoisted up, over the hole one by one, threaded together and lowered until the bottom is reached, or until they will go no further. The casing rarely needs to be driven, and then only with light blows, this being accomplished by stringing up the tools and dropping them gently on a block placed on the upper joint [illegible]

To remove casing the process of lowering is reversed. When it does not pull readily, pulley blocks or hydraulic jacks or both are used, and occasionally dynamite is lowered into the hole and exploded to jar the ground loose. There are also a number of special tools, such as steel nipples, casing spears and the like, used in special cases and better described in the makers' catalogues than is possible here.

Finally, a serious factor in delaying drilling is the fishing job. The cable or one of the tools may break, a joint may become unscrewed, or the tools may be wedged so tightly by sudden falls of ground or runs of sand, that the jars will not work and the rope must be cut. Then the fishing job commences. Many and various tools are kept ready for emergencies, for it takes weeks to get anything from the supply houses. A fishing job is delightfully uncertain; it may last an hour or a week, or the hole may eventually have to be abandoned. In the last case, a new hole is usually started a few feet away. A second and a third string of tools may be lowered into a hole, to recover the ones already there, only to be lost in turn. Sometimes when success seems assured, some unexpected occurrence puts things in worse shape than before. Thus in one hole, a bit broke off at the pin, and the driller lowered a horn socket gently, to feel for the part remaining and learn, if possible, how it lay. The horn socket is aptly described by its name—resembling a megaphone somewhat, in shape—and in this case it slipped over the bit and took just enough friction hold to bring it along to the surface and then drop it back in the hole, where it remains yet, all further efforts to recover it proving unavailing.

The object of this drilling is, of course, to obtain information concerning the ground penetrated. For this purpose the sludge is bailed out at 5 ft. intervals, approximately the true depth being determined each time by measuring on the boiler line. The sludge is dumped into a trough and conducted to a split divider which diverts ⅛ of the material into a tub. This amount may subsequently be reduced to 1/16, 1/32, or 1/64 if desired, by repouring the contents of the tub through the divider. The sludge is then dried over a fire, care being taken to prevent loss of sulphur through roasting; and the dried sample—which should weigh 25 or 30 lbs.—is sacked, tagged with the number of the hole and the depth at which it was obtained, and sent to the assay office. A sampler is employed on each shift to do this work. When two machines are working close together he can attend to both. He also takes a portion of each sample and pans it, noting the copper and iron minerals present, and their approximate abundance. The sulphides and oxides concentrate in the bottom of the pan; the copper carbonates and silicates are washed off, but may readily be detected even in minute quantities because of their bright colors. This and other information is recorded on a report blank.

The nature of the rock penetrated may be determined by the relative quantities of various minerals found in the sludge, and also by examination of such small uncrushed fragments as are often bailed out. When the formation is not the same from top to bottom, and the hole is caving, the exact nature of the rock penetrated may be indeterminable.

Faults and veins are quite readily detected in the capping over the ore through the presence of clay in the sample, also through marked variations in the amounts of iron oxides, copper carbonates, or quartz present in the sample. The width of the fault is represented by the distance through which this marked difference in mineralization occurs, but when the fault is steeply inclined, this is of course much greater than the true width. Faults in the sulphide zone are not so readily detected and doubtless are often overlooked.

Too much reliance should not be placed on the results obtained by drilling. Raises have been put up on a number of holes both at Ray and Miami, and while in some cases the drill returns and those form the raise check out quite satisfactorily, in other cases very poor results are obtained. A variation as great as 0.5 per cent has been found to occur in ores averaging 3 per cent or less. As a rule, the drill returns are low, a fact which is rather hard to explain. It is possible that the heavy sulphides tend to settle in the bottom of the hole and in fissures and pockets in the sides where they are undisturbed by the churning of the tools. In uncased holes, cavings from the overburden would of course lower the percentage of copper, and on the other hand, it has been found that after the hole has passed through a sulphide body, the samples may still indicate good ore. Under such conditions, casing changes the grade of samples materially.

Moreover, it is so easy for a careless sampler to neglect his work, especially at night. An unwashed trough may collect much concentrate; an uncleaned divider may clog and not split the sludge properly. Allowing the solids in a sample to settle and decanting off most of the water before placing the tub over a fire, is a common and legitimate practice—but too often much solid matter is allowed to float out with the water.

However, regarded not as a means of developing ore bodies, but as a means of prospecting for them, determining their boundaries and obtaining a fairly close idea as to their tenor, the churn drilling machine is certainly a rapid, efficient and comparatively cheap instrument.

The drills are owned and operated by the mining and development companies, and no contract work has as yet been attempted in the territory.

The accompanying cost data are based on an assumed average life of four years per machine. A drilling machine with tools sufficient to operate for that length of time would cost about $6,000.

The minimum amount of road required per hole is about 300 ft. When holes are drilled at 400 ft., 600 ft., or greater intervals, the item of roads becomes correspondingly greater. On the fairly steep slopes (20°) encountered in the Miami district, $0.75 is an average cost per foot of road.

COST OF DRILLING.

Item.	Cost per ft. of hole.	
Labor—		
2 drillers at $6.00 per day	$0.48	
2 helpers at $4.80 per day	0.38	
1 sampler at $4.00 per day	0.16	
1 foreman at $6.00 per day (2 machines)	0.12	
	$1.14	$1.14
Roads—		
Labor at $2.00 per day	$0.50	
Foreman at $4.00 per day	0.05	
Powder, caps and fuse	0.03	
Tools, etc.	0.01	
	$0.59	$0.59
Coal, coke, oils, etc		0.27
Water		0.10
Teaming		0.10
Assaying, office and incidentals, etc		0.16
Interest at 5 per cent and depreciation		0.20
Total cost per ft. of hole		$2.57

The monthly average of the cost per foot of hole drilled varies with one company from $2.00 to $3.00. In another instance, where holes are drilled further apart and the drilling is poorer, the cost per foot has run as high as $5. When drilling is the only means of development being used on a property, the cost of camp maintenance and incidentals considerably swells the cost account. It would hardly be fair, however, to charge these items up to drilling when a comparison with other districts is being made.

Roads and Streets Section

Note: This section is devoted to methods and costs of road and street construction. It will cover road building in all its details, the construction of pavements, sidewalks and gutters, the testing and use of paving materials and the machinery and tools used in road building and paving.

Paving Roadways Having Steep Gradients.

One of the most difficult questions which sometimes confronts city engineers is the selection of the proper material for paving streets having steep gradients. Where the street carries a considerable amount of traffic seven special factors are involved, chief of these being the consideration of providing a good foothold for the horses. In a recent issue of The Surveyor Mr. W. J. Howard-Smith discusses this problem in an interesting manner, and we have taken the matter that follows from his article.

Flint-macadam gives perhaps the most secure foothold, and some soft granite macadams may, in dry weather, be only a degree more slippery, but the greasy mud which in damp weather forms on the surface of macadam constitutes a grave objection on a hilly road and a special danger for mechanical traction.

Unfortunately slurry-bound macadam, no matter what may be the kind of stone employed, seldom long maintains a good surface. On the up-hill side it is broken up by the gripping action of the hoofs, while on the down grade it is ploughed into by the skid pans and braked wheels of heavy vehicles, deep ruts, which become a dangerous menace to traffic and necessitate constant attention and replacement of the broken surface, being thus formed. Unfortunately, when once the surface crust is broken in this way it is almost impracticable to repair the damage with any hope of permanency. The loosened metalling is kicked and scattered again and again over the roadway, to become a dangerous nuisance; and at times of heavy rainfall the down-hill rush of surface water scours out the smaller particles and then finds admittance to the foundation, thereby becoming a source of further trouble.

EXAMPLES OF STREETS WITH STEEP GRADIENTS PAVED WITH GRANITE BLOCKS.

	Locality.	Gradient.	Approximate length in yards.
(1)	City of London — Several streets leading from Thames street	1 in 11 to 1 in 15	..
(2)	Westminster—Regent st., Piccadilly circus	1 in 12 to 1 in 18	..
(3)	Bradford—Church street..	1 in 9¾	...
	Bradford—Godwin street..	1 in 12	...
	Bradford—Bridge street...	1 in 13	...
(4)	Croydon—Crown hill	1 in 12	...
	Croydon—Pitlake bridge ..	1 in 13	...
	Croydon—Waddon bridge..	1 in 14	...
	Croydon—Vicarage road...	1 in 14	...
	Gateshead—Church street.	1 in 12	160
(5)	Halifax—Pye nest	1 in 10	250
	Halifax—Upper Crown st.	1 in 12½	93
	Halifax Bolton brow	1 in 13	393
	Halifax—Haley hill	1 in 13	244
(6)	Leeds—Cookridge street..	1 in 11¼	...
	Leeds—Beeston hill	1 in 11¼	...
	Leeds—Woodhouse street..	1 in 13	...
(7)	Newcastle-on-Tyne — Pilgrim street	1 in 6	110
	Newcastle-on-Tyne — Pilgrim street	1 in 8	80
	Newcastle-on-Tyne—Hanover street	1 in 7	200
	Newcastle-on-Tyne—Akenside hill	1 in 7½	90
	Newcastle-on-Tyne Manor street	1 in 9	170
(8)	Penge—Crystal Palace hill	1 in 12	150
(9)	Windsor—The main street	1 in 9	100

Remarks—(1) These streets have very heavy lorry traffic to and from the river wharves. Billingsgate Fish Market, etc. (2) One of the busiest places in London. Setts specially dressed to a smooth surface and laid with extra close joints. (3) Several other busy streets, granite sett paved on gradients generally similar to these. (4) And several streets rather less steep. The paving is of Grey Royal, special dressed blocks 5 in. wide by 4 in. deep laid with very close joints. (5) In parts only, the middle of roadway, i. e., tramway tracks are granite setts, the haunches being of gritstone. (6) Cookridge street is a very busy thoroughfare; the two largest public halls in the city are situate at the steepest part. (7) And many other main thoroughfares in the city similarly paved, but not quite so steep. (8) Paving is of Grey Royal special dressed blocks 5 in. wide. (9) Is also the principal approach to Windsor Castle.

Both road locomotive and motor car traffic are particularly damaging to metalling on hills; the scrubbing effect of the armored tires churns up the binding particles, and the cross bars, studs and wheels of locomotives plough into the surface, especially after frost, and crush to powder the loose, friable stones.

The employment of macadam treated with tar or with any other substance which tends to make a greasy and slippery surface is, of course, out of the question, and the same objection applies to asphalt and wood paving. Basalt lava has been tried, in the form of setts from 6 in. to 8 in. sq., but, while not slippery, its unequal and open texture, the rock frequently being full of large air-holes or honeycombing, leads to rapid wear.

All things considered, states Mr. Smith, granite setts—especially when of the more modern and superior form known as special dressed blocks—form the most desirable and certainly the most durable surface for steep gradients. In fact, this is practically the only material that will satisfactorily withstand the destructive effect of modern road traffic. While somewhat costly in first laying, its long life—probably extending to 50 years or more—and cheap maintenance, make it in the long run an economical paving.

There may be an idea that where granite paving is laid on steep gradients complaints of slipperiness will be rife. In the accompanying table is given some data, kindly furnished, in most cases, by the engineers of the towns mentioned, and it will be seen from this that the complaints are practically a negligible quantity, even although such paving is laid on roadways as steep as 1 in 6, as at Newcastle. In addition to those given in the table many other cities including Liverpool, Glasgow, Edinburgh, Sheffield, Huddersfield, Aberdeen, and Swansea have examples of granite block paving on steep inclines.

In the North of England gritstone (otherwise freestone or "lonkey") setts are very largely employed for paving steep roadways, even up to 1 in 4 gradient, without complaint of slipperiness. As these setts are often 12 in. or more in width, it is obvious that horse foothold must be obtained on the rock itself, and not at the joints. By similar reasoning it follows that where granite is used it is all-important that it should be of a particularly gritty texture. Neglect of this precaution necessitates recourse to the spreading of sand or grit over the surface—which eventually results in the formation of dust and mud.

Assuming that the right kind of granite is employed, the requisite grittiness of surface will be regularly maintained by the gradual recession under attrition of the softer mineral constituents, thereby leaving the harder mineral grains standing up as minute nodules or prominences on the surface. Hence the hard particles must be of the most durable and resistant nature, as upon them falls the duty of withstanding the severe effects of hill traffic.

The most resistant substances in such granites are quartz and felspar. The softer constituent, usually mica, should lie between 15 and 25 per cent of the surface area.

For a granite to possess the right granular roughness a particular degree of coarseness of texture is requisite. If too fine, the surface is apt to polish and become very slippery, especially in hot weather. If too coarse, the hard prominent minerals wear into polished surfaces, upon which a horseshoe obtains no grip. Again, the coarser granites are not usually very tough, and are prone to break off on the arrises of the setts, which then assume a rounded form with wide joints.

This causes the paving to be noisy, uncleanly and generally objectionable.

As this roughness of granular texture is the factor mainly to be relied on to provide secure foothold, it follows that the setts need not be narrow. They should, however, have a level surface and narrow joints, not only for ease of traction, but because wide joints collect dust and mud, and, as is well known, mud on the surface of paving is a main cause of horses slipping and motors skidding.

The old idea that it was incumbent to have wide joints for obtaining horse foothold on granite sett paving is now looked upon as an exploded fallacy. It certainly was productive of an uneven surface, and is largely to blame for the prevalent view that granite paving must necessarily be noisy. That this is not the case, and that such paving may be made fairly comparable with wood for quietness is evidenced in the surfaces of Oxford-circus, Piccadilly-circus, and the adjoining part of Regent street, London (the latter on a steep gradient, as referred to in the table). Each of these places is paved with granite blocks, specially dressed in order to provide a level surface and narrow joints. There is enormous traffic over this paving, and surrounding it are some of the highest rented shops in London. It has been laid several years, but there are no complaints of noise, though soft wood abuts in the adjoining streets. At Croydon, a high-class residential town, a similar superior class of granite paving is laid in several of the best thoroughfares, sometimes between lengths of soft wood. It is officially stated that no complaints of noise due to it have been received, nor is the difference in this respect between these two materials very marked.

The paving at Croydon is notable for the form of the blocks. They are of Grey Royal granite, special dressed and laid with close joints. The result is an excellent surface, almost equalling asphalt in smoothness. Although this smooth paving is laid on numerous steep gradients throughout the town, complaints of slipperiness are unheard of.

Where traffic is of exceptional amount it may be found desirable—in order to minimize tractive effort up steep inclines—to lay "wheelers." These should be of the hardest rock, in blocks 20 in. or 24 in. wide, 8 in. deep, and not less than 3 ft. long, laid at 6-ft. centres. The surface should be smooth quarry faced, and the joints dressed squarely to full depth; the end joints should abut quite closely, as any undercutting will tend to make the stones tilt.

Methods of the New York State Commission of Highways for Testing Stone Used in Road Construction.

In connection with the Bureau of Research, the New York State Commission of Highways has established a Testing Department, which has charge of tests of the various materials used in the State Highway construction. The laboratory is equipped for making a complete standard test on highway stone. The apparatus consists of a hand stone-breaking press, a Deval abrasion machine of four cylinders, a Dorry grinding disk for hardness, two ball mills, a Page hydraulic briquette molding machine, two impact machines which are models of those in use in the office of Public Roads in Washington, and a diamond core drill. These, with one 4 H. P. motor for the main drive and two smaller ones for the impact machines, and such accessories as scales, a Lapadary saw, etc., complete the equipment.

In the recently issued report of the State Commission of Highways the methods employed by the Testing Department in making tests of highway stone are described as follows:

Upon receipt of the stone sample at the laboratory it is given a sample number which serves as a means of identification throughout the test and by which number the sample is thereafter known and reported upon.

A small specimen of this sample is then placed on file in the Bureau of Research after which the stone to be tested is broken into sizes as nearly uniform as possible by means of the hand breaking press. It is then thoroughly washed, after which it is dried for four hours, when 50 pieces of a total weight of 5 kilograms are put into a cylinder of the Deval machine and subjected to an abrasion of 10,000 revolutions at the rate of 2,000 revolutions per hour. Then the stone is removed and all fragments above the size of 0.16 cm. are washed, dried for a period of four hours, weighed, and the percentage of loss by abrasion computed per kilogram.

The diamond core drill is used for the purpose of obtaining cores from the specimen upon which the hardness and toughness tests are performed. These cores are cylinders of varying lengths with a diameter of 25 mm. For the hardness test two cores are first carefully weighed and then placed in the Dorry machine so that the ends rest on the upper side of the cast-iron grinding disk. Crushed quartz of a standard quality and size is fed on the disk from a funnel. The disk is rotated for 1,000 revolutions, after which the cores are weighed and reversed end for end in the machine. The disk is then rotated for another thousand revolutions. The cores are then taken out and weighed and the average loss in weight for 1,000 revolutions is ascertained. The empirical formula for computing the hardness value is that the hardness shall be represented by 20 less ⅛ the loss in weight, during the test, expressed in grams.

For the toughness test two core pieces are sawed by the Lapadary saw to a 25 mm. length. These are securely clamped in the impact machine and subjected to blows of a 2-kilogram hammer, transmitted through a 1-kilogram weight. The first drop is from a 1 cm. height with an increase of 1 cm. for each succeeding blow. The toughness value is represented by the number of blows required to break the specimen.

For the cementation test the material is prepared by putting fine stone and dust from same in the ball mill with a percentage of water where it is ground to a paste under the rolling action of two cast-iron balls for two hours. This is then moulded into briquettes 25 mm. in diameter and 25 mm. in length in the Page hydraulic press. After 20 hours in air and 4 hours in a steam bath these are subjected to successive blows of a hammer 1 kilogram in weight dropping from a fixed height of 1 cm. The cementing value is taken as the average number of blows necessary to rupture a briquette, tests being performed upon five briquettes in order to determine the average number. This latter test which is of recent development has not proven as satisfactory as the other tests, as the cementing value obtained by it does not seem to be proportional to the cementing value of the same stone when used in the form of screenings on the road. This is possibly due to the fact that in the laboratory the stone is ground into a fine powder or flour and cementing qualities are obtained under these conditions which do not exist in the coarser dust and small particles of stone when used as screenings on the road. An illustration of this is that a limestone, the screenings of which are known to have good binding qualities on the road, when tested in the laboratory will show a cementing value of about 60, while trap screenings alone do not bind as readily on the road as limestone screenings but the cementing value of trap as obtained from this test in the laboratory is frequently found to be as high as 200 or more.

To determine the water absorbed in pounds per cubic foot, a smooth worn stone, which has been through the abrasion test, is used. After being weighed in air it is immersed in water and immediately weighed in the water. After 96 hours of immersion it is again weighed in water. The absorption is then computed from the difference between the first and second weighings in water. The specific gravity and the weight per cubic foot of stone is determined from the air weighing and the first weighing in water.

The geological classification is determined in the laboratory, a microscopic or chemical analysis being made when necessary. Upon completion of the laboratory tests the results thereof are submitted to the Commission.

Notes on Road and Street Work.

Rolling Snow on Country Highways.—The practice of rolling snow on country highways has been in use in Vermont for over 20 years. This method has also been used in Wisconsin, Michigan and the northern counties of New York state and has proved extremely successful. The advantage over other methods of removal of obstructions caused by snow is that a hard, wide and level track is made, which permits teams to pass one another without inconvenience or danger, the snow being compacted for a width of 8 to 10 ft., or thereabouts, and is therefore smooth on either side of the beaten path, and when new snow strikes this smooth rolled surface it is easily blown away and gives little or no trouble. Sleighing remains good as long as any snow remains. In the spring, when snow is melting, little inconvenience is experienced, as the beaten track remains compact and hard and will sustain the traffic until the roadbed is exposed. The principal object derived from rolling snow is to build up the track to a height where the drifting snow will not stop in the beaten pathway. The best results are obtained by rolling immediately after the first snowfall and continuing after all succeeding falls of 8 ins. or more, and also after all heavy winds. In this way the track is kept hard from the bottom, and, as heretofore stated, during thaws or in the spring when the final thaws come, no trouble is experienced from "breaking through" or "slumping." The rollers most commonly used are of wood and of a diameter varying from 3½ to 6 ft. and with a length of 6 to 12 ft. The average weight of a 10-ft. roller, 5 ft. in diameter, is about 3,800 lbs. and the average cost of the same is $35. Usually they are not longer than 10 ft., but many are 8 ft. in length. Rollers of from 8 to 10 ft. produce the best results at a fair average cost. With rollers of 6 ft. and 8 ft. in length, the common practice is to drive the "near" horse in the "off" track going out, or vice versa, and the same coming back, thus rolling a track about 12 ft. wide with an 8-ft. roller and 14 ft. with a 10-ft. roller. Experience has demonstrated that the 10-ft. roller, made in two parts, is preferable for the majority of roads. In some localities plows especially built for opening roads through deep snows are used. These are quite massive affairs, requiring from four to eight horses to draw them, and varying in cost from the simple home made plow built at a cost of about $50, to the heavy affair used in Canada, which costs about $250. It is claimed that plowing, especially in localities where the snowfall is heavy, has the effect of making a channel in the center of the highway through which water from melting snow will flow, thus washing out the center of the road. In many towns in northern New York snow packers are used. The affair acts on the principle of a stone boat, and its effect is practically the same as a roller. In the town of Brighton in Franklin County, New York, all of the main roads were rolled, the average cost for five years being about $5 per mile. In the town of Duane, ten miles through an open country, which drifted badly, were rolled regularly and were kept in good condition throughout the entire winter for a total cost of $55. In the same town three miles of road were kept open by plowing, at an expense of a little over $30. Five miles of the same road immediately adjoining and of similar character were rolled and kept in better condition than that which was plowed, at an expense of $28. Plowing and shoveling for the entire winter cost $10 per mile. Rolling for the entire winter cost $5.60 per mile, and a bulletin of the Town Highway Bureau of the New York Department of Highways, from which the above notes have been taken, states that a better track was maintained by rolling than by plowing and shoveling.

Inspection and Repairing of Wooden Highway Bridges.—The following directions for the inspection and repairing of wooden bridges are taken from a bulletin recently issued by the Bureau of Town Highways of the New York Department of Highways for the guidance of county and town superintendents: The timbers of wooden bridges should be inspected by boring with a ¾-in. auger into the main members. This boring should be done in such a way that rain water cannot enter the hole; i. e., the hole should enter the timber from the under side. The holes should afterward be plugged with wood. The iron hangers should be equally strained. This condition can be determined by striking adjacent rods with a piece of hard wood or iron and noting the tone or pitch. The rod having the lower tone can be tightened until the pitch is the same as that of the rod having the higher tone. In case a nut is rusted fast and cannot be moved by a wrench, it can be very readily loosened by heating it quickly with a gasoline torch. Care should be exercised to avoid heating the rod, as the idea is to expand the nut and thus loosen it. If a wooden bridge is in such good condition that it will probably not be renewed for some years the covering (roof or weather boarding) should be very carefully watched, as a heavy wooden bridge might last for years if properly covered, while a small leak in the roof, if neglected, might be the cause of the bridge decaying in a few seasons. Splices and keys in the bottom chord should be watched to see that there is no crushing of the wood back of the splice bolts. The floor beams should be large enough to get a bearing over the entire width of the bottom chord and the planking should be laid with openings to clear the deck of water and dirt. The planking in all cases should be spiked to the floor joist to prevent undue vibration and noise. The mud sills and corbels should be renewed as fast as decay becomes apparent. There should be an apron of wood or stone between the bridge deck and the roadway dirt. This apron should be renewed from time to time as the necessity becomes apparent. If the trusses become weak they should be made safe in the following manner: There should be placed on the ground under the bridge or in the bed of the stream a mud sill of wood about 10 ins. square and about 3 ft. longer than the width of the bridge. A corresponding cap of like dimensions should be attached under the bridge and in contact with the trusses at a panel point. Two vertical pieces about 8 by 8 or 10 by 10 and a little longer than the distance between the mud sill and cap should be provided and should be placed by blocking the upper ends under the cap piece and then driving the lower ends until they are perfectly rigid. The lower ends should be retained by blocks spiked to the mud sills. These trestle bents should always be put up in pairs at an equal number of panel points from each end.

Side Hill Roads.—An interesting feature of the method of constructing roads in Allegany county, New York, is the manner of building dug roads on a road parallel to a side hill. These roads are built with but one ditch, which is on the upper side of the road. This ditch intercepts the water coming down from the hillsides; this water is carried across the road at short intervals by means of sluices. These roads have a continuous slant from the outer shoulder to the inner ditch, which overcomes the danger of vehicles sliding in icy weather.

Governor Hughes has signed the bill recently passed by the New York legislature providing for the issuance of $7,000,000 in 4 per cent bonds for the improvement of the Cayuga and Seneca canals. These canals are to be made a part of the barge canal system.

Water-works and Sewer Section

Note: This section is devoted to methods and costs of constructing sewers and water-works. It will cover the construction work for all details of water supply and sewerage, including sewage purification and water filtration.

Methods of Constructing the Western Ave. Sewer, Chicago, Ill.

In 1904 the City of Chicago proposed to build a sewer on Western Ave. from 71st St. to the Chicago Drainage Canal. The sewer proposed was to be 9 ft. in diameter at the outlet, reducing to 6 ft. at 71st St. Mr. Isham Randolph, then Chief Engineer of the Sanitary District of Chicago, proposed a plan to the city by which the Sanitary District could use a part of this sewer and by building an extension at 39th St. to the stagnant arm of the Chicago River known as "Bubbly Creek," would be able to induce a flow through the creek and keep it in a sanitary condition.

The plan proposed is now being carried out under contract to J. W. Farley of Chicago, Ill. The sketch, Fig. 1, may be followed in a description of the location of the sewer. From the outlet into the Drainage Canal the line of sewer goes south on Western Ave. passing under the Illinois & Michigan Canal, where the sewer takes the form of an inverted siphon, to 71st St. At 39th St. a branch runs east about 1,850 ft. and north about 500 ft. to "Bubbly Creek." The contract for constructing this branch also is let to J. W. Farley. The section of the sewer which will carry the flow from "Bubbly Creek" is a vertical elipse 12x14 ft. This is built of concrete. Figure 2 shows the section of the 39th St. branch. The main sewer on Western Ave. from 39th St. to the outlet is of the same inside dimensions but the walls are 16 ins. thick all the way round and contain no reinforcement. It is this section which is at present being constructed and it is the purpose of this article to describe the methods employed for the construction. The balance of the sewer running on Western Ave. from 39th St. to 71st St. will be built of brick and will have a diameter of 9½ ft. at 39th St., reducing down to 6½ ft. at 71st St. The average depth of excavation for the construction of the brick sewer will be about 17.7 ft., while the excavation for the concrete section averages 26 ft. in depth. About 500 ft. from the outlet at the Drainage Canal this sewer passes under the Illinois & Michigan Canal in the form of an inverted siphon. The cross section of the siphon is reduced gradually from the vertical elipse of the main sewer section to a horizontal elipse 12x9 ft. The grade of the sewer is lowered 5 ft. in approaching this canal and raised again 4.99 ft. on the opposite side. In the reduction of the cross section it will be noticed that the horizontal diameter remains constant. The reduction of this area will cause a higher velocity of flow and tend to prevent sedimentation in the siphon. Figure 3 shows the inverted siphon in profile, the dotted curves representing the cross sections every 12 ft.

For purposes of construction the contractor has employed a separate outfit on the work of the siphon. This will be put in in two sections, a cofferdam being used and built to take care of one half of the work at a time. The cofferdam is built of 2x12-in. plank of three thicknesses placed so that the edges overlap. Stringers were placed on the inside about midway up, and these were braced apart with 8x8-in. timbers. Iron rods, ¾-in. in diameter, run through the cofferdam directly over the 8x8-in. timbers. These rods react against any tendency of the cofferdam to spread. The plant for handling this work consists of a Page & Schnable revolving derrick. For driving the sheeting a pair of pile driver leads were suspended from the boom of the derrick and a steam hammer was operated in them. The derrick handled the excavation in skips, taking the skips out of the trench, where the excavation was made by hand, and then was dumped into cars.

The disposal of the spoil presented some difficulty on account of a lack of a convenient dumping ground. This was secured by an arrangement with the Chicago & Alton R. R. which parallels the lower half mile of the sewer within two blocks. The railroad company built a spur from their right-of-way to the sewer and the spoil was loaded into the standard gage gondola cars and taken by the railroad company for use in track elevation. These standard gage railroad cars were switched around on the sewer work by the dinky engines shown in the accompanying views. In order to accommodate the dinky engines on the standard gage track a third rail was employed and a special coupling was made. In this manner the spoil from the lower half mile of the sewer was disposed of. The spoil for the balance of the sewer is at present being taken by the dinky engines in 4-yd. narrow gage cars, to McKinley Park, a haul of three-quarters of a mile, and is to be used there for filling low places and for making landscape effects.

The plant employed by the contractor in

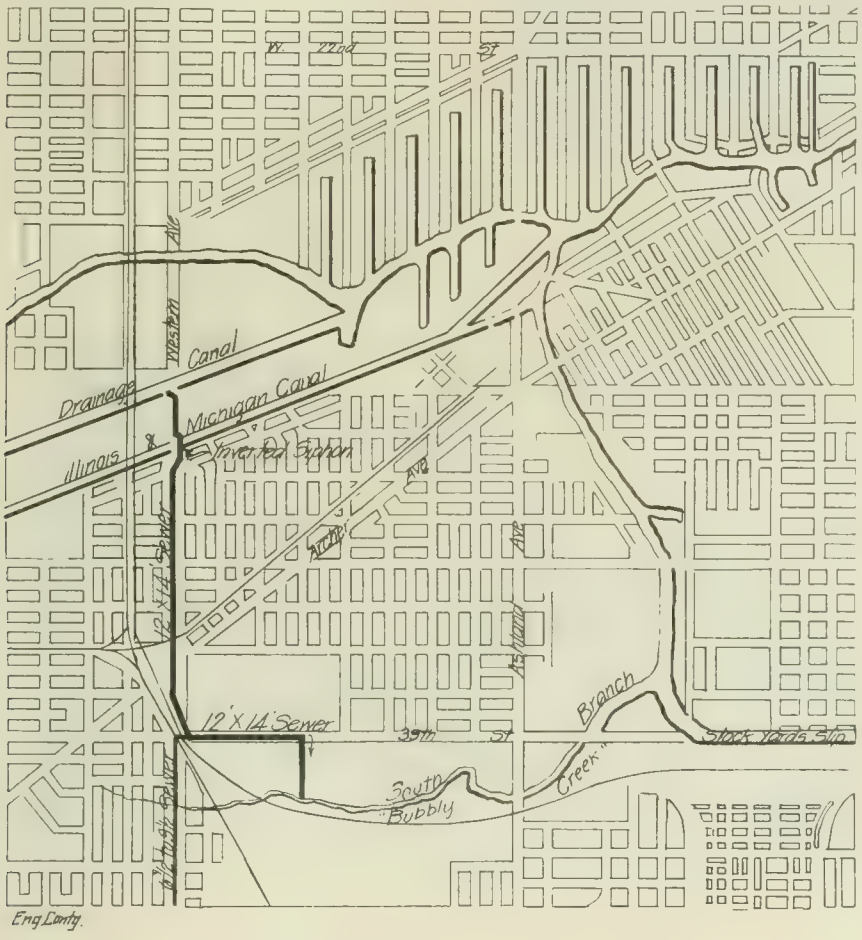

Fig. 1.—May Showing Location of Western Ave. Sewer and Branch from Bubbly Creek.

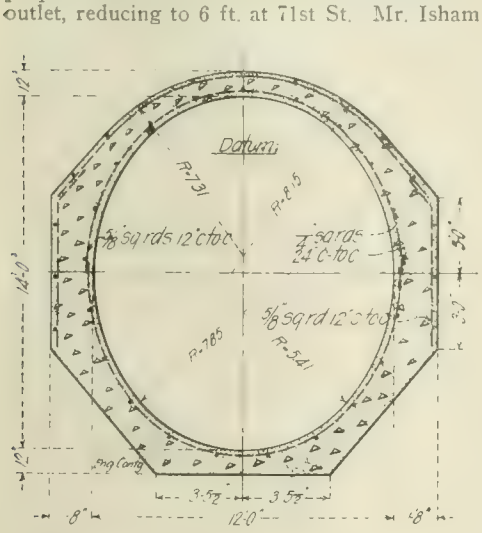

Fig. 2.—Section of 39th St. Sewer.

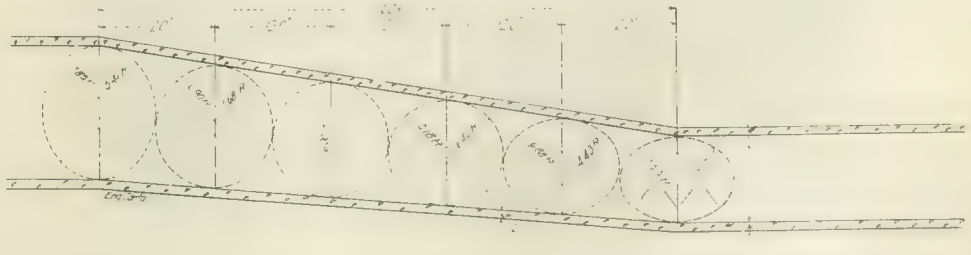

Fig. 3.—Half Longitudinal Section of Siphon Under Illinois & Michigan Canal.

building the main sewer presents some interesting features. The work was started from the siphon and carried south. At 35th St. the shovel has been 64 lin. ft. of excavation. This section averages 7¼ cu. yds. of clay per lineal foot. All back fill is taken directly

Fig. 4.— View Showing Derrick and Mixer Mounted on Same Platform.

considerable rock was encountered and some blasting had to be done. A steam drill was used and the loose rock was taken out in a skip handled with the derrick, shown by Fig. 4. This derrick is interesting for the fact that the same platform carries the concrete mixer used in placing the cement and both were furnished with steam from the same boiler.

The feature of the entire construction, however, is the use of a steam shovel in digging the trench. The trench is 16 ft. wide and about 26 ft. deep. A 7-ton Bucyrus shovel is mounted on rollers and straddles the ditch as shown by Fig. 5. To dig the required depth a 56 ft. dipper arm is used. In beginning the work, the excavation 9 ft. in depth was first taken out and the ditch was sheeted the entire length. The shovel was then backed up and proceeded to take out the balance of the cut. The sheeting consists of 2-in. plank with 4x10-in. stringers braced apart by 8x8-in. timbers fitted at one end with screw jacks. These braces are placed about 8 ft. apart. It will be seen that with these braces in the trench every 8 ft. it would be impossible for the steam shovel to work the second cut. To make this possible a frame is used. This frame is made of four 12-in. I-beams, two on each side of the trench, braced apart by two 8x8-in. timbers placed one at each end of the I-beams. The beams are 50 ft. long and the braces are fastened to them so that the entire frame can be picked up and carried ahead with the shovel. When the frame is set in the ditch it supports the sheeting against the

Fig. 5.—View Showing Steam Shovel and Machinery for Excavating 26-ft. Trench.

banks, and all other braces are temporarily removed leaving an open space in which the dipper can work. The best day's work for

from the shovel by the dump cars to the point of backfilling and dumped there. The shovel is operated by 3 men and is followed up by a gang of from 6 to 12 men (according to difficulties encountered) working under a foreman in the bottom, and 4 men on top. These men in the bottom trim the cut with grub-hoes to a templet placed by the engineer and replace all timbering and bracing, taken out to accommodate the shovel. They also look after all work of moving the shovel, and set the forms for the concrete as soon as the bottom part of the invert is laid.

The forms for concrete consist of 2x8-in. lagging held in place by ribs made of 6 in. channels, bent to fit the elipse. Altogether 320 ft. of forms are used. This amount is sufficient to allow the forms to remain in place the required 5 days and at the rate of maximum progress of 40 ft. a day allows plenty of forms for resetting. Two Chicago mixers, mounted in the same manner as the shovel in Figs. 4 and 6, are employed for the concrete work. One mixer, Fig. 4, follows directly behind the shovel and mixes and delivers the concrete to place in the lower half section of the sewer. The other mixer, Fig. 6, follows the first one, and, after the forms for the upper half section have been placed, delivers the concrete through a chute for this section.

The chutes are made in sections which consist of 10-in. diam. galvanized iron pipes, 3 ft. long and tapered ½ in. at one end to fit into the next section. They are fastened together by means of hooks riveted to the small end of one section and rings fastened to the large end of the next section. At the beginning of the work 8-in. pipes were tried as chutes but were replaced by 10-in. pipes on account of trouble caused by clogging.

Fig. 6.—View Showing Mixer and Mounting for Concreting Arch of Sewer.

One gang of men operates the two mixers and they are run alternately, first on the invert and then on the arch. This allows time for placing the arch forms and by the use of two machines, saves moving backward. The number of men in the concrete gang is about 20; fourteen men wheel the material from the street, two are on the platform to handle water and cement, one man at the chute and two dump men, and an engineer.

The walls of the sewer are 16 ins. thick and contain no reinforcement. The cubical contents is 2.2 cu. yds. to the lineal foot.

All labor employed is union labor and the working force on the main sewer consists of 60 men divided about as follows:

Shovel crew	3 men
Excavation	16 men
Rock filling	10 men
Concrete mixers	20 men
Derby engineers and laborers	6 men
Handling forms and sheeting	5 men

The force at work on the siphon consists of 22 men; also 20 men are employed on the dump in McKinley Park. This force, with the superintendent and office men consists of an average of 110 men.

The contract price for the concrete sewer is $28 per lin. ft. The siphon work is let at $60 per lin. ft. The contract calls for the completion of the work by Dec. 1, 1910.

It may be interesting to note in conclusion some facts regarding the operation of the new sewer by the Sanitary District. At present

the pumping station at the foot of 39th St. is diluting all sewage and is diverting it from the lake through a conduit on 39th St. to that branch of the Chicago River known as the stock yards slip. See Fig. 1. When the new sewer is completed the amount of lake water pumped in with the sewage will be increased to 1,000 ft. per second. The increased head caused by this amount of water will cause about 175 to 200 cu. ft. of water to pass through Bubbly Creek and into the sewer. This amount of flow will change the water in Bubbly Creek once in 16 to 18 hours. The condition of this place has been bad for so long that the accomplishment of a sanitary condition will be a great relief to that section of the city.

The Los Angeles Aqueduct: Structural Details, Economic Studies, Working Organization, and Service Constructions.

STRUCTURAL DETAILS.

The Los Angeles Aqueduct comprises six storage reservoirs and 217 miles of conduit. The capacity of the conduit is 430 second feet and the aggregate capacity of the six reservoirs is 638,893 acre feet. The purpose of the work is to collect and store the waters of the Owens River water shed in the Cascade Mountains and to convey this water to the head of the San Fernando valley near Los Angeles for distribution for irrigation and domestic purposes. The work itself is notable because of its size and its variety of conduit construction and because it is being carried out entirely by day labor. This article is an outline of the development and character of the work and of its management.

Reservoir System.—Gagings of the streams of the Owens River water shed show that a continuous flow of 400 second feet, or 20,000 miners inches, is available. This is closely 260,000,000 gals. per 24 hours. This flow is not regular; there are years when it greatly exceeds the figure named and other years when it drops considerably below it. Neither is the flow regular throughout any year, there being a wide range between maximum and minimum monthly flow. To secure the maximum available supply then requires that the flow be regulated by storing the excess flow of certain periods to make up for the deficient flow of other periods. Two storage reservoirs were planned, one to furnish yearly regulation and another to furnish monthly regulation.

Yearly regulation is provided for by a reservoir in Long Valley near the headwaters of the Owners River. This reservoir will impound the excess discharge of years of excessive flow and hold it for years of deficient flow. With a dam 140 ft. high the capacity of Long Valley Reservoir is 260,000 acre feet. By adding 10 ft. to the height of the dam an additional storage capacity is had of 44,980 acre feet. In years of deficient flow the water in this reservoir will be fed into the Owens River in such quantities as may be necessary to maintain the required average yearly flow.

To regulate monthly variation in flow a second reservoir known as the Haiwee Reservoir will be constructed at a point about 60 miles below the conduit intake from the Owens River. The location of this reservoir is shown on the profile Fig. 1. The Haiwee Reservoir will have two dams, one at the upper end and one at the lower end of the long narrow valley which it occupies. With a lower dam 80 ft. high its capacity will be 63,800 acre feet. The continuous draft from this reservoir will be 430 second feet and 63,800 acre feet will supply this draft without receiving any inflow for 2½ months.

The two reservoirs described are all that are required for the regulation of the flow from the Owens River water shed, that is, they will assure the continuous delivery of 400 second feet of water through the conduits regardless of monthly and yearly variations in supply. To regulate the distribution of this conduit flow, however, distributing reservoirs are essential, and two are provided, known as San Fernando Reservoir, Numbers 1 and 2. The capacities of these reservoirs are, respectively, 15,900 acre feet and 21,050 acre feet, or a total of 36,950 acre feet. This is sufficient to supply 100 gals. per capita per day for four months to a population of 1,000,000. The function of these reservoirs is nominally to regulate the difference between supply and consumption. The supply to the reservoirs is constantly 400 second feet; the consumption is in excess of this in summer and less than this in winter. They also insure an adequate supply of water should the flow through the aqueduct be for any reason cut off.

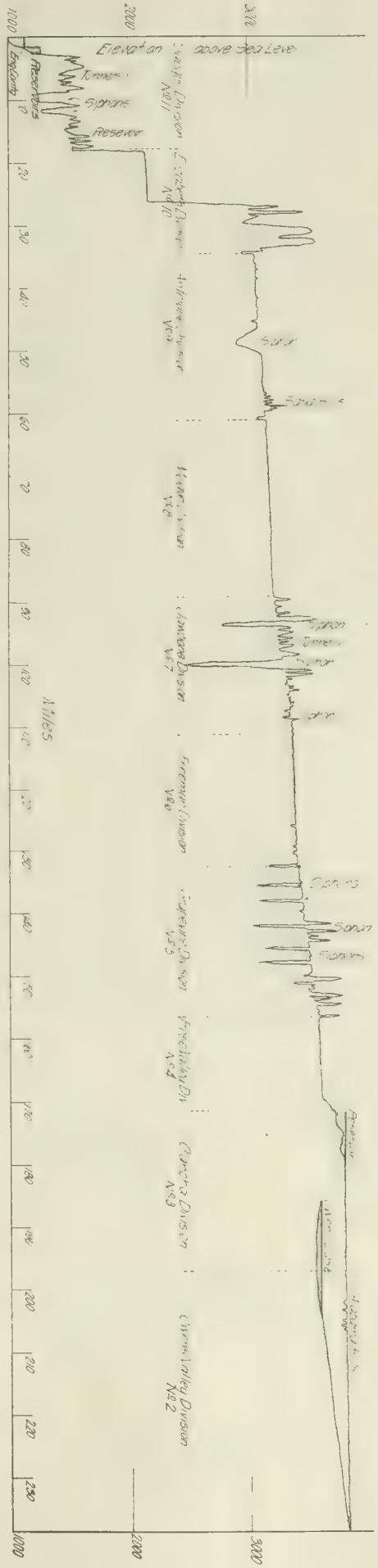

Fig. 1.—Profile of Los Angeles Aqueduct.

The Long Valley, Haiwee and San Fernando reservoirs are sufficient for water supply proper. As will be noted from the profile Fig 1, there are, however, two other reservoirs. These are introduced solely for the subsidiary purpose of power development, which is being worked out in conjunction with the work of water supply. Referring to the profile Fig. 1 it will be seen that there is a sharp fall in the line beginning at about Mile 25. It is in this drop that the main head is available for water power. The conduit from the Haiwee Reservoir has a capacity of 430 second feet; the consumption for power purposes will vary from 80 second feet to 1,000 second feet. By placing a reservoir at the head of the power conduit line and another at its lower end it will be seen that the uniform flow of 430 second feet can be changed to variable flow through the power conduit, and this variable flow changed again to uniform flow below the second reservoir.

The reservoir located at the head of the power conduit is the Fairmont Reservoir and, with a dam 105 ft. high, has a capacity of 7,620 acre feet. The power conduit extends from the south portal of the Elizabeth Tunnel to a power house in San Francisquito Canyon. The gross drop of head is 890 ft. From the tail race of this first power house the power conduit will extend to a second power house, with a net drop of head of 578 ft., and from the second power house tail race the conduit will reach to Dry Canyon Reservoir, having a capacity of 1,325 acre feet, with a dam 55 ft. high. The power conduit from Fairmount Reservoir to Dry Canyon Reservoir will have a capacity of 1,000 second feet.

The preceding description explains the nature and purpose of the several reservoirs. Their construction will necessitate the construction of seven dams. Table I. shows the dimensions of these dams and summarizes other facts concerning the reservoirs. All the dams, with the possible exception of that at Long Valley Reservoir, will be hydraulic fill dams with masonry core walls.

Conduit Line.—The conduit line may be divided into: (1) diversion conduit, (2) main conduit, and, (3) power conduit. Each division is composed of varying lengths of the following types of aqueduct: (1) unlined open canal, (2) lined open canal, (3) lined and covered canal, (4) tunnel, (5) inverted siphons and (6) flumes. The total lengths of aqueduct of the several types are as follows:

Kinds.	Feet.	Miles.
Unlined canal	111,200	21.08
Lined canal	[illegible]	152.25
Rock tunnels	91,019	17.24
Earth tunnels	58,508	11.08
Siphons	74,847	14.19
Flumes	9,050	1.72
Total	[illegible]	217.56

Taking up first the main divisions of conduits, we have first the diversion conduit from the intake in Owens River to the Haiwee Reservoir. This conduit is virtually a new channel for Owens River, and it has a capacity of 800 second feet at the intake and gradually increases to a capacity of 900 second feet at the reservoir, this increase being provided to accommodate the water coming from tributary streams below the intake. In construction the channel will be unlined canal for approximately 21 miles and of lined canal for the remainder of the 60 miles of length.

The sections at various points are shown by the drawings of Fig. 2 The construction quantities per lineal foot of canal for the various sections shown are:

Section.	Excavation. Cu. yds.	Concrete. Cu. yds.
Intake to Alabama Hills.....	14.81	....
Ala. Hills to Cottonwood Creek.	10.31	1.02
Cottonwood to Haiwee	11.28	1.07
Alabama Hills	9.58	0.77

The main conduit extends from Haiwee Reservoir to Fairmont Reservoir, 138.15 miles, and from Dry Canyon Reservoir to San Fernando Reservoir No. 1, 11⅞ miles. The break from Fairmont Reservoir to Dry Canyon Reservoir, a distance of 19.2 miles, is called power conduit, as it is an essential part of the power development as previously stated.

The various structural sections adopted for main conduits are shown on Figs. 3, 4 and 5. It will be seen that in addition to divisions of the main conduit type, as tunnel, canal, etc., further subdivision was made into sizes. The capacity is in all cases 430 second feet and the relative size of each type is controlled by the gradient or fall it will have. These sections were designed in the office of the chief engineer and the estimated cost for each type for varying conditions of typography and soil was determined by the chief engineer. Flume and siphon construction are not shown on Figs. 3, 4 and 5; they may be described as follows:

Siphons will be U-shaped pressure pipe which will carry water across canyons or valleys wherever they prove to be more economical than it would be to build a canal following the contour around the depression. They will be rivetted steel pipe with a minimum thickness of ¼-in. and a maximum thickness of 1 in. Altogether there will be 74,847 lin. ft. of siphons on the aqueduct.

Flumes are located over shallow depressions where the maximum depth is not more than 30 to 40 ft. Most of them will be fabricated from steel plates and angles arranged to form an effective canal section, and at the same time to be a self-supporting girder bridge. Where the cost of forms does not run too high reinforced concrete will be substituted for steel.

ECONOMIC GRADIENT AND CROSS SECTION STUDIES.

The controlling elevations of the aqueduct, as will be seen from the profile Fig. 1, are: (1) Black Rock Springs, fixing the intake in the Owens River at an elevation of 3,814.8; (2) Haiwee Reservoir, at an elevation of 3,760, to insure sufficient capacity for seasonal regulation; (3) Fairmont Reservoir, at an elevation of 3,035; (4) San Fernando Reservoirs. For the 60 miles of diversion channel there is, therefore, a fall of 54.8 ft., which gives an average gradient of 0.91 ft. per mile or 0.173 ft. per 1,000 ft. This gradient is rigidly fixed by nature. The conduit was given a grade of 1 ft. per mile from the intake to the south end of the Alabama Hills, and a grade of 0.15 ft. per 1,000 ft. for the remaining distance.

For the remainder of the conduit careful studies were made to determine economic gradients and cross-sections. It is evident, since the aqueduct passes through all kinds of country and includes various types of conduits, that it would not be good engineering to use the same gradient for the entire length. There is evidently some distribution of gradients required for the different types of conduit and the various kinds of material encountered which will make the combined cost for the total distance a minimum. To determine these gradients unite construction costs were estimated for each type of construction for various grades. It is evident that the steeper the grade the smaller and hence cheaper the conduit

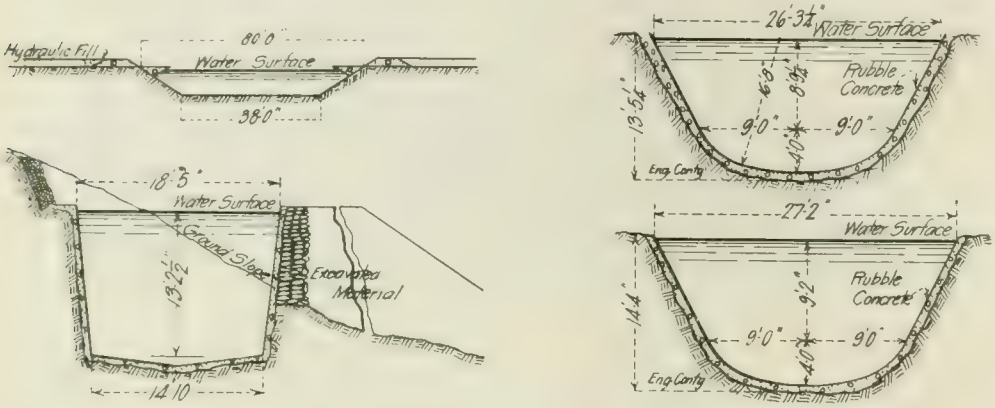

Fig. 2.—Sections of Los Angeles Aqueduct from Intake to Haiwee Reservoir.

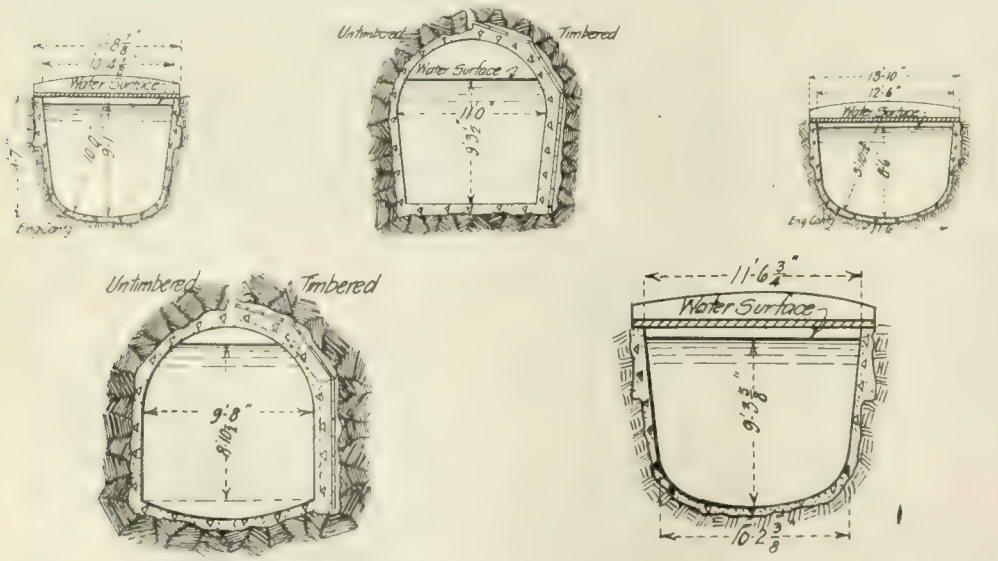

Fig. 3.—Sections of Los Angeles Aqueduct on Antelope, Mojave and Sagus Divisions.

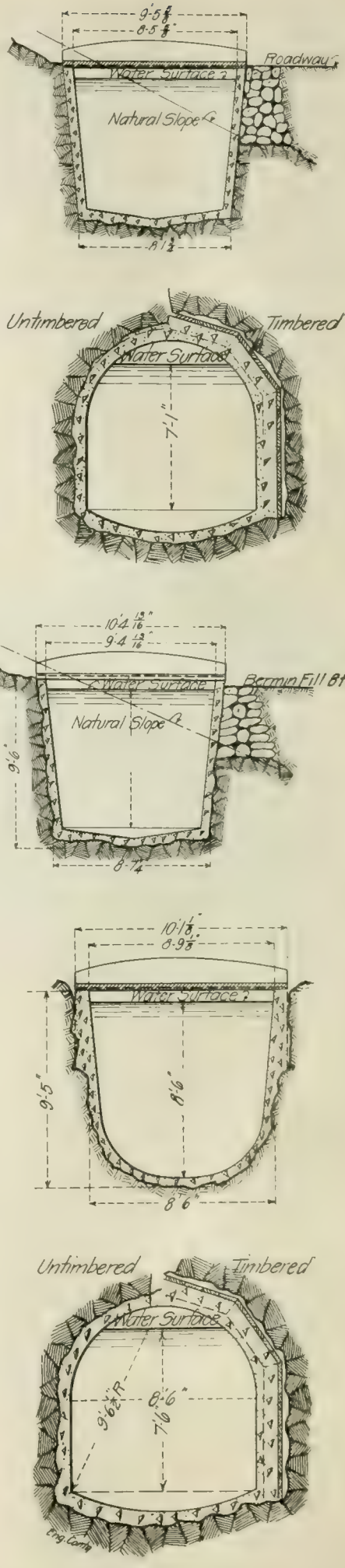

Fig. 4.—Sections of Los Angeles Aqueduct on Jawbone Division.

section. The assumed slope multiplied by the total length of each section gives the total head or fall, and the unit cost multiplied by the length gives the total cost. These data for each section were platted as curves, designated as gross cost curves. The more

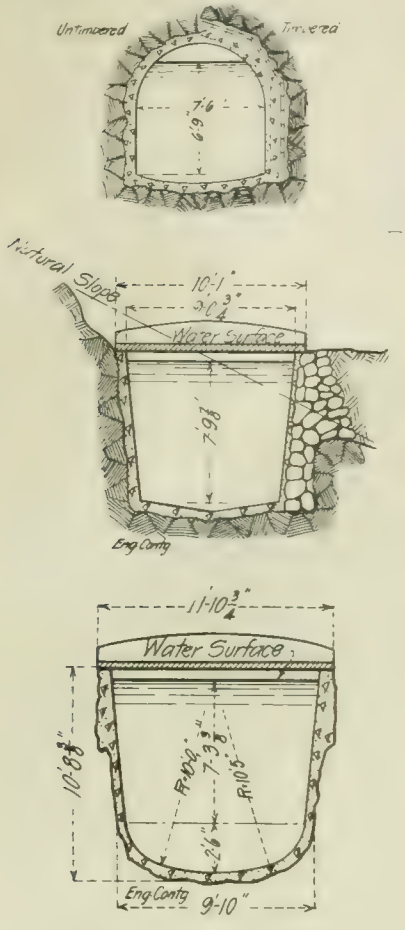

Fig. 5.—Sections of Los Angeles Aqueduct on Rose Valley, Grapevine and Freeman Divisions.

head that is consumed in any gradient for any given section, the higher in elevation the portion of the line above must be located. Where these upper portions are situated on steep hills, there will be a corresponding increase in construction cost, due to the increased cost of hoisting materials. In addition a raise in grade elevation may increase the pressure head on all siphons above the portion of line in question. These charges were computed and added to the gross cost curves, giving net cost curves, showing the relation between total head and total cost for each section of aqueduct. The diagram Fig.

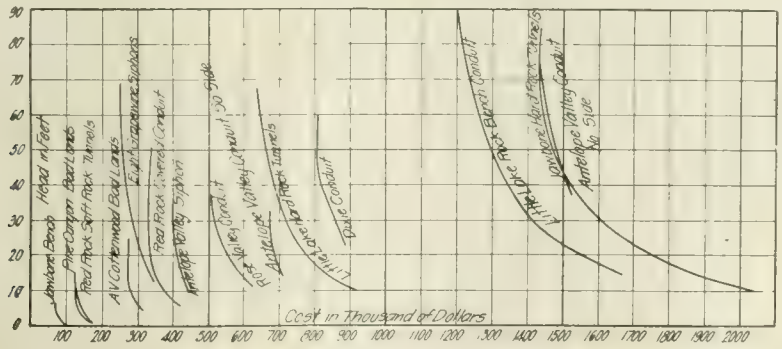
Head in Feet
Cost in Thousand of Dollars
Antelope Valley Conduit
Grapevine Valley Conduit
Pine Canon Conduit
Fred Finch Siphon
Fred Finch Tunnels
Fred Finch Open Conduit
Antelope Valley Siphon
Antelope Valley Tunnels
Antelope Valley Conduit
Pine Canon Tunnels
Grapevine Siphons
Grapevine Tunnels
Grapevine Conduit
Pine Conduit
Antelope Valley Conduit
Antelope Valley Conduit
Limited Bench
Pine Canon Boat Lines
Fred Finch Open Conduit
Fred Finch Siphon
Fred Finch Tunnels
Antelope Valley Conduit
Antelope Valley Conduit
Antelope Valley Conduit
Grapevine Siphons
Grapevine Tunnels
Grapevine Conduit
Pine Conduit
Antelope Valley Conduit
Antelope Valley Conduit
Antelope Valley

TABLE I.—DAM DIMENSIONS AND RESERVOIR CAPACITIES, LOS ANGELES, AQUEDUCT.

Name	Height in ft.	Length in crest of dam ft.	Volume of dam cu. yds.	Depth of water ft.	Capacity acre ft.
Long Valley	140	520	760,000	150	340,980
Upper Haiwee	..	1,820	148,130	80	63,800
Lower Haiwee	80	1,210	521,879		
Fairmont	105	1,516	723,862	105	7,620
Dry Canyon	55	604	178,000	55	1,325
Fernando No. 1	115	4,530	2,423,741	115	15,900
Fernando No. 2	125	2,105	1,583,222	125	21,050

work. The cost reports that are being furnished at the present time consist of a "Ten Day Cost and Progress Report" and a "Monthly Cost and Progress Report," which are similar as to form. As the title of the former report would indicate, it is rendered at the close of the tenth, twentieth and last days of each month. Engineers are expected to forward their report promptly at the close of each period; and in the interests of promptness, they are permitted to sacrifice a certain amount of accuracy; but the monthly report, which is a summary of the ten-day reports, must be prepared accurately. One of each of these reports is required for each engineer's work order upon which work is being prosecuted. These reports are transmitted by the engineer in immediate charge of the work to the chief engineer through the office of the division engineer. They are filed for reference in the chief engineer's office; and upon the completion of the engineer's work order, a detailed statement of the cost is prepared and furnished to all engineers interested. At the end of each month a total monthly cost and progress report is prepared in the office of the chief engineer and forwarded to the Board of Public Works, showing the total cost and progress of all work orders under construction during the month.

Housing Employes and Live Stock.—To house the several thousand persons employed on the work and to shelter stock and tools there are required some 500 buildings. These buildings include lodgings, dwellings, offices, mess houses, hospitals, warehouses, shops, etc., and are both of fixed and portable construction.

The climate along by the aqueduct varies from the intense summer heat of the desert, when the thermometer reaches 110°, to a temperature of 10° and 20° above zero in winter. The effort was made to make the lodgings comfortable in both summer and winter as far as consistent with proper economy. The bunk houses for the laborers are made to accommodate two men to the room. Each room has an outside window. The cost of these buildings is about $25 for each man housed. Four-room dwellings are erected for the division engineers, who pay a monthly rent sufficient to return the investment. These dwellings each cost from $600 to $900, depending upon the location and the cost of hauling the material. A building which will cost $600 in Los Angeles will cost $800 erected at South Portal or Grapevine, on account of the long wagon haul.

Medical Service.—Besides housing the several thousand employes, medical and surgical attendance is provided, for which the men are taxed $1 per month for those receiving $40 per month and 50 cts. per month for those receiving less. Except for certain diseases the men get free medical service. A camp or tent hospital is provided at every camp, a field or division hospital at each division headquarters and a general hospital at Los Angeles. The medical corps also oversees sanitation of camps, etc.

SERVICE LINES AND POWER.

The length of the conduit and its out-of-the-way location made necessary the provision of transportation lines, telephone communication, water supply and power plants. These various services are briefly described as follows:

Transportation.—The economical transportation of materials necessary for the construction of the aqueduct, from a financial standpoint and next to the actual consideration of engineering difficulties, forms one of the most important factors of the undertaking.

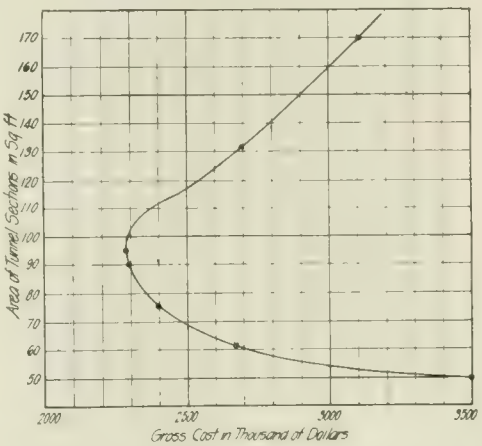

Fig. 8.—Diagram Showing for Elizabeth Tunnel Variation of Gross Cost With Areas of Cross Section.

The aqueduct, throughout the major portion of its length, traverses the most arid part of Southern California. The country is sparsely settled and, until this time, has been unable to offer substantial inducements to common carriers.

It being apparent that methods other than ordinary wagon haul must be adopted for the conveyance and prompt delivery of material and supplies, estimates were made by the engineers of the Los Angeles aqueduct for both narrow and broad gage railroad lines, practically paralleling the proposed conduit location from the south side of Antelope Valley to within 10 miles of the intake on the Owens River, on the basis of hauling 287,500 tons of through and 1,500,000 tons of local freight, together with such traffic as might accrue from contiguous territory. It was shown by these estimates that, in the event of no satisfactory bids being received for the construction of such railroad, the aqueduct could construct and maintain such a line, salvaging all track and operating material at the end of five years, and still reduce transportation charges from 25 cents, an average cost of desert haul, to less than 10 cents per ton mile. With this possible end in view, surveys were made from Antelope Valley to the proposed upper terminus in the Owens Valley.

California & Nevada Railway.—Advertisement for bids for the transportation of approximately 320,000 tons of freight from Mojave, north to various stated points adjacent to the proposed aqueduct location, was made by the Board of Public Works, April 2, 1908. The accompanying specifications provided for the construction and operation of a standard gage steam railroad along a certain defined route, and established a definite time of completion. A contract was made on the 22nd day of the same month with the Southern Pacific Co., agreeing to such conditions, and specifying a distance tariff on all tonnage according to the western classification. This road is called the California & Nevada Ry.

For the purpose of serving the south end of the Freeman Division and Section 1 of the Jawbone Division a spur line was constructed.

Prior to the completion of the California & Nevada Ry., all materials necessary for the preliminary construction and commissary supplies were transported by wagon haul from the Mojave warehouse north to the various camps. These materials included all lumber for bridges and buildings, pipe and fittings for water supply; cement, tools and powder for the building of roads and trails; wire, poles and hardware for both telephone and transmission lines; and all supplies necessary for the subsistence of from 200 to 1,000 men. With such volume of freight it was found both economical and expedient to advertise for bids for wagon transportation on the basis of main and branch road haul, the former item to embrace haul on the stage road from Mojave north, and the latter to apply to haulage from such main road over all branches feasible for travel with well-broken freight teams. A contract was entered into Dec. 30, 1907, specifying a net price of 28 cts. for main road and 30 cts. for branch road haul per ton mile. This contract called for the distribution of approximately 1,000 tons of freight. A contract was also made Dec. 11, 1907, for a number of freighting outfits, the same being compensated for at certain prices for six, eight and ten-animal teams. A further contract, dated Sept. 18, 1908, has been made for the hauling and loading of gravel and other material. This contract was designed chiefly for the transportation of cement and gravel on the Mojave Division.

In the effort to reduce the cost of wagon haul below that of ordinary team transportation, trials have been made of traction engines of various design. It was found that the familiar types of engines, with comparatively narrow wheel treads, were useless in the deep dust and sand of desert roads. A special type, however, called the "Caterpillar" or "Paddlewheel" engine—so designated from the peculiar construction of its rear and propelling wheels—has been placed in service with good results.

This engine, instead of having the large hind wheel commonly known, carries its weight on five truck wheels which run on a track of plow steel, so protected that it is nearly impossible for sand to reach the bearings. The hind wheels are of the sprocket type and engage an endless belt of "shoes" or "platforms" which pass around the sprocket and center wheels, 78 ins. distant, the latter acting as idlers. These platform wheels have the same tractive area as an ordinary round wheel, 54 ft. in diameter.

While manufactured for either steam or gasoline power, the latter has been found best adapted for use on the aqueduct. The motor used is of the four-cylinder, vertical, water cooled type, with 6x8-in. cylinders, developing 40 brake h. p. at 550 R. p. m. Distillate is used for fuel at a cost of less than 1 ct. per h. p. hour.

The capacity of these engines naturally varies with the grade. Loads of from 15 to 20 tons are possible on level roads. Specially built trucks capable of carrying from 6 to 10 tons are used. Compressors, transformers and other heavy machinery, weighing from 7 to 10 tons, are easily transported over grades of loose sand ranging from 12 to 20 per cent,

TABLE II.—SHOWING FRICTION HEADS AND ECONOMIC SLOPES FOR VARIOUS TYPES OF CONDUIT, LOS ANGELES AQUEDUCT.

Section.	Length in Feet.	Friction Heads.	Economic Slope.	Entry Head.
A. V. Conduit (South Side)	71,000	71.85	.0012	1
A. V. Siphon	20,000	20.00	.001	1
A. V. Cottonwood Bad Lands	24,000	12.00	.0005	1
Cottonwood Siphon	3,300	6.6	.002	1.6
A. V. Conduit (North Side)	187,000	64.75	.00035	1
Pine Canyon Bad Lands	8,000	8.00	.001	1
Pine Canyon Siphon	3,300	6.6	.002	0.8
Jawbone Hard Rock Tunnels	15,000	58.5	.0013	1
Jawbone Small Siphon	1,000	2.0	.002	
Jawbone Siphon	6,300	30.4	Compd.	
Jawbone Bench Conduit	5,000	4.0	.0008	
Red Rock Soft Rock Tunnels	7,810	7.81	.001	1
Red Rock Siphon	1,000	2.0	.002	
Red Rock Covered Conduit	10,000	16.0	.0004	2
Dixie Covered Conduit	109,000	43.6	.0004	2
Little Lake Rock Bench	93,000	83.7	.0009	8
Eight Grapevine Siphons	12,400	31.00	.0025	1
Little Lake Hard Rock Tunnels	22,600	45.20	.002	
Rose Valley Covered Conduit	70,600	28.24	.0004	
Total	728,310	495.25		24.40

and around the sharp curves of mountain roads. Ordinary wagon transportation of such loads under like conditions would be an impossibility.

Accurate cost data has been kept of the performance of these machines, together with team haul, for the purpose of comparison. Recent work in the Jawbone and Mojave section shows an average ton mile cost of 20 cts. for engine haul, against an average of from 40 cts. to 50 cts. for team transportation.

Water Supply.—Water supply for camp and construction purposes has been developed from streams, springs and wells as sources by installing pumps and reservoirs and pipe lines extending along the work.

Telephone Line.—The main telephone line extends from Los Angeles to the intake of the aqueduct and is 240 miles along, not including several branches. For some 22 miles the poles are rented, but for the remainder of the distance the standard construction consists of two No. 10 bare copper wires, supported on oak brackets on 4x6x18-ft. redwood poles spaced 160 ft. These poles are from the butt cuts of selected redwood. The estimated cost for the first 22 miles was $95 per mile and the actual cost $101 per mile. The average estimated cost for the various sections of the remaining 208 miles was $232 and the actual cost $188, which includes estimates, plans, location and supervision. Western Electric Co. five-bar, 2,500-ohm long distance telephone sets and protectors are used and cost about $16.50 for each complete installation.

Power Development.—Preliminary estimates and study showed that, for those sections in which the work is heavy and the power requirements considerable, electrical energy could be generated at certain central points and delivered at the work at a lower cost and with more satisfactory results than could be realized by the distribution of the necessary generating machinery and fuel along the line. It was further shown that hydro-electric power could be developed along the Division Creek and the Cottonwood Creek and delivered to all points from the intake in the Owens Valley to the south end of the Jawbone Section, giving reliable power at from one-quarter to one-third less cost than it could be furnished in any other way. In each case, interest on the investment and total depreciation of the systems, with the exception of a reasonable return from the machinery and copper were included in the costs.

The power systems determined upon, and which are either completed or the necessary machinery and materials contracted for, consist of three hydro-electric plants and 188 miles of 33,000-volt transmission lines, with 20 transformer stations, some of which are portable. The generating plants are Division Creek No. 1, Division Creek No. 2 and Cottonwood Creek, with a total continuous capacity of 2,600 k. w. at the switchboard and which can be expected to deliver under actual conditions of operation and of load, an amount equivalent to 2,100 k. w. continuously or for 24 hours per day through the year. These plants will furnish power at all points from the intake to the Pinto Hills, or south end of the Jawbone Division, which district is covered by 146 miles of main transmission line and 6 miles of branch lines in the Jawbone Tunnel Section. The remaining 36 miles of transmission is near Saugus, reaching all points from the south portal of the Fernando Tunnel to the north portal of the Elizabeth Tunnel and connecting from the Castac substation of the Edison Electric Company, from which company power is purchased for this part of the work.

Approximately 26 miles of the 36 miles of 33,000-volt, 3-phase transmission line near Saugus was completed Aug. 1, 1908, reaching the portals of the Elizabeth Tunnel. This line is built of 30-ft. cedar poles, an average distance of 200 ft. apart, one 6-ft. and one 15-in. cross-arm per pole, supporting three number 4 solid copper wires on 7-in. two-part porcelain insulators. The estimated cost of this line was $881 per mile, and though the line was built in bad weather during February and March, the actual cost was kept within the estimate, or $868 per mile. This cost includes all engineering, location and brushing.

For the main line, 106½ miles south from Cottonwood, and 6 miles of branch line in the Jawbone Division, the construction is the same as for the lines near Saugus, except that because of the excessive haulage cost and the temporary character of the line a special 28-ft. pole, built up of lumber and spaced 175 ft. is used. The estimated cost was $994 per mile and the actual cost $795. This line was built in good weather by energetic line foremen and good men. The cost includes all location and supervision.

Conclusion.—The foregoing is an account of the structural features of the Los Angeles Aqueduct and of the plans and service constructions that have been developed for prosecuting the work. Methods of construction and costs will be given for typical classes of work in future issues as material develops. As an example we give in this issue a description of the methods and cost of lining a section of covered conduit, using a special collapsible form. Similar costs and methods of particular pieces of work will be published from time to time. The work as described is being done under the direction of William Mulholland as chief engineer and J. B. Lippincott as assistant chief engineer by day labor. Over 6,000 men are employed, and the pay roll is some $300,000 per month.

Method of Stream Gaging by Use of Rod Floats with an Outline of the Reductions.*

The example given is that of gaging the French Broad River, near Asheville, N. C., in November, 1896. The place chosen was a fairly straight section of the river, and reasonably free from the influence of obstructions. This being a mountain stream of small depth and steep slope, a place was chosen where the water was deep and the local slope light. At that stage, which was considerably above low water, the river had a surface width of about 350 ft. A base line 200 ft. in length was laid off on the right bank as near to the water and as nearly parallel to the main thread of the stream as practicable. Three sections or ranges were laid off at right angles to the base line at either end and from middle point, and were marked by range flags on either shore. The sections were sounded with a 12-ft. pole shod at lower end and graduated to feet and tenths from a boat rowed slowly across the stream and against the current, upon the marked range. The soundings were taken as nearly as possible at equal intervals and were located in the following manner: With transit set at intersection of base line and range, and with stadia rod held in boat abreast of sounder, the stadia distance was read off direct. In lieu of a stadia, a level rod might have been used for this distance, but either should be inverted in order that one wire of the instrument might be kept at the zero point of the rod. Not much practice is required to catch distances at a glance with a considerable degree of accuracy. With a recorder at the instrument, every sounding may be located, but with a reasonably regular bottom the location of every alternate sounding will suffice.

Rod floats, 1 ft. to 5 ft., had previously been prepared and adjusted to differ in submerged length by 6 ins., having each a freeboard of about 2 ins. The rods were of white pine 1½ ins. in diameter, and were weighted by lead pipe of some external diameter fitted at the lower end. Final adjustment for submersion of rod was made with shot held in the lower end of the pipe with a plug. The rods were fitted with a staff of No. 10 wire, some of 8 ins. long, carrying a flag some 6 ins. square, by means of which the rod could be kept in view. Any light material or a section of tin pipe might be used for a float, and it might be ballasted with an iron bolt. Whether its length is an even unit or if it projects a considerable distance above the water is immaterial, so long as it is not affected by the wind. It is not necessary to have so many rods, or that they float so near the bottom of the stream, so long as we have the data for reducing from rod velocity to mean velocity, through wide variations. The writer has gaged a stream of 800 ft. in width and from 3 to 15 ft. in depth, with only four lengths of floats.

In the French Broad gaging in question the rods were run across the ranges about every 30 ft., or as near that spacing as it was convenient to place them without undue delay. From inspection of sections the longest rod was started in each case, which it was presumed would float without touching the bottom. If a particular rod struck bottom the flag announced that fact, the observation was canceled and a shorter rod started. With transit on base line at upper section and with stadia rod held in boat as for sounding, the boat was placed in the approximate thread of the stream some 15 to 20 ft. above the range. The float was dropped from stern of boat and started on its trip. The second of crossing the upper range line was noted and recorded. The stadia distance to the boat, which was made to follow the road only as far as this range, was then noted. An assistant preceded the rod to the lower range, 200 ft. away. As it approached that range he called out "stand by," and at the instant of crossing he called "mark," the time being noted and recorded. The rod being followed by the transit, its angular position with reference to the base line at the instant of crossing the lower range was determined. At the signal from the shore the rod was picked up by the boat and returned to its starting line. To facilitate the recovering of the rod a light linen or silk line was made fast to its upper end and paid out freely from the boat, which was kept well above and to one side of the rod during its run.

All of the notes of this survey not given in the first six columns of Table I are shown graphically upon the accompanying diagram. The basis of the diagram is a plan of the base line and the ranges, with the water lines of the river. With the range lines as water surface lines, cross sections of the river were constructed from the sounding noted. Sections of the river at upper, middle and lower ranges are shown by the polygons *U u u U'*, *M m m M'* and *L l l L'*, respectively, in light full lines. The paths of the twelve floats were platted from notes in columns 3 and 4 of Table I. It will be noticed that all of the floats in this particular case inclined more or less toward the base line, showing that line not to have been located parallel to the average thread of the current. This or any reasonable inclination of float paths does not affect the accuracy of the results obtained, since the increased distance run is inversely proportioned to decreased perpendicular distance between their paths. The depths of the stream, perpendicularly below the intersection of each path with the range lines, are then scaled, and a fourth cross section is constructed on the middle range, from depths which are the weighted means of the depths of the three intersections. This mean depth is taken as ¼ the sum of the upper depth, the lower depth and twice the middle depth. This mean section is shown by the polygon *M 3M 7M 11M M'*, in a dashed line thus: — — — — —, and these depths are entered in column 9 of table. The time of passage of floats over this 200-ft. stretch of river is then deducted from the difference between columns 5 and 6 of table and entered in column 7. The velocity of float in feet per second is then computed and entered in column 8.

This brings us to a consideration of the reduction from the velocity of the rod as run to the mean velocity of that thread of the stream from the surface to the bottom. The accompanying formula for such reduction is that

*Extract from a paper by Geo. W. Brown in the "Wisconsin Engineer" for April, 1910

given by Mr. Francis in his Lowell Hydraulic Experiments:

$V_m = V_r\ [1 - 0.116\ (\sqrt{D} - 0.10)]$, in which

V_m = mean velocity for full depth,
V_r = observed velocity of rod float, and
D = depth of stream below bottom of rod / depth of stream,

D = The percentage of the depth of the stream which is below the bottom of the rod.

The above formula is strictly true when the bottom of the rod is approximately 5 per cent above the bottom of the stream, and should not be used without modifications when it is more than 10 per cent above the bottom. The writer has made experiments to determine what modifications could be used in such cases. In a stream 12 ft. in depth, five rod floats ranging from 7 to 11 ft. in length were dropped into the same thread of water from a boat anchored in the stream at a point above the upper range and some two or three seconds apart. The passage of these rods across the ranges was noted and recorded. The rods were picked up by a second boat, returned to the starting point, and were run over and over again, in order to eliminate local effects as far as possible and to secure a mean velocity for the thread of the stream. The mean of the several observed velocities for each float was taken as the mean velocity of the stream for the depth to which the float extended. Such a modification of the Francis formula was required that the mean velocity for the full depth might be determined from the mean velocity of the shorter floats. It was found that within the range in question—that is, when the distance below the bottom of the rod was no more than one-third of the depth of the stream—the value of V_m would be given with a great degree of accuracy by substituting a variable for the quantity ".10" in the last term of the formula. This term was found to increase algebraically about one per cent for every one per cent increase in the value of D. With the term "-.10" correct then D equals 5 per cent, the terms within the parenthesis will vary as follows:

$\sqrt{.05} - .10$; $\sqrt{.10}$ 0.05; $\sqrt{.15} - 0.00$; $\sqrt{.20} + 0.05$; $\sqrt{.25} + 0.10$; $\sqrt{.30} + 0.15$; $\sqrt{.35} + 0.20$.

in the .20. In the French Broad gauging the values of D varied from 7 to 33 per cent and the consequent corrections to $\sqrt{D}$ varied from + 0.18 to — 0.08. These corrections are given in column 10 of table. The corrections to V are given in column 11, and the value of V_m in column 12. In column 13 is shown the discharge for one foot in width of stream in cubic feet per second; the product of the mean depth (Col. 9) by the mean velocity (Col. 12).

With the middle range line of diagram as a base the various mean velocities are platted in vertical ordinates immediately under the intersection of that line by the corresponding floats. These points being connected with each other and with the middle range at shore lines (as shown in dash and dot line), gives the curve of mean velocities. Upon the same base line, and with convenient scale, volumes of discharge (Col. 13) are laid off in vertical ordinates, and being connected with each other, and with the base line gives the discharge polygon, the area of which, interpreted by proper scales, gives the discharge of the stream in cubic feet per second. It will be observed that, in a general way, the mean velocity and discharge polygons are parallel to the curve of mean depth. The area of the discharge polygon can be determined with a planimeter, or from cross-section paper, or it can be computed directly.

The field work of the gaging in question began after 8 o'clock in the morning, and was finished at 11:30 a. m., by a party consisting of a chief, a recorder, one boatman and two helpers. The work was reduced and platted, and the results obtained by the chief of party and his recorder in less than an equal length of time.

Three or four gagings of a stream at low, mean and high stages, will afford a diagram by which its discharge may be determined for any reading of the river staff. For stream gaging, this method affords sufficient accuracy, since the uncertainties of the volume thus obtained are very much less than the uncertainty of the particular stage of the stream, with reference to its high, low or medium stage.

The method of stream gaging with rod floats is better adapted to deeper than to shallower streams, to a limit of 18 to 20 ft. in depth; and is applicable to widths up to 800 or 1,000 ft. Rod floats are also adaptable to tidal streams of reasonable depths, but the methods of use and of the reductions are not so simple as in the case given.

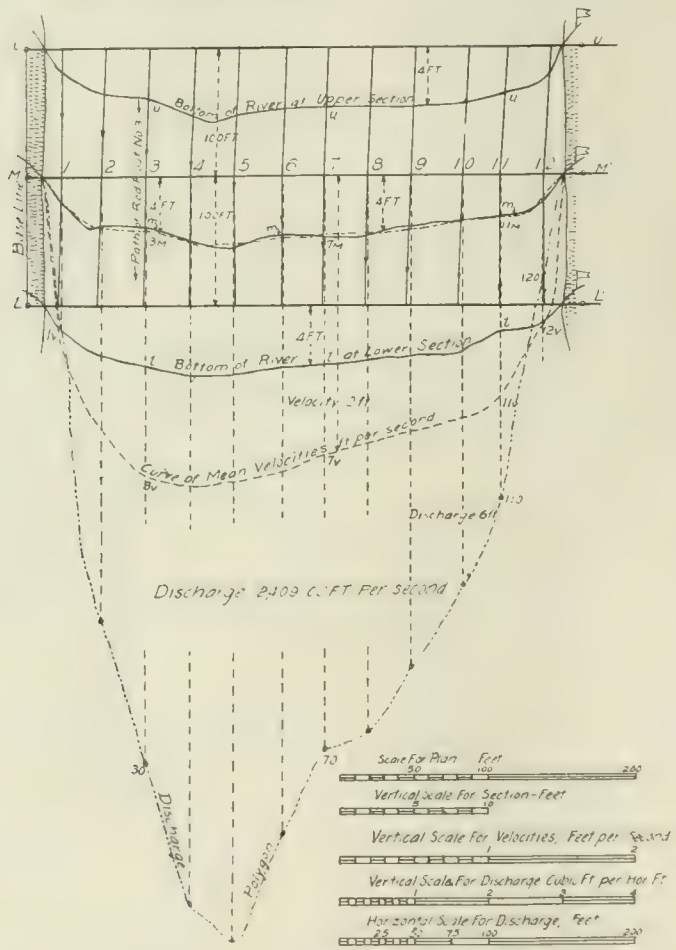
Bottom of River at Upper Section
Bottom of River at Lower Section
Velocity in
Curve of Mean Velocities
Discharge 6th
Discharge 2303 CUFT Per Second
Polygon
Scale For Plan Feet
Vertical Scale For Section-Feet
Vertical Scale For Velocities, Feet per Second
Vertical Scale For Discharge Cubic Ft per Hor Ft
Horizontal Scale For Discharge, Feet

Diagram Showing Form of Record of Stream Gagings with Rod Floats.

TABLE 1.

Number of float	Distance from shore at intersection of float line	Distance from base line at intersection of upper range, feet	Angle at P between base line and float at its crossing of first range	Time of crossing upper range	Time of crossing lower range	Time of float in drifting with current 200 feet—seconds.	Velocity of floats in feet per second, equals Vr.	Mean depth of water in path taken by float—feet.	Correction "X" to be applied to "r" in formula	Correction from rod velocity (Vr), to mean velocity (Vm).	Mean velocity (Vm) of vertical film—feet per second.	Volume of discharge for 1 ft. in width of stream. cu. ft. per second	Number of float.
1	1.5	25	6 35	10 11 03	10 [illegible] 40	166	1.20	1.8	+ .02	.95	1.140	2.052	1
2	3.0	53	13 53	18 06	19 50	104	1.92	3.4	+ .03	.96	1.843	6.266	2
3	3.5	84	21 36	24 09	[illegible] 40	91	2.20	3.8	+ .07	.98	2.156	8.193	3
4	4.0	115	28 57	30 05	31 32	87	2.30	4.6	+ .02	.96	2.208	10.157	4
5	4.0	144	35 16	36 52	38 13	86	2.32	4.8	+ .02	.95	2.204	10.579	5
6	4.0	175	40 50	44 50	46 22	92	2.17	4.3	+ .08	.98	2.127	9.146	6
7	3.5	203	44 58	50 47	52 23	96	2.08	4.0	+ .02	.96	2.000	8.000	7
8	3.5	233	49 02	56 46	[illegible] 25	99	2.02	4.0	+ .02	.96	1.939	7.756	8
9	3.0	264	52 14	11 03 41	11 05 23	102	1.96	3.7	+ .04	.95	1.862	6.889	9
10	3.0	[illegible] 97	55 31	11 18	[illegible] 58	110	1.82	3.3	+ .06	.97	1.765	5.824	10
11	2.5	326	58 04	17 54	19 52	118	1.70	2.8	+ .04	.97	1.649	4.617	11
12	1.0	352	60 13	25 22	28 [illegible]	164	1.22	1.5	+ .18	.91	1.110	1.665	12

Wages in the Building Trades.—A late report by the Board of Trade showing the earnings of laborers in the building and wood working trades in the United Kingdom is summarized as follows by Consul Benjamin F. Chase of Leeds: The total number employed in these trades in 1906 was about 1,250,000, of which about 1,000,000 belong to the different branches of the building trade. The average net earnings per man during that summer were $7.66 per week. The average full time earnings of all men were $8.03, for skilled workmen $8.84, and for ordinary labor $5.94. In the harbors, docks, sewers, etc., the average full time earnings of men were $7.74. In the saw mills, machine joining and box and packing case making industries, $6.59. In cabinet making and allied trades, $8.03. The average wage in the building trade has advanced about 18 per cent since 1886. In Leeds the hours of labor and rate of wages in these trades in 1909 were as follows:

Employment.	Hours	Rate.	Overtime.
Bricklayers	49½	$9.53	1¼ to 1½
Cabinetmakers	49½	6.60	1¼ to 1½
Joiners:			
Summer	49½	9.03	1¼ to 1½
Winter	41½	7.57	1¼ to 1½
Plasterers	49½	9.53	1½
Plaster laborers	49½	7.02	1½
Plumbers	49½	7.57	1¼ to 1½
Polishers	52½	8.51	.....
Slaters and tilers	50	9.12	.....

Railway Section

Note: This section is devoted to methods and costs of constructing railways. It will cover road-bed and track construction, contractor's plant and organization, surveying methods and permanent way structures.

Cost of Operating the New York City Railway Co. Lines—218 Miles of Electric Street Railways.

This company operates 70 per cent of the surface railways of Manhattan. The following data relate to the fiscal year ending June 30, 1908, during the last nine months of which the company was in the hands of a receiver. The cost of operation was very high, due mainly to unusual expenditures for maintenance, but partly to poor management. About 10 per cent of the car mileage was operated by horses and the rest by underground electric contact (conduit system). Unfortunately the published cost records do not separate the cost of horse operated mileage from electric operated mileage, nor is statement given of the exact car mileage of each. However, the number of horses is given and we can closely approximate the horse car mileage, for it is a well-established fact that street car horses average 14 to 16 miles per day.

Another confusing feature exists in the fact that 28 per cent of the electricity generated was sold; but this credit needs only to be borne in mind to avoid a misinterpretation of the statistics.

We shall first give a detailed statement of the track mileage operated and the plant, as of June 30, 1908:

	Miles.
Road, first track	112.0
Second track	106.1
Total trackway operated	218.1
Sidings, turnouts, storage tracks, etc.	17.4
Total track	235.5

There were operated by this company 76.5 miles of double track electric line (underground contact) and 26.7 miles of double track horse car line.

The rolling stock was as follows on June 30, 1907:

	Motor.	Non-motor.
Closed passenger cars	1,804	128
Open passenger cars	863	131
Combination passenger cars	80	...
Total	2,747	259
Express cars	30	...
Freight cars	4	...
Service cars	40	17
Snow plows	7	10
Sweepers	65	30
Grand total	2,893	316

During the year 1908 the company installed 276 new passenger cars and withdrew 999 old passenger cars, but the following statement of rolling stock, as of June 30, 1908, does not check very well with the above statement:

	Motor.	Non-motor.
Closed passenger cars	1,184	596
Open passenger cars (incl. horse cars)	714	...
Total passenger cars	2,898	596
Express cars	6	12
Snow plows	5	10
Sweepers	67	21
Work cars	49	19
Grand total	3,025	658

The report for 1907 gives the maximum weight of passenger cars at 11 tons and the maximum length at 40 ft. The report for 1908 gives the average seating capacity at 36 passengers per car.

The power plant was as follows:

Station Equipment:	Rate of capacity.
80 boilers	21,050 HP.
11 steam engines	55,000 HP.
11 generators (direct, A. C.)	38,500 KW.
2 station transformers	750 KW.
6 exciters	1,280 KW.
Substation Equipment:	
30 rotary converters	30,720 KW.
93 transformers	35,925 KW.
662 storage battery cells	4,160 amp. hrs.

There were 2,185 horses.

The traffic statistics were:

Passenger car miles	50,637,061
Express and mail car miles	114,684
Work car miles	132,297
Passenger car hours (estimated)	7,724,247
Passenger car miles per mile of trackway	262,300
Pasengers at 5 cts.	308,376,992
Passengers at 4 cts. and 3 cts.	4,613,960

There were 6.16 passengers per car mile, or 46.55 passengers per car hour. The average speed was 7.56 miles per hr. There were 232,300 passenger car miles per mile of trackway (218 miles). Although there were nearly 3,500 passenger cars, the mean number in use was reported to be 2,856, and they averaged 17,800 miles during the year. Since there were 2,792 conductors, it is doubtful whether the average number of cars in use was as many as reported.

General Office Staff:
- 8 general officers.
- 29 other officers.
- 404 employes.
- 441 Total general office.

Transportation:
- 113 starters.
- 4 register takers.
- 2,792 conductors (319 on horse cars).
- 2,540 motormen.
- 331 drivers (horse cars).
- 130 switchmen and yardmen.
- 1,621 road and trackmen.
- 122 station porters and watchmen.
- 100 other employes.
- 294 hostlers, stablemen, etc.
- 8,131 Total transportation.

Power:
- 9 engineers.
- 41 oilers.
- 19 wipers.
- 20 firemen.
- 17 coal passers.
- 18 water tenders.
- 15 ashmen.
- 16 boiler cleaners.
- 34 dynamo and switchboard men.
- 56 electricians.
- 296 linemen.
- 155 other employes.
- 696 Total Power.

Car Houses and Shops:
- 112 car cleaners.
- 23 car oilers.
- 678 other car house employes.
- 163 carpenters.
- 37 blacksmiths.
- 70 machinists.
- 20 armature winders.
- 150 electrical helpers.
- 135 painters.
- 276 other employes.
- 1,664 Total Car Houses and Shops.

10,932 Grand Total Employes.

In 1907 the average number of employes, including officials, was 8,816, and they received $6,682,276.

The operating expenses were as follows, first giving the totals and then the costs per car mile:

Maintenance of Way and Structures:	
1. Track and roadway	$ 858,734
2. Electric line	265,903
3. Buildings and fixtures	159,731
Total Maintenance of Way	$1,284,368
Maintenance of Equipment:	
4. Steam plant	$ 92,467
5. Electric plant	54,715
6. Cars	950,128
7. Electric equip. of cars	1,060,123
8. Miscel. equipment	48,798
9. Shop expense	68,817
10. Renewal of horses, harness, etc.	192,435
Total Maintenance of Equip.	$2,467,483
Operation of Power Plant:	
11. Wages	$ 243,140
12. Fuel	695,903
13. Water	66,652
14. Lubricants and waste	22,013
15. Miscellaneous supplies	29,962
Total Gross Expenses of Power Plant	$1,057,670
Credit from sale of electricity	281,880
Net Expense of Power Plant	$ 775,790
16. Provender and stable expense	387,235
Total Power Plant and Stable	$1,163,025
Operation of Cars:	
17. Superintendence of transp.	$ 169,379
18. Wages of conductors	1,673,426
19. Wages of motormen	1,854,895
20. Wages of miscel. car service men	243,214
21. Wages of car house men	306,867
22. Car service supplies	56,871
23. Miscel. car service expense	152,564
24. Hired equipment	1,785
25. Clearing and sanding track	130,057
26. Removal of snow and ice	76,194
Total Operation of Cars	$4,670,252
General Expenses:	
27. Salaries of general officers	$ 91,119
28. Salaries of clerks	115,199
29. Printing and stationery	26,253
30. Miscel. office expense	7,589
31. Stores expenses	74,952
32. Stable expenses	98,841
33. Advertising and attractions	3,213
34. Miscel. general expense	54,065
35. Damages	1,064,716
36. Legal expense incident to damages	314,633
37. Miscel. legal expense	122,874
38. Rent of land and buildings	119,787
39. Rent of track and terminals	52,842
40. Insurance	128,386
Total General Expense	$2,273,469
Grand total	$11,858,597
Taxes assessed	$ 1,207,237

Since there were 50,637,061 passenger car miles, the cost per car mile was as follows:

	Cents per car mile.
Maintenance of Way and Structures:	
1. Track and roadway	1.694
2. Electric line	0.526
3. Buildings and fixtures	0.316
Total Maintenance of Way	2.536
Maintenance of Equipment:	
4. Steam plant	0.181
5. Electric plant	0.108
6. Cars	1.876
7. Electric equip. of cars	2.095
8. Miscel. equipment	0.097
9. Shop expense	0.136
10. Renewal of horses, harness, etc.	0.380
Total Maintenance of Equip.	4.873
Operation of Power Plant:	
11. Wages	0.479
12. Fuel	1.372
13. Water	0.132
14. Lubricants	0.044
15. Miscellaneous supplies	0.059
Total	2.086
Credit from sale of electricity	0.554
Net expense of power plant	1.532
16. Provender and stable	0.764
Total Operation of Power Plant	2.296
Operation of Cars:	
17. Supt. of transportation	0.335
18. Wages of conductors	3.304
19. Wages of motormen	3.662
20. Wages of miscel. car service men	0.490
21. Wages of car house men	0.606
22. Car service supplies	0.113
23. Miscel. car service expense	0.301
24. Hired equipment	0.004
25. Cleaning and sanding track	0.257
26. Removal of snow and ice	0.150
Total Operation of Cars	9.222
General Expense:	
27. Salaries of general officers	0.179
28. Salaries of clerks	0.227
29. Printing and stationery	0.052
30. Miscel. office expense	0.015
31. Stores expense	0.148
32. Stable expense	0.195
33. Advertising and attractions	0.006
34. Miscel. general expense	0.107
35. Damages	2.102
36. Legal expense incident to damages	0.622
37. Miscel. legal expense	0.243
38. Rent of land and buildings	0.237
39. Rent of track and terminals	0.105
40. Insurance	0.254
Total General Expense	4.492
Grand total	23.419
Taxes assessed	2.384

We have already stated that the maintenance expenses were unusually high during 1908. A comparison with the fiscal year ending June 30, 1907, will give a better conception of the matter. A summary of the operating expenses per car mile, for the two years, is as follows:

Year.	1907.	1908.
Maintenance of way and structures.	1.700	2.536
Maintenance of equipment	2.920	4.873
Operation of power plant	1.962	2.296
Operation of cars	8.707	9.222
General expense	4.424	4.492
Total	19.713	23.419

The maintenance of way expenses were abnormal for the year 1907, as well as for the year 1908, although not in so great a degree.

The maintenance of track and roadway (Item 1) amounted to $3,940 per mile of trackway (218 miles) for the year 1908, and $2,560 per mile for 1907. The maintenance of electric line (Item 2) was $1,220 per mile of trackway for 1908, and $650 for 1907. All of these are excessively high unit costs.

The maintenance of cars (Items 6 and 7) amounted to $575 per passenger car for the year 1908, and $400 per car for 1907. About 20 per cent of the cars were open cars in 1908, but 29 per cent were open cars in 1907. While these car maintenance costs are high, we are of the opinion that the average of these two years is not far above normal for large street cars that have been in use a number of years. Unfortunately no data are available by which the average first cost of these cars can be determined. It is probable, however, that the first cost was about $4,000 per car.

The total rated capacity of the dynamos was 38,500 KW. The maintenance of the steam and electric plant (Items 4 and 5) was as follows for the year 1908:

	Per KW.
Steam plant	$2.40
Electric plant	1.42

It was slightly less for the year 1907.

The renewal of horses, harness, etc. (Item 10) is clearly out of the ordinary, being nearly $88 per horse. For the year 1907 the same item was $38 per horse.

Coming now to the operation of the power plant, we find it necessary to show the cost per KW. hr., for 28 per cent of the electricity produced was sold. Moreover, 10 per cent of the cars were not operated by electricity.

There were generated 169,604,248 KW. hrs., requiring 3.19 lbs. coal per KW. hr. The coal was 38 per cent anthracite and 62 per cent bituminous, and the average price was $3.00 per ton of 2,240 lbs. Of the electricity generated, 47,075,911 KW. hrs. (or 28¼ per cent) were sold at 0.6 ct. per KW. hr. There were left 122,528,337 KW. hrs. to operate the electric cars, etc. Of the 50,637,061 passenger car miles, we estimate that 11 per cent were horse car miles. There were nearly 1,100 teams of horses. Allowing 15 miles per team per day for 365 days, we have 5,922,500 horse car miles. We have already seen that about 11½ per cent of the conductors were horse car conductors. In round numbers, therefore, 45,000,000 car miles were electric passenger car miles, which required 122,528,337 KW. hrs., or about 2.72 KW. hrs. per car mile. We have seen that the cost of operating the power plant (Items 11 to 15) was $1,057,670. This is equivalent to 0.62 ct. per KW. hr. Since a 38,500 KW. plant produced nearly 170,000,000 KW. hrs., each KW. produced nearly 4,410 KW. hrs. There are 8,760 hrs. in a year, hence the load factor was $4,410 \div 8,760 = 50$ per cent.

The provender and stable expense (Item 16) amounted to $176 per horse, or practically 50 cts. per day. In addition there were general stable expenses (Item 32) amounting to $45 per horse, or 12 cts. per day. There was one stableman for every 7.3 horses. In 1907 the maintenance cost per horse per day was as follows:

	Per day
Wages of stablemen	$0.15
Provender	0.29
Stable equipment, coal, etc.	0.02
General stable expense	0.08
Horseshoeing	0.03
Total	$0.57

The provender and stable expense (Item 16) amounted to $387,235 for 1908, or about 7 cts. per horse car mile. Whereas the other items of power plant operation (Items 11 to 15), deducting electricity sold, amounted to $775,790, or 1.68 cts. per electric passenger car mile. It will be seen, therefore, that had all cars been operated by electricity the cost of power per car mile would have been exceedingly low.

When we come to consider the cost of operation of cars, we find that the wages of conductors and motormen (Items 18 and 19) amount to nearly 7 cts. per car mile. This is unusually high, yet the hourly rates of wages were moderate, conductors receiving 21½ cts. and motormen 22½ cts. per hr., during the first year, and an increase of 1 ct. per hr. for each of the succeeding two years, and another 1 ct. after the fifth year. About half the men were first year men. In striking contrast with this is the corresponding cost of wages of conductors and motormen on the New York Subway (see ENGINEERING-CONTRACTING, April 13, 1910), which was less than 1.8 cts. per car mile. This difference is due largely to the higher speed of the subway cars, and partly to the fact that one motorman operates several cars in a train.

The cost of damages due to accidents (Items 35 and 36) is worthy of particular note. For the year 1908, this sum was $1,379,349. For the year 1907 it was $1,590,577. We see that for 1908 the cost of accidents was more than 11 per cent of the total operating cost, and was equivalent to 2.72 cts. per car mile, being considerable more than the entire cost of power plant operating expenses! Indeed, if an additional employe had ridden on each car, the added wages would not have greatly exceeded the outlay due to damages. During 1908 the total number of accidents of all kinds was 14,551, which resulted in 151 deaths. Of the deaths only 20 were passengers and 15 were employes. There were 738 persons injured, making a total of 889 killed and injured.

In greater New York during the same year 398 were killed and 18,006 were injured on all the street car lines.

Dividing the $1,377,349 by the 218 miles of trackway operated by the New York City Ry. Co., we get nearly $6,800 per mile as the cost of accidents for the year 1908. Capitalizing this at 6 per cent we have $113,000 as the justifiable expenditure per mile of trackway to prevent the accidents.

The operating income for the year was:

Passengers	$15,569,429
Mail	1,465
Express	34,594
Advertising	224,249
Rent of tracks	14,899
Rent of equipment	16,134
Sale of power	12,429
Total	$15,873,130

Cost of Constructing, Equipping and Operating 36 Miles of Electric Suburban Railway—New York and Long Island Traction Co.

This company was incorporated in 1899. Its stock is controlled by the Interborough Rapid Transit Co. The following data are based upon a report for the fiscal year ending June 30, 1908.

The mileage owned was as follows:

	Miles of roadbed.
Mineola to Grant St., Brooklyn	24.85
Mineola to Jerico and Hempstead turnpike	5.86
Hempstead to Belmont Park	5.58
Total miles of first track (no second track)	36.29
Sidings, storage track, etc.	4.36
Total track owned	40.65

In addition, the company has trackage rights over 4.55 miles of double track line, or 9.10 miles of track, over which it operates its cars.

The cost of construction and equipment of the 36 miles owned is reported as follows:

1. Engineering and superintendence	$ 43,871
2. Right of way (7.32 miles owned)	70,771
3. Real estate used in operation of road	7,427
4. Track and roadway construction	593,298
5. Electric line construction	150,277
6. Buildings and fixtures used in operation	11,424
7. Power plant equipment	147,581
8. Shop tools and machinery	1,786
9. Cars	114,620
10. Electric equipment of cars	77,293
11. Miscellaneous equipment	19,539
12. Organization	81,377
13. Interest and discount	20,302
14. Miscellaneous	1,522
Total	$1,374,088
15. Road built and equipped by contract	944,468
Grand total	$2,318,556

Item 15 is the only one that is not very clear. When roads of this sort are "built and equipped by contract," the contractors are usually the promoters, and they frequently pay themselves very liberally in stock. In fact, items of this kind often represent nothing else than the promoters' profits.

Dividing each of the 15 items by 36.29, we get the following cost per mile of road:

	Per mile of Road.
1. Engineering and superintendence	$ 1,210
2. Right of way	1,951
3. Real estate	204
4. Track and roadway constr.	16,347
5. Electric line constr.	4,141
6. Buildings	1,141
7. Power plant equipment	4,067
8. Shop tools and machinery	50
9. Cars	3,158
10. Electric equip. of cars	2,130
11. Miscel. equipment	537
12. Organization	2,326
13. Interest and discount	560
14. Miscellaneous	41
Total	$37,867
15. Road built by contract	26,025
Grand total	$63,888

Since there are 1.12 miles of track per mile of road, each of the above items should be divided by 1.12 to get the cost per mile of track.

A study of these costs leads to the conclusion that Item 15 represents very little else than promoters' profits. Certainly Items 4 and 5, which aggregate $20,488, suffice to cover the ordinary cost of grading and track and electric line construction of a single track electric road.

The following are the physical characteristics of the line:

Rails weigh 65 to 107 lbs. per yd.; 26.2 miles being 7-in. girder, and 10.1 miles being 70 lbs. tee-rails. The average age of the rails was 4.2 yrs., of ties 3.5 yrs., as of June 30, 1908. There were 7 miles of cinder ballast; no other ballast reported. The electric line construction consists of 4.56 miles of overhead trolley, span wire, and 31.73 miles of side brackets. There are 52 poles per mile, 34.19 miles being wood poles and 2.10 miles iron or steel. There are 2,261 lin. ft. of steel bridges (trestles?); 638 lin. ft. of combination bridges; 2,241 lin. ft. of timber trestles; and one overhead railway crossing; 8 pipe culverts and 3 stone box culverts.

The power equipment was as follows:

	Total cap.
3 boilers (water tube)	900 HP.
2 steam engines	1,500 HP.
2 generators (direct A. C.)	1,000 KW.
3 station transformers	900 KW.
1 booster for outside feeder	350 KW
1 auxiliary generator	120 KW
2 rotaries	600 KW
2 exciters	100 KW.
2 rotary converters in sub-stations	400 KW.
3 transformers in sub-stations	600 KW.
275 storage battery cells in sub-stations	200 amp. hr.
1 motor-generator in sub-station	10 KW.

The rolling stock (all owned by the company) was as follows:

4 closed motor cars, 20 tons each, 42 ft. long.
25 semi-convertible motor cars, 18 tons, 40 ft. long.
1 combination passenger and express, 21 tons.

30 total revenue cars.
3 snow plows (motor), 10 tons.
2 sweepers (motor), cost $4,600 each.
3 service cars (1 motor car).

The average seating capacity of the cars was 44 passengers.

We have seen that these 30 passenger cars cost $114,620 (Item 9) for the bodies and trucks, and $77,293 (Item 10) for the electric equipment, making a total of nearly $6,400 per car having an average weight of a little more than 18 tons.

We have seen that the capacity of the power plant was 1,000 kw., and that the power plant equipment (Item 7) cost $147,581, or $148 per kw. Item 6 gives the cost of all buildings at $41,424. Presumably a large portion of this expense was for power station and sub-station buildings.

The power plant generated 4,491,600 kw. hrs., consuming 3.50 lbs. of anthracite per kw. hr., the cost of which was $3.40 per ton of 2,000 lbs. In addition to this, 333,319 kw. hrs. were purchased, at 2.5 cts. per kw. hr.

The employes' and operating expenses were as follows for the year ending June 30, 1908:

General Office Staff:
2 general officers.
3 other officers.
10 other employes.

15 total general office staff.....$8,029

Transportation:
2 inspectors.
2 train clerks and dispatchers.
1 superintendent.
42 conductors (20 cts. per hr.).
40 motormen (20 cts. per hr.).
2 switchmen, flagmen and yardmen
18 road and trackmen

107 total transportation $55,444

Power:
2 engineers.
1 oiler.
3 firemen.
3 coal passers.
2 dynamo and switchboard men
4 linemen.
3 other power plant employes.

18 total power $10,947

Car House and Shops:
3 car cleaners.
2 car oilers.
6 car house repairers.
1 other car house employe.
1 carpenter.
1 blacksmith.
1 machinist.
2 armature winders.
1 electrical helper.
4 other shop employes.

22 total car house and shops.....$13,922

163 total employes $83,342

The operating expenses were as follows:

	Maintenance of Way and Structures:	
1.	Track and roadway	$ 11,261
2.	Electric line	3,876
3	Buildings and fixtures	293
	Total maintenance of way	$ 15,430
	Maintenance and Equipment:	
4.	Steam plant	$ 1,299
5	Electric plant	246
6.	Cars	12,881
7.	Electric equip. of cars	17,276
8	Miscel. equip.	312
9	Shop expense	2,251
	Total maintenance of equipment	$ 34,215
	Operation of Power Plant:	
10	Wages	$ 8,047
11.	Fuel	26,779
12.	Lubricants and waste	727
13.	Miscel. supplies and expenses	229
14.	Hired power	8,333
	Total operation of power plant	$ 44,075
	Operation of Cars:	
15.	Superintendence of transportation	$ 900
16.	Wages of conductors	25,359
17.	Wages of motormen	20,499
18.	Wages of miscel. car service men	5,131
19.	Wages of car house and employes	28
20.	Car service supplies	1,860
21.	Miscel. car service expense	6,843
22.	Cleaning and sanding track	1,297
23.	Removal of snow and ice	844
	Total operation of cars	$ 57,802
	General Expenses:	
24	Salaries of general officers	$ 2,960
25.	Salaries of clerks	965
26.	Printing and stationery	770
27.	Miscel. office expense	94
28.	Stores expenses	372
29.	Stable expenses	245
30.	Miscel. general expenses	1,720
31.	Damages	21,201
32.	Legal expense incident to damages	3,220
33.	Miscel. legal expense	2,916
34.	Rent of land and buildings	640
35.	Rent of track and terminals	16,667
36.	Insurance	587
	Total general expense	$ 52,359
	Grand total	$203,882

The taxes assessed for the year were $22,474.

The traffic statistics were as follows:

Passenger car miles	1,184,581
Same per mile of all track	29,141
Same per passenger car in use	39,486
Same per passenger	0.217
Freight, mail and express car miles	None
Service car miles	No record
Passenger car hours	100,915
Passenger car miles per hr. (speed)	11.74
Car trips	42,801
Car miles per trip	27.68
Passengers at 5 cts.	5,416,662
Passengers at lower rates	39,303
Passengers in chartered cars	5,200
Passenger fares per car mile	4.61

The operating expenses per passenger car mile were as follows:

		Cents per Car Mile.
	Maintenance of Way and Structures:	
1.	Track and roadway	0.951
2.	Electric line	0.329
3.	Buildings	0.023
	Total maintenance of way	1.303
	Maintenance of Equipment:	
4.	Steam plant	0.110
5.	Electric plant	0.019
6.	Cars	1.082
7.	Electric equip. of cars	1.459
8.	Miscel. equip.	0.028
9.	Shop expenses	0.190
	Total maintenance of equipment	2.888
	Operation of Power Plant:	
10.	Wages	0.675
11.	Fuel	0.262
12.	Lubricants and waste	0.062
13.	Miscel. supplies and expenses	0.019
14.	Hired power	0.703
	Total operation of power plant	3.721
	Operation of Cars:	
15.	Superintendence of transp.	0.076
16.	Wages of conductors	1.722
17.	Wages of motormen	1.731
18.	Wages of miscel. car service men	0.432
19.	Wages of car house employes	0.003
20.	Car service supplies	0.157
21.	Miscel. car service expense	0.577
22	Cleaning and sanding track	0.110
23.	Removal of snow and ice	0.071
	Total operation of cars	4.879
	General Expenses:	
24.	Salaries of general officers	0.250
25.	Salaries of clerks	0.082
26.	Printing and stationary	0.065
27.	Miscel. office expense	0.007
28.	Stores expenses	0.031
29.	Stable expenses	0.020
30.	Miscel. general expenses	0.145
31.	Damages	1.789
32.	Legal expense incident to damages	0.272
33.	Miscel. legal expense	0.247
34.	Rent of land and buildings	0.054
35.	Rent of track and terminals	1.408
36.	Insurance	0.050
	Total general expense	4.420
	Grand total operating expenses	17.211
	Taxes	1.899

Maintenance of track and roadway (Item 1) cost $310 per mile of road (36.3 miles), as compared with $225 for the preceding year. Maintenance of electric line (Item 2) cost $107 per mile of road, as compared with $181 for the preceding year. Maintenance of power plant (Items 4 and 5) cost:

	Per KW.
Steam plant	$1.26
Electric plant	0.29
Total	$1.55

During the previous year these maintenance costs were:

	Per KW.
Steam plant	$2.38
Electric plant	1.09
Total	$3.47

The maintenance of cars and their equipment (Items 6 and 7) cost $1,000 per passenger car, which was practically the same the preceding year. Since the average cost of the cars was $6,400 each, the maintenance expenses exceeded 16 per cent, for it should be noted that Item 9, shop expenses, should be prorated among Items 4 to 8. All these cars were in service throughout the year, for none of them were open cars for summer use only.

The operation of the power plant (Items 10 to 13) cost $35,742 for the production of 4,491,600 KW. hrs., or nearly 0.8 ct. per KW. hr. The purchase of additional power at 2.5 cts. per KW. hr accounts largely for the high cost of power per car mile; but it should be noted that these large cars, running at comparatively high speed, consumed 4.07 KW. hrs. per car mile. On the other hand, the high speed reduced the cost of conductors' and motormen's wages per car mile.

This 1,000 k. w. plant produced 4,492 k. w. hrs. per k. w. of plant capacity. Since there are 8,760 hrs. in a year, the load factor was $4,492 \div 8,760 = 51.4$ per cent.

Damages (Items 31 and 32) were very high. Rent of track (Item 35) also ran up the car mile cost of general expenses.

The operating income was:

Passengers	$277,773
Chartered cars	923
Advertising	450
Rent of tracks	138
Rent of equipment	1,098
Miscellaneous	374
Total	$280,756

Some Notes on the Florida East Coast Railway Work.

In reply to a request for cost data on the construction of the Florida East Coast Ry. Extension to Key West, a member of the editorial staff, who was formerly connected with that work, has received the following letter:

Sirs: Regarding cost data, it will be impossible for me to give you any for the reason that I do not know much about the costs. The costs are not of much value for the reason that there will never be any work done in the world under the same conditions. Our situation is so different from any other work on earth that the costs would only be of value to satisfy curiosity. One can't keep men in an out of the way place like this without paying them and when bad weather comes, delays are experienced on account of being out of some kind of material and the expense goes on. For that reason it costs almost as many dollars to build two piers a week as to build eight piers a week. If things keep moving right along—each item of work in its proper sequence, it is easy to complete as high as eight or even ten piers a week. A little blow comes along and destroys three or four coffer dams. That ties up the lower shaft work of the pier while we build some more cofferdams and set, seal and wait four days to harden before pumping. In the meantime the upper shaft work catches up and everything is "two blocks." A schooner of sand or gravel sometimes is becalmed over among the Bahamas and doesn't get in sometimes for 30 or 40 days. These things cannot be helped, but all cost money. On the other hand, we might, and even do, sometimes have a couple of months of good weather and with plenty of material, and we build concrete cheaper than it was ever built in this country, price of material considered. Even that is not a fair estimate for cost for we might not be able

View Showing Construction of Piers for Florida East Coast Railway Viaducts.

to do it again in a year. I am writing you rather in full on this for the reason that it might furnish a good reason why no one has ever taken up that phase of the subject.

The method of construction is almost exactly the same as it was when you were here except in minor matters, which have reduced the number of men necessary to do the work, and the machines have also been reduced somewhat in number and cost of operation. The pile driver drives the 17 anchor piles inside, and the 12 anchors and fender piles around the outside of the place where the cofferdam will set. Then the "catamaran" sets the cofferdam and the pump barge cleans it out and places sand bags around it. Work Barge No. 5 places the concrete seal. After four days Derrick Barge No. 96 pumps out the cofferdam, cleans off the [illegible] sets the lower form. Work Barge No. 5 concretes the [illegible] placing the 34 reinforcement rods. Then Derrick Barge No. 3 sets the upper form and Work Barge No. 5 concretes it and the job is done. The "catamaran" pulls its own cofferdam and also at the same time pulls the lower shaft forms.

Derrick Barge No. 9 is fitted with a long boom and she sets the steel girders. The steel setting is a very small matter for this machine for the reason that she has set as high as eight 80 ft. spans in a day, and, with very favorable conditions, could possibly set as high as twelve spans. We use the derrick and crew for almost an endless variety of service besides keeping the steel set as fast as the concrete is completed.

The present design—piers and steel girders—calls for a continuous viaduct from Knights Key across Pigeon Key to Little Duck Key. This will be 6¾ miles long. The west 9,000 ft. approaching Little Duck Key, however, will in all probability be 25 ft. concrete arches.

C. S. COE,
Division Engineer.

Knights Key, Fla., April 24, 1910.

For the reader to understand more clearly the conditions and method used in construction a little explanation is necessary. As is pretty generally known, the railroad is built over salt water, connecting the chain of islands between the southern point of Florida and the island of Key West. The first 3 miles of bridge work was from Long Key, west, and was in the form of 50-ft. concrete arches. The work now going on is of piers and steel girders. The piers are 80 ft. on centers and the girders are 9 ft. in depth, the top of rail being about 30 ft. above the water. The water is, on an average, about 16 ft. deep, but in one or two places is as deep as 30 ft. The tide runs very swiftly and when three or four cofferdams are set in a row the velocity of the tide is increased to about 7 miles per hour. This causes no little difficulty in setting the cofferdams and holding them in place.

The bottom, or foundation for these piers, is coral rock and is generally pretty clean, but a dredge goes ahead of the work and cleans up any muck which may accumulate, or be in the way of the pile driver. The pile driver follows and drives 17 piles for the foundation anchor piles in each pier, and 12 piles to be used as anchor piles for the cofferdam. In driving these piles a 6-in. punch is first used and the piles are then placed and driven about 4 ft. into the coral rock. The hardness of the rock varies greatly. In some places 10 or 20 blows of an 800-lb. steam hammer will drive the punch 4 ft. into the rock, and then again another point 5 ft. away may require 600 or 800 blows to get the same penetration.

The cofferdam is built upon a scaffolding supported by the piling, and when already to be lowered and set in position it is handled by a derrick on the catamaran. It is built of 4x8-in. lumber and braced inside with 8x10-in. timbers. All joints are calked and closed with pitch and tar. After anchoring in position and pumping out the cofferdam a 4-ft. seal is placed. Four days are allowed for the seal to set and then the cofferdam is again pumped out and the carpenters build up the lower half of the pier form and place the 34-in. reinforcing rods. These rods are set 6 ins. from the face of the pier all around and in a vertical position or parallel to the batter of the pier.

Unclassified and General Articles

Note: This section is devoted to methods and cost articles on construction work not properly coming under any of the preceding classifications.

Cost of Power for Various Industries Under Ordinary Conditions.*

Twenty-five years ago the expression "cost of power" was fairly well defined as meaning the yearly cost per indicated horsepower if produced by steam; or power on the wheel shaft if produced by water for 10 hours a day and about 308 days a year, or for 24 hours for the same number of days. This was fairly well understood by those who had to deal with these matters and who gave the matter any thought.

Since that time, when mechanical transmission of power by shafting, belting, ropes, etc., were about the only methods in use, there has been developed the electrical transmission of power now so commonly in use, with new units of power, as electrical horsepower and kilowatts.

Also there has now come into common use the steam turbine, for which there is no indicated horsepower, the measurements of power from which must be brake horsepower, electrical horsepower or kilowatts. There is the power produced by water wheels, which is gross horsepower, net horsepower at the wheel shaft and, when transformed into electric power, it is measured in electrical horsepower and kilowatts.

New industries like public lighting and street railway companies have also come into existence. In these plants, the cost of power is affected very greatly by factors which were unknown to the type of plant which was common to industrial concerns of the past.

So today the statement, "cost of power," unless clearly defined, may mean one of many things, and the men who are used to thinking in the units and figures common to the old type of plant are sometimes at a loss to know what is meant when the cost is stated in some of the newer ways, as, for instance, so much per kilowatt hour, delivered. These figures must be translated back into indicated horsepower or its equivalent before any definite impression is made on their minds. Even then they may be at a loss to understand why the costs are so different from the ones they have in mind as a basis of comparison. It is the object of this paper to explain briefly some of the reasons for the very great differences in the cost of power under various circumstances, hoping that these explanations may be of value to those who have to deal with these matters. It is our intention to treat the factors affecting the net costs to various industries of both steam and water power, and to give a few examples of these which have come up during the course of our own engineering practice.

The gas engine, while giving some very fine results in some industries like steel mills, where the waste gases from the furnaces are used in gas engines, will not be considered further in this paper, as it is not sufficiently in common use yet to be of especial interest to us in this section of the country.

Items in Cost of Power.—It may be said generally that the cost of producing power can be divided into two parts:

(1) *Independent charges,* or the part which is independent of the output, embracing fixed charges on the plant, as interest, depreciation, insurance and taxes, and, to a certain extent, repairs.

(2) *Proportional charges,* or the part which is proportional to the output, including such charges as coal, labor, supplies, etc.

Steam plants in general may be said to have low independent charges and high proportional or operating costs.

Water power plants are usually the reverse, with high fixed charge accounts and low operating costs.

Another item which should be mentioned as affecting the cost of power is what Dr. Steinmetz calls "reliability factor," which takes into consideration the spare machinery needed to insure continuous service. The charges on this spare equipment are apt to have quite a bearing on the cost of power in a central station supplying power for public uses, where reliability must be one of the chief considerations and more spare or duplicate plant is usually maintained than in a private plant. This same factor, too, may have quite an important bearing on the value of a water power privilege.

Factor Affecting the Cost of Power.—The chief conditions which affect the cost of steam power are as follows:

(1) Cost of fuel delivered to the furnaces.
(2) Amount of power produced.
(3) The load factor in its relation to fixed charges, whether the power is continuous and uniform, or intermittent and variable.
(4) The net cost of power is reduced considerably in some concerns where the waste heat of the power plant can be used in the manufacturing processes in the form of low pressure steam or warm water.

The chief conditions which affect the cost of water power are as follows:

(1) Fixed charges on the development.
(2) Amount of power produced in its relation to fixed charges.
(3) The load factor in its relation to efficiency of wheels, pondage and reservoir capacity.
(4) The cost of supplementary power necessary to make up for the fluctuations of the water power, if required.

Variation in Cost of Steam Power.—Steam power costs the most per unit of power when produced in small amounts, and the cost is increased for fluctuating loads and when used for purposes where the load factor is small. By "load factor" we mean, in this particular instance at least, the average output in per cent of the full capacity of the plant. The cost of power in very small amounts has been eliminated from this paper, and it has been assumed that the plants discussed for different uses are fairly large and of about the same capacity.

Steam power costs the least per unit of power for comparatively steady continuous loads, as for paper mills and other similar industries, and the cost may be still further reduced where there is use for exhaust steam or other by-products from the plant. Such conditions as the last are found in colored textile mills. Power costs the most in plants having a low load factor with a variable load and where there is no use for the by-products of the plant, as in a lighting or street railway plant. Between these extremes are various industries for which the cost of power will vary greatly.

Industries running ten hours a day have a low load factor comparatively, but the load while on is often fairly steady, particularly in textile mills. Public service plants usually have a load factor somewhat lower than textile mills, but the load is extremely variable, which is not nearly so favorable to economical operation as the textile load would be.

An example of the reverse of the procedure in a colored textile mill might be cited in the case of a steel mill, where the waste gases from the furnaces might be used in a steam or gas engine plant, thus making the net cost of power very low.

Power for Various Industries.—So far as we know, the net cost of steam power is the least and the net value of water power (but not of water) also the least for colored textile mills of any of the important industries. This is

*A paper by Charles T. Main and F. M. Gunby, read before the Boston Society of Civil Engineers and published in the Journal of the Association of Engineering Societies for March, 1910.

due to the usually steady load and to the fact that the waste products from the steam plant are most valuable for manufacturing purposes to those industries. If the heat required is not obtained from the waste products, it must be obtained direct from a separate boiler plant.

The net cost of steam power for textile mills gradually increases from the cost to the mill which can use all of the waste products, which will have the lowest cost, to the case of mill making white goods, where only exhaust steam for warming the buildings and drying the yarn on the slashers can be used. Next to this latter case in favor of net low cost are the industries of any nature where exhaust steam can be used only for heating. In order to give a general idea of the usual costs of power under ordinary conditions in this section of the country, an analysis of the cost of power for a station of 2,000 k. w. capacity is given below. This station is similar to some which have been constructed within the last few years. Later on will be given some of the effects of by-products from the plant for manufacturing purposes.

Cost of Power for Textile and Similar Industries.—Let us first consider the cost of power under the various conditions for textile mills, and from these cases an idea of the cost to various other industries can be derived.

As electric driving is becoming so common in textile mills, we will assume for the basis of these costs that the stations considered below will be electric and of 2,000 k. w. capacity, composed of two 1,000 k. w. units. The costs of power from this station will usually be given as so much per kilowatt. In case it is desired to reduce this cost per e. h. p., divide by 1.34. To get it to cost per indicated horse power, multiply the cost per electrical horse power by about 87 per cent, or the cost per kilowatt by about 65 per cent. It must be remembered also that there is no spare apparatus in these plants. This may be considered as fair average practice at present for manufacturing plants, but of course would not be tolerated for public service plants where reliability is so necessary.

In making up the cost of power here, all charges have been considered except the interest charges on the cost of land. These charges would be very variable, depending on the location of the plant. The cost of land for the station has also been omitted from the cost per kilowatt of the station. There are many opinions as to the proper percentage to charge to depreciation, interest, etc. In making up these costs, interest has been taken at 5 per cent; depreciation, repairs on the apparatus, at 5 per cent, and on the building at 2½ per cent; insurance and taxes at 1 per cent, making a total of 11 per cent on the apparatus and 8½ per cent on the buildings. This was for 10-hour power. For 24-hour power the depreciation and repairs on apparatus were taken at 13 per cent instead of 11 per cent. A small amount is added in both cases for incidentals.

These figures, of course, would not do for a station where the manufacture of current was the main product, as for a public service plant, because here, during a period covered by 4 per cent depreciation newer and more efficient types of apparatus might make it necessary to discard apparatus which was mechanically good. This course would not be so necessary in a manufacturing plant, where the saving of a small percentage of the cost of power is not of such vital importance as are some other considerations.

You will note that we say "cost of power as a straight power proposition." The reason for this is that the net cost of this power can be materially reduced by using the by-products from the plant for manufacturing purposes, as will be explained later.

Ten-Hour Power.—With a steam engine plant with direct connected generators the cost of the plant per kilowatt of capacity is about $125. The cost of power from this station, with coal at about $4.25 a long ton in the pocket or $4.75 on the grates, would be about $33 per kilowatt per year of 3,000 hours, as for a textile mill, as a straight power proposition. This is equivalent to about $24.60 per electrical horse power per year and about $21.50 per indicated horse power per year. This is equivalent to a cost of 1.10 cents per kilowatt hour.

If steam turbines are used instead of steam engines, the cost of the station will be reduced to about $105 per kilowatt capacity. The cost of power produced on steam turbines would also be reduced to about $29.50 per kilowatt year, against $33 for the engine plant. A part of this difference is made up from the reduced cost of the station and apparatus and a part from the better economy of the turbines, which we have assumed are using superheated steam and high vacuum, which is common practice. The use of superheated steam is not common practice in engine plants, and the engine plant considered was assumed as not equipped with superheaters.

Twenty-four Hour Power.—If steam power were to be generated for 24 hours a day for 6 days in a week or say 300 days a year, as for a paper mill or other similar industries, the cost of power would be about $57.50 per kw. per year for the engine plant and about $53 per kw. per year for the turbine plant. These costs reduce to 80 cts. per kw. hour and 73½ cts. per kw. hour, respectively.

These figures should be compared with 1.10 cts. per kw. hour for the engine plant and 0.983 cts. for the turbine plant when producing 10 hour a day power. The difference in the cost for the two kinds of power is due to the fact that practically the same amount of fixed charges is spread over a much greater number of kilowatt hours. There is also some saving in coal per kw. hour due to the elimination of banking of fires for a large portion of the time.

Load Factors.—The power plant for the textile mill operating 10 hours a day, 300 days a year, would have a load factor of about 40 per cent, while the plant operating 24 hours a day for 300 days would have a load factor of about 93 per cent. These figures of course assume that the plants are just large enough to drive their loads. This assumption is hardly true, especially at present, when the use of electric transmission makes it easy to provide spare units. The term "load factor" as used here means the ratio of the actual kilowatt hours generated in a year to the number which would have been generated had the plant run at full load every hour in the year. It must be remembered also that for the industrial plants under consideration the load is nearly constant throughout the operating time, which means good operating conditions.

Public Service Plants.—In a lighting plant for a city, even with the same load factor as for the 10-hour textile mill, which would be high for most of these plants, the operating conditions would not be nearly so favorable as in a textile mill, as about the same amount of banking would have to be done, and the prime movers would have to operate at variable loads. This latter undesirable feature would not be so serious in a large station as in a smaller one, so far as the efficiency is concerned, as the variation could be more nearly cared for by varying the number of units and thus operating all of them at advantageous points.

The cost of power for this type of plant is more, other things being equal, than for a plant of the same size for a textile mill having the same load factor. This is due to the effect of variable load towards a reduction in efficiency, and because of the greater cost of plant and consequently greater fixed charges per unit of output. It should be borne in mind, however, that these public service plants are usually of very large size and that their output delivered has to compete in price with the cost of power from very small stations. This would give the advantage all to the central station as far as the actual cost of making power is concerned. To the cost of making the power, the central station must add the cost of transmitting, distributing and selling it.

Effect of Use of Waste Products from Power Plant for Manufacturing Purposes.—For many years it has been common practice to use the by-products, such as exhaust steam and warm water from the steam plant, for manufacturing purposes and for heating buildings, etc. It has been also common practice to take steam out of the receiver between the cylinders of a compound engine for these purposes. The saving from using the exhaust of a noncondensing engine, which would otherwise go to waste, is large, because there is no additional steam required for the engine unless the back pressure is increased. Any use of the steam is nearly all clear profit, and if all of it is used, the only part left to charge to power is the difference in B. t. u. due to the difference in pressure and the condensation in the engine cylinder, jackets, etc. The use of large noncondensing engines for producing power, except in special cases, is becoming comparatively rare, but the use of steam from the receiver of a cross-compound condensing engine for manufacturing purposes and for heating, etc., is a common practice.

It should be remarked in passing that the steam turbine at present does not lend itself to the uses of obtaining manufacturing steam under such widely varying conditions as does the steam engine. There are, as far as we know, no reliable data taken from actual operation or tests on this subject, but from some figures which have recently been made by one of the large companies, we should think that it is a subject well worth thorough investigation. There seems to be no good reason why in time the practice of bleeding turbines should not be common.

Receiver Steam.—The table given below shows the amount of coal chargeable to power when certain percentages of the steam entering the high pressure cylinder are taken out of the receiver. This table takes into consideration the effects on the economy of the engine of not passing all of the steam into the low pressure cylinder, cylinder condensation, etc. The percentages in the first column are the percentages of the steam passing the high pressure cylinder which is taken out of the receiver for manufacturing purposes. The second column is the total coal burned, and the third is the coal chargeable to power after deducting the coal chargeable to manufacturing:

Per cent of exhaust steam used for heating purposes.	Lbs. of coal per i.h.p. per hour, all coal charged to power.	Net lbs. of coal per i.h.p., per hour after deducting for exhaust steam used.
0	1.75	1.75
25	2.06	1.50
50	2.38	1.25
75	2.69	1.00
100	3.00	0.75

If the mill did not obtain its power from steam, so that it could use the low pressure steam of the plant for manufacturing, it would have to maintain a boiler plant of sufficient size to produce an amount of steam equivalent to that bled out of the receiver. The amount of B. t. u. or its equivalent in coal chargeable to power is represented by the amount of work done by the engine, and the losses due to the presence of the engine. The cost of generating the rest of the steam is chargeable to the manufacturing processes. By cost of generating steam is meant the total cost, including coal, labor, fixed charges and supplies of all kinds for the boiler plant. The cost in the engine room does not vary with the bleeding of steam, except possibly in some very unusual cases.

Examples of Manufacturing Plants.—A few examples of the reduction in cost of power due to the uses of the by-products from a steam engine plant and the bleeding of steam from the receiver may be of interest. These are all given for textile mills as a basis. The corresponding costs for other industries can be calculated from the table and curves when the amount of steam required is known.

In one colored cotton and silk mill the power to run the mill was about 1,800 i. h. p. and for manufacturing purposes about 25 per cent of the steam for this was required in the form of steam from the receiver. This did not include the steam for heating the building, but the cylinder ratio was such that it was deemed unwise to bleed a greater amount of steam from the receiver. Assuming the cost

of power $33 per kw. with no bleeding, we get cost chargeable to power with 25 per cent bled continuously $12.75+$17=$29.75. The saving then would be $33—$29.75=$3.25 per kw. year; $12.75 is the engine room charge. This was for the use of low pressure steam alone. Probably another material saving could be made by using the overflow from the condenser for water for dyeing purposes, etc.

In another mill where much more dyeing was done, requiring a large quantity of hot water, also a large amount of exhaust steam for manufacturing and heating, the cost of power, if no steam and waste products had been used, would have been about $34 per kw. year; but when the proper credits had been allowed for items chargeable to manufacturing purposes, the cost was reduced to about $26 per kw. year, or a reduction of about $8 per kw. year.

In a plain or white goods mill where no steam would be required for manufacturing other than warming the building and slashing, the saving to be effected by using receiver steam for these purposes would be about $2 per kw. About three-fifths of this, or $1.20, is for heating and the rest for slashing, so about $1.20 per kw. is the amount of the reduction which could be made in heating the buildings of an industry similar to a textile mill. The above examples represent fairly average conditions.

Several years ago in one mill there was an 800 h. p. simple, noncondensing engine exhausting into the dyehouse. If the dyehouse was running full, the firemen in the boiler room could not tell whether this engine was running or not.

In paper mills the usual custom is to drive the paper machines with simple, noncondensing engines, the exhaust from which is used in the drying cans. The net cost of this power for coal is very small. In some mills some steam is also taken from the receiver of compound engines for other low pressure work.

The Cost of Water Power. The cost of water power depends upon a great variety of factors, but the essential feature is usually the fact as to whether the combined result of all these factors is such as to make the cost of the development per horse power delivered a reasonably small amount so that the fixed charges shall not be excessive. In other words, the allowable cost of water power cannot be materially more than the net cost of producing the same amount of power for the same purpose in some other satisfactory manner, usually by steam.

There is an idea fairly common among laymen that water power is free or at least that after the development has been completed the cost of operation is practically nothing. This is not true because the fixed charges go on whether power is generated and sold or not. The largest item in the cost of water power is usually fixed charges. For instance, if a development should cost $125 per kw., the fixed charges alone would amount to about $12.50 per kw. per year whether the plant was operated or not.

Another idea is that if a development which is to produce 10-hour power costs about $100 per h. p. if carried to its most economical point, it will be a safe investment, but that if the cost reaches $200 per h. p. it will be well to proceed cautiously before investing in it. In general this idea is well grounded, but it should not be applied to all cases, as there are many factors affecting the cost of power and such great differences in the market that each case requires very careful study and general rules are not to be relied upon.

The cost of maintaining and operating a supplementary steam plant to make up for the shortage of power during low water and floods, the effects of droughts, transmission problems in the case of electric plants, etc., must all be carefully considered as factors properly affecting the actual cost of power delivered from the hydraulic plant.

For the reason that water powers usually have high independent charges they are more valuable for use on loads with high load factors than with low load factors and are hence more valuable for 24-hour power than for 10-hour power. Their value increases as the price of coal rises.

Many of the modern developments are of very large size and the cost per horse power of the plant is in some cases small. In the determination of the cost of power, the cost per horse power of development should not be allowed to confuse or cause misrepresentation of the actual cost of power delivered. Usually the larger the development installed, the smaller is the cost per horse power of development, but it does not follow in all cases that the cost of delivered power will be smaller per horse power. After the engineers have made their estimates of the cost of physical structures for these developments, there must usually be added generous items for interest during construction, interest on cost before there is any return, rights of way, incidentals, promoting, etc. The neglect of considering items like these has caused several of the recent developments to get into disrepute.

There are usually more elements of chance and more unknown factors in a hydraulic development than in a steam plant, and these facts should be taken into consideration and properly cared for.

On the other hand, a development properly made and at a reasonable cost is a valuable asset and one which bids fair to increase in value if the price of coal increases in the future as in the past.

The prices of power where the development cost $100 and $200 per horse power mentioned above do very well for the ordinary case in the eastern states. There are, however, some particular uses, like mining, for instance, where there is no supply of wood, and coal is expensive, where a high cost of development is warranted and a high price can be obtained for the power. For example, there is one development where the cost of power at some mines was from $150 to $200 a year. A hydro-electric development was made and power delivered at about $100 a horse power, thus making a great reduction in cost to the mine owners and yielding a substantial profit to the electric company.

There is a development which cost about $400 a horse power to develop. A small portion of this power could be disposed of at the mines for $75 a horse power with comparatively short transmission lines, but the remainder had to be carried a long distance and sold in competition with other power. The fixed charges alone on this development were about $30 to $35 a year a horse power, and the running expenses were also high. It was impossible to produce power cheaply enough in this case to compete with other sources of powers and pay the fixed charges on the investment.

The following example is typical of many developments in New England streams with mechanical transmission of power. Compare the cost of producing 1,000 h. p. by steam and water power on an average stream at a fixed locality, where coal is $4.50 a ton delivered to boiler house, and the production of 1,000 h. p. by steam power alone at a chosen locality, where coal is $4 and $3.50 per ton delivered to boiler house.

The assumed power of the river varies in an average year so that for the driest month 490 h. p. will be produced by water, leaving 510 h. p. to be produced by steam; and for the other months in the year the water power varies so that for four months in an average year no steam power will be required at all. The average of this steam power will be about 238 h. p. for eight months per year.

In a dry year the minimum water power will be 250 h. p. It will be necessary to run the supplementary plant for about eight months, supplying in an average year from nothing to 510 h. p. and in a dry year up to 750 h. p. In order to have such a plant run anywhere near efficiently and cost a reasonable sum, it should be of such a size as to be overloaded for a portion of the time and underloaded for the rest of the time. In this case a plant rated at 500 h. p. capable of 50 per cent overloading would answer.

The water power plant will cost about $75 per h. p. of development, or $75,000.

The cost of the water power will be as follows:

Fixed charges on cost of plant, interest, depreciation, insurance, taxes and repairs, say 9 per cent, $75,000 by 0.09	$6,750
Attendance and supplies	500
Cost of water power if no charge is made for water	$7,250

The cost of supplementary power is as follows:

Estimated cost of plant, 500 h.p. at $60	$30,000
Fixed charges at 11 per cent	3,300
Average deficiency of water power, 338 h. p. for eight months.	
Coal 338 h.p. by 2.10 lb. by 205 days by 10 hr. = 650 tons at $4.50	2,925
Attendance	1,700
Oil, waste and supplies	200
Cost of supplementary steam power	$ 8,125

$7,250 + $8,125 = $15,375, total yearly cost of water power and supplementary steam power.
$15,375 ÷ 1,000 = $15.38 per h.p.

Compare this with the cost of 1,000 h. p. produced by steam alone where coal is $4 per ton. This power should easily be made for $20 a year a horse power, thus leaving a margin in favor of water power of $20—$15.38=$4.62 a horse power. With coal at $3.50 a ton, the cost of steam power alone should be not over $18.50, with a margin in favor of water power of about $3 a horse power.

Variation in Value of Water Power.—The value of a hydro-electric power to various industries will vary in approximately the same ratio as the cost of producing power in some other way, if considered as power pure and simple, without taking into consideration other important items affecting the business, which are sometimes more vital than the cost of power itself.

To illustrate the value and cost of power under different conditions it may be well to mention the two following cases:

A price for hydro-electric power was submitted to a colored textile mill, of 1.2 cts. per kilowatt hour. After due consideration, it was decided that the mill could not afford to accept the offer, the principal reasons being:

(1) On account of the use of steam for manufacturing purposes and of the water of condensation for dyeing, the net cost of steam power would be less than the price of hydro-electric power.

(2) It was better for the textile company to own and control its own plant, if it had the capital to build it, which it had, than to purchase current brought over many miles of pole line, and be tied up to some foreign company.

The cost of power per kilowatt at the switchboard from the hydro-electric company for the operating time of the mill was about $36 per kilowatt per year, and for the steam plant which the mill was proposing to install this cost was estimated at about $34 per kilowatt year; but if the power had been bought from the hydro-electric company, the mill would have had to install and operate a boiler plant nearly as large as the one required for both power and manufacturing steam. It was estimated that the use of the waste products from the steam plant would reduce the net cost of the power at least $8 per kilowatt.

In another case offers from two hydro-electric companies were made to furnish power. One offer was promptly turned down as being too high a charge. A second offer was to furnish current at 1.2 cts. per kilowatt hour, which is the same price which was refused for the colored mill. For a plain cotton mill, however, it was decided to be proper to accept the offer of 1.2 cts. per kilowatt hour.

The principal reasons for accepting this offer were:

(1) 1.2 cts. per kilowatt hour equals about $36 a kilowatt per year, or $27 an electric horse power delivered. This reduced back to indicated horse power equals about $23.50 per year, which was very near the estimated cost of steam power for the quantity required and at the price of coal for this particular industry.

(2) The mill desired to postpone the expenditure necessary for a steam plant if it could be done without serious loss.

Relative Importance of Cheap Power.—It is evident that where power is the chief product

of a plant, and is sold as energy in the form of electric lighting or electric power, it is important to produce the output at the minimum price.

In most industrial plants power is a means used to produce other product, which is sold, and it is apparent that, other things being equal, the necessity for cheap power is more important where the cost of power is a large proportion of the cost of the product, as in electro-chemical works, and the least important where the cost of power is a small per cent of the total value of the product.

Textile mills require considerable power to run them, and the method and cost of production of this power must be kept in mind in selecting a location for a new mill and in estimating the value of an old mill already located, but it should not be allowed to play too important a part in the decision.

The chief items of cost entering into the product of a mill are materials and labor. The cost of power in a fair sized mill should not be over 5 to 6 per cent of the total value of the product. It is, therefore, far more important to locate in some place where operatives skilled in the particular kind of business to be carried on or who can be trained to this work can be obtained at reasonable wages, and where the cost of transportation of raw material and finished product is a relatively small amount, than it is to seek a location where cheap power can be obtained, but where the other items are lacking. A saving of 10 per cent in cost of power would represent a saving of about one-half of 1 per cent of the value of the product.

The relative importance of locating a plant with reference to cheap power increases as the ratio of the cost of power to the value of the product increases. The relative importance of locating a plant with reference to the supply of help decreases as the amount of help required decreases. These factors tend to make textile mills locate with reference to good help and the paper mills with reference to cheap power. The latter use less help per horse power than the former, and usually use the power for 24 hours per day. This causes water power to be more valuable to paper mills than to textile mills.

Standard Prices for Hydro-Electric Power.—Sometimes this question is asked, "Is there any standard price for electric power delivered?" There does not appear to be any standard, the prices varying largely according to the amount taken. For small amounts large prices can be obtained. The price, of course, must have a close relation to that at which power from a steam station would be sold. The prices for power in large amounts, as for textile mills for permanent power, seem to vary between $20 and $25 per horse power delivered for 10-hour power, and for 24-hour power $30 to $40 per horse power.

For surplus or secondary power which can be furnished for more than six months but less than twelve months a year, the charges cannot usually be more than at a rate of $10 to $15 a year a horse power in large amounts for 10-hour power, or say about $1 a month a horse power for such time as it is furnished, for about all that is usually saved is coal, as the fixed charges are going on all the time in the steam plant, and often a portion of the steam plant is run all the time. In a recent case it was estimated that some colored mills could afford to pay at the rate of about $15 per year for secondary power, where the power could be obtained about ten months a year. This case represents fairly average conditions, where coal costs about $4 per ton and where the power is fairly steady from day to day, so that it is not necessary to keep a full force of steam plant help.

Conclusions.—A table of the average results of the costs of power in the vicinity as outlined in this paper would be about as follows:

Under the last column heading are given the possible reductions which may be made in the net cost of power by the use of by-products from the plant for manufacturing purposes. The extreme high saving from the engines would occur only when the engine was running noncondensing, which would be an extreme case.

The saving from the use of by-products from the turbine plants has not yet been determined. The condenser water can certainly be used, and probably quite a saving can also be made from bleeding low pressure steam.

Typical use of plants.	Type of prime mover.	Hours per year.	Cost per Year. — Kw.	E.H.P.	I.H.P.	Cost per kw. hr. cts.	Possible reduction from use of by-products for manufacturing.
Textile Mill	Steam engine	3,000	$33.00	$24.60	$21.50	1.10	$1.20 to $12.00
Textile Mill	Steam turbine	3,000	29.50			.983	
Paper Mill	Steam engine	7,200	57.50	42.90	37.40	.798	1.00 to 18.00
	Steam turbine	7,200	53.00			.736	
Textile Mill	Water power	7,200	26.70 to 33.50	20.00 to 25.00		.89 to 1.12	None
Paper Mill	Water power	7,200	40.00 to 53.50	30.00 to 40.00		.55 to .75	None

Some Costs of Stadia Surveys for the New York State Water Supply Commission.*

Genesee River Surveys.—At the beginning of the year work was in progress on a topographical survey of the Genesee Valley, undertaken in order to determine just what land subject to flood and what work in the way of channel-straightening would be required to improve the present conditions. This survey was made by stadia methods, and as the configuration of the ground was not favorable for triangulation, a system of primary stadia traverses was used for control with very satisfactory results. Over 60 miles of bench levels were run, based upon several convenient bench marks of the U. S. Geological Survey, and about 100 additional bench marks established, to which the stadia surveys were connected. An area of about 56 square miles was survey, and detailed topography taken, showing the contour of the ground, its subdivision and ownership, character of culture, and the location of all railroads, highways, buildings, fences, etc. A field force of twelve men was employed from the beginning of the year until the end of July.

Division headquarters were maintained first at Mount Morris and later at Rochester, with a computing and drafting force of two to four men. Here the field notes were reduced and the results mapped upon a scale of 100 ft. per in., these maps being later reduced to smaller scale and combined into final form at the Albany office.

Canaseraga Creek Surveys.—Upon the completion of the Genesee River surveys described above, late in July, 1909, the entire force was transferred to the Canaseraga Valley, and division headquarters re-established at Mount Morris. This project had already been investigated, and the work to be done determined, but under a recent change in the law it was required to define the extent and ascertain the ownership of the land which would be benefited by, and should bear the cost of, the projected work.

After a preliminary examination of the territory involved, it was decided that instead of making separate surveys of the outlines of the flooded area and the property lines within that area, it would be both quicker and cheaper to make a single stadia survey of the entire valley, from which all this information could then be obtained. A primary traverse and system of bench levels was therefore run, and stadia topography taken, exactly as already described in the case of the Genesee River surveys. The force employed was ten men in the field and two in the office, and the work, including computing and mapping on the scale of 100 ft. per inch, occupied the months of August, September and October.

Much time and pains were spent in obtaining accurate knowledge of the extent of land which is subject to damage by flood. After the completion of this field work and large scale mapping, the maps so plotted were reduced to a scale of 400 ft. per inch, and embodied in a single sheet, on which was plotted also the outline of maximum flood, as determined from the various data enumerated above. This line constitutes the boundary of the improvement district, and a written description of it, by courses and distances, was prepared.

	Portage Reservoir, June-Nov., 1908, 18.2 sq. miles.		Genesee River Improvement, Nov. '08, July, 1909, 56.1 sq. mi.		Canaseraga Creek Improvement, Aug.-Oct., 1909, 21.8 sq. mi.	
	Total.	Per sq. mile.	Total.	Per sq. mile.	Total	Per sq. mile
Field salaries	$8,847	$376.40	$8,681	$154.70	$2,925	$134.40
Field expenses and supplies	1,188	65.30	1,284	22.90	485	22.20
Total field work	8,033	441.40	9,965	177.60	3,412	156.60
Office salaries	2,320	127.40	2,901	51.70	1,175	53.90
Office expenses and supplies	159	8.80	342	6.10	105	4.80
Total computing and mapping	2,479	136.20	3,243	57.80	1,280	58.70
Total cost	$10,512	$577.60	$13,208	$235.40	$4,693	$215.30

Cost of Stadia Surveys.—The appended table shows unit costs of the topographical surveys made in 1908 for the Portage reservoir project, and in 1909 for the projects described above. For comparison with other figures of the same nature, it may be stated that these costs include all expense of every nature, such as rent, light and heat of field offices, livery, traveling expenses, stakes and office supplies, which was incidental to the field work, and to the reduction of the notes, plotting them to a large scale on detail paper, and inking the resulting maps.

The reduction of these original maps to smaller scales and their preparation in final form for filing or publication was not done by the division force, but at the Albany office, and the cost of this work is not included here.

The large reduction in cost between the Portage and Genesee surveys is due to the more favorable ground encountered, to the greater proficiency of the men employed, most of whom were at first entirely unfamiliar with stadia surveys, and to the interest taken by them in the work, and the resulting improvements in methods which were brought into use from time to time. The Canaseraga costs are somewhat lower than those of the Genesee, mainly because of the more favorable season at which the work was done.

*Extracts from the Fifth Annual Report of the Commission for the year ending Feb. 1, 1910.

Technical Society Meetings.

The list following names those technical societies in which engineers and contractors are most interested, whose meetings are to be held within three months of the date of this issue. There are given for each society listed the date and place of meeting and the name and address of the secretary, to whom all communications and inquiries should be addressed.

American Electrochemical Society.—May 5-7. Annual meeting at Pittsburg, Pa. Secy., Jos. W. Richards, South Bethlehem, Pa.

Appalachian Engineering Association.—May 6-7. Annual meeting at Winston-Salem, N. C. Secy., Henry M. Payne, Morgantown, W. Va.

National Fire Protection Association.—May 17-19. Annual meeting at Chicago, Ill. Secy., Franklin H. Wentworth, 87 Milk St., Boston, Mass.

American Railway Association.—May 18. Annual meeting at New York City. Secy., W. F. Allen, 24 Park Pl., New York City.

International Railway Fuel Association.—May 23-26. Annual meeting at Chicago, Ill. Secy., D. B. Sebastian, 327 La Salle Station, Chicago, Ill.

National Electric Light Association.—May 23-28. Annual meeting at St. Louis, Mo. Secy., T. C. Martin, 29 West 39th St., New York City.

American Society of Mechanical Engineers.—May 31-June 3. Spring meeting at Atlantic City, N. J. Secy., Calvin W. Rice, 29 West 39th St., New York City.

Engineers' Society of Pennsylvania.—June 1-3. Annual convention at Harrisburg, Pa. Secy., E. R. Dasher, Gilbert Bldg., Harrisburg, Pa.

Personals.

Charles Lyon McIntosh, Treasurer of the J. I. Case Threshing Machine Co., of Racine, Wis., died April 19 at Naples, Italy.

Mr. Ernest Clapp, a civil engineer of Hanna, Wyo., and Miss Ida Willis of Burlington, Vt., were married April 23, in the latter city.

Mr. Robert W. Boyd, Consulting Engineer, successor to Mr. Rudolph P. Miller, has removed his offices to the Tilden Bldg., 105 W. 40th St., New York City.

Mr. Edward Wegmann, Consulting Engineer for the old Aqueduct Commission of New York City, has been appointed Chief Engineer of the New Aqueduct Commission.

Nathan S. Teeple, formerly Superintendent of Construction for the Merritt & Chapman Derrick & Wrecking Co., died April 21 at his home in Brooklyn, N. Y., aged 76 years.

Mr. Will J. Sands, for the past six years Manager of the pumping engine and hydraulic turbine department of Allis-Chalmers Co., has resigned that position and will open an office in Boston, Mass., as a consulting engineer.

Mr. R. D. Stewart has been appointed Chief Engineer and General Superintendent of the Laramie, Hahns Peak & Pacific Ry., with headquarters at Laramie, Wyo., succeeding Mr. J. J. Argo, who has been appointed Locating Engineer.

Mr. Morris K. Trumbull, heretofore Engineer of Track Elevation for the City of Chicago, has been appointed Principal Assistant Engineer of the Chicago & Western Indiana R. R. and the Belt Ry. Co., of Chicago, with headquarters at Chicago.

John Henry Miller, capitalist, who conceived the plan and constructed the Belt Line tunnel of the Baltimore & Ohio R. R., at Baltimore, Md., said to be the first electric railroad tunnel in the country, died April 24 at Baltimore of angina pectoris.

Mr. L. G. Curtis heretofore Division Engineer Maintenance of Way of the Chicago division of the Baltimore & Ohio Ry., at Chicago, has been appointed Engineer Maintenance of Way of the recently organized Northwest system. Mr. E. D. Jackson, Assistant Engineer at Baltimore, Md., succeeds Mr. Curtis.

Mr. Charles A. Sussdorf has been appointed Assistant Deputy State Architect of New York. He will have charge of work under construction at the various state institutions. Mr. Sussdorf was born in Brooklyn and entered the employ of the state in 1895 under the late Isaac G. Perry, capitol commissioner, and has served almost continuously since that time.

Mr. Louis K. Rourk, Assistant Division Engineer of the Central Division of the Isthmian Canal, has been appointed Superintendent of Streets of Boston, Mass., succeeding Mr. Guy C. Emerson. Mr. Rourke was graduated from the Massachusetts Institute of Technology in 1895 and has been in the employ of the Ithmian Canal Commission since November, 1905.

W. Bledyn Powell, City Architect of Philadelphia, Pa., died April 26, at his home in that city after a long illness from cancer. He became architect for the city of Philadelphia 20 years ago and finished the construction of the City Hall. He also was connected with the construction of the Broad Street station of the Pennsylvania R. R., at Philadelphia. He was

The following changes in the Engineering Department of the Illinois Central R. R. have been announced: Mr. Harry R. Safford, resigned as Chief Engineer of Maintenance of Way to accept the position of vice president of Edgar A. Allen & Co. of Sheffield, England. The position of chief engineer of maintenance of ways is abolished and Mr. Lewis W. Baldwin has been appointed Engineer of Maintenance of Way and Lawrence A. Downs, formerly Assistant to the Chief Engineer of Maintenance of Way, is made Assistant Engineer of Maintenance of Way. Daniel J. Brumley, formerly Engineer of Construction, has been appointed Engineer of Construction, and the engineering departments of maintenance of way and of construction have been combined under Chief Engineer A. S. Baldwin.

Catalogs Worth Having.

Engineers and contractors should have on file the latest catalogs of machines, tools and supplies that they use. In sending for catalogs reviewed or advertised in this paper, you will confer a favor on us if you will write directly to the advertisers and state that you saw the catalog mentioned in ENGINEERING-CONTRACTING. If you are in the market for tools, machinery or supplies, tell us and we will notify promptly the leading manufacturers.

Waterproofing.—Paper, 6x9 ins., 20 pp. Hydrex Felt & Engineering Co., New York.

This is a reprint of a paper read before the Western Society of Engineers, by Edward W. DeKnight, manager of the company.

Concrete Mixing Plants.—Paper, 10x6¾ ins., 24 pp. J. L. Smith Co., Old Colony Bldg., Chicago, Ill.

This is a very excellent and useful catalog containing drawings of Smith mixers of various sizes and styles. The book also contains a dozen or more designs of concrete mixing plants. These designs are for different sizes of plants and are for different local conditions and are of suggestive value in designing such plants for any location.

Gas Engines and Gas Producers.—Paper, 9x6 ins., 16 pp.

Gas and Gasoline Engines.—Paper, 9x6, 32 pp. are also given.

Fans.—Paper, 6x9 ins., 20 pp.

The Backus Water Motor Co., 98 Vanderpool St., Newark, N. J.

The catalogs here mentioned and published by the company are excellent. The gas engine and producer catalog contains illustrations and descriptions of gas producer plants for manufacturing gas particularly adapted to gas engine use. Also the gas engines of different types manufactured and tables of comparative operating costs. The gas and gasoline engine catalog contains a complete line of engines which are all of the horizontal four-cycle type and slow speed. The catalog of fans gives good descriptions and cuts showing exhaust fans and applications. Tables of sizes, speeds and prices

Railway Motor Cars.—Paper 6x9 ins. 30 pp. Catalog No. 101 B. Fairbanks, Morse & Co., Chicago and New York City.

This catalog gives illustrations and descriptions of gasoline motor cars for railroad work. The pamphlet covers all kinds of handcars and inspection cars, and also the more recently developed cars for passenger service.

Explosions.—Paper 4x9¼ ins. 20 pp. Trojan Powder Company, 65 Pine St., New York City.

Cement.—Paper 6x9¼ ins. 8 pp. Vulcanite Portland Cement Co., Philadelphia and New York.

A paper on hair cracks on concrete surfaces with methods of preventing or removing them.

Acme Corrugated Metal Culverts.—Paper 6x9 ins., 16 pp. The Canton Culvert Co., Canton, Ohio.

A catalog of "nestable" culverts made of No-Co-Ro Metal, a non-rusting material.

Roll Crushers.—Paper 6x9 ins, 16 pp. The Jeffrew Manufacturing Co., Columbus, Ohio.

A catalog of crushers for coal coke gypsum, salt, etc.

Reinforced Concrete Construction.—Paper, 6x9¼ ins., 98 pp. American Concrete-Steel Co., Union Building, Newark, N. J.

This is a catalog of illustrations and descriptions of concrete buildings of all kinds which have been built by the above company of Engineers and Contractors. The illustrations also cover the system of reinforcing concrete employed by this company. The catalog is very complete.

Hoisting Engines.—Paper, 8¼x10¾ ins., 28 pp. National Hoisting Engine Co., Harrison, N. J.

This catalog is devoted exclusively to hoisting engines, derricks and accessories. It contains about twenty-five different types of hoisting engines and tables of dimensions, weights, etc.

Leveling Rods.—Paper 3½x9 ins., 48 pp. W. & L. E. Gurley, Troy, N. Y.

This is a very excellent and complete catalog of level rods and lining poles. It contains full page, colored cuts of the various patterns made and carried by this company, together with prices and description of details.

Portable Woodworking Machines.—Circulars 4x9 ins., 8 pp.

Diaphram Bilge Trench Pump.—Circular 3½x6 ins., 4 pp. C. H. & E. Mfg. Co., 321 Mineral St., Milwaukee, Wis.

These circulars illustrate and set forth the uses of the portable machinery which the above company manufactures. The machines are all built to be handled in one piece including gasoline engine. Prices are also given.

Hydro-bar Water Proofing.—Paper 6x9 ins. 20 pp. F. William Stocker & Co., Inc., General Sales Agents, 34 N. 33d St., New York.

A catalog, illustrative and descriptive of the merits of this waterproofing material.

Improvement of New York Harbor.—Cloth 6x9⅜ ins. 60 pp. Joseph Edwards Dredging Company, 16 Exchange Place., New York.

Because of his having designed and managed a plant for use on the Improvement of New York Harbor some years ago, and has received various inquiries relating to the work from engineers and others who are contemplating similar improvements elsewhere, Mr. Joseph Edwards has prepared this book as a means of facilitating the above inquiries. It gives an excellent account of the work covering the necessity for deeper water in Lower Bay, location and character of its channels; their condition before and after the work was done; the estimated and actual cost of the improvement; prices per cubic yard paid for the work; the means and method employed, and a discription of the plant with drawings.

Keystone Cable Drills.—Paper 8½x11¼ ins. 36 pp. Keystone Driller Co., Beaver Falls, Pa., and Monadnock Block, Chicago.

An excellent catalog giving a description of Blast Hole drilling with well drilling machines. All sizes, depths and loading of holes; discription of machines, steam and electrically driven, and price lists.

Water Pipe.—Paper 9x6 ins. 28 pp. The East Jersey Pipe Co.

A very well gotten up catalog containing discriptions and illustrations of both the Riveted and Lock Bar Pipe made by this company. Also a discussion on pipe carrying capacity. Diagrams of safe working pressure for different heads up to 1000 ft., and sizes of pipe up to 96 and 1 1/16 ins. thick are given.

Good Roads Convention in Montana.—A good roads convention is to be held in Billings, Mont., June 16, 17 and 18, for the purpose of discussing ways and means for the improvement of the public highways of Montana and to awaken a more general interest in that state in road building and improvement. The following persons have been named by Governor Norris as the executive committee: W. B. George, I. D. O'Donnell, P. B. Moss, W. S. Garnsey, H. W. Rowley, J. Collins West, E. B. Campbell, Christian Yegen, R. E. Shepherd and W. A. Selvidge of Billings, W. M. Bickford and E. C. Largey of Butte, J. C. McCarthy of Bozeman, Frank M. Smith of Helena, W. R. Allen of Anaconda, A. W. Miles of Livingston, W. A. Talmage of Red Lodge, J. M. Keith of Missoula and C. F. Murphy of Great Falls. A meeting of the executive committee is to be held at Billings, March 19, at 2 o'clock p. m., to make preliminary arrangements for the convention, and for the transaction of such other business as may properly come before the committee.

Forest Products Laboratory.—The opening of the Forest Products Laboratory at Madison, Wis., will take place on June 4. To aid by means of experiments and demonstration in lessening waste in the manufacture and use of wood is the object of this laboratory. The state of Wisconsin has erected for the purpose a new building at the university and will provide light, heat, and power. The Forest Service has supplied the equipment and apparatus and will maintain the force of thirty-five or forty persons required to carry on the work. Through this arrangement the United States has secured perhaps the largest and best equipped wood testing laboratory in the world. The laboratory will be prepared to make tests on the strength and other properties of wood, to investigate processes of treating timber to prevent destruction by decay and other causes, to study the saving of wood waste by distillation processes, and to determine the relation of the microscopic structure of wood to its characteristics and properties. Facilities are at hand in fact for almost any kind of test on wood that practical conditions may require. Lumber manufacturing and wood using industries should make large practical use of this laboratory in finding methods of reducing the waste of wood—a subject of vital concern.

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Containing Items of Interest to Railroad, Public Works and Other Contractors.

The Doings of the Week.

The New York State Public Service Commission will hold its first hearing at New York city on May 9 on the construction of the proposed new subway rapid transit system for that city.—An important development in the railroad bill situation now under consideration by congress was taken on April 29, when the house adopted the Madden amendment, which provides for the valuation, physical and otherwise, of the railroad properties of the country. Contracts for levee work for the Mississippi Levee Commissioners involving the moving of 927,000 cu. yds. of material were let last week as follows: Roach, Stansell & Jennings, Memphis, Tenn., 527,000 cu. yds.; Dulaney & Foote, Grace, Miss., 252,000 cu. yds.; Clarke & Co., Natchez, Miss., 148,000 cu. yds.—The city of Ashtabula, O., opened bids April 27 for a considerable amount of improvement work to Ashtabula Creek in that city, the Inland Waterways Improvement Co. of Ashtabula at $281,000 being the lowest bidder.—Among the railroad construction contracts let recently are the following: John Marsch, 181 La Salle St., Chicago, for grading of second track for the Elgin, Joliet & Eastern Ry. from Frankfort, Ill., to Matterson, 7½ miles; A. H. Hartigan & Co., Gary, Ind., for grading for second track for the Elgin, Joliet & Eastern Ry. from Griffith to Ivanhoe Sand Pit, Ind., 5½ miles; Newkirk & Powers Construction Co., Joliet, Ill., for masonry work for 13 miles of double track work on the Elgin, Joliet & Eastern Ry.; Cowan Construction Co., for extension of the Oak Point line of the Canadian Northern Ry.; C. J. Murray, for the extension of the Canadian Northern Ry. line west from Prince Albert, and for the line northwest of Prince Albert; Martin, Welch & Co., subcontract from J. W. Stewart & Co., for building 20-mile section of the V., V. & E. Ry. between Abbottsford and Chilliwack; P. M. Johnson Son & Allhands, St. Elmo, Ill., for extending the Buckeye spur of the St. Louis, Brownsville & Mexico Ry. for a distance of eight miles; Holmes & Sharkey, Press & Rush, L. A. Johnson, Jno. Parr and Beatty & Powell, subcontracts from Geo. H. Webster, Alix, Alberta, for work on the Tofield-Calgary branch of the Grand Trunk Pacific Ry. in Alberta; Bean & Jones, Benton Harbor, Mich., for clearing, grading and building culverts between Eau Claire and Dowagiac, Mich., for the Dowagiac Ry. Co.; Fred A. Baxter, Superior, Wis., for grading of Soo Ry. ore line and yards at Superior; Fred T. Ley & Co., Springfield, Mass., for constructing ten reinforced concrete bridges and eight concrete culverts for the electric railway now under construction between Portland, Me., and Lewiston, Me.

This in on Potter.

Down in New York they tell this story on Alexander Potter, the consulting engineer of that city. Mr. Potter be it known is not exactly large in physical build and moreover he is of a very quiet disposition. A little while ago he bought a place in the country and undertook a considerable amount of reconstruction work on it, Mrs. Potter having charge of the job. She bossed the job nearly every day and hired and fired the laborers herself. Laborers were scarce in that neighborhood and pretty nearly every man who came along was sure of a job. None of those who were at work had ever seen Mr. Potter, as he was too busy in town to take more than a Sunday look at what had been done during the week. One day, though, says the New York Press, Potter was out of sorts and decided to stay at home and get close to nature with his wife's gang of Italians. So in the oldest clothes he could find he joined the diggers. He was thinking of what a fine shoveler he was when some one behind him gave him an ungentle kick. He dropped his shovel and swung around. A big Irishman was glowering down at him. "Yees'll fill yer shovel better than thot or ye'll fill yer coat an' git out-a here," the Irishman said in a voice of authority. Potter realized that he had been taken for a new man on the job and made no reply. The next two hours he worked harder than he ever had in his life before. He did not dare quit until Mrs. Potter appeared. At last she came. "You're wanted at the telephone, dear," she called out as she approached. The big Irishman did not quite "tumble" even then; but he did when he saw his new laborer walk off to the house with the "lady boss."

The First Railroad in Illinois.

In 1837 the state of Illinois laid out an ambitious scheme in the way of railroad construction. In that year a bill was introduced in the legislature to build eight lines of railroad: First, the Central from Cairo to Galena; second, a branch of the same, from Hillsboro eastward to the Indiana state line; third, the Southern Cross railroad, from Alton to Mt. Carmel; fourth, the Northern Cross road, from Quincy via Jacksonville, Springfield and Decatur to the Indiana state line; fifth, from Peoria to Warsaw; sixth, from Alton eastward to intersect the Central, though there now seems some doubt as to whether this was not included in the Mt. Carmel-Alton project; seventh, from Belleville to intersect the Southern Cross; and eighth, from Bloomington to Mackinaw, with branches to Peoria and Pekin. As the construction of these eight railroads would have cost the state something like $10,000,000, there was naturally much opposition to the bill. Finally, however, a compromise was effected and the bill was passed, under the condition that the Northern Cross railroad should be built first. The building of the line was placed in charge of the commissioner of the first judicial district and surveys were at once started. The engineers succeeded in getting a good line with practically no curves until they reached Jacksonville. The first survey through that town ran along the northern outskirts where the Wabash R. R. now has its route. Certain of the townspeople objected to this survey, claiming that the selection of this route was due to the fact that the commissioner owned property through which the road was to run. This the commissioner denied and to add strength to his denial had the route changed. Accordingly much to the disgust of the engineers two long transverse curves were interjected into an otherwise straight road, turning the line into West State St., and sending it along the main street and through the central square of the town. It is needless to add that the townspeople were glad enough to get the track back again to the original survey, ten years later. The first locomotive the "Rogers" used on the road was built by Rogers, Grossvenor & Ketchum of New Jersey. It was intended for the Bloomington & Mackinaw R. R., a road which met an untimely end, even before the completion of surveys. As the Northern Cross R. R. had previously ordered a locomotive from the same concern, and as this locomotive had been "lost in transit," the one intended for the B. & M. R. R. was turned over to it. The machine was shipped by sea to New Orleans and then by packet to Meredosia where it was put on the rails on Nov. 8, 1838. Illinois was then something of a wilderness and there was no one who knew how to keep the locomotive in repair. As a result the "Rogers" and another locomotive that was used for a time began to fall to pieces and when in 1844 they were in such shape that they kept people awake by their noise they were discarded, and mule power substituted. The "Rogers" was then turned over by the state to James M. Semple, at that time U. S. Senator from Illinois, to experiment with in carrying out a plan he had devised of constructing a large prairie steam wagon, with which he intended to carry passengers over the great prairies of Illinois. The locomotive was turned over to Mr. Semple near Berlin in the western part of Sangamon County, where after many strange experiences, he was compelled to abandon it within a few hundred feet of the railroad tracks. Here under the influence of the weather and the appropriations of those who wanted a bit of metal or wood it went to pieces.

Cleaning Pipe Sewers.

Pipe sewers are often cleaned by passing a rope through the sewer and pulling it back and forth until the obstructing cause is loosened. To get the rope through the sewer is in some cases more or less of a problem. In some of the Pacific coast cities the sewer officials are said to have pressed the catfish into service as an aid in getting the rope through the sewer. Out there when a sewer gets plugged up, the sewer cleaner goes to the river, catches a catfish, ties a string to its tail and drops it down a manhole into the sewer. The fish at once starts for the river and forces its way through any obstruction not as solid as brick, dragging the string after it. Then the laborer goes to the next manhole and picks up the string which he uses to draw a wire through the sewer, and with this wire a rope is pulled through. "Uncle" Herman Burt, who has been in charge of the sewer system of a Massachusetts city for the past 30 years, uses a somewhat similar plan. In his case, however, he uses a ferret for pulling the string through the sewer. In order to offer some inducement to the ferret to make the trip, a rat is usually let loose in the sewer, and the ferret is said to follow in hot pursuit dragging the string after it. This scheme is reported to have worked well except in cases when the ferret caught up with the rat. When this happened they had to pull the ferret out by the tail and get a new rat.

The Omaha & Council Bluffs Street Ry. Co., of Omaha, Neb., is to have work started at once on its Elmwood Park extension at Omaha. The extension will go from 48th and Leavenworth Sts. to the park entrance, and is to be completed within six weeks.

Confirmed Reports by Engineers and Contractors

RAILROADS, POWER DEVELOPMENTS, LEVEES, DRAINAGE AND IRRIGATION WORKS.

Railroads—Steam and Electric.

CALIFORNIA.

The San Jacinto Valley Ry. Co. has made surveys for part of its projected 32-mile electric railway from Hemet to Riverside. The capital for construction has been secured and construction contracts will be let within 90 days. J. S. Jackson, San Jacinto, Cal., is interested.

COLORADO.

The Colorado & Southern Ry. is to reballast and lay heavier steel rails on its line between Greeley and Fort Collins. The work is not to be done this year, but probably will be done next year.

The Paradox Pacific Construction & Land Co. is having surveys made for its projected line (Paradox Valley R. R.) from Montrose, Colo., to Paradox, Colo. The line will be about 105 miles long, and the capital for its construction has been secured. Construction contracts are to be let some time in July. Fred L. Lucas, 706 Ideal Bldg., Denver, Colo., is chief engineer, and Carmon Layton, Montrose, Colo., is President.

IDAHO.

The Yellowstone Park R. R. Co. has completed surveys for its projected 40 mile line from Ashton to Driggs, Idaho. The capital for construction has not been secured as yet and the time for awarding construction contents has not been determined. This is an Oregon Short Line project and Wm. Ashton, Salt Lake City, Utah, is Chief Engineer.

ILLINOIS.

The Oil Belt Traction Co. of Oblong, Ill., will be ready about June 1 to let contracts for about 12 miles of good grade work for an electric railroad between Bridgeport and Hardensville, Ill. G. W. Low, Oblong, Ill., is engineer for this company.

The Elgin, Joliet & Eastern Ry. has awarded the contract for grading of second track from Frankfort to Matteson, a distance of 7½ miles, to John Marsch, 181 La Salle St., Chicago. The masonry work on this section of second track has been let to the Newkirk & Powers Construction Co., of Joliet. Contract for grading second track from Griffith to Ivanhoe Sand Pit, Indiana, a distance of 5½ miles, has been let to the A. F. Hartigan Co. of Gary, Ind. Newkirk & Powers Construction Co. also have the masonry work on this job. There will be about 50,000 yds. of grading between Frankfort and Matteson and about 25,000 yds. between Griffith and Ivanhoe.

MONTANA

The Eastern Montana Electric Ry. Co. has completed its preliminary work and now has location work under way. As previously noted, the company projects an 80 mile line from Red Lodge, Mont., via Clark's Fork and Bear Creek. F. A. Kesselhuth, Stapleton Bldg., Billings, Mont., is Chief Engineer. The eastern office of the company is at Room 1006 27 William St., New York City.

OHIO.

J. T. Adams, Railroad Contractor, Columbus, O., is now in Jamestown, N. Dak., where he will let about 30 miles of good scraper work on the Midland Continental Ry; 75 per cent of this is slip scraper work and side borrow and all of it short haul. Good prices will be paid.

PENNSYLVANIA

The Blue Ridge Ry. Co., organized at Waynesboro to build a 2½ mile extension of the Chambersburg, Greencastle & Waynesboro Street Ry., has secured the necessary capital for construction purposes and will let construction contracts this fall. The line is to extend from Pen Mar to Blue Ridge and will require one mile of side cutting on mountain side, which will be heavy work. G. B. Beaver, Waynesboro, Pa., is President, and R. D. Sefton, Waynesboro, is General Manager.

TEXAS.

P. M. Johnson Son & Allhands, with home office at St. Elmo, Ill., has been awarded the contract for extending the Buckeye spur of the St. Louis, Brownsville & Mexico Ry. from its present terminus, Collegeport, a distance of eight miles.

CANADA.

The Algoma Central & Hudson Bay Ry. Co., C. N. Coburn, Chief Engineer, Sault Ste. Marie, Ont., will receive tenders until noon, May 16, for the clearing of right of way, construction of bridges, cleaning of cuts, making up embankment of that portion of Algoma Central & Hudson Bay Ry. main line already graded between present end of steel, mile 69, north of Sault Ste. Marie and Hawk Lake Junction, approximately 100 miles. This work will be let in sections.

Grading work is now under way on the Tofield-Calgary branch of the Grand Trunk Pacific Ry. in the Province of Alberta. This contract was let to Geo. H. Webster of Winnipeg, Man., and work headquarters at Alix, Alberta, as previously noted in this paper. This is prairie work, but is heavy; there is no rock. The contract includes about 3,000,000 cu. yds. of earth excavation, one bridge over Red Deer River, 1,480 ft. long, 140 ft. high, steel with concrete foundation and wood culverts requiring about 2,000,000 ft. B. M. of cedar. The sub-contractors on the work are Holmes & Sharkey, Press & Rush, L. A. Johnson, Jno. Parr and Beatty & Powell.

Power Developments, Levees, Drainage and Irrigation Works.

COLORADO.

Enginers of the Clay Creek Reservoir & Irrigation Co., of Lamar, Colo., are rapidly completing the survey of the reservoir site and actual work on the construction of the system will begin within the next 30 days. The construction work will be done by a firm of Kansas City contractors. The Clay Creek system contemplates the irrigation of 8,000 acres south of Lamar. The capacity of the reservoir will be 11,000 acre feet and about 20 miles of ditch will be constructed. The parties back of this system are contemplating putting in two, and possibly three, systems, each of which will be larger than that on Clay Creek. Announcements in regard to these will possibly be made within the next 30 days. C. M. Scott, Lamar, Colo., is secretary of the Clay Creek Reservoir & Irrigation Co.

No. of Ditch.	Location. County	Town.	Range.	Length in Miles.	Average Depth in Feet.	Bottom Width Feet.	Cubic Yards.
No 83.	Marshall	155-157	41-43	14.25	6.0	60	720,000.0
No. 90.	Kittson	158-160	45-46	13.0	7.0	10	302,484.4
Lateral No. 1.	Kittson	158-160	45-46	2.5	5.5	6	22,878.1
Lateral No. 2.	Kittson	158-160	45-46	2.75	6.0	6	27,286.9
Lateral No. 3	Kittson	158-160	45-46	3.5	6.0	6	36,390.7
Lateral No. 4.	Kittson	158-160	45-46	2.5	6.0	6	28,058.4
Lateral No. 5.	Kittson	158-160	45-46	6.5	6.0	6	61,001.1
Lateral No. 6	Kittson	158-160	45-46	0.75	5.0	6	8,000.1
No. 91.	Roseau	159-160	42-44	12.5	8.0	16-20	254,422.8
Lateral No. 1.	Roseau	161	42	6.5	6.0	6-8	93,688.3
Lateral No. 2.	Roseau	160	42	6.25	6.0	6	62,632.4
Lateral No. 3.	Roseau	160	42-43	10.0	6.0	6-8	103,750.4
Lateral No. 4.	Roseau	160	41-43	17.0	6.0	6-10	192,901.3
Lateral No. 5	Roseau	159-160	41-43	15.75	6.0	6-8	131,657.8
Lateral No. 6	Roseau	159-160	43	8.2	6.0	6	76,751.3
Lateral No. 7.	Roseau	159-160	43	8.2	6.0	6	70,257.9
Lateral No. 8	Roseau	159-160	43	8.25	6.0	6	93,542.0
Lateral No. 9	Roseau	159-160	43	8.1	6.0	6	68,186.5
Lateral No. 10.	Roseau	159-160	44	4.5	5.0	6	39,900.4
Lateral No. 11.	Roseau	160	42	5.5	5.0	6	44,746.5
Lateral No. 12	Roseau	159	43	5.5	5.0	6	52,744.9
Lateral No. 13.	Roseau	159	42	5.5	5.0	6	51,526.6
No. 92.	Koochiching	152-153	25-26	10.5	6.0	8-10	118,965.0
Lateral No. 1.	Koochiching	153-154	25	5.0	6.0	6	90,573.0
Lateral No. 2.	Koochiching	152-153	25	2.4	5.0	8	24,938.3

The ditches are to have side slopes 1 to 1. The nearest railway stations to the work are as follows: Ditch No. 83, Sandridge, six miles; Ditch No. 90, and laterals, Karlstad, 1 to 8 miles; Ditch No. 91 and laterals, Green-

ILLINOIS.

Bids were received April 25 by Major Thos. H. Rees, U. S. Engineers, Chicago, Ill., for dredging 700,000 cu. yds. in the Calumet River, Illinois. For dredging 445,000 cu. yds. at or near the forks, the following bids per cubic yard place measurement were received, the methods of disposal being as follows: (1) On adjacent shore, (2) in 50 ft. of water in lake, (3) along shore and not more than two miles from mouth of river; Samuel O. Dixon, Milwaukee, Wis., (1) 24 cts., (2) 28 cts., (3) 23 cts.; Duluth-Superior Dredging Co., Duluth, Minn., (1) 23 cts., (2) 28 cts., (3) 24 cts.; the Fitzsimmons & Connell Co., Chicago, Ill., (2) 30 cts., (3) 25 cts.; Great Lakes Dredge & Dock Co., Chicago, Ill., (1) 22.8 cts., (2) 27 cts., (3) 22.8 cts. For dredging 255,000 cu. yds. below the forks the following bids were received: Buffalo Dredging Co., Buffalo, N. Y., (2) 30 cts., (3) 25 cts.; Samuel O. Dixon, Milwaukee, Wis., (1) 25 cts., (2) 28 cts., (3) 25 cts.; Duluth-Superior Dredging Co., Duluth, Minn., (1) 24 cts., (2) 29 cts., (3) 24 cts.; the Fitzsimmons & Connell Co., Chicago, Ill., (2) 30 cts., (3) 25 cts.; Great Lakes Dredge & Dock Co., Chicago, Ill., (1) 23.5 cts., (2) 27.5 cts., (3) 23.5 cts. The bid of the Great Lakes Dredge & Dock Co. was recommended for acceptance.

MASSACHUSETTS.

Bids as follows were received Apr. 23 at the U. S. Engineer's Office at Newport, R. I., for dredging in harbors at New Bedford and Fair Haven, Mass: Coastwise Dredging Co., Norfolk, Va., $9,605; J. S. Packard Dredging Co., Providence, R. I., $9,295.

MICHIGAN.

Love & Nelson, Muskegon, Mich., have been awarded the contract at $33,586, for constructing revetments along Black River on both sides of the channel inside of Government piers. The revetment is to be installed to enable South Haven harbor to obtain benefits of a former appropriation of $279,000 and additional appropriation in present Government River and Harbor Bill.

MINNESOTA.

The State Drainage Commission, George A. Ralph, State Engineer, St. Paul, Minn., will award contracts May 18 for the following drainage work:

bush, 1¼ to 8 miles, and Strathcona, 2 to 4 miles of lateral 11, 12 and 13; Ditch No. 92 and laterals, Margie, 1 to 6 miles. Ditch No. 83 is located in river bottom, open land. Ditch No. 90 and laterals are in open meadow and marsh. Ditch No. 91 and laterals follow old ditch in open meadow and marsh land, and Ditch No. 92 and lateral are through scattering tamarac timber.

The following bids, per cu. yd. scow measurement, were received Apr. 25, at the U. S. Engineer's Office, Duluth, Minn., for dredging in Duluth—Superior Harbor, $20,000 being available for the work: Zenith Dredge Co., Duluth, Minn., 14 cts.; Great Lakes Dredge & Dock Co., Chicago, Ill., 15½ cts.; Duluth-Superior Dredging Co., Duluth, Minn., 12½ cts.

MISSISSIPPI.

Contracts for levee work for the Mississippi Levee Commissioners, W. J. Shackelford, chief engineer, bids for which were opened April 27 at Greenville, Miss., have been let as follows: New levee at Riverton, to Roach, Stansell & Jennings of Memphis, Tenn., 527,000 cu. yds. at 21½ cts.; new levee at Shiloh, secs. 1 and 2 to Dulaney & Foote, Grace, Miss., 252,000 yds. at 16 cts., sec. 3 to Clarke & Co., Natchez, Miss., 148,000 yds. at 16.4 cts.

NEW YORK.

The D'Olier Engineering Co., 121 S. 11th St., Philadelphia, Pa., as previously noted, has been awarded contract No. 90 for work on the New York State Barge Canal. This contract calls for furnishing and installing equipment for operating and lighting locks at Whitehall, Comstock, Smiths Basin, Oswego, Fulton, Baldwinsville, and Phoenix. The work includes: 200 cu. yds. excavation, 310 cu. ft. chipping concrete, 200 cu. yds. forming embankment, 44 cu. yds. second-class concrete, 380 cu. yds. first-class reinforced concrete, 203,000 lbs. structural steel, 24,000 lbs. metal reinforcement, 153,000 lbs. iron castings, plain, 4,400 lbs. iron castings, machined, 21,600 lbs. metal ducts, 200 sq. yds. repaving gutters, 60 lin. ft. wrought iron pipe railing, 10,200 lin. ft. concrete conduit, single duct, 3,720 lin. ft. concrete conduit, double duct, 930 lin. ft. reinforced concrete conduit, double duct, 470 lin. ft. drilling 1½-in. holes for ducts, 280 lin. ft. drilling 3-in. holes for ducts, 500 lin. ft. 3-in. fibre duct, 30 squares roofing, 71,300 lbs. lead-covered rubber insulated conductors, etc.

OHIO.

The following bids were received April 27, by the Director of Public Service of Ashtabula, O., for improving Ashtabula Creek at that city: Buffalo Dredging Co., Buffalo, N. Y., $317,068; Great Lakes Dredging & Dock Co., Cleveland, O., $289,600; The Inland Waterways Improvement Co., Ashtabula, O., $281,000. The work includes approximately, 360,327 cu. yds. of earth excavation; 136,487 cu. yds. of rock excavation, and 2,160 lin. ft. of "I" beam bulkhead.

WYOMING.

E. J. Fisher, Rock Springs, Wyo., has been awarded the contract for constructing the Covey Canal at Cokeville, Wyo. The work includes 80,000 cu. yds. earth excavation, 2,000 cu. yds. rock excavation, 2,000 cu. yds. of embankment, and about 10 bridges.

Right of way and site for a depot have been granted by Secretary Ballinger to the Belle Fourche Valley R. R. at Newell, S. Dak. Surveys through the town were made by the railroad engineers some time ago.

It is now believed that construction work on the proposed Ely-Goldfield R. R. will not be started until late this summer. The reason for this, according to a statement of W. R. Alberger, Los Angeles, Cal., Traffic Manager of Tonopah & Tidewater R. R., given in the Tonopah Sun, is as follows: "There have been some alterations necessary with regard to the original survey which will delay the beginning of the construction of the road. These changes in the survey are now being made, which will not, however, alter the route as surveyed to a great degree. No contracts have been let, nor will any be awarded until a perfect survey is completed. It will probably be late in the summer before the laying of the road-bed will begin."

The Cimarron & Northwestern Co. has received a shipment of ten cars of steel rails for the proposed 9-mile extension of the road from the Ponil into the Bonita Canyon in New Mexico. Engineers are now at work locating the definite right of way for the new work. H. G. Frankinburger, Cimarron, N. Mex., is secretary of the company.

Surveys are under way by the engineers of the El Paso & Southwestern Ry. Co., for the location of a route for an extension from Benson, Ariz., to Tucson and Phoenix. Construction work, it is said, will be started on the proposed road this summer. Walter Douglas, Bisbee, Ariz., is vice president of the El Paso & Southwestern Ry.

Surveys are now being completed for the construction of a line of railroad from Jackson, Ky., through the mountains entering the richest coal fields in the state. Construction work will be started, it is said, this summer, providing all right of way can be secured by the promoters.

The New Orleans Great Northern Ry. is stated to have secured the right of way for its road to enter Jackson, Miss., from the junction with the Illinois Central tracks, four miles south of the city. All surveys have been completed and arrangements made to start the work of grading and track laying. From Negan, the present northern terminus of the Great Northern tracks, to the limits of the city proper is about three miles, from whence the line will parallel the track of the Illinois Central, cross those of the Gulf and Ship Island and the Alabama and Vicksburg and run up the Pearl river front to the property which has been acquired for terminal buildings, yards, switches, round house and such essentials. Eventually it is intended to extend through and beyond the city, passing around the entire front, and thence on up the valley of Pearl river.

According to advices from Jackson, Ky., the Lexington & Eastern Ry. Co. will start work at once on the extension of its line to a connection with the Kentucky River Development Company's line at Quicksand. John Marston, Lexington, Ky., is chief engineer of the L. & E. Ry.

Engineers are at work making surveys for the construction of the Southern New England Railway, the recently chartered Grand Trunk Ry. branch. Three engineering parties are engaged upon the work and are located at Woonsocket, R. I., Webster, Mass., and Palmer, Mass. The entire force numbers 36 men.

The citizens of Abbeville, S. C., have requested the city council to appropriate $1,000 for the purpose of defraying the expenses incident to making a preliminary survey of a feasible route for the proposed trolley line from Abbeville to Due West, or to such point in the vicinity of Due West as shall be deemed best. The engineer is to be secured by a committee appointed by Mayor J. E. Jones of Abbeville.

The Eureka & Palisade Ry., A. R. Randolph, assistant superintendent, Palisade, Nev., is to rebuild the washed out portion of its line.

Preliminary surveys are to be started soon for the Lynchburg, Amherst & Northern R. R., which projects a line from Lynchburg to Amhurst, Va. The road will require the building of three steel bridges. Among those interested in the company are: H. L. Page, president; J. T. Bonney, secretary; H. C. Joyner, J. E. Bowman, C. A. Jubert, Flickley Tucker, W. Ward Hill, C. L. Scott and C. J. Campbell, all of Amherst, Va. Wallace A. Taylor, of Lynchburg, Va., and W. E. Walker, of Sweetbrier, Va.

The Southern Pacific Company has had engineers in Reno, Nev., surveying in the west end of the yards, and has ordered all persons who own buildings on railroad land in that portion of the city, or who are living in houses on the Southern Pacific land to vacate immediately. It is believed that the company intends to build new freight sheds there and to lay more tracks. It also intends to build a new depot and to improve the grounds in the interior of the city.

Reports from Miles City, Mont., state that the Tongue River Ranch Co., which company owns the former A. B. Clarke ranch on the Tongue River, has let a contract to Magnus Svenson for the construction of a rock and brush dam across the river at the head of the ditch which irrigates the ranch, or a portion of it. The ranch is located about 45 miles from Miles City. The ditch in connection is nine miles in length and Mr. Svenson's contract will include cleaning this out and repairing it also.

Engineers of the Tonopah & Goldfield R. R., F. T. Armstead, Engineer Maintenance of Way, Tonopah, Nev., have completed surveys for a route from Tonopah Junction to the Mono Lake District. A feasible route was found.

In a recent interview J. C. Stubbs, vice-president of the Harriman Lines, reported the progress of double track work on the Union Pacific as follows: Work of second tracking has been finished from Omaha to Watson's Ranch, about 201 miles; about 25 miles more has been completed between Kearney and North Platte, and we are going right along to complete the work from North Platte to Julesburg, about 80 miles, and to fill in the gaps between Watson's Ranch and North Platte, about 75 miles. In addition, 20 miles from Cheyenne to Ruford is completed; 40 miles between Lookout and Hanna, Wyo., 60 miles between Rawlins and Wamsutter; 26 miles between Point of Rocks and Blairtown, and 30 miles between Green River and Granger.

Fred T. Ley & Co., Springfield, Mass., has been awarded the contract for constructing 10 reinforced concrete bridges and 8 concrete culverts for the electric railway now being built between Portland, Me., and Lewiston, Me., for Libbey & Dingley, Lewiston, Me. The line will be 35 miles long, and it is expected that the road will be opened to traffic next summer.

The City Council of Chicopee, Mass., has voted to request the Springfield Street Ry. Co., Springfield, Mass., to continue one of its Chicopee Falls lines across the Chicopee bridge and along Montgomery and Sheridan Sts. by St. Patrick's church to the junction of Sheridan and Emmet Sts.

The Newport & Licking Valley Traction Co. has opened offices in Cynthiana, Ky., and is preparing to have the grading work started. All the right of way has been secured and engineers are now reported to be preparing final details for the line between Cynthiana and Paris, Ky.

The Charleston Ry. & Lighting Co., has been organized with a capital stock of $2,000,000 to take over the Consolidated Ry. Gas & Electric Co. of which P. H. Gadsden, Charleston, S. C., is president. It is reported that a number of improvements will be made in Charleston.

W. H. Fox, superintendent, Tennessee Central, Nashville, Tenn., has submitted a proposition to a committee of citizens of DeKalb county, offering to construct an extension from the main line to Smithville and onto Chattanooga, Tenn., providing the county will vote to take stocks amounting to $150,000, and issue bonds for that amount.

Items Concerning Contractors and Their Work

RAILROADS, POWER DEVELOPMENTS, LEVEES, DRAINAGE AND IRRIGATION WORKS.

Alabama Notes.

FROM CORRESPONDENTS AND OTHER SOURCES.

W. J. Cameron, G. C. Kelly, and F. G. Anderson have applied to the city council of Birmingham, Ala., for a franchise to build street car lines in the principal streets of the city.

The city council of Birmingham has granted a franchise to the Birmingham Railway, Light & Power Co. to construct an extension to the suburbs of Corey. Work on the line, which also is to extend to Ensley, is to be started soon.

The Dauphin Island Ry. & Harbor Co. has been formed at Birmingham, with a nominal capital stake of $3,000. The objects of the company are to establish a coaling station on Dauphin Island, at the mouth of Mobile bay, the dredging of a 30-ft. channel from Mobile bay to Dauphin bay being included in the plans. The charter granted authorizes the company to engage in a general railway business, as well as the establishment of other means of transportation. The temporary offices of the company will be in Birmingham, J. M. Dewberry of that city being agent. Officers and incorporators are: George T. Bishop of Cleveland, O., president; F. F. Graves of Chicago, vice president; J. M. Dewberry of Birmingham, secretary; Frank H. Senn of Cleveland and D. E. Mitchell of Lebanon, Tenn., directors.

Arkansas Notes.

FROM CORRESPONDENTS AND OTHER SOURCES.

The Cotton Belt (St. Louis Southwestern) has instituted condemnation proceedings for the building of its new shops at Argenta.

Commercial Club of Nashville, Ark., is taking up the matter with other organizations of securing the extension of the Louisiana & Arkansas R. R. from Hope, via Columbus, Nashville and Lockesburg to De Queen.

The Hot Springs Glenwood & Western R. R. Co., has been incorporated with a capital stock of $75,000 and proposes the construction of a railroad from Glenwood in Pike County to Caney in Montgomery County, a distance of 6 miles with an ultimate intention of extending the line to Hot Springs. The incorporators are A. L. Clark, J. A. Bonner, W. E. Mayher, C. T. Crosby and S. W. Pryor. A portion of the required capital amounting to $12,000 has already been subscribed.

Advices from Rector, Ark., state that S. P. Weigart and associates are taking steps to secure the construction of an extension of the Kennett-Piggott Railroad to the proposed townsite in Blue Cave township, Clay County.

California Notes.

FROM CORRESPONDENTS AND OTHER SOURCES.

Thomas W. Forsyth has asked the board of supervisors of San Francisco to offer for sale a franchise for an electric railroad to commence at the intersection of Parnassus and Third Aves., along Parnassus Ave. to J St., and along J St. to Pacheco St.

The Riverside Portland Cement Co. of Riverside is reported to have been awarded the contract by Los Angeles county for furnishing 100,000 tons of crushed rock for the highway work for 70 cts. a ton on board of cars at Riverside. The board of supervisors has already contracted to buy 76,000 tons from the same company at the same price.

The Northern California Power Co. has brought condemnation suits at Redding to acquire the last of the land needed for its projected storage reservoir. The company proposes to make a storage reservoir of 1,540 acres on Dry Burney Creek, eight miles from Kilarc in a straight line. A dam 38 ft. high will be built and this will restrain water to a depth of 35 ft. over this 2½ square mile area. The power company has a power plant at Kilarc that generates 4,000 h. p. It is proposed to increase the capacity of the Kilarc plant to 7,000 h. p. and build an auxiliary plant down stream, using the same water again, and generate 4,000 h. p. The proposed reservoir is eight miles from Kilarc in Dry Burney Creek basin. A tunnel 7,000 ft. long will be dug through the divide between Old Cow Creek Valley and Dry Burney Creek basin to convey the water.

Announcement has been made that the Los Angeles Pacific Electric Ry. intends to four track its entire route from Los Angeles over the short line to Santa Monica within the near future.

The directors of the Bear Valley Mutual Water Co. have accepted the plans of John S. Eastwood, C. E., of Fresno, for the new dam which is to be built about 150 ft. below the present dam. It will be 65 ft. high and will cost $80,000. It is known as the multiple arch type and eight arches will be used to span the canyon. Work is expected to start at once with Engineer Eastwood in charge, and to be completed by Sept. 1 of this year. The new dam will double the capacity of the present Bear Valley Lake.

The Sacramento Riverside Bath Co. intends to erect a wharf on its river front property, a short distance below Sacramento. The company already has a spur track close to the front from the Sacramento Southern R. R. The wharf may be erected this year.

The Sacramento & Yolo Belt Line Co. has been incorporated with a capital stock of $50,000, of which $500 has been subscribed, and proposes to build a belt line of railway within the corporate limits of the city of Sacramento and in the county of Yolo. The principal place of business is Sacramento. The directors are W. A. Curtis, Charles R. Root, H. A. Reed, D. A. Lindley, and Charles Wesley Reed of Sacramento.

The Atchison, Topeka & Santa Fe Ry. (Coast Line) is to enlarge its shops at San Bernardino. Work is to begin at once on the main shop, which will have outside dimensions of 100x500 ft., and will cost $250,000.

An application is to be made shortly to the County Supervisors for a franchise for an interurban road between Fresno and Coalinga. It is stated that the road has already been financed and that construction work will be started Sept. 1. H. P. Knight of the Hughes Hotel, Fresno, is said to be interested.

A permanent organization to be known as the Twin Peaks Tunnel and Improvement convention, having for its object the speedy construction of a tunnel through Twin Peaks to the outlying district, has been formed at San Francisco. It is estimated that the tunnel could be built for $1,800,000. C. F. Adams, San Francisco, is Secretary.

Advices from Lodi state that the Valley Spring R. R. is to be extended to the heavy lumber regions of the Sierra Nevada Mountains, going by way of the celebrated Calaveras Big Trees, and in time connecting with some line west of the Rocky Mountains.

Colorado Notes.

FROM CORRESPONDENTS AND OTHER SOURCES.

Residents of East Greeley are to petition the Greeley Street Ry. Co. to extend its street car line east in 13th St.

The voters in the Riverside Irrigation District in Morgan County will vote May 14 on the proposition for constructing a reservoir on Wild Cat Creek, six miles north of Fort Morgan. The dam will be 5,345 ft. long, 80 ft. at the highest point, with a 16-ft. crest. The reservoir complete will water 30,000 acres in Morgan County and cost $750,000. Canfield & Shields, Fort Morgan, are interested.

The Missouri Pacific and Denver & Rio Grande Railroad officials are taking up the matter at Denver of constructing a double track line between Pueblo and Wallsenburg, a distance of 55 miles. The estimated cost of the work is $1,500,000. J. G. Gwyn, Denver, Colo., is Chief Engineer of the Denver & Rio Grande R. R.

The Denver & Intermountain R. R. Co., Denver, Colo., is to expend $150,000 in improving road beds and straightening its lines.

The San Luis Southern Ry., recently completed from Blanca, Colo., on the Rio Grande River, to San Acacio, New Mexico, is planning the extension of the line southward through New Mexico at once.

The city council of Durango has at last granted a franchise to the Southern Pacific R. R. for right of way through the city. Durango has raised over $100,000 for the line and it is believed that the company will build into the city by April 1, 1911.

The Northern Colorado Power Co., Charles Williams, general manager, Mercantile Bldg., Denver, has decided to commence immediately the construction of a power transmission line into the Greeley section from the company's plant at Lafayette. All of the towns along the Union Pacific railroad will be reached by the new line. The approximate cost of the contemplated improvement to the company's service is $200,000.

Georgia Notes.

FROM CORRESPONDENTS AND OTHER SOURCES.

At a recent meeting of the stockholders of the projected Wrightsville, Adrian & Lyons R. R., the following officers were elected: T. J. James, Adrian, Ga., president; W. F. Staten, Odrian, secretary; E. J. Summer, Wrightsville, Ga., treasurer.

The stockholders of the Middle Georgia Interurban Ry. Co., S. P. Smith, Secretary, will meet at the company's office in Atlanta on May 6, to act on the issuance of $200,000 of stock and $50,000 of bonds.

The Brinson Railway of Georgia, is to be reincorporated with a right to issue $500,000 of preferred stock. The new name will be Brinson Railway Co., as it has taken over the Savannah Valley Railroad Company since its organization. G. M. Brinson, Springfield, Ga., is President and General Superintendent of the company.

The Valdosta Street Ry. Co., W. S. West, President and General Manager, Valdosta, is to extend its line through several streets at Valdosta and form a belt line.

Idaho Notes.

FROM CORRESPONDENTS AND OTHER SOURCES.

The Boise & Interurban Ry. Co., W. E. Pierce, president, Boise, Idaho, is planning to extend its tracks to Eastside addition and points beyond the Natatorium at Boise, the work including a double track up Warm Springs Ave. from a point near the Masonic cemetery.

Owners of the Mineral Point mining property at Osburn have decided to run a cross cut tunnel, 1,500 ft. long. W. B. Forrester, Osburn, Idaho, is in charge of the work.

The International Railroad Co. has filed articles of incorporation for the Coeur d'Alene & Pend d'Oreille R. R., an extension of 10 miles from the main line to Coeur d'Alene and from the main line to Lake Pend d'Oreille, a distance of 15 miles. The new company is capitalized at $600,000, and the incorporators are Austin Corbin, Albert Allen, G. H. Martin, E. J. Roberts and A. H. Sperry. The headquarters are at Spokane, Wash.

Illinois Notes.

FROM CORRESPONDENTS AND OTHER SOURCES.

The Joliet & Southern Traction Co., H. A. Fisher, president, Joliet, will expend about

$150,000 this season in Joliet for improvements. These will include the construction of the Jackson St. line connecting up the terminals in Joliet with the main line on East Jackson St. One-half mile of this line has been built and lying idle for two years, held up by track elevation and the Jackson St. viaduct. Most of the material for completing the line has been on hand for the same length of time

The Woodstock & Sycamore Traction Co. is laying steel on its division between Sycamore and Genoa, and it is expected that this part of the line will be in operation by July 1. The greater part of the work has already been done between Genoa and Woodstock. Grading, fencing, bridges, etc., have been completed. The work is about two-thirds done and it is expected that the entire road will be in operation in a short time.

The Consolidated Dredging Co. of Chicago has been incorporated with a capital stock of $5,000 and proposes to engage in a general contracting business, the incorporators being Philip Clarkson, Charles B. Elder, and William Eliot Furness.

Advices from Rockton state that Chicago capitalists, headed by Bradner Smith & Co., paper manufacturers, Chicago, will invest $1,000,000 in building a dam across Rock River at Rockton, Ill., to develop electricity.

The Steven Construction Co., of Chicago, has been incorporated with a capital stock of $25,000, and proposes to engage in contracting in concrete and cement construction. The incorporators are Archibald F. Steven, Grant Forbes, Robert B. Steven and M. J. McGlone.

City Council of Wilmington, Ill., has granted the Illinois Light & Power Co., a franchise for 50 years to do business in that city providing the company will construct within the next five years, an electric interurban railway between that city and Kankakee, Ill.

The McGrath Construction Co. has been awarded the contract for the transportation of the materials necessary for the construction of bridges and culverts along 90 miles of the Chicago & Northwestern Ry. Cutoff between Sparta and Milwaukee, to be built by Bates & Rogers, 355 Dearborn St., Chicago, Ill. The materials will be hauled from Westfield, Packwaukee, Monello and other stations along the Northwestern and Illinois Central Railroads, and will require the use of 150 teams of horses eight months and two hauling engines. The cost of the transportation is alone estimated at $200,000.

Reports from Chrisman, Ill., are to the effect that the Cleveland, Cincinnati, Chicago & St. Louis R. R., will at no distant date commence the construction of the double track between Paris and Danville, Ill. W. B. McLaughlin, Mattoon, Ill., is Engineer Maintenance of Way.

G. P. Connell, who has the contract for the construction of the Northwestern Yards at Nelson, Ill., reports that the work will necessitate an expenditure of approximately $100,000.

Surveys have been started for the terminal work on the Northwestern Ry. at Fulton, Ill., mentioned in our last issue. The work as proposed will include 35 miles of switch tracks and a round house with 65 stalls, 900 acres of land being purchased for the work. W. C. Armstrong, Chicago, Ill., is Terminal Engineer.

The Big Four has made preliminary surveys between Danville and Ridgefarm for the double tracking of its line between these two places.

The Chicago, Burlington & Quincy Ry. is planning to make extensions to its yards in Galesburg. The work is to be done in June and July.

The East Side Park Commissioners of East St. Louis, have secured options on nearly all the land that was formerly Pittsburg Lake, and which has been drained by the canal now nearly completed. These options have been secured with a view of building an artificial lake about three-quarters of a mile wide and two miles long, around which will be built a tree-bordered boulevard, which may also be used as an automobile speedway.

Indiana Notes.

FROM CORRESPONDENTS AND OTHER SOURCES.

Contracts for all the crushed stone for concrete on the Evansville & Mt. Carmel extension of the Big Four have been awarded to the Eichel Stone & Lime Co. of Evansville. The contract for sand and gravel was awarded to the Evansville Sand & Gravel Co. The orders are for immediate delivery.

The purchase by the Terre Haute, Indianapolis & Eastern Traction Co. of a majority of the stock of the Indianapolis Traction & Terminal Co., as mentioned in our last issue, will result in the erection of a power house at Indianapolis of a capacity of 40,000 k. w. The station will be erected on a plot of ground ten acres in extent, on the north side of West 10th St., immediately west of White River. Plans for the plant have been drawn already and the contract is to be let immediately. The structure will be of brick and steel construction.

The Bedford Power Co. of Bedford, is planning to construct a hydro-electric plant on the south fork of the White River at a point about 12 miles from Bedford. The work will cost about $250,000. J. W. Esterline, Lafayette, Ind., is the Engineer.

An announcement was recently made in Greenfield, Ind., by J. H. Crabb, promoter of the proposed Circuit Traction Company, that bonds for the proposed line had been sold and matters looking toward its construction were progressing rapidly.

Iowa Notes.

FROM CORRESPONDENTS AND OTHER SOURCES.

The Boone Electric Co., John Reynolds, manager, Boone, has been granted a 25-year franchise by that city for the street railway system and light plant. Extensive improvements will be made at once, it is said.

A construction company is to be organized by August E. Steffen and Charles Kindt of Davenport, Ia., and R. C. Campbell of London, England, and New York, for the purpose of constructing the Iowa City-Ottumwa interurban line. All surveys for the line have been completed and all right of way secured, and it is reported that the interurban company has secured the necessary capital for the construction of the line. Roscoe Wilson, Iowa City, is secretary.

The Chicago, Rock Island & Pacific is to expend about $50,000 this year for improving its yards at Cedar Rapids. Grading work has been started.

The Chicago & Northwestern Ry. has awarded a contract to the LaCrosse Dredging Co., LaCrosse, Wis., to dredge out enough material from a sand bar by hydraulic process to put in a fill from 5 to 6 ft. deep and extending over a large portion of the lowland acquired by the Northwestern between Fulton and East Clinton during the past few months. The tract of land is to be converted into storage yards during the coming year.

The Fort Dodge, Des Moines & Southern R. R., J. L. Blake, General Manager, Boone, has begun to electrify the Crooked Creek railroad, extending from Lehigh in Webster County to Webster City. The road, which is about 25 miles long was purchased recently by the Fort Dodge, Des Moines & Southern road, which now has a road running from Fort Dodge to Judd. The road is intended to eventually connect the former steam road with Fort Dodge.

According to advices from Eldon, Ia., the Chicago, Rock Island & Pacific R. R. Co. will commence construction work this summer on the proposed Eldon-Libertyville cutoff. The tracks through Eldon will be raised 12 ft., eliminating all grade crossings. The work which will require about two years' time for completion, will cost, it is estimated, about $3,000,000. The heavy grade will be reduced to about 8 per cent and trains will not require pushers.

Walter Ray, president of the Ocala & Southwestern Ry. has petitioned the city council of Ocala, Fla., for a right of way through one of the city streets in the extreme western portion of the city.

Kansas Notes.

FROM CORRESPONDENTS AND OTHER SOURCES.

The Yankton & Southern Ry. Co., which projects a 1,000-mile north and south railroad from Yankton, S. Dak., is reported to be making good progress in financing its proposed line. Fremont Hill, Wichita, Kas., president of the company, recently returned from an 18-month trip in Europe in the interests of the company. The route for this road was surveyed some time ago. The survey from Yankton runs practically straight south along the sixth principal meridian west from Washington until it reaches the south line of Kansas. On this route it passes through David City, Norfolk, and Fairbury in Nebraska; Washington, Clay Center, Abilene, Newton, Wichita, and Wellington, in Kansas; then swinging east, through Weleetka and Atoka, in Oklahoma, and Palestine, Houston, and Galveston, Texas.

The Air Line Construction Co., with headquarters at Kinsley, Kan., has been incorporated with a capital stock of $200,000, and proposes the construction of steam and electric railways and to equip them with telephone and telegraph lines. The incorporators are M. C. Tubbs, Kinsley, Kan.; W. F. Brown, Marion, Kan.; T. E. Luttgerding, El Dorado, Kan.; M. J. Cudney, Belpre, Kan.; George Smith, St. John, Kan.

Michigan Notes.

FROM CORRESPONDENTS AND OTHER SOURCES.

The Dowagiac Ry. Co., a subsidiary branch of the Benton Harbor-St. Joseph Ry. & Light Co., has begun condemnation proceedings to secure the last piece of right of way for its ten mile spur from Eau Claire to Dowagiac. Construction work is said to be already under way.

Frederick J. Hepburn of Lima, O., has been appointed as general manager of the Saginaw-Bay City Railway Co., which includes the Bay City and Saginaw street railways and the interurban connecting the two cities.

The Ashland Light & Power Co. of Ashland, Wis., has taken over the electric light plant at Bessemer, Mich. As soon as the franchise applied for is granted the building of a street railway from the western limits of the city through to Wakefield will proceed. The line will take in the several mining locations between the two places. Power for operation will be procured from Copper Falls on the White River, 20 miles west of Bessemer, where the power plant is now under construction.

Bean & Jones, Benton Harbor, Mich., have been awarded a contract by the Dowagiac Ry. Co., for the clearing, grading and building of culverts of the line between Eau Claire and Dowagiac. The distance between Eau Claire and Dowagiac is ten miles.

William H. Osmun, Pontiac, Mich., has a plan under way and has been promised the right of way for a steam railroad to connect Pontiac with the Michigan Central lines at Utica. The line would be about 12 miles long.

Bids were opened April 20, at South Haven, for the improvement of the harbor at that place, the following bids being received: Love & Nelson, Muskegon, Division No. 1, embracing 1,390 lin. ft., $17,236, or $12.40 per lin. ft. Division No. 2, 700 lin. ft., $7,350, or $10.50 per lin. ft. Division No. 3, 600 lin. ft., $9,000, or $15 per lin. ft. Total $33,586. The Fitzsimmons Connell Co., Chicago, Division No. 1, $14 per lin. ft., or $19,460; No. 2, $12.50 per ft., or $8,750; No. 3, at $16.00 per ft., or $9,600. Total $37,810.

The Grosse Isle R. R. Co. has been incorporated and proposes to operate a steam or electric line from Detroit to Grosse Isle, over a bridge, franchise for the construction of which has been secured by the organizers of the company. Among those interested are Edward Voigt, Henry P. Borgman, Kirkland B. Alexander, and Wallace E. Brown, of Detroit, and ex-Justice Riopelli of River Rouge.

Minnesota Notes.

FROM CORRESPONDENTS AND OTHER SOURCES.

The Northern Dredge & Dock Co., Duluth, has been awarded the contract for dredging of Ontonagon Harbor on the south shore for the U. S. government, the contract amounting to $5,000.

The commissioners of Freeborn county, Albert Lea, Minn., according to reports, will on May 4 take action on a proposition to buy a $1,000 suction dredge to clear and keep free the county ditches, and possibly to dredge shallow places in Fountain, Albert Lea, and other lakes.

The Great Northern Ry., D. M. Philbin, Superintendent, Superior, Wis., is to build a 6-stall round house at Grand Rapids, Minn.

Duluth and the Ranges.

BY PETER E. MEAGHER.

J. A. Higgins, contractor on the Soo Line, was a caller recently and reported his work in very good condition.

C. J. A. Morris of Morris & Shepard, Contractors, St. Paul, Minn., spent a couple of days with us last week. All of their team work is in excellent condition, and their railroad work at Stanley, N. Dak. has got very nicely started. They have this line practically covered, but have one or two more nice pieces of machine work left. Anyone looking for work of this kind, by addressing them at St. Paul, Minn., will get full information.

H. J. Cooper, the Iron Range Contractor, came in last week, and we sold him a J. I. Case Steam Road Roller to be used on his street contracts the coming season.

J. E. Long of Erickson & Long, railroad contractors, called in to see us a few days ago. They have five different contracts on the Great Northern R. R. at the present time, and are working quite a few men.

P. G. Pastoret and Dave Lawrence of the Pastoret-Lawrence Co., general contractors, were visitors with us last week. They have sewer, water works, and street paving contracts under way at the present time at Grand Forks, N. Dak., Rice Lake, Wis., Duluth, Eveleth, Gilbert, Marble and Coleraine, Minn. They have started all of these jobs and are rushing the same to completion as fast as possible. Pastoret-Lawrence Co. are one of the largest general contracting firms in this section of the country, and have been very successful.

O. A. Lewellen, General Agent for the Northwest, with headquarters at Minneapolis, for the J. O. Case Co., manufacturers of road rollers, traction engines and portable boilers, spent a couple of days here with us recently, looking up trade in his line.

George E. Slater, representing the Carnegie Steel Co., Illinois Steel Co., and the Tennessee Coal, Iron & Railroad Co., spent a few days in this vicinity recently. He reported the demand for steel rail and structural steel very good, and the outlook for the future in his line was very bright.

Frank Thomas and James McCoy of Thomas & McCoy, contractors, was a caller here recently. They are not doing anything at the present time, but are figuring on several jobs, which if they are awarded, will start on at once.

Foley, Welch & Stewart, general contractors, were awarded a contract by the Soo Railway Co. for a coal dock to be erected at Superior, Wis., to cost $350,000. They will start on this work at once.

Arthur Mitchell, General Superintendent for this territory for MacArthur Brothers Co., was a caller here last week. He reported their work as being in very good shape.

W. S. Charles of Jones Brothers, railroad contractors, was a caller here this week from Cincinnati, O. He was up here looking over the stripping contract that they have at the Crosby Mine on the Iron Range. He said that their work throughout the country was in very good shape.

W. H. Peterson, team contractor, was a caller at this office this week, and reported that he had taken a subcontract for 100,000 yds. of work from Peter Shugart on the Northern Pacific Railway in North Dakota, and was going to ship his outfit on the same at once.

Howell Lloyd, representing the Knox Manufacturing Company, manufacturers of couplings and valves, Philadelphia, Pa., was a caller at this office last week. He was up in this section of the country calling on the users of the line that they manufacture.

William Donald, who was Superintendent in charge of one of MacArthur Brothers stripping contracts on the Iron Range near Duluth, resigned his position last week and left for Chicago.

J. Newville has taken a subcontract from Morris & Shepard at Stanley, N. Dak., and has already started two machine outfits on the same.

The labor situation in Duluth and vicinity at the present time is in quite a healthy condition. There is a great demand for men, and just enough men to fill the positions offered, although the men are quite independent, and are particular as to just what kind of work they wish to take. There is a lot of construction work going on here at the present time, and a great deal more in sight. And, from the general outlook at present, the year 1910 will be one of the most prosperous we have had here for some time.

Contractors and others interested in the Equipment and Employment business are cordially invited to call at the offices of Peter E. Meagher, 409 West Michigan St., when they are in Duluth.

Missouri Notes.

FROM CORRESPONDENTS AND OTHER SOURCES.

J. H. Van Brunt, St. Joseph, manager of the company which is to build an interurban electric line from St. Joseph to Savannah, is closing deals for right of way and it is expected that construction work will be started soon. The chief engineering feature of the line will be a 500-ft. steel trestle, 100 ft. high, spanning Dillon Creek, 1½ miles south of Savannah.

The Chicago, Milwaukee & St. Paul R. R. has bought four acres of land adjoining and directly north of its yards in Chillicothe and thus has given rise to the report that the railroad was to enlarge its yards, or was to remove its yards from Laredo to Chillicothe.

Advices from Carthage, Mo., state that all of the stock for the proposed interurban railway between Carthage and Springfield has been susbcribed, and all right of way secured. Orders have been placed for 45 miles of rail and construction work is to be started. The survey made by the Western Traction Co. several years ago from Carthage to Sarcoxie, Peirce City, Monett, Verona, Mount Vernon, Aurora, and thence to Springfield, was followed.

The directors of the Mexico-Perry Traction Co., which is building from Mexico to Hereford, Callaway county, have notified the Columbia Commercial Club that they will make a proposal looking toward building into Columbia.

Announcement has been made that construction work on the first section of the St. Louis-Kansas City Electric Ry. will be started in six weeks between Columbia and Harrisburg, a hamlet in Northern Boone county. This road will tap the Harrisburg coal fields. The St. Louis-Kansas City Electric Railway Co. has leased over 10,000 acres near Harrisburg and will open three mines when the road is built to that town. The shops will be located at Columbia.

Montana Notes.

FROM CORRESPONDENTS AND OTHER SOURCES.

According to reports circulating in Bozeman, Mont., work is progressing rapidly on the Three Forks extension of the Gallatin Valley Ry. Contracts for grading have been let as follows: J. N. Brown, 7 miles; A. Perkins, 7 miles; Logan Whittaker, 4 miles. It is expected that all grading will be completed by Oct. 15.

Contractors are making rapid progress on the grade work for the double tracking of the Northern Pacific from Missoula, Mont., and Desmet. The heaviest portion of the work has been completed and the remaining consists of a few light fills and shallow cuts. The completion of this section, which includes the construction of a 3-track concrete bridge over the Rattlesnake Creek, will give the Northern Pacific company a double track line between Garrison and Desmet, a distance of 76 miles.

According to reports from Dillon, Mont., R. H. Jones and A. L. Wright, promoters of the proposed railroad in the Big Hole Basin, are making preliminary surveys for the line and collecting data on general resources.

According to a statement recently made by W. H. Smead, Missoula, Mont., an electric road to connect Missoula and Kalispell will soon be constructed and right of way and route are now being looked up.

Officers and Directors of the proposed railroad between Butte, Mont., and Boise, Idaho, are at present considering two routes between the cities. According to the present preliminary survey, the line will lead from Butte, Mont., to a point below Silver Bow Junction, and from there will parallel the Oregon Short Line to a point near Divide, where it will cross the Big Hole River pass through Wisdom over the Bitter Root Range to Salmon City, Idaho. The change under consideration would carry the line from Butte down Silver Bow Creek nearly to the Mouth of Mill Creek, thence through the Continental Divide by way of French Gulch, crossing the Big Hole River at Ralston, where it would coincide with the original survey. S. H. Bracy, 1606 Tribune Bldg., Chicago, Ill., is interested.

Surveys have been started at Ralston, Mont., for a railroad between Anaconda, Mont., and Wisdom. The surveys are being made under the direction of Thomas M. Ward, C. E., of Spokane, Wash. Preliminary surveys made previously are reported to have found a grade of less than 2 per cent over the grade between Anaconda and Ralstons.

New York Notes.

FROM CORRESPONDENTS AND OTHER SOURCES.

The State Public Service Commission of New York city, as noted in our last issue, is to begin hearings shortly for the building of new subways in that city. Public hearings on the form of contract for the Broadway-Lexington Ave., the Canal St. line, the Broadway-Lafayette Ave. loop line in Brooklyn, and the extensions of the 4th Ave. line will take place on May 9 and May 16. This means that contracts are to be let in the near future for subways to cost over $125,000,000, and not simply for the $70,000,000 Broadway-Lexington Ave. line. As soon as the hearings on the form of contract are disposed of the advertising of the contracts is the next step. This will begin about June 1 and will continue for 90 days, so that bidders may have sufficient time to formulate their bids.

The Third Ave. Ry. Co. of New York city has been incorporated with a capital stock of $16,590,000. The company is a reorganization of the Third Ave. company, formed by interests which bought the property of the old company at the special master's foreclosure sale March 1.

The Western New York & Pennsylvania Traction Co. has applied to the State Public Service Commission for permission to increase its capital stock, and this has given rise to the report that the company will this year build its proposed extensions along the Erie to Forestville and thence to Dunkirk.

The Boston & Albany R. R., M. B. Freeman, chief engineer, Boston, Mass., has petitioned the State Railroad Commissioners for authority to issue $2,000,000 of 4 per cent 25-year bonds, dated May 1, 1910, the proceeds to be used for additions and improvements to the property.

The matter of constructing an electric railway from Glens Falls to Argyle, is proposed, and V. R. Coon, Elizabethtown, N. Y., General Manager of the Elizabethtown Terminal R. R., has the matter under consideration.

The Buffalo, Rochester & Pittsburg Ry., E. F. Robinson, Chief Engineer, Rochester, N. Y., is reported to be considering building a

branch to run from Saltvale through Warsaw to Bliss. The object of the branch line is to reduce distance and save mileage. It is 20 miles from Warsaw to Bliss by the present line, while it is less than 12 miles in a direct line. The proposition seems to be to build a branch line from the main line at Saltvale, down the valley through the village of Warsaw and up through Wethersfield Springs and Wethersfield Center to Bliss.

The Elmore & Hamilton Contracting Co. of Albany, is reported to be making good progress on its double track work for the Albany Southern R. R., near East Greenbush, N. Y.

The Boston & Albany R. R., F. B. Freeman, Chief Engineer, Boston, Mass., is said to be planning to have work started on a second double track tunnel at Canaan on the main line. This new tunnel will be separated from the present tunnel by a solid wall and will be 500 ft. in length but on a much easier grade. It is to be used for eastbound freight trains exclusively.

Ohio Notes.

FROM CORRESPONDENTS AND OTHER SOURCES.

The Northern Ohio Traction Co., Wm. Christy, vice president, Akron, is to make a number of extensions in Akron provided the city will extend the franchises of the company for 25 years.

General R. P. Kennedy of Bellefontine, Judge H. T. Mathers of Sidney, John T. Adams, a contractor of Columbus, and three Philadelphia capitalists inspected a proposed right of way for a Bellefontaine and Sidney traction line. The right of way secured touched De Graff, Quincy, Silver Lake, Port Jefferson, and Pemberton.

William H. Luchtenberg & Co., Columbus, have started work on the construction of the Toledo & Ohio Central and the Hocking Valley crossings over Rich Town, State and Broad Sts., at Columbus. It is hoped to complete the work by Dec. 1.

The village board of Crooksville has passed an ordinance granting a franchise to the Southeastern Traction Co. to extend its track through the village. The right of way granted the company extends along State St. to the corporate limits. The Southeastern Co. asked for the right of way with a view to extending its lines to New Lexington, and possibly on to Lancaster. The right of way has been secured along the greater part of the contemplated route.

The commissioners of Fairfield County held a meeting at the court house at Lancaster on April 27 to take definite steps for straightening the channel of the Hocking River.

The R. B. Gordon, the dredging boat which is to be used in straightening the Wabash River, was formally launched on the St. Marys reservoir on April 20. The dredge is named after former Congressman Bob Gordon, who has taken the contract to straighten out the Wabash and remove the obstructions. The dredge is 100 ft. long and 40 ft. wide.

The Pennsylvania R. R. is stated to be planning to construct a new yard at Austinburg for its Pittsburg, Youngstown & Ashtabula branch line. This branch is also to be double tracked and it is said that work on this will be started late in the summer. The first part to be double tracked will be the line between Ashtabula and Austinburg. It is said that the grade of the P., Y. & A. will be lowered.

The city council of Cleveland has adopted a resolution calling upon the city engineer to prepare plans and estimates for the elimination of Collision and Irishtown bends in the lower Cuyahoga River, an improvement that will mean an expenditure of from $1,500,000 to $1,750,000. A. B. Lea, Cleveland, is director of public service.

The Hunkin-Conkey Construction Co., Cleveland, has been awarded the contract for constructing a 100 ft. pile and timber dock on the river near the Merwin Ave. bridge at Cleveland for the Cleveland Builders' Supply Co.

The Lake Shore & Michigan Southern Ry. will have work started shortly on a portion of the Oil City branch of the J. & F. division. The part to be double tracked this year will be between Polk Junction and Sandy Lake, a distance of 28 miles.

The city council of Cleveland is to be asked to set aside a site for the construction of a harbor for yachts and motor boats near the bath house in Gordon park.

The new owners of the Marietta, Columbus & Cleveland R. R. have had surveys completed for the extension of the road from Palos Junction to Athens, where a connection will be made with the Hocking Valley, and it is said that construction on the extension will begin this season. J. C. Reddell, Marietta, is General Manager.

The Hocking Valley Ry., F. B. Sheldon, Chief Engineer, Columbus, O., has engineers in the field surveying routes for an extension from Jackson or Wellston to the Ohio River and a connection with the Chesapeake & Ohio Ry. The route now being surveyed is quite different from that which had been rumored would be that of the extension. The present survey parallels the Detroit, Toledo and Ironton to Cone Station from Jackson and from Cone runs down the Little Scioto to Sciotoville, four miles above Portsmouth, where it is said that the Ohio River will be bridged and a connection made with the Chesapeake and Ohio. The river can be bridged to much better advantage near Sciotoville than at Portsmouth and there is plenty of room on both sides of the Ohio for terminals. It is also said that a route will be surveyed to Huntington and that the extension will be built on the line which proves the most feasible. The Portsmouth route is the shorter of the two, and it is said that better grades can be obtained on it.

According to an agreement between the city of Crooksville, Ohio, and the Southeastern Interurban Co., the proposed line will be constructed through the city by July 15, thus making the prospects bright for an extension of the line to New Lexington and possibly Lancaster, O., this summer.

It is reported that active construction work will be started at once on the proposed Cleveland & Pittsburg R. R. double track south of Alliance, O. Headquarters of the engineers and construction officials will be at Alliance.

The Lake Erie & Pittsburg R. R. which has under construction a line from Youngstown, O., to Lorain, at a recent meeting of officers and directors, decided to stop work on the line beyond Cleveland for a time until business warrants its completion. Samuel Rockwell, Cleveland, O., is Chief Engineer of the company.

Oklahoma Notes.

FROM CORRESPONDENTS AND OTHER SOURCES.

The Oklahoma City Industrial Co., Oscar G. Lee, president, Oklahoma City, is raising funds for the construction of a belt line street car line at Oklahoma City.

Track laying on the southern extension of the Missouri, Oklahoma & Gulf R. R. between Durant and the Red River has been started. The laying of tracks on the Texas side of the river to Sherman, Texas, which is to be the southern terminal, will begin as soon as that on the Oklahoma side of the river is completed. The bridge across the river is expected to be completed by June 1.

The Chamber of Commerce of Oklahoma City has given a bonus of $100,000 for the construction of a railroad, the Denver, Kingfisher & Gulf, from Denver to Oklahoma City. It is stated that work will be started within 30 days and that shops and terminals will be located at Oklahoma City.

The City Commissioners of Ardmore have begun condemnation proceedings to secure land on the Washita River, 12 miles from the city, for a site for a municipal power plant. It is estimated that a plant to develop 2,500 HP. can be built for $300,000; and the City Commissioners will call for an issue of bonds for building the plant. J. W. Maxcy Co., Houston, Tex., are the engineers.

Advices from Oklahoma City, Okla., state that plans and specifications have been completed by the City Engineer, for the elevation of railroad tracks entering the city.

Oregon Notes.

FROM CORRESPONDENTS AND OTHER SOURCES.

Residents of the new additions east of the present end of the Mt. Tabor and Reservoir line at Portland have asked the county to grant them a franchise over the Base Line road for six blocks. They intend to build a street car line for six blocks along the Base Line road to the east and joining with the Mt. Tabor line. Having built it they will make the Portland Railway, Light & Power Co. a present of the six blocks of line.

The Lane County Asset Co. of Eugene has secured a considerable amount of right of way for its projected railway between Eugene and Coos Bay, via Florence. As previously noted, preliminary surveys are already under way. F. B. Kidder and S. P. Ness, Eugene, are interested.

The Coos Bay & Oregon Central R. R. Co. has filed its articles of incorporation at Salem. The company has a capital stock of $4,000,000. The purpose of the organization, as set forth in the articles, is to build a rail line between Coos Bay and Boise, Idaho. C. F. Hendrickson, Sam Connell and J. H. Cole, all of Portland are the incorporators. The company is stated to have already made a survey from Coos Bay to Roseburg, and is also said to have preliminary surveys under way up into the Cascade mountain range. Engineer F. A. Haines, Marshfield, Ore., is in charge of the preliminary work, and the new company is said to have taken over the rights and interests possessed by the Coos Bay, Oregon & Idaho Ry., which has been busy for the past year between Roseburg and Marshfield.

The City Council of Albany has granted the Oregon Electric Ry. a franchise for the use of 5th St. in that city its entire length and the use of Baker St., from 4th to 6th, one block on each side of the 5th St. line. The road agreed to begin work at once and furnished a $10,000 bond to have the extension of the road from Salem to Albany in operation within two years.

The Jordan Valley R. R. Co., of Scio, Ore., has been incorporated with a capital stock of $50,000, and proposes a line from Munkers, in Linn County, east to Scio, thence easterly by the most practicable route to the Jordan Valley; and from Scio southerly to Lacomb. A. G. Prill, E. C. Peery and Charles Wesley are the incorporators.

The City Council of McMinnville has granted a 25-year franchise to the Oregon Electric Railroad Co. to construct lines entering the city along B St., also on Lincoln St., for switching purposes. A bond was filed by the company for $10,000, to have the road completed and in operation within two years.

Resident Engineer H. E. Beard, of the Oregon Trunk Line is in Madras, Ore., preparatory to starting construction of the line south of that city through Bend.

Pennsylvania Notes.

FROM CORRESPONDENTS AND OTHER SOURCES.

Final surveys have been started for the projected electric railway of the Pittsburg, Butler, Slippery Rock & Northern Ry. Co. The line crosses the Western Allegheny near Isle, 12 miles west of Butler. The project is a part of a through line between Butler and Conneaut Lake, and it is understood will connect with the Pittsburg and Butler line. J. H. Barrett, Pittsburg, Pa., is the engineer.

The Easton & Washington Traction Co. and the Northampton Traction Co. are to pass under one management at an early date. The former line extends from Phillipsburg, N. J., to Port Murray, N. J., a distance of 18 miles, and it contemplates pushing east to obtain connections across the state to Jersey City. The Northampton Traction Co. operates lines from Easton, Pa., to Nazareth and to Bangor, with connections to Portland. A 4-mile line is contemplated to Delaware Water Gap from Portland, giving trolley connections from Philadelphia to Stroudsburg. Over $1,000,000 is embraced in these plans.

The Baltimore & Pennsylvania Ry. Co., J. Pierce Bruns, president, 1209 Calvert Bldg., Baltimore, Md., chartered recently, is reported

to be about ready to have work started on the construction of its electric railway from Hanover, Pa., to Reistertown. Of the $600,000 capital stock of the company $60,000 is reported to have been already subscribed. The line will pass Fowlesburg, Arcadia, Hampstead, Greenmount and Manchester, paralleling the Western Maryland to that point. From Manchester the line will be constructed in a direct route toward Hanover, passing Melrose. The contract for constructing the line has been let to the Maryland Construction & Development Co., Baltimore, Md.

The Philadelphia, Bethlehem & New England R. R. Co. has been organized with a capital stock of $250,000 by Charles M. Schwab and associates for the purpose of constructing a railroad 25 miles long from Durham to the steel works at Bethlehem, connecting with the Lehigh & New England R. R. near Nazareth.

The Tarentum, Brackenridge & Freeport Street Railway Co., which was refused a franchise over certain streets in Brackenridge, will use a private right of way which goes around the borough. Tarentum has granted a franchise, and work will commence soon on the construction of the line to Freeport. It will connect with the Allegheny Valley Street Ry. at Tarentum.

The New York Central & Hudson River R. R. has surveys under way for a proposed branch line between Keating and Avis. The engineers are surveying two routes, one of which passes through Lockport and the north side of the river and the other will pass through Lock Haven from north to south; thence east to a point near the Strohecker home in Castanea township. Both the routes have already been gone over and the present corps are again going over the work.

Promoters of the Scranton-Binghamton Trolley Line, it is reported, have submitted a proposition to the city of Montrose asking for right of way in Montrose, Pa., and Bridgewater township, a site for a station in the city and bond subscription of $100,000.

According to reports the Bessemer & Lake Erie R. R. Co. contemplates an expenditure of $1,750,000 this summer for the improvement of its line between Conneaut Harbor and the steel mills in the Pittsburg District.

Officials of the Pittsburg, McKeesport & Westmoreland St. Railway Co. are planning the construction of a line to Donora, Pa., where it will cross the river through Rostraver township, Westmoreland County. A loop will then be built up the river between Donora and Monessen crossing the river by means of a new bridge to be constructed where it will connect with the Monessen and thence over the same route to Westmoreland County seat.

Texas Notes.

FROM CORRESPONDENTS AND OTHER SOURCES.

H. M. Hyatt, representing the Empire Construction Co., of St. Louis, Mo., has organized a company to build an interurban line from Dallas to Cleburne. As proposed the route is from Dallas west to Eagle Ford, passing near the two cement plants and Gates. Then the road will go directly west to Grand Prairie, thence south to Cleburne.

C. V. Burkhead, representing San Antonio capitalists, James T. Priest and N. A. Dawson of South Austin and Frank M. Maddox have appeared before the commissioners court at Austin, asking for a franchise for a proposed street railway for South Austin. The agreement as reached provides for the annual payment of $1,200 for ten years, and after that period 5 per cent of the gross income of the line, provided it does not fall below $1,200. The San Antonio parties propose to build at least one and a half miles of track within a year after their requirements have been complied with. The line will run up town as far as Sixth street.

Col. I. D. Polk, of Beaumont, has applied to the city council of that city for a franchise for the use of certain streets and alleys in the city of Beaumont and the right to lay track and operate electric cars. He also has applied for franchise for the erection and operation of a plant to furnish light and power. The franchise for the street railway is desired in connection with a plan to build and operate an interurban line from Beaumont to Port Arthur. The new enterprise contemplates the erection of a new light and power business on a large scale and the operation of the interurban cars on an hourly schedule between Beaumont and Port Arthur. It is also stated that the ground on which the big plant is to be constructed has already been secured.

The Atchison, Topeka & Santa Fe Ry. has completed plans for freight offices, warehouses and transfer sheds at Temple, which will call for the expenditure of $60,000. K. S. Hull, Temple, is Division Superintendent.

The Southern Pacific Railway is stated to have a large hydraulic dredge at work on the oyster reef at Sabine Pass, pumping out oyster shell for use in ballasting the tracks of the Sabine & East Texas Railway from Beaumont to Sabine. It is also said that the road is to be further improved by putting down 90-lb. rails for the entire track from Sabine to Beaumont.

It is reported that the Cotton Belt Ry. will extend its line from McGregor to Hamilton instead of from Gatesville and has given up the intention of paralleling the Temple Northwestern railway.

The Eastern Texas Traction Co. is securing right of way from its projected interurban line between Greenville and Wolfe City. Joseph F. Nichols, Levy Bldg., Greenville, Tex., is secretary.

The Houston & Bay Shore Traction Co. mentioned in our last issue, has applied to the County Commissioners at Houston for a franchise from the county to construct an interurban line from Houston to Morgan's Point, through La Porte. The company desires the franchise for a period of 50 years, and agrees to guarantee the county that work will begin on the construction within 60 days after the official action of the court. The company was formed by A. Foster Irwin, of Detroit, Mich.

John C. Whitney, President of the Commercial Club of Carthage, Tex., has a proposition under way to build a railroad from Shreveport, La., to Waco, Tex., over the following route: Shreveport to Carthage, thence to Mount Enterprise, thence to Rusk, thence to Palestine, thence to Fairfield, thence to Mexia and on to Waco.

G. S. Vivian of Chicago, representing financial interests in that city, has been in Temple in conference with the directors of the Commercial club in regard to a proposition to construct an interurban electric line between Temple and Waco.

The contract for bridge work on the Temple Northwestern Railway has been awarded the firm of C. G. Patton of Houston. The piling to be used between Temple and the Leon river will be supplied by W. D. Parish of Temple.

All arrangements have been made for the construction of the proposed Smithville-Aransas Pass Railroad of Texas, excepting definite decision on the towns included along the right-of-way. Engineers will start work upon the survey at once. James H. Collins, 88 LaSalle St., Chicago, Ill., is interested in the project.

The Kansas City, Mexico & Orient Ry. Co. has contracted for nearly 50 miles of right of way for the proposed extension of the line from San Angelo to Allende, Mex., where connection will be made with the National Railways of Mexico. W. W. Colpitts, Kansas City, Mo., is Chief Engineer of the railroad.

Officials of the Texas Central R. R. Co. are to submit a proposition to the city of Abilene, Texas, involving the extension of the Deleon line to that place. Henry K. McHarg, Stamford, Conn., is president and C. Hamilton, Waco, Texas, is Vice President and General Manager.

The Texas Traction Co., J. F. Strickland, President, Dallas, is considering extending its line from Dallas to Waco. The line at present is in operation between Denison and Dallas.

The directors of the Quanah, Acme & Pacific Ry., at a meeting at Quanah, voted to increase the capital stock to $750,000 and to float bonds on 44 miles of road now completed at $30,000 per mile. It was decided to push construction as rapidly as possible to Roswell and El Paso, work to start early in May.

Utah Notes.

FROM CORRESPONDENTS AND OTHER SOURCES.

E. M. Boyer, Springville, has started work on his contract for constructing a long tunnel for the new Bingham & Garfield Ry.

The Sevier River Land & Water Co., promoting the Lynndyl irrigation project and land opening, according to reports from Salt Lake City, has announced its intention to at once start on the high line canals, one to start at a point on the river above Leamington and to extend to Holden, the other on the other side of the original tract, to extend to Aiken. In addition it is proposed to generate power for the town of Lynndyl at the point where the first canal passes the new townsite.

A. W. McCune has completed negotiations and preliminary plans for the construction of the Amazon & Pacific Ry., which proposes a line across Peru in South America. Mr. McCune has received from the government of Peru concessions covering the building of the line. This concession includes 5,000,000 acres of land and approximately $25,000 per mile for the line on the Pacific slope and $65,000 per mile for the other line to the Amazon. The company proposes the construction of a line from Goyllarisquiga to Puca Alpa, Peru, a distance of 220 to 250 miles, according to diffrent surveys. Mr. McCune is now at his home at the head of Main St., Salt Lake City, Utah, where he will remain until June when he will return to Peru to begin work on the road.

The Gunnison Valley Power Co. has been granted a franchise at Ephraim. Orders for the machinery are reported to have been placed. Construction work on the power development is to be started shortly, it is said. O. M. Duggins, Provo, Utah, is Manager.

Reports from Salt Lake City, Utah, state that double track work has been started on the western end of the Lucin cutoff and that about five months will be required for its completion. G. F. McGonagle, Salt Lake City, Utah, is Engineer, Oregon Short Line R. R.

West Virginia Notes.

FROM CORRESPONDENTS AND OTHER SOURCES.

The Hampshire Southern R. R. now under construction from Romney to Petersburg, W. Va., a distance of 45 miles, has been opened to traffic between Romney and Moorefield, Va. The line will be completed about July 1, it is said.

Stockholders of the Atlantic Northern R. R. Co., at a recent meeting held at Kingwood, W. Va., named the following officers: James W. Flynn, President; William M. Schaeffer, Vice President; E. M. Lantz, Treasurer; W. S. Downs, Secretary; Julius K. Monroe, General Manager. The proposed route of the company is from Rowlesburg up the Cheat River, intersecting the Western Maryland R. R., at Parsons, W. Va.

Organization of the Cheat River & Monongahela Valley R. R. Co., has been perfected, and the following officers named by the stockholders: Neil J. Fortney, President; E. M. Lantz, Vice President and Treasurer; W. S. Downs, Secretary; Julius Monroe, General Manager. The projected line of the company will run from Albrightsville, on the Cheat River, to a point below Point Marion where it will cross the Monongahela from there to some point in Pennsylvania. The headquarters are at Kingwood, W. Va.

Washington Notes.

FROM CORRESPONDENTS AND OTHER SOURCES.

Construction work is under way on the Inland Empire Line (C., M. & St. P. Ry.) from Couer d'Alene to Dishman's, six miles east of Spokane. Otto Hansen, 720 Paulsen Bldg., Spokane, has over 70 men and 40 teams at work on his grading contract which

extends from Spokane bridge to Dishmans. The work includes a considerable amount of rock excavation just west of Spokane bridge. Jones & Onserud, Hutton Bldg., Spokane, have the contract for constructing the line from Coeur d'Alene to Spokane Bridge, and will begin work shortly.

A six months extension of time has been granted the Nooksack Valley Traction Co. in which to begin actual construction of the interurban line from Bellingham to Marietta, Ferndale and Lynden.

Construction work on the street railway between Centralia and Chehalis has been started at Centralia, and the contractors in charge of the work have opened headquarters in that city. About 50 men will be employed in the work.

Up to the end of 1909, the Seattle & Lake Washington Waterway Co., which has done all the dredging on the tideflats at Seattle, has excavated from Seattle waterways and used for raising the level of the tidelands above high tide a total of 13,794,906 yds. With that material 802 acres of tidelands have been filled and raised. The following statement shows the total amount of work done by the Seattle & Lake Washington Waterway Co. during each year:

	Cubic yards.	Cost.
1895	216,949	$ 40,790.79
1896	877,978	164,247.01
1897	337,894	62,914.68
1898	.....	.....
1899	.....	.....
1900	102,468	18,985.20
1901	1,605,173	298,298.70
1902	1,761,367	327,466.36
1903	2,198,008	409,196.39
1904	894,288	170,118.87
1905	74,647	13,909.58
1906	1,962,838	365,009.57
1907	3,127,468	573,374.01
1909	5,635,828	1,080,535.59
Total	18,794,906	$3,524,847.04

The Seaboard Engineering & Construction Co., of Seattle, has been incorporated with a capital stock of $1,000,000, the incorporators being Henry S. Noon, Harrison B. Martin and W. G. Beard.

The Occidental Fish Co., Seattle, has had plans prepared for a modern wharf and sheds to be erected at the foot of Bay St., Seattle, by the company. The new dock will be 66x 122 ft. In addition to the dock and shed a 3-story warehouse will be erected.

The Spokane, Portland & Seattle Railroad Co., T. H. Croswell, Chief Engineer, Portland, Ore., purposes to spend $2,000,000 for the building of grain docks, grain elevators, spurs and trackage along the Columbia River adjacent to Vancouver this year. The company has asked certain franchises from the city and county officials and work will be commenced as soon as possible.

Surveys have been started for the proposed Bellingham-Skagit County interurban line, which is to be built for the Stone & Webster Engineering Corporation, of Boston, Mass. S. L. Shuffleton, Sunset Block, Bellingham, is Engineer for Stone & Webster.

The Tacoma Railway & Power Co., of Tacoma, has been petitioned to double track its McKinley Park line.

Acording to an announcement, reported to have been recently made by D. C. Corbin, Spokane, Wash., President of the Spokane International Ry. Co., construction work will be started shortly on the 10-mile branch from Spokane to Coeur D'Alene, Idaho. Materials are said to have been ordered and right of way all secured.

Wisconsin Notes.

FROM CORRESPONDENTS AND OTHER SOURCES.

J. A. Orton & Sons, contractors for the Chicago & Wisconsin Valley R. R. line established a camp near Ketchum's Point, Portage. Orton & Sons have the contract to grade the road from Portage to Briggsville in Marquette county. Work will also be started in Portage and a city loop will be built connecting the Soo Line and Chicago, Milwaukee & St. Paul line. It is hoped to have the line completed between Briggsville and Madison within a year.

Construction work on the Janesville & Madison interurban line is to be started this month according to a statement at Janesville of Joseph Ellis, Engineer, of the Cincinnati Construction Co., which is backing the project.

Fred A. Baxter, Superior, has been awarded the contract for the grading of the Soo Ry. ore line and yards, south of the Superior city limits, and the dock site on St. Louis Bay. Work will commence at once and will be completed by July 1, so that laying of steel may be finished by Aug. 1, when dock is to be ready for shipping ore.

O. Latham, Shawano, Wis., has resumed work on cutting the right of way for the Wisconsin & Northern R. R. extension northwest for Shawano.

Canadian Notes.

FROM CORRESPONDENTS AND OTHER SOURCES.

The Canadian Northern Ry. has recently awarded the following contracts: The Extension of the Oak Point line to the Cowan Construction Co. C. J. Murray has been awarded the extension of the line west from Prince Albert, 30 miles of which have already been constructed. The same contractor has also been awarded the line northwest from Prince Albert. McMillan Bros. have been awarded the construction of the Thunder Hill branch.

The Canadian Government has decided to renew subsidies previously granted for 3,048 miles of railroad. In all 44 subsidies are proposed, and on the basis of $3,200 a mile the total will amount to $8,862,400, but there is small probability that 10 per cent of this amount will ever be called for. Among the subsidies renewed are the following: To the St. Mary's & Western Ontario Ry. Co. for a line of railway from Embro to Exeter, not exceeding 36 miles. To the Manitoulin & North Shore Ry. Co. for three lines of railway, not exceeding in all 194 miles. To the Algoma Central & Hudson's Bay Ry. Co. for three lines not exceeding in all 275 miles. To the Bracebridge & Trading Lake Ry. Co. for a line of railway from Bracebridge, in Muskota, to a point at or near Baysville, Ontario, not exceeding 16 miles. To the Lac Seul, Rat Portage & Keewatin Ry. Co. for a line not exceeding 22 miles. To the Nepigon Ry. Co. for lines not exceeding in all 80 miles. To the Ontario, Northern & Temagami Ry. Co. for a line from a point at or near Sturgeon Falls, in a northwesterly direction, to a point on the westerly shore of Lake Temagami, in the district of Nipissing, not exceeding 50 miles. For a line of railway from Sharbot Lake or Bathurst station, in the Province of Ontario, or between these points, via Lanark village, to Carleton Place, not exceeding 41 miles. To the Erie, London & Tillsonburg Ry. Co. for a line of railway from Port Burwell to London, not exceeding 35 miles To the Toronto, Lindsay & Pembroke Ry. Co. for a line of railway from Golden Lake to Bancroft, not exceeding 51 miles. To the Kingston, Smith's Falls & Ottawa Ry. Co. for a line of railway from Kingston to Ottawa, not exceeding 101 miles. To Pacific, Northern & Omineca Ry. Co. for a line of railway from Edmonton, northwesterly, to or toward Peace River, not exceeding 110 miles. To Southern Central Pacific, Ry. Co. for following lines of railway: (a) from a point two miles west of Pincher station on the Crows Nest Pass branch of the Canadian Pacific railway, northwesterly, not exceeding 10 miles; (b) from a point two miles west of Pincher station on Crows Nest Pass branch of Canadian Pacific railway southwesterly, not exceeding 40 miles. To Kettle River Ry. Co. for the following lines of railway: (a) from Midway to a junction near Merritt with Nicola, Kamloops and Similkameen railway not exceeding 250 miles; (b) from a point on the company's line of railway near Coldwater River to a point on the Fraser River, not exceeding 50 miles. To Kootenay Central Ry. Co. for a line of railway from Golden toward the international boundary line via Windermere and Fort Steele, then crossing the Crows Nest Pass railway at or near Elko, not exceeding 186 miles. To Esquimalt & Nanaimo Ry. Co. for a line of railway from a point on its main line of railway at or near Duncan's to Cowichan Lake, not exceeding 24 miles.

The Northern Navigation Co. is to construct a 600 ft. addition to the New Ontario dock at Sault Ste. Marie, Ont.

A resolution is before the Canadian Parliament providing for a government guarantee of bonds of the Canadian Northern Alberta Ry. Co. for the construction of a line from Edmonton west to the coal areas near the Brazau River and the headwaters of Macleod River, a distance of 150 miles. The guarantee is to the extent of $13,000 per mile for the first 50 miles and $25 per mile for the balance of the line, with interest at the rate of 3½ per cent per annum, payable half-yearly. Usual conditions with regard to security are imposed. The guarantee supersedes a previous guarantee of bonds to the Edmonton, Yukon & Pacific Ry.

J. W. Stewart & Co., Vancouver, B. C., contractors for building the V., V. & E. railway between Princeton and Abbottsford, have awarded to Martin, Welch & Co., a sub-contract for the 20 mile section between Abbotsford and Chilliwack. Construction work has been started from Abbotsford.

Location surveys for the Canadian Northern Ry.'s route between Kamloops and Yellowstone Pass at the summit of the Rockies have been completed and work is now under way revising the location of the company's line on the main Thompson River between Kamloops and Lytton.

The citizens of Moose Jaw, Sask., have voted in favor of a by-law giving a street railway franchise to a company composed of Otttawa capitalists, who will start work at once on putting in a system.

Probably the first contract to be let for the Hudson Bay R. R. will be for the construction of the bridge across the Saskatchewan at The Pas, and this will cost about $250,000. About $350,000 will also be available for grading. As the country north of The Pas is especially favorable for railway construction this sum should be sufficient to carry on the work for a considerable distance out and contracts will probably be let for the first 40 miles, all of which has now been located. At the present time there is available the sum of $680,000 for engineering and construction if the $500,000 included in the government supplementary estimates is passed. Of the total sums available it will need approximately $80,000 for the pressing forward of the engineering and location work, which is now being carried on. Three parties are now in the field. Still other parties will be put out as soon as navigation opens to the upper end of Lake Manitoba.

Fallon Bros., Cornwall, Ont., have been awarded the contract at $70,000 for improvements around Lock 17 of the Cornwall Canal. The improvements consist of 180 ft. of concrete wall along the north bank, followed by 520 ft. of heavy cribwork designed to set the current in the canal more directly towards the lock than at present. Fallon Bros. also have the building of a large new weir just below the locks.

Mexican Notes.

FROM CORRESPONDENTS AND OTHER SOURCES.

The Governor of the State of Zacatecas, Mexico, has granted Gustave Madero, Monterey, Mex., a formal construction concession for the building of the long projected Zacatecas and Orient Railway, a new line which will be built from Camacho station, located 199 kilometers south of Torreon and 232 kilometers north of Zacatecas, on the El Paso-Mexico City line of the National Railways, to the important mining camp of Mazapil, in the extreme northeasern corner of the state of Zacatecas. According to the terms of the concession construction work is to be started June 1.

The Transvaal Copper Co., of Cincinnati, O., is said to have capital available for the construction of a railroad from Cumpas to the company's mines, from 30 to 40 miles west

of that point, for further extensive development and for smelting operations.

According to reports, Harris Walthal, who received a concession from the Mexican Government about a year ago for the construction of a railroad from Durango to the old mining town of San Dimas, in the Sierra Madras, has succeeded in organizing a strong British company to carry out the terms of the concession. The line as proposed will be about 125 miles in length.

The Trenton Street Ry. Co. of Trenton, N. J., has opened bids covering the proposed introduction of 14,450 ft. of new rails in Trenton and the restoration of pavements along the route. It is estimated that the improvement will cost upwards of $100,000.

The recent visit to Anderson, S. C., of the owners of the Anderson Traction Co., has given rise to the report that the road was to be extended. T. B. Lot is Engineer.

The Public Service Corporation, Newark, N. J., which recently obtained possession of the Camden & Trenton Traction Co.'s line, will, it is reported, erect one of its power plants in Burlington, N. J. The corporation, it is also reported, is endeavoring to purchase the franchise of the Burlington electric light and power plant, thus practically completing its control of the lighting facilities of the city.

R. E. Cowden has completed preliminary surveys for a railroad from the properties of the Nevada United Mines Co. of Denver, at Wardner to connect with the Nevada Northern Ry. According to the present plans the road will be 14 miles long, and an average grade of 1 per cent has been obtained for practically the entire distance. The worst stretch of road will have a 3 per cent grade for half a mile. Mr. Cowden is chief engineer for the Mayo River Power & Light Co. in Mexico, which is controlled by the directors of the Nevada United Mines Co.

The Vicksburg, Shreveport & Pacific Ry. (Queen & Crescent) is reported to have acquired control of the Louisiana & Northwestern, running from McNeil, Ark., to Natchitoches, La., and crossing the Vicksburg, Shreveport & Pacific at Arcadia, La. It is also stated the Louisiana & Arkansas has bought the embankment and right of way of the old Klingman road from Minden to Homer, La., and will extend its line to that point. W. H. Vance, Stamps, Ark., is engineer, Louisiana & Arkansas Ry.

The Orleans Levee Board, Sidney F. Lewis, Engineer, New Orleans, La., has voted that the levee grade from Lafayette to Louisa St. be changed from 25 to 23 ft. This will mean a saving of about $1,000,000 to the Levee Board in the purchase price of properties.

The street railway company at Phoenix, Ariz., Kenneth Shibley, engineer, has begun preliminary work on its Mesa St. car line in order to comply with franchise requirements. The line when completed will be about seven miles long.

J. H. Nesbitt has been awarded the contract for the erection of a $26,000 power house for the Norfolk & Western Ry., in Roanoke, Va.

Reports from Armour, S. Dak., state that engineers have headquarters there and are making surveys for the construction of the proposed line of the Sioux Falls, Bridgewater & Wheeler R. R. The company is supposed to be subsidiary to the Rock Island system.

The Nolachcky Power Co. has been organized and proposes to build a dam at the Devils Looking Glass on the Nolachcky River, one mile from Erwin, Tenn.

Surveys are to be made, it is reported, at the instance of L. E. Johnson, Roanoke, Va., President of the Norfolk & Western Ry. for an electric railway between Welch, W. Va., and Bluefield, W. Va.

BIDS ASKED.

Bridges.

Bids are asked on following work, the notes being arranged alphabetically by states:

Brooks, Minn.—Until 9 a. m., May 7, by Town Board of Poplar River, at the office of A. Laniel, Brooks, Minn., for the construction and material of a 22-ft. girder bridge on steel pile foundation with reinforced concrete backing.

Shakopee, Minn.—Embankment.—Until 8 p. m., May 10, by Common Council, for the necessary labor and materials for the construction of an embankment across the washout in the bank of the Minnesota River, west of the north end of the bridge crossing said river in Shakopee, Minn. Alex Schaefer is City Recorder.

Taylor Falls, Minn.—Until 1 p. m., June 3, by Village Council, Taylor Falls, Minn., for the construction of a steel arch or reinforced concrete bridge across the St. Croix River, between the villages of St. Croix Falls and Taylor Falls, Minn.

Taylors Falls, Minn.—Until 1 p. m., June 3, by the Commissioners of the Interstate Park, for the construction of a steel arch or reinforced concrete arch bridge over the St. Croix River, between St. Croix Falls, Wis., and Taylors Falls, L. P. Wolff, Consulting Engineer, 204 Essex Bldg., St. Paul, Minn. Official advertisement will be found elsewhere in this issue.

Nevada, Mo.—Until 2 p. m., May 17, by James M. Clack, County Highway Engineer, for the construction of a steel bridge across the Marmaton at the Cogswell Ford in Section 34, Lake Township; one across the Big Drywood at Brook Ford on the south side of Section 16, Harrison Township; a steel bridge across the Little Drywood at Henson Ford on the south side of Section 31, Center Township; a steel bridge across the Green River in Section 25, Lake Township.

McCook, Neb.—Until noon, June 1, by County Clerk, for the construction of a wooden bridge across the Republican River on the county line.

Jamestown, N. Y.—Until noon, May 14, by Board of Estimate and Review, for the construction of two reinforced concrete bridges, one a girder bridge at Winsor St., and the other a double arch bridge at Fairmont Ave.

Cincinnati, O.—Until noon, May 27, by Board of County Commissioners, for the construction of a box culvert and retaining wall on Bogart Road near Albert Bogart's place in Anderson Township. Fred Dreihs is Clerk.

Cincinnati, O.—Until noon, May 20, by Board of County Commissioners, for the construction of culverts and changing course of creek on West Fork Road, between Schoolhouse and Rehkamp in Millcreek Township.

Cleveland, O.—Until 11 a. m., May 25, by County Commissioners, for the construction of bridge work per Report No. 2614, concrete arch on Union St., Bedford, over Tinker's Creek, Bedford Township.

Lima, O.—Until noon, May 10, by County Commissioners, for the erection and completion of a steel or concrete bridge across the Hog Creek on the line between Allen and Hardin Counties. C. R. Phillips is Clerk of the Board.

Van Wert, O.—Until noon, May 25, by Joint Board of County Commissioners of Allen and Van Wert Counties, for the necessary labor and material for the construction of a bridge across the canal on county line between said counties and at the Ludwig Road crossing. C. R. Phillips is Clerk of the Allen County Board.

Warren, O.—Until May 23, by County Commissioners for the construction of a bridge over Yankee Run on East Liberty St., in the village of Hubbard.

Lancaster, Pa.—Until 10 a. m., May 6, by County Commissioners, for the construction of a concrete or steel county bridge over the Conestoga Creek at Rupp's Mill in West Earl Township, Lancaster County, Pa. Frank Eshleman is County Controller.

New Castle, Pa.—Until noon, May 12, by Board of County Commissioners, for the necessary labor and material for the construction of five bridges in Lawrence County. S. E. Crawford is Clerk.

Norristown, Pa.—Until 11 a. m., May 4, by County Commissioners, for the paving with creosoted wooden block the approach to the West Airy St. bridge. Robert C. Miller is Clerk.

Cameron, Tex.—Until May 18, by Commissioners' Court, for the construction of a steel bridge at San Gabriel Crossing, San Gabriel River in the village of San Gabriel.

Cheyenne, Wyo.—Until 10 a. m., May 5, by Board of County Commissioners, C. Edward Artist, County Clerk, for the construction of a wood and steel bridge over the North Platte River. The structure will be 1,300 ft. long and 12 ft. wide.

Buildings.

Bids are asked on following work, the notes being arranged alphabetically by states:

Fort Mason, San Francisco, Cal.—Until 11 a. m., May 17, by Constructing Quartermaster, Fort Mason, San Francisco, Cal., for the construction, installation of plumbing, heating and electric wiring in two single barracks at Fort Winfield Scott, Cal.

Fort Dupont, Delaware City, Del.—Until 11 a. m., May 16, by Constructing Quartermaster, Fort Dupont, Delaware City, Del., for furnishing and installing metal frame window screens in five new buildings at Fort Dupont, Del.

Wilmington, Del.—Until May 14, by Engineer Fourth Light House District, Wilmington, Del., for the erection of a dwelling at Liston's range rear light station, Del.

Wilmington, Del.—Until May 10, by Engineer Fourth Light House District, Wilmington, Del., for removing the superstructure of the Gross ledge light station, Delaware Bay.

Dayton, Ia.—Until 9 a. m., May 20, by Rev. N. E. Kron, for the erection and completion of the Swedish Lutheran Church, material brick, at Dayton, Ia.

Harlan, Ia.—Until May 14th, by Brown Bros., Security Savings Bank Bldg., Cedar Rapids, Ia., Architects, for the steam heating, plumbing and electric wiring complete for the main building of the Interstate Associated Colleges, Harlan, Ia.

Osage, Ia.—Until noon, May 19, by O. A. Houghland, Architect, Chariton, Ia., for the construction of a public library building, including all necessary labor and material. O. L. Cole is President.

Fort Leavenworth, Kan.—Until 11 a. m., May 24, by Capt. William D. Davis, Constructing Quartermaster, for the construction, plumbing, heating, wiring and fixtures of following buildings: Two sets field officers' quarters, two double sets company officers' quarters, three 4-set officers' quarters.

Springfield, Mass.—Until May 12, by Municipal Building Commission, for Contract No. 3, heating and ventilation, and Contract No. 5, plumbing for the auditorium, tower and passage and municipal office building of the new municipal buildings in this city.

Portland, Me.—Until 10 a. m., May 18, by Capt. C. F. Humphrey, Jr., Constructing Quartermaster, Portland, Me., for construction of a cable storehouse, plan 251-A, and an ordnance shop, plan 189-B, including plumbing in the latter building at Fort Preble, Me.

Carrollton, Mo.—Until 3 p. m., June 2, by James Knox Taylor, Supervising Architect, Treasury Department, Washington, D. C., for the construction, including plumbing, gas piping, heating apparatus, electric conduits and wiring, of the United States Post Office at Carrollton, Mo.

Ellendale, N. D.—Until 1:30 p. m., May 20, by W. M. Kern, Ellendale, for the erection, including material and labor for the 6-room school building except heating and plumbing.

Fargo, N. D.—Until 1 p. m., May 10, by Board of Trustees, for the erection of a fireproof chemistry building, located at the Agricultural College grounds, Fargo.

Fort H. G. Wright, N. Y.—Until 10 a. m., May 20, by Capt. F. T. Arnold, Constructing Q. M., New London, Conn., for furnishing and installing screens and metal weather strips on ten buildings at Fort H. G. Wright, and on ten buildings at Fort Terry, N. Y. Official advertisement will be found elsewhere in this issue.

Fort Porter, N. Y.—Until 11 a. m., May 20, by Constructing Quartermaster, for addition to guard house at Fort Porter, N. Y.

New York, N. Y.—Until 10 a. m., May 10, by Board of Health, 55th St., Borough of Manhattan, New York, N. Y., for furnishing all the labor and materials necessary or required to erect exclusive of foundations two open-air pavilions, together with all work incidental thereto, upon the grounds of the Riverside Hospital at North Brother Ave., Bronx, New York City.

New York, N. Y.—Until 11 a. m., May 14, by Commissioners of Board of Water Supply, John A. Bensel, President, 165 Broadway, New York, for the construction of four field office buildings and five horse sheds, in the Croton, White Plains and Hill View Division of the Catskill Aqueduct, in the towns of Mount Pleasant and Greensburg and the city of Yonkers, Westchester County, N. Y.

Columbus Barracks, O.—Until 10 a. m., May 25, by Capt. H. J. Hirsch, Constructing Quartermaster, for the construction and erection of a garbage crematory at this post.

Van Couver Barracks, Wash.—Until 11 a. m., May 20, by Capt. Clyfard Game, Constructing Quartermaster, for the construction of a frame storehouse, with slate roof, 240 ft. long, at this post.

Elkins, W. Va.—Until 3 p. m., May 9, by County Court, for the erection of a jail building and jailor's residence for Randolph County.

Fort Myer, Va.—Until 11 a. m., May 11, by Capt. Warren W. Whiteside, Constructing Quartermaster, for the addition to the present administration building at Fort Myer, Va.

Fort Monroe, Va.—Until 10 a. m., May 27, by Capt. Ernest R. Tilton, Constructing Quartermaster, for the construction, including plumbing, heating, electric wiring and fixtures of nine double sets of noncommissioned officers' quarters, at Fort Monroe, Va.

Columbus, Wis.—Until 9 a. m., May 16, by G. S. Lashier, Chairman County Building Committee, Fall River, Wis., for the construction, including labor and material, of a solid brick and stone school building.

Winnipeg, Man.—Until 11 a. m., May 11, by Chairman Board of Control, for necessary labor and material for the construction of two fire stations and drill tower.

Winnipeg, Man.—Until 11 a. m., May 5, by Board of Control, for the construction of an additional floor to the crematory. M. Peterson is secretary.

Port Arthur, Ont.—Until 4 p. m., May 15, by Father J. A. Grenier, parish priest, for the construction of a Roman Catholic church. C. Emile Tanguay is Architect.

Roads and Streets.

Bids are asked on following work, the notes being arranged alphabetically by states:

Stockton, Cal.—Until 10 a. m., May 14, by Board of Supervisors, for paving certain roads, viz.: Cherokee, Lane, Waterloo, Linden Copperopolis, Farmington, Mariposa, French Camp and West Side Roads, in San Joaquin County.

Bridgeport, Conn.—Until May 6, by city clerk, for furnishing and laying of pavement of Stratford Ave. Brick and wood blocks will be used, but the wood will be used as much as possible, the brick to be placed on steep grades.

Coeur D'Alene, Idaho.—Until 4 p. m., May 16, by city clerk, for improvement of streets, including grading, curbing with concrete, parking streets in Local Improvement Districts Nos. 7, 8, 9, 10 and 11.

Jacksonville, Ill.—Until 10 a. m., May 17, by Board of Local Improvements, for the construction of pavement on West College St. The work includes 5,444 lin. ft. of curb and gutter, 7,780 sq. yds. paving and 2,899 cu. yds. excavation. The cost of the work is estimated at $19,846.

Vincennes, Ind.—Until May 10, by Board of Public Works, for grading and graveling and curbing 11th St. and Fair Ground Ave.

Wabash, Ind.—Until 1 p. m., May 27, by Commissioners of Wabash, Whitley and Huntington Counties, at Wabash, Ind., for the construction of a gravel road on boundary line between Wabash, Whitley and Huntington Counties. J. P. Noftzger is auditor of Wabash County.

Denton, Md.—Until noon, May 10, by County Commissioners, for the improvement of Public Highway in Federalsburg, known as Bridge St. The work includes about ½ mile of road. J. L. Dukes is clerk of the County Commissioners.

Aurora, Neb.—Until noon, May 7, by Board of County Commissioners, for the improvement of a number of county roads leading into this city. D. H. Saylor is County Clerk.

Washington, N. C.—Until 7 p. m., May 12, by Board of Improvements, for the improvement of East Main and East 2d Sts., between Harvey and Market Sts.; West Main St., between Gladden and Bridge Sts.; West 2d St., between Market and Van Orden Sts.; Market St., between Main and 4th Sts, and Water St., between Market and Union Alley; approximately 6,130 lin. ft. Improvements to include grading, curbs, gutters, bituminous macadam or brick pavement, catch basins and cement sidewalks.

Winston Salem, N. C.—Until 10 a. m., May 10, by Board of County Commissioners, for the construction of a macadam road 4 miles in length. A certified check for $1,000 must be filed with each bid.

Elizabeth, N. J.—Until 2:30 p. m., May 18, by County Board of Chosen Free Holders, for the construction of a stone road in Raritan Road and Lake Ave., extending from Terrill Road to Palisade Ave., in Fanwood and Clark Townships. The work includes 32,374 cu. yds. excavation and 23,800 sq. yds. of macadam. F. J. Hubbard is County Engineer, 201 Park Ave., Plainfield, N. J.

Albany, N. Y.—Until 1 p. m., May 6, by Commission of Highways, Albany, N. Y., for the improvement of the Goldens Bridge-Turk's Hill Road No. 770, a length of 3.85 miles in the town of Lewisboro, Westchester County, New York. S. Percy Hooker is Chairman of the Commission.

Brooklyn, N. Y.—Until 11 a. m., May 11, by Alfred E. Steels, Borough President, for regulating and grading and curbing and laying sidewalks on portions of Avenue C, Dorchester Road, Fifth Ave., Fifty-fifth St., Hegeman Ave., Huron St., Sherman St., Sterling Pl., Seventh Ave., Seventy-second St., and Sutter Ave.

Brooklyn, N. Y.—Until 3 p. m., May 12, by Commissioners of Parks, Arsenal Bldg., Manhattan, N. Y., for repairing asphalt pavement on a concrete foundation in the roadway of Glenmore Ave., Eastern Parkway extension Stone Avenue and repairing asphalt block pavement on Bushwick Ave., between Eastern Parkway extension and Jamaica Ave., together with all the work incidental thereto.

Cincinnati, O.—Until noon, May 6, by Director of Public Service, for furnishing the necessary labor and material for the paving of Beechwood Ave., from Cinnamon St. to Cohoon St., with brick. The work includes grading, setting limestone curbs and constructing the necessary drains and inlets.

Cincinnati, O.—Until noon, May 20, by Board of County Commissioners, for the oiling of Blue Rock Pike, from Colerain Pike to the River Road, in Colerain Township.

Hamilton, O.—Until noon, May 24, by Board of County Commissioners for the reconstruction and repair of the public roads known as the Lebanon and Oxford Turnpike, from the Trenton Bridge over the Miami River eastwardly and the Middletown & Hamilton pike from its intersection with said road and by the construction and erection of embankments and levees to protect same. J. E. Brate is county auditor.

Houston, Tex.—Until noon, May 13, by John B. Ashe, county auditor, for paving 4 miles of the Lynchburg-Crosby Road; the remainder of the Seabrook Road.

Arlington, Va.—Until 11 a. m., May 10 by Capt. H. L. Pettus, Depot Quartermaster, Washington, D. C., for Tarvia on roadway in Arlington, Va., National Cemetery.

Olympia, Wash.—Until May 10, by State Highway Commissioner, for grading, bridging and graveling of state road No. 15, known as the Lewis River Road, extending from Woodland several miles toward Mount St. Helens.

Elgin, Que.—Until May 10, by Andrew Coffey, Mayor, for the construction of about 8 miles of macadamized road in the aforesaid municipality. Work must be done with modern crusher, sprinkled and rolled and completed before November 1.

Sewers.

Bids are asked on following work, the notes being arranged alphabetically by states:

Little Rock, Ark.—Until noon, May 16, by City Secretary M. A. Metzger, for the construction of 3½ miles of sanitary sewers, and a septic tank for the city. The work is estimated to cost $18,000. Lund & Hill, Little Rock, Ark., are the consulting engineers.

Searcy, Ark.—Until 3 p. m., May 25, by J. F. Headlee, Secretary, Board Public Improvements, for furnishing materials and constructing a system of sanitary sewers. W. S. Shields Engineering Co., Engineers, 1201 Hartford Bldg., Chicago, Ill. Official advertisement will be found elsewhere in this issue.

St. Petersburg, Fla.—Until 8 p. m., May 5, by W. F. Divine, City Clerk, for the construction of a sewer system as follows: No. 9, 234 ft. of 6-in. pipe; No. 10, 720 ft. 6-in. pipe; No. 11, 280 ft. of 10-in. pipe and 1,250 ft. of 6-in. pipe; No. 12, 6,862 ft. of 6-in. pipe and 2,750 ft. of 8-in. pipe and 1,325 ft. of iron pipe 8 ins.

Baltimore, Md.—Until 11 a. m., May 11, by Board of Awards for the necessary material and labor for the erection and installation of electrical and mechanical equipment for the sewage disposal works at the Back River. The work includes the following approximate quantities: 2 150 H. P. Hydraulic Turbines, with governors, complete; 2 110 K. V. A. Alternating Current Generators and Exciters, complete; 1 50 H. P. Alternating Current Motor; 4 35 H. P. Alternating Current Motors; 1 5 H. P. Alternating Current Motor; 1 Two-Stage Centrifugal Pump; 4 10-in. Single-Stage Centrifugal Pumps; 1 5 K. W. Motor-Generator; 1 75 H. P. Oil Engine; 3 37½ K. V. A. Transformers; 5 25 K. V. A. Transformers; 1 15 K. V. A. Transformers; 1 5 Panel Switchboard in Powerhouse; 1 Arc Lamp Regulator, complete; 15 Alternating Current Arc Lamps; 1 Traveling Crane, complete; Tile and Metal Conduits; exterior and interior wiring; lighting fixtures; cast and wrought iron pipe and fittings.

Missouri Valley, Mo.—Until 7:30 p. m., May 4, by T. M. Gilmore, city clerk, for the installation of a sewer system as follows: 4,704 lin. ft. of 18-in., 390 lin. ft. of 15-in. 2,770 lin. ft. of 12-in., 7,774 lin. ft. of 10-in., 16,534 lin. ft. 8-in. 26 flush tanks, 64 manholes, 200 ft. 12-in. and 84 ft. 18-in. cast iron pipe; concrete bulkhead. Iowa Engineering Co., Clinton, Ia., are the engineers for the work.

St. Louis, Mo.—Until Noon, May 31, by Board of Public Improvements, for the construction of South Harlem Joint District Sewer—Section Section, in South Harlem Joint Sewer District, under the authority of Ordinance No. 25034, embracing sewers of the following sizes and lengths, to-wit: A sewer of reinforced concrete, 14 ft. wide by 11 ft. 2¾ ins. high (inside measurements), 2,919.55 ft. in length; a sewer of reinforced concrete, 12 ft. wide by 9 ft. 7¼ ins. high (inside measurements), 4,031.25 ft. in length; a branch sewer of brick, 7 ft. 6 ins. in diameter (inside measurements), 1,041.53 ft. in length; a branch sewer of brick 7 ft. in diameter (inside measurements), 100 ft., more or less, in length; with junctions, manholes and all other necessary appurtenances. Deposit required, $5,529.00.

Sanford, N. C.—Until 8 p. m., May 17, by J. D. Gunter, Sr., Town Clerk, for constructing sewer system to include 7 miles of 8-in. to 20-in. pipe sewers and concrete settling tank. Gilbert C. White, Engineer, Durham, N. C. Official advertisement will be found elsewhere in this issue.

Sanford, N. C.—Until 8 p. m., May 17, by Mayor and Board of Aldermen, for the construction of sewer system. The work includes about 7 miles of pipe sewers from 8 to 20 in. in diameter, with appurtenances and concrete settling basin. J. D. Gunter, Sr., is clerk. Gilbert C. White, Durham, N. C., is engineer.

Binghamton, N. Y.—Until May 11, by City Clerk, for the construction of a sewer on James St.

York, Pa.—Until 4 p. m., May 9, by Board of Public Works, for the construction of 3,498 ft. of sewer pipe on East Market St., from Sherman and Edgar Sts.

Aberdeen, S. Dak.—Until 8 p. m., May 23, by F. W. Raymond, City Auditor, for the construction of any and all of the sewers ordered by the City Council.

Princeton, W. Va.—Until noon, June 8, by F. R. Van Antwerp, chief engineer, for the construction of sanitary sewers with a small amount of 24-in. cast iron pipe and vitrified pipe or sizes 10-in., 12-in., 15-in., 18-in., 20-in., 22-in., 24-in., 27-in. and 30-in., with necessary manholes and lampholes.

Water Supply.

Bids are asked on following work, the notes being arranged alphabetically by states:

Searcy, Ark.—Until 3 p. m., May 25, by J. F. Headlee, Secretary, Board Public Improvements, for furnishing material and constructing a water works system. W. S. Shields Engineering Co., Engineers, 1201 Hartford Bldg., Chicago, Ill. Official advertisement will be found elsewhere in this issue.

Fort Dupont, Del.—Boiler Pump, Etc.—Until 11 a. m., May 23, by Constructing Quartermaster, Fort Dupont, Delaware City, Del., for furnishing and installing two 75-hp. water tube boilers, one feed pump, one feed-water heater, new steam and exhaust mains and making certain removals and changes in pump house, at Fort Dupont, Del.

Brooklyn, N. Y.—Until 2 p. m., May 11, by Henry S. Thompson, Commissioner of Water Supply, Gas and Electricity, Park Row Bldg., New York, for furnishing, delivering and laying high pressure fire service mains and appurtenances in the Gowanus and South Brooklyn Districts.

Youngstown, N. Y.—Until 8 p. m., May 10, by Board of Trustees, for the installation and furnishing of equipment for the water works system. J. F. Witmer, Buffalo, N. Y., is Engineer. Charles Taylor is Village Clerk.

Lorain, O.—Until noon, May 26, by Director of Public Service, for furnishing necessary labor and materials for the improvement of the water works system. The work includes furnishing and laying a new 48-in. cast iron or 51-in. steel intake pipe from the present filter house to a point about 2,800 ft. in Lake Erie; furnishing and placing the necessary specials, valves and fittings; furnishing and placing a new intake crib, together with the necessary excavating, filling, etc.

Fort Meade, S. D.—Until 10 a. m., June 1, by the Constructing Quartermaster, for constructing concrete dam and clearing reservoir site. Official advertisement will be found elsewhere in this issue.

Miscellaneous.

Bids are asked on following work, the notes being arranged alphabetically by states:

Fort Morgan, Ala.—Electric Lighting System—Until 1:30 p. m., May 23, by Capt. H. B. Chamberlain, Constructing Quartermaster, for the construction of an electric lighting system at Fort Morgan.

Washington, D. C.—Fire Engine—Until 2 p. m., May 16, by District Commissioners, for furnishing one combination chemical engine and hose wagon for use in the fire department of the District of Columbia.

Greenfield, Ind.—Drainage Work.—Until June 7, by G. W. Allen, Drainage Commissioner, for the construction of a drain.

Baltimore, Md.—Monument—Until 11 a. m., May 11, by Board of Awards, for the necessary labor and material for the cutting and setting of granite stone work for the Key Monument, which is to be placed at the intersection of Lanvale St. and Eutaw Place. B. T. Fendall is city engineer.

Boston, Mass.—Removing Wreck—Until noon, May 21, by Lieut. Col. Edward Burr, U. S. Engineer, Boston, Mass., for removing wreck of barge "City of Montreal," in Plymouth Harbor, Mass.

Fort Missoula, Mont.—Electric Lighting System—Until noon, May 20, by Maj. A. B. Shattuck, Constructing Quartermaster, for the following work: 1st, furnishing and installing meters and fixtures in eleven sets of officers' quarters, four sets non-commissioned officers' quarters, two double barracks, one stable, one bakery and one post exchange and gymnasium; 2d, the construction of a street light line, service connection with buildings, including all necessary items for same; 3d, furnishing and installing Tungsten lamps, switchboard and all apparatus necessary for a substation; 4th, construction of a reinforced concrete building for transformer substation.

Fort Totten, N. Y.—Torpedo Anchors—Until noon, June 6, by Disbursing Officer Torpedo Depot, for furnishing and delivering 936 cast-iron automatic torpedo anchors.

Fort Caswell, N. C.—Electric Plant—Until 3 p. m., May 26 by Lieut. William R. McCleary, Constructing Quartermaster, for the construction of an electric power plant and electric lighting system.

Cincinnati, O.—Boat—Until 2 p. m., May 18, by Lieut. Col. J. G. Warren, U. S. Engineer, for the construction of hull of one maneuver boat.

Richmond, Va.—Railroad—At once by T. T. Adams Co., Richmond, Va., for the construction of 8 miles of narrow gage steam logging road along Armstrong Creek, McDowell County, N. C.

Fort Ethan Allen, Vt.—Shower Baths—Until 10 a. m., April 20, by Capt. R. J. Fleming, Constructing Quartermaster, for removing old bath tubs and installing showers in four double barracks, at Fort Ethan Allen, Vt.

Colville, Wash.—Drainage.—Until 2 p. m., May 16, by Drainage Commissioner, District No. 2, Stevens County, at the office of W. M. Manning, Colville, Wash., Engineer, for the construction of a proposed Drainage Improvement in said district. The work includes 11 miles of ditch or canal.

Sault Ste. Marie, Ont.—Railroad Work—Until noon, May 16, by Chief Engineer Algoma Central & Hudson Bay Ry., for clearing right of way, construction of bridges, cleaning of cuts and making up embankments. The work is also noted under Confirmed Reports in this issue.

Excavation, Earth and Rock.

Bids are asked on following work, the notes being arranged alphabetically by states:

Wilmington, Del.—Dredging—Until noon, May 24, by Maj. R. R. Raymond, U. S. Engineer, Wilmington, Del., for dredging Mispillion and Appoquinimink Rivers, Del.

New York, N. Y.—Telegraph System.—Until 10:30 a. m., May 9, by R. Waldo, Fire Commissioner, 157 East 67th St., Manhattan Borough, New York, for furnishing all the labor and materials required for establishing, building and equipping an underground fire alarm telegraph system in the borough of Brooklyn.

Fort Caswell, N. C.—Electric Lighting System and Power Plant.—Until 3 p. m., May 25, Lieut. W. E. McCleary, Constructing Quartermaster, for the necessary labor and material for the installation of an electric lighting system and power plant.

Cincinnati, O.—Maneuver Boat.—Until 2 p. m., May 18, by Lt. Col. J. G. Warren, U. S. Engineer, for the construction of hull for one maneuver boat.

Cincinnati, O.—Elevators.—Until Noon, May 27, by Board of County Commissioners, for the reconstruction of the hatch, cars and inclosure work for two electric passenger elevators in Hamilton County Court House, on Court and Main Sts.

Johnson City, Tenn.—Power Plant.—Until May 15, by City Council for the construction of a power plant.

Sparta, Wis.—Heating Plant, Laundry, Etc.—Until 6 p. m., May 17, by J. W. Leverich, Chairman Building Committee, for the erection and completion of a boiler house, central heating plant, laundry and plumbing for the Chronic Insane Asylum at Sparta, Wis.

London, Ont.—Steam Roller.—Until 4 p. m., May 5, by J. A. Tancock, Chairman of the Committee, for furnishing a steam roller of 12 to 15 tons. A. O. Graydon is City Engineer.

Materials, Machines, Supplies, Etc.

Bids are asked on following work, the notes being arranged alphabetically by states:

Washington, D. C.—Pumps, Pipe, Etc.—Until May 5, by Capt. F. C. Boggs, General Purchasing Officer, Isthmian Canal Commission, Washington, D. C., for furnishing two portable pumps, 4-in. discharge, 6-in. suction; 1,500 ft. of double galvanized spiral riveted pipe, 12 ells and 3 reducers, together with the following spare parts: One set rotor and stator winding, one set motor bearing linings, one set pump bearing linings, two sets rubber bushings for flexible couplings, 400 ft. linen hose, 4-in. and two triple pole knife switches.

Washington, D. C.—Dynamite, Etc.—Until 10:30 a. m., May 20, by Capt. F. C. Boggs, General Purchasing Officer, Isthmian Canal Commission, Washington, D. C., for the furnishing of dynamite, blasting caps, fuses, insulating tape, connecting and lead wire.

Washington, D. C.—Cross & Switch Ties—Until 10:30 a. m., May 28, by Capt. F. C. Boggs, General Purchasing Officer, Isthmian Canal Commission, Washington, D. C., for the furnishing of cross and switch ties, according to Canal Circular 579.

Washington, D. C.—Steel Tanks—Until 11 a. m., June 5, by the Bureau of Yards and Docks, Navy Department, Washington, D. C., for the construction of steel fuel oil and gasoline storage tanks at naval stations on U. S. Naval property at Bradford, R. I., Norfolk, Va., Charleston, S. C., Key West, Fla., Guantanamo, Cuba and San Juan, P. R. R. C. Hollyday is chief of the bureau.

Washington, D. C.—Miscellaneous Supplies—Until 10:30 a. m., May 26, by Capt. F. C. Boggs, General Purchasing Officer, Isthmian Canal Commission, Washington, D. C., for furnishing miscellaneous supplies as follows: Hand cars, push cars, warehouse trucks, wheelbarrows, jacks, anvils, vises, forges, shovels, spades, picks, hammers, machinists', blacksmiths' and track tools, garden tools, machetes, drills, saws, pipe tools, shears, belt punches, files, scythestones, tool handles, differential, snatch and tackle blocks,, wire rope attachments, sister hooks, hose clamps, brooms, brushes, garbage cans, squilgees, valves, cocks, pipe fittings, cotton mop heads, solder, sash cord, oakum, manila rope, marline, vitrified sewer pipe, brick, fire clay, asbestos cement, rosin, caustic soda, carbolic acid, tie plugs, etc.

Washington, D. C.—Castings, Cement, Pipe, Etc.—Until 2 p. m., May 23, by District Commissioners, for furnishing the following materials. Granite curbing, asphalt paving blocks, repressed vitrified paving blocks, repressed vitrified invert sewer bricks, red sewer bricks, Portland cement, miscellaneous castings, sand and gravel, terra cotta sewer pipe and for hauling broken stone.

Baton Rouge, La.—Steel Rails—Until noon, May 15, by Board of Control, for 2½ or 3 miles of relaying or new American steel rails, 35 or 40 lbs., f. o. b. cars Angola, La. W. W. Heard is president.

New York, N. Y.—Broken Stone—Until noon, May 10, by President Borough of Richmond, for furnishing and delivering broken stone and screenings at stable "A," Swan St., Tompkinsville, S. I.; at stable "B," Columbia st., West New Brighton, S. I.; and at Tompkins Ave. yard, Clifton, S. I.

New York, N. Y.—Lumber—Until 2 p. m., May 6, by Wendell L. Simpson, Maj. 19th Infantry, U. S. Army, Assistant Purchasing Officer, Panama Railroad Co., 24 State St., New York City, for furnishing 1,700 pieces of lumber, sway bracing, delivery of said material to be made by steamer free of charges on dock at Cristobal, Canal Zone.

New York, N. Y.—Gravel.—Until 3 p. m., May 12, by Park Commissioners, Arsenal Bldg., Fifth Ave. and Sixty-fourth St., Borough of Manhattan, for furnishing and delivering Hudson River road gravel in Parks and on Parkways in Boroughs of Brooklyn and Queens.

Tompkinsville, N. Y.—Machine Tools—Until May 10, by Engineer Third Light House District, Tompkinsville, N. Y., for furnishing one Universal Milling Machine and one 24-in. upright sliding head drill, motor driven.

Philadelphia, Pa.—Dredge, Scow, Etc.—Until noon, June 17, by Joseph F. Hasskarl, Acting Director, Department of Wharfs and Docks, for constructing the following: One combination dredge (scoop and clam shell type), one tug boat not less than 80 ft. over all; one tug boat not less than 65 ft. over all; one or two bottom dump scows of not less than 500 cu. yds. capacity each; one or three bottom dump scows of not less than 250 cu. yds. capacity each; one deck scow of sufficient size to carry 150 tons of coal and fifteen pantoons.

Memphis, Tenn.—Stone.—Until Noon, May 17, by Maj. M. L. Walker, U. S. Engineer, for furnishing 18,000 cu. yds. stone and spalls.

CONTRACT LET.

The following contracts have been let recently:

BRIDGES.

Marshalltown, Ia.—Bridges—M. M. Stark Co., Des Moines, Ia., at $14,090, for the construction of six reinforced concrete bridges, ranging in length of their spans from 30 to close to 100 ft. Work must be completed by Oct. 1.

Clinton, Ill.—Bridges—Decatur Bridge Co., at $1,350, for the construction of two steel bridges with concrete abutments across the dredge ditch near the Philip Day and Gus Peterson farms, southeast of Weldon.

Indianapolis, Ind.—Retaining Wall.—Volff & Fritz, at $1,133, for the construction of a retaining wall at west end of bridge over Buck Creek, on north line of Section 15-15-5, Warren township; at $400 for the construction of a bridge over Buck Creek. Bids were opened April 23.

Topeka, Kan.—Bridge—Leavenworth Bridge Co., at $3,559, for the construction of a 188-ft. span on the Willard bridge across the Kaw-river.

Topeka, Kan.—Bridge.—Leavenworth Bridge Co., Leavenworth, Kan., at $3,550, for the construction of 188-ft. steel span on bridge at Willard, Kan. Bids were opened April 22.

Springfield, Mo.—Bridge.—Canton Bridge Co., New York Life Bldg., Kansas City, Mo., at $750, for the construction of a concrete girder bridge over the Sac River at Valley Water Mill. Bids were opened April 27.

Chillicothe, O.—Bridge.—E. Hurff & Son, Chillicothe, O., at $1,150, for the construction of a reinforced concrete arch bridge over Bulls Run, about two miles from Hallsville in Colerain Township. Bids were opened April 25.

Lima, O.—Bridge—Hackdorn Contracting Co., 506-7 Van Vorhis Bldg., Indianapolis, Ind., at $10,630, for the construction of a reinforced concrete bridge over the Ottawa River, near Faurot Park. The bridge comprises two 60-ft. spans with 30-ft. roadway. Bids were opened April 14.

Mt. Vernon, O.—Bridges.—Walter Rabjohn, Greer, O., at $16,043, for the construction of the substructure of a bridge in this city; Mt. Vernon Bridge Co., at $24,100, for the construction of the superstructure of the bridge. Bids were opened April 23.

Newport, Tenn.—Bridge—Converse Bridge Co., Chattanooga, Tenn., at $5,927, for the erection of a steel bridge over the Nola Chucky River.

Seattle, Wash.—Bridges—Hurley-Mason Co., this city, at $500,000, for the construction of 27 bridges for the Northern Pacific Railway. The bridges will be constructed between Vancouver and Tenino.

Headingly, Man.—Bridges—Dominion Bridge Co., for the construction of two steel bridges for the C. P. R.; one in this city and the other at Souris.

ROADS AND STREETS.

Attalla, Ala.—Sidewalks, Curb, Gutter, Etc.—Morris & Angel, Sheffield, Ala., at $8,860, for the construction of 5,100 sq. yds. of artificial stone sidewalks, at $0.94½; for 100 sq. yds. of driveway at $1.20, and for 7,800 lin. ft. of 30-in. combined curb and gutter. Bids were opened April 27.

Attalla, Ala—Sidewalks & Curb—Morris & Angle, Sheffield, Ala., at $8,859, for the construction of certain sidewalks and combined curb and gutter on Fourth St., Fifth St. and Fifth Ave. Quantities and prices as follows. 5,100 sq. yds. of artificial stone sidewalks, $4,820; 100 sq. yds. of artificial stone driveway, $140; 7,800 lin. ft. artificial stone combined curb and gutter, $3,900.

Bridegport, Conn.—Paving—W. H. Arthur, Stamford, at $1.35 per sq. yd., for laying creosoted wood blocks on Elm St.; Wyckoff Pipe & Creosoting Co., at $1.65 per sq. yd., for furnishing the wooden blocks for the paving.

Amboy, Ill.—Paving.—Rink & Schnell, Clinton, Ia., at $1.38 per sq. yd., for the construction of brick pavement for two different improvements, and at $0.35 per cu. yd., for concrete curbing. Bids were opened April 20.

Peoria, Ill.—Paving.—J. W. Bushall, for the resurfacing with asphalt of the roadway of the following: Seventh Ave., from Franklin to Union St.; Hamilton St., from Monroe to Glen Oak Ave.; Hamilton St., from Randolph to North St.; North Jefferson Ave., from Hamilton to Cornhill St. The work includes 100,000 sq. yds. of asphalt. Bids were opened April 11.

Marion, Ind.—Road—Mackey & Druckemiller, city, at $6,135, for the construction of a county road between Wabash and Grant counties. The road will be of gravel, extending along the county line east from the Lagro road about three miles.

South Bend, Ind.—Paving—Harry N. Barnes, for paving Prairie Ave. with brick.

Grinnell, Ia.—Paving — William Horrabin, Iowa City, Ia., for paving in the downtown alleys at the following bid: Brick, $1.93, extra grading $0.36, overhaul 1½ cents, curb $0.40.

Perry, Ia.—Paving—William Horrabin, city, for the construction of 52,200 sq. yds. of bitulithic and creosoted blocks on streets in this city. The work will cost between $125,000 and $130,000.

Vicksburg, Miss.—Paving & Sewering—Southern Paving & Contracting Co., Chattanooga, Tenn., at $100,000, for paving Cherry St., from Glass Bayou to Finney St.; 36 blocks; also storm sewers for same distance. Bids were opened April 18.

St. Joseph, Mo. — Paving — Rackliffe-Gibson Construction Co., at $2,500, for paving Grand Ave., from the Great Western viaduct east to 18th St., with Hassam; also for paving the alley between 10th and 11th and Olive and Lafayette Sts.

Grand Forks, N. Dak.—Paving—Bitulithic & Contracting, Ltd., for the construction of 25,000 sq. yds. of pavement in this city.

Bethlehem, N. H.—Paving.—F. E. Ellis, Melrose, Mass., for the construction of one mile of macadam road in this town, surfaced with native stone. Bids were opened April 29.

Concord, N. H.—Road.—Martin & Condin, Watertown, N. H., for the construction of 3,850 ft. of macadam road in Pembroke, N. H. Bids were opened April 8.

Hooksett, N. H.—Road.—Martin & Condin, 81 Palfrey St., Watertown, Mass., for the construction of 8,000 lin. ft. of macadam (native stone) in this town. Bids were opened April 22.

Swanzey, N. H.—Road.—Lane Construction Corporation, Meridian, Conn., for constructing four miles of macadam road, surfaced with native stone, in this town. Bids were opened April 22.

Brooklyn, N. Y.—Paving.—Barber Asphalt Paving Co., 30 Church St., New York, at $1.74 per sq. yd. for block, and $6.00 per cu. yd. for concrete foundation, for paving with asphalt block paving on a concrete foundation the roadway of 41st St., from 6th Ave. to Utrecht Ave. The total bid is $27,425. Bids were opened April 20.

Brooklyn, N. Y.—Paving Sand.—Phoenix Towing & Transfer Co., 17 State St., New York, at $0.57 per cu. yd. to plant, $0.47 to dock, for furnishing and delivering 8,000 cu. yds. of asphalt sand; and for furnishing 8,500 cu. yds. of paving sand. Bids were opened April 20.

New York, N. Y.—Hastings Pavement Co., 25 Broad St., city, at $2.60 per sq. yd. for repairing asphalt blocks over street openings, fire burns, etc., during 1910 (4,000 sq. yds.); Asphalt Construction Co., 203 Broadway St., at $1.70 per sq. yd., for repairing asphalt pavement over street openings (4,000 sq. yds.); L. J. Moran, 562 Burnside Ave., at $8,987, for regulating, grading, etc., and setting new flagstone on portions of Ludlow Ave.; James Di Minnea, city, at $1,102, for the same on Belmont St. Bids were opened April 19.

Cincinnati, O.—Road.—W. A. Faulman, Hazelwood, O., at $3,647, for the improvement of the Symmestown road between Billiard's hill and Weller school, in Symmes township.

Cleveland, O.—Paving—Adams Bros., Zanesville, O., at about $37,000, for paving two and a half miles of country roads near this city. The foundation will be of concrete.

Columbus, O.—Road—Wilson & Yardley, at $4,935, for the construction of a mile of the North Starr Ave. Pike.

Xenia, O.—Paving.—L. D. Wilson & Co., city, at $6,790, for macadamizing two miles of Jamestown and Bowersville Pike, from the south corporation line of Jamestown to the Plymouth Pike. The work includes 2,711 cu. yds. of stone

placed on road complete according to specifications, at $1.82 9-10 per cu. yd. Bids were opened April 25.

Butler, Pa.—Paving—Tony Morelli, at $1,748 and $1,715, for paving American Ave. and Mercer St., respectively. The material used will be DuBois and Butler brick.

Houston, Tex.—Roads—Following contracts have been awarded by the county commissioners for the construction of 31½ miles of new highway in Harris county: Sunderman & Dolson, at $61,452, for 17 miles along the Webster Air Line Road; W. D. Haden, at $10,725, for two and one-half miles of the La Porte and Seabrook Road; W. S. Hipp, at $32,960, for eight miles of the Main St. Road; L. R. Davis, at $18,720, for four miles of the Westheimer Road. Bids for the construction of three miles of road along the Lynchburg and Crosby Road were rejected.

Ellensburg, Wash.—Paving.—D. A. William Co., Tacoma, Wash., for about six blocks of brick paving and for 17 blocks of asphalt paving, including gutter, curbing, sidewalking and surface sewers. Bids were opened April 11.

Edmonton, Alta.—Paving—Bitulithic & Contracting, Ltd., for paving a number of streets in this city.

St. Boniface, Man.—Paving — Bitulithic & Contracting, Ltd., for laying between 50,000 and 75,000 sq. yds. of bitulithic pavement in this city.

SEWERS AND WATER SUPPLY.

Stuttgart, Ark.—Sewer.—Kress Construction Co., North Main St., Oklahoma City, Okla., at $17,150, for the construction of about six miles of sewer and purification works. Bids were opened April 25.

Hartford, Conn.—Sewer—Ryan, Unmack Co., New Haven, at $22,030, for the construction of section C of the Homestead Ave. sewer.

Canton, Ill.—Sewer—E. R. Harding & Co., Racine, Wis., at $51,239, for the construction of the sewer extension in this city.

Rock Island, Ill.—Sewer & Water Mains—P. F. Trenkenschuh, at about $3,420, for the construction of a sewer and laying water mains in Krell's addition on 20th St., between 12th Herbert and other streets

Boonville, Ind.—Reservoir—Foster & Raiser Construction Co., Union City, Ind., at $18,865, for the construction of a new city lake. Work is to be completed by November.

Davenport, Ia.—Sewer—E. S. Glaspel, at $0.58¾ per lin. ft. for the construction of a sewer about a block long between Taney and Marshall and Ainsworth and Fillmore Sts.

Lansing, Mich.—Sewers—Fisher & Noyce, at $800, for the construction of a sewer in Jerome and Harley Sts.; J. H. Algate, at $38,564, for the construction of sewers in Cedar, Baker Herbert and other streets.

Albert Lea, Minn.—Water Mains—Cook Construction Co., Des Moines, Ia., at $2,933, for the construction of water mains for this city. Bids were opened April 26.

St. Joseph, Mo.—Sewer—D. B. Kelly, at $552, for the construction of a sewer in district No. 109.

Reidsville, N. C.—Sewerage System—O'Connor & Garvey, Knoxville, Tenn., at $42,181, for the construction of a sanitary sewer system. The work includes 10 miles of terra cotta pipe sewer, eight to 15 in. reduction tank, and structures for three sewage pumping stations. Bids were opened April 21.

Reidsville, N. C.—Sewer System.—O'Connor & Garvey, Knoxville, Tenn., at $42,181, for the construction of a system of sanitary sewerage for this town. The work includes excavations for and laying about 10 miles of sewer pipe, 8 to 15 ins. diameter, and building of disposal plant, also several pumping stations. Bids were opened April 21.

Chatham, N. J.—Sewerage System—Clarke & Co., Morristown, N. J., at $36,458, for the construction of a sewerage system in this city. The work includes eight miles of sewers, eight to 15 in. in diameter.

Fort Hamilton, N. Y.—Wire Screens.—Roebuck Weather Strip & Wire Screen Co., Brooklyn, N. Y., at $184, for furnishing and installing door transom and window screens in new double barracks building at this post.

Hamilton, O.—Sewers—W. H. Louthan, at $11,066, for the construction of the Third Ward sanitary sewer system; Garver Contracting & Transfer Co., at $1,631, for the North E. St. sanitary sewer from Millville to Elvin Ave.; John H. Hiatt, at $2,982, for the improvement of Rhea Ave., from Eaton to Mason Ave.

Florence, S. C.—Water Works—Matthews & Johnson, for the extension of the water works system in this city; American Cast Iron Co., Chattanooga, Tenn., for furnishing pipe and other materials.

Florence, S. C.—Water Extensions.—Johnson & Matthews, Florence, S. C., at $4,940, for material and constructing water extensions. Bids were opened April 18.

Nashville, Tenn.—Sewers—John Broderick, at $1,127, for the construction of a sewer in alley 207 and Garfield St.; J. W. Jordan, at $415, for the construction of a sewer in alley 414.

Cia Juarez, Mex.—Sewer—Compania Bancariade Fomento de Blends Raices, S. A., of Mexico City, for the construction of sewers, 14 kilometers in length, in this city. The contract also includes two large pumping stations, the pumps to be operated by electricity.

EXCAVATION, MISCELLANEOUS, MATERIALS.

Tortugas, Fla.—Removing Wreck.—Peter T. Knight, Key West, Fla., at $390, for removing the wreck of schooner Nannie Bohlin in channel at Tortugas. Bids were opened April 18.

Fort Oglethorpe, Ga.—Wells.—Frank C. Buttz, Indianapolis, Ind., for sinking one 8-in. tubular well at this post. Perry Andrews, N. Jackson St., Atlanta, Ga., for sinking an 8-in. tubular well. The cost will be $10.50 per ft. cased, and $8.50 per ft. not cased. Bids were opened April 14.

Fort Wayne, Ind.—Pipe—American Pipe & Foundry Co., Kansas City, Mo., at $25 per ton, for furnishing the city with 150 tons of water main pipe.

Muskegon, Mich.—Cement Pipe—Grand Rapids Building Supply Co., for furnishing this city with 100 carloads of cement sewer pipe.

Sturgis, Mich.—Electrical Equipment—Allis-Chalmers Co., at $16,492, for one vertical hydro-electric direct connected unit of 550 kw. capacity, comprising one hydraulic vertical reaction turbine, shaft, bearings, one 600 kw. A. C. generator; one 45 kw. 125 volt vertical exciter unit, comprising turbine, shaft, and exciter generator; one hydraulic governor for A. C. generator unit; 6 oil cooled A. C., single phase 60 cycle transformers, 2,300 to 23,000 volts 200 kw. capacity each; one 3 panel switchboard with equipment for handling output of above apparatus.

St. Louis, Mo.—Pipe—Dimmick Pipe Co., at $52,437, for furnishing the water department with pipe.

Springfield, Mo.—Station.—Murch Bros., St. Louis, Mo., by the Missouri Pacific Railroad, for the erection of a new modern passenger station at this city to cost $45,000.

New York, N. Y.—Lumber—W. Clave Lumber Co., 1 Madison Ave., New York city, at $14,170, for furnishing lumber for parks in this city.

Schenectady, N. Y.—Concrete Piles—Raymond Concrete Pile Co., New York and Chicago, for placing concrete piles in the foundations of St. Adelbert's (Polish) Church, at this city. W. L. & H. G. Emery, architects.

Akron, O.—Building—Metz Bros., Buffalo, N. Y., at $248,687, for the construction of the Portage hotel in this city.

Philadelphia, Pa.—Hydraulic Dredge—Ellicott Machine Co., Bush & Severn Sts., Baltimore, Md., at $88,500, for furnishing the department of wharves, docks and ferries with a hydraulic dredge. Bids were opened March 28.

Beaumont, Tex.—Buildings—H. D. Applegate & Sons, city, at $88,000, for the construction of three new brick school buildings—the Millard, South End and Averill addition schools.

Winnipeg, Man.—Building—Peter Lyall & Sons, at $300,000, for the interior finishing and the three office floors of the entire building of the union C. N. R. and G. T. P. depot. The total cost of the building will be about $1,300,000.

PROJECTED WORK.

Bridges.

Items Arranged Alphabetically by States.

Birmingham, Ala.—According to reports from this place the officials of the St. Louis & San Francisco R. R. are considering the construction of a large bridge at 12th Ave.

Stockton, Cal.—Surveyors of this county and San Joaquin County are taking up the matter of constructing a joint bridge over the river near Escalon. F. E. Quail is County Surveyor.

Washington, D. C.—Board has adopted the recommendation of the committee on bridges including the replacement of the Rock Creek bridge at Calvert St.; new bridge across Klingle ford on Connecticut Ave.; construction of a viaduct or subway at the inter-section of Cedar St. and the tracks of the Baltimore & Ohio R. R.; for the construction of a bridge across Rock Creek at Q St.

Macon, Ga.—City Council has requested the Central of Georgia R. R. to erect a new bridge on Second St. It is expected that a concrete structure will be installed.

Metropolis, Ill.—Officials of the Paducah & Illinois Ry. Co. are soon to make an application to the United States for permission to construct a bridge over the Ohio River at or near this city 12 miles below Paducah. The structure as proposed will accommodate double track service and is estimated to cost $3,000,000.

Streator, Ill.—City Clerk John D. Patterson sold bonds May 2 in the sum of $40,000 for the construction of a bridge.

Sycamore, Ill.—A survey is being made by W. M. Hay for a new road which it is proposed to open from the House farm north of Cortland village running westerly to a point near the piano factory in De Kalb and connecting with Pleasant St. in that city.

Huntington, Ind.—Allen and Huntington County Commissioners are taking up the matter of constructing two bridges across creeks on the county line.

Alma, Kan.—Plans and specifications have been completed for the construction of seven new county bridges, five of which will be concrete structures.

Louisville, Ky.—Consulting Engineers J. M. Johnson and G. E. Greiner are preparing plans for the construction of the proposed bridge of the Kentucky & Indiana Bridge and Railroad Company over the Ohio River between this city and New Albany, Ind.

Northfield, Mass.—At a town meeting an appropriation of $1,500 was made for repairing the bridge to Mt. Hermon.

Saginaw, Mich.—Committee of the Board of Trade is taking up the matter of constructing a viaduct in the First Ward over the Pere Marquette R. R. tracks and those of the Saginaw Valley Traction Co.

Duluth, Minn.—Estimates are now being prepared by County Highway Commissioner of the cost of filling in the old Tower Ave. bridge and rebuilding it across the river. The present structure is 2,000 ft. in length, consisting mostly of piles on the Tower Ave. side. The new span over the river will probably be of steel.

Kansas City, Mo.—The Atchison, Topeka & Santa Fe Ry. Co. is to construct a new bridge across the river at this place.

Sibley, Mo.—According to announcement reported to have been made by officials of the Atchison, Topeka & Santa Fe Ry. that company will construct a new bridge over the river at this place.

St. Joseph, Mo.—It is expected that the City Council will soon take up the matter of constructing viaducts over the railroad tracks at Sixth, Monterey, 8th, Sycamore, 11th and Atchison Sts.

Fulton, N. Y.—Reports are to the effect that Joseph Connors, Mayor, is considering the feasibility of constructing a bridge at Broadway to cost between $70,000 and $80,000.

Glenville, N. Y.—The construction of the new barge canal will necessitate the raising of two bridges over the Mohawk River, known as the Scotia and Alpaus bridges. The Scotia bridge will cost the town about $30,000 and the railway about $35,000. The work on the Alpaus bridge will cost the railway company about $25,000.

Herkimer, N. Y.—County Engineer has reported it necessary to construct a new bridge over East Creek between the towns of Manheim and St. Johnsville. The estimated cost of the structure is $22,800.

Hudson, N. Y.—Work is soon to be started on the construction of the new steel bridge on the road between this city and Clayerack.

Massena, N. Y.—An election has been carried to bond the town for the construction of a $40,000 bridge across the Grasse River at Massena Center. The structure will be of suspension type with concrete piers and anchorages.

Drayton, N. Dak.—According to advices from this place a new steel bridge will be built across the Red River this summer.

Cleveland, O.—The High Level Bridge Commission is considering the sites adaptable for the construction of the proposed structure and it is believed that Huron Road, S. E., and Lorain Ave., will be the terminals named in the next ordinance to be filed by Alderman Schwarzer.

Covington, O.—The Louisville & Nashville R. R. Co. is seeking right of way for the construction of a new bridge across the Licking river at 11th and Byrd Sts. in this city. The structure as proposed will be of lift type and will cost, it is estimated, $45,000.

Huron, O.—Plans for the construction of the proposed new bridge to be built over the Huron River at this place have been received.

Lancaster, O.—County Commissioners and City Director of Public Service are taking up the matter of constructing a new bridge on the extension of 6th St. over the Fetter's Run.

Warren, O.—County Commissioners have decided upon the construction of a bridge over Mosquito Creek and mill race on Park Ave., in the city of Niles. Fred T. Stone is Auditor of Trumbull County.

Scranton, Pa.—Plans and estimates have been filed with Director of Public Works by E. L. Walters, Supt., Bureau of Building Inspection, for the construction of the proposed $3,000 viaduct at Market Place.

Houston, Texas.—Plans are to be prepared for the construction of a viaduct over the Bayou and railroad yards at Main St. It is said the structure will either be all steel or reinforced concrete.

Bellingham, Wash.—County Commissioners have had plans prepared for the construction of a bridge over the Nooksack River at Nugents crossing on the Deming Road. The structure will have a 240-ft. span and an approach 800 ft. in length.

Colfax, Wash.—County Commissioners are considering plans for the construction of a bridge across the South Palouse River in this city. It is expected that bids for the work will be asked shortly.

Conconully, Wash.—Commissioners of this county have been considering the construction of five bridges located as follows: One at Nighthawk across the Smilkameen; one at Winthrop over the Methow; three over the Okanogan at Tonasket, Omak and Malott.

Delmar, Wis.—Town Board has decided to install two cement bridges one at Otter Creek on the Franklin St. road and the other at the foot of Sherman Hill between Boyd and Cadott. Plans for the structures have already been made by State Engineers.

Basin, Wyo.—County Commissioners have ordered the County Clerk to notify the Reclamation Service to remove the bridge at Marquette in order to make possible the construction of a new bridge at that site.

Roads and Streets.

Items Arranged Alphabetically by States.

Los Angeles, Cal.—Highway Commission is discussing plans, now under way, for the improvement of the San Fernando road, Newhall Pass and Fremont Pass. The Commission has completed specifications for the Los Angeles-Inglewood-Redondo highway.

Sisson, Cal.—Board of Supervisors of Siskiyou County will build a road to the snow line on Mount Shasta from this city.

Aurora, Ill.—North Ave. is to be paved with asphalt from Broadway to Jackson St., at an estimated cost of $20,536, also State St., from Benton to Claim St., at an estimated cost of $17,361.

Chicago, Ill.—City Council is considering the widening and improving of 12th St., and other projects.

Chicago, Ill.—Property owners on North Park Ave. between Clark St. and Fullerton Ave. are contemplating grading and repaving that section of the avenue at an estimated cost of $31,600.

Cairo, Ill.—City Council has passed an ordinance providing for the paving of Commercial Ave. from the north line of Second St. to the south line of 34th St., with brick. W. B. Thistlewood is City Engineer.

Milton, Ill.—City has voted the issuance of bonds in the sum of $1,000 for the construction of sidewalks.

Ft. Wayne, Ind.—Petition is being circulated asking the Board of Public Works to provide for the paving of Clinton St. for some distance north of the city limits with tarvia macadam.

Des Moines, Ia.—City Council has deemed it advisable to pave with creosoted wood blocks, Tamarack or Southern Long Leaf Pine with 20 lbs. of creosote oil per cu. ft. of timber on a 6-in., Portland cement foundation, 8th St. from Cherry St. to Mulberry St. Neal Jones is City Clerk.

Manchester, Ia.—City Council is contemplating constructing cement pavement on Franklin St., from Butler to Clara Ave.

Marshalltown, Ia.—City Council intends to pave the following streets and alleys: S. 4th St., from Main to Church St.; S. 3d St., from Main to Church St.; S. 2d St., from Main to Church St.; W. Church St., from 9th St. to 12th St.; S. 12th St., from Church St. to Main St.; E. Church St., from 5th Ave. to 7th Ave.; N. 13th St., from Main St. to Summit St.; S. 6th Ave., from Main St. to Church St.; S. 4th Ave., from Church St. to Boone St.; E. Boone St., from 3d Ave. to 4th Ave.; W. Nevada St., from end of present pavement to east side of 1st St.; S. 1st St., from Church St. to Nevada St.; Market St., from 1st Ave. to 2d Ave.; S. 3d Ave., from Nevada St. to Chicago and Northwestern Railway; S. 6th St., from Church St. to the railroad; W. Linn St., from Center to 1st St.; E. North St., from Center St. to 2d Ave.; alley, from east line of 2d Ave. to west line of 3d Ave. in block 13; alley, from south line of Main St. to north line of Church St. in block 13; alley, from north line of Main St. to south line of State St. in block 12; alley, from west line of 3d Ave. to the east line of alley intersection in block 12; alley, from west line of 3d Ave. to the east line of the alley intersection in block 2, Anson's second addition; alley, from south line of alley intersection in block 2, Anson's second addition south to the present pavement in the block.

Waterloo, Ia.—Resolution has been introduced in the City Council providing for grading, curbing, guttering and paving of Baltimore St., from the southeasterly line of 4th St. to the northwesterly line of 5th St.

Fort Scott, Kan.—A rock road from Kansas City to Fort Scott along what is known as the old Kansas City Road is being advocated by Mayor W. E. Brooks.

Manhattan, Kan.—A. M. Breese, commandant at Fort Dodge, has conferred with Highway Engineer Gearhart concerning the road that is to be built between the fort and the city. The government has appropriated $5,900 as partial payment and the county will pay the additional cost.

Bemidji, Minn.—An ordinance has been introduced in the City Council calling for an appropriation of $12,000 to be used in paving the streets of the business district of the city.

Chisholm, Minn.—Residents of the Glen location have filed a petition with the village council for a cut-off road from the Glen location to Chisholm.

Duluth, Minn. A [illegible] road from Smithville to New Duluth, connecting Grand Ave. at its eastern terminal and Commonwealth Ave. at its western end, is projected by the West Duluth Commercial Club.

Starkville, Miss.—A model road is to be built between this town and the college. The citizen committee has raised over $2,500 towards the construction.

St. Joseph, Mo.—Board of Public Works has been petitioned for the paving of the alley running north and south, between Charles and Messanie Sts. and 13th and 15th Sts., with brick.

St. Joseph, Mo.—Farmers in the vicinity of Garrettsburg and Saxton have petitioned the county court for the construction of a macadamized road from the Ewing crossing eastward to the railroad crossing, a distance of about one mile.

Billings, Mont.—City Council has passed ordinances providing for the paving of the north side business section of the city. District No. 47, which includes N. 28th and N. 29th St., and First, Second, Third and Fourth Aves., north, is to be paved with creosoted blocks at an estimated cost of $84,915; also Section 18, to include parts of First and Second Aves., north, and parts of the streets from 22d to 30th St., with vitrified brick at an estimated cost of $120,150. Bids for this work will probably be received until June 7.

Buffalo, N. Y.—Aldermanic street committee will consider the recommendation of the Department of Public Works and the suggestion of the International Railway Co. that brick be substituted for stone in the paving of Best, between Jefferson and Genesee Sts., and Sycamore, between Filmore and Walken Aves.

Le Roy, N. Y.—Town board has voted to raise, $3,500 for improving the town roads. A total of $6,650 is now available for road improvement.

New York, N. Y.—Board of Estimates has authorized the expenditure of $1,760,000 in the repaving of streets in Manhattan, Brooklyn and the Bronx. Of this total $800,000 each is to be expended in Brooklyn and Manhattan and $160,000 in the Bronx.

Mebane, N. C.—Mayor J. T. Shaw will sell bonds May 16 in the sum of $15,000 for street improvements.

Akron, O.—Plans are being made for the construction of the Arlington Road. The road is to be paved with brick 14 ft. wide on the right hand side approaching the city; a dirt road will be maintained on the left hand side. It is estimated that the work will cost $17,942.

Ashland, O.—County Engineer T. Brindle has been instructed to prepare profiles and estimates for the improvement of the following roads: Wooster road to Fraunfelter school house; Perrysville road to first crossing; Mifflin road, one-half mile; Troy road to Wertman's Corners; Orange road.

Bellevue, O.—Citizens of this city are contemplating paving Fairfield Ave., with brick. William List is mayor.

Bowling Green, O.—F. W. Toan, Auditor of Wood County, received bids May 3 for bonds in the sum of $50,000 for the construction of a public highway.

Canton, O.—People of Jackson Township are considering the advisability of petitioning the County Commissioners for the construction of a new highway a half mile in length in that township to complete a link in the direct road from Massillon to Akron.

Canfield, O.—Township trustees will have two and one-half miles of road macadamized this summer, one and one-fourth miles north of town and one and one-fourth miles west.

Cleveland, O.—Commissioners of Cuyahoga County have sold bonds in the sum of $41,250 for the improvement of Bradley road.

Columbus, O.—Petition has been filed with the County Commissioners for improving a road beginning at the corporation line of Hilliards to Scofield's corner, a distance of 3½ miles, in Franklin County. John Scott, Clerk of the Board of Commissioners.

Franklin, O.—City Council passed an ordinance to proceed with the paving of S. Main St. Bids are to be advertised for soon.

Norwalk, O.—County Surveyor John Laylin is preparing plans for the construction of two and one-half miles of stone road.

Wooster, O.—City Council has passed an ordinance providing for the paving of both Madison Ave. and Quinby Ave. H. H. Franks, City Clerk.

Zanesville, O.—Commissioners of Muskingum County have been petitioned for the construction of a road from Coal Hollow road, in Brush Creek Township to the Duncan Run Coal Co.'s land, a distance of ⅝ of a mile.

Zanesville, O.—County Commissioners have decided to improve the Coopermill road. The road will extend from the corporation line of the city one mile west and will be paved with vitrified brick.

Portland, Ore.—Property owners on Killingsworth Ave. have decided that they will have that street paved between Union Ave. and E. 42d St. with bitulithic. J. W. Morris is City Engineer.

Reading, Pa.—City Council has been petitioned for the paving of Eighth St., between Buttonwood and the Junction, with vitrified brick.

Alice, Tex.—City has voted the issuance of bonds in the sum of $30,000 for street improvements.

Lockhart, Tex.—City will hold an election May 21 to vote on the proposition of issuing bonds in the sum of $25,000 for good roads.

Farmington, Utah.—County Commissioners have appropriated $6,000 for the improvement of the roads of Davis County.

Salt Lake City, Utah.—County Commissioners have decided to use $2,000 appropriated by the legislature for the use of Salt Lake County in improving its highways for the improvement of 12th South St.

Norton, Va.—Mayor J. J. Body will sell bonds May 10 in the sum of $35,000 for street improvements.

Olympia, Wash.—A road is to be constructed between Lakes Crescent and Sutherland and on to Turner's flats. H. L. Bowlby is State Highway Commissioner.

Cheyenne, Wyo.—Civic Improvement Club adopted a resolution that the City Engineer should prepare a plan for the establishment of uniform grades for the entire city for street, sidewalks, curbing, gutters and storm sewers.

Sewers.

Items Arranged Alphabetically by States.

Hailey, Ida.—L. C. Kelsey, former City Engineer of Salt Lake City, has been engaged to superintendent the construction of a sewage system in this city to cost about $50,000.

Chicago, Ill.—A new drainage district has been created in this city as follows: Beginning at Fullerton Parkway it takes in Belmont, Commonwealth Ave., Sedgwick St., Webster Ave., Garfield Ave., North Clark St. and North Park Ave. Blvd.

Venice, Ill.—City Council has passed on an ordinance providing for the construction of a sewer system to cost $184,000.

Columbus, Ind.—City Council has ordered the construction of a new sewer to be known as the Maple Grove sewer. The estimated cost is $29,000.

La Fayette, Ind.—City Council voted to appropriate $15,000 toward the construction of the Congress St. sewer. The total cost of the sewer is estimated at $36,000.

Cedar Falls, Ia.—City Council has been petitioned for the construction of a sanitary sewer in portions of Franklyn, Clay, 15th, Walnut, Olive and Tremont Sts. H. Joseph Pfeiffer, mayor.

Colfax, Ia.—Specifications and proposals are being prepared for the construction of 11,200 ft. of sewerage for this city, to be completed August 1.

Humboldt, Kan.—Plans and specifications are being prepared by J. S. Worley Co., consulting engineers, 206-7 Reliance Bldg., Kansas City, Mo., for a system of sewers and sewage purification plant to cost between $75,000 and $80,000 for this city. A part of this system will be built this summer.

Hutchinson, Kan.—City engineer has prepared profile drawings for a new sanitary sewer which it is proposed to build from 14th Ave. south down the alley between Monroe and Jackson St., emptying into the old sewer at Fourth Ave. Profile drawings have also been prepared for an extension of the sanitary sewer between Sherman and Ave A, from Monroe to Jefferson.

Houghton, Mich.—City council has approved the plans of Engineer Craig for the construction of sewers in four districts of the city. The total cost of the sewers is estimated at $21,613.

Owosso, Mich.—City will construct sewers this year at an estimated cost of $30,000.

St. Paul, Neb.—At a recent meeting of the citizens of this city a favorable vote was polled for the construction of a sewer system at an estimated cost of $9,000.

York, Neb.—City council has passed an ordinance providing for the establishment of a storm sewer and drain district No. 1; to change the course of the channel and to fill up old channel. W. L. Kirkpatrick, mayor.

Brooklyn, N. Y.—Woodside Improvement Association, organized to promote the construction of sewers in the Woodside district, has increased its capital stock from $30,000 to $50,000. The sections to be sewered are along Betts Ave., Howell Ave., the lower end of Fifth St., Anderson Ave. and Fourth St. Louis Windmuller is one of the directors.

Watertown, N. Y.—City held a special election April 18 to vote on the issuance of bonds in the sum of $31,000 for the construction of sewers. Fred W. Streeter is city clerk.

Carrington, N. Dak.—City has voted to establish a sewerage system. The trunk system, laterals and septic tank are to cost about $20,000. Steps will be taken immediately to establish the system.

Canton, O.—City Engineer Phil H. Weber has been instructed to prepare an estimate of the cost of constructing a sanitary sewer in Lewis Ave., from Newton St. to Brown Ave.

Defiance, O.—City Engineer Carl Smith has estimated the cost of constructing a 1,050 lin. ft. sewer in Fourth St., with 22, 18 and 8 in. pipe, at $3,183.

Mansfield, O.—City council has adopted the following resolutions: To construct a sewer in Buckingham St., from Bowman to Mulberry St.; sewer on the north side of Chestnut St.; sewer in Harker St., from Bowman to Woodland Ave.

Middletown, O.—City Auditor John Kunz will sell bonds May 6 in the sum of $100,000 for sewer construction.

Salem, O.—City council has been petitioned for the construction of a sanitary sewer extending from the intersection of Evans and Washington St., east on Evans St. to South Union, north on South Union to McKinley Ave., and south to Maple St.

Wilmington, O.—Plans and specifications for the proposed sewerage system for this city have been prepared and approved. L. I. Compton, engineer.

Wooster, O.—City council has passed an ordinance providing for the construction of a sewer in Quinby Ave. H. H. Franks, city clerk.

Youngstown, O.—Plans are being prepared for the construction of sewers in district No. 1.

City will sell bonds for the extension to the sewer in Park Ave. F. M. Lillie, city engineer.

Zanesville, O.—City will let a contract about July 15 for the construction of sewers in the city aggregated to cost $27,400. The sewers will be constructed on the following streets and avenues: Maysville Ave., Pine St., Eppley Ave., Johnson St., Blue Ave., Peters Alley, Vroom Alley, Wickham Alley, Luck Ave., Vine St., West Main St., Indiana St., Virginia St., and Galigher St.

Zanesville, O.—Service director has been authorized to advertise for bids for the construction of a sewer in Marble Alley.

Yukon, Okla.—City will hold an election some time during this month to vote on the proposition of issuing bonds for the construction of sewer and water works.

Bridgeton, Pa.—City council has adopted an ordinance providing for the construction of a sewage disposal plant to cost about $40,000.

Connellville, Pa.—Petition is being circulated by the residents of Hill St. to secure a sewer from the borough. The sewer if constructed will be about 250 ft. long.

Reading, Pa.—City will probably float a bond issue in the sum of $200,000 for the purpose of constructing water and storm sewers.

Reading, Pa.—An ordinance has been introduced in the city council to increase the bonded indebtedness of the city $200,000 for the purpose of constructing between five and six miles of storm sewers. E. B. Ulrich, city engineer.

Gaffney, S. C.—Bonds have been sold for the construction of a sewer system in this city. The work of installing the system will be started within the next 20 days.

Beeville, Tex.—City has voted the issuance of bonds in the sum of $30,000 for the construction of sewers.

Belton, Tex.—Engineering corps of the Fountain-Shaw Co. of Houston, Tex., is running survey for the Belton Sanitary Sewer Co. As soon as survey is made and plans accepted the system will be installed. It is estimated that the system will cost $30,000.

Gatesville, Tex.—Citizens are contemplating constructing a sewerage system at an estimated cost, $18,000.

Norton, Va.—Mayor J. J. Body will sell bonds May 10 in the sum of $100,000 for sewer construction.

Pasco, Wash.—Plans for municipal improvements to be made this year are being prepared by City Engineer Graves and engineers of the Northwestern Engineering Co. The work includes the placing of the sewer system, to cost about $50,000; the paving of Lewis and Fourth Sts., for about five blocks, and possibly the installation of a pressure city irrigation system.

Prosser, Wash.—Plans and specifications will be prepared by City Engineer F. A. Jenne, for the construction of a sewer system for this city. The system will include Richland addition, property lying between Bennett and Meade Aves., from First Ave. to Ninth St., property lying between Stacy and Sheridan Ave., from Sixth St., northwest to the Yakima river.

Seattle, Wash.—Bids opened April 22 by C. B. Bagley, secretary of the Board of Public Works, for constructing the Lake Washington District section of the North trunk sewer have been rejected. The work will be readvertised soon

Prairie Du Chein, Wis.—Survey has been made of the streets in this city preparatory to the preparation of plans for the construction of a sewer system.

Cody, Wyo.—City council is considering the plans for the construction of an adequate sewer system and a gravity system of water works. F. L. Houx, mayor.

Estevan, Sask.—City has voted the issuance of bonds in the sum of $35,000 for the construction of a sewer and the extension to the city hall.

Prince Albert, Sask.—City will expend about $15,000 for the construction of sewers this season.

Water Supply.

Items Arranged Alphabetically by States.

Gadsden, Ala.—A movement has been started in this city to induce the city council to procure water for the city's supply from Cove Creek, about five miles from the city. It is estimated that it would cost about $35,000 to pipe the water to the city.

Berkeley, Cal.—City contemplates the installation of a municipal water system.

Sacramento, Cal.—City will hold an election soon to vote on the issuance of $666,000 in bonds for the construction of a filtration plant.

Gainesville, Ga.—City has voted the issuance of $100,000 worth of bonds for the construction of water works and sewers.

Corydon, Ia.—Citizens have voted to issue bonds in the sum of $45,000 for the purpose of installing a water works and sewer system.

Silver City, Ia.—Business Men's Improvement Club of this city is agitating the installation of a water works.

Winfield, Ia.—Citizens of this city are agitating the construction of a waterworks system.

Idaho Falls, Ida.—Citizens are in favor of bonding the city in the sum of $95,000 for the construction of a new waterworks and power station.

Champaign, Ill.—Water company of this city will extend its mains and construct a new filter plant. The work will be done as soon as possible.

Galesburg, Ill.—Citizens have voted to bond the city for improvements to the water works system.

Rankin, Ill.—Citizens have voted in favor of the installation of a water works.

TRADE NOTES.

The Standard Bitulithic Co. has removed its offices to the Hudson Terminal Bldg., 30 Church St., New York City.

The Hurley Tracklaying Machine Co. has moved its offices from the Railway Exchange Bldg., Chicago, Ill., to the Fisher Bldg., that city.

The Sullivan Machinery Co. has removed its general offices, at Chicago, from the Railway Exchange Building, to Suite 413 Peoples' Gas Light & Coke Building, 150 Michigan Ave., Chicago.

The Barron & Cole Co., Franklin St., and West Broadway, New York City, has taken over the exclusive selling agency for the Menzies One Horse Pick-up Street Sweeper and Hand Cleaning Machine. Barron & Cole have also been made exclusive Eastern and export sales managers for the Eureka Stone and Ore Crusher, and have likewise taken over the exclusive sale of the Healey Sewer Cleaning Machine.

The Allis-Chalmers Co., Milwaukee, Wis., has been awarded the contract for the initial installment of machinery for the large hydro-electric development in California of the Northern California Power Co. The contract calls for all the machinery and accessories and will include the following: three 7,000 H. P., 450 r. p. m. single horizontal turbines with cast iron spiral casings. The runners are 50 in. in diameter and the gate valves 42 ins. in diameter. A size 2 oil pressure governor will control them. These turbines are each connected to a 5,000 K. V. A., 6,600 volt, 60 cycle, 3 phase alternator. Excitation current will be supplied by either of two 225 K. W., 120 volt generat s direct connected to 350 H. P., 525 r. p. m. single impulse turbines controlled b" type "O" governors. The turbines will operate under a head of 450 feet.

CONTENTS OF APRIL 27, ISSUE OF ENGINEERING-CONTRACTING.

EDITORIAL: Page.
A Noteworthy Series of Articles on Electric Railway Operating Costs.....375
How Can Recognition Be Secured for the Civilian Assistant Engineer of the Army? 376
Experimental Grouted Macadam Road....376
Results of Tests for Leakage Under Pressure of a Reinforced Concrete Pipe.....377
Method of Constructing Reinforced Concrete Trestles for Railway, With Some Costs 377
Methods and Cost of Constructing a Concrete Lock on the Illinois & Mississiippi Canal 380
The North Shore Channel of the Sanitary District of Chicago; Methods and Some Costs on Sections Four and Six.....383
A New Type of Stone Crusher.....384
Methods of New York State Commission, of Highways in Testing Bituminous Materials Used in Road Work.....385
A Method of Preventing Sewer Flooding in Riverside Districts 387
Some English Costs of Washing Filtering Material Using a Special Washing Machine 387
The Results of Experiments on Pollution in Shallow Wells for Municipal Water Supply 388
Cost of Constructing and Operating the Electric Street Railways of Long Island City—The New York and Queens County Railway 390
Cost of Generating Electric Power for Operating the Elevated and Subway Cars in Manhattan, New York City.....391
Some Conditions, Methods and Cost of Construction Work, in Peru, South America 392
Organization and Equipment of Survey Parties. Georgian Bay Ship Canal Survey. With Data on Allotment and Cost of Rations 393
Character and Methods of English Ordinance Surveys With Data on Costs.....394
Example of the Relocation of Roads in Hilly Country 395

PROPOSALS FOR PUBLIC BUILDINGS.

War Department, Office of the Constructing Quartermaster, New London, Conn., April 13, 1910. Sealed proposals for the construction, plumbing, heating, electric wiring and fixtures of one guardhouse and one quartermaster's storehouse at Fort Terry, N. Y., will be received here until 10 a. m., May 13, 1910, and then opened. Deposit of $5 required for each set of plans. Information furnished on application. Envelopes containing proposals should be indorsed "Proposals for Public Buildings," and addressed CAPT. F. T. ARNOLD, Constructing Quartermaster, New London, Conn.

DRAINAGE DITCHES.

Angleton, Texas.

Sealed proposals will be received by the Board of Commissioners of Brazoria County Drainage District No. 3, of Brazoria County, Texas, at the office of the County Judge of Brazoria County, at Angleton, Texas, until noon of the 10th day of May, 1910, for the performing of the following work, of which the following is an approximate estimate of the work to be done:

Ditch No. 1	497,394 cu. yds.
Ditch No. 2	31,241 cu. yds.
Ditch No. 3	20,788 cu. yds.
Ditch No. 4	26,300 cu. yds.
Ditch No. 5	35,228 cu. yds.
Ditch No. 6	51,093 cu. yds.
Ditch No. 7	104,327 cu. yds.
Ditch No. 8	11,850 cu. yds.
Ditch No. 9	17,001 cu. yds.
Ditch No. 10	38,142 cu. yds.
Cut-offs on slough	26.660 cu. yds.

Seven miles of slough to be cleared.
Wet excavation.....122.000 cu. yds.

The above is the engineer's approximate estimate. Plans and specifications may be seen at the office of A. R. Leckie, engineer in charge, at Bay City, Texas; also at the office of T. W. Carlton at Alvin, Texas; also at the office of the County Judge of Brazoria County at Angleton, Texas.

Bids will be received for the whole work complete or for any division thereof; each bid shall be accompanied by a certified check for at least 5 per cent of the total amount bid, which shall be forfeited to the Drainage District in case the bidder refuses to enter into a proper contract if his bid is accepted. All bids shall be in writing and sealed and delivered to the chairman of the Drainage Commissioners.

After opening the bids the certified checks will be returned to the unsuccessful bidders. The right is reserved to reject any and all bids.

F. M. RAGLAND, Chairman.
T. W. CARLTON, Secretary.
S. K. MEBANE.
Board of Drainage Commissioners.
A. R. LECKIE,
Engineer in Charge.

STEEL WHARF SHEDS.

New Orleans, La., April 20, 1910.

Sealed proposals will be received by the Board of Commissioners of the port of New Orleans, at their office, Nos. 601-602 Hibernia Bank & Trust Co. Building, until Friday, May 20, 1910, at 1:30 o'clock p. m., for the fabrication and erection of the structural steel and cast iron for any or all of the following sheds:

Eighth-Harmony street shed No. 2.
Sixth street shed.
Third street shed.
Soraparu street shed.
Branch M. King shed.

Deposit, One thousand dollars ($1,000.00) cash or certified check.

Payment: Eighty per cent (80%) monthly.

Bond: In full amount of contract.

Plans, specifications, proposal forms, etc., prepared by J. F. Coleman & Co., Engineers, are on file at the office of the Engineer, A. C. Bell, No. 606 Hibernia Bank & Trust Co. building, New Orleans, La., by whom full sets will be furnished on deposit of twenty-five ($25.00) dollars, the said deposit will be returned upon the safe return of said set in good order.

The right is reserved to reject any or all bids.

HUGH McCLOSKEY.
President.

(Proposal Advertisements Continued on Page 66.)

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BRIDGE.

Taylors Falls, Minn.

Sealed proposals for the construction of a steel arch or reinforced concrete arch bridge across the St. Croix River between the Villages of St. Croix Falls, Wis., and Taylors Falls, Minn., will be received jointly by the undersigned at the Village Council rooms in the Village of Taylors Falls, Minn., until one o'clock p. m., on the third day of June, 1910.

Bids may be made for the construction of said bridge in accordance with the Engineer's plans and specifications, copies of which are now on file and can be seen at the offices of the Village Recorder of the Village of Taylors Falls, Minn,. the Village Clerk of St. Croix Falls, Wis., and of L. P. Wolff, Consulting Engineer, 204 Essex Bldg., St. Paul, Minn. Bids may also be made upon plans prepared by the bidders, subject to the conditions set forth in the said specifications.

All proposals must be made on blank forms furnished for that purpose by the Engineer and each proposal must be accompanied by a certified check for a sum equal to ten per cent (10%) of the amount of the bid and made payable unconditionally to the order of the Village Treasurers of the Villages of St. Croix Falls, Wis., and Taylors Falls, Minn., as a guarantee of good faith.

The right is reserved to reject any or all bids.

COMMISSIONERS of the Interstate Park of the Dalles of the St. Croix for Wisconsin and Minnesota.

BOARD OF TRUSTEES of the Village of St. Croix Falls, Wisconsin.

VILLAGE COUNCIL of the Village of Taylors Falls, Minnesota.

SEWER SYSTEM.

Searcy, Ark., April 27, 1910.

Sealed proposals will be received by the Board of Public Improvement, of Sewer District No. 1 City of Searcy, Arkansas, until 3 o'clock p. m., on the 25th day of May, 1910, for furnishing all material and constructing a system of sanitary sewers consisting of approximately:

2800 feet of 15 inch, 2700 feet of 12 inch, 2070 feet of 10 inch, 17960 feet of 8 inch, and 12150 feet of 6 inch tile pipe sewers, 125 manholes, 10 flush tanks and a sewage purification works, the latter consisting of a concrete tank, ejector station and filter.

Plans and specifications may be examined and blank proposals secured at the office of the Secretary of the Board in Searcy, Ark., and at the office of the W. S. Shields Engineering Co., 1201 Hartford Bldg., Chicago.

Each proposal shall be accompanied by a certified check made payable to J. Hicks Deener, Treasurer, for a sum of $300.00, as a guarantee that the bidder will enter into contract as required if awarded the work.

The Board reserves the right to reject any or all proposals.

BOARD OF PUBLIC IMPROVEMENT.
E. A. ROBBINS Chairman,
J. F. HEADLEE, Sec'y.
GEO. C. THOMAS.

STREET PAVING.

Billings, Montana, April 22, 1910.

Sealed proposals for paving certain streets and avenues of the City of Billings, Montana, described in Resolution No. 274, creating Special Improvement District No. 48, will be received by the City Council up to 8 o'clock p. m. of the seventh day of June, 1910, addressed to the undersigned, and endorsed: "Proposals for Vitrified Brick Paving."

The work for which proposals are invited consists of, approximately, 32,040 square yards of vitrified brick pavement, according to the plans and specifications on file in this office.

Each proposal must be made upon blanks furnished by the city, and accompanied by a certified check for $5.000 on some responsible bank in the City of Billings, and made payable to the City of Billings. The successful bidder must enter into an undertaking in the sum of thirty thousand dollars, with approved sureties. Plans and specifications may be inspected at this office. Anyone desiring a complete set of plans and specifications for personal use in submitting a bid may obtain the same upon application to the City Engineer, and by payment of five dollars to cover cost.

Payment will be made, on monthly estimates by the City Engineer, in warrants drawn upon the fund of Special Improvement District No. 48.

The city reserves the right to reject any and all bids.

By order of the City Council.
J. D. MATHESON, City Clerk.

STREET PAVING.

Billings, Montana, April 22, 1910.

Sealed proposals for paving certain streets and avenues of the City of Billings, Montana, described in Resolution No. 273, creating Special Improvement District No. 47, will be received by the City Council up to 8 o'clock p. m. of the seventh day of June, 1910, addressed to the undersigned, and endorsed: "Proposals for Creosoted Block Paving."

The work for which proposals are invited consists of, approximately, 22,644 square yards of creosoted block pavement, according to the plans and specifications, on file in this office.

Each proposal must be made upon blanks furnished by the city, and accompanied by a certified check for $5,000 on some responsible bank in the City of Billings, and made payable to the City of Billings. The successful bidder must enter into an undertaking in the sum of twenty thousand dollars, with approved sureties. Plans and specifications may be inspected at this office. Anyone desiring a complete set of plans and specifications for personal use in submitting a bid may obtain the same by application to the City Engineer, and by payment of five dollars to cover cost.

Payment will be made, on monthly estimates by the city engineer, in warrants drawn upon the fund of Special Improvement District No. 47.

The city reserves the right to reject any and all bids.

By order of the City Council.
J. D. MATHESON, City Clerk.

WATER-WORKS SYSTEM.

Searcy, Ark., April 27, 1910.

Sealed proposals will be received by the Board of Public Improvement, of Water District No. 1, City of Searcy, Arkansas, until 3 o'clock p. m. on the 25th day of May, 1910, for furnishing all materials and constructing a water works system consisting of approxiatemly:

1320 feet of 10 inch, 3400 of 8 inch, 39400 feet of 6 inch, 830 feet of 4 inch, cast iron water mains, 65 hydrants, 3 10 inch, 4 8 inch and 44 6 inch valves with boxes, also a pump room, a 60,000 gallon elevated steel tank, a concrete surface reservoir, an artesian well, deep well pump, centrifugal force pumps and a 75 K. W. engine generator, all with their respective equipments.

Proposal (a) shall include the furnishing of all material and constructing the distribution system complete with hydrants and valves. This proposal shall be accompanied by a certified check for $500.00.

Proposal (b) will be for the construction of an additional pump room and shall be accompanied by a certified check for $50.00.

Proposal (c) shall be for the elevated steel tank and its foundation and be accompanied by a certified check for $200.00.

Proposal (d) shall be for the construction of an artesian well and shall be accompanied by a certified check for $100.00.

Proposals for machinery, if separate shall include all equipment F. O. B. cars Searcy and be accompanied by a certified check of 5% of the amount of the proposal.

A proposal covering the entire work shall be accompanied by a certified check for $1,000.00.

All checks shall be made payable to J. Hicks Deener, Treasurer, and be submitted as a guarantee that the bidder will enter into contract as required if awarded the work.

Plans and specifications may be examined and blank proposals secured at the office of the Secretary of the Board in Searcy, Ark., and at the office of the W. S. Shields Engineering Co., 1201 Hartford Bldg., Chicago.

The Board reserves the right to reject any and all proposals.

BOARD OF PUBLIC IMPROVEMENT.
E. A. ROBBINS, Chairman,
J. F. HEADLEE, Sec'y,
GEO. C. THOMAS.

FORT MEADE, S. D., May 2d, 1910. Sealed proposals, in triplicate, will be received here until 10 a. m., Mountain Time, June 1st, 1910, for constructing Concrete Dam and clearing reservoir site, in connection with Fort Meade, S. D., water system. Plans and specifications may be seen at offices of Chief Quartermaster, Dept. of the Missouri, Omaha, Nebr.; Dept. of the Colorado, Denver, Colo.; Dept. of the Lakes, Chicago, Ill.; Dept. of Dakota, St. Paul, Minn., and this office, at which latter place all information may be obtained on application. A deposit of $10.00 to insure return is required before plans are sent on individual application. Envelopes containing proposals should be endorsed "Proposals for Dam" and addressed to Constructing Quartermaster.

(Proposal Advertisements Continued on Page 67.)

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CONTENTS.

EDITORIAL:

A Notable Series of Articles. 421
Standardizing the Bag of Cement. 421
Seventy-Two Cities Now Under the Commission Form of Government. 421

CONCRETE SECTION:

Method and Cost of Placing Concrete, Lining Inside of Cast Iron Lining of River Section of Pennsylvania Railroad North River Tunnels, New York City. 422
Tests on Rate of Cooling of Concrete in the Gatun Locks of the Panama Canal. . 407

EARTH AND ROCK SECTION:

Methods and Cost of Excavating Land Sections of Pennsylvania R. R. North River Tunnels, New York City. 427

ROADS AND STREETS SECTION:

A Portable Drier for Heating Binder Stone 432
Methods of Constructing Bituminous Macadam Roads to Resist the Destructive Action of Heavy Motor Traffic. 432

WATER-WORKS AND SEWERS SECTION:

Experience with and Results from Municipal Water Softening. 435
Some Data on the Quantity and Cost of Bleaching Powder for Disinfecting Sewage Effluent 437

GENERAL SECTION:

Cost of Generating and Distributing Electricity for Light and Power, Edison Electric Co. 437
Results of Tests of Simple and Inexpensive Surveying Instruments. 438
A Method of Sinking Curbed Foundation Wells Using Shields and Compressed Air with Some Notes on Chicago "Caisson" Foundations 440
Road Repairs and Maintenance Work of the Metropolitan Park Commission of Massachusetts in 1909. 401
Personals 401

A Notable Series of Articles.

No more notable series of articles has been published in recent years than that describing the terminal work of the Pennsylvania R. R. in New York City, which is appearing in the *Proceedings* of The American Society of Civil Engineers. It has been the endeavor of ENGINEERING-CONTRACTING to lay before its readers such portions of these articles as have related specifically to methods and costs, but first and last, although the space taken up has been considerable, only a fraction of the whole has been given. We mention this with two purposes: First to urge such of our readers as are particularly interested to secure the complete articles and second to commend the officials of the Society instrumental in securing for engineers this comprehensive and authoritative account of a great engineering work, and also the authors who at no little labor have collected the various articles. Several of these articles are unique in the character of the data presented and altogether they make a record which has few equals in engineering literature. It should, we believe, be the purpose of the Society to assemble these articles in order in a single volume which engineers can purchase and have for use separate from the regular volumes of *Transactions*.

Standardizing the Bag of Cement.

Following a discussion of the subject at the last monthly meeting of the American Society of Engineering Contractors, the following resolution was voted:

Resolved, that it is the sense of this meeting that the American Society of Engineering Contractors adopt, and advocate for general use, as a standard bag of cement, one weighing ninety-four (94) pounds, and that this be considered the equivalent of one cubic foot.

This resolution places the Society alongside the other principal societies of cement users and we believe, expresses the sentiment and to a large degree the practice of contractors generally. We believe further as we have said before that engineers should fall in line and specify that a bag of cement weighing 94 lbs. net should be considered to be a cubic foot of cement in proportioning concrete by volume. The question is not an academic one, it is one of practical business. There are strong business reasons why the weight and the cubic foot should be got together in the commercial package of cement. The present weight of 94 lbs. net of a bag of cement is to all practical purposes established and cannot readily be changed. The engineer must make his volume unit correspond.

Seventy-Two Cities Now Under the Commission Forms of Government.

According to a recent count, 72 American cities have followed in the footsteps of Galveston, and have adopted a commission form of government. As we have previously explained, a small commission replaces the city council or board of aldermen, and, in most cases, the office of mayor also is abolished. The commission becomes not only the legislative but the executive head of the municipality. The members of this commission are presumed to be elected as a non-partisan board of directors to run the business of the city.

The remarkably rapid spread of this new form of city government indicates clearly the existing popular disgust with present political conditions in most cities. The ward politician appears destined to become an extinct species in the very near future. Not even the natural conservatism of the majority of mankind is likely to prevent a very rapid change in the prevailing form of city government, for the belief is deep seated that no change can possibly be for the worse.

The ultimate success of the commission form of government rests upon the character of the men selected as commissioners. It is our belief, however, that the task of selecting capable and honest men is greatly simplified by reducing the number to be selected. Also it is apparent that one honest commissioner has far greater power for good when he is not lost in a crowd, but stands conspicuously among a few who may be opposing him. These and other reasons strongly commend the commission form of city government, but the strongest commendation comes from the invariable success that has thus far followed its adoption.

We wish it were possible to provide, in every case, that at least one member of these city commissions should be a civil engineer. So large a percentage of municipal expenditure goes for civil engineering structures—sewers, streets, waterworks, etc.—that it is clearly the part of wisdom to have as one member of the commission a man who is not compelled to rely entirely upon others for advice in matters pertaining to engineering. We are perfectly familiar with the antiquated argument that expert engineers can be hired by a commission, and that an engineer on any such commission is apt to disagree and quarrel with engineers whom the commission may employ. The *Outlook* voiced this popular fallacy about two years ago in discussing the appointment of a member of the Board of Water Supply for New York City, and made the amusing blunder of commending the appointment of a man who was himself an engineer who had served with distinction in another executive capacity.

The city executive who is an engineer is certainly far more capable of judging whether engineers employed by the city are competent or not, and whether they are performing their work economically or not. The president of the Pennsylvania R. R. is a civil engineer, and so, too, was his predecessor. Is it not rather significant that this great railway is held up as a model of organized efficiency? What becomes of the theory that a civil engineer will disrupt an organization by professional quarrels? The theory is, and always has been, pure nonsense—and worse, for it has often stood in the way of the appointment of engineers to executive positions.

In the nomination of men for positions as city commissioners, the boards of trade or chambers of commerce will doubtless have important voice, particularly if citizens come to realize that the judgment of business men is apt to be more sound than that of the average voter. We commend to engineers the practice of joining these commercial organizations, if it is their desire either to take part in the business management of municipalities or to secure public positions of an engineering nature. We are acquainted with several engineers who have made themselves known to the business public in this manner and have subsequently secured and held important positions through the organized effort of business men.

Test of Sand Blast Finish for Concrete.— An experiment was recently tried, using the sand blast on a block of concrete to determine the feasibility of using the same method for finishing the Rocky River Bridge instead of bush hammering the surface of the structure. The bridge has an arch span of 280 ft. between springing lines, and the number of square yards to be surfaced by bush-hammering is about 10,000. The entire exposed surface of the bridge was "faced," during construction with a mixture of 1 to 4 cement and fine blue granite 2 ins. thick. It was desired to cut out the cement on the surface and show the granite. The experiment showed that about 80 lbs. pressure was necessary to accomplish the cutting with the sand-blast—only about 60 lbs. are used when cleaning stone or steel. The sand blasting required about the same time as bush-hammering, and the resulting cost was about the same by either method. It was also shown that the sand blast tended to expose all the defects in the surface and where any rough places in small cracks appeared, the blast cut into them and made them appear worse than before. Bush-hammer on the other hand tends to fill in any small cracks or defects in the surface and cover them up.

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Concrete and Reinforced Concrete Section

Note: This section is devoted to methods and cost of constructing concrete and reinforced concrete structures. It will cover the selection, testing and proportioning of concrete materials; laboratory tests of concrete; concrete mixing, transportation and placing; fabrication and placing of reinforcement, and form construction and erection. It will also contain articles on new and interesting developments in the design of reinforced concrete.

Method and Cost of Placing Concrete Lining Inside Cast Iron Lining of River Section of Pennsylvania Railroad, North River Tunnels, New York City.*

This lining was placed in stages, as follows: First, the invert; second, the duct bench; third, the arch; fourth, the ducts; and fifth, the face of the bench. This division can be seen by reference to Fig. 1. All the work was started on the landward ends and carried toward the middle of the river from both sides. Except where the Weehawken face of the iron was cleaned with scrapers and wire brushes, and washed with water. Any leaks in the calking and grummeting (all more than 12 months old) were required. All the grout hole plugs were examined, and the plugs in any leaking ones were taken out smeared with red lead, and replaced. The leakage in the calking was due to the fact that the tunnel had been settling slightly during the whole 12 months of pile tests, and, therefore, had opened some of the joints. After the calking had been repaired and the surface thoroughly cleaned, the flanges were covered with neat cement (put on dry or poured on in the form of thick grout) just before the concrete was placed.

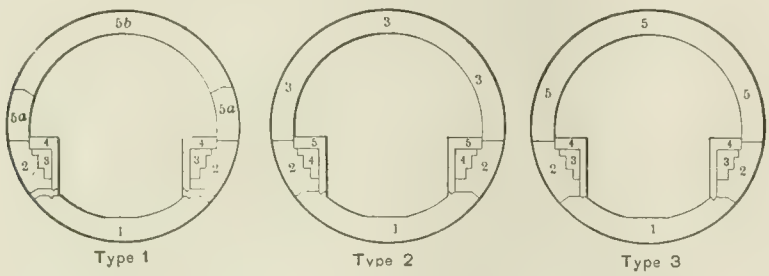


Fig. 1—Typical Cross Sections Showing Successive Stages in Placing Concrete Lining.

force passed the lowest point of the tunnel, nearly 900 ft. to the west of the middle of the river, all the work was down grade.

Before any concrete was placed, the surface of the iron was cleaned with scrapers and wire brushes, and washed with water. Any leaks in the calking and grummeting (all more than 12 months old) were required. All the grout hole plugs were examined, and the plugs in any leaking ones were taken out smeared with red lead, and replaced. The leakage in the calking was due to the fact that the tunnel had been settling slightly during the whole 12 months of pile tests, and, therefore, had opened some of the joints. After the calking had been repaired and the surface thoroughly cleaned, the flanges were covered with neat cement (put on dry or poured on in the form of thick grout) just before the concrete was placed.

Invert Concrete.—The form used for the landward type of concrete, that is, the one with a middle drain, consisted of a frame made of a pair of trussed steel rails on each side of the tunnel and connected at intervals with 6x6-in. cross-timbers; two "wing forms" were hung from this frame by adjustable arms. These wings formed the curved sides of the invert, the lip, and the form for the middle drain. The whole form was supported on three wheels, two on the rear end running on a rail laid on the finished concrete, and the third in front attached to the frame by a carriage and running on a rail temporarily laid on the iron lining. The form was braced from the iron lining by 6x6-in. blocks.

For the soft-groundtype of invert, namely, the one without the middle drain, a form of the same general type was used, except that the form for the middle drain was removed. After the form had been in use for some time, "key pieces" (made of strips of wood about 1 ft. 3 ins. in length and 3x3 ins. in cross-section) were nailed circumferentially on the under side of the wings at 2-ft. intervals. This was done because, at the time, it was not known whether ballasted tracks or some form of rigid concrete track construction would be adopted, and, if the latter, it was desirable not to have the surface smooth.

The concrete was received in cars at the rear end of the form and dumped on a temporary platform. It was then loaded into wheelbarrows on the runways, as shown in Fig. 2. The concrete was thrown from the barrows into the invert, where it was spaded and tamped.

In cases where there was steel-rod reinforcement, the concrete was first brought up to the level of the underside of these rods, which came between the wings; the rods were laid in place, and then more concrete was placed over the rods and brought up to the level of the bottom of the wings. Where there was no reinforcement, the concrete was brought up in one lift.

After this was finished, the concrete behind the wings was placed, thoroughly spaded and tamped, and, where there were longitudinal reinforcing rods, these were put in at their proper level. Where there were circumferential rods, the 16-ft. rods had already been put in when the lower part of the concrete was placed. As the invert was being finished off, the 8-ft. rods were embedded and tied in position.

The longitudinal rods were held in place at the leading end of each length of arch by the wooden bulkhead, through which holes were drilled in the proper positions. At the rear end they were tied to the rods projecting from the previous length. The quantity of water used in mixing the invert concrete

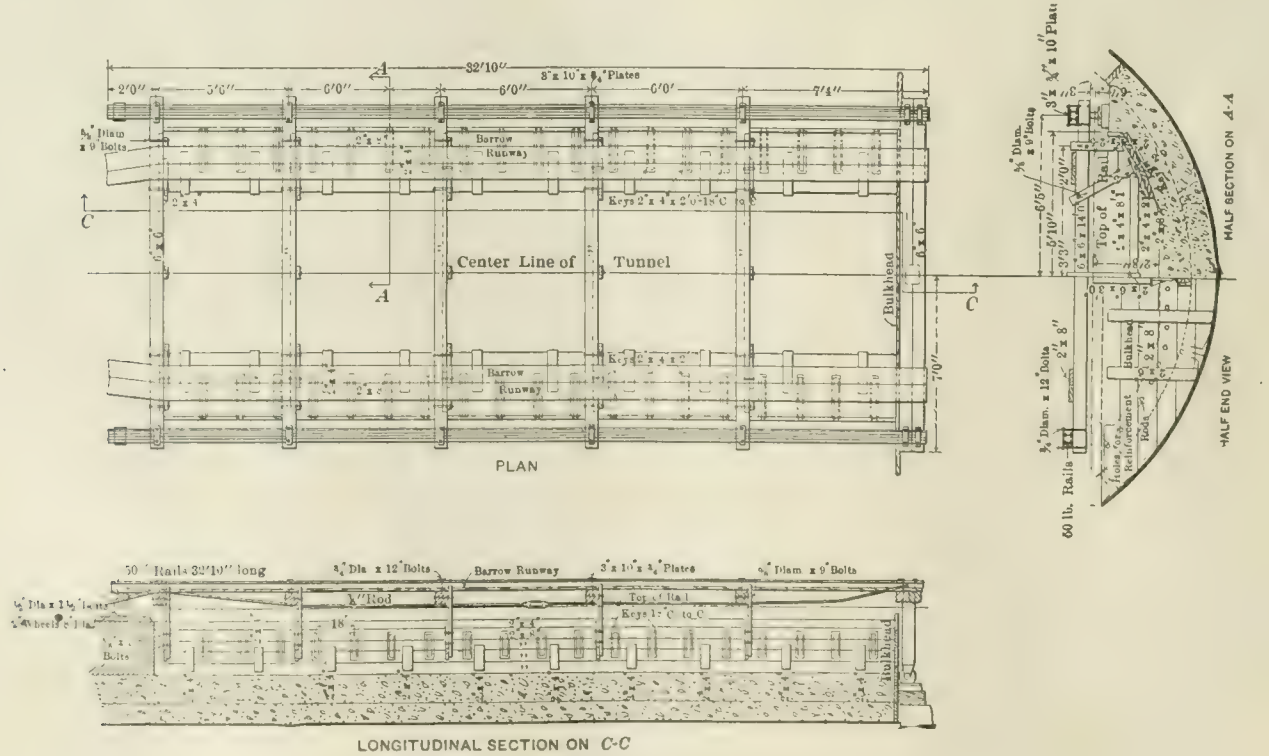
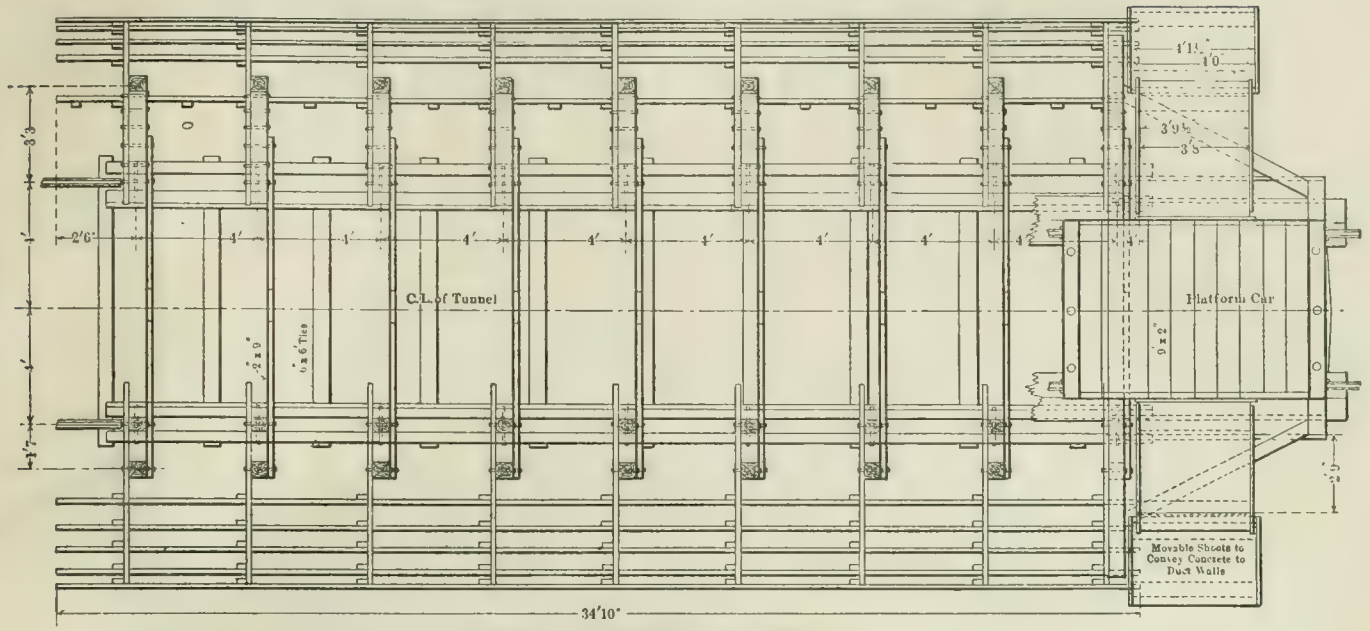
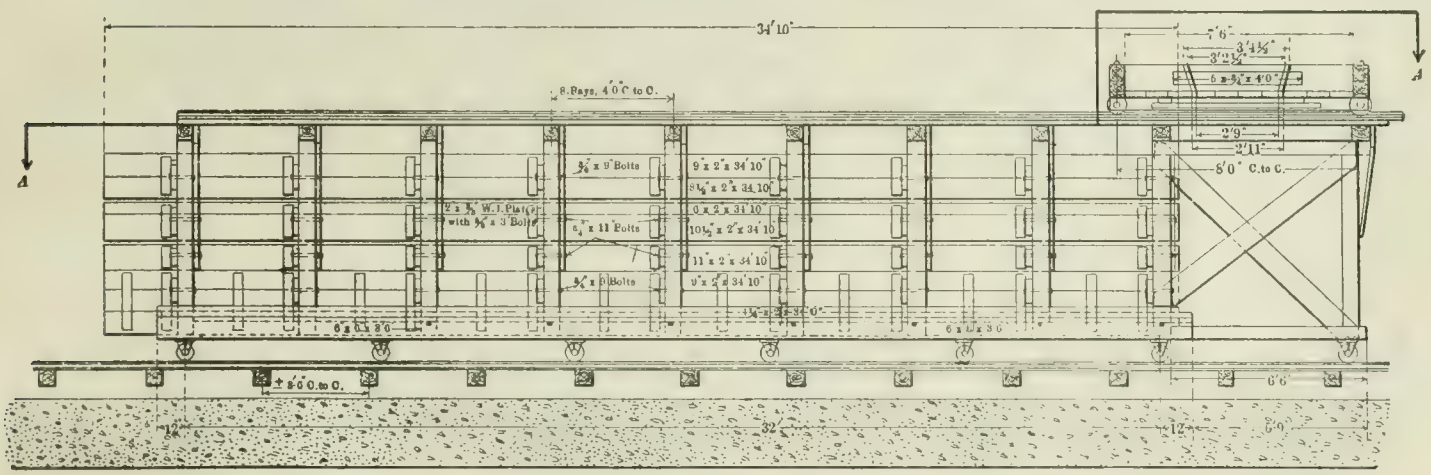


Fig 2—Standard Concrete Form in River Tunnels.

*Arranged from a paper by B. H. M. Hewell and W. L. Brown, Proceedings American Society of Civil Engineers, Vol. XXXVI, p. 690.



PLAN ALONG *AA* (FLOOR SYSTEM NOT SHOWN)



LONGITUDINAL SECTION ON CENTER LINE LOOKING TOWARD POWER CONDUIT BENCH.

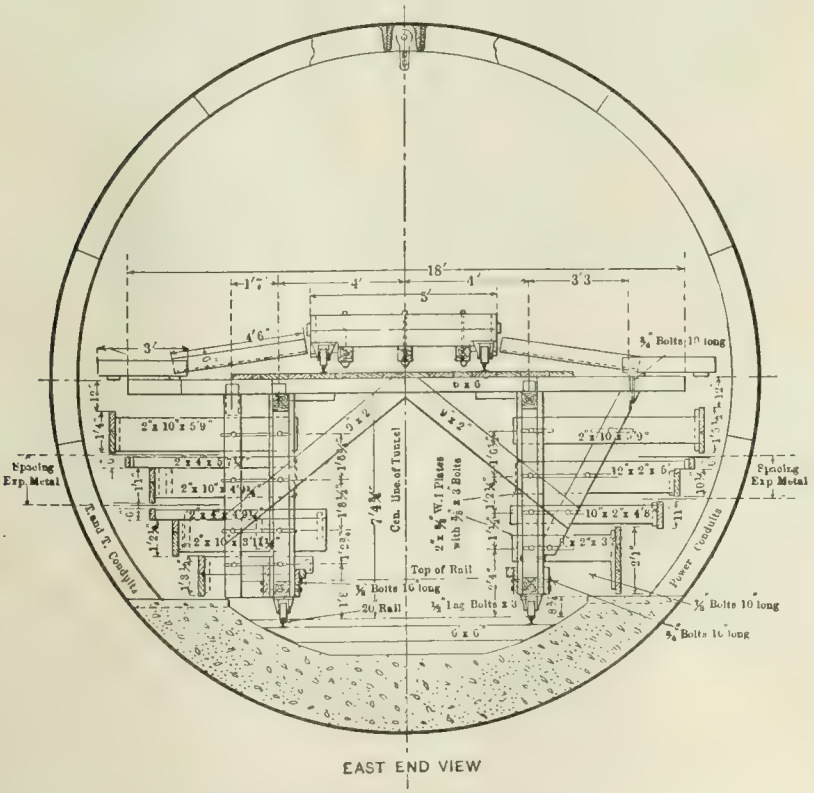


Fig. 3—Duct Bench Concrete Form.

needed very nice adjustment; if too wet, the middle would bulge and rise when the weight of the sides came on it; and, if too dry, it would not pack properly between the flanges of the iron lining. The difficulties as to this were often increased by the flow of accumulated leakage water from the tunnel behind on the concrete while it was being put in. To prevent this, a temporary dam of sand bags was always built across the last length of finished invert concrete before beginning a new length. A sump hole, about 4x4 ft. and 1 ft. deep, was left every 800 ft. along the tunnel, and a small Cameron pump was put there to pump out the water.

The invert forms were left in place about 12 hrs. after the length was finished. The average time taken to fill a length of 30 ft. was 7 hrs., the form was then left 12 hrs. and it took 2 hrs. to set it up anew. The total time for one length, therefore, was 21 hours, equal to 34 ft. per 24 hours. At one place, a 45-ft. form was used, and this gave an average speed of 45 ft. per 24 hours.

An attempt was made to build the invert concrete with forms (seeing that a rough finish was desired, as previously explained, to form a key for possible sub-track concrete), but it proved a failure.

1 Foreman at	$3.25 per shift
2 Spaders at	2.00 per shift
9 Laborers at	1.75 per shift

The average time taken to lay a 30-ft. length of invert was 7 hours; the two spaders remained one hour extra, smoothing off the surface.

For setting the form, the force was:

1 Foreman at	$4.50 per shift
5 Carpenters at	3.25 per shift
6 Carpenters' helpers at	2.25 per shift

The average time taken to erect a form was 2 hours, 1 carpenter and 1 helper remaining until the concrete was finished.

Duct Bench Concrete.—The duct bench is the portion of the concrete on which the ducts are laid. The exact height of the steps was found by trial, so as to bring the top of the ducts into the proper position with regard to the top and the face of the bench.

Both kinds of duct bench forms were of the same geenral type. A drawing of one of them is shown by Fig. 3. The form consisted of a skeleton framework running on wheels on a track at the level of the temporary transportation tracks. The vertical faces of the steps were formed by boards supported from the uprights by adjustable arms. The horizontal surfaces were formed by leveling off the concrete with a shovel at the top of the vertical boards. Where the sheets of expanded metal used for bonding came at a step, the lower edge of the boards forming the back of the step was placed 1 in. above the one forming the front of it; but, when the expanded metal came in the middle of a step, a slot 1 in. wide was left at that point to accommodate it. A platform was formed on the top of the framework for the form, and on this a car forming a sort of traveling stage was run. There was ample room to maintain traffic on a single track through the form.

The concrete, for the most part, was received at the form in ¾-cu. yd. dumping buckets. The buckets were lifted by the rope from a small hoisting engine. This rope passed over a pulley attached to the crown of the tunnel and dumped into the traveling stage on the top of the form. In this the concrete was moved along to the point where it was to be deposited, and there it was thrown out by shovels into the form below. For a portion of the period, while the duct bench concrete was being laid, it was not necessary to maintain a track for traffic through the form and, during that period, the concrete for the lower step was placed from below the form, the concrete being first dumped on a temporary stage at the lower track level.

Owing to the horizontal faces of the steps being uncovered, there was a tendency for the concrete there to rise when concrete was placed in the steps above. For this part of the work, also, it was necessary to see that the concrete was not mixed too wet, for, when that was the case, the concrete in the upper steps was very apt to flow out at the top of the lower one. At the same time, there was the standing objection to the mixture being too dry, namely, the responsibility of getting a sufficient amount of spading and tamping done.

In the section of the tunnel in which there were circumferential reinforcement rods in the duct bench, the rods were in place before the laying commenced, as they had been placed with the invert concrete. The circumferential reinforcing rods in the arch came down into the upper part of the duct bench concrete; these rods were put in position and tied to the iron lining in the crown at the same time as the duct bench concrete was being finished off. Openings for the manholes were left in the duct bench at the regular stationing.

The average time taken to fill a length of 35 ft. was about 6 hours; the form was then left in position for about 8 hours—usually enough to let the concrete set properly—and then moved ahead; it then took about 3 hours to set it up again ready to continue work. The total time for a length, therefore, was about 17 hours, equal to an average progress of about 49 ft. per day. The average force engaged in duct bench concrete (not including transport) was:

1 Foreman at	$3.25 per day
2 Spaders at	2.00 per day
9 Laborers at	1.75 per day

Arch Concrete.—By far the greater part of the arch work was put in with traveling centers before the face of the bench was built, in which case the whole of the arch was built at once. A short length of arch at each end of the tunnel was built after the face of the bench, in which case the haunches or lower 5 ft. were laid first and the upper part of the arch later.

The first traveling centers were used on the New York side, and were 50 ft. long. The laggings were of 4-in. yellow pine, built up in panels 10 ft. long and 16 in. wide for the sides, and solely longitudinal lagging 5 ft. long for the key.

It was pretty certain that the results to be obtained from forms of such a length would not be satisfactory, and this was pointed out to the contractor, who, however, obtained permission to use them on trial. Grout pipes were built in, as it was not likely that the concrete could be packed tightly into the upper part of the lining.

After about 300 lin. ft. of arch had been built with these forms, a test hole was cut out and large voids were found, and, to confirm this, another hole was cut, and similar conditions observed.

1 Foreman at	$3.25 per day
4 Spaders at	2.00 per day
12 Laborers at	1.75 per day

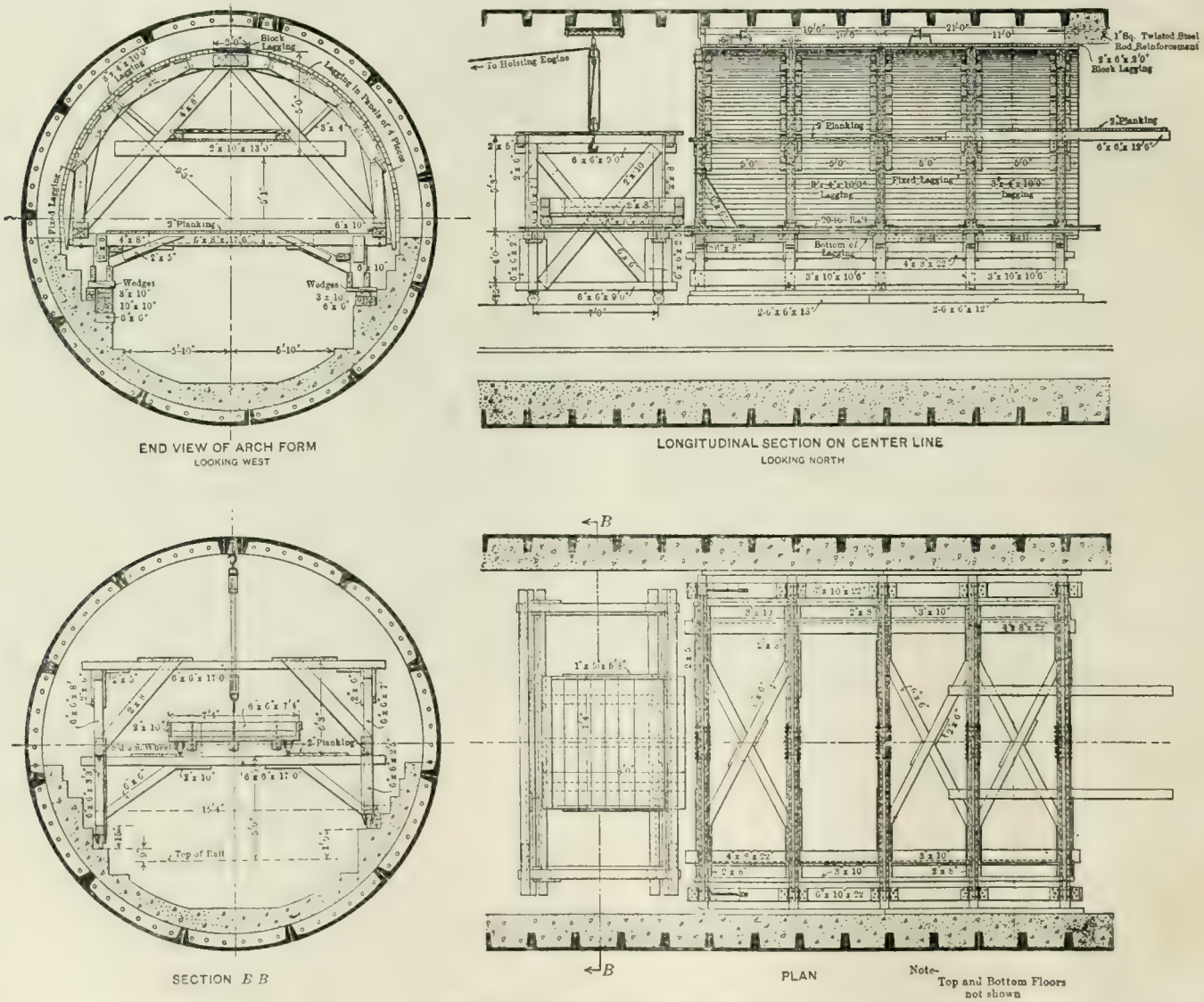


Fig. 4—Details of Arch Forms.

The results were so unsatisfactory that orders were given that the use of longitudinal key lagging should be discontinued, and cross or block lagging used instead. These block laggings were 6 ins. in length (in the direction of the tunnel) and 2 ft. in width; at the same time, the system of grout pipes was changed. It was soon found that with block lagging a better job could be made of packing the concrete up into the keys, but the time taken to "key up" a 50-ft. length was so great that the rest of the arch had set by the time the key was finished. Despite a lot of practice, this was the case, even in the unreinforced type. When the reinforcing rods were met, the time for keying up became still greater, and therefore the contractor was directed to shorten the forms to 20-ft. lengths. A typical working force for a 50-ft. length was:

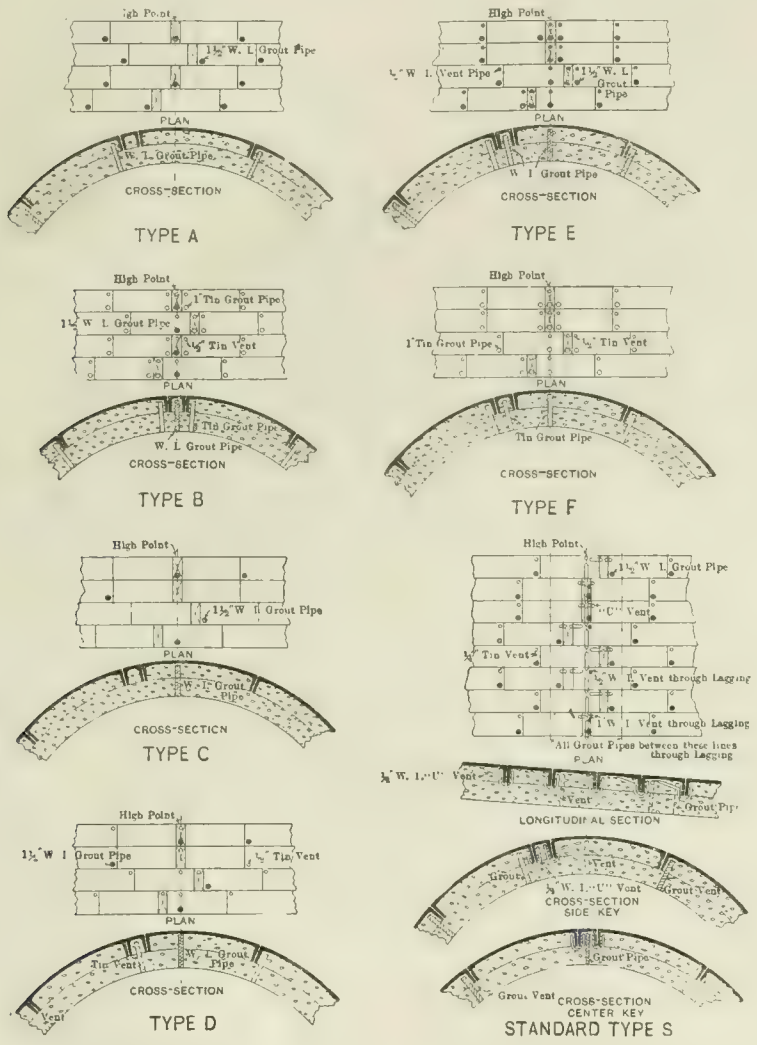


Fig. 5—Various Types of Grout Pipe Arrangement.

1 Foreman at	$3.25 per shift
2 Spaders at	2.00 per shift
10 Laborers at	1.75 per shift

Details of the 20-ft. forms are shown by Fig. 4. The lower 4 ft. of lagging was built on swinging arms, which could be loosened to allow the centers to be dropped and moved ahead. The rest of the lagging was built up in panels 10 ft. long and 1 ft. 4 in. high. The ribs rested on a longitudinal timber on each side; these were blocked up from the top step of the duct bench concrete. When the form was set and when it was released, it was moved ahead on rollers placed under it.

The concrete was received at the form in ¾-cu. yd. dumping buckets; from the flat cars on which they were run, these were hoisted to the level of the lower platform of the arch form. At this level the concrete was dumped on a traveling car or stage, and moved in that to the point on the form where it was to be placed. For the lower part of the arch, the concrete was thrown directly into the form from this traveling stage, but, for the upper part, it was first thrown on the upper platform of the arch. The hoisting was done by a small Lidgerwood compressed-air hoister, and set up on an overhead platform across the tunnel. The pulley over which the cable from the hoister passed was attached to the iron lining near one end of the form, and the traveling stage ran back from the arch form on a trailer, shown by Fig. 4. When it was impossible to hang a pulley—owing to the concrete arch having been built at the point where the trailer stood—an A-frame was built on the trailer, and the pulley was attached to that.

In laying the lower part of the arch, about 1 ft. of lagging (including the swinging arms) was first set, the other panels being pulled up toward the top of the arch. When that was filled, the next panel above was lowered into place, and the work continued. As the concrete rose toward the key, it was packed up to a radial surface, so that the arch would not be unduly weakened if the sides set before the key was placed. All the time, great care was taken to see that the concrete was carefully packed into the segments of the metal lining. The quantity of water used in the concrete was carefully regulated, more being used in the lower than in the upper parts of the arch.

In places where there were no reinforcing rods, the width of the concrete key was the length of the block lagging, namely, 2 ft. Where there was circumferential reinforcement, the key had to be more than 5 ft. wide, in order to take the 5-ft. closure rods used in the key. This naturally increased the time of keying very much. On the places where the 5-ft. longitudinal laggings were used, it was impossible to fill the flanges of the metal lining much higher than their undersides.

As the concrete used in the key had to be much drier than that used elsewhere, it was not easy to get a good surface. This trouble was overcome by putting a thin layer of mortar on the laggings just before the concrete was put in.

The overhead conductor pockets were a great hindrance to the placing of the key concrete, especially where the iron was below true grade. Whenever an especially troublesome one was met, a special grout pipe was put in to fill up unavoidable holes by grouting after the concrete had set. All the circumferential reinforcing rods were bent in the tunnel by bending them around a curved form of less diameter than the required bend. This generally left them all right in the middle of their length, but with their end portions too straight; in such cases the ends were bent again. All rods were compared with a template before being passed for use.

The arch forms were left up for 48 hours after keying was finished. Levels taken after striking the forms showed that no appreciable settlement occurred. An average gang for a 20-ft. length of arch was:

Table I shows the progress attained under various conditions.

Whenever the face of the bench concrete was constructed before the arch, the latter was built in two separate portions, that is, the bottom 5 ft., or "haunches" of the arch, as they were termed, were built on each side and the rest of the arch later. This involved the use of two separate sets of forms, namely, for the haunch and for the arch. Not very much arch was built in this way, and, as the methods were in principle precisely the same as those used when all the arch was built in one operation, no detailed description is needed.

No provision was made in the contract for grouting the concrete arch, but it soon became evident that by ordinary methods the top part of the concrete could not be packed solid against the iron segments, especially in the keys. As it was imperative to have the arch perfectly solid, it was determined to fill these unavoidable gaps with a 1 : 1 Portland cement grout, at the same time making every effort to reduce the spaces to a minimum. This made it necessary to build grout pipes into the concrete as it was put in.

The first type of grout pipe arrangement is shown as Type *A*, in Fig. 5. This was used with the longitudinal key laggings; when this method was found to be no good, and cross-laggings were used, the system shown as Type *B*, in Fig. 5, was adopted, in which vents were provided to let out the air during grouting. The expense of these pipes was high, and the contractor obtained permission to use sheet-iron tubes, which, however, were found to be unsuitable, so that the screwed pipes were used again. The contractor next obtained permission to try dispensing altogether with the vent pipes, and so Type *C*, in Fig. 5 was evolved. This, of course, was found to be worse than any of the other systems, as the imprisoned air made it impossible to force grout in. Several other modifications were made, and are shown in Fig. 5.

It was then decided to devise as perfect a system as possible, without allowing the question of cost to be the ruling factor, and to use that system throughout. In this system, shown as Type *S*, in Fig. 5, most of the vent pipes were contained in the concrete, and their size was independent of the thickness of the arch, so that they were easily fixed in position and not subject to disturbance while placing the concrete. This system was used for about 80 per cent of the total length of the tunnel, and proved entirely satisfactory. The machine used for grouting was the same as that used for grouting outside the metal lining.

The only compressed air available was the high-pressure supply, at about 90 lbs., a reducing valve, to lower this pressure to 30 lbs. was used between the air line and the grouting machine. This was thought to be about as high a pressure as the green concrete arch would stand, and, even as it was, at one point a section about 2 ft. by 1 ft. was blown out.

A rough traveling stage resting on the bottom step of the duct bench concrete was used as a working platform. In the earlier stages of the work the grouting was carried on in a

TABLE I.—AVERAGE TIME TAKEN FOR VARIOUS OPERATIONS CONNECTED WITH BUILDING CONCRETE ARCHES IN SUBAQUEOUS TUNNELS.

Average time, in hours, form stood after filling.	Type of reinforcement.	Length of section in feet.	Time, in hours, moving and erecting forms.		Time, in hours, placing concrete in arch.	Time, in hours, placing concrete in key.	Time, in hours, placing concrete in key and arch.	Total time, in hours, for moving, erecting and filling.	Total time, in hours, per linear foot, for moving, erecting and filling.	Remarks.
			Moving.	Erecting.						
70	A day work	50	20		15	15.40	30.40	50.40	1.01	.....
	A day work	20	2	3	8.30	2.40	11.10	16.10	0.80	.....
53	B day work	20	2	3	10.40	11.20	22.00	27.00	1.35	Includes placing rods.
53	C day work	20	2	3	11.00	7.20	18.20	23.20	1.16	do.
53	D day work	20	2	3	9.50	4.35	14.25	19.25	0.91	do.
53	D piece work	20	2	3	6.15	2.05	8.20	13.20	0.65	do.
53	Sub-Type No. 1 piece work	20	2	3	6.00	3.00	9.00	14.00	0.70	do.

rather haphazard manner, but, when the last system of grout and vent pipes was adopted, the work was undertaken systematically, and was carried out as follows:

Two 20-ft. lengths of arch were grouted at one time, and, in order to prevent the grout from flowing along the arch and blocking the pipes in the next lengths, a bulkhead of plaster was made at the end of every second length to confine the grout.

After a section had been grouted, test holes were drilled every 50 ft. along the crown to see that all the voids were filled; if not, holes were drilled in the arch, both for grouting and for vents, and the faulty section was regrouted. An average of ¾ bbl. of cement and an equal quantity of sand was used per linear foot of tunnel. The average amount put in by one machine per shift was 15 bbl., and therefore the average length of tunnel grouted per machine per shift was 20 ft. The typical working force was:

1 Foreman at.....$3.75 per shift
1 Laborer running grout machine at ..... 2.00 per shift
2 Laborers handling cement and sand at ..... 1.75 per shift
1 Laborer tending valve and grout pipes at ..... 1.75 per shift

After the grouting was finished, the arches were rubbed over with wire brushes to take off discoloration, and rough places at the junctions of adjoining lengths or left by the block laggings were bush-hammered.

Face of Bench Concrete.—The form used for this portion of the work consisted of a central framework traveling on wheels, and, from the framework, two vertical forms were suspended, one on each side, and equal in height to the whole height of the bench. Adjusting screws were fitted at intervals both at top and bottom, and thus the position of the face forms could be adjusted accurately. The face forms were built very carefully of 3-in. tongued and grooved yellow pine, and one 50-ft. form was used for 3,000 ft. of tunnel without having the face renewed. Great care was taken to set these forms true to line and grade, as the appearance of the tunnel would have been ruined by any irregularity. Joints between successive lengths were finished with a V-groove.

The concrete was received at the form in dumping buckets; these were hoisted to the top of the form by a Lidgerwood hoister fixed to a trailer. The concrete was placed in the form by shoveling it from the traveling stage down chutes fitted to its side. The quantity of water to be used in the mixture needed careful regulation. The first few batches in the bottom had to be very wet, and were made with less stone than the upper portion, in order that the concrete would pack solidly around the niche box forms and other awkward corners.

The forms for the boilers and refuge niches were fastened to the face of the bench forms by bolts which could be loosened before the main form was moved ahead, and in this way the ladder and niche forms were left in position for some time after the main form was removed.

At first the forms were kept in place for 36 hours after finishing a length, but, after a little experience, 24 hours was found to be enough. In the summer, when the rise of temperature quickened the set, the time was brought down to 18 hours. The average time taken for a 50-ft. length was:

Laying concrete ..... 4½ hours
Interval for setting.....18 hours
Moving forms ahead and resetting.... 5 hours
Total .....27½ hours

The typical working gang was:

Laying Concrete:
1 Foreman at.....$3.25 per shift
2 Spaders at..... 2.00 per shift
8 Laborers at..... 1.75 per shift
Moving and Setting Forms:
1 Foreman at.....$4.00 per shift
10 Laborers at..... 1.75 per shift

After the forms were removed, any rough places at the lower edge, where the concrete joins the "lip," were bush-hammered; no other cleaning work was done.

Duct Laying and Rodding.—It will have been seen that the duct-bench concrete was laid in steps, in which the ducts were laid, hence the maintenance of the grade and line in the ducts was an easy matter. The only complication was the expanded metal bonds, which were bent up out of the way of the arch forms and straightened out again after the arch forms had passed. The materials, such as ducts, sand, and cement, were brought into the tunnel by the regular transportation gang. The mortar was mixed in a wooden trough about 10 ft. long, 2 ft. 6 ins. wide and 8 in. deep.

After the single-way ducts had been laid, all the joints were plastered with mortar, in order to prevent any foreign substance from entering the ducts. This was not necessary with the multiple duct, as the joints were wrapped with cotton duck. The ducts were laid on a laying mandrel, and, as soon as possible after the concrete was laid around a set of ducts, they were "rodded" with a rodding mandrel. Not many obstructions were met, and these were usually some stray laying mandrel which had been left in by mistake, or collections of mortar where the plastering of the single-way joints had been defective.

In the 657,000 duct ft. of conduit in the river tunnels only eight serious obstructions were met. That the work was of exceptionally high quality is shown by the fact that a heavy 3-in. lead cable has been passed through from manhole to manhole (450 ft.) in 6 min., and the company, engaged to lay the cables in these ducts, broke all its previous records for laying, not only for tunnel work, but also in the open.

The typical working force was:

Laying Multiple Ducts:
1 Foreman at.....$3.50 per shift
9 Laborers at..... 1.75 per shift
Laying Single-Way Ducts:
1 Foreman at.....$3.50 per shift
3 Laborers at..... 1.75 per shift
Rodding Multiple Ducts:
1 Foreman at.....$3.50 per shift
5 Laborers at..... 1.75 per shift
Rodding Single-Way Ducts:
1 Foreman at.....$3.50 per shift
5 Laborers at..... 1.75 per shift

The average progress per 10-hour shift with such gauge was:

Laying multiple ducts..... 4,000 duct ft.
Laying single-way ducts..... 1,745 duct ft.
Rodding multiple ducts..... 4,040 duct ft.
Rodding single-way ducts..... 2,532 duct ft.

Tests on Rate of Cooling of Concrete in the Gatun Locks of the Panama Canal.

Six resistance thermometers will be embedded in the walls of the locks at Gatun, in order to determine the degree of heat attained at various stages of the hardening of the concrete. The concrete is made of 1 part slow setting Portland cement, 3 parts sand, and 6 parts 3-in. rock. On account of the time that elapses between the mixing of the concrete and its delivery into the forms, the mixture is made about the consistency of thin plaster. After it is placed in some parts of the wall, large rock is added, forming a cyclopean concrete. From the time concrete begins to crystallize until it reaches its final set the increase in temperature is rapid. From the setting point the increase is slow, but usually continues during the whole of the hardening process, which is indefinitely long, probably lasting for several years. It is to gather data with regard to this hardening, and the heat produced by the chemical changes that accompany it that the thermometers will be embedded in the concrete.

The thermometer consists of three parts—(1) a resistance bulb; (2) wire connecting the bulb with an indicating instrument; (3) an indicating instrument. The resistance bulb is an iron cup in which there is inserted a specially prepared metal, the resistance of which to the flow of electric current varies directly as the temperature. This bulb is embedded in the concrete at any point desired, and two copper wires connect it with the indicating instrument. The wires are encased in lead armor to make them waterproof, and their resistance is determined at the time of installation and the corrections remain practically constant. Any number of bulbs may be connected with a single indicating instrument, but the indicator to be installed at Gatun is capable of registering for eight bulbs, although for the time being only six will be used. The indicating instrument and the switches connected with it are self-contained and mounted on a marble slab, the whole being easily portable. By closing the circuit of any thermometer, which is done by means of a push button switch, the resistance of that thermometer is measured, and the instrument records it in terms of temperature.

The thermometer is operated by one small storage battery giving approximately two volts at the terminals. The frequency with which the temperature will be taken, will be determined by the rate at which it changes from time to time. The results will be plotted with time as the abscissa, and temperature as the ordinate, and in this way a complete graphical record of the hardening and cooling of the concrete will be kept.

A Home Made Hand-Level.—At times a hand level is a very useful instrument, but a great many more times, it is not on hand when wanted. On such an occasion a simple substitute may be devised which will work admirably. A glass tube 26 ins. long is heated and bent to the form of a rectangle 8 x 5 ins. and is half filled with water, colored with ink. The ends are then heated and welded together. After cooling, the liquid can pass around the entire square. This tube is then tied to a stiff cardboard for protection. The surfaces of the liquid present a level line of sight just about as serviceable as that of a regular hand level.

Earth and Rock Section

Note: This section is devoted to methods and costs of excavating earth and rock and building embankments. It will cover the grading of roads and railroads, diking and canal work, dredging, building reservoirs and earth dams, sewer and water pipe trenching, quarrying, etc.

Method and Cost of Excavating Land Sections of Pennsylvania R. R. North River Tunnels at New York City.*

A general account of the progress, method of work, plant used, and results obtained will now be given for the Land Tunnels. The work on these tunnels on the Manhattan side was carried on from the shaft at 11th Avenue and 32d St. In this short length of about 977 ft. there are no less than nine different kinds of cross-section. The reason for these changes is the fact that the two lines of track are here not straight and parallel to the center line between the tunnels, but are curved, although symmetrical about this center line. The various changes of section are to enable the tunnels to be built in straight lengths, thus avoiding the disadvantages attending the use of curved forms, and at the same time minimizing the quantity of excavation, an item which accounts for from 60 to 70 per cent of the total cost of tunnels of this type. Of course, there are corresponding and obvious disadvantages in the adoption of many short lengths of different cross-sections, and these disadvantages were well brought out in the course of the work; on the whole, however, they may be said to have justified their adoption.

These New York Land Tunnels were divided into three contracts, viz.: From Station 190 + 15 (the Portal to the open work of the Terminal Station at the east side of Tenth Avenue, New York City) to Station 197 + 60, called "Section Gy-East." The next contract, called "Section Gy-West Supplementary," extended from Station 197 + 60 to Station 199 + 20, which is the east side of Eleventh avenue. The third contract was called "Section Gy-West," and extended from Station 199 + 20 to Station 231 + 78 (the dividing line between the States of New York and New Jersey). Thus, for nearly all its length, this contract consists of shield-driven tunnel. The portion between Stations 199 + 20 and 199 + 91.5, however, was of the Land Tunnel type, and therefore will be included here. A fourth contract extended from Station 231 + 78 to the Weehawken Shaft at Station 263 + 50, and of this all but 230 ft. was of the shield-driven type, only the portion next to the Weehawken Shaft being of the Land Tunnel type.

The four contracts were let to one contractor (The O'Rourke Engineering Construction Company), and the work was carried on simultaneously in all four, so that the division into contracts had no bearing on the methods of work adopted, and these will now be described as a whole and with no further reference to the different sections.

Excavation.—Work was started on the New York side on April 18, 1904, the Weehawken shaft being at that date still under construction. The contractor found a shaft already prepared for his use, and cross-drifts at grade and at right angles to the future tunnels, and extending across their entire width. The first essential was to get access to the shield chambers, which were to lie about 330 ft. to the west of the shaft, so that the construction of these enlargements in which the shields for the subaqueous tunnels were to be built might be finished as soon as possible and thus allow the earliest possible start to be made with the shield-driven tunnels.

With this in view, two bottom headings, on the center line of each of the two tracks, were driven westward from the western cross-heading at the foot of the shaft. When about 138 ft. had been made in this way, the two headings were brought together and a break-up was made to the crown level of the tunnel, as the depth of rock cover was doubtful. From this break-up a top heading was driven westward to Station 200 + 30. While widening the heading out at Station 200 + 20 the rock was penetrated on the south side. The exposed wet sand and gravel started to run, and, as a consequence, a change in design was made, the shield chambers (and consequently the start of the shield-driven tunnels) being moved eastward from their original location 133 ft. A certain amount of time was necessarily spent in making these changes of design, which involved a rearrangement of the whole layout from the Terminal Station to the start of the River Tunnels. On July 5, 1904, however, the new design was formally approved. No sooner had this been decided than a strike arose on the work, and this was not settled until Aug. 1, 1904, but from that time the work progressed without delay.

A top heading was now driven over the original bottom heading west of the shaft, and at the same time the original cross-drifts from the shaft were amalgamated with and broken down by a heading driven at the crown level of the "Intercepting Arch" which here cuts across the ordinary run of tunnel at right angles and affords access to the tunnels from the shafts.

The excavation of the upper portion of the

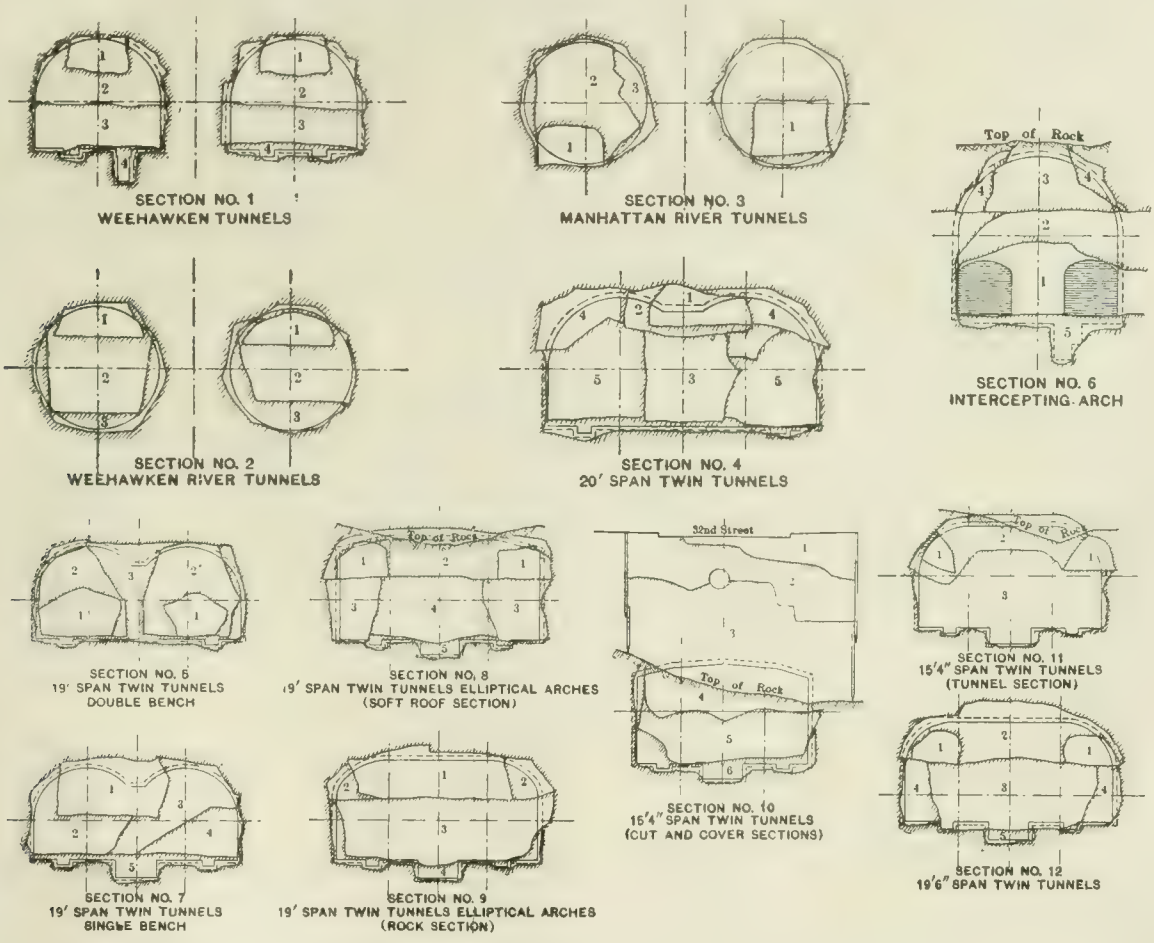


Fig. 1—Sketches Showing Sequence of Operations in Excavating Tunnels.
(Numbers show order in which sections were excavated; sections cross-hatched were excavated under a previous contract.)

*Arranged from a paper by B. H. M. Hewett and W. L. Brown, Proceedings American Society of Civil Engineers, Vol. XXXVI, p. 690.

intercepting arch at its southern end gave some trouble, and caused some anxiety, as the rock cover was penetrated and the wet sand and gravel were exposed. This made it necessary to timber all this section heavily, and the tracks of the New York Central Railroad directly above were successfully supported. The general way in which this timbering was carried out will be described under the head of "Timbering."

Meanwhile, the excavation of the tunnels west of the intercepting arch was continued until the North and South Tunnels were taken out to their full outlines, leaving a core of rock between them. This core was gradually removed, and timbering supporting the rock above the middle wall was put in as excavation went on. The ground, which was entirely of micaceous schist, typical of this part of Manhattan, seamed with veins of granite, was rather heavy at the west end, or adjacent to the shield chambers, and required complete segmental timbering across the whole span. One heavy fall of rock in the core wall between the North and South Tunnels took place on Nov. 2, but fortunately as much rock as possible. In Section Gy-East the conditions were exceptionally variable, as the rock was subject to sudden changes from a soft crumbling mica schist to broad bands of hard granite, and, in addition, the rock surface was very irregular, and, for a good length of this section, was below the crown of the tunnel, a condition which led to the adoption of the cut-and-cover method for part of the work.

The irregularity in conditions called for varying methods of procedure, but in general the methods were as shown by Fig. 1 and described as follows:

In Solid Rock.—Where there was plenty of good rock cover, a top middle heading was driven, which was afterward widened out to the full cross-section of the twin tunnel arches. If necessary, a few lengths of segmental timbering were put in before taking down the bench, which was generally kept some 40 or 50 ft. behind the breast of the heading. After the bench was down, the middle conduit trench was excavated and the trimming done.

In Soft Rock.—Where there was not enough rock cover, or where there was actual continually in soft ground. To ascertain the extent of this condition the contractor decided to make soundings as far as 10th Ave., which was done by sinking trial pits and making wash-borings in the street. These soundings showed that there would be soft ground in the crown from Station 194 + 75 to Station 194 + 25 (at one point to a depth of 12 ft. below the crown), and on each side of this section the cover was insufficient from Station 193 + 58 to Station 195 + 30. This condition being known, it was decided to adopt cut-and-cover work for this length, the principal reasons being that repairs to sewers, streets, and drains would be no more, and probably less, expensive than with the tunnel method; the underpinning of a heavy brick brewery building adjoining the works on the north side would be facilitated, and the opening in the street, through which muck and materials could be handled, would relieve the congested shaft, through which the large volume of muck from the River Tunnels was then being conveyed. On the other hand, the cut-and-cover method was adversely affected by the presence of a heavy timber trestle built

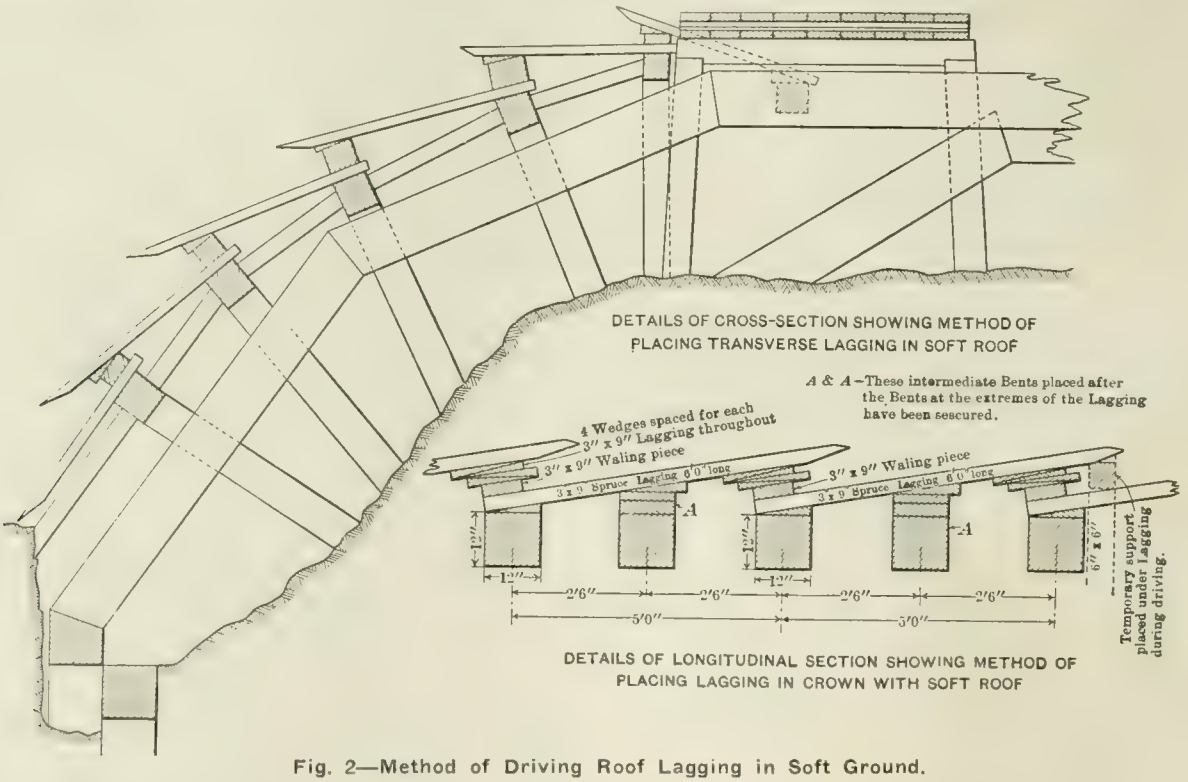

DETAILS OF CROSS-SECTION SHOWING METHOD OF PLACING TRANSVERSE LAGGING IN SOFT ROOF
A & A—These intermediate Bents placed after the Bents at the extremes of the Lagging have been secured.
4 Wedges spaced for each 3" x 9" Lagging throughout
3" x 9" Waling piece
3 x 9 Spruce Lagging 6'0" long
3" x 9" Waling piece
3 x 9 Spruce Lagging 6'0" long
A
A
12"
12"
12"
6" x 6"
2'6"
2'6"
2'6"
2'6"
5'0"
5'0"
Temporary support placed under Lagging during driving.
DETAILS OF LONGITUDINAL SECTION SHOWING METHOD OF PLACING LAGGING IN CROWN WITH SOFT ROOF

Fig. 2—Method of Driving Roof Lagging in Soft Ground.

did not extend beyond the limits of the permanent work. On Nov. 7, 1904, the excavation east of the intercepting arch was begun by driving a bottom heading in the South Tunnel. This was continued to Station 197 + 14 and then was taken up to the crown level and worked as a top heading with the view of keeping track, by making exploratory borings upward from the roof at frequent intervals, of the rock surface, which was here irregular and not known with any degree of certainty. The work was not pressed with any vigor, because all efforts were then being bent toward excavating from the River Tunnels soft ground in the roof, wall-plate headings at the springing line level were driven ahead of the remainder of the work. The wall-plates were laid in these, the roof was taken out in short lengths, and segmental timbering spanning from wall-plate to wall-plate was put in. The roof being thus held, the bench excavation proceeded without trouble. Where the rock was penetrated and soft ground showed in the roof, poling boards were driven ahead over the crown-bars, as shown by Fig. 2.

Cut-and-Cover Work.—After some 225 ft. had been driven from the intercepting arch, it was found that the crown of the tunnel was down the south side of the street and over which passed all the excavation from the Terminal Station, amounting to a very heavy traffic. As this trestle had to be supported, it complicated the situation considerably. Very little active progress was made between June, 1905, and April, 1906, as the contractor's energies during that time were much taken up with the progress of the shield-driven tunnels. In April, 1906, preparations were made to start a 50-ft. length of open cut, rangers being fixed and sheathing driven; and the sewer which ran down the middle of this street was diverted to the outside of the open-cut length.

April and May were occupied in driving the sheathing down to rock, supporting the trestle, underpinning the adjoining brewery, and excavating the soft material above the rock. On June 2, 1906, rock was reached, and, by July 31, the excavation was down to subgrade over nearly the whole 50 ft. in the first length. In the meantime another length was opened up, and eventually a third.

The surface of the rock now seemed to be rising, and the heavy buildings had been passed, so that tunneling was reverted to for the rest of the work, though many difficulties were caused by soft rock in the roof from time to time.

When the excavation for the open-cut work

TABLE I.

Portion of excavation	Feet of hole drilled per cubic yard of excavation			Lbs. of powder used per cubic yard of excavation		
	15'4" span twin tunnel	19'6" span twin tunnel	24'6" span twin tunnel	15 ft bench	19 ft bench	24 ft bench
Wall-plate heading*	13.0	10.97	10.97	3.77	2.85	2.85
Total Heading*	7.87	8.17	7.81	2.31	2.02	1.78
Bottom and taker bench*	5.97	6.15	7.56	0.94	0.93	1.13
Trench*	9.82	15.96	18.10	1.84	2.48	2.73
Average for section*	6.69	7.43	8.95	1.28	1.36	1.45
Actual amount	6.82	7.27	8.95	1.22	1.24	1.27

*Figures taken from typical cross-sections.

†This gives the actual amount of drilling done and powder used per cubic yard for the whole period of 5 months of observation, but as this length included 280 ft. of heading and only 220 ft. of bench, the average figures (for powder especially) are too low.

TABLE II—ROCK TUNNEL EXCAVATION UNDER 32D ST., EAST OF CUT-AND-COVER SECTION.
DRILLING AND BLASTING.—DETAILED COST OF LABOR IN DRILLING, ALSO QUANTITY AND COST OF POWDER USED.

Type	1907	Drilling and Blasting. Total feet drilled. Heading.	Bench.	Total.	No. of drill shifts. (10-hour.) Heading.	Bench.	Total.	Feet drilled per man per hour. Headings.	Bench.	Total.	Quantity of excavation, in cubic yards. Actual.	Paid for.	Cost of labor only Drilling and sharpening. Per cubic yard Total.	Per lin. ft.	Powder Used. Total quantity. Actual.	Paid for.	Cost per cubic yard at 11 cents per pound. Actual.	Paid for.
Ke.	May	2,971	5,758	8,549	98	204	302	33.031	2.734	2.831	1,736	1,564	$ 2,331	$0.27	$1.34	$1.40	1,595	$0.10	$1.10
	June	2,093	6,194	8,287	85	223	308	2.462	2.777	2.691	809	698	2,440	0.29	3.01	3.49	1,960	0.27	0.31
	July	...	7,627	7,627	...	268	268	....	2.845	2.845	1,022	960	2,031	0.26	1.98	2.11	966	0.10	0.11
	Aug.	...	2,552	2,552	...	95	95	...	2.688	2.688	743	716	640	0.25	0.86	0.89	430	0.06	0.07
	Sept.	...	2,133	2,133	...	79	79	....	2.700	2.700	238	238	533	0.25	2.24	2.24	280	0.13	0.13
	Total	5,064	24,084	29,148	183	869	1,052	2.767	2.77	2.77	4,548	4,276	$ 7,975	$0.27	$1.75	$1.87	5,231	$0.13	$0.13
Ke.	May	6,976	...	6,976	216	....	216	3.229	....	3.229	614	527	1,604	0.23	2.61	3.04	1,230	0.22	0.26
	June	4,089	...	4,089	135	...	135	3.029	....	3.029	357	259	1,234	0.30	3.45	4.76	1,036	0.32	0.44
	July	...	3,733	3,733	...	140	140	....	2.666	2.666	530	404	1,084	0.29	2.04	2.68	550	0.11	0.15
	Aug.	...	6,715	6,715	...	249	249	...	2.769	2.769	925	890	1,901	0.28	2.05	2.13	905	0.10	0.11
	Estim.	...	14,742	14,742	...	546	546	....	2.700	2.700	3,254	2,908	4,570	0.31	1.40	1.57	2,470	0.08	0.09
	Total	11,065	25,190	36,255	351	935	1,286	3.152	2.694	2.819	5,680	4,988	$10,393	$0.29	$1.83	$2.08	6,191	$0.12	$0.14
Ko	May	...	1,617	1,617	...	55	55	...	2.921	2.921	250	188	471	0.29	1.88	2.50	376	0.17	0.22
	June	...	2,948	2,948	...	107	107	....	2.755	2.755	496	347	883	0.29	1.78	2.54	357	0.08	0.11
	July	...	3,734	3,734	...	131	131	....	2.850	2.850	626	606	1,003	0.27	1.60	1.65	609	0.11	0.11
	Aug.	...	8,260	8,260	...	290	290	....	2.848	2.848	718	709	2,161	0.26	3.00	3.04	918	0.14	0.14
	Estim.	...	4,787	4,787	...	285	285	....	1.680	1.680	665	535	2,397	0.50	3.96	4.48	762	0.14	0.16
	Total	....	21,346	21,346		868	868	....	2.460	2.460	2,695	2,385	$ 6,915	$0.32	$2.57	$2.90	3,022	$0.12	$0.14
	Grand total.	16,129	70,620	86,749	534	2,672	3,206	3.020	2.710	2.710	12,923	11,649	$25,283	$0.29	$1.96	$2.17	14,444	$0.12	$0.14

The work done during the 5 months when these analyzed cost figures were kept includes 280 ft. of bench and 220 ft. of heading. This excess of bench over heading causes the general average amounts per cubic yard to be too low.
*Actual amount of excavation. †Amount of excavation paid for.

of the Terminal Station had advanced to the line of 10th Ave., the contractor started a heading from this point and drove westward under 10th Ave. until the headings driven eastward from the cut-and-cover portion, were met. This was done to expedite the work under 10th Ave., where the ground was not very good, where there were several important gas and water mains in the street, and where, moreover, the tunnels were of exceptionally large span (24 ft. 6 ins.), making a total width of some 60 ft. for the excavation. The excavation for the New York Tunnels was practically finished in January, 1908.

Drilling and Blasting.—The foregoing short description will serve to show in a general way the scheme adopted in making the excavation. A few details on drilling and blasting methods may not be out of place. Percussive drills run by air pressure were used. They were Ingersoll-Sergeant, Nos. 3½, A-86, C-24, and F-24. The compressor, without assistance, could supply air for nine drills, but, when fed by compressed air from the lower pressure, its capacity was increased three or four times.

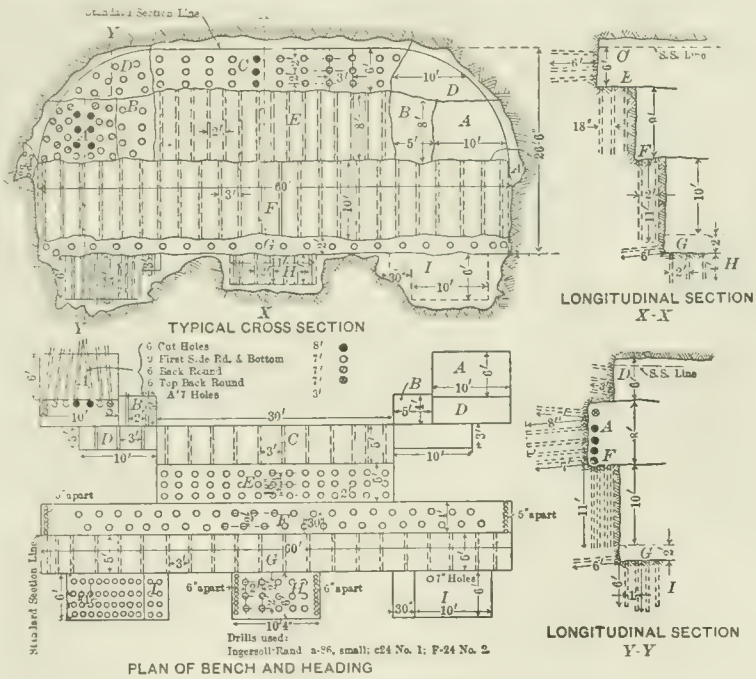
The air was compressed to 100 lbs. per sq. in. in the power house, and was delivered at about 80 lbs. per sq. in. at the drills. A 3-in. air line was used. The drill steel was 1⅛ to 1⅜-in. octagonal. The holes were about 3¼ ins. in diameter at starting and 2⅝ ins. at the full depth of 10 ft. The powder used on the New York side was 40 per cent Forcite, the near presence of heavy buildings and lack of much rock cover necessitating light charges and many holes spaced close together.

To compensate the contractor for the inevitable excavation done outside the neat lines of the masonry lining, the excavation was paid for to the "Standard Section Line" which was 12 ins. outside the neat lines on top and sides and 6 ins. outside at the bottom of the cross-section. The actual amount of excavation done was about 11 per cent greater than that paid for. The distance excavated beyond the neat line, because of the very heavy timbering necessary, was about 2.1 ft. instead of the 1 ft. allowed, and at the bottom about 0.85 ft. instead of the 0.50 ft. paid for.

For a period of 5 months detailed records were kept of the drilling and blasting. About 12,900 cu. yds. of excavation are included. A sketch and table showing the method of driving the heading, the number and location of the holes drilled, and the amount of powder used, is given by Fig. 3. From this and similar figures the information in Table 1 is derived.

Table II gives the rate and cost of drilling, and the cost of powder. It will be seen that the average rate of drilling was 2.71 ft. per hour per drill or 27.1 ft. per drill per shift.

Table III shows the result of observation as to the time taken in various subdivisions of



Sub-divisions	Volume of each sub-division paid for	No. of sets of holes	No. of holes in set	No. of times fired	Total lbs. of powder per hole fired	Linear feet of tunnel broken	Total length drilled	Total length of similar headings	Length drilled per linear foot of tunnel	Cu. yds. per linear foot of tunnel	Total feet drilled per cubic yard	Total lbs. of powder per linear foot of tunnel	Total lbs. of powder per foot drilled	Total lbs. of powder per cubic yard
a	b	c	d	e	f	g	h	i	j	k	l	m	n	o
									$\frac{\Sigma c+d}{g}$	$\frac{b+i}{g}$	$\frac{j}{k}$	$\frac{c+d+f}{g}$	$\frac{m}{j}$	$\frac{m}{k}$
A	17 775	• 1	6	3	4.50									
		⊙ 1	9	1	1.50									
		⊙ 1	6	1	1.00									
		⊗ 1	6	1	0.75	6.0	195	2	65.00	5.925	10.97	17.00	0.261	2.848
A'	1 00	2	3-4	1	0.25	5.0	21	2	8.40	0.400	21.00	0.70	0.166	1.750
B	5 925	• 2	3-4	1	1.00	4.0	35	2	17.50	2.962	5.90	3.50	0.200	1.181
C		⊙ 1	3	2	1.125									
	33 33	4	7	1	1.125	5.0	156	1	37.20	6.666	5.58	6.975	0.187	1.046
D	6 665	2	5-6	1	0.75	3.0	33	2	22.00	4.444	4.95	5.500	0.250	1.237
		Total for Heading							156 10	20.397	7.81	33.675	0.227	1.778
E	50 00	9.0	5	1	1.50	5.0	405	1	81.00	10.000	8.10	13.500	0.167	1.350
F	88 88	10.5	4	2	1.50									
		+ 5.0	4	1	1.50	4.0	552	1	170.50	22.222	7.67	23.230	0.136	1.046
G	22.22	5.5	4	2	1.00	5.0	132	1	26.40	4.444	5.94	4.400	0.166	0.990
		Total for Bench							277.90	36.666	7.56	41.150	0.150	1.133
H	9.77	5	3	1	0.50									
		4	6	1	0.50	6.0	156	1	26.00	1.628	15.96	3.250	0.125	1.995
I	26 66	8	5	1	1.00	6.0	272	2	84.00	4.444	18.90	13.333	0.158	3.000
		Total of Trench							110.00	6.072	18.10	16.583	0.151	2.731
		Total for Whole Section							548.00	63.135	8.95	91 108	0.172	1.446
		+ line holes							Powder taken at 0.5 lb. per stick					

Fig. 3—Details of Method of Drilling and Blasting in Typical (not exact average) Section

TABLE III.—ANALYSIS OF DRILLING TIME ON SECTION GY-EAST.

Position in Section	Nature of Rock.	No. of Drill Shifts observed for average.	Average Time Taken. Setting up.	Drilling.	Necessary delays.	Unnecessary delays.	Taking down machine.	Loading and firing.	Total drilling.	Mucking.	Total.	Feet Drilled. Per shift.	Per working hour.
			h.m.	h.m.	h.m.	h.m.	h.m.	h.m.	h.m.	h.m.	h.m.		
Heading	Quartz	7	0:38	4:52	1:40	....	0:05	0:04	7:19	2:41	10:00	22.0	2.86
Heading	Hard mica schist	1	0:15	8:00	1:45	....	....	....	10:00	....	10:00	42.0	4.20
Bench	Quartz	23	1:23	5:57	2:23	0:05	0:05	0:07	10:00	....	10:00	25.9	2.59
Bench	Med. mica schist	16	1:10	6:08	1:50	0:12	0:07	0:07	9:34	0:26	10:00	22.22	2.32
Center trench	Med. mica schist	10	0:58	5.53	1:33	0:06	0:12	0:30	9:12	0:48	10:00	22.0	2.39
Center trench	Soft mica schist	9	1:10	6:40	1:17	0:10	0:20	0:23	10:00	....	10:00	26.44	2.64
General average		67	1:08	5:58	1:53	0:07	0:09	0:12	9:27	0:33	10:00	24.1	2.54
Percentage		..	11.3	59.7	18.9	1.1	1.5	2	94.5	5.5	100	....	...

the drilling operations. These observations were not carried on for a long enough period to give correct results, but the percentages of time spent on each division of the operation are believed to be about right. The headings of this table are self-explanatory. The necessary delays include all time spent in changing bits, making air-line connections, etc. The unnecessary delays are stoppages caused by lack of supplies or insufficient air pressure.

By Table II it will be noticed that the cost of labor for drilling and sharpening steels was about $0.29 per lin. ft. of hole drilled. The total cost, including repairs, supply of air, etc., came to about $0.38, as will be seen from Table IV.

Timbering.—On the New York side nearly the whole length of the excavation needed timbering, to a greater or less extent, and for the most part required timbering of quite a heavy type.

Whenever any considerable support was needed for the ground, segmental timbering was used. In most cases, this was supported by wall-plates at the springing line, and was set with an allowance for settlement, so that it would be clear of the work when the masonry lining was put in. As the twin-tunnel section involved the excavation of the North and South Tunnels at the same time, the cross-section of the upper part of the excavation consisted of two quadrants rising from the springing line and connected at the top by a horizontal piece from 19 to 28 ft. in length. This made a rather flat arch to support by timbering.

The timber for the segmental work was 12 x12 in. yellow pine. In light ground the bents were spaced at 5-ft. centers, in heavy ground 2-ft. 6-in. centers.

When the soft ground in the roof was struck, posts had to be used in the heading to support the caps. When the bench was removed, the posts were replaced by others down to the bottom of the excavation. These long posts were a great hindrance to all the work, and each replacement of short posts by long ones meant a settlement of the caps; consequently, it was decided to use in the section cast of the cut-and-cover, where all the ground was heavy, a temporary inner bent of segmental timber, within and reinforcing the permanent bent, and resting on separate wall-plates. This is shown by Fig. 4. These temporary bents were inside the work, and were removed as the arch was built. However, the caps settled considerably in some cases, so that it was not possible to do away with posting entirely.

In heavy ground the caps were set about 1 ft. above the neat line of the crown of the brick arch, in some cases they were set only 6 in. above, but the settlement was often more than this, causing great trouble in cutting out the encroaching timber when the arch had to be built.

In the tunnels east of the cut-and-cover portion, wall-plate headings were driven (shown by areas marked *A* on Fig. 3), and, when a length of wall plate had been set, the full-width heading was advanced a foot or two at a time, the timber segmental bents being set up as soon as possible; lagging was then driven over the cap into the soft ground. Fig. 4 shows the double set of segmental bents adopted in the 15-ft. 4-in. twin tunnels east of the cut-and-cover section.

When the soft ground came down so low as to interfere with the excavation of the wall-plate headings, a small heading was driven into the soft ground on the line of the ends of the caps, and lagging was driven down from this to the wall-plate heading, as illustrated in Fig. 2.

In the 19-ft. 6-in. tunnels the wall plate for the inner bent was supported by a side-bench, termed the "Raker" bench. This was left in position until the rest of the bench and the middle subgrade conduit trench had been excavated; it was then possible to support the caps by two rows of posts from subgrade level, take out the inner bents, and excavate the raker bench.

The 24-ft. 6-in. twin tunnels, which are at the extreme eastern end of this section, adjoining the open-cut work of the Terminal Station, and under Tenth Ave., were driven from the Terminal Station West, and the timbering had to be made very secure on account of the pipes and sewers in the street above. Detailed records were kept of the amount of timber used and the cost of labor and material expended in timbering. These records cover the same portion of tunnel as that for which the detailed records of drilling costs, previously referred to, were kept. These records are shown in Tables V and VI. It will be noted that the timber used in blocking, that is filling up voids outside the main timbering, amounted to more than two-thirds of the total timber, and that the cost of labor in erecting the timbering exceeds the prime cost of the timber by about one-third. The following distinction is made between permanent and temporary timbering. The permanent timbering is that which is concreted in when the masonry is built; the temporary consists of the lower bents and posts, which have to be removed when the masonry is built.

A typical day's working force for drilling, blasting, mucking, and timbering is shown in Table VII. Where there was any large quantity of soft ground in the roof, the timber gang was much larger than shown in Table VII and was helped by the mucking gang. The drillers did most of the mucking out of their heading before setting up the drills.

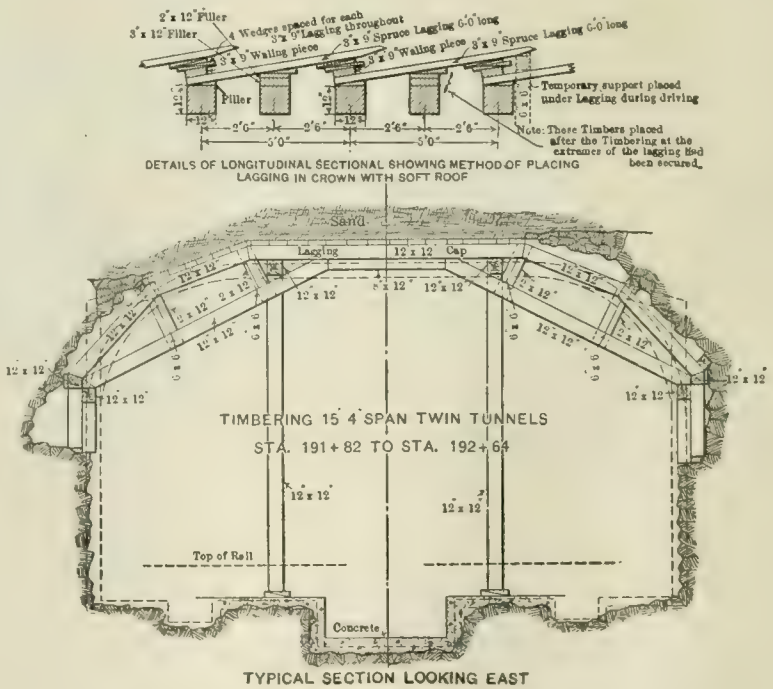

2"x 12" Filler
3"x 12" Filler
4 Wedges spaced for each 3'x 9' Lagging throughout
3"x 9" Waling piece
3"x 9" Spruce Lagging 6'-0" long
Filler
Temporary support placed under Lagging during driving
Note: These Timbers placed after the Timbering at the extremes of the lagging had been secured.
DETAILS OF LONGITUDINAL SECTIONAL SHOWING METHOD OF PLACING LAGGING IN CROWN WITH SOFT ROOF
Sand
Lagging
12 x 12 Cap
TIMBERING 15' 4" SPAN TWIN TUNNELS
STA. 191+82 TO STA. 192+64
Top of Rail
Concrete
TYPICAL SECTION LOOKING EAST

Fig. 4—Method of Timbering in Tunnel with Soft Roof.

Excavation of Weehawken Rock Tunnels.—This subject may be dismissed in a few words, as very few features of interest were called into play. The rock was of good quality, being the sandstone typical of this part of the country. Little or no timbering was needed, there were no buildings above the tunnel to be taken care of, and large charges of powder could be used.

Work was begun on Sept. 1, 1904, immediately on the completion of the work on the shaft. The North and South Tunnels in this case are completely independent. The procedure adopted was to drive a top heading on the center line of each tunnel and to break down the bench from this. The drilling was at first supplied with steam power from a temporary plant, as the contractor was at that time installing his permanent plant, which was finished at the end of November, 1904. At this time the rate of advance averaged 3½ lin. ft. of full section per day of 24 hours. By the

TABLE IV—ANALYZED COST OF DRILLING.

Items of Cost	Cost per ft. of Hole Drilled. 15 ft. 4 in.	19 ft. 6 in.	24 ft. 6 in.	Average	Cost per Drill Shift. 15 ft. 4 in.	19 ft. 6 in.	24 ft. 6 in.	Average.
Drilling labor	$0.25	$0.28	$0.31	$0.28	$6.95	$ 7.75	$ 7.60	$ 7.45
Sharpening	0.02	0.02	0.01	0.016	0.53	0.42	0.34	0.43
Drill steel (5 in. per drill shift)	0.007	0.007	0.006	0.007	0.19	0.20	0.15	0.19
Drill repairs	0.02	0.02	0.02	0.02	0.61	0.59	0.42	0.54
High pressure air	*0.05	0.04	0.07	0.07	1.39	1.86	1.67	1.82
Totals	$0.35	$0.38	$0.41	$0.385	$9.67	$10.82	$10.18	$10.43

*This is an estimated figure, ascertained by taking a proportion of the whole charge for plant running.

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TABLE V.—SUPPLEMENTARY ANALYSIS OF TIMBERING, ROCK TUNNEL EXCAVATION UNDER 32D STREET, EAST OF CUT-AND-COVER SECTION. ANALYZED COST OF TIMBERING, PER FOOT RUN AND PER BENT.

	Permanent Timbering. Lumber in feet, B.M.			Cost, in dollars.			Temporary Timbering. Lumber in feet, B. M.			Cost, in dollars.				Grand Total Lumber in feet, B. M	Cost, in dollars.		
Ke	Upper bent.	Blocking	Total.	Lumber.	Labor.	Total.	Lower bent.	Blocking	Total	Lumber.	Erection labor.	Removal labor.	Total. labor.	Total		Lumber	Labor.	Total.
Per foot of tunnel	274	294	568	23.75	37.50	61.25	479	193	672	29.13	28.85	8.29	37.14	66.27	1 240	52.88	74.64	127.52
Per bent, 2 ft. 6 in., center to center	685	735	1 420	59.38	93.75	153.13	11.97	483	16.80	72.81	72.13	20.73	92.86	165.67	3 100	132.19	186.61	318.80
Per cubic yard excavation	7.8	8.3	16.1	0.67	1.06	1.73	13.6	5.5	19.1	0.82	0.82	0.23	1.05	1.87	35.2	1.49	2.11	3.60
Ki																		
Per foot run of tunnel	227	164	391	16.81	12.82	29.63	186.33	42.80	229.13	9.65	10.38	9.74	29.12	29.77	6 20	26.49	32.94	59.43
Per bent, 3 ft. 6 in., center to center	830	601	1 431	61.56	46.88	108.44	681.25	156.50	837.75	35.31	37.97	34.09	72.06	107.37	22 69	96.87	118.94	215.81
Per cubic yard excavation	5.3	3.8	9.1	0.39	0.30	0.69	4.33	0.99	5.32	0.22	0.24	0.23	0.47	0.69	14.4	0.61	0.77	1.38
Ko																		
Per foot run of tunnel	261	408	669	28.00	29.79	57.79	350	61	411	18.45	20.83	12.16	32.99	51.44	1 080	46.45	62.78	109.23
Per bent, 3 ft. 8 in., center to center	962	1 508	24.70	103.38	110.00	213.38	1 291	227	1 518	68.16	76.92	44.59	121.51	189.67	3 988	171.54	231.50	403.04
Per cubic yard excavation	4.1	6.5	10.5	0.44	0.47	0.91	5.5	1.0	6.5	0.29	0.33	0.19	0.52	0.81	17.1	0.73	0.99	1.72

end of January the Weehawken rock tunnels were completely excavated, and by the middle of April, 1905, the excavation for the shield chambers was finished; the erection of the shields was started at the end of that month.

TABLE VII.

Grade.	Total No.	Rate per day.	Drilling and blasting: No.	Mucking: No.	Timbering: No.
Superintendent	1	$7.70	1	1	1
Assistant engineer	1	5.80	1	1	1
Electrician	1	3.50	1	1	1
Engineer	1	3.50	...	1	...
Signalman	1	2.00	...	1	...
Foreman	3	4.00	1	1	1
Driller	3	3.00	3	...	...
Driller's helper	5	2.00	5	...	...
Laborers	14	2.00	...	14	...
Timbermen	3	3.00	...	...	3
Timbermen helpers	4	2.00	...	...	4
Machinist	1	4.00	1	...	...
Blacksmith	2	3.50	2	...	...
Blacksmith helper	2	2.00	2	...	...
Nipper	2	2.00	2	...	...
Waterboy	1	2.00	1	...	...
Total	47	....	20 1/2	17 3/8	9 1/8

The general scheme of excavation is shown by Fig. 1. The bench was kept 50 or 60 ft. behind the face of the heading. The powder used was 60 per cent Forcite. The general system of drilling was as shown in Fig. 5. The average length of hole drilled per cubic yard of excavation was 2.9 ft., as against 7.70 ft. at Manhattan; and the amount of powder used was 1.96 lb. per cu. yd., as against 1.24 lb. at Manhattan. There was little timbering. A length of about 30 or 40 ft. adjoining the Weehawken shaft was timbered, and also a shattered seam of about 17 ft. in width between Stations 262 + 10 and 262 + 27.

The two entirely separate tunnels gave a cross-section which was much more easily timbered than the wide flat span at Manhattan,

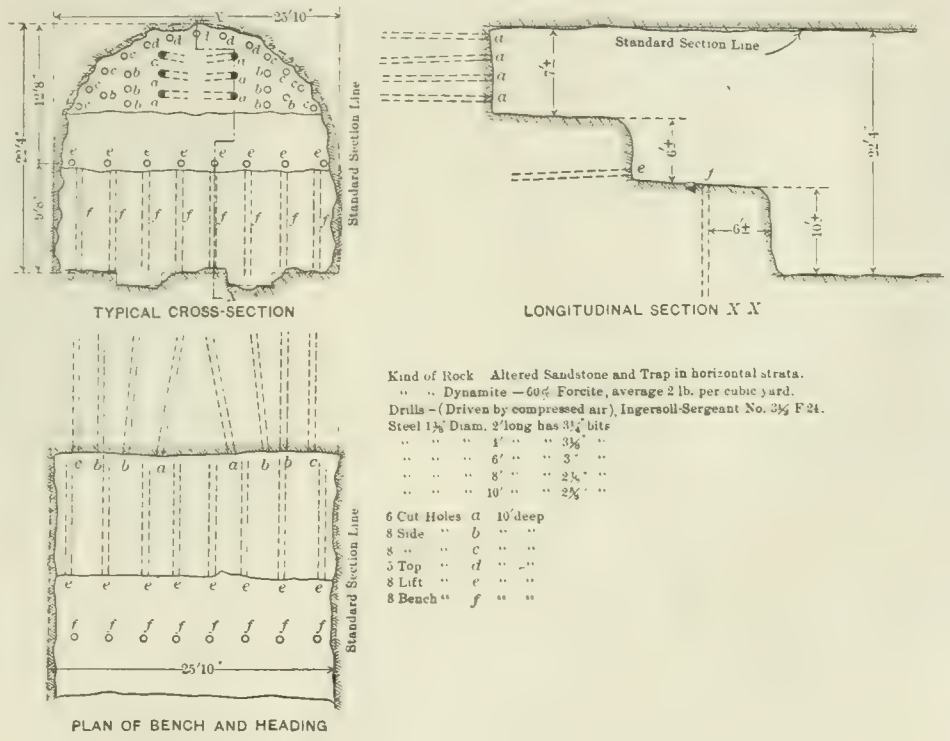

25'10"
Standard Section Line
TYPICAL CROSS-SECTION
Standard Section Line
LONGITUDINAL SECTION X X
PLAN OF BENCH AND HEADING
Kind of Rock Altered Sandstone and Trap in horizontal strata.
" " Dynamite—60% Forcite, average 2 lb. per cubic yard.
Drills—(Driven by compressed air), Ingersoll-Sergeant No. 3½ F24.
Steel 1⅝" Diam. 2' long has 3¼" bits
" " " 4' " " 3⅛" "
" " " 6' " " 3" "
" " " 8' " " 2¾" "
" " " 10' " " 2⅝" "
6 Cut Holes a 10' deep
8 Side " b " "
8 " " c " "
5 Top " d " "
8 Lift " e " "
8 Bench " f " "

Fig. 5—Typical Method of Drilling in Wehawken Land Tunnels.

TABLE VI.—TIMBERING: DETAILED COST OF TIMBER, LABOR AND SUPERINTENDENCE. ROCK TUNNEL EXCAVATION UNDER 32D STREET, EAST OF CUT-AND-COVER SECTION.

		Timber used, in feet, B. M.			Excavation in cubic yards.		Cost of timber.			Cost of labor.	Total cost.	Cost per cubic yard (actual).			Cost per cubic yard (paid for).			Cost, per 1,000 ft., B. M., of total timber.		
	Date.	Main timber	Blocking timber.	Total timber.	Actual.	Paid for.	Main.	Block.	Total			Timber.	Labor.	Total.	Timber.	Labor.	Total.	Total timber.	Labor	Total.
	1907	a	b	c	d	e	f	g	h	i	j	h	i	j	e	e	e	c	c	c
Ke	May	18,016	15,234	33,250	1,736	1,664	$ 810	$ 565	$1,375	$ 1,792	$ 3,167	$0.79	$1.03	$1.82	$0.82	$1.07	$1.90	$41.35	$53.89	$ 95.24
	June	14,048	11,528	25,576	809	698	630	457	1,087	1,576	2,663	1.34	1.95	3.29	1.55	2.25	3.81	42.50	61.62	104.12
	July	20,092	7,339	27,431	1,022	960	900	300	1,200	1,580	2,780	1.16	1.55	2.72	1.25	1.64	2.89	43.74	57.60	101.34
	August	6,485	2,632	9,117	743	716	290	110	400	300	700	0.53	0.40	0.94	0.57	0.41	0.98	43.87	32.90	76.77
	September	1,632	2,224	3,856	238	238	73	94	167	60	227	0.70	0.25	0.95	0.70	0.25	0.95	43.31	15.56	58.87
	Removal	.....	.....	.....	.....	.....	.....	.....	.....	663	663	...	....	..	....	....	....	.....	.....	.....
	Total	60,273	38,957	99,230	4,548	4,276	$2,703	$1,526	$4,229	$ 5,971	$10,200	$0.91	$1.51	$2.22	$1.00	$1.40	$2.40	$42.62	$60.19	$102.81
Ki	May	.....	3,537	3,537	614	527	.....	$ 150	$ 150	$ 100	$ 250	$0.24	$0.16	$0.40	$0.28	$0.19	$0.47	$42.41	$28.27	$70.68
	June	300	.....	300	357	259	$ 14	.....	14	44	58	0.04	0.12	0.16	0.05	0.17	0.22	46.66	146.33	193.33
	July	7,776	5,811	13,587	530	404	350	233	583	525	7,108	1.10	0.99	2.09	1.44	1.30	2.74	42.91	38.64	81.54
	August	19,712	5,702	25,414	925	890	887	220	1,107	1,018	2,125	1.20	1.10	2.30	1.24	1.14	2.38	43.56	40.06	83.61
	September	20,556	9,218	29,774	1,585	1,501	925	325	1,250	1,028	2,278	0.79	0.65	1.44	0.83	0.68	1.51	41.98	34.53	76.51
	Removal	.....	.....	.....	1,669	1,407	.....	.....	.....	1,139	1,139	....	0.68	0.68	....	0.81	0.81	.....	.....	.....
	Total	48,344	24,268	72,612	5,680	4,988	$2,176	$ 928	$3,104	$ 3,854	$ 6,958	$0.55	$0.68	$1.23	$0.63	$0.77	$1.40	$42.75	$53.09	$95.84
Ko	May	4,332	8,788	13,120	250	188	$ 175	$ 366	$ 561	$ 303	$ 864	$2.24	$1.21	$3.45	$3.00	$1.61	$4.61	$42.76	$23.10	$ 65.86
	June	7,132	10,017	17,149	496	347	324	396	720	562	1,282	1.45	1.13	2.58	2.07	1.61	3.68	41.98	32.77	74.75
	July	3,070	200	3,270	626	606	134	10	144	156	300	0.23	0.25	0.48	0.23	0.26	0.49	44.04	47.70	91.74
	August	10,704	2,102	12,806	718	709	481	80	561	727	1,288	0.78	1.01	1.79	0.80	1.02	1.82	43.80	56.77	100.57
	September	2,400	245	2,645	396	324	108	8	116	400	516	0.29	1.01	1.30	0.36	1.23	1.59	43.85	151.23	195.08
	Removal	.....	.....	.....	209	211	.....	.....	.....	535	535	....	2.56	2.56	....	2.54	2.54	.....	.....	.....
	Total	27,638	21,352	48,990	2,695	2,385	$1,242	$ 860	$2,102	$ 2,683	$ 4,785	$0.78	$1.00	$1.78	$0.88	$1.12	$2.00	$42.91	$54.75	$97.65
	Grand total	136,255	84,577	220,832	12,923	11,649	$6,121	$3,314	$9,435	$12,508	$21,943	$0.73	$0.97	$1.70	$0.81	$1.07	$1.88	$42.73	$56.65	$99.38

and the segmental timbering was amply strong without posts or other reinforcement.

Table VIII is a summary of the cost of excavating the Land Tunnels, based on actual records carefully kept throughout the work.

TABLE VIII. — COST OF EXCAVATION OF LAND TUNNELS, IN DOLLARS PER CUBIC YARD.

	Manhattan	Weehawken.	Total yardage and av. cost.
Cubic yards excavated	43,289	8,311	51,600
Labor			
Surface transport	$0.49	$0.87	$0.55
Drilling and blasting	2.37	1.55	2.24
Mucking	2.49	2.08	2.42
Timbering	0.87	0.18	0.76
Total labor	$6.22	$4.68	$5.97
Material:			
Drilling	$0.15	$0.15	$0.15
Blasting	0.21	0.21	0.21
Timber	0.39	0.20	0.36
Total material	$0.75	$0.56	$0.72
Plant running	$0.76	$0.65	$0.74
Surface labor, repairs and maintenance	0.15	0.08	0.14
Field office administration	1.05	1.18	1.07
Total field charges	$8.96	$7.15	$8.64
Chief office administration	$0.34	$0.38	$0.34
Plant depreciation	0.66	1.01	0.72
Street and building repairs	0.27	...	0.23
Total average cost per cubic yard	$10.23	$8.54	$9.93

Colon Breakwaters.—After June 30, 1910, appropriations will be available for beginning construction on the $11,543,600 breakwaters to be constructed at Colon, Panama Canal Zone. Work has already been begun on the service buildings that will be required for the work. There will be two breakwaters. The west breakwater, extending from Toro Point at an angle of 42° 53′ from Colon light, will be constructed first. It will be about 10,500 ft. in length, with a width at the top of 15 ft., and a height above mean sea level of 10 ft. The width at the bottom will depend largely on the depth of water. The survey of the bottom of the bay along the line of the breakwater showed the greatest depth to be about 43 ft., and at this point the embankment will approximate 180 ft. in width. The east breakwater will be an isolated structure located at an interior angle of about 135° to the west breakwater, and will be about 5,700 ft. in length, with the other dimensions practically the same as those of the west breakwater. The amount of fill estimated required in the construction of the breakwaters is 4,915,000 cu. yds., about one-half of which will be material excavated on the Point for the core of the west breakwater, and the balance Porto Bello rock. The east breakwater will require about one-half as much material as the west breakwater, but the cost of construction will be relatively larger, because the fill will probably have to be made entirely by barges and scows. The construction of the inner end of west breakwater will proceed by driving piling for trestle on which a track will be laid and trainloads of material hauled out on it and dumped. The shore end will be built entirely of Toro Point rock, in order to observe the effect of wave action. The width of the ship channel between the ends of the two breakwaters will be 2,000 ft., measured at right angles to the center line of the Canal prism. The total cost of both breakwaters is estimated at $11,543,600.

On Sept. 30, 1909, there were under construction in Virginia 295.9 miles of roads built, or to be built, by state money aid or convict labor, at a cost of $352,720.40, including work in thirty-six different counties. Of this mileage of road, 187.42 miles are of macadam, costing $292,713.63; 55.8 miles are of gravel, costing $32,161.63; 52.6 miles are of sand clay, costing $27,845.12.

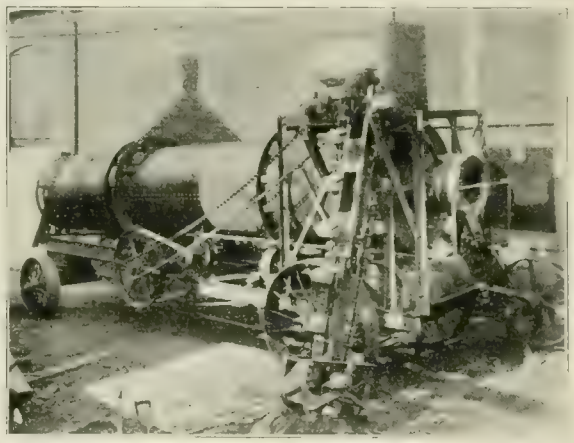
Roads and Streets Section

Note: This section is devoted to methods and costs of road and street construction. It will cover road building in all its details, the construction of pavements, sidewalks and gutters, the testing and use of paving materials and the machinery and tools used in road building and paving.

A Portable Dryer for Heating Binder Stone.

In the construction of macadam roads to resist the action of heavy motor traffic by incorporating some stable, tough and elastic binder in the wearing surface, it is important that the stone should be quite dry in order that it may be thoroughly coated with the binder. It has been found almost impossible to make a bituminous material adhere to a stone that is full of moisture. The heating of the stone has the further advantage, especially in the mixing method of construction, that the mass may be much more thoroughly and easily mixed and handled.

The accompanying illustration shows a portable dryer and heater which has been designed for the heating of binder stone and sand for mixing with asphaltic binder to make top dressing for macadam or asphalt road. The machine was designed to heat the binder rock and sand to a temperature of 350°, so that it will be absolutely dry and when mixed with the asphalt will form a perfect bituminous concrete.



Portable Dryer for Binder Stone for Road Work.

The dryer is of the Ruggles-Coles type "A" double shell. The shell is made of 5-16-in. steel upon which is riveted two rolled steel tires and girth gear. The tires rest upon chilled ground bearing wheels and are supported on a rigid structural steel framework mounted on heavy wheels, 54-in. diameter, 10 in. face at the rear and 36-in. diameter and 8-in. face at the front. Mounted at the feed end is an elevator for feeding the stone or sand to the dryer; this elevator may be telescoped out of the way when it is desired to move the machine.

The fuel is fuel oil contained in a tank having a capacity for 10 hours' supply. The Rockwell type of burner is used, elevating the oil and burning it by compressed air. The oil is burned in the central flue, and the products of combustion pass to the delivery end through this central flue and back through the material and are carried out by an exhaust fan. At the delivery end, if desired, is bolted a double screen which will screen the material into three grades and deliver them into separate bins which are not shown in the photograph.

A test of this dryer and heater on April 15 at York, Pa., is stated to have shown the following results:

Crushed limestone carrying 2½ per cent of moisture was fed to the heater as fast as two men could shovel into the elevator. This was dried, heated and screened at the rate of 10.9 tons per hour and was delivered at a temperature of 450°. As the stone was measured before being fed a greater amount could not be handled than the quantity above stated. But in order to reach the capacity of the machine, a wet sand carrying 5½ per cent of moisture was afterwards fed to it with three men shoveling at the rate of approximately 13 tons per hour and was delivered and screened at a uniform temperature of 350°. The fuel consumption was 1.1 gallons of oil per ton of dried and heated stone, and approximately 1.8 gallons per ton of sand.

This machine weighs approximately 20,000 lbs. and is to be moved by means of a traction engine, which will also deliver the power for driving it. An independent oil engine can be supported on the framework for driving, if desired. The machine is made by the Ruggles-Coles Engineering Co., 51 Church St., New York City.

Methods of Constructing Bituminous Macadam Roads to Resist the Destructive Action of Heavy Motor Traffic.

At the First International Road Congress in 1908 the idea was brought out that in the construction of new and the resurfacing of old macadam roads which were to carry heavy motor traffic the binder should be incorporated in at least 2 ins. of the upper surface of the road. Experiments were conducted to develop this idea and the methods of construction thus developed may be divided into three classes: (1) The penetration method: where the binder is poured in from the surface, thus saturating a prepared top coating of stone; (2) the mixing method: where the binder is first mixed with the surface stone and rolled into place; (3) the prepared surface: where the surfacing is prepared at central points in large quantities, and delivered to the roadside ready to be spread and rolled into place. In a paper on the destructive action of motor traffic on roads read before the Engineers' Club of Philadelphia and printed in the Proceedings of the club, Mr. W. H. Fulweiler describes these three methods of construction and points out what in his opinion are their advantages and disadvantages. The matter that follows has been taken from Mr. Fulweiler's paper. This consists in first preparing a well compacted top layer of stone smaller than 1½ ins., and filling the voids by pouring in the hot fluid binder. In order that suc-

cessful results may be obtained, a number of points must be observed:

In resurfacing an existing road, the old surface should be picked up with a scarifier, brought to the proper cross-section and rolled. With new work, the foundation or lower course of the larger stone should be filled or sealed with some form of binder, either screening, sand, gravel or a mixture of these with loam. This is used to prevent the bituminous binder for the upper course running down into the foundation, where it would be of no use.

The stone for the upper layer is then spread to a depth that will give a finished depth of at least 2 ins., and, better, 2½ ins.

This stone should, if possible, be graded slightly, that is, sizes should be from 1½ ins. to ¾ in. As the rolling is started, a small quantity of ¾-in. stone should be spread evenly ahead of the roller so that the whole layer may be thoroughly keyed up from the bottom, and the larger surface voids filled with ¾-in. stone. The quantity of ¾-in. stone used will run from 15 to 20 per cent. The rolling should continue until a firm, compact surface is obtained, free from waves, but should not be carried on after the edges of the larger stones (particularly with limestone) begin to round off. When this layer is properly rolled and thoroughly dry, the binder may be applied.

The uniform distribution of the binder and its temperature are quite as important as the preparation of the stone. In order that the binder shall properly coat all the stone and fill the smaller voids, thus giving a well-bound aggregate, it is very important that its consistency at the time of its application should bear a proper relation to the temperature of the stone.

If the binder is applied too cool, it chills on the surface and does not flow freely into the smaller voids, and thus coat the lower stone, and an excess will have to be used to even cover the surface.

If, on the other hand, it is too fluid, it runs directly through the upper course of stone without leaving a coating of the proper thickness, and collects in pools on the binder of the lower course, where it rises in places to the surface, forming soft spots in summer. There is also a tendency to apply an insufficient quantity, owing to the ease with which it flows over the surface stone.

The subconscious effect of the fluidity on the man who is applying the compound is very interesting, as the amount applied per square yard can be varied quite widely by changing the temperature without the laborer being aware of it.

That the compound should be applied uniformly is, of course, self-evident, and there are a number of schemes for doing this. The earliest was the use of ordinary coal-scuttles, the flat lip delivering a fairly even ribbon of binder on the road. Garden sprinklers with either a specially punched rose or a thin, vertical, fan-shaped nozzle have been used on small stretches quite successfully. Light skeleton frames enclosing 1 or 2 sq. yds. of surface have been used as a guide to determine the proper amount to be applied.

On larger areas iron tank wagons are usually employed to heat the binder, and it is applied through a hose with a flat fan-shaped nozzle. This method has been improved recently by applying pressure from small cylinders of highly compressed air and the use of a spraying nozzle.

Several forms of mechanical distributing devices have been recently developed, which seem to do very efficient work. Their claim for recognition so far, according to Mr. Fulweiler, has been based more on rapidity than on uniformity of result, for the reason that the stone surface is not entirely uniform, and a skilful workman can apply just the correct amount at each point; while, on the other hand, the machine moves so rapidly that it is more difficult to quickly change its rate of delivery to suit varying conditions.

It will generally be found that the rate of progress with this method is dependent more upon the facilities for heating the binder to the proper temperature and delivering it to the work than upon the method of applying it. The time saved by rapid spraying is frequently lost by waiting for hot material, or in driving back and forth from the tank car or other source of supply, as an iron tank wagon holding 400 or 500 gals. is no mean haul. The great weight of a full tank wagon, even with wide tires, frequently causes ruts in the stone that are very difficult to roll out, and sometimes show in the finished surface.

The quantity of binder per unit of area varies quite widely with the depth, quality, and preparation of the stone and the skill and method of application. For a 2½-in. top layer it will require not less than 1.5 gal per square yard, and may run as high as 3 gals.; but from 1.5 to 1.75 gal. should, if properly applied, give a well-bound aggregate.

As soon as the binder has been applied, clean ½-in. stone should be spread evenly in sufficient quantity to just cover the surface without an excess, and the surface should be rolled.

A flush coat of very hot binder is then applied to seal off the surface interstices of the ½-in. stone and thoroughly cover it. This should require from ⅜ to ¾ gal. per square yard, depending principally upon the manner in which it is applied. It is essential, however, that the surface should be completely and thoroughly covered. About ¼-in. of fine stone screenings are applied over the flush coat to give a finish to the road, and protect the surface while the binder is setting up.

Under favorable conditions and proper workmanship this method yields very good results, but it is exceedingly important that every little detail be carefully watched.

Improper preparation of the lower or foundation course, lack of care in securing a dense and compact upper course, presence of excessive dust or moisture in the upper course, cold, damp weather, uneven distribution or the use of a binder not adapted to the conditions, and careless application of the flush coat, are all points which if overlooked or neglected will cause unsatisfactory results.

The fact that no special appliances beyond the heating tank are required and that the labor cost is low, brings this method within reach of the ordinary road contractor.

Methods of using non-bituminous binders.—There are two non-bituminous binders that are used in a manner somewhat similar to the penetration method. They are "Glutrin" and "Rocmac."

Glutrin is prepared from the waste liquor from sulphite process of making wood-pulp. It is a dark brown liquid of about 30° Beaumé, and is said to be a complex organic salt of calcium.

This is diluted with water and sprinkled on the road from an ordinary sprinkling cart, so that it is extremely easy of application. On drying, it yields a very hard and compact surface that is quite free from dust, and that seems to resist ordinary traffic very well. The length of time that it remains effective depends somewhat on the rainfall (as it is soluble in water) and on the traffic, but on roads not subjected to heavy motor traffic, it will apparently last through a season.

The other material is known as "Rocmac," and is said to be a compound having sodium silicate as a base, and sugar, mixed with powdered calcium carbonate, a pure form of limestone.

This mixture is applied to the depth of about an inch over the old surface, and the stone for the top course spread over it. The surface is rolled until the binder has filled the voids and rises on the surface. It is then swept evenly over the road, and a thin coating of limestone dust is sprinkled over it to protect it while setting up, which requires from two to six days. The compound combines chemically with the limestone, forming a cement, which serves to bind the wearing surface into a compact mass.

The Mixing Method.—In order to secure more complete control over the distribution of the binder, and a more compact stone mixture in the wearing surface, considerable attention has been devoted to the mixing method of construction.

This is but a development of the earlier form of tar macadam that has been used with varying degrees of success during the past 50 years. With the increase in our knowledge of the properties of binders and their preparation, and the proper working conditions for their use, which has resulted from the experimental work done both here and abroad during the past ten years, this form of construction has been brought very much to the fore. Already two State road authorities, Rhode Island and New Jersey, have decided to use it exclusively.

With this method the foundation course need not be filled, as in the penetration method, but it should be thoroughly compacted. In resurfacing old work—after the surface has been brought to crown, some form of bond should be provided between the old and new work. This is best secured by rolling in an even one-stone layer of 2½-in. stone.

A light sprinkling of tar oil is of considerable advantage before spreading the top course, as it penetrates the dust on the surface of the binding stone and secures a better adhesion of the tarred aggregate.

The important points in the preparation of the wearing surface are the grading and quality of the stone, the quantity and quality of the binder, and the method of combining them.

In general, the better qualities of trap and granite still retain their advantages when used in this method, but many rocks that would weather badly or be too brittle in the ordinary water-bound macadam, may prove very useful when incorporated with a bituminous binder, as the stone is protected from the atmospheric agencies to a considerable extent, is held more firmly in position, and is subjected less to internal attrition.

In the earlier form of tar macadam but little attention was paid to securing a compact mixture. Several courses of uniform sizes of stone were used, the finer at the surface. As the method was developed, the necessity for more careful and uniform grading of the mixture became apparent, and it has been found more desirable to have a reasonably large proportion of the larger size stone in the surface, with sufficient smaller particles to properly fill the voids and interlock and support the larger sizes.

The stone mixtures in use vary quite widely from the more or less complicated grading used in the Warren Bros. "Bitulithic" (where an attempt is made to reduce the voids in the stone mixture to a minimum by careful grading and the use of "dust" or "filler") to the rather more open mixture which is used by the Rhode Island Commissioners, and contains nothing smaller than ½-in. stone.

It is possible that the mixture with the minimum voids secured by the use of "filler" may be theoretically stronger, yet very satisfactory results may be secured with mixtures whose voids will run very much higher. The more open mixtures give very much less trouble in mixing, as the finer dust and stone particles have a tendency to collect the binder and roll into balls, so that the larger stone size does not secure a proper proportion of the binder. This is not so noticeable when using heated stone as when the stone is mixed cold. Various schemes have been proposed to obviate this difficulty, one being to mix the larger stone with a slight excess of binder, and then add the finer stone particles and dust.

Owing to the fact that the whole process is under complete control, the binder may be considerably heavier and stronger than that used in the penetration system. It is thus possible to use a semifluid binder, if desired, and to secure the maximum strength possible in the finished surface. Due regard must be paid to the behavior of the binder when exposed to low temperatures, as it is important that it should always remain elastic and show no tendency to become brittle and thus powder under the traffic. When the stone has been properly graded, the binder may become quite soft under summer temperatures without the surface yielding to any noticeable extent.

The quantity of binder varies with the grading of the stone. In very dense stone mixtures, owing to the larger percentage of the smaller sizes and the greater surface they expose per unit of weight, an additional amount of binder would be required, but to some extent this is reduced by the smaller

percentage of voids in these mixtures that have to be filled.

The percentage by weight will run from 5 to 6 per cent, to 8 or 10 per cent, the latter being used in mixtures containing a large proportion of fine screenings, sand, and dust. The average percentage for the usual mixture is about 6, so that a cubic yard of stone would require about 170 lbs. of binder.

It is exceedingly important that the stone should be quite dry in order that it may be thoroughly coated with the binder, but in summer weather it is not essential that it should be heated unless there is a considerable percentage of fine stone or dust in the mixture.

While heating the stone is both troublesome and expensive, yet the mass may be much more thoroughly and easily mixed and handled, trouble from damp stone is avoided, and better results may in general be expected when this is done. In cold weather it is, of course, quite essential.

The stone should be heated until it is thoroughly dry, about 200° to 225° F. being sufficient, while the binder should be heated to some point dependent upon its nature that will render it quite fluid, usually from 250° to 300° being sufficient.

The mixing may be done on movable wooden platforms, as in concrete work, or in some form of mechanical mixer. The blade type of trough mixer seems to give the best results, as its action is more nearly like that of the usual form of mixer used in the asphalt plants.

Usually two turns on the mixing board by hand will give a good coating. It is better to add half of the binder to the stone; turn once then add the remainder and turn again.

The mixed aggregate should be placed on the road as soon as possible, as it may then be handled with greater ease and there is less tendency for the binder to collect in the lower layers. If it must be hauled to any distance from the mixer, the pile as dumped from the cart should be carefully turned over before being placed, as there is a tendency for the stone to segregate in sizes and the binder to collect at the bottom. Bottom dump carts are particularly likely to leave the mixture in this condition.

In leveling the aggregate care should be taken not to bring an excess of the larger sizes of the stone to the top, as it is almost impossible to get them down again, thus leaving the surface rough and full of large voids.

As soon as the surface has cooled so that the roller may be used, a light rolling is given to insure a smooth surface. After several hours, when the body has cooled so that it will not slip, a thorough rolling is given until the surface is as compact and smooth as possible. At least a 10-ton roller should be used for the final finish, and a 15-ton would be preferable. A flush coat of very hot binder is then applied, as in the penetration method, to seal off the surface voids. About 0.5 to 0.7 gallon per square yard is required. This is followed by a light coat of hard, clean stone screenings and a final rolling. The screenings give a finish and tooth to the surface, which would otherwise tend to be "slick," especially in frosty weather.

The rate of progress by this method is necessarily much slower than with the penetration method, and the labor cost correspondingly much higher. Six mixers and two tar men, if kept supplied with materials, should mix and lay about 300 sq. yds. of 2½-in. top dressing per day. This rate of progress will require favorable conditions. With machine mixing and proper facilities this should be doubled.

Another form of construction is that known as the "Petrolithic" or "Imperial." With this method the old road surface is plowed up, harrowed, and thoroughly pulverized, and a heavy grade of asphaltic base oil is applied and thoroughly worked into the soil. The surface is then compacted by means of a rolling tamper. A layer of crushed stone is then put on the road and another coating of oil is supplied. A rolling tamper is then put on again until the surface is compacted, and final smoothing is generally given with an ordinary steam-roller.

Prepared Top Surfacing.—In order to obviate the difficulties in securing a properly graded and uniformly mixed aggregate for this form of construction, and the other attendant difficulties of preparing a uniform product at the roadside, a number of preparations have been brought out which are ready to spread on the road and roll into place.

Probably the first was "Tarmac." This is an English preparation made of graded slag, which is mixed hot with coal-tar and seasoned for some time before being used. "Tarfaat" is a similar mixture prepared of smaller sizes for surfacing only. "Tarlithic" resembles "Tarmac," but the aggregate is made of stone. "Quarrite" is tarred stone of uniform size. These are delivered in the different sizes and mixed on the road, the argument being that with stone of uniform size there are relatively fewer points of contact than in the graded mixtures, so that the aggregate can be more easily handled and a tougher binder employed.

In this country "Amiesite" has been used to some extent. This is a graded stone mixture and an asphaltic base oil, treated by a patented process with lime and sand. This material is supplied in two sizes, a larger size for the body of the road and a finer size for the surface. It has given very promising results. "Filbertine," an asphalt-stone mixture, is another preparation that has been recently put on the market.

The Wadsworth macadam is a prepared natural bituminous rock or sand. This material is spread on the 1½-in. stone and rolled into the interstices, thus compacting the whole layer and forming a smooth surface. At any distance from the mines the freight charges make it rather expensive, and it only works well under certain temperature conditions, and, like all natural products, the percentage of bitumen and the grading of the sand particles vary considerably.

The grading of the sand, moreover, is not very satisfactory, according to the present standards that have been evolved in the asphalt paving industry. It has given very satisfactory results, however, in some instances.

The principal labor cost in using these prepared materials is the handling from the car, as they have a tendency, especially in cold weather, to pack quite solidly, requiring both time and patience for their removal. Considerably more rolling is also required to compact them than in the other methods, as they yield quite slowly and must be rolled very hard to secure the best results.

The principal disadvantage so far in the use of these prepared materials is their high cost, which is due both to the high cost at the point of shipment and the necessity of paying freight on a long haul of the stone, which might otherwise be obtained locally.

Another point is the fact that, as in the penetration method, the quality of the binder must be sacrificed to some extent to enable the material to be handled and compacted for some time after its manufacture, and yet harden to such a point when in place that it shall acquire a proper strength to perform its function of resisting the action of the traffic.

When these points have been satisfactorily solved, the method seems to be an ideal one.

Mr. Fulweiler summarizes the relative advantages and disadvantages of these methods as follows:

Penetration System: Its disadvantages are:

1. The care necessary to secure a properly prepared upper course of stone.
2. The difficulty in obtaining uniform distribution of the binder through the wearing surface.
3. The necessity for using an excess of binder.
4. That the quality of binder must be sacrificed to some extent to the requirement of the method.
5. And that in cold or damp weather this method cannot be successfully used.

Its advantages are:

1. Low labor cost.
2. Quickness and ease of application.
3. No expensive apparatus required.

Mixing Method.—The disadvantages are:

1. High labor cost.
2. Slowness of application and trouble required in mixing.
3. More apparatus required.

Its advantages are:

1. Complete control over the distribution of the binder and resulting uniformity of the mixture.
2. Ability to use a more suitable quality of binder, and to effect a considerable saving in the quantity required.

Prepared Surfacing.—Its disadvantages are:

1. Very high first cost.
2. Trouble in handling during cool weather.
3. Quality of binder that must be employed.

Its advantages are:

1. Ease of application.
2. Uniformity of mixture.
3. No apparatus required.
4. Freedom for weather restrictions.

An Economical Outfit for Drilling Holes in Concrete.

A considerable amount of money has been spent in drilling holes in concrete. Occasions are bound to arise after concrete is in, which make drilling and cutting necessary. The Chicago & Northwestern Ry. Co. has several home-made outfits with which it is accomplishing its drilling by the use of air. At all stations where the track elevation is completed on the line through Evanston, Ill., an iron fence is being placed along the top of the retaining walls. Holes have to be drilled for the fence posts. The holes required are 1 in. in diameter and 9 ins. deep.

The plant is mounted on a flat car. Steam is furnished by a small traction engine of about 10 hp. capacity. The body of a locomotive tender is also placed on the car for coal and water supply. Two 8-in. Westinghouse air pumps, of the type used on locomotives, supply the air through two air drums each of about 15 cu. ft. capacity, connected in compound. Two pneumatic hammers are kept at work with this outfit. The air is kept at about 65 lbs. pressure. The hammers are arranged with a sort of chuck which contains the head of the drill which is about 18 ins. long. For twisting the drill while the hammer is working, the operator uses a wrench and twists it back and forth in a semi-circle. No water is used in the hole and the dust is blown out every minute or so by the use of the exhaust on the hammer.

It takes one man to run the outfit and two men drilling. A foreman on the job looks after this work and also looks after the gang which sets up the fence after the holes are drilled. Each hammer drills about 100 holes in 10 hours.

A Master of Chancery's sale was held at Elizabeth, N. J., on May 5, to sell the New Jersey Short Line Ry., extending from Elizabeth, N. J., to Milltown, connecting in the latter place with the "Fast Line." The "Fast Line," if constructed, will give an air line from Elizabeth to Trenton, crossing the Raritan River near Martin's dock. It is reported the Public Service Railway wants to get this right of way and then make a connection by means of the Camden & Trenton line to Camden. The Pennsylvania R. R. Co. also is reported to be eager to get this property.

The Baltimore & Ohio R. R., A. W. Thompson, chief engineer, Baltimore, Md., is planning extensive improvements in Baltimore and vicinity which will involve an expenditure of about $5,000,000. The railroad will tear down the Camden station and erect a new one for passenger purposes only, at the southeast corner of Howard and Camden Sts. When the present station is razed it is proposed to build a double track elevated road to the open country beyond Gwynn's Falls. This will eliminate all grades for the passenger business and trains can be operated at a high speed. The site of the present Camden station is to be made a freight yard, with the Camden warehouses as the storage points.

Water-works and Sewer Section

Note: This section is devoted to methods and costs of constructing sewers and water-works. It will cover the construction work for all details of water supply and sewerage, including sewage purification and water filtration.

Experience with and Results from Municipal Water Softening.*

Municipal water softening is still in its infancy. Early experiences in municipal water softening in America were not satisfactory, but through no fault of the principles involved.

The theory of water softening is not new. The theory of the softening of waters containing a temporary hardness, due to calcium and magnesium carbonates held in solution, by the presence of free carbon dioxide, was enunciated by Dr. Clarke, of England, some fifty years ago. The treatment of such waters consists of the addition of lime water or milk of lime, applied in carefully regulated quantities. The resultant reaction is the immediate union of the added lime and the free carbon dioxide, causing the precipitation of calcium and magnesium carbonates.

Waters possessing permanent hardness, as well as those which are contaminated by mine or factory refuse imparting to the water metallic salts and free sulphuric acid in solution, cannot be thoroughly treated with lime alone. This hardness can be most economically counteracted by the use of lime and soda carbonate. This principal is familiarly known as the Porter-Clarke method, and although it was suggested over fifty years ago, no other process has been invented to supplant it during all these years. There are a number of different water softening systems on the market at the present time. The principal advantage of one system over another is simply one of economies in the distribution and use of chemicals and the removal of waste products of the process.

So far in this country water softening has been employed in municipal plants only when, to use the vernacular, the cities employing it have been "up against it." This was notably the case in Winnipeg, Canada; Oberlin, Ohio; McKeesport, Pa.; and Columbus, Ohio. Perhaps no city has ever been in greater need of nor has had a harder problem of water softening than the city of McKeesport, and the author was fortunate enough to be retained to devise a plan for its solution. For at least six months of each year the water of McKeesport was fit neither for man nor beast, nor for any commercial purposes whatsoever, save, perhaps, for street sprinkling. So bad was the water supply at McKeesport that it was characterized in the United States Geological Reports as the worst water in the country. It was so bad that, notwithstanding confirmatory reports upon the plans proposed from persons qualified to judge as to the probable outcome of the treatment, money for the construction of the plan was appropriated reluctantly by the governing bodies. In fact, each time that the Board of water commissioners applied to councils for an appropriation to carry on the work of construction, it was the signal for a tirade of abuse on the part of some members of councils against the throwing away of the people's good money for something that was sure to prove an absolute failure. By emulating the motto, "Keeping everlastingly at it brings success," we succeeded in completing the plant in record time under the greatest handicaps. So convinced was the author that the plant would handle the water satisfactorily even in its worst condition, that it was put into commission before its full completion. This was done because the river water was more highly acid at this time than at any previous time, and a test of the plant under such conditions was highly desirable.

The conditions existing during the first three months of the trying out period, viz: October, November and December, 1908, have not been duplicated since. During this period, also the water consumption in the city was so great, due to imperfect plumbing fixtures, which had been eaten out by the action of sulphuric acid contained in the untreated water, and to faucets left open in the vain hope that the quality of the water would thus be improved, that the plan was called upon to treat practically the full quantity which the plant was designed ultimately to treat.

The high acidity in the McKeesport water is due to the large amount of mine water discharged into the tributary creeks of the Youghiogheny River, and to the spent acids from the galvanizing works along the shores of the Youghiogheny. The washings from the coke beds is another contributary cause. Furthermore, the difficulties of treating the Youghiogheny River water have been increased during the last few years by the abstraction from the watershed of practically the entire flow of the Indian Creek, one of the main feeders of the Youghiogheny, and the transporting of this water for the benefit of the Pennsylvania Railroad into an entirely different watershed. The Indian Creek was one of the most permanent streams in the watershed, and the water from this stream went a long way toward counteracting the effect of the impurities in the river.

The acidity in the water for a number of years previous to the operation of the plant was as follows:

Year.	Average acidity. Parts per million.	Maximum acidity. Parts per million.
1901	43.0	125.0
1902	42.1	200.0
1903	34.5	140.0
1904	50.6	170.0
1905	32.1	80
1906	28.0	120
1907	43.4	133
1908 October to December	156.0	240
1909	33.0	210

The variable character of the water to be treated is indicated by the fact that the water has jumped from a hardness of 110 at 4 o'clock in the morning to a hardness of 510 four or five hours later, and from an acidity of 30 up to an acidity of 210 during the same period. To produce a uniform product from the plant under such conditions requires the greatest care and watchfulness on the part of the employes of the plant. A reasonably uniform product has been obtained.

The McKeesport plant was fully described by the author in a paper read before the Engineer's Society of Pennsylvania, and appears fully illustrated in their Journal for April, 1909. Novel features of the plant which might be mentioned, and which a year and a half of operation have given a sufficient test, are as follows:

The method of cleaning the settling tanks without emptying them or interfering in any way with the continuous operation of the plant. Carriers are built under the floor of the settling tanks. The carriers in each of the four tanks are divided into four zones. Small circular holes 7/8-in. in diameter, spaced 4 ft. apart, connect the bottom of the tanks with the carriers. The outlet end of each set of carriers is controlled by a valve. In cleaning the basins, the valve controlling each zone is kept open until the precipitated solids are removed, and the water runs free from sludge. The amount of water used in cleaning the settling tanks and baffling tank is approximately 1,700 gals. per day for each degree of hardness in the water.

Another novel feature in the plant is the economic use of wash water. The entire machinery is operated by a water motor on the top floor of the softening building. The waste water from the motor enters the wash water basin for the filters. This water, charged against the plant as power, should not be charged as wash water, thus effecting a substantial saving. The amount of wash water shown in the annexed table is, however, the actual amount of water used in washing the filters, and amounts to 0.72 per cent of the total amount pumped.

Still another feature in the McKeesport plant is the arrangement for the entry of water into and exit of water from the settling basins. The design of the plant allows the water to enter the settling tanks over a long weir with a relatively short travel through the tank to the long overflow weir, with a gradual reduction in velocity as it approaches the outlet weir. For a given capacity of tank the longer the weirs and the shorter travel through the tank to the overflow, the less the velocity, and consequently the greater the precipitation. The water as it leaves the settling tanks is perfectly clear and free from turbidity.

The character of the McKeesport water is so unusual that tables of cost of operation are apt to be misleading to other municipalities, because the persons seeking data of cost and practicability of water softening are apt to be swayed adversely in their opinions by applying to their own cases the costs of producing a softened water at other places, as for instance at McKeesport, without taking into consideration the possible differences in conditions between the water to be dealt with at different places.

The only fair way to analyze the cost of any particular plant is to weigh the cost thereof against the benefits to be derived therefrom. Bearing this in mind, we have on the one hand to consider, *(a)* first cost of plant; *(b)* cost of operation. As against this we must also consider, *(c)* the improvement in the water; *(d)* the decrease in operating expenses of the plant; *(e)* decrease in wear and tear upon the plant; *(f)* decrease in plumbing bills paid directly by private citizens; *(g)* the decrease in the cost of soap; *(h)* lengthening the wear of linens, flannels, and other fabrics; and *(i)* increase in the length of life or boilers.

Taking the case of McKeesport, the annual interest on the cost of construction is approximately $10,000.

The cost of operation for one year is $30,700.

The total cost of producing 4,000,000 gallons of softened filtered water a day is $40,700 per annum.

Against this we have the following saving.

Since the softening plant has been installed, the Water Department has dispensed with a number of its employes engaged on repaving curb connections whose wages, according to the president of the board of water commissioners, amounted to $15,000.

The private consumers expended annually in maintaining their plumbing fixtures over $35,000.

Since the softening plant has been installed, only 72 per cent of the water previously required is now pumped, thus making a reduction in the coal consumption of $6,090 per annum.

The reduction in repairs of plant amounts to $3,000 a year.

From the best evidence obtainable, the saving in soap and soap compounds alone amounts to over $10,000 a year, and the saving in the wear and tear in washing of fabrics of all kinds can be set down at $20,000 a year.

Summarizing these, we have, on the one hand, an added cost of treating the water of $40,700; and, on the other a saving, as enumerated above, of $89,090.

This balance sheet shows that the introduction of the water softening plant for the city of McKeesport, instead of being an added burden to the people, has proved to be a saving of $48,390 per annum.

As a side light upon the saving effected in the McKeesport plant, it may be stated that, before the water softening plant was put into commission, about 156 plumbers were at work in the city. Out of this number, only 46 were

*Paper by Alexander Potter read at the annual convention of the American Water Works Association April 26-30, 1910.

TABLE I.—SHOWING CHARACTER OF WATER TREATED, AMOUNT OF CHEMICALS USED AND COST OF TREATING AT McKEESPORT, PA., FROM FEBRUARY, 1909, TO MARCH, 1910

WEEK ENDING	CHARACTER OF WATER AND AMOUNT USED								TREATMENT OF WATER								COST OF TREATMENT OF WATER							
	Alkalinity		Hardness		Amount F.W. Pumped Million Gallons	Wash Water			Lime		Soda Ash		Coagulant		Hypochlorite of Lime		Chemicals		Labor					
	Parts Per Million					No. of hrs between washings of Filters	Amt. per Day Gals	% of F.W.																
	R.W.	F.W.	R.W.	F.W.					Per Day Pounds	Million Gallon Pounds	Per Day Pounds	Million Gallon Pounds	Per Day Pounds	Per Million Gallon Pounds	Per Day Pounds	Per Million Gallon Pounds	Per Day	Per Million Gallons	Per Day	Per Million Gallons	Total Cost Per Million Gallons			
February 13	0	38	57	43	3.795	202	21,428	0.55	800	212	1,929	509	400	152	....	....	$ 21.00	$ 6.32	$37.27	$ 9.83	$16.15			
February 20	0.7	42	54	48	3.582	336	12,856	0.36	600	166	1,800	500	743	207	....	....	24.14	6.72	35.94	10.00	16.72			
February 27	1.0	47	65	56	3.516	336	12,856	0.37	914	261	2,186	623	1,186	213	....	....	31.69	9.02	29.91	8.49	17.51			
March 6	12.0	51	80	74	3.484	252	17,143	0.49	1,000	286	2,700	773	686	196	....	....	34.38	9.92	29.49	8.44	18.36			
March 13	17.0	58	75	68	3.464	252	17,143	0.50	514	148	3,086	892	400	116	....	....	35.69	10.32	30.76	8.82	19.14			
March 20	21.0	46	99	72	3.462	504	8,571	0.25	3,057	885	4,114	1,190	457	132	....	....	55.11	15.90	31.12	9.00	24.90			
March 27	19.0	31	107	57	3.917	168	25,714	0.66	3,600	918	3,857	984	171	44	....	....	53.53	13.65	29.67	7.57	21.22			
April 3	10.0	34	76	52	3.607	144	30,000	0.82	3,543	980	2,443	676	1,200	333	....	....	44.99	12.50	30.94	8.56	21.06			
April 10	2.0	27	72	53	3.600	202	21,428	0.60	1,714	476	1,800	502	800	222	....	....	28.86	8.00	30.49	8.46	16.46			
April 17	1.0	22	72	54	3.645	144	30,000	0.80	1,371	376	1,671	458	571	157	....	....	24.97	6.84	30.51	8.26	15.10			
April 24	1.0	24	72	60	3.699	202	21,428	0.60	1,886	506	1,029	277	286	77	....	....	19.38	5.25	30.94	8.38	13.63			
May 1	1.0	22	79	65	3.490	202	21,428	0.60	2,314	671	1,157	331	800	229	....	....	25.22	7.23	31.44	8.97	16.29			
May 8	1.0	19	95	66	3.748	144	30,000	0.80	4,000	1,068	2,314	618	629	168	....	....	41.82	11.14	31.44	8.40	19.54			
May 15	30.0	34	132	73	3.942	168	25,714	0.65	3,371	854	4,757	1,208	114	29	....	....	60.77	15.47	30.07	7.63	23.10			
May 22	79.0	41	256	92	3.944	252	17,143	0.40	6,657	1,690	6,668	1,690	....	....	....	....	92.48	23.52	29.55	7.53	31.05			
May 29	76.0	32	264	88	4.125	72	55,714	1.40	6,628	1,608	6,086	1,480	....	....	....	....	86.54	20.98	31.44	7.62	28.60			
June 5	51.0	31	163	62	4.010	101	40,000	1.00	3,286	3,820	3,343	857	114	28	....	....	49.05	12.27	30.69	7.63	19.90			
June 12	0	33	69	47	4.064	101	28,571	0.70	1,657	408	2,318	571	971	238	....	....	34.00	8.38	31.44	7.72	16.10			
June 19	5.0	29	66	51	3.877	112	25,714	0.70	886	227	1,800	464	686	177	....	....	23.72	6.10	31.22	8.07	14.17			
June 26	21.0	30	87	55	4.074	101	28,571	0.70	1,343	331	2,314	569	....	....	....	....	26.63	6.54	31.44	7.72	14.26			
July 3	58.0	32	95	48	4.491	92	31,429	0.70	1,657	368	3,857	860	....	....	....	....	41.80	9.30	31.44	6.98	16.28			
July 10	53.0	33	152	68	4.362	92	31,429	0.70	2,942	673	5,657	1,300	....	....	....	....	63.12	14.46	30.85	7.06	21.52			
July 17	101.0	32	250	86	4.614	63	45,714	1.00	6,429	1,400	10,019	2,170	228	49	....	....	119.40	15.84	32.72	6.88	32.90			
July 24	111.0	34	291	99	3.972	84	34,286	0.90	5,857	1,480	10,286	2,580	57	14	....	....	117.19	29.52	31.29	7.88	37.40			
July 31	63.0	34	215	86	4.284	46	62,857	1.50	3.886	908	6,429	1,498	....	....	....	....	73.74	17.17	31.01	7.25	24.42			
August 7	85.0	37	262	91	4.586	40	71,428	1.60	6,257	1,360	9,514	2,072	....	....	....	....	111.74	24.31	31.01	6.79	31.10			
August 14	89.0	39	281	114	4.743	36	80,000	1.70	6,114	1,385	10,029	2,120	....	....	....	....	115.78	24.44	29.98	6.36	30.80			
August 21	4.0	32	119	70	4.478	46	62,857	1.40	5,857	638	3,600	805	772	172	....	....	49.10	11.02	31.01	6.88	17.90			
August 28	0	31	69	56	4.374	126	25,000	0.60	1,886	431	2,314	529	578	132	....	....	32.29	7.35	31.01	7.07	14.42			
September 4	29.0	31	139	71	4.210	40	72,214	1.70	3,600	851	3,871	918	....	....	....	....	49.65	11.76	31.01	7.34	19.10			
September 11	41.0	25	164	91	3.922	63	45,714	1.20	4,000	1,020	3,857	985	....	....	....	....	51.31	13.08	31.01	7.90	20.98			
September 18	35.0	25	152	81	4.091	72	40,000	1.00	2,400	586	3,343	818	....	....	....	....	40.05	9.78	31.01	7.58	17.36			
September 25	49.0	26	157	78	3.934	59	48,571	1.20	3,257	827	4,629	1,178	....	....	....	....	55.20	14.01	29.49	7.49	21.50			
October 2	68.0	26	188	100	3.819	56	51,429	1.30	4,857	1,275	5,400	1,420	....	....	....	....	68.76	17.96	29.98	7.84	25.80			
October 9	81.0	23	220	88	3.530	112	25,714	0.70	4,287	1,214	6,687	1,890	....	....	....	....	77.96	22.03	31.01	8.77	30.80			
October 16	109.0	38	280	83	3.704	92	45,714	1.30	5,514	1,492	10,543	2,850	118	32	....	....	118.80	32.14	29.51	7.96	40.10			
October 23	39.0	36	178	68	3.497	336	8,571	0.24	2,971	851	5,143	1,470	....	....	....	....	58.62	16.78	31.01	8.82	25.60			
October 30	7.0	30	82	52	3.341	168	17,143	0.51	1,800	539	2,314	692	172	51	....	....	29.84	8.93	31.01	9.27	18.20			
November 6	22.0	40	112	59	3.355	202	14,286	0.30	1,000	297	3,859	1,180	286	85	....	....	40.43	12.04	31.01	9.26	21.30			
November 13	34.0	36	153	57	3.572	168	17,143	0.50	3,000	840	4,886	1,368	....	....	21	6	57.80	16.22	30.19	8.44	24.66			
November 20	38.0	35	149	42	3.376	144	20,000	0.60	3,000	886	4,886	1,448	....	....	29	16	58.14	17.17	31.01	9.19	26.36			
November 27	50.0	34	174	48	3.535	202	14,286	0.40	3,000	847	5,914	1,668	....	....	23	6	67.05	18.98	31.01	8.76	27.74			
December 4	37.0	32	140	51	3.528	168	17,143	0.50	3,000	850	4,371	1,238	....	....	6	2	52.14	14.78	31.01	8.76	23.56			
December 11	50.0	31	208	61	3.714	252	11,429	0.30	3,000	808	6,171	1,660	....	....	....	....	68.28	18.40	31.22	8.40	26.80			
December 18	13.0	31	119	48	4.250	101	28,571	0.70	3,000	706	4,114	966	258	61	....	....	51.09	12.24	31.22	7.34	19.58			
December 25	10.0	25	111	59	4.332	252	11,429	0.30	3,000	693	2,829	653	....	....	23	5	39.28	9.08	30.78	7.06	16.14			
January 1	23.0	28	113	43	4.631	144	20,000	0.40	3,000	616	5,143	1,108	20	4	....	....	51.36	11.09	31.22	6.74	17.83			
January 7	5.0	29	82	42	4.387	101	30,000	0.70	1,571	358	2,314	528	714	161	6	1	31.62	7.21	31.01	7.08	14.29			
January 14	8.0	28	78	58	4.142	168	17,143	0.40	571	128	2,057	463	257	58	26	6	24.91	5.61	30.68	6.90	12.51			
January 22	6.0	34	89	58	3.894	202	14,287	0.40	1,286	330	2,314	592	457	117	46	12	33.85	8.69	30.97	7.95	16.64			
January 29	27.0	28	140	64	3.965	202	14,286	0.40	2,600	656	3,600	910	457	115	10	3	46.22	11.68	31.82	8.03	19.71			
February 5	38.0	32	168	67	3.716	144	20,000	0.50	3,057	823	5,143	1,382	....	....	10	3	59.59	16.04	31.68	8.53	24.57			
February 12	50.0	32	193	65	4.063	144	20,000	0.50	3,514	753	6,171	1,516	....	....	10	3	70.34	17.32	31.82	7.83	25.15			
February 19	30.0	29	116	50	4.286	126	25,000	0.60	3,029	708	3,857	899	....	....	14	5	47.58	11.12	31.82	7.43	18.55			
February 26	13.0	26	81	41	4.135	168	20,000	0.50	1,457	352	1,543	373	....	....	20	5	20.38	4.92	29.25	7.06	11.98			
Average	33.0	32.5	139	66	3.928	152	29,235	0.72	2,930	750	4,100	1,016	292	76	15.0	4.0	$ 52.95	$13.36	$31.16	$ 8.05	$21.41			

left four months after the plant was put into commission, and at the present time about the same average number of plumbers are employed in McKeesport.

In making the above comparison, the author has not touched upon the saving in life due to the reduction in typhoid fever, which has been quite marked, for he believes it is not altogether fair to take the difference in the death rate for the year before and the year following the introduction of such an improvement, and credit this saving of life wholly to the water treatment plant, because for such a comparatively short period there may have been many other causes contributing to the reduction of the death rate. It is fair to assume, however, that no one factor was more responsible for the reduction in the typhoid fever death rate than the water treatment plant.

Beside all these considerations, there stands out prominently the fact that the McKeesport water now has that palatable, crisp, fresh taste which is delightfully refreshing—a quality often lacking in public water supplies. The water is acceptable for drinking, cooking and bathing alike. A greater cleanliness on the part of the people is also observed generally throughout the city.

The author presents herewith a table showing the characteristics of the water from week to week; also the amount of lime and other chemicals used in the treatment of it, together with the cost of treatment.

The plant at McKeesport includes a filtration plant, which is in itself an interesting study aside from the softening plant.

During the summer of 1909, when the bacterial count in the raw water ran from 5 to 100 or 200, the bacteria in the settled and filtered water showed increases over the number in the raw water. The numerical increase in the bacteria in the filtered water over the raw water completely annihilated removal or efficiency percentages and did not present a very creditable showing. Furthermore, it was impossible to determine the character of the bacteria on any one day until two days later, consequently there was always a possibility, when the raw water contained baccili coli, of their passing through the filter as well. It is important to note also that so far as the reduction of bacteria is concerned, the filters failed to produce any reduction over the settled water. In fact, it is the exception rather than the rule, that the bacterial count of the filtered water is lower than the bacterial count in the settled water; all of which goes to show that, in a water similar to that treated at McKeesport, it is possible to dispense with the filter entirely.

Consequently, in October, 1909, the use of hypochlorite of lime was used at the suggestion of the author, and has been in use ever since. The effect of the use of hypochlorite of lime has been to almost completely sterilize the water in the softening plant. The use of a sterilizing agent is a sufficient safety factor for destroying bacteria that would not otherwise be entangled and brought down with the precipitates in the settling basins. The amount of hypochlorite of lime used varies from two and one-half to twelve pounds per million gallons, and averages 4.0 lbs. per million gallons. In the McKeesport plant, the hypochlorite of lime is admitted at the entrance of the baffle mixing tanks about one hour before the soda is admitted to the baffle mixing tanks. The hypochlorite of lime is dissolved in the coagulant tanks, and the coagulant pumps are used for the application of the hypochlorite to the water.

No coagulant has been used since the application of the hypochlorite of lime. A remarkable condition exists with the water at McKeesport, where with 450,000 bacteria and 1,500 turbidity in the raw water, no coagulant was used, and yet a clear water was secured from the filters.

In the opinion of the author, there are very many towns in which the introduction of water softening, coupled with the use of some sterilizing agent, would present the most satisfactory solution of the water purification problem, and be commercially more desirable.

It is to be hoped that this phase of the question will receive greater attention than in the past, for it at once makes commercially available the treatment of waters for other than purely sanitary purposes. There are so many cities throughout the United States and Canada afflicted with hard waters, that the purely commercial aspect of water softening must demand attention to a great degree in the future than it has in the past. The benefits of a soft water are fully as valuable to the private citizen in the uses to which he puts his water supply as they are to the large manufacturing concerns which, it is well known, are being forced to install private softening plants for the preservation of their boilers, and the percentage of saving to the private citizen, by the introduction of softened water, will be found to be just as great proportionately as the saving to the manufacturer.

The average cost of chemicals at the Mc-

Keesport plant during the last year was as follows:

	Per ton of 2,000 lbs.
Lime	$ 8.30
Soda ash	18.00
Sulphate of iron	11.00
Alum	12.50
Hypochlorite of lime	42.00

The character of the water at McKeesport perhaps requires the application of a greater amount of chemicals per million gallons than any other water in the country, and the satisfactory results obtained, should go a long way toward dissipating the somewhat prevalent idea that the use of chemicals in water treatment is injurious to health.

Some Data on the Quantity and Cost of Bleaching Powder for Disinfecting Sewage or Effluent.*

Bleaching powder is an impure commercial product manufactured in large quantities abroad by some of the earlier chemical methods, and in this country at Niagara by modern electrolytic methods. Owing to the fact that in the latter case it is essentially a by-product of the much more important caustic soda industry, its present market price is very low, and in fact less than the cost of production on a small scale. Upon admixture with water it goes into solution only partially; a residue of carbonate of lime and an excess of free lime remaining in the tank as a white sludge. In practice it is desirable at large works to keep this mixture stirred up and to discharge the sludge with the solution; at smaller works economy indicates the use of the clear solution and the disposal of the lime sludge in a convenient manner. To the layman one of the most striking features of this process is the relatively small amount of disinfectant necessary. For crude sewage an amount of so-called "available chlorin" equivalent to about five parts per million parts of sewage, which amounts to about 125 lbs. of bleaching powder per million gallons, suffices. Upon the present market price of $25 per ton or less, it will be seen that the cost of bleaching powder necessary will be in the neighborhood of $1.70 per million gallons of sewage disinfected. By the use of the quantity indicated, disinfection is accomplished within a very few minutes, and storage periods of not over thirty minutes are ample. Sewage stronger than the average American sewage would require somewhat larger amounts than these indicated, but twice the quantity probably represents the maximum. For partially purified effluents, such as those resulting from trickling filters, lesser quantities are sufficient. At Baltimore three parts per million of available chlorin, or 75 lbs. of bleaching powder per million gallons were found effective in the disinfection of the trickling filter effluent. At Boston satisfactory disinfection of a similar effluent was accomplished through a period of six months by the application of three and a half parts of available chlorin. Effluents of a higher degree of purity can be disinfected with corresponding smaller amounts. The total cost of the processes, including interest charges and depreciation upon the necessary fixtures, labor and other items, will range from $1 or less in the case of effluents to about $3 in the case of crude sewages. These details are given in the accompanying table.

*Extract from a paper by Earle B. Phelps, Proceedings Engineers' Club of Philadelphia, April, 1910.

ESTIMATES OF THE COST OF OPERATION OF A PLANT FOR DISINFECTING SEWAGE OR EFFLUENT WITH CHLORIDE OF LIME. BASED ON A CAPACITY OF 5,000,000 GALLONS A DAY.

Available chlorin, parts per million.	Bleach, pounds per mil. gal. (approx.)	Time of contact, hours.	Cost Per Million Gallons. — Fixed. Storage tanks.	Other fixed charges.	Operating. Bleaching powder.	Labor.	Power.	Total.
1	25	5.0	$0.10	$0.02	$0.30	$0.10	...	$0.52
2	50	2.5	.05	.04	.60	.10	...	.79
3	75	1.6	.04	.05	.90	.10	$0.02	1.11
4	100	1.2	.03	.07	1.20	.10	.02	1.42
5	125	0.8	.03	.08	1.50	.10	.03	1.74
10	250	0.5	.02	.16	3.00	.15	.06	3.39
15	375	0.5	.02	.24	4.50	.20	.09	5.05

Unclassified and General Articles

Note: This section is devoted to methods and cost articles on construction work not properly coming under any of the preceding classifications.

Cost of Generating and Distributing Electricity for Lighting and Power, New York Edison Co.

In our issue of April 6 we gave the cost of generating and distributing electricity for lighting in Brooklyn. We now take up a similar analysis of the cost to the New York Edison Co. which produces nearly 70 per cent of the electricity used for lighting in New York city.

The following data are based upon this company's report for the fiscal year ending June 30, 1907:

Plant.—There are 8 generating stations having a total rated capacity of 108,300 kw., but two of these stations supply nearly 80 per cent of the current. There are 23 substations of 93,750 kw. capacity. The details of the plant equipment are as follows:

Station Equipment:	
144 boilers, water tube	76,382 HP.
45 superheaters	29,250 HP.
30 steam engines, direct connected	82,900 HP.
5 steam engines, belted	1,725 HP.
9 turbo-units, A. C.	53,500 KW.
21 generators, direct connected, A.C.	93,000 KW.
34 generators, direct connected, D.C.	14,100 KW.
3 generators, belt connected, A.C	900 KW.
2 generators, belt connected, D.C.	300 KW.
10 exciters, motor driven	1,400 KW.
3 exciters, steam driven	225 KW.
2x140 storage battery cells	12,000 A.H.
2 station transformers	2,500 KW
1 frequency changer	1,000 KW
Substation Equipment:	
100 rotary converters, etc.	93,750 KW.
276 transformers for rotaries	108,735 KW.
32x150 storage battery cells, 3 hr. rate	192,000 A.H.

The company had 70,533 meters in service and 34,531 arc lamps in service, of which lamps it owned about half, and 2,665,085 incandescent lamps. In round numbers there were the following amounts of circuits:

	Ft. of circuit.	Million feet of wire.
Direct current (underground)	10,183,000	4,619,000
Alternating current (underground)	1,000,000	179,000
Alternating current (overhead)	1,096,000	794,000
Total	12,279,000	5,592,000

There were 639,735 lin. ft. of streets occupied by pole lines. The underground wires occupied conduits rented from other companies, a rental of $1,000 per mile of single 3-in. duct per year being paid; aggregating a total of $845,000. This is an enormous rental, but it should be remembered that the Edison Co. controls the companies from which it rents the conduits.

The company owned 74,169 meters, the first cost of which is not reported. The Edison Illuminating Co. of Brooklyn owned 18,088 meters whose first cost averaged $18.40 each.

The company owned the following lamps:

1,957 arc—A. C., inclosed.
13,806 arc—D. C., inclosed.
1,813 Nernst.
6,522 Glowers.

The total number of arc lamps on its circuits Dec. 31, 1907, was 34,547, and the total number of incandescents was 3,056,777.

The operating expenses were as follows for the year:

Production Expense.	
1. Salaries	$ 35,908
2. Labor	508,773
3. Fuel	1,210,599
4. Oil, waste and sundries	54,565
5. Water	135,211
6. Repairs, buildings and structures	37,435
7. Repairs, motive power	211,175
8. Repairs, electric apparatus	22,631
9. Station expense	24,893
10. Purchased power	75,220
Total production expense	$2,316,418
Distribution Expense.	
11 Salaries	$ 64,146
12. Substation labor and expense	148,499
13. Rental of conduits, etc.	1,014,081
14. Incandescent lamp renewals	538,213
15. Wiring and jobbing (profit or loss)	139,713
16. Repairing and maint. street lamps	68,096
17. Repairs, substation bldgs. and apparatus	202,611
18. Repairs, poles and lines	21,716
19. Repairs, subways and cables	56,856
20. Repairs, meters	221,894
21. Repairs and expense commercial lamps	12,872
Total distribution expense	$2,388,698
General Expense:	
22. Salaries of officers	$ 51,241
23. Office salaries	335,825
24. Office expense	294,009
25. Legal expense	116,630
26. Advertising and soliciting	218,850
27. Insurance	118,393
28. Engineering and testing	78,707
29. Leaseholds, rentals, etc.	47,656
Total general expense	$1,262,311
30 Taxes, general	$ 702,628
31. Uncollectible bills	35,464
32. Depreciation and contingent expense	1,721,413
Grand total	$8,425,933

There were 299,172,431 kw. hrs. produced (at the switchboard) and 209,024,002 kw. hrs. sold (at the meters), showing a transmission loss of 30 per cent.

Since the plant capacity was 108,300 kw. and since there are 8,760 hrs. in a year, the total capacity was 950,708,000 kw. hrs. Therefore the average load was 299,172,431÷950,708,000=31½ per cent. Each kw. produced 2,760 kw. hrs. at the switchboard during the year, of which 70 per cent, or 1,932 kw. hrs. was sold.

The operating expenses per kw. hr. produced (at the switchboard) were as follows:

	Cents per KW. hr.
Production Expense:	
1. Salaries	0.012
2. Labor	0.171
3. Fuel	0.406
4. Oil, waste and sundries	0.018
5. Water	0.045
6. Repairs, buildings and structures	0.012
7. Repairs, motive power	0.070
8. Repairs, electric apparatus	0.007
9. Station expense	0.008
10. Purchased power	0.025
Total production expense	0.774
Distribution Expense:	
11. Salaries	0.021
12. Substation labor and expense	0.050
13. Rental of conduits, etc.	0.339
14. Incandescent lamp renewals	0.147
15. Wiring and jobbing	0.047
16. Repairing and maintg. str. lamps	0.023
17. Repairs, substation bldgs. and appar.	0.068
18. Repairs, poles and lines	0.007
19. Repairs, subways and cables	0.019
20. Repairs, meters	0.074
21. Repairs and expense commercial lamps	0.004
Total distribution expense	0.799
General Expense:	
22. Salaries of officers	0.017
23. Office salaries	0.113
24. Office expenses	0.098
25. Legal expenses	0.039
26. Advertising and soliciting	0.073
27. Insurance	0.040
28. Engineering and testing	0.026
29. Leaseholds, rentals, etc.	0.016
Total general expense	0.422
30. Taxes	0.235
31. Uncollectible bills	0.011
32. Depreciation and contingent expense	0.575
Grand total	2.816

The cost of operation was as follows per kw. hr. produced (at the switchboard) and per kw. hr. sold.

	Cents per KW. hr. Produced	Cents per KW. hr. Sold
Production expense	0.78	1.11
Distribution expense	0.80	1.14
General expense	0.42	0.61
Taxes	0.24	0.34
Uncollectible bills	0.01	0.02
Depreciation, contingency and renewal	0.57	0.82
Total	2.82	4.04

In considering these costs, it should be remembered that 35 per cent of the "Distribution Expense" is due to the rental paid for conduits at an exceedingly high rate. How high it really is can best be seen by studying the actual cost of similar conduits in Chicago, as given in Mayer's "Telephone Construction, Methods and Cost."

The item of "Depreciation and Contingencies" is worthy of special note, as it aggregates the large sum of $1,721,413. Of this sum $594,735 was actually charged off for depreciation, the balance going to a "contingency and renewal fund," which, so far as can be ascertained from the report, is but another name for a depreciation fund.

The report does not show what the plant actually cost, but it does show that $43,417,883 bonds have been issued, which doubtless represents approximately the actual engine cost, or about $400 per kw. capacity. Possibly additions, paid for out of earnings, have increased the cost to $500 per kw.

As throwing light on what such a plant may actually cost in New York city, the following data relative to the United Electric Light and Power Co. will serve. This company was incorporated in 1887, and on June 30, 1907, it was operating four generating stations of a combined capacity of 10,200 kw. Its cost of construction and equipment was as follows:

	Per KW.
Land for generating stations	$ 22
Land for substations	3
Buildings for generating stations	23
Buildings for substations	5
Electrical and steam apparatus (generating)	92
Substation apparatus	31
Construction cables	165
Subsidiaries	20
Tools and implements	2
Stable equipment	4
Office furniture and fixtures	1
Installation: Includes line transformers, meters, arc lamps, motors, etc.	142
Maps and instruments	3
Total	$523

The United Electric Light and Power Co. rented its conduits of which it occupied about 300 miles of ducts, and it had 820,000 million mil. ft. of wire.

In our issue of April 6 we showed that the first cost of the plant of the Edison Electric Illuminating Co. of Brooklyn was $437 per kw.

Let us express the cost of repairs on the New York Edison plant in terms of the kw. of rated capacity:

Repairs:	Per KW.
Station buildings and structures	$0.35
Motive power	1.95
Electric generating apparatus	0.21
Substation bldgs. and apparatus	1.87
Poles and lines	0.20
Subways and cables	0.52
Meters	2.54
Street arc lamps	0.63
Commercial arc lamps	0.12
Total	$ 8.37
Incandescent lamp renewals	4.46
Grand total	$12.83

If these repair costs are expressed in percentages of the probable first costs of the various items, it will be seen that they are all very low. It would seem, therefore, that the apparently large amount ($1,721,413) charged off for depreciation and renewals is none too high.

We have seen that the actual cost, as reported, was 4.04 cts. per kw. hr. sold. The average income was 6.49 cts. per kw. hr. sold. The plant represents a first cost of $500 per kw.—the interest charge at 6 per cent would be $30 per kw. We have seen that each kw. produced 1,932 kw. hrs. sold. Hence $30÷1,932=1.56 cts. This is the interest charge, which added to 4.04 gives a total cost of 5.60 cts. per kw. hr. sold. This would leave a profit of nearly 0.9 ct. per kw. hr. It should be remembered, however that we have assumed a high first cost, and that a high price was paid for rental of conduits. However, no exorbitant profit has been made although the profit has unquestionably been liberal.

The payroll was approximately as follows for the year ending June 30, 1907, based upon the payroll for the week ending June 29, 1907:

Employes:		Total.
881	General	$ 672,678
519	Technical	447,283
857	Generating plants	756,050
122	Substation plants	110,113
972	Distribution department	727,677
565	Construction department	450,694
98	Monthly salaries	256,306
4,014	Total	$3,420,801

This is equivalent to an average of nearly $16.40 per man per week. That this payroll is higher than normal is quite evident from the following tabulation of wage earners on the payroll June 30, and Dec. 31, 1907. The average wage is that paid by the Edison Illuminating Co. of Brooklyn, which presumably differed little from the New York Edison Co.

	June 30.	Dec. 31.
Foremen at $3.80	103	103
Assistant foremen at $4.03	43	44
Inspectors at $3.09	40	48
Engineers at $3.95	52	51
Firemen at $2.85	130	148
Coal passers at $2.22	31	47
Oilers and water tenders at $2.49	201	202
Electricians at $2.67	109	39
Electricians' helpers at $1.84	..	24
Dynamo attendants at $2.33	47	40
Switchboard attendants at $3.13	97	100
Machinists at $2.77	56	48
Machinists' helpers at $2.13	56	53
Blacksmiths at $2.43	9	8
Linemen at $2.44	14	13
Lamp trimmers at $1.66	37	30
Wiremen and helpers at $2.59	186	131
Meter readers at $2.96	36	37
Teamsters and stablemen at $2.40	96	72
Electric wage earners not elsewhere specified at $1.76	1,172	782
Total wage earners	2,515	2,020

The number of salaried employes and their weekly wages for the same time were as follows:

	June 30.	Dec. 31.
Canvassers at $25.48	71	55
Cashiers and bookkeepers, men, at $20.69	93	98
Cashiers and bookkeepers, women	25	26
Clerks (men) and salesmen at $15.93	395	343
Clerks and saleswomen at $8.71	36	40
Collectors at $23.36	29	34
Demonstrators at $14.46	1	..
Messengers, telephone operators, etc., at $6.87	55	47
Stenographers, men, at $10.58	39	36
Stenographers, women, at $13.01	65	57
Superintendents	17	17
Watchmen, elevator men, etc.	132	110
All other salaried employes	533	429
Total salaried employes	1,491	1,282
Grand total employes	4,006	3,302

The average weekly salaries are based on those paid by the Edison Illuminating Co. of Brooklyn.

For the half year, July 1 to Dec. 31, 1907, the total payroll was:

Officers (5)	$ 25,000
Salaried employes	626,955
Wage earners	988,320
Total	$1,640,275

During this same half year, 166,731,594 kw. hrs. were generated, and it required 4.11 lbs. of coal per kw. hr. generated. The coal was nearly all anthracite, less than 20 per cent being bituminous, and the average price was $1.96 per ton of 2,000 lbs. The high coal consumption and the low price indicate a very poor quality.

The reader will be able to make some very interesting comparisons between the unit costs given in this article and similar costs given in our issue of April 6.

The total length of railways in Mexico subject to federal jurisdiction is now 12,278 miles which with 3,000 miles of railways subject to the jurisdiction of state governments gives a total length of 15,278 miles. Since September, 1909, 99 new miles of track have been built on the federal railway system.

Results of Tests of Simple and Inexpnesive Surveying Instruments.*

Agricultural bulletins and instrument catalogs describe from time to time various simple and inexpensive devices and instruments for performing survey work. The demand for such apparatus usually comes from agriculturists or mechanics who have not had engineering training. Neither have they sufficient work to justify the purchase of the ordinary grade of engineer's instruments. The work on which such instruments is to be used is not of sufficient importance or magnitude to justify the employment of an engineer unless one should be near at hand. In many of our agricultural districts an engineer is not available except by the expenditure of considerable money for traveling expense and time. Unless this work is of considerable magnitude an engineer is not employed and agricultural improvements are carried on by such methods as the ingenuity of the workman may happen to devise.

Consequently there is apparently a field for an instrument that can be used by a person of ordinary mechanical ability; something between the range of the carpenter's level and square and the engineer's level and transit. The writer has had inquiries at various times for advice in regard to such an instrument. On examining into this subject he was not able to secure any definite data. Engineers who are competent to pass judgment on such devices use first-class instruments and have no time to experiment with second-class ones. Information in regard to second-class instruments or home-made devices simply state that such an instrument was used for a certain purpose and cost so much, there being no data given to indicate the range, efficiency and accuracy. Hence it appeared desirable that these various devices should be tested by one person under the same conditions, and that a study might be made of each, having in view its use by persons unskilled in surveying.

This test work was carried on during the summer of 1909 under the direction of the writer, at the University Farm, St. Paul, Minn., as part of the agricultural experimental work by the Division of Agricultural Engineering. The actual testing was done by Mr. H. B. Roe, a regular employe of the division, who had had ten years' experience in railway engineering work, assisted by Mr. Geo. F. Krogh, who is also a regular employe of the division as draftsman and general field assistant. All the field work and compilation of results was done by these two men, the object being to test each instrument in skilled hands and under the best conditions, and from that information determine its value under less favorable conditions. The land selected for the test was neither entirely level nor extremely hilly, but presented such topographic features as would ordinarily be found on farms where there would be a demand for this class of work.

In carrying out these experiments the following points of comparison have been kept continually in mind; (A) construction; (B) first cost; (C) simplicity of operation or knowledge necessary to adjust and operate; (D) the reach or range of sight and the consequent rapidity of work; (E) retentivity of adjustments under varying conditions of handling and weather; (F) results and remarks. For convenience each instrument tested is numbered and referred to by its number, the object being to determine the value of the general pattern of the instrument rather than the individual make of any special pattern.

In the elevation tests, readings were all taken on hubs, an engineer's 20-in. Y-level being used as a standard. Whenever a defect was detected in an instrument which was liable to be intensified by conditions of weather or change of ground, a special test was carried on under these conditions to determine their actual influence. The reach of the standard level was 500 ft. each way, or 1,000

*Abstract of a paper by J. T. Stewart, Professor of Agricultural Engineering, University of Minnesota, St. Paul, Minn., prepared for the annual meeting of the Illinois Society of Engineers and Surveyors.

ft. at a set up; with a self-reading rod, 1,320 ft. at each set up, ½ mile being covered with a self-reading rod in 30 mins.

No. 1 (Straight-Edge).—This was an ordinary straight edge 12½ ft. long, having a 30-in. leg on each end to raise the main part above the ground so that grass, rough ground, etc., between the stakes would not interfere with setting it. It is leveled by an ordinary carpenter's level attached to the upper side with a clamp. Complete cost: Carpenter's level, 75 cts.; wooden rod, $1; material in frame, $1.25; labor in making frame, $2.75; total $5.75.

The adjustment and method of using are the same as with the carpenter's level. The reach at each set-up is 12½ ft., ½-mile covered in 3 hrs. 5 mins.

Retentivity of adjustment was very poor, as variable humidity and windy weather made almost continuous adjusting necessary, due to warping and twisting. The results obtained by the use of this instrument were so unreliable that it can be of no use in survey work where levels are carried any distance when any degree of accuracy is desired. It is unwieldy in windy weather and the adjustments are rendered unstable by warping and twisting.

No. 2 (Triangle).—This instrument is a wooden triangle having a reach of 12½ ft. and is set level by a carpenter's level attached to a cross-bar with a clamp. Complete cost: Carpenter's level, 75 cts.; material in triangle, $1.50; labor making triangle, $4.24; total, $6.50.

Adjustment and method of using are the same as with the carpenter's level. The reach at each set-up is 12½ ft., ½-mile covered in 2 hrs. 20 mins.

Retentivity of adjustments was good, as they were not affected by weather changes. A triangle can be used to good advantage for preliminary levels when time is not an object. While the errors were somewhat variable the general results were fair. However, too much reliance should not be placed on it for setting long lines of grade stakes where great accuracy is required.

The same 30-in. standard carpenter's level was used on both Nos. 1 and 2. The bubble was too slow for accuracy when used in running long lines. A small level put up in a metallic case so constructed that it can be attached to a carpenter's square was tried, but it was worthless on account of the slow bubble.

No. 3 (Hose with Glass Tubes).—This outfit consisted of 25 ft. of a good grade of ¾-in. garden hose with a glass tube fastened in a 4-ft. length of hose coupled to each end. Complete cost: 25-ft. hose, $3.75; 8-ft. hose in 4-ft. lengths, $1.20; 2 couplings, 20 cts.; 2 glass tubes 18 ins. long, 20 cts.; 2 graduated rods, $2; total $7.25.

There were no adjustments. The reach was 25 ft. at each set up; ½-mile covered in 2 hrs. 20 mins.

It was sensitive to variation in temperature; as the water grows warm in the hose results become more unreliable, especially on sloping ground, the tendency being to run the elevation low. Where water is kept cool, either by using the instrument morning and evening, by frequent changes of water, or by working in cold weather, this instrument is simple, reliable and convenient. A 50-ft. length of hose tried, ½-mile being covered in 1 hr. 10 mins., but it was so heavy to drag that it was very tiring on the operators and caused the hose to wear. The errors due to varying temperature in the water were also increased.

No. 4 (Carpenter's Level with Sights).—This was the same carpenter's level that was used with Nos. 1 and 2, but fitted with the peep sights carried in stock for carpenter's levels and then mounted on a home-made tripod. Complete cost: Carpenter's level, 75 cts.; sights, 50 cts.; labor and material of making tripod, $9.75; flexible rod 6 ft. long, $1.50; total, $12.50.

It requires practically the same knowledge for adjustments and operation as is required for the engineer's Y-level. The reach with a self-reading rod, is 75 ft. each way or 150 ft. at a set-up; with a target rod, 200 ft. at a set-up. With a self-reading rod, ½-mile covered in 2 hrs. 15 mins.

Retentivity of adjustments was good. The results were very good. A better bubble in the carpenter's level would make this a very practical instrument.

No. 5 (Sighting Tube).—This was a factory-made instrument with a 1-in. sighting tube 10 ins. long, having a plain glass in place of an objective and a pin hole for an eye piece; it was mounted on a tripod. Complete cost, including a 6-ft. flexible rod, $16.

This requires the same knowledge for adjusting and using as the engineer's dumpy level. The reach with self-reading rod is 75 ft. each way, or 150 ft. at a set-up. With target rod, 200 ft. at a set-up. The ½-mile was covered with a self-reading rod in 1 hr. 15 mins.

Retentivity of adjustment is good, but very slow to adjust when adjustment is required. This instrument, as it came from the factory, had too large a pin hole in the eye plate and too coarse a cross hair. Tests showed it to be impossible to adjust closely or to obtain anything approaching accurate results. After the pin hole and cross wire were reduced to half the size good results were obtained. The elevations varied slightly from that of the Y-level. The bubble, however, was too slow.

No. 6 (Small Dumpy Level).—This was a small factory-made dumpy level with a 10-in. telescope and 1-in. objective glass, mounted on a tripod. Complete cost, including a 6-ft. flexible rod, $25. It requires the same knowledge to adjust and operate as the engineer's dumpy level.

Reach with self-reading rod, 400 ft. each way, or 800 ft. at a set-up. With target rod, 1,000 ft. at a set-up. The ½-mile was covered with a self-reading rod in 45 mins. Adjustments unreliable. This is a well put-up instrument with the exception of a slow bubble and no focusing screws. It gave fairly good results, but the slow bubble caused occasional variation.

No. 7 (Telescope and Leveling Plate).—This was a factory-made instrument consisting of a telescope passing through a metal disc which rests upon a circular plate. The bubble is placed parallel to the telescope in the top of the disc, the plate resting on the leveling screws. The disc and plate are not fastened to the tripod head and must be taken off and carried in the hand when moving from one station to another. Cost, including a folding wooden rod 10 ft. long, $15.

This requires the same knowledge to adjust and operate as the engineer's dumpy level. Reach with self-reading rod, 300 ft. each way, or 600 ft. at a set-up; with target rod, 700 ft. at a set-up. The ½-mile was covered with a self-reading rod in 1 hr. 30 mins. Retentivity of adjustments is fair.

This instrument compares favorably with the engineer's level, but there was a tendency to run high. This was probably due to the coarse, irregular cross hairs and the construction of the leveling disc, which had a tendency to rise or fall in correcting slight deviations of the bubble as the telescope rotated on its vertical axis.

No. 8 (Telescope in Box).—This instrument has a telescope 9 ins. long, with a ⅝-in. objective, placed in a rectangular metal box 7½ ins. long and 2¼ ins. wide, the leveling bubble being placed in the upper side of the box. The instrument is attached to a tripod by means of a ball and socket joint with a leveling plate. Complete cost: Instrument, $30; 6-ft. folding leveling rod, $1.50; total, $31.50.

It requires the same knowledge to operate as the engineer's level. It is very hard to adjust, as it has no capstan screws and there is no provision for making the horizontal cross hair horizontal except when the instrument is manufactured. In the instrument tested this hair was not horizontal.

The reach with self-reading rod is 400 ft. each way, or 800 ft. at a set-up. With target rod, 1,000 ft. at a set-up. With a self-reading rod, ½-mile was covered in 1 hr. While this instrument is intended to be simple, it is really complicated, with no particular advantages. It did very good work in skilled hands but undoubtedly would be a failure in the hands of an amateur.

No. 9 (Architect's Dumpy Level).—This was a small factory-made level listed as an architect's dumpy level. It has an 11-in. telescope with a 1⅛-in. objective, being constructed the same as an engineer's dumpy level. Complete cost: Instrument, $45; flexible rod, $1.50; total, $46.50.

No. 10 (Convertible Y-Level).—This was a factory-made instrument listed as an architect's convertible Y-level. It is a combination level and transit. It can be set up as a Y-level, and the telescope can be taken out of the Y's. The detachable horizontal axis screws into the sides of the telescope and when placed on the Y's it can be used the same as a transit. Complete cost: Instrument, $75; flexible rod, $1.50; total, $76.50.

The following applies to Nos. 9, 10 and 11 (the last being an "architect's Y-level"). Each requires the same knowledge to adjust and operate as an engineer's level. Reach with self-reading rod, 400 ft. each way or 800 ft. at a set-up; with a target rod, 1,000 ft. at a set-up. The ½-mile was covered with a self-reading rod in one hour. The retentivity of adjustments is as good as with the engineer's level. The plan and construction of these instruments is the same as the standard engineer's instruments, but they are smaller and lighter, consequently their range is somewhat less. The sensitiveness of the bubbles is well suited to the magnifying power of the lenses.

While these tests were primarily made to determine the value of each instrument as a level, some of the instruments were arranged for the approximate measurement of angles. Consequently, an area was laid out and the angles measured with such instruments as had a compass or circle attachment. An engineer's plain surveying transit was used as a standard.

No. 5. A circle 3¼-in. diameter, graduated in degrees, was under the telescope. A metal arm attached to the spindle moved on the inner side of this circle and revolved with the telescope. No. 6 had practically the same angle attachment. In No. 7, the 4-in. metal disc had a zero line on one side, and revolved on the inner surface of the plate, which was graduated in degrees. In No. 8, a 3-in. compass was attached to the top of the box. In No. 10, a 3-in. compass was inside the circle on the bar which carried the Y's while on the outside and beneath the bar was a vernier which moved on a 3½-in. circle divided into degrees. In No. 11 (architect's Y-level), the bar which carried the Y's, had underneath it a 3-in. circle graduated in degrees. The sides of the bar were curved outward in a circle, and one of the sides carried a vernier which moved on the upper surface of the circle.

Summary of Factory Instruments.—None of the factory-made instruments were entirely satsfactory, until No. 9 (the architect's dumpy level) was reached. This seems to be the cheapest instrument that can be really depended on. Such an instrument, including a satisfactory rod, would cost $41. If it is desirable to have an instrument that can be used for measuring angles, it then becomes necessary to get the architect's Y-level No. 11. This instrument, with the same rod as above, would cost $51.

All of the factory instruments preceding No. 9 were unsatisfactory or faulty in some respect, as in the effort to meet the demand for cheap instruments the instrument makers have turned out crudely made instruments, not thoroughly tested. Too much care has been taken to secure a good telescope, without proper regard to the cross hairs and sensitiveness of the bubble. The fact that the accuracy of the leveling instrument is dependent on the bubble rather than the magnifying powers of the telescope seems to have been overlooked. All of these cheaper instruments have very light tripods, and the rods that come with them are only makeshifts and of little value, being either poorly made or too short for actual service.

Conclusions.—From the experiments the following conclusions can be drawn. The small levels usually carried in stock by hardware men are worthless when used as bubbles on crude surveying instruments. The bubble of the ordinary carpenter's level is not of sufficient sensitiveness to insure at all times good results when used on an instrument for running long lines.

The straight edge is not satisfactory as a surveying instrument.

A triangle is of considerable value where great accuracy is not required. Its sufficiency could be considerably increased by using a better grade bubble than comes in the ordinary carpenter's level.

The 25-ft. length of hose is the best instrument for the inexperienced person to use. Its accuracy is good when the conditions named under No. 3 are observed. There is only a small outlay in the intial cost, for garden hose can be used for other farm purposes.

The smallest sum that can be invested in an outfit that will be reliable and give satisfactory results is $41 for an equipment which will not measure angles, or $51 for an equipment that will measure angles. The knowledge to adjust and operate them would require a general knowledge of the engineer's level.

Where it is not possible to invest in the cost of instruments 9 and 11, and something more convenient than the hose is desired, a carpenter's level fitted with sights, having a bubble just a little better than ordinarily comes in such a tool, and mounted on a home-made tripod, will give better results than the cheaper factory-made instruments of a corresponding price. Such an equipment ought to be fitted out at a cost not to exceed $15 for the instrument, while the cost of a suitable rod (which should be the same as for Nos. 9 and 11) would bring the total price of the outfit up to $21. Such an instrument would be more stable when set up and would stand more rough usage than any of the factory instruments tested preceding No. 9. When not in use as a surveying instrument, the level could be used as a carpenter's level.

Any of the instruments give satisfactory results in angle work for farm surveys where the boundary lines are established.

A Method of Sinking Curbed Foundation Wells Using Shields and Compressed Air with Some Notes on Chicago "Caisson" Foundations.*

A large portion of the city of Chicago is built upon an ancient swamp. At some time in the past it must have been a veritable quagmire. The mean elevation of the streets is about 15 ft. above the level of Lake Michigan. The underlying rock in the business portion of the city is found at depths of from 90 to 120 ft. below the street level. This rock outcrops at a distance of from 5 to 8 miles west of the lake shore. Immediately overlying the rock is a variable stratum of sand, gravel and boulders. This is a water bearing stratum. At many places it is only a few feet thick; at other places it reaches a depth of 15 or 20 ft. Overlying this stratum is one usually termed "hardpan." In composition it is variable, being principally a hard blue clay resembling shale, but not laminated. Frequently sand pockets and boulders are found in it, especially near the bottom of the stratum. Over the hardpan and reaching to within a few feet of the surface is a stratum of soft, plastic, homogeneous blue clay.

Very often there is no clearly defined line of demarcation between the soft blue clay and the hardpan underneath; but the former gradually merges into the latter. Except for the sand and boulders found in the hardpan, there is apparently very little difference in composition between it and the blue clay. The hardpan appears like blue clay from which all the water has been squeezed by the great pressure of the material above. The blue clay can be easily cut with the spade, while the hardpan can only be loosened by the pick or mattock. The top stratum, over the blue clay, consists of loam with yellow clay and sand in some places.

Until in recent years, all heavy foundations, such as bridge piers and abutments, and foundations for the heavier class of buildings, were placed on pile foundations. Piles from 50 to 60 ft. long were easily driven their full length through the soft blue clay with their points penetrating the hardpan underneath. This type of foundation is still used to a great extent, and will probably continue to be used for some time to come.

Many of the buildings which were built 15 years ago and earlier were placed on what were termed "spread foundations." They were sometimes called "floating foundations." These consisted of small masonry piers or pedestals under the points of support, the bases of which were widened to distribute the pressure over as great an area as possible. They were generally only carried down to a depth of 10 to 15 ft. below the surface. These small piers were frequently built of concrete in which steel I beams were laid side by side imbedded to distribute the pressure.

The pressure on the clay from foundations of this type was usually limited to about 3,000 lbs. per sq. ft., and it was expected that some settlement would take place in them. In erecting buildings on such foundations, provision was always made for a certain amount of settlement, usually not less than 6 ins., and very often as high as 18 ins., by setting the buildings a certain distance above the grade to which they were expected to ultimately settle. The problem for the engineer in this class of buildings was to distribute the weight so equally that the settlement would be uniform. This condition was very difficult to secure, and many examples of cracked walls have been the result.

Buildings placed on these spread foundations were generally limited to 6 or 7 stories in height, and as the ground space in the city became more valuable it became desirable to provide more stable foundations. With the spread foundations also it was impossible to provide much basement room, as the space was so largely taken up by the foundation piers. It was therefore desirable to provide a type of foundation that would permit of more basement room for storage purposes and for the location of power and heating plants. These necessities led to what is now termed the "caisson method."

This method consists of the sinking of circular wells to the hardpan or to the solid rock and filling them with concrete. The credit for this invention is due to Gen. William Soey-Smith, and was first employed on the Stock Exchange building, built in 1889. The word "caisson" as applied to this type of foundation is a misnomer, but it has been so extensively used in this connection that we may assume it to have become legitimate through custom.

The process of sinking these caissons is very similar to the well known method of sinking wells. The bore is lined or curbed with sections of plank 4 or 5 ft. long and usually about 3 ins. thick and 4 ins. wide. These plank are braced and held in position by circular bands of iron, one being placed near the top and one near the bottom of each section. It is customary to use tongued and grooved plank to prevent serious leaks in case much water is encountered. The several sections of plank lagging are added as the digging proceeds. The caissons are seldom made less than 4 ft. in diameter, as it is difficult for a man to work in a smaller space, and they do not often exceed 8 ft., although some have been built as large as 12 ft. in diameter.

If the foundation is carried down only into the hardpan, it is customary to enlarge the diameter of the caisson at the bottom in order to give a greater bearing area.

The caisson is usually carried down to the required depth with a uniform cross section, then one or two sections of the lagging are removed and the bell shaped form given to the lower portion. The rate of increase in the diameter should not exceed 1 ft. of increase to 1 ft. of height, or, in other words, the slope of the side should not exceed 1 ft. horizontal to 2 ft. vertical.

It is always advisable to increase the diameter at the bottom, even though the allowable pressure on the underlying material should not require it, for the increase costs but very little, and adds greatly to the stability of the entire column. A simple calculation will show that the unit pressure on the foundation is greatly diminished by this increase in area, for the area increases as the square of the diameter, while very little is added to the weight of the column. Assuming a caisson 6 ft. in diameter and 100 ft. deep with the bottom 5 ft. belled out to a diameter of 10 ft.; then we have:

Volume of caisson including the bell	110 cu. yds.
Volume of caisson without the bell	105 cu. yds.
Increase in volume	5 cu. yds
Percentage of increase in volume	5 per cent
Area of base 10 ft. in diameter	78.5 sq. ft.
Area of base 6 ft. in diameter	28.3 sq. ft.
Increase in area	50.2 sq. ft.
Percentage increase in area	178 per cent

Where the caisson is carried down to the rock, the footing is not usually enlarged. It would be much better if it could be enlarged as is done when the footing is made in the hardpan, but the dangers and difficulties are so great that it is not often undertaken. There is usually so much water encountered in the stratum overlying the rock that it is dangerous to remove any portion of the lagging for enlarging the bottom. It is very often necessary to put in the lagging in short sections near the bottom in order to prevent the caving and sloughing in of the surrounding material. A few anxious hours are generally spent by those responsible for the safety of the work when the rock is about reached, and a great sense of relief is felt when the rock is cleaned off and a few feet of concrete are placed in the bottom.

It is customary to allow about 20 tons pressure on the rock and from 5 to 7 tons on the hardpan. The pressure on the rock itself could be taken at a much higher value, in fact there is practically no limit to the pressure which might be safely put upon it, but it is the strength of the concrete to resist pressure that fixes the limit. The pressure on the hardpan might be safely put at a higher figure if we were certain as to what lay underneath. It is the possibility that there may be pockets of softer material between it and the rock that has made engineers conservative in fixing the limit of 5 to 7 tons.

After the caisson has been carried to the rock, it is filled with concrete. The iron bands supporting the lagging are removed as fast as the concrete is filled in so that it will hold the lagging in place. The removal of the iron bands is only for the purpose of saving them for use in other caissons. Sometimes the lagging is also removed a section at a time, just before filling with concrete. This method is preferable to leaving the lagging in, but it is not always practicable to remove it on account of the danger of the sides caving in. When the lagging is removed, there is a greater certainty of having all the spaces absolutely filled with concrete and a greater frictional resistance is secured between the concrete and the surrounding material. It is impossible to dig the wall so true that the lagging will fit tight against the earth at all points, and there are always more or less open spaces outside the lagging which eventually will become filled by the settlement of the earth, and this settlement is apt to extend clear to the surface and cause settlement in surrounding buildings.

The process of sinking caissons is quite a rapid one. The rate of sinking through the soft material will average from 8 to 10 ft. per day, but through the hardpan it is often not more than half that much.

The exacavated material is hoisted to the surface in buckets by a winch head or a windlass operated by a hoisting engine. A very simple method has been devised by which one hoisting engine is made to do the work for several caissons at once. A wooden tripod is erected over each caisson, to which is at-

*Abstract of paper by W. C. Armstrong, Formerly Engineer Chicago & North-Western Ry., in the Iowa Engineer for April 1919.

tached an iron sheave and winch head keyed to the same shaft. The tripods over several caissons are set over the centers of the caissons. A steel cable passing from the drum on the engine is then extended to each tripod and given one wrap around each sheave. The cable is then returned to the engine and the two ends spliced. It operates the same as an ordinary rope drive so often applied for the transmission of power. The engine is run slowly and continuously so that each winch head in the system is always revolving. A rope is attached to the bucket and given a number of wraps around the winch head, the free end of the rope being held by the man operating the bucket, and is paid out when the bucket is descending, and coiled up again when the bucket is being hoisted. It is not necessary that all the caissons in one system be in the same line, for the direction of the drive rope can be easily changed by means of snatch blocks. Frequently four lines of caissons forming a rectangle may be seen in operation at the same.

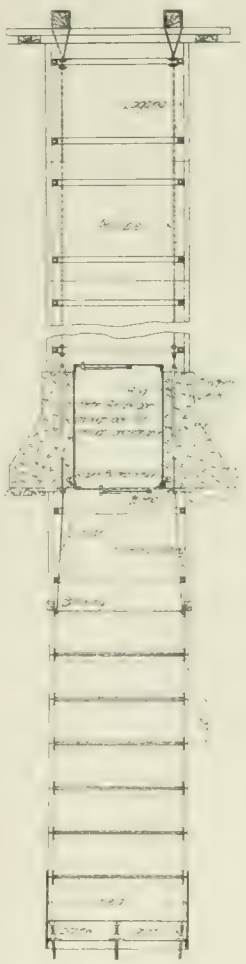
The invention of the caisson method has made possible the construction of very deep basements as well as "sky scraper" buildings. Some of the recent buildings erected in Chicago have basements reaching a depth of 50 ft. below the street. These, of course, consist of several floors below ground. The tunnels of the Illinois Tunnel Co., which traverse nearly every street in the business districts of the city, have spurs into the deeper basements, by means of which goods are delivered to and from the railroad stations, coal is delivered for the use of power plants and the ashes from same are removed; and all this traffic is constantly going on underground to the great relief of the overcongested streets.

The sinking of caissons has all been done by the open process here described, except in a few instances where air has been employed. The Northwestern Ry. Co. was the first concern to employ the use of air for this class of work. The new bascule bridge across the north branch of the Chicago river leading into the Wells street station is carried on six caissons 10 ft. in diameter, on which air was used in the operation of sinking. It is possible that they might have been sunk by the open method, but it was deemed advisable to use air as a precaution against possible accident, as there were unusual conditions to be met. The caissons were sunk in the bed of the river where there was about 12 ft. of water and several feet of soft, slimy mud in the bottom.

Air was also used in some of the caissons sunk for the foundations of the new Northwestern passenger station. These were started by the open method, and a few of them completed to the rock by that method, but much difficulty was encountered after reaching the gravel and boulders over the rock. There was a large amount of quicksand in this stratum and so much water flowed in that it was found impracticable to keep it baled out so that progress could be made with the digging. The flow of water carried in such quantities of sand that it was feared large pockets would be formed outside of the caisson which would lead to dangerous settlements of the surrounding material. The use of air was therefore resorted to. The airlock was placed in the hardpan stratum as far below the surface as possible. The caisson was enlarged at this point, and the lock sealed in a collar of concrete. A sectional view of this construction is shown in Fig. 1.

A circular shield 5 ft. long and made of ⅜-in. steel plate was inserted below the lock. Around the cutting edge of this shield an angle was riveted as shown in the sketch. The lagging to be used was made up in sections about 2 ft. long. It was composed of tongued and grooved plank to which were bolted circular angle bands at the top and bottom. The joints in the plank were caulked with oakum and tar and made as nearly air tight as possible. The sections of lagging were made of the proper diameter to fit closely the inside diameter of the shield. Between the bottom angle of the lagging and the angle around the cutting edge of the shield, jackscrews were placed for forcing the shield downward. Whenever the shield was forced down far enough, and the material was excavated the jacks were removed and another section of lagging was put in place. The top angle of the lower section of lagging was bolted to the bottom angle of the upper section after a rubber gasket had been inserted between them to prevent the escape of air.

However, with all the precautions taken to prevent the escape of air, it was found that it did escape quite rapidly. Part of it escaped through the sections of lagging, some escaped through the joints between the lagging and the shield, and a great deal escaped through the gravel and boulder stratum through which the caisson was being sunk. After considerable experimenting, it was found that the escape of air through the lagging and the shield could best be prevented by plastering with mud. For this purpose the soft blue clay found above the hardpan proved very efficient. The loss of air through the gravel and boulders could not be prevented and the only way



Sketch Showing Method of Sinking Curbed Foundation Well With Shield and Compressed Air.

to overcome this loss was by forcing in a greater supply of air. Eighty-eight caissons under the station building were sunk by this method, and four supporting the chimney for the power house.

The cost of caissons sunk by the open process will vary from $10 to $20 per cu. yd. Caissons founded in the hardpan can usually be completed for $10 per cu. yd., while those carried to the rock will vary more in cost, depending upon the difficulties met with. The cost of the concrete may be regarded as the constant factor in the total cost, and is usually somewhat less than half the total, while the cost of excavating is the variable factor. Where air is used the cost is subject to greater variations and is so contingent upon the conditions met with in the excavation of the work that no reliable figure can be given. Generally it will be about double the cost of excavation.

The novel method of shaft sinking referred to by Mr. Armstrong is further described in the following data collected by one of the editors.

At the work on the Chicago & Northwestern Ry. Terminal station, the first group of six caissons was excavated in the ordinary manner and it was found that on account of the difficulty with water and sand in the lower strata, another method would have to be used. Accordingly, Geo. A. Fuller Co., the General Contractors for the erection of the station, let a sub-contract to The Foundation Co. of Chicago, to excavate the lower part of the caissons and place concrete in them up to a point above the water-bearing stratum. The point at which The Foundation Co. took the work was about 70 to 80 ft. below street level and the work was carried to rock, which was from 106 to 116 ft. below the street. This part of the work was carried on under air pressure.

Provisions were made in each caisson to start the work under air pressure before the excavation had reached the bottom of the hard-pan. A collapsible steel air lock was hung in the caisson 5 or 6 ft. from the bottom and concreted in. The lock was 4½ ft. in diameter and 5½ ft. long, and was fitted with doors of the Moran type. The air pipe was passed through the lock and not through the concrete. Arrangement was also made to pass the wire cable through stuffing boxes in the lock and thus it was possible to leave the cable attached to the bucket. With the lock in position a shield was placed directly under it and the excavation continued without air pressure until water bearing strata were reached. The lock was then closed and as much air pressure turned on as was required to hold back the water.

The shield used was 4 ft. long and slightly larger in diameter than the bottom of the footing. It was made of steel plates in four vertical sections, which were arranged to be joined on the inside. An angle, bent to fit the circle, was riveted to the inside at the bottom of the shield. This was used to provide a footing for the four 10-ton screw jacks which were placed between the angle and the lagging above. Below the air lock the lagging used was 2 ins. thick, tongued-and-grooved, and in 3 ft. lengths. When the shield had advanced 3 ft. another section of wooden lagging was placed and the bottom of the preceding lagging still overlapped the shield 6 or 8 ins. This provided a seal between the shield and lagging and caving was thus prevented. A set of iron hoops, ¾x3 ins., were used to brace the lagging above the airlock, but below it angles were used. This lagging was assembled in sections before lowering into the caisson. The sections were made to comprise one-fourth of the circle and the angles arranged so as to be bolted to the angles on the adjacent sections.

When the shield was set firmly on rock at the bottom of the caissons, the bolts in the angle near the cutting edge were removed so that the angle was recovered. The concrete was then deposited in the bottom and carried up to the next angle which was also removed and saved for future use. The lagging was thus left in place and braced at all times either by the angles or the concrete.

After the concrete was placed as far as the lock the latter was collapsed by removing a key in one of the joints between the two longitudinal sections which composed it, and the lock was removed. Following this the balance of the concrete was dumped into the open caisson directly from the surface. The amount of drop thus secured produced satisfactory results without requiring tamping and without separating the aggregate.

The plant used to supply air consisted of three Ingersoll-Rand duplex air compressors, each with a capacity of 1,200 cu. ft. of free air per minute when operating against a 25-lb. pressure.

Four 125 hp. boilers were used to supply steam and were usually operated at their full capacity. Even with this output of 3,600 cu. ft. of free air per minute it sometimes was possible to supply enough air to operate only six caissons at a time. This was due to encountering clean, loose gravel in the caissons through which the air passed readily. It was found that the air passed out from the cais-

sons through these water-bearing strata, following along under the deep bed of clay until it reached a point where an opening had been made through the clay to the upper surface. These points, of course, were wherever another caisson had been completed and the air found its way up alongside the lagging which was left in place.

The progress made on the work by The Foundation Co. averaged about six completed caissons a day. An average of 12 gangs of men were kept at work in 3 shifts of 8 hours. Each gang consisted of from 1 to 3 men in the bottom, according to the diameter of the caisson; 1 man in the air lock and 2 men at the top.

We are indebted to Mr. Frederick W. Adgate, Western Manager of The Foundation Co. for the above drawing, illustrating the method used.

Road Repairs and Maintenance Work of the Metropolitan Park Commission of Massachusetts in 1909.

During 1909 the Engineering Department of the Metropolitan Park Commission of Massachusetts continued the use of tars and oils for road repairs and road treatments. The material used for this work were the same as used in previous years, heavy asphaltic oils being used upon the gravel surfaced roads and on some macadam, and refined tars and residual asphalts upon the greater portion of the macadam road surfaces.

Calcium chloride solution was used on some of the roadways which are not subjected to heavy automobile traffic, or where they are used to a large extent by pedestrians, as at Nantasket and Nahant Beaches and in the woods reservations. In the selection of the material to be used on the various roadways the kind of roadway surfaces and the existing traffic conditions were considered, and that material used which seemed to be best adapted to these conditions.

The type of roadway surfacing generally used during 1909 for new construction work has differed from that previously used, and consists of a crushed stone base of a thickness of 4 ins., with a gravel top or wearing surface from 2 to 3 ins. in thickness, thoroughly saturated with heavy asphaltic oil.

A summary of the cost of the road repairs and maintenance work is given in the accompanying table, the data being rearranged from the recently issued report of the Commission.

The following will explain more fully the various classes of work noted in the table:

By surface treatment is meant the application of refined tars, asphaltic oils or calcium chloride to the surfaces of roadways which are in good condition, for their preservation and for the suppression of the dust. Usually it is necessary only to clean the roadway before treating, and give a light dressing of crushed stone screenings, sand or gravel after treating.

By resurfacing it is meant that a macadam or gravel surfaced road which has become badly worn is loosened up on the surface to a depth of about 3 in., by the use of a scarifier. The surface is then reshaped and from 2 to 3 ins. of new material added, and the road rolled and treated with bituminous binder in the same manner as in new construction work.

By construction it is meant that an old earth roadway is excavated to subgrade sometimes with changes in the line of grade, and a new surface of crushed stone or gravel or a combination of both is constructed thereon. The depth of the surfacing material is generally about 6 ins.

All of the Engineering work of the Metropolitan Park Commission is done under the direction of John R. Rablin.

Cost of Gravel Surfacing with Traction Outfit.—The greater part of the roads in the town of Glenville, N. Y., are surfaced with pit gravel, the town doing the work with a traction engine outfit. In the following cost data, covering a period of years, no account is made of the value of gravel. The outfit consists of a traction engine, four 5 cu. yd. cars, bin and conveyors. It cost $3,250. The average yearly repair bill has been $50 per year, and the average cost of working per day without the bin has been $10. The average cost of working per day with bin has been $16. When using the elevator and bins nearly double the yardage per day has been moved. The average cost per cubic yard of gravel placed on road (three mile haul) has been 42 cts.; for a one mile haul the cost has been 20 cts. per cubic yard and in some cases the cost has been as low as 15 cts. per cubic yard. The cost of surfacing one mile of road with 4 ins. of gravel (three mile haul) has been $350 to $400 per mile. The cost of surfacing one mile of road with 4 ins. of gravel (one mile haul) has been $225 to $300 per mile. The labor required is as follows:

	Per day.
One engineer	$3.00
One helper	1.75
2 laborers, at $1.50	3.00
When using bin, one team	4.00

SUMMARY OF COST OF ROAD REPAIRS AND MAINTENANCE IN 1909 BY THE METROPOLITAN PARK COMMISSION OF MASSACHUSETTS.

	Length, ft.	Width roadway, ft.	Sq. yds.	Kind of binder or dust layer.	Labor cost, cents.	Gravel, cents.	Broken stone, cents	Sand, cents.	Binder or dust layer, cents.	Total, cents per sq. yd.
Surface Treatment—Detailed Cost Per Sq. Yd. in Cents.										
Blue Hills Parkway	15,200	26-36	62,100	Asphaltoilene[1]	.1	....	.5	....	3.1	4.6
Charles River Reservation	13,100	40,50,60	76,100	Calcium chloride	.2	....	....	....	.7	2.7
Fresh Pond Parkway	2,700	40	12,000	Calcium chloride	.1	....	....	....	1.5	1.6
Furnace Brook Parkway	7,750	36-40	31,010	Calcium chloride	.1	....	....	....	.3	.4
Lynn Falls Parkway	2,600	40	11,555	Calcium chloride	.7	....	....	....	[illegible]	2.7
Lynn Shore Reservation	7,180	40	34,817	Calcium chloride	.2	....	....	....	1.6	1.8
Middlesex Falls Reservation	3,000	18	6,000	Calcium chloride	.7	....	....	....	1.3	2.0
Middlesex Falls Reservation	1,700	18	3,400	Calcium chloride	.3	....	....	....	.9	1.2
Nantasket Beach Reservat'n	3,760	40	24,935	Calcium chloride	.5	....	....	....	[illegible]	3.5
Quincy Shore Reservation	11,800	24-40	37,155	Calcium chloride	.1	....	....	....	.3	.4
Charles River Reservation	5,000	24	13,333	Liquid asphalt[2]	.9	.7	....	....	3.5	5.1
Revere Beach Reservation	7,900	40	29,840	Liquid asphalt	1	....	1.4	....	2.2	4.6
Parkway	2,350	40	10,440	Tarite-asphalt[3]	2.1	....	1.9	....	2.5	6.5
Revere Beach Reservation	1,800	40	6,800	Tarite-asphalt	1.9	....	.9	....	2.9	5.7
Middlesex Falls Reservation	3,220	19	6,798	Asphaltic oil[4]	2.2	....	....	....	[illegible]	3.0
Middlesex Falls Reservation	880	20	1,956	Asphaltic oil[4]	.5	....	....	....	1.2	1.7
Mystic Valley Parkway	8,600	36	34,000	Asphaltic oil[4]	.4	....	....	....	.9	1.3
Neponset River Parkway	2,750	26	7,944	Asphaltic oil[5]	.5	....	....	....	[illegible]	3.5
Stony Brook Reservation	13,075	16	23,247	Asphaltic oil[5]	.8	....	....	....	[illegible]	3.2
Mystic Valley Parkway	1,900	34	7,178	Tarvia-asphalt[6]	4.4	....	3.4	....	4.9	12.7
Middlesex Falls Parkway	2,300	30-36	8,000	Tarvia-asphalt[6]	3.1	....	2.6	....	3.7	9.4
Revere Beach Parkway	5,075	28	13,139	Tarvia-asphalt	1.6	....	1.7	.1	2.4	5.8
Revere Beach Parkway	700	36	2,333	Tarvia-asphalt	1.7	....	1.7	....	3.3	6.7
Revere Beach Parkway	4,100	36	16,400	Tarvia-asphalt	1.6	....	.9	....	1.4	3.9
Revere Beach Parkway	3,600	36	12,900	Tarvia-asphalt	2.7	....	1	....	3.4	7.1
Resurfacing—Detailed Cost Per Sq. Yd. in Cents.										
Middlesex Falls Reservation	800	20	1,778	Calcium chloride	12.3	20	....	....	6	32.9
Middlesex Falls Reservation	3,000	18	6,000	Asphaltic oil	2.2	17.7	....	....	1.5	21.4
Middlesex Falls Parkway	3,200	36	12,800	Asphaltic oil	1.9	16.3	....	....	1	19.2
Revere Beach Parkway	3,300	36	13,200	Asphaltic oil	8.3	3.4	....	[illegible]	7.2	19.2
Revere Beach Parkway	1,600	26	4,622	Asphaltic oil	6.2	....	5.7	....	4.7	16.6
Middlesex Falls Reservation	2,600	25	7,222	Tarvia-asphalt	11.6	....	7.1	....	9.8	28.5
Reconstruction.*—Detailed Cost Per Sq. Yd in Cents.										
Middlesex Falls Reservation	4,790	19	10,112	Liquid asphalt	14	21.9	24.3	..	6.6	66.8
Mystic Valley Parkway	2,070	36	8,280	Liquid asphalt	14	18.9	18.2	....	7.6	58.7
Middlesex Falls Reservation	1,330	19	2,808	Tarite-asphalt	25.3	....	15.3	..	15.2	55.4
Middlesex Falls Parkway	600	35	2,333	Tarvia-asphalt	25	....	18.2	....	8.6	51.8
Patching—Detailed Cost Per Sq. Yd. in Cents.										
Revere Beach Parkway	5,200	26-36	17,189	Tarvia-asphalt	.9	....	....	....	.5	1.4
Revere Beach Reservation	4,300	40	16,240	Tarite-asphalt	.6	....	....	....	1.5	2.1
Construction—Detailed Cost Per Sq. Yd. in Cents.										
Middlesex Falls Reservation	2,400	20	5,333	Calcium chloride	27.6	17.8	19.8	..	1.6	66.8

*Includes sub-grading.
[1]Good Roads Improvement Co. [2]Indian Refining Co. [3]American Tar Co. [4]Texas Co. [5]Standard Oil Co. [6]Barrett Mfg. Co.

Personals.

Mr. E. B. Parsons has been re-elected City Engineer of Oconomowoc, Wis.

Rear Admiral Philip Hichborn (retired), chief constructor of U. S. Navy from 1893 until his retirement in 1901, died May 1 after a long illness. He was 71 years old.

Charles R. Clow, vice-president of the firm of James Clow & Sons, large dealers in plumbers' and water works supplies and machinery, died in Chicago, Ill., on May 7, 1910, of cerebral hemorrhage. He was born at Pittsburg, Pa., March 22, 1865.

Mr. Walter Irvine Schlichter has been appointed Professor of Electrical Engineering at Columbia University. Prof. Schlichter was graduated from Columbia in 1896 and has for a number of years been with the General Electric Co. at Schenectady, N. Y.

Charles F. Foster, Mechanical Engineer, died suddenly May 7 at his residence in Chicago, Ill. Mr. Foster was the chief mechanical engineer of the Columbian Exposition and filled similar positions at the Atlanta and St. Louis expositions. He was engaged in general engineerng business at the time of his death.

William Storrs MacHarg, M. Am. Soc. C. E., died at Chicago, Ill., on May 6, 1910, of heart disease and parlysis. Until his final illness Mr. MacHarg had been a consulting engineer in charge of the intercepting sewer system of Chicago. He had charge of the sewerage and water supply systems and the fire protection system for the World's Columbian Exposition and was well known for his work in similar lines throughout the west. Mr. MacHarg was born at Albion, N. Y., Nov. 18, 1867.

Governor Deneen of Illinois has appointed the following commission to establish fire fighting and rescue stations in coal fields in Illinois, as provided in an enactment at the special session of the legislature. The commission, composed of two operators, two members of the miners' union, a state mine inspector, a representative of the University of Illinois and a representative of the federal government, follows: J. W. Miller, Gillespie; John L. Schmidgall, Murphysboro, operators; Charles Krallman, Glen Carbon; Charles Bennett, La Salle, miners; Hector McAllister, Streator, state mine inspector; Prof. H. H. Stoek of the State University; Dr. J. A. Holmes of the Geological Survey, Washington, D. C.

Mr. A. W. Thompson, Chief Engineer of the Baltimore & Ohio R. R., has announced the following changes in the engineering organization: Mr. John T. Wilson, former assistant engineer at Baltimore, has been promoted to district engineer, with jurisdiction between Philadelphia and the Ohio river at Parkersburg and Wheeling, with headquarters in Baltimore. Mr. R. N Begien, former division engineer of the Philadelphia division, has been appointed assistant to the chief engineer, with offices at Baltimore, and will be succeeded by Mr. E. T. Brown, former division engineer of the Shenandoah division. Mr. G. T. Warren becomes division engineer of the Shenandoah division at Winchester, Va., succeeding Mr. Brown.

John H. Converse, President of the Baldwin Locomotive Works, died suddenly May 3, at his suburban home at Rosemont, near Philadelphia, Pa., of heart disease. Mr. Converse was born in Burlington, Vt., in 1840, and was graduated from the University of Vermont in 1861. For the first three years after leaving college Mr. Converse was engaged in journalism. In 1864 he came to Chicago and secured a position in the general manager's office of the Chicago & Northwestern Ry. Two years later he removed to Altoona, Pa., becoming an assistant to Edward H. Williams, then general superintendent of the Pennsylvania R. R. When in 1870 Mr. Williams purchased an interest in the Baldwin Locomotive Works, Mr. Converse went with him, and three years later became a member of the firm. The entire remainder of Mr. Converse's business life was devoted to this establishment, and for nearly the whole time he was its administrative head.

Engineering-Contracting Monthly Review Index of Civil Engineering Literature.

A classified index and review of the civil engineering papers, articles, reports, pamphlets and books published during the month just passed is given in the succeeding pages. The literature indexed and reviewed—with the exception of books—relates solely to civil engineering. In the section devoted to Book Reviews all books in all branches of engineering are listed as received and such of them as seem worthy are reviewed as fully as due regard for conciseness will permit. In choosing books for review rigid selection is exercised. Next to careful choice of books for review timeliness of review is sought. All books are reviewed within a month of their receipt. The same statement is true of the articles and papers that are indexed. Also, as in choosing books for review, the choice of articles and papers for indexing is based on merit. Numerical strength in "titles indexed" is not sought; excellence of selection is sought.

The purposes of the Monthly Review Index are: First, to inform civil engineers and contractors of the articles and papers of merit that are published each month, in such a way as will give a clear idea of their character and scope; second, to supply the user with the date and place of publication, the length of each article and the cost at which it can be secured. The name, adopted abbreviations, place of publication and price per number of each periodical examined for civil engineering articles are given in the list immediately following. The other information is given in the index proper for each article separately.

Books reviewed will be sent post paid on receipt of price by the Book Department of ENGINEERING-CONTRACTING; periodicals, etc., containing articles indexed should be ordered direct from the publishers.

LIST OF PERIODICALS INDEXED.

American Architect (Am. Arch.), New York, N. Y.; w.; 7x10 in.; 15 cts.
American Builders' Review (Am. Bldrs. Rev.), San Francisco, Cal.; m; 7x10 in.; 50 cts.
American Carpenter and Builder (Am. Car. & Bldr.), Chicago, Ill.; New York, N. Y.; m; 7x10 in., 20 cts.
American Engineer and R. R. Journal (Am. Engr. & R. R. Jl.); York, N. Y.; m; 7x10 in.; 20 cts.
American Gas Light Journal (Am. G. L. Jl.), New York, N. Y.; w; 10x13 in.; 10 cts.
American Institute of Electrical Engineers Proceedings (Am. I. of E. E. Proc.), New York, N. Y.; m; 4x7 in.; 50 cts.
American Machinist (Am. Mchst.), New York; w; 7x10 in.; 15 cts.
American Society of Civil Engineers Proceedings (Am. Soc. C. E. Proc.), New York, N. Y.; m; 4x7 in.; 75 cts.
American Society of Mechanical Engineers Journal (Am. Soc. M. E. Jl.), New York, N. Y.; m; 4x7 in., $1.
Annales des Ponts et Chaussees (An. P. & C.), Paris, France; m.
Applied Science, Toronto, Ont.; m; 6x9 in.; 20 cts.
Architects and Builders' Journal (Arch. & Bldrs. Jl.), Baltimore, Md.; m; 9x12 in.; 20 cts.
Architects and Builders' Magazine (Arch. & Bldrs. Mag.), New York, N. Y.; m; 5x8 in.; 20 cts.
Architect and Engineer of California (Arch. & Engr.), San Francisco, Cal.; m; 5x7 in.; 15 cts.
International Railway Congress Bulletin (Int. Ry. Cong. Bul.), Brussels; m; 50 cts.
California Journal of Technology (Cal. Jl. of Tech.), Berkeley, Cal.; m; 4x7 in.; 25 cts.
Canadian Architect (Can. Arch.), Toronto, Ont.; m; 7x19 in.; 20 cts.
Canadian Cement and Concrete Review (Can. Cem. & Conc. Rev.), Toronto, Ont.
Canadian Engineer (Can. Engr.), Toronto, Ont.; w; 7x11 in.; 20 cts.
Canadian Machinery and Manufacturing News (Can. Mach. & Mfg. News), Toronto, Ont.; m; 7x10 in.; 15 cts.
Canadian Mining Journal (Can. Min. Jl.), Toronto, Ont.; bi-w; 7x10 in.; 20 cts.
Canadian Municipal Journal (Can. Mun. Jl.), Montreal, Que.; m; 6¾x10 in.; 10 cts.
Canadian Society of Civil Engineers Proceedings (Can. Soc. C. E. Proc.), Montreal; m; 4x7 in.; 50 cts.
Carpentry and Building (Carp. & Bldg.), New York, N. Y.; m; 11x8 in.; 10 cts.
Cassier's Magazine (Cas. Mag.), New York; m; 5x8 in.; 25 cts.
Cement, New York, N. Y.; bi-m; 5x8 in.; 25 cts.
Cement Age (Cem. Age), New York, N. Y.; m; 4¾x8 in.; 15 cts.
Cement and Engineering News (Cem. & Eng. News), Chicago, Ill.; 7x10 in.; 25 cts.
Cement Era (Cem. Era), Chicago, Ill.; m; 7x10 in.; 10 cts.
Cement Record (Cem. Rec.); m; 4¾x8 in.; 15 cts.
Cement World (Cem. Wld.), Chicago, Ill.; m; 9x11 in.; 10 cts.
Chemical Engineer (Chem. Engr.), Chicago, Ill.; m; 4x7 in.; 15 cts.
Clay Worker (Cl. Wkr.), Indianapolis, Ind.; m; 7x10 in.; 20 cts.
Compressed Air (Comp. Air), New York, N. Y.; m; 5x7 in.; 10 cts.
Concrete, Detroit, Mich.; m; 6x9 in.; 15 cts.
Concrete Age (Conc. Age), Atlanta, Ga.; m; 9x11 in.; 10 cts.
Concrete and Constructional Engineering (Conc. & Cons. Eng.), London, England; m; 5x7 in.; 25 cts.
Concrete Engineering (Conc. Eng.), Cleveland, O.; m; 7x10 in.; 10 cts.
Contractor (Contr.), Chicago, Ill.; bi-w; 7x10 in.; 20 cts.
Cornell Civil Engineer (Cor. Civ. Engr.), Ithaca, N. Y.; m; 4x7 in.; 25 cts.
Domestic Engineering (Dom. Engr.), Chicago, Ill.; w; 6x9 in.; 10 cts.
Electrical Age (Elec. Age), New York, N. Y.; m; 7x10 in.; 10 cts.
Electrical Review (Elec. Rev.), New York, N. Y.; 8x10 in.; 10 cts.
Electric Railway Journal (Elec. Ry. Jl.), New York, N. Y.; w; 7x10 in.; 10 cts.
Electrical World (Elec. Wld.), New York, N. Y.; w; 7x10 in.; 10 cts.
Electric Traction Weekly (Elec. Trac. Wkly.), Chicago, Ill.; w; 7x10 in.; 10 cts.
Engineer (Engr. Lon.), London, England; w; 4x11 in.
Engineer (Engr.), Chicago, Ill.; bi-w; 7x10 in.; 20 cts.
Engineering (Eng.), London, England; w; 8x11 in.
Engineering-Contracting (Eng.-Contg.), Chicago; w; 7x10 in.; 10 cts.
Engineering Digest (Eng. Dig.), New York; m; 5x8 in.; 20 cts.
Engineering and Mining Journal (Eng. & Min. Jl.), New York; w; 7x10 in.; 15 cts.
Engineering Magazine (Eng. Mag.), New York; m; 5x7 in.; 25 cts.
Engineering News (Eng. News), New York; w; 8x11 in.; 15 cts.
Engineering Record (Eng. Rec.), New York; w; 8x11 in.; 10 cts.
Engineers' Club of Philadelphia Proceedings (Engr.'s Club, Phila. Proc.), Philadelphia; qr; 4x7 in.; 25 cts
Fire and Water Engineering (F. & W. Engr.), New York, N. Y.; 8x11 in.; 10 cts.
Le Genie Civil, Paris, France; w.
Good Roads Magazine (Gd. Rds. Mag.), New York, N. Y.; m; 7x10 in.; 10 cts.
Industrial Magazine (Ind. Mag.), Cleveland, O.; m; 4x7 in.; 10 cts.
Industrial World (Ind. Wld.), Pittsburg, Pa.; w; 7x10 in.; 10 cts.
Insurance Engineering (Ins. Eng.), New York; m; 4x6 in.; 25 cts.
Iron Age, New York, N. Y.; w; 7x11 in.; 15 cts.
Iron Trade Review (Iron T. Rev.), Cleveland, O.; w; 7x10 in.; 15 cts.
Irrigation Age (Irr. Age), Chicago, Ill.; m; 7x9 in.; 10 cts.
Journal Association of Engineering Societies (Jl. Assoc. Engr. Soc.), Boston, Mass.; m; 4x7 in.; 30 cts.
Journal Franklin Institute (Jl. Frank. Inst.), Philadelphia, Pa.; m; 4x7 in.; 50 cts.
Journal New England Waterworks Association (Jl. N. E. W. W. Assoc.), Boston, Mass.; q; 4x7 in.
Journal Western Society of Engineers (Jl. W. Soc. Engrs.), Chicago, Ill.; bi-m; 4x7 in.; 50 cts.
Journal of Electricity, Power and Gas (Jl. Elec., P. & G.), San Francisco, Cal.; w; 7x10 in.; 10 cts.
Journal of Worcester Polytechnic Institute (Jl. W. P. I.); m; 4x7 in.; 20 cts.
Machinery, New York, N. Y.; m; 7x11 in.; 20 cts.
Marine Review (Marine Rev.), Cleveland, O.; w; 7x10 in.; 15 cts.
Mines and Minerals (Mi. & Mls.), Scranton, Pa.; w; 7x9 in.; 20 cts.
Mining and Scientific Press (Min. & Sci. P.), San Francisco, Cal.; w; 7x11 in.; 15 cts.
Mining Reporter (Min. Rep.), Denver, Colo.; w; 7x10 in.; 15 cts.
Mining World (Min. Wld.), Chicago, Ill.; w; 7x10 in.; 10 cts.
Modern Machinery (Mod. Mchy.), Chicago, Ill.; m; 7x10 in.; 10 cts.
Municipal Journal and Engineer (Mun. Jl. & Eng.), New York, N. Y.; w; 7x10 in.; 10 cts.
Municipal Engineering Magazine (Mun. Eng. Mag.), Indianapolis, Ind.; m; 4x7 ins.; 25 cts.
Ores and Metals (O. & M.), Denver, Colo.; bi-w; 6x10 in.; 10 cts.
Pacific Building Engineer (Pac. Bldg. Engr.), Seattle, Wash.; w; 9x11 in.; 15 cts.
Popular Mechanics (Pop. Mech.), Chicago, Ill.; m; 5x7 in.; 10 cts.
The Polytechnic (Poly.), Troy, N. Y.; m; 5x8 in.; 15 cts.
Power and Engineer (Pwr. & Engr.), New York; m; 7x10 in.; 20 cts.
Railway Age-Gazette (R. R. Age-Gaz.), New York; w; 8x11 in.; 15 cts.
Railway Master Mechanic (Ry. M. M.), Chicago; m; 7x10 in.; 10 cts.
Railway and Engineering Review (Ry. & Eng. Rev.), Chicago, Ill.; w; 9x11 in.; 10 cts.
Railway and Locomotive Engineering (Ry. & Loco. Eng.), New York, N. Y.; m; 7x10 in.; 20 cts.
Railway and Marine World (Ry. & M. Wld.), Toronto, Ont.; m; 7x10 in.; 15 cts.
Railway Engineering and Maintenance of Way (Ry. Eng. & M. W.), Chicago, Ill.; m; 7x10 in.; 10 cts.
Roadmaster and Foreman (Rd. & For.), Chicago; 7x10 in.; 10 cts.
Rock Products (Rk. Prod.), Chicago, Ill.; bi-w; 9x11 in.; 10 cts.
Rose Technic, Terre Haute, Ind.; m; 4x7 in.; 15 cts.
School of Mines Quarterly (Sch. Min. Quart.), New York, N. Y.; qr; 4x7 in.; 50 cts.
Schweizerische Bauzeitung, Zurich; w.
Scientific American (Sci. Am.), New York; w; 9x14 in.; 10 cts.
Scientific American Supplement (Sci. Am. Sup.), New York, N. Y.; w; 9x14 in.; 10 cts.
Sibley Journal of Engineering (Sib. Jl. Eng.), Ithaca, N. Y.; m; 4x7 in.; 20 cts.
Stevens Institute Indicator (Stev. Inst. Ind.), Hoboken, N. J.; m; 4x7 in.; 20 cts.
Street Railway Bulletin (St. Ry. Bul.), Boston; m; 6x10 in.; 10 cts.
Surveyor (Surveyor), London, England; w; 6x11 in.; 10 cts.
Technology Quarterly (Tech. Qr.), Boston; qr; 4x6 in.; 35 cts.
U. S. Department of Agriculture Bulletin (Dept. Agr. Bul.), Washington, D. C.; 4x7 in.
U. S. Geological Survey Bulletin (Geo. Surv. Bul.), Washington, D. C.; 4x7 in.
Zeitschrift d. Oest. Ing. u. Arch. Ver., Vienna; w.
Zeitschrift d. Ver Deutscher Ing.; Berlin; w.

ROAD AND STREETS.

Retrospective and Suggestive. By Wm Weaver, Surveyor, Apr. 22, 1910; 1 p.

The author points to the difficulty which confronts the engineer in providing a road suitable alike for motor and horse traffic. He advises the more extensive use of destructor material for road work, especially in towns.

The Roads Question.—By H. T. Wakelam, Surveyor, Apr. 22, 1910; 2 pp.

The author gives some little data on the use of bituminous materials in road construction and improvement. An interesting feature of the article is a table showing the total percentages of annual increase of maintenance expenditures in various counties in England during 10 years.

Tar-Macadam: A Plea for Standardization.—By J. Walker Smith, Surveyor, Apr. 22, 1910; 5 pp.

The author takes it as an axiom that tar in some form is destined to play an important part in the road construction of the future. He deals in much detail with the two main methods of construction by pitch macadam and tar concrete or ordinary mixed tar macadam. An interesting feature of the article is a description of the elaborate mixing installation which the author proposes to install for Edinburg. Another valuable feature of this article is the specifications favored by Mr. Smith for bituminous bound roads. This is a valuable article by the author of "Dustless Roads" and the article is practically a supplementary chapter to that book.

A Word on the Carriageway.—By Henry E. Stilgoe, Surveyor, Apr. 22, 1910; 3 pp.

The writer of this article emphasizes the essential importance of good foundations in roadwork. The comparative economy of road materials is considered both as regards first cost and average life, and the conditions which justify the substitution of the paved road for the macadamized one, are discussed. The article includes a table showing the comparative cost of constructing and maintaining 10,000 sq. yds. of carriageway paved with granite and wood blocks on streets with heavy traffic.

Tarring.—By R. J. Thomas, Surveyor, Apr. 22, 1910; 1½ pp.

The article gives detail of cost of sweeping off dust and tarring surfaces during three months treatment of rural main roads. The work was done by eight gangs each, using a 50 or 80 gallon portable side fired boiler. The general instructions under which the tar painting was done are included.

Convex, Concave and Center-Channel Roads.—By Harold G. Turner, Surveyor, Apr. 22, 1910; 2½ pp.

The article contains a comprehensive list of the arguments which may be urged for and against the adoption of concave section for roads as compared with the center-channel roads or the usual convex form. The question is considered as regards initial cost, cost of upkeep, sanitation and utility possibilities and general considerations.

Wood Paving.—By James P. Norrington, Surveyor, Apr. 15, 1910; 1 pp.

The author describes various kinds of wood block paving and gives data as to life. He concludes that all paving should be laid diagonally, that the concrete should be 9 in. thick and that creosoted deal is preferable.

The Highway System of Los Angeles County, California.—By Prof. A. Hood, Mun. Eng. Mag., 7 pp.

Los Angeles county is spending $3,000,000 for the construction of 307 miles of highways. This article is a general description of the work being done.

Specifications for Cresote Oil.—Mun. Eng. Mag., May, 1910; 4 pp.

A report to a committee regarding specifications for creosote oil. Contains a fairly complete compilation of the various specifications for creosote oil and its use for wood preservation.

Road Maintenance in Cheltenham.—By J. S. Pickering, Surveyor, Apr. 15, 1910; 1 p.

Describes the methods of highway maintenance in the residential English town of Cheltenham. A new method of tar construction which the author has used with success is described.

Modern Conditions Affecting the Road Engineer.—By W. H. Maxwell, Surveyor, Apr. 15, 1910; 2½ pp.

The author deals with the increase and change in character which have taken place in traffic in recent years and points out the variety of conditions which the engineer has to meet. The selection of road materials and "half width" repair are discussed and the advantages and disadvantages of tar macadam are given and the process of tar painting dealt with. Attention is called to dampness as a fatal obstacle to successful tar painting. Road signs, mile stones and guide posts are also considered.

Dust Palliatives, Random Setts and Tarmac.—By C. J. Mason, Surveyor, Apr. 15, 1910; 1 p.

The following points are brought out in this article: The need for diverting fast motor traffic from existing highways; the economy in watering effected by the spraying; and the efficiency of random setts and slag tarmac.

On the Need for a State Highway Authority and Office of Record.—By E. J. Lovegrove, Surveyor, Apr. 15, 1910; 1½ pp.

The author advocates the establishment of an English state department to deal primarily with trunk roads and national grants in aid for roads maintenance and improvement. He further advocates the establishment of a state highway laboratory and emphasizes the need for standardization of road materials.

Tramway Margins.—By J. S. Killick, Surveyor, Apr. 15, 1910, 1 p.

The author discusses the difficulties connected with the maintenance of tramway margins and particularly of the joint between a paved track and a macadam road. H also discusses the causes of the disintegration of the macadam margin, and points out objects to the whole roadway being paved with granite pitchings.

Tramway Track Maintenance and Renewal.—By Henry Mattinson, Surveyor, Apr. 15, 1910; 4 pp.

The article treats of the causes of deterioration of tramway tracks particularly in regard to damage by way, and gives methods by which such damage may best be prevented. Observations are also given in regard to "anchoring" "swinging rails." The subjects of loose joints and welding are discussed and the matter of the wear of rails is treated. The author also considers special track work, repairs, renewals and track reconstruction.

Notes on Every-Day Highway Construction and Maintenance.—By Geo. G. Manning, Surveyor, Apr. 15, 1910; 1 p.

The author describes his experience with tar construction and calls attention to the importance of local conditions as factors which must determine the materials or methods to be adopted for the maintenance of highway surfaces.

The Use of Tar on Roads.—By W. J. Atkinson, Surveyor, Apr. 15, 1910; 2 pp.

This article deals with the properties of tars as regards their suitability for road work and discusses the relative importance of the chemical and physical properties. The author expresses the view that tar is best employed in the surface layer of the road only, and emphasizes the need for a good foundation.

Modern Road Repairs.—By E. Purnell Hooley, Surveyor, Apr. 15, 1910; 2 pp.

The author compares water bound and waterproof roads as regards their wearing qualities and discusses the important effect of the weather upon road surfaces. The method of constructing a tarmac road is considered in some little detail.

Roads and Vehicles.—By Col. R. E. Crompton, Surveyor, Apr. 15, 1910.

The author discusses the future of road engineering from the point of view of an engineer responsible for the construction and maintenance both of the roads and of the vehicles which use them. He first deals with the difficulties and importance of studying the improvement of modern road and in uncertain weather, and then proceeds to a consideration of the effect of the vehicles, both fast and heavy, on the roads as governed by the nature of their wheels. He reaches the conclusion that the solution of the modern road problem lies in impervious construction of road surfaces combined with improvements in wheel construction by which impact shocks and other evils may be reduced.

Somes Notes on Traffic and Road Maintenance.—By A. Dryland, Surveyor, Apr. 15, 1910; 2 pp.

The author calls attention to the enormous increase in traffic in late years, both as regards weight and speed, and describes the effect of this new traffic. As remedial measures he suggests wood paving tar macadam and tar painting.

The Dimensions of Roads and Streets.—By H. Percy Boulnois, Surveyor, Apr. 15, 1910; 2½ pp.

The author takes exception to the present accepted English standard for relative widths of footways and roadways and presents figures to substantiate his contention. The article also contains some interesting remarks on certain resolutions of the Paris Road Congress, by laws as to the width of streets, the width of vehicles, the "rule of the road," gradients and camber.

Road Construction and Maintenance.—By John S. Brodie, Surveyor, Apr. 15; 1 p.

The article treats of the more important aspects of road construction, and includes short specifications of standardized types of street construction which the author has designed as the result of his experience.

Irish Roads: Construction, Maintenance and Administration. Surveyor, Apr. 15, 1910, 4 pp.

This article has been prepared from answers given by practically all of the County Surveyors of Ireland to questions addressed to them in 1907. The matters dealt with cover the whole field of road construction, maintenance and administration as regards Ireland. The complete list of answers in pamphlet form, entitled "Irish Roads," can be obtained from the Sackville Press, Findlater Pl., Dublin, Ireland, for 15 cts. with postage added.

Some Notes on Highway Law.—By Sydney G. Turner, Surveyor, Apr. 22, 1910; 2½ pp.

The author discusses first, the definition of a "Highway" and the extent of the right of the public over a way which has been dedicated. He then deals with the various ways in which highways may be created and what is involved in the dedication. He also considers the liability to repair the main roads and gives some notes on nuisance to highways and on the question of extraordinary traffic.

Road Crust Construction.—By Jos. Mathison, Surveyor, Apr. 22, 1910; 2½ pp.

The author writes of his experience with a four years trial of Ferromac in road construction. Some data on the cost of the work are given.

Public Roads and Vicinal Railways.—By R. O. Wynne-Roberts, Surveyor, Apr. 15, 1910; 5½ pp.

This author endeavors to show in this article how narrow railways on public roads connecting neighboring towns could promote the development of rural districts, result in the improvement of highways and assist the road authorities.

Average Unit Prices and Some Details of Pavements Constructed in 1909 in a Number of Representative American Cities.—Eng.-Contg., April 6 and 13, 1910; 4¼ pp.

Tables giving amount, price and general structural characteristics of stone block, macadam, bitulithic, asphalt, creosoted wood block and brick pavement laid in some 30 to 50 representative cities of the United States. A table is also given showing amount and cost of all pavement laid and amount of paving planned for coming year in about 150 cities.

Experimental Work of the New York State Highway Commission in 1909 with Glutrin and with Resurfacing with Bituminous Macadam and Asphalt Macadam.—Eng.-Contg., Apr. 13, 1910; 2½ pp.

Describes methods of making the treatment with figures of amounts of materials required, rates of work, etc., and in particular gives itemized costs of a number of examples of resurfacing work. A notably valuable article.

Methods of Constructing Sand Clay Roads in the Middle West and Cost Data on the Construction of Four Roads of This Type.—Eng.-Contg., Apr. 20, 1910; 3½ pp.

General methods of construction are described under headings: Sand clay construction in the gumbo or plastic soil sections, use of sand clay on sand hill roads, improving loam and alkali soil roads, and sand oil coverings for sand clay

roads. Four specific examples of sand clay road construction are given with itemized unit costs of the work.

Test of Street Flushing or Washing Machines, Department of Street Cleaning, New York City.—Eng. News, Apr. 14, 1910; 1¼ pp.

Describes machines tested, methods of making tests and gives conclusions from results. Tables are given summarizing in various ways according to different units the results obtained. These data are valuable.

Preservatives for Wood Paving Blocks.—Eng. Rec., Apr. 16, 1910; ¾ p.

A discussion with comparative figures of the relative value of creosote oil and tar for preserving wood blocks for paving. Argument tends to show the avoidability of the cheaper tar compounds.

Construction of Sand-Clay and Earth Roads.—Contr., April 15, 1910. 4 pp.

Condensed from a circular prepared by W. L. Spoon, Superintendent of Road Construction. Contains summaries of costs.

SEWERS.

Construction Methods of the Louisville Sewerage Work.—Eng. Rec., Apr. 2, 1910; 1¾ pp.

A general summary of the construction methods being employed for these large size concrete sewers.

Sewage Disposal Ideals.—Eng. Rec., Apr. 9, 1910; 2¾ pp.

A general discussion of the ideal conditions and methods of sewerage disposal.

A Notable British Court Decision Regarding Stream Pollution by Birmingham Sewerage Works.—Eng. News, Apr. 21, 1910; 1 5/6 pp.

Decision in a suit to dissolve an injunction against the sewage of Birmingham being discharged into the River Tame. Conclusion was that owing to the effluent being better than the river water the river water is improved rather than injured.

Sewage Disposal Works at Indiana, Pa.—Eng. Rec., Apr. 30, 1910; 1½ pp.

Describes sewage disposal works comprising screening and grit chambers, two sludge tanks, closing tank and coke chamber, sprinkling filters, settling tanks and sludge pond for a city of 8,000 population. General plans of sprinkling filter are given.

The Sewage Disposal Plant at Roebling.—Eng. Rec., April 9, 1910; 3⅓ pp.

General description with plans of a sewage disposal plant comprising screening and sedimentation chambers, primary and secondary contact beds and sand fillers for an industrial town of 2,000 population.

Sewage Disposal at Birmingham and Salisbury, England.—Eng. Rec., Apr. 16, 1910, 1⅔ pp.

Describes briefly the general characteristics and conditions of operation of the sewage disposal works for the cities named.

Constructing Concrete Sewers in Open Trench.—Eng. Rec., April 16, 1910; 1 p.

General description of methods of constructing some 2,600 ft. of 3⅓ to 10½ x 14 ft. concrete sewers.

Constructing a Large Brick-Lined Sewer Tunnel, Brooklyn, N. Y.—Eng. Rec., April 9, 1910; 1¾ pp.

Describes and illustrates method of constructing 2,000 ft. of 11½ ft. brick sewer in tunnel by the Mees system. A useful article.

Sewage Disposal Plant at Independence, Kans. By A. A. Stivers. Cem. Rec., April, 1910. 1 pp.

A description, accompanied by the plans, of the concrete septic tank and filter beds. The costs of construction are given.

WATERWORKS AND HYDRAULICS.

Water Supply in India.—By Percy G. Scott, Surveyor, Apr. 8, 1910; 3 pp.

An abstract of a paper read before the English Society of Engineers. In it the author describes the methods of designing and constructing the water supply scheme for Moulmein, one of the principal ports of Burma, a city of 60,000 people. The supply is obtained from a storage reservoir and is brought to the city by gravity. The article is interesting inasmuch as it describes the methods adopted in the construction of water works in a tropical country.

Construction of the Belle Fourche Dam.—Eng. Rec., Apr. 2, 1910; 3⅔ pp.

Gives map of work and layout of construction plant and services and sections and profile of this large earth dam. A general description of the methods of construction and of the construction plant accompanies the illustrations.

Sand Filters and Disease Germs.—By Rudolph Hering. Min. Jl. & Eng., Apr. 27, 1910; 2 pp.

An article dealing with efficiency of sand filters, water purification in removing pathogenic bacteria. The author states that there appears to be sufficient evidence that with a sufficient quantity of nutriment dissolved in the water pathogenic bacteria not only pass through sand filters, but their number may also actually increase within them. Numerous references are cited to bear out this statement.

Water Purification at Columbus.—May 4, 1910; 4 pp.

A description of the 30,000,000 gal. plant at Columbus, O. The water purification combines softening and filtration by mechanical or rapid filters. The article is taken from a paper by John H. Gregory read before the American Society of Civil Engineers.

Sterilization of Water.—By Walden & Powell. Mun. Eng. Mag., May, 1910; 5 pp.

An interesting article regarding the sterilization of water by ozone. It also contains much information regarding the action of hypochlorite of calcium upon raw water. The matter is taken from a paper read before the American Water Works Association.

The Ground Arch in Filter and Covered Reservoir Construction.—Eng.-Contg., April 6, 1910; 7⅔ pp.

A very complete discussion of the design of ground arch roofs with comparisons of economy and statistics on the ground arch reservoir and filter roofs and floors constructed in the United States. The most complete paper in print on its subject. Same, Eng. News, Apr. 7, 1910, 5¾ pp.

A Novel Method of Placing Cast Iron Wells in a Water-Works Crib.—Eng.-Contg., Apr. 13, 1910; 3¾ pp.

Describes and illustrates the structural features and methods of construction and itemizes the trim changes for each feature of the construction work. A record of an ingenious method of sinking cast-iron cylinder wells.

Designs and Contract for Rebuilding the Colorado River Dam at Austin, Texas.—Eng. News, Apr. 14, 1910; 2¾ pp.

Describes briefly feature of original dam and gives plans and portions of specifications for the proposed new dam.

The Chances of Pollution in Shallow Wells for Municipal Water-Supply.—Eng. News, Apr. 21, 1910; ¾ p.

Gives results of investigations made in several cities to determine what chance there was of water pollution in wells from infiltration of impurities from nearby sources of various characters.

The Production and Utilization of Ozone, with Especial Reference to Water Purification. Eng. News, Apr. 28, 1910. 8¼ pp.

A notably complete historical and descriptive article on systems of water purification by ozone. The various foreign and American ozone systems are described, with illustrations of plant used. A 1½-page editorial discusses the possibilities and probabilities of the system.

A 10,000,000-Gal. Pressure Mechanical Water-Filtration Plant at Duke's Farm, Somerville, N. J.—Eng. News, Apr. 14, 1910; 1 p.

Shows cross-section and gives general description of the plant.

The Slow Sand Water Filters Under Construction at Reading, Pa.—Eng. News, Apr. 14, 1910; 3¾ pp.

Gives general plans and special details and a full general description of the conditions, the old and new filters and the general methods of construction. Several structural departures from previous practice are described. A notable feature is the very complete drawings of the forms used for constructing the vaulted roof.

Experiments with Hypochlorite of Lime as a Water Disinfectant, at Hartford, Conn.—Eng. News, Apr. 7, 1910; ¾ p.

Describes methods of making experiments and gives results of bacterial analysis of raw and treated water, and showing percentage of reduction of bacteria by disinfection.

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Hypochlorite of Lime as an Adjunct to Mechanical Water Filtration at Quincy, Ill.—Eng. News, Apr. 7, 1910; ½ p.

Describes and gives results of tests of water to determine efficiency of treatment with hypochlorite of lime.

The Use of Hypochlorite of Lime in Connection with the Mechanical-Filtration Plant of Harrisburg, Pa.—Eng. News, Apr. 7, 1910; 1 p.

Outlines character of plant; gives methods employed in the use of hypochlorite and results obtained; presents conclusions and remarks on the general operation of the plant.

The Use of Hypochlorite of Lime to Disinfect the Water-Supply of Montreal, P. Q.—Eng. News, Apr. 7, 1910; 1¼ pp.

Illustrates and describes plant, and gives results of treatment and figures on quantities and costs of chemicals used.

A 20,000,000-Gal. Hypochlorite Water-Disinfecting Plant at Minneapolis, Minn.—Eng. News, Apr. 7, 1910; 1¼ pp.

Gives plans and general description of plant and presents table showing presence and absence of colon bacilli before and after treatment.

The Use of Sulphate of Alumina and Hypochlorite of Lime in the Storage and Distributing Reservoir of the Nashville Water-Works.—Eng. News, Apr. 7, 1910; ⅔ pp.

Outlines methods of application of the chemicals and gives analysis showing results obtained.

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Development of the Ninety-Nine Islands Station of the Southern Power Company.—Eng. Rec., Apr. 2, 1910, 5½ pp.

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An Earth Reservoir at Ogden, Utah.—Eng. Rec., Apr. 16, 1910; 1¼ pp.

Describes general construction of an earth reservoir 237x260 ft., with general account of structural features.

A Hydroelectric Development of the Weber River, Utah.—Eng. Rec., Apr. 2, 1910; 4 pp.

Principally of value for description and illustration of structural features and general methods of construction of wood stave and reinforced concrete pipe line.

The Hunters Brook Tunnel Construction.—Eng. Rec., Apr. 2, 1910; 1½ pp.

Describes plant employed and general methods being followed in driving two tunnels, one 6,150 ft. long.

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Submerged Pipe Line from Jersey City to Ellis Island.—Eng. Rec., Apr. 2, 1910; ⅔ p.

Describes general methods employed in laying a submerged 8-in. cast-iron pipe line 2,100 ft. long.

The Lock Leven Power Plant.—Can. Engr., April 15, 1910. 3¾ pp.

A description of an hydro-electric development at Kinlockleven, Argyleshire, Scotland. 30,000 h.p. is developed through six parallel penstocks. Power used for production of aluminum.

Yorkton Compressed Air Water Works System.—By F. T. McArthur. Can. Engr., April 15, 1910. 1½ pp.

An illustrated description of a 500,000 daily capacity plant.

Water Powers in Northern Ontario.—By L. V. Rorke. Can. Engr., April 15; 1910. 2 pp.

Abridged from an address made before the Engineers' Club of Toronto. A description of the topographical features of the Hudson Bay water shed with reference to the discharge and horsepower available of different streams.

The Construction of the Rainbow Falls Hydro-Electric Development. — Com. & Eng. News, April, 1910. 5¾ pp.

A description of the construction of the dam on the Missouri River where 21,000 K.W. will be developed with a 108-ft. head. Illustrated.

RIVERS, HARBORS AND CANALS.

The Excavating Equipment on Contract 61, Barge Canal.—Eng. Rec., Apr. 2, 1910; ½ p.

Describes scraper bucket excavation plant with some dates on force employed and output.

Excavating Plant on Contract 29, Barge Canal.—Eng. Rec., April 2, 1910; ⅓ p.

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Excavation Methods on Contract 9, Barge Canal.—Eng. Rec., Apr. 2, 1910; 1¼ pp.

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The Construction Plant on Contract 40, Barge Canal.—Eng. Rec., Apr. 2, 1910; 4½ pp.

Describes the plant used comprising cantilever cranes, cableways, double boom excavator and central power plants. Chiefly of interest as illustrating scheme adopted of loading cranes, cableways, etc., with steam shovels. Some general figures of yardage are given.

Lock of the Black Roak Harbor Improvement, Buffalo.—Eng. Rec., Apr. 2, 1910; 2 pp.

Describes construction of steel sheet pile cofferdam 260 x 947 ft., and general arrangement and operation of plant for constructing the concrete lock.

Progress in the Improvement of the Detroit River.—Eng. Rec., Apr. 2, 1910; 2½ pp.

A general description of the progress being made and of the general methods of work.

A Comparison of Stream Discharges Indicated by Current Meter and by Weir Formulas, Yakima River, Wash.—Eng. News, Apr. 28, 1910; 1⅓ pp.

Compares by means of diagrams, results obtained by current rates and by formula for an overflow dam.

The Influence of Forests on Climate, Floods and Erosion.—Eng. News, Apr. 14, 1910; 2¾ pp.

A criticism of the arguments and figures presented in the report to Congress of Willis L. Moore on The Influence of Forests on Climate and on Floods, which was printed in Eng. News, March 3, 1910.

Cumberland River Canalization.—Eng. Rec., Apr. 16, 1910; 2⅔ pp.

Illustrates general structural features of crib dams and concrete locks. Nos. 4 and 5 of above named improvement describes briefly the work and gross itemized costs of the work.

Construction of the Tribes Hill Lock and Dam, Barge Canal.—Eng. Rec., Apr. 2, 1910; 2⅔ pp.

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Method of Building Lock and Dam.—Contr., April 15, 1910. 6 pp.

Work on structures on the Monongahela River at Brownsville, Pa. An illustrated description of the government work.

RAILWAYS

Proposed Catenary Construction for Harlem River Branch of New York, New Haven and Hartford Railroad.—Elec. Ry. Jl., April 16, 1910; 2½ pp.

A descriptive and illustrated article on a 6,000 ft. 4 track experimental section built last fall at Stamford, Connecticut.

Report on Milwaukee Traffic.—Elec. Ry. Jl., April 9, 1910; ⅔ p.

Condensed preliminary report of the Wisconsin Railroad Commission on the traffic conditions of the Milwaukee street railway system.

Stresses Developed by Collisions of Freight Cars.—By Col. B. W. Dunn. R. R. Age-Gaz., Apr. 22, 1910; 3 pp.

An article relating to the allowable speeds for freight cars in coupling. A discussion of the subject with descriptions of tests that have been made.

Track Elevation on the Chicago, Milwaukee & St. Paul, at Evanston, Ill.—R. R. Age-Gaz., Apr. 8, 1910; 4⅔ pp.

This article gives a description of the work, illustrations and plans showing the construction and designs of the concrete subways and also describes the methods used to handle traffic during construction.

The Railways Cost of Living.—R. R. Age-Gaz., Apr. 15, 1910; 3½ pp.

This paper is a discussion of the increasing living cost of railways based upon the report of the Interstate Commerce Commission. The account of the railways for 1897 is compared with that for 1907 with diagrams.

New Locomotive Terminal of the Vandalia at Terre Haute.—R. R. Age-Gaz., Apr. 22, 1910; 3¼ pp.

A description of this terminal with plans of tracks, of engine house and of the 750 ton capacity coaling station.

Western Pacific Yards and Terminals.—By Gustave E. Lunsnerich. R. R. Age-Gaz., Apr. 22, 1910; 5¼ pp.

A well illustrated article relating to the design of yards and terminals of the Western Pacific Ry. using a report of the traffic tonnage of the road as a basis. Plans of engine terminals car terminals, yards and railway buildings are given.

Some Engineering Features of the Detroit River Tunnel.—R. R. Age-Gaz., Apr. 29, 1910 5¼ pp.

A description of the method used in sinking the steel shells into a trench dug in the bottom of the river, uniting them end to end and embedding them in a concrete casing, and lining them. This article contains photographs of different steps of the work, and sections drawings showing the completed tunnels.

Cost of the New York Subway and of Operating It.—Eng.-Contg., Apr. 13, 1910; 1¼ pp.

Gives mileage of different types of construction, quantities per mile of track, contract prices, character and amount of plant and equipment, and itemized operating costs.

Construction of a 135-Mile Wood Stave and Cast Iron Pressure Pipe Line for Railway Water Supply with Some Costs.—Eng.-Contg., Apr. 13, 1910; 2¼ pp.

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Method of Reconstructing the Washington Street Tunnel of the Chicago Railways Company; a New and Economical Method of Constructing Tunnels.—Eng.-Contg., Apr. 20, 1910; 5 pp.

Work comprised replacing old tunnel with new and deeper tunnel. General structural features are illustrated and described and method of construction described in detail. Article notable for special system of construction employed.

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Method and Cost of Constructing Street Railway Track, with Grouted Crushed Stone Foundation. Eng.-Contg., April 20, 1910, ⅓ p.

Describes methods of construction and gives itemized unit costs of track and foundation and of concrete pavement foundation and brick paving. Same article, Eng. News, 1910.

A Two-Story Street Railway Terminal of the Public Service Railway, Hoboken, N. J.—Eng. News, Apr. 21, 1910, 3 pp.

Gives general plans and some details of steel work for a two-story loop terminal structure for street cars. General description of the plans. Track lay-outs are shown.

A Five-Mile Trestle Across Albemarle Sound, Norfolk & Southern Ry.—Eng. News, Apr. 21, 1910; 2⅔ pp.

General description of structural features of pile trestle some 5 miles long. Chiefly interesting for drawings of trestle construction.

City Track Construction for Electric Interurban Railways. Eng. News, Apr. 14, 1910; ¾ p.

Discusses general requirements of city track construction and, in detail, method of construction with grouted crushed stone foundation, with itemized costs.

The Long Island Improvements of the Pennsylvania System.—Eng. Rec., Apr 16, 1910, 4 pp.

Gives general map and yard lay-outs for the Sunnyside yards of the above named railway. A general description of the work accompanies the plans. Of interest particularly for the yard track plans shown.

Forest Hills Terminal, Boston Elevated Railway.—Eng. Rec., April 6, 1910; 3 pp.

Illustrates main structural features and describes the construction of an elevated station 75 ft. x 360 ft., built of steel encased in concrete. A number of drawings are given of the sectional forms used in concreting the steel work.

Tunnel Lining, Chicago, Milwaukee & Puget Sound Railway. Eng. Rec., Apr. 2, 1910; 2 pp.

Describes plant and general methods employed in lining with concrete a number of railway tunnels. Some data are given regarding arch centers.

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Methods employed on work now in progress on Washington street tunnel under Chicago River. Illustrated.

Cost of Constructing and Operating the Electric Street Railways of Long Island City.—Eng.-Contg., April 27, 1910, 1⅓ pp.

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Piers of the Penhorn Creek Railroad Viaduct.—Eng. Rec., Apr. 2, 1910; 1 p.

General description of methods of sinking cylindrical concrete caissons by open dredging. Interesting because of the use of concrete cylinders.

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Oak Point Float Bridge Substructure Construction.—Eng. Rec., Apr. 2, 1910; 2 pp.

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method of construction. Two half sections of the bridge structure are shown

A Portable Floating Cofferdam.—Eng. Rec., Apr. 2, 1910, 1⅓ pp.

Illustrates and describes special movable cofferdam used for unwatering seams in face of a dam below water. General methods of use are described with total costs.

Different Methods of Erecting Steel Viaducts.—Eng. Rec., Apr. 2, 1910, 1¼ p.

A descriptive article outlining the various methods commonly employed in erecting steel viaducts. Interesting as a general summary of practice.

Deep Pneumatic Foundations for New York Municipal Building.—Eng. Rec., Apr. 2, 1910, 2 pp.

Describes plant employed and general methods of work in sinking 107 caissons for column foundations.

Steel-Frame Buildings at Gary, Ind.—Eng. Rec., Apr. 9, 1910, 2 p.

Illustrates and describes the main features of the structural steel work for a number of large mill buildings.

Deep Foundation Construction in an Occupied Building.—Eng. Rec., Apr. 6, 1910; 1 p.

Describes method of sinking separate foundations for 600-ton vault inside of and through the foundations of a bank building. Steel cylinders filled with concrete were sunk by the Clark process.

A Storage Building for an Automobile Factory.—Eng. Rec., Apr. 16, 1910, 1½ p.

Describes the general construction of a large 4-story reinforced concrete warehouse, with flat steel floors.

Erection of Steel Frame Buildings at Gary, Ind.—Eng.-Rec., April 23, 1910; 2⅔ pp.

Describes and illustrates two steel traveling derricks used in erecting steel work for several large mill buildings.

Pneumatic Caisson Piers in Alaska.—Eng. Rec., April 23, 1910; 3⅔ pp.

Illustrates design of caissons and locks and describes general methods of sinking caissons and constructing many for several large concrete piers.

The Superstructure of the McKinley Bridge at St. Louis.—Eng. Rec., April 30, 1910; 2½ pp.; folding plates.

Illustrates profile elevation and details of viaduct approach and main iron spiners (500 ft.) for this new Mississippi River bridge 2,514 ft. long. The drawings are briefly described.

Open Cofferdam Foundations in Quicksand.—Eng. Rec., April 2, 1910, 1⅓ pp.

General description of method of underpinning adjacent buildings and cofferdamming a foundation excavation about 95x100 ft. Drawings are given of special details and a few data on driving sheet piles.

The Bear River Viaduct.—Eng. Rec., April 30, 1910, 1½ pp.

Describes the structural features and general method of erection of a single track railway viaduct 810 ft. long and 192 ft. high.

The Erection of Tinkers Creek Viaduct.—Eng. Rec., April 2, 1910, 3 pp.

Describes general method of erecting a double track, plate girder viaduct 1,300 ft. long. Detail drawings of the erection traveler are given and with description constitute the useful feature of the article.

The Passyunk Avenue Bridge Piers.—Eng. Rec., April 2, 1910, 2 pp.

Describes with illustrations of essential details construction of timber caissons for two piers sunk in 22 ft. and 35 ft. of water. Illustrates diagram layout of contractor's plant and describes general method of construction.

A Steel Arch Bridge in the Province of Yun-Nan, French China.—Eng. News, April 21, 1910, 1¾ pp.

Illustrates and describes structural features and general method of erection of an arch of 180½ ft. span composed of two triangular trusses hinged at springs and crown.

Widening the Floor of a Double-Track Masonry Viaduct.—Eng. News, April 14, 1910, 1¼ pp.

Describes and illustrates method of widening a masonry arch bridge by removing parapet walls and extending out a reinforced concrete bracket platform on each side. Details are shown of the bracket construction and reinforcement.

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A Discussion of the Supporting Power of Piles.—Eng.-Contg., April 20, 1910, 2⅓ pp.

Discusses the subject under the heads of piles acting as columns, piles acting as floats, piles as combined columns and floats, forces acting on piles, indirect methods of test and factors theoretically essential to a complete pile formula.

The Calculation of Continuous Bowstring Girders, and Its Application to a Reinforced Concrete Viaduct.—By H. Lossier. Conc. & Cons. Eng., April, 1910. 5 pp.

The present article is a translation from a pamphlet written by Mr. H. Lossier, and deals with the case of a continuous bowstring viaduct designed by Messrs. Consideric, Pelnard & Lossier, and which has just been adopted by the Contras (Gironde) as the result of a competition. The object of the paper is to show the remarkable simplicity with which the ellipse of elasticity permits the solution of apparently very complex hyperstatic systems.

Regulations for Reinforced Concrete Buildings in London.—By Wm. Dunn. Conc. & Cons. Eng. April, 1910. 6 pp.

The question of regulations for reinforced concrete buildings occupied considerable attention before the House of Commons. Mr. Dunn gives his views in this article, which were generally adverse to the regulations proposed.

Prevention and Cure for Weak Foundations.—Cem. Age, April, 1910. 5 pp.

For buildings that could not well be founded on solid rock and whose dimensions do not warrant the use of caissons. The concrete pile is cited as a preventative and the Breachaud patents for the sectional method of underpinning buildings is pointed out as a cure for weak foundations.

Comparative Cost of Girder Construction in Structural Steel and Reinforced Concrete.—By E. G. Perrot. Conc. Eng., April, 1910. 2 pp.

A description of the above as relating to the construction of a large floor above the gymnasium of the Turngemeinde Club house, Philadelphia.

Substructure of New P. & L. E. Bridge.—Contr., April 1, 1910. 3 pp.

Description of construction work on double track bridge, one of the largest cantilever structures yet built.

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The Determination of Ordinary High Water Plane on the Pacific Coast of the United States—A Discussion
By D. E. HUGHES and OTTO VON GELDERN, Technical Society of the Pacific Coast

Public Sanitary Station at Brookline
By ALEXIS H. FRENCH, Boston Society of Civil Engineers

Public Sanitary Station at Lawrence—With Discussion
By ARTHUR D. MARBLE, Boston Society of Civil Engineers

The Economy Resulting from the Use of the Level on the Farm
By GEORGE M. LEWIS, Montana Society of Engineers

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CONCRETE AND REINFORCED CONCRETE.

Application of Concrete in Barge Canal Work.—By Russel S. Grunman. Cem. Age, April, 1910. 6 pp. Cont. from March issue.

Containing descriptions of the method of mixing and placing concrete on the barge canal work, and a general description of the concrete structures on the canal.

The Remarkable Fireproof Properties of Cinder Concrete.—By Prof. Ira H. Woolson. Cem. Age, April, 1910.

On account of the behavior and present condition of the cinder concrete wall of the floor testing building at the fire testing station of the author.

The Properties of German Portland Cements.—By Clifford Richardson. Cem. Age, April, 1910. 2 pp.

The results of a test in the Royal Testing Laboratories at Grosslichterfelde West, near Berlin, in 1907-08.

Cement in Sea Water.—Cem. Age, April, 1910. 1 p.

Condensed from a report of Mr. A. Paulson, Chief Engineer of the Danish State Hydraulic Works.

Reinforced Concrete Coke Bunker at Dunfermline, Scotland.—Conc. & Cons. Eng., April, 1910. 11 pp.

This article gives detailed particulars and drawings of a 390-ton capacity coke bin recently built in Scotland.

Tests on Reinforced Concrete Conducted in Great Britain.—Conc. & Cons. Eng., April, 1910. 8 pp Part VII of a series.

A series of tests on beams and columns. Illustrated.

Reinforced Concrete Trestles.—By C. H. Cartlidge R. R. Age Gaz., April 22, 1910. 3½ pp.

Relating to a standard plan for trestles now in use on the C., B. & Q. R. R. for bridges such as occur a great many times in the Mississippi valley over bayous or swamps. These places may not be filled and if replaced with steel on permanent supports would be very expensive. A detailed plan is given, together with several illustrations.

Concrete Building Construction of Separately Molded Members and Its Cost.—Eng.-Contg. April 6, 1910. 3⅔ pp.

Cites the more notable examples of buildings constructed of separately molded concrete members, gives general and detailed costs and describes various "systems" of construction of this type. The Watson system is described in detail and itemized costs given of large factory buildings. A notably good article on this type of construction.

Design and Construction of Concrete Retaining Walls for Pennsylvania Terminal Station, New York City.—Eng.-Contg., April 13, 1910. 2⅔ pp.

Work includes gravity walls up to 62 ft. in height. Article explains conditions to be met, assumptions made in designing, and general design adopted. Methods of construction are described and drawings of forms given.

Some Methods of Waterproofing Concrete Structures With Results From Practice.—Eng.-Contg., April 13, 1910. 1¾ pp.

A symposium of practice and experience in waterproofing concrete roofs and bridge floors on several large railway systems.

An Analysis of Concrete Bridge Failures.—Eng.-Contg., April 13, 1910. 3½ pp.

Cites eleven failures of concrete bridges of which reliable data could be obtained, illustrates and describes for each case the character of the failure, analyzes the cause of the failure and summarizes the results, showing six failures due to faulty foundations and five due to defective design.

Cost of Abutment Masonry and Slope Paving for Highway Bridge Foundations, Illinois & Mississippi Canal.—Eng.-Contg., April 20, 1910. ⅔ p.

Abutments contained 190 cu. yds. natural cement concrete in footings and 248 cu. yds. Portland cement concrete in abutments proper. Itemized unit costs are given for one bridge and total unit costs are summarized for some 20 other bridges.

Some Experiments on the Cost and Durability of Cement Drain Tile.—Eng.-Contg., April 13, 1910. 1¼ pp.

Gives results of a series of experiments made to determine the cost of hand molding cement drain tile and to what extent water dissolved the cement out of such tile. A notable contribution of valuable data on the much disputed question of the durability of cement drain tile.

Special Forms for and Methods of Constructing Weber Concrete Chimneys.—Eng.-Contg., April 20, 1910. 1¾ pp.

Describes two styles, straight and tapering, of chimneys, discusses the general requirements of successful chimney construction and outlines actual methods of work, with descriptions and illustrations of unique forms for chimney work.

Forms of Concrete Pile Construction and a Statement of the Advantages and Disadvantages of Concrete Piles.—Eng.-Contg., April 20, 1910. 1¼ pp.

Gives historical outline of development of concrete piles, describes the various forms or types of cast and driven piles and cost in place piles, estimates commercial use and itemizes the several advantages and disadvantages of concrete piles. A good general article.

A Three-Hinged Reinforced Concrete Arch Viaduct.—Eng. Rec., April 30, 1910. 3¼ pp.

Illustrates the main structural features and describes the construction of a concrete viaduct of universal arrangement having three-hinged arches made up of separately molded arch ribs.

Methods of Computing Flat Reinforced Concrete Plates.—Eng. Rec., April 9, 1910. 3⅓ pp.

An important mathematical discussion of methods of computing reinforced concrete floor consisting of flat plates supported directly on columns.

A Concrete Girder Bridge with Curved Bottom Chord.—Eng. Rec., April 9, 1910. 1 p.

Gives essential plans and describes structural features of a reinforced concrete girder bridge in which the bottom chords of the girders are curved.

EARTH AND ROCK EXCAVATION.

Hydraulic Excavation in the Pacific Division of the Panama Canal.—Eng. Rec., April 2, 1910, 2¾ pp.

Gives map of area to be excavated by hydraulic ???????? and general plan of pumping plant. Describes the layout and main structural features of work and plant and outlines general plan of operation.

Methods and Costs of Cleaning 30,000 Cu Yds. of Sediment from a Water Works Reservoir.—Eng.-Contg., April 6, 1910, ¼ p.

Reservoir drained and sediment washed out with hose streams. Methods described, time required for and cost of work itemized.

Method and Cost of Making a 16,000 Cu. Yd. Blast on the Pecos & Northern Texas Ry.—By C. S. Young, Eng.-Contg., April 6, 1910, ⅔ p.

Describes arrangement of tunnel and methods of loading and firing blast and gives general costs. Dynamite and black powder were used.

Cost of a Record Steam Shovel Run.—Eng.-Contg., April 20, 1910, ¼ p.

Shovel excavated 4,823 cu. yds. in one day; itemized cost of labor and supplies given, showing a cost of 1.14 cts. per cu. yd.

Cost of Excavating 1,850 Cu. Yds. of Granite in Trench for Sewer Construction.—Eng.-Contg., April 20, 1910, ¼ p.

Gives itemized unit costs of excavating 550 ft. of trench in granite rock.

New Crushing Plants of the Casparis Stone Company.—Eng. Rec., April 2, 1910, 1⅔ pp.

Interesting for plans and sections and layout plats of two large crushing plants. A general description of the main structural features is given.

The Ashokan Reservoir Stone Quarry.—Eng. Rec., April 2, 1910, 1⅔ pp.

Describes the character of the quarry being used to obtain some 1,000,000 cu. yds. of stone for the work named, being general description of methods and plant employed.

SURVEYING AND DRAFTING.

The Stadia and Stadia Surveying.—Eng. News, April 28, 1910, 1¾ pp.

An argument on the usefulness of stadia surveys, with description and illustration of a special stadia rod and numerous notes and instructions on methods.

Tests of Simple and Inexpensive Surveying Instruments.—Eng. News, April 21, 1910, 1¼ pp.

Describes several instruments of the type indicated and gives results of tests made to determine their accuracy. General conclusion is that such instruments are rarely satisfactory.

The Mille Lac Lake Survey, Minnesota; Methods and Costs.—Eng. News, April 7, 1910, 1 p.

Describes method of making a transit and stadia survey and soundings on Mille Lac. Costs of the different items of the survey are given.

Reconnoissance Method of Determining the Volume of Reservoir Sites.—Eng. Rec., April 30, 1910, 3¾ pp.

Discusses the various methods of determining roughly the quantity of water that can be carried by basins available for reservoirs, and describes in detail the triangulation method developed by the author of the article. A notable article.

MISCELLANEOUS.

Sanitation in Construction Camps of the Catskill Aqueduct.—Eng. Rec., April 2, 1910, 3⅓ pp.

Describes arrangement of plant and appliances for disposing of sewage and garbage and other wastes in construction camps. Some of the special apparatus employed is illustrated. A useful article.

Town Scavenging and Refuse Disposal. By Hugh S. Watson. Mun. Eng Mag., May, 1910; 3½ pp.

Describes the various types of English destructions, as Heenan & Froudes destructor, Manlove, Alliot & Co.'s destructor, Goddard, Massey & Warner's destructor, and the Horsfall destructor.

Refuse Disposal in Milwaukee. By Fred S. Sly. Mun. Jl. & Eng., May 4, 1910; 8 pp.

Describes the methods and plants used in Milwaukee during the past 30 years, and gives a summary of the plans contemplated for utilizing surplus steam power for the disposal plant. A detailed description of the refuse destructor finally decided on is given, and several drawings and illustrations of it are shown.

System in Park Expenditures. By Arthur C. Comey. Mun. Jl. & Eng., April 13, 1910, 4 pp.

A description of the way the Park Board of the city of Utica, N. Y., keeps its accounts. Illustraitons of the forms used are shown and their use described.

New York City Pipe Galleries. By Walter G. Turini. Mun. Jl. & Eng., April 13, 1910, 1½ pp.

Describes the pipe galleries constructed in Delancy St., New York city, in connection with the subway.

Subaqueous Tunnels. By R. B. Woodworth, R. R. Age-Gaz., April 8, 1910, 3 pp.

This is the fifth of a series and relates to the shield method of construction. The subject is taken up in practical illustrations. The material for this paper has been drawn largely from the technical press, its purpose being to sort, classify and digest for the use of any tunnel builder.

First Cost of Plant and Cost of Generating and Distributing Electricity for Lighting. Edison Illuminating Co. of Brooklyn.—Eng.-Contg., April 6, 1910, 1⅓ pp.

A critical analysis of costs of plant and of operation for 1907 of the plant named. Unit costs are given per kilowatt or per kilowatt hour. This is a noteworthy article.

Methods of Refuse Collection and Disposal in Boston, With Some Cost Data.—Eng.-Contg., April 6, 1910, ¾ p.

Describes method of collection, gives by districts totals and per capita amounts of refuse of each kind, gives costs of collection and disposal by day labor and by contract and recommends a method of collection and disposal by contract as the more economical.

Municipal Markets of St. Louis.—By Charles Claude Casey. Mun. Jl. & Eng., Apr. 27, 1910. 5½ pp.

A description of three municipally operated markets of St. Louis, Mo. The structural features are described, as well as the methods of sanitation and refrigeration.

Current Prices of Materials, Supplies and Small Tools Used in Construction Work.—Eng.-Contg., April 6, 1910. 5¾ pp.

Current wages for street work in some 100 cities; union wages in New York City; prices for materials, supplies and tools for bridge and building work, concrete and reinforced concrete work, earth and rock excavation, paving and road work, railway work, sewerage and waterworks construction, and miscellaneous work.

Contract News Section

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ENGINEERING-CONTRACTING

A Consolidation of Engineering-Contracting—Contract News—Engineering World—The Dirt Mover.

Containing Items of Interest to Railroad, Public Works and Other Contractors.

The Doings of the Week.

The State of Florida has again taken steps for the drainage of the Everglades, and is again asking for bids for the work. Bids are now asked for excavating five drainage canals of a total length of 235 miles, requiring 18,000,000 cu. yds. of earth excavation and 6,000,000 cu. yds. of rock excavation.—The Baltimore & Ohio has disposed of $40,000,000 three-year 4½ per cent notes, which will be placed here and in Europe. The proceeds will be used for improvements and the purchase of equipment and the financing will cover the company's requirements for the next three years. The Sundry Civil Appropriation bill has been reported to the U. S. House of Representatives. It carries a total of $111,849,211, among the largest items being the following: $37,859,890 for the continuation of the construction of the Panama Canal; for public buildings, $6,145,000; Life Saving Service, $2,362,000; Interstate Commerce Commission, $1,360,000; rivers and harbors improvements under contract, $8,051,000.—After tests made simultaneously in Canada, the United States and England, at the instance of the Canadian board of engineers, who have prepared the plans for the superstructure of Quebec bridge, the engineers have reported that the plans are satisfactory. As a result tenders for the bridge will be asked shortly.—The largest railroad construction contract of the week appears to be the one secured by H. C. Henry, Seattle, Wash. This contract calls for constructing the Oregon Trunk Ry. from Madras, Ore., south 125 miles. Another large contract let recently was secured by Foley, Welch & Stewart, St. Paul, Minn. This contract called for the construction of a 130-mile branch line between Medford, N. Dak., and Drake, for the Minneapolis, St. Paul, Sault Ste. Marie Ry. In the line of electric railways, the largest contract let recently appears to have been secured by Aug. E. Steffen, Davenport, Ia., the contract calling for the construction of the projected line of the Iowa City, Ottumwa, Southwestern Electric R. R., from Ottumwa, Ia.—The formal opening of the Tucson & Western Coast of Mexico Ry. was celebrated at Tucson, Ariz., on May 5.

Government Aid in Road Building.

The U. S. Government, aside from its attempt many years ago to hold the National Turnpike, has never embarked on any general scheme for building highways. To be sure it established, several years ago, the office of Public Roads as a branch of the Department of Agriculture, and this bureau has done excellent work along experimental lines and in giving instructions in the art of road building. The appropriations allowed the Office of Public Roads, however, have been small, and no attempts have been made by the office to engage in general road construction work. There is now, however, a bill before Congress to appropriate $500,000 for road work. According to the terms of the bill, this amount is to be expended "by the Secretary of Agriculture in co-operation with the Postmaster General in improving the condition of the roads over which rural delivery is or hereafter may be established to be selected by them for the purpose of ascertaining the possible increase in the territory which could be served by one carrier and the possible increase in the number of delivery days each year, the amount required for proper maintenance in excess of local expenditure for rural delivery routes and the relative saving to the Government in the maintenance of rural delivery routes by reason of such improvements, and also the relative saving in the cost of the transportation of agricultural and other products from the farms or other points of production to the usual market place by reason of such improvements." The bill further provides that the state or county shall spend as much money as the government does for the improvement of the rural route or routes selected.

These Decadent Days.

Times change, and men change, and it would also seem that the manners of grading gangs change if there be any truth in the following: Two large railroads had grading crews at work building the grade for branch lines. These crews engaged in a race to reach the point where the two branch lines crossed, the agreement being that the road which first got its grade finished to the crossing point should not have to construct the crossing. As the construction of a crossing would involve a cost of something like $20,000 or $30,000 vigorous efforts were naturally put forth by both gangs to reach the crossing point first. The two gangs were in sight of one another for some little time and this as well as the fact that a bonus was promised the winner added to the interest of the struggle. Finally, however, one of the gangs reached the crossing and then, according to press dispatches, "The foreman of the losing gang came forward and warmly shook his opponent's hand and congratulated him on his success. The men of the grading gangs, after wildly cheering for some little time, fraternalized and then both parties sat down to lunch together," all of which seems to go to show that times and grading gangs change. In the old days when railroads were new grading crews were composed largely of sons of the Emerald Isle: men in red shirts and black hats; men who could work and talk and smoke at the same time; men who would fight the foreman, the walking boss, and the contractor at the drop of the hat. Imagine two of these old-time gangs engaging in a race of this kind. Would it have ended in a shaking of hands?

Mississippi River Improvement Work.

If everything goes smoothly and Congress finally adopts the present River and Harbor Bill, there will be available after July 1 $20,000,000 with which to secure a 6-ft. channel in the Mississippi River from St. Louis to St. Paul. The bill provides that work shall be completed in 12 years, which was something of a disappointment to the advocates of the improvement, who had originally planned on having the $20,000,000 immediately available so that the channel could be completed in 1915 at the time the Panama Canal is to be finished. The bill carries an appropriation of $500,000 for the exploitation of a plan of Ray S. Reid, Waterways Commissioner of Wisconsin, for a new system of tow boats and barges. Permanent and systematic work on the improvement of the Mississippi River was begun in 1878 and has since the beginning continued with little change in policy. The system followed makes use of the principal of contraction of the channel in the closure of chutes, construction of wing dams and revetment of caving banks. The work since 1878 has been to obtain a 4½-ft. channel stage at low water, and the work of the future will be to extend the wing dams to create further contraction and secure the 6-ft. low-water channel stage. Up to the present time about $10,200,000 has been expended by the Government.

Special Dispensation for "Sand Hogs."

Those of our contractor friends who employ that class of workers euphoniously named "sand hogs" will be interested in a court announcement recently made in the case of a colored gentleman, William Smith, who had stabbed a friend in the excitement resulting from a disputed crap game. Mr. Smith seemed in a fair way to get the law's limit of five years for his pleasure when it developed that he was a compressed air worker or "sand hog." The judge, therefore, made the sentence six months with the following announcement: "Court records seem to prove," said his honor, "that, either because they breathe too much oxygen or are affected by the air pressure, sand hogs are more quarrelsome than the average man of other callings. They are constantly getting into trouble and I think, in part at least, they cannot help it." The moral would seem to be: Don't play craps with a colored man full of "oxygen."

No Free Transportation in Texas.

One of the time-honored perquisites of the railroad contractor appears to be threatened, in Texas at least, by a recent opinion of Assistant Attorney General of that state. The Missouri, Kansas & Texas R. R. had asked permission of the State Railroad Commission to issue passes for the men in the employ of a grading contractor and had also asked permission to deadhead the grading outfit. The opinion issued by the Attorney General held that such action would violate Section 2, Chapter 42, Acts of the 30th State Legislature, and that the Commission had no authority to approve such an application.

The New Orleans Great Northern R. R., N. G. Pearsall, general manager, Bogalusa, La., is stated to have purchased right of way and made all arrangements for the establishment of its own terminal facilities in Jackson, Miss. Right of way has been purchased for a distance of two miles north of the corporate limits. It is also stated that plans have been formed for an extension of the line in a northeasterly direction up the Pearl River Valley, with the ultimate purpose of building a north and south trunk line.

Grading and clearing work on the Florida extension on Piney Island near Fernandina, Fla., is well under way. The Florida Construction & Realty Co. has the contract for the work as stated some time ago in this paper. Frank Drew, Live Oak, Fla., is president of the railway.

Confirmed Reports by Engineers and Contractors

RAILROADS, POWER DEVELOPMENTS, LEVEES, DRAINAGE AND IRRIGATION WORKS.

Railroads—Steam and Electric.

GEORGIA.

The Griffin City & Suburban Ry. Co. of Griffin, Ga., recently incorporated, proposes to construct four miles of street railway in Griffin and its suburbs. The company hopes to begin construction work in July. H. H. Bass, Griffin, Ga., is interested.

The Rome & Northern R. R. has completed location surveys for its 34-mile extension from Gore to Tunnel Hill, Ga., to a connection with the Western & Atlantic R. R., and construction contracts will be let in a short time. R. G. Peters, Manistee, Mich., is President and H. M. Smith, Rome, Ga., is Chief Engineer.

IDAHO.

The Caldwell, Roswell, Big Bend Interurban Ry. Co. has been organized and proposes to build an electric railway southwest from Caldwell, Idaho, to Snake River via Roswell, a total distance of 27 miles. H. S. Kneedler, secretary, Caldwell, informs us that the right of way has been pledged and that residents along the line will give $109,000 in the form of assessments on land within 3 miles radius. The company has been incorporated with a capital stock of $250,000, of which $27,000 has been subscribed. Surveys for the line have been made. H. S. Williams, Caldwell, Idaho, is chief engineer, and H. W. Dorman, Caldwell, is president.

IOWA.

Aug. E. Steffen, Davenport, Ia., has been awarded the contract for constructing the projected line of the Iowa City, Ottumwa Southwestern Electric R. R. This company projects a 75 mile line between Ottumwa and Iowa City, via Sharon Center, Frytown, Amish, Wellman, Krota and Ollie. Frank Tanner, Iowa City, Ia., is vice president.

KANSAS.

The Wamego & Rock Creek Valley Ry. is ready for bids from contractors for grading 20 miles of line from Westmoreland to Wamego. The work is to be completed in one year and will require 367,000 cu. yds. of earth excavation. C. C. Eastman, Westmoreland, Kan., is chief engineer.

NEBRASKA.

The Falls City, Sycamore Springs, Sabetha & Southwestern Ry. Co. has completed surveys for its projected 21 mile line. The capital for construction has not been secured as yet and no construction contracts will be let until it is obtained. George Campen, Lincoln, Neb., is chief engineer; J. H. Miles, Falls City, Neb., is president, and E. V. Kauffman, Sabetha, Kan., is vice president.

NORTH CAROLINA.

T. T. Adams Co., Richmond, Va., has been asking bids for constructing eight miles of narrow-gage steam logging road along Armstrong Creek, McDowell County, N. C. The road is to be used for hauling logs into the plant located on C. C. & O. Ry.

NORTH DAKOTA.

Foley, Welch & Stewart, St. Paul, Minn., have been awarded the contract by the Minneapolis, St. Paul & Sault Ste. Marie Ry., for constructing 130 miles of branch line between Medford, N. Dak., and Drake.

OREGON.

H. C. Henry, Seattle, Wash., has been awarded the contract for constructing the Oregon Trunk Ry., from Madras south 125 miles. Work on that section of the Oregon Trunk Ry. from Clio to Madrid, 110 miles along the west bank of the Des Chutes River is now about 75 per cent completed and should be finished for trains about Jan. 1, 1911. Porter Bros., The Dalles, Ore., Spokane and Portland, have this contract and have the following sub-contractors at work: W. E. Boie & Co., Boyington & Stevens, Bergstrom Bros., L. P. Campbell, Baker & Scarpelli, H. B. Boie & Co., A. Scarpelli & Co., Burns & Jordan, D. V. McDonald, H. E. Carleton & Co., A. E. Griffin & Co., Copenhagen Bros., C. A. McPhail & Co., Randall & Baker, McDonald & Nelson, A. M. Dassault, Porter & Conley and Porter & Clarkson. The Porter Bros'. contract includes 1,000,000 cu. yds. of earth excavation, 4,325,000 cu. yds. of rock excavation, 100,000 cu. yds. of embankment, 3,000 lin. ft. of rock tunnels, three steel bridges about 300 ft. long each and one steel bridge over the Columbia River, 50 wood trestles, about 5,000 lin. ft. in all, 15,000 cu. yds. of concrete masonry for piers of the steel bridges and stone masonry for the Columbia River bridge; also 40,000 to 50,000 lin. ft. of piling in trestle foundations.

TEXAS.

All financial arrangements have been made for the Aransas Pass & Northern R. R. and engineering work is now underway. Construction work will be commenced about Oct. 1. James H. Collins, 88 LaSalle St., Chicago, Ill., is interested.

Harty & Ford, 307 Scanlan Bldg., Houston, Tex., has finished all of the clearing on its section of the Galveston-Houston interurban line and has started grading with 50 teams. The fencing gang is following close behind the grading. It is hoped to complete the grading by Sept. 1.

M. J. Healy, Pyote, Tex., is promoting a project for the construction of a 350-mile line from Tucumcari, via Texico, thence south through the border counties in Texas and New Mexico. The road is to be known as the Tucumcari, Portales & Gulf R. R., and surveys have been made for the first 50 miles.

The Eastern Texas Traction Co. has surveys underway for its projected line, and has made arrangements for securing the capital for its construction. The projected length of this road is 150 miles and its route is Greenville, Wolfe City, Benham, Paris, Denison and Dallas. Joseph F. Nichols, Greenville, is secretary.

C. M. McConnico, Ed. Powell, and J. S. Moore, of Lufkin, Tex., have sub contracts from the Grigsby Construction Co. of Dallas, Tex., for grading work on the Temple & Northwestern Ry. extension from Temple to Hamilton. This extension requires about 100 miles of grading work averaging 12,000 cu. yds. per mile, and including some rock. The line of the road crosses the Leon River five times.

Power Developments, Levees, Drainage and Irrigation Works.

COLORADO

The Chama Valley Lands & Irrigation Co. of Kansas City, Mo., has purchased the "Tierra Amarilla Grant" of 520,000 acres, located in Archuleta County, Colorado, and Rio Arriba County, New Mexico. This tract of land embodies within its borders something over 100,000 acres of irrigable land, and also about 80,000 acres well adapted to dry farming. The company will in the immediate future spend about $1,000,000 for installing an irrigation system. H. I. Reid, Colorado Springs, Colo., is engineer.

FLORIDA.

Bids are being asked by the Board of Drainage Commissioners of the State of Florida, at the Capitol, Tallahassee, Fla., until 10 A. M., June 15, for excavating five drainage canals in the Everglades. The aggregate length of these canals is 235 miles, and their construction requires the excavating of approximately 18,000,000 cu. yds. of earth and 6,000,000 cu. yds. of rock. Specifications, etc., can be obtained from J. O. Wright, Chief Drainage Engineer, Tallahassee, Fla.

MICHIGAN.

J. E. Hathaway & Co., Milwaukee, Wis., at $55,616 was low bidder Apr. 29, for repair of south revetment at Grand Haven, Mich., for the U. S. Government. The work includes cutting down and removing old work, oak piles, oak timber, pine or Douglas fir timber and plank, drift bolts, screw bolts, angle irons, tie rods, spikes, carriage bolts and pile shoes.

NEW JERSEY.

The International Contracting Co., 17 Battery Pl., New York City, has been awarded the contract for dredging in the Passaic Run below the Montclair and Greenwood Lake Bridge, New Jersey, for the U. S. government. Bids for the work were opened April 26. The contract price is 50 cents per cu. yd., and the work amounts to about 39,000 cu. yds.

NEW MEXICO.

Will Benson, C. E., Artesia, N. Mex., has been granted 90 second feet of water from the Penasco River in Eddy County. The company in which Mr. Benson is interested will install an electric power plant capable of developing 10,000 hp. The power will be used mostly to pump water for irrigation.

Plans are under way for the construction of a power plant on the Penasco River, about 30 miles west of Artesia, N. Mex. It is proposed to construct a flume about 1,500 ft. long, which will carry about 100 cu. ft. of water per second, giving a fall of about 97 ft. It is expected to use the power for pumping purposes on the lands in the Artesia District. W. P. Turner, 221 North Main St., Roswell, N. Mex., is interested.

OHIO.

The Great Lakes' Dredge & Dock Co., Williamson Bldg., Cleveland, has begun work on its contract for dredging Secs. Nos. 1 and 2 of the Cuyahoga River for the City of Cleveland. The contract includes 525,000 cu. yds. of earth excavation, and the company is using a 4 cu. yd. dipper dredge on Sec. No. 1 and a 7 cu. yd dipper dredge on Sec. No. 2.

OREGON.

Eschbach-Bruice Co., North Yakima, Wash., have been awarded the contract for the construction of an earth dam with concrete core at Coe Siding, on the Q. R. & N. Ry., for an irrigation project. The contract includes 140,000 cu. yds. earth excavation, 3,000 cu. yds. rock excavation and 1,500 cu. yds. concrete masonry.

The plans of the Eastern Oregon Irrigation Co. are being rushed to completion and the Company hopes to perfect them so, that actual work of construction can be started this season. The project will call for about 30 miles of main canal, carrying at least 500 second feet of water, one diversion dam of reinforced concrete, at least one large impounding dam and all of the lateral canals, the length of which cannot be stated at this time. The project will provide water for the irrigation of about 30,000 acres of rich fruit lands located in Baker County, Oregon, the water being appropriated from Eagle Creek which is one of the best and most reliable streams in the entire State of Oregon. E. M. Blake, 301 Overland Bldg., Boise, Idaho, is General Manager.

RHODE ISLAND.

Following bids were received April 27, by Lieut. Frank H. Phipps, Contracting Q. M., Fort Adams, R. I., for the construction of sea wall and removal of face cover at Fort Adams: (1) Standing for construction of rip rap wall, (2) for construction of granite block wall, (3) for excavation Area A, (4) for excavation of Area B, (5) for excavation of both areas, and (6) for construction of wall with interlocking concrete pile to it 8 ft. m. l. w. John Cashman & Sons Co. West Quincy, Mass., (1) $10,000, (2) $16,000, (3) $12,000, (4) $7,000. Boston & New York Contracting Co., 220 Devonshire St., Boston, (3) $14,944, (4) $8,900, (5) $22,974. Joseph C. Terry, Fall River, Mass., (1) $12,000, (2) $12,000. Roy H. Beattie, Fall River, Mass., (1) $7,490. Phoenix Construction Co., 41 Park Row, New York, (1) $17,000, (2) $35,000, (3) $21,600, (4) $8,400. The T. A. Scott Co., Inc., New London, Conn., (2) $15,830. Darling & Slade, Fall River, Mass., (1) $10,700, (2) $11,200, (3) $15,420, (4) $4,870. The Underpinning Co., 290 Broadway, New York, (1) $16,000, (3) $9,500, (4) $5,525, (6) $18,000.

SOUTH DAKOTA.

Sweeney & Son, White Bear, Minn., have been awarded the contract at 6.7 cts. per cu. yd. for constructing the Conde open dredge ditch for the Commissioners of Codington County, S. Dak. Bids for the work were opened May 4. The ditch is to be 13 miles long and the excavation will be 15 ft. wide at the bottom, 25 ft. wide at the top and the depth will not exceed 8½ ft. Material includes no rock and consists of soil, dark loam.

MEXICO.

Thos. B. Ragan, No. 120 6a Calle de Ayuntamiento, Mexico City, Mexico, has a proposition to supply the City of Vera Cruz, Mexico, with a modern water system. He proposes to bring the water from a neighboring stream, which is to be dammed at a point at 21 miles from the city. The water is to be brought to the city through a 3-ft. concrete pipe.

S. Pearson & Son, 4 a Calle de Humboldt 31, Mexico, D. F., has work now under way on a contract for a large hydro-electric development scheme on the Conchos River at Santa Rosalia, Chihuahua, in the north of Mexico. The contract includes: earth excavation, 74,000 cu. meters; rock excavation, 278,000 cu. meters; concrete masonry, 82,000 cu. meters; stone masonry, 275,000 cu. meters; fill, 141,000 cu. meters; clearing, 606,000 sq. meters. The contract includes one main dam, dimensions of which are 80 meters high and 250 meters long crest; one subsidiary dam 730 meters long and 22½ meters high in deepest part, railway line standard gage 35 kilometers long between Sta. Rosalia and the site of the dams at La Boquilla. Power houses and generating stations and sub-stations, 200 miles of steel towers and transmission lines; also administration and staff houses and offices as well as workmen's dwellings and all other appurtenances. There are 70,000 cu. meters of excavation in the foundations of the dam, and in the spillway which is 60 meters wide there are 200,000 cu. meters of rock excavation. The plant when completed will develop 40,000 H. P. Fred Adams is Managing Director for the contractors.

Reports are to the effect that the Great Northern Ry. Co. is considering the construction of the proposed line from Bismarck, N. Dak., to Sioux City. The new line as projected will follow the west bank of the Missouri River to Pierre, S. Dak., where it will cross the stream. H. F. Hamilton, Minot, N. Dak., is Resident Engineer of the company.

Organization of the Newton Northwestern R. R. has been completed and charter obtained to construct the projected line from Newton, Miss., to Carthage in Leak County. Surveyors are now in the field procuring right of way for the line. The following are the incorporators: D. L. Ragland, W. A. Brown, W. V. Fant, H. C. Maiure, J. C. McClinton, W. B. Richardson and T. A. Baucum of Newton, Miss. The directors as follows were appointed: D. L. Ragland, President; W. A. Brown, Vice President and Manager; W. V. Fant, Secretary and Treasurer; W. B. Richardson and T. A. Baucum.

President Miller of the Laramie, Hahn's Peak & Pacific R. R., has appointed R. D. Stewart Chief Engineer and J. J. Argo, Laramie, Wyo., Locating Engineer of the company. The latter will organize an engineering corps to locate a line for the extension of the railroad into Rout County, Colo.

P. Costello, of Blanching, Ill., has moved his outfit from Savanna, Ill., to a point near Arena, N. Dak., where he has a railroad grading contract. O. S. Smith, of Steele, N. Dak., has a contract east of Arena, some six or eight miles.

The Fort Smith, Van Buren & Eastern Interurban Ry. Co., of Fort Smith, Ark., is said to be ready to begin building its road as soon as the city council of Van Buren, Ark., grants the desired right of way.

C. A. Magee, Parkston, S. Dak., who is promoting a project for the construction of an electric railway from Sioux City to Wessington Springs via Sioux Falls, S. Dak., is reported to have disposed of the bond issue in Holland.

Surveys are to be started at Abbeville, S. C., for an electric railway to extend from that city to Greenville, S. C. From Donalds to Abbeville, 15 miles, there will be only one small stream to cross and no heavy grades. J. S. Stark and R. E. Cox of Abbeville and R. C. Brownlee and Dr. Jesse Bell of Due West are interested.

Preliminary surveys are to be started from Winnemucca this month, it is said, for the proposed railroad from Winnemucca to Paradise Valley. It is intended to ultimately extend the line north through Quinn River Valley to National and McDermitt and thence through Jordan Valley, Oregon, to Caldwell or Boise City, Idaho. J. G. Jacobs, Salt Lake City Utah, is the promoter. R. E. Tilden, Winnemucca, Nev., is the engineer.

Residents of Pensacola, Fla., have requested the City Council to grant them a franchise for a railroad in that city. It is proposed to revise the Andalusia R. R. project and to have Pensacola parties construct the line from Pensacola to Andalusia.

The Arizona Eastern R. R., L. H. Long, Assistant Chief Engineer, Tucson, Ariz., is reported to have offered to take over the bonuses and right of way of the projected Phoenix & Buckeye R. R., and to construct that line to east side of the Hassayampa River by Aug. 1. The offer is conditioned on the Phoenix & Buckeye R. R. securing an ordinance permitting the building of a line into Phoenix, Ariz., from the west, together with some additional right of way, etc.

Advices from De Funiak, Fla., state that the proposed Gulf, De Funiak & Northern R. R. has completed surveys at that place for its terminal and is now engaged in surveying for its line.

Truck growers of Long Beach, Miss., are asking that the Gulf & Ship Island R. R., J. T. Jones, President, Gulfport, Miss., build a spur track to the gardening section of Long Beach, Miss.

The Hartford Electric Light Co., of Hartford, Conn., is to increase its capital stock by $600,000. The new capital will be used to double the capacity of the plant at Dutch Point.

The Frederick R. R., O. B. Coblintz, Chief Engineer, Frederick, Md., has filed a mortgage for $1,500,000 to secure a new bond issue to refund the oustanding bonds on the properties of the road and to make extensive improvements, including the extension of the road from Thurmont to Emmitsburg and then on to Gettysburg, the building of a new power house and railroad shops, and the probable extension of the trolley line from Jefferson to Brunswick.

Advices from Douglas, Ariz., state that the El Tigre Mining Co. contemplates the erection of a central power plant in Douglas, in which will be generated power not only to run the proposed new cyanide plant at the mines, but also for an electric railway which will be built from Douglas to El Tigre.

The Cumberland Valley R. R., G. C. Coons, Chief Engineer, Chambersburg, Pa., will, it is said, not only build a high line through Hagerstown, Md., and establish large yards in the southern suburbs on the Lawrence farm, recently bought by the company, but will also double track the road from Hagerstown to the Potomac River, a distance of about 12 miles, and erect a steel bridge across the Potomac river at Falling Waters.

The Board of Works of Paterson, N. J., has passed an ordinance directing that the poles and wires in the center of the city be removed not later than June, 1911. All overhead wires, with the poles carrying them, except trolley poles and arc lights, must be removed from the district bounded by the Passaic River, Spruce St., Grand St., Essex St., Straight St., and the river.

The city of Marksville, La., will vote May 14 to vote upon the proposition of levying a special tax of 5 mills for ten years in favor of the Avoyelles, Palmetto & Gulf R. R., which is projected from Opelousas through Palmetto, in St. Landry, Plaucheville, to Marksville.

Rapid progress is being made on the Great Northern R. R. line from Ayr to Surrey, N. Dak., and it is the intention of the company to have grading work finished to the terminals this Fall. Thomas Thompson is the contractor who has charge of the work in the vicinity of New Rockford, N. Dak. D. J. Hull, Jamestown, who has charge of securing right of way for the line, has experienced very little trouble, it is said.

Commercial Club of Nashville, Ark., is considering a proposition of a syndicate to build a railroad from some point in Oklahoma to that place.

Officials of the St. Louis, Iron Mountain & Southern R. R. have authorized an expenditure of $750,000 for double tracking the Arkansas Division from a point 14 miles north of Little Rock, Ark., to Bald Knob, a distance of 47 miles. E. J. Correll, Little Rock, Ark., is Engineer Maintenance of Way.

The Union Pacific R. R., A. J. Wharf, division engineer, Cheyenne, Wyo., is reported to be planning to begin work early in July on the extension of the yards, the erection of a new roundhouse, an electric turntable 105 ft. long, and the rebuilding of the freight depot at Laramie, Wyo.

Surveyors are now at work running lines for the construction of the proposed Watertown, S. Dak.,-Devils Lake, N. Dak., extension of the Chicago, Milwaukee & St. Paul R. R. It is expected the new road will be by way of Fargo, N. Dak. W. H. Penfield, Butte, Mont., is Division Engineer.

The Chicago, Milwaukee & St. Paul R. R. Co. has taken up the matter of improving the Platte line. The road bed will be partly rebuilt and other improvements made.

Property owners of Oceanville are preparing a petition urging the Atlantic City & Suburban Ry. of Atlantic City, N. J., to extend its trolley line from Absecon up the shore to Oceanville and Port Republic and eventually to Tuckerton, N. J., to connect with the railway at that point.

Items Concerning Contractors and Their Work

RAILROADS, POWER DEVELOPMENTS, LEVEES, DRAINAGE AND IRRIGATION WORKS.

Alabama Notes.

FROM CORRESPONDENTS AND OTHER SOURCES.

The City Council of Gadsden has granted a franchise to Harry A. Rodgers for the building of a car line through the city. The new line is to be an interurban road running between Gadsden, Alabama City and Attalla, including the steel plant, and will also run to the Lookout mountain top. One mile of the line must be completed within six months and the whole system completed and running within 18 months. Surveys are to be made at once to determine the route to be selected in reaching the mountain. The route for the balance of the line has already been decided upon.

The Alabama, Tennessee & Northern R. R., Wm. Toxey, Chief Engineer, Cochrane, Ala., has grading work under way on its extension to York, Ala.

California Notes.

FROM CORRESPONDENTS AND OTHER SOURCES.

Timber experts of the United States government are inspecting the proposed route of the Humboldt & Eastern Electric Ry. Co., and it is believed that some definite action will be taken shortly to have active construction work started on the line. As proposed the road will extend eastward from Humboldt bay for 175 miles to the upper Sacramento valley. Seventy miles of the road will extend through the Trinity national forest in Humboldt, Trinity and Shasta counties. Brouse E. Brizard, H. L. Jackman, W. S. Clark and Ed Bond of Eureka are interested in the railroad.

H. I. Gray has placed a large canal ditcher at work on his contract for digging the main ditch of the Sacramento Valley Irrigation Co., from where it leaves the river near Willows to the Bayless camp, a distance of over 12 miles.

The Twin Peaks Tunnel Convention mentioned in our last issue as being organized at San Francisco to secure the building of a tunnel through the Twin Peaks has opened permanent headquarters at the office of Secretary C. F. Adams, 832 Mills building, San Francisco.

Engineers have been at work in the vicinity of Suisun and Fairfield surveying the right of way for the proposed electric line of the Vallejo & Northern R. R.

R. C. Williams of Sacramento is interested in a project for the construction of a new suburban electric line at Sacramento, connecting with the J. St. extension at Cutter Ave. and extending along Cutter Ave. to the M St. road, thence across Homestead to a tract of land owned by him thence to Elmhurst and terminating on the Upper Stockton Road in front of the Gerber residence.

Advices from Truckee, Cal., state that surveyors are now employed laying out a new route for the Southern Pacific curves between that city and Reno. Stakes are being placed for cuts, fills and tunnels.

The Southern Pacific Ry. Co., it is said, will extend the branch line from Lodi to Valley Springs on to the mountains. William Hood, San Francisco, Cal., is chief engineer of the company.

Among the improvements included in the number for which the Atchison, Topeka & Santa Fe R. R. Co., has appropriated $15,000,000, is the construction of yards at Calloway, Cal., and the double tracking of the line from Albuquerque, N. Mex., to San Francisco, Cal.

The Sacramento Belt Line Co. is soon to commence the construction of wharves and warehouses on the Sacramento River in Washington, opposite Sacramento, and the building of a railroad to connect them with the various railroads in Sacramento.

The Imperial Valley Ry Co. of Redlands has been incorporated with a capital stock of $2,000,000, of which $75,000 has been subscribed, and proposes the building of a number of lines of railroad through the Imperial Valley. The plans propose the building of about 70 miles of road as follows: A railroad from Imperial City to a point about seven miles to the east. Another branch will be built from Imperial to the town of El Centro, over the most direct route available, the estimated length being four miles. Another branch will begin at El Centro and extend to a point about twelve miles southwesterly. A branch will begin at the town of Brawley and extend northwesterly for a distance of ten miles. A line beginning at Brawley will extend about seven miles easterly. From Holtville a branch will be built to a point about twelve miles northerly, and to connect at Holtville with the easterly line of the road last mentioned. A line will begin at Holtville and will run nine miles in a southeasterly direction. Calixico will be the beginning terminal for a line to Mellowland. This line will be 14 miles in length and will extend in a northeasterly direction. W. F. Holt, Redlands, Cal., is President.

Colorado Notes.

FROM CORRESPONDENTS AND OTHER SOURCES.

R. L. Richmond has been awarded the contract for the earth removing work on the McCall reservoir for the city of Longworth.

The C. G. Sheely Construction Co., Denver, has work well under way and will complete the construction of the Halligan dam for the North Poudre Irrigation Co. of Fort Collins, so that it can be formally opened for use by May 31. The dam is located on the north fork of the Cachela Poudre river, 12 miles north of Livermore. It is 335 ft. in length, with a width of two ft. at the top and 34 ft. at the bottom. Its height, from the lowest outlet to the top of the spillway, is 69.8 ft. The construction is of cyclopean masonry.

E. E. Van Diest, of Colorado Springs, is drawing plans for a storage reservoir to be constructed on property owned by the Myron Stratton Home, just south of Colorado Springs, on the site formerly occupied by the old Broadmoor dairy building. The reservoir, which will be utilized to irrigate land surrounding the Myron Stratton Home buildings, will impond 600 acre feet and will cost between $20,000 and $25,000.

D. D. Morgan has been awarded the contract for grading two miles of the Laramie, Hahns Peak & Pacific R. R., at Hebron, Colo. Contracts are being carried out in the grading of the line for several miles west of Foxpark, Wyo., and the company expects to award the remainder of the grading within the next few weeks and complete the work to Hebron this year. J. J. Argo, Laramie, Wyo., is chief engineer.

The Denver, Laramie & Northwestern Ry. Co. is now laying track on the line from Milliken to Greeley, Colo., a distance of 15 miles and it is expected to have trains in operation by May 15.

The Colorado & Red Canon Railway Co. has been incorporated at Denver, Colo., with a capital stock of $600,000 and proposes the construction and operation of a railroad in this state. The incorporators are N. J. Olsen, George C. Harp and W. M. Foster, Hotchkiss, Colo.

Advices from Greeley, Colo., are to the effect that all work will be completed on the Union Pacific's Pleasant Valley branch by May 15. The grading outfit will then be shifted to the Cow Creek branch.

Georgia Notes.

FROM CORRESPONDENTS AND OTHER SOURCES.

Plans are under way, it is said, to combine two railroad projects in South Georgia, consisting of the line for which charter has been granted from Waycross, through Bexley to Vidalia and the proposed line from Wrightsville through Adrian to Vidalia, thus giving a through line from Wrightsville to Waycross, Ga. The promoters are to take up the matter of constructing an extension to St. Marys from Waycross.

The Augusta, Lincolnton & Northern R. R. Co., has been granted a charter to construct a 100-mile railroad from Augusta, Ga., through Richmond, Columbia, Lincoln, Oglethorpe and Madison Counties, connecting Augusta with Lincolnton, Tignall, Washington and Danielsville. The incorporators are as follows: Samuel L. Wilkes and J. C. Groves, Lincolnton, Ga.; John J. Wilkinson, C. D. Bolton and Thomas W. Hill, Wilkes, Ga.; Thomas L. Verdel, W. A. Swift, T. M. Swift, Jr., and Z. C. Hayes, Elberton; E. N. Cobb, Athens, Ga. The shares are in $100 denomination and all common stock.

The Waycross & Southern R. R. has applied for a charter to construct a line south and southwesterly from Waycross, Ga. The company has a capital stock of $100,000 and headquarters at Waycross. The incorporators are as follows: James W. Oakford, of Scranton, Pa.; Daniel L. Hebard, of Piquaming, Mich.; Bryan Cumming, of Summerville Richmond county, Georgia; Chas. S. Hebard, of Thomasville; F. L. Space, of Forty Fort, Pa.; Walter Briggs, of Scranton, Pa.; R. R. Hopkins, of Brunswick; Stanley Manness, J. M. Hopkins and B. W. Redding, of Waycross.

Idaho Notes.

FROM CORRESPONDENTS AND OTHER SOURCES.

The Caldwell-Roswell-Big Bend Interurban Ry. Co. has filed its articles of incorporation at Caldwell, Idaho. The capital stock is $250,000 and the incorporators are: W. P. Howard, J. H. Lowell, Harvey Hatch, Thomas Walsh of Roswell, Robert McGuire, James Garfield, H. W. Dorman, Elmer A. Clark and B. M. Holt of Caldwell.

Illinois parties, including Capt. Henry C. Garvin of Springfield, Ill., and Charles Ullrich, of Springfield, are investigating the feasibility of financing an electric railroad to connect the towns of Albion and Burley.

The Northern Pacific Ry. has again sent its engineers to the Bitter Root Mountains and a crew is now engaged on the first 40 miles of line that is to be constructed this year, towards Lewiston.

According to reports from the vicinity of Ida Grove, Idaho, the Chicago & Northwestern R. R. is planning the construction of a line from Odebolt to Cushing, in order to shorten the distance between Des Moines, Ia., and Sioux City. H. Rettinghouse, Boone, Ia., is division engineer of the railroad company.

Officials of the Oregon Short Line R. R. have ordered tracklaying to start immediately on the branch line from Moreland, to Pingree, Idaho. G. H. Trout, Pocatello, Idaho, is assistant engineer of the company.

Illinois Notes.

FROM CORRESPONDENTS AND OTHER SOURCES.

The Rock Island Southern Ry. is considering continuing its stub line from Aledo to Viola. The matter of building a stub line to Alexis is also under consideration.

C. W. Gindele Co., Chicago, Ill., has been awarded the contract for the construction of a 10-stall round house at Nelson for the Chicago & Northwestern Ry. G. P. Connell has the contract for grading for the switch tracks at Nelson, as well as for the grading work at Fulton.

The Elgin, Joliet & Eastern Ry., A. Montzheimer, Chief Engineer, Joliet, Ill., is to expend approximately $3,000,000 for improve-

ments. Some of these are already under way. Contracts for grading for second track work were awarded recently as noted in our last issue. The improvements include the following: New roundhouse in East Yards at Joliet; new brick freight house in Joliet; new side track to accommodate 1,000 cars; entire renovation of East Joliet shops; replacing all worn rails over entire system; double roadbed on entire Eastern division; new roundhouse at Waukegan; extensive improvements on the Southern division; yard improvements at Gary and Waukegan; enlargement of sidings at Coyne's Station, Walker, Normantown, Frontenac, Warrenhurst, Sutton and Bennington.

The Wood River Drainage Commission has filed its report with the County Court at Edwardsville. The improvement proposed is to clear the old channel of brush and trees and to cut a straighter channel. Levees will be constructed in some places to prevent overflows. The estimated cost of the work is $287,000.

The Bromwell Construction Co. has begun work on its contract for the concrete construction in connection with the track elevation work of the Santa Fe in Joliet.

Officials of the Chicago, Milwaukee & St. Paul R. R. are considering the elevation of its tracks within the city limits of Elgin, Ill. Edward Laas, Fullerton Ave., Chicago, Ill., is Engineer Maintenance of Way of the C., M. & St. P. Ry. Co.

Indiana Notes.

FROM CORRESPONDENTS AND OTHER SOURCES.

The Hammond, Whiting & East Chicago Ry. Co. proposes to lay double track on Schrage Ave., and to pave its right of way through Whiting.

Right of way is being secured for a proposed electric railway between Bremen and Mishawaka. Application has been made to the Town Trustees of Bremen for an entrance to that city, and application has also been made to the County Commissioners. The line will be about 16 miles long and is to be constructed this summer. Omar E. Neff, Milford, Ind., is interested.

The Commissioners of Henry County, New Castle, Ind., are considering petitions for dredging Fall Creek for a distance of about 11 miles. It is estimated that the work will cost $75,000 to $100,000.

It is now said that the proposed interurban line from Newcastle to Muncie, Ind., will be built this year. This branch has been projected for about seven years and it is said that the original promoters will be able to finance the project. E. T. Ice, Muncie, Ind., is interested.

The U. S. Steel Corporation has asked Congress for permission to fill in several hundred acres of submerged lands in Lake Michigan, at Gary, with a view to building a large harbor for the unloading of ore boats. The plans include several piers 2,500 ft. long on which railroad tracks will be extended in order to permit transfer of the ore directly from the boats to cars.

Entire right of way for the South Bend & Logansport Line has been secured and arrangements made with the Baltimore & Ohio R. R. Co., to cross their line at Lapaz and the Wabash Railroad at Lakeville, Ind. Harry A. Butterfield, Goshen, Ind., is doing the grading.

John T. Adams, the railroad contractor of Columbus, O., who was in charge of the construction of the Indianapolis, New Castle & Toledo Traction Co. line from Newcastle, Ind., to Indianapolis, Ind., to a connection with the Belt Line Ry., has completed the contract and moved his outfits to other points.

Rapid progress is reported by the men engaged in constructing the fourth track on the Lake Shore System, and it is expected that the line will be completed to Chicago by the first of July. The fourth-track system is already in operation between Toledo, O., and Elkhart, Ind.

The project for the Wabash & Rochester Interurban Ry., which failed after $110,000 had been voted in subsidies, has been revived. Representatives of the Winona Interurban Co. have been along the line and will ask a subsidy, it is said, and connect this line, if successful, with the former line. Nine miles of the Winona road could be used, the extension being built from that strip on to Wabash and thence to Rochester. The old property will be sold at receiver's auction.

Engineer Pastelle, of Chicago, Ill., President of the Northwestern Indiana Traction Co., has applied to the City Council of Hammond for a franchise. The company is reported to have secured the necessary capital for beginning construction work as soon as the franchise is received.

Iowa Notes.

FROM CORRESPONDENTS AND OTHER SOURCES.

The Sioux City & Eastern Interurban Ry. Co. has filed its articles of incorporation at Sioux City. The project is backed by farmers in the vicinity of Climbing Hill. and as proposed the line will come into Sioux City via Battle Creek, Climbing Hill and Ida Grove. The company has a capital stock of $100,000. W. L. Harding, Sioux City, is attorney for the company and the incorporators are A. H. Tennis, H. C. Fedderson, W. B. Goodrich, C. S. Malcom, W. H. Steinhauer, William Hainer and W. L. Harding.

It is reported that contracts have been let and that construction work will be started in June on the first section of the South Dakota Interurban line west from Sioux City. This road was formed to build a line from Sioux City, Ia., to Pocatello, Idaho, a distance of 800 miles. For that length the line will be electric, using electric motors. From Pocatello to the Pacific Coast connection is made with steam lines already in operation. It is proposed to erect a large power house every 75 miles. The plans include large steel bridges to be built over the Sioux, Jim, Vermilion and Wind rivers. Capt. C. J. Dubois, Macon, Mo., is chief engineer.

George D. Dobson, of Des Moines, Secretary of the State Drainage, Waterways and Conservation Commission, who has just completed a survey of the Boone River from Webster City to its mouth, has reported that the fall of the Boone river is sufficient to develop water power enough to supply the power and light needs of Webster City.

The Chicago Great Western Ry. is reported to have acquired control of the St. Paul & Des Moines R. R., which has 121 miles of line in operation. It is said that Mason City will be made a division point between St. Paul and Kansas City.

The Chicago, Rock Island & Pacific Ry. is to expend $25,000 to $30,000 in building more sidings in its yards at Waterloo. The Chicago, Great Western R. R. is also planning to enlarge its yards at that city.

The Chicago Great Western R. R. has been making preliminary surveys in the vicinity of Waterloo for the purpose, it is said, of building a cutoff in connection with the plan for shortening the main line at various points between Oelwein and Kansas City.

Surveys have all been completed for the proposed line of the Muscatine North and South R. R., mentioned in a recent issue of Engineering-Contracting, and construction work will be started some time this spring.

Engineers are reported to be working north from Denison on surveys for a proposed interurban line from Sioux City to that place. A company has been incorporated at Sioux City with a capital stock of $100,000 to build the proposed line.

Kansas Notes.

FROM CORRESPONDENTS AND OTHER SOURCES.

The Midland Valley R. R., C. Kaighn, Engineer, Muskogee, Okla., is said to be considering extending its line from its present terminus at Arkansas City to the northwest. The route, according to reports, is by the way of Oxford, Wellington, Wichita and direct to McPherson, where it will connect with the Union Pacific.

The Gulf & Northwestern Ry. has been having resurveys made of its proposed line to ascertain the most practicable route with a view to final location. At a recent meeting of the stockholders of the company at Cheyenne, Kan., the following officers were elected: James A. Sprague, vice president; J. A. Keernan, secretary; J. F. Kimmel, treasurer, and C. C. Fodman, general manager.

The Chicago, Rock Island & Pacific Ry. has bought 14½ acres of land at Wichita for its new freight yards at that place. About $200,000 will be expended on the improvements, which will consist of a 5-stall roundhouse, a power plant, water tanks, coal chutes, cinder pits, car repair shops and tracks. A track extending from the roundhouse to the southern limits of the city will be built for the passing of long freight trains.

Officials of the Atchison, Topeka & Santa Fe R. R. Co. have accepted plans for the relocation of the line between Lake View and Lawrence, Kan., which was washed out by the new river channel. According to the new surveys the work will necessitate the raising of the grade 6 ft. for a distance of two miles, but will save about 1,000 ft. in distance. Grading will be commenced within a short time, it is said. J. M. Meade, Topeka, Kan., is Engineer of the eastern lines of the Atchison, Topeka & Santa Fe Ry.

J. B. Piper, a former real estate man of Omaha, Neb., proposes the construction of a direct railway line from Wichita, Kan., to that city.

Kentucky Notes.

FROM CORRESPONDENTS AND OTHER SOURCES.

The Louisville, Lincoln Farm & Mammoth Cave Traction Co., has securred franchises and right of way for its projected electric interurban line between Glasgow, Ky., and New Haven, Ky., over the L. and N. turnpike, with auxiliary lines from Buffalo, Ky., via Lincoln farm, to Hodgenville, Ky., on the Illinois Central Railway, and to Mammoth Cave, head of navigation on Green River. The company was chartered some time ago and arrangements are now under way for financing the project. J. M. Richardson, Glasgow, Ky., is president and J. Ward, Glasgow, Ky., is secretary.

Advices from Carlisle, Ky., state that the Louisville & Nashville R. R. is planning, among other improvements, the extension of its lines into Nicholas County and the double tracking of its main line from Cincinnati to Butler and the construction of a line from the latter place through Pendleton, Robertson, Nicholas and Bath Counties to the Morgan County Coal Fields.

Louisiana Notes.

FROM CORRESPONDENTS AND OTHER SOURCES.

The towns of Plaucheville, Moreauville and Longbridge, La., have voted a 5-mile tax for ten years in favor of the Avoyelles, Palmetto & Gulf R. R. The tax which has been voted will yield $30,000 annually. The Avoyelles, Palmetto & Gulf R. R. is projected from Opelousas, to St. Landry Parish, La., to Marksville, through the towns of Port Barre, Plaucheville, Moreauville and Mansura. An election has been ordered and will soon take place in Marksville on the question of a tax in favor of the road. No opposition of any consequence has developed as yet.

The Progressive Union of Hammond, La., has taken steps to organize a company for the construction of a motor line between Hammond, Natalbany and Genesee.

Plans are on foot to drain more than 35,000 acres of prairie land lying between Bayous Terrebonne and Lafourche, in the Parishes of Terrebonne and Lafourche, and taking in the Bayou Blue country. The drainage district will start from a point north of Houma, and terminate at a point northeast of Schriever, including lands of the Acadia plantation.

The Payne Investment Co. of Omaha, Nebr., is reported to be negotiating for the purchase of 50,000 acres of unclaimed land in Terrebonne Parish and St. Mary Parish.

The Natchitoches & Southwestern Ry. Co. is said to have preliminary matters well along, so that actual construction work can be started

soon. Capt. C. H. Teel, Colfax, La., is president.

Michigan Notes.

FROM CORRESPONDENTS AND OTHER SOURCES.

A company is being organized in Kalamazoo, according to reports from that city, for building an electric railroad from Kalamazoo to Otsego, via Plainwell. The line would be about 15 miles long. George E. Bardeen, Otsego, is interested.

Officials of the Chicago, South Bend & Indiana Ry. Co., which recently acquired the Southern Michigan Ry., has given assurances that the proposed line to Dowagiac will be built as soon as possible. The Dowagiac line is a part of the proposed Kalamazoo extension of the old Southern Michigan company. If the Dowagiac division is built it is probable that the full distance will be accomplished at some future day. The line would reach Decatur, Lawton and Paw Paw lake beyond Dowagiac. Samuel Murdock, Lafayette, Ind., is secretary.

The Michigan United Rys. Co. has petitioned the City Council of Detroit for a 30-year, eight-for-25 cents fare franchise to operate street cars from the western limits to the center of the city. It proposes, if it is successful in securing an entrance to Detroit, to extend its interurban service from Jackson by way of Ann Arbor.

The Grand Trunk Ry. is reported to have acquired control of the Detroit & Mackinac R. R., and is said to intend to extend the line across the upper peninsula, over the border line and back into Canada.

L. J. Weadock, of Toledo, O., and J. Harry Kinesly, Jr., of Cleveland, O., are promoting a project for the construction of an electric line to Fenton and Long Lake, a distance of 16 miles. It is intended if the company is organized to obtain the franchises held by Chester H. Bliss of Flint, who obtained them two years ago. These franchises run for another year.

The Northern Construction Co. of Lansing has started tracklaying from Morrill on the new Lansing-Owosso interurban line.

The Village Council of Caro has granted a franchise to the Detroit, Bay City & Western R. R., to use certain streets for railroad purposes.

Minnesota Notes.

FROM CORRESPONDENTS AND OTHER SOURCES.

W. M. and E. M. Prindle, of Duluth, have been granted a street railway franchise at Virginia, Minn. Material for the line is said to have been already ordered.

W. H. Small, of Aitkin, who has been in charge of the sub contractors for Foley, Welch & Stewart on the Cuyuna and Thief River Falls divisions of the Soo line, is soon to engage in the railroad contracting business on his own account and has taken a contract in North Dakota.

Among the dock contracts which Barnett & Record, Minneapolis, now have under way at the Head of the Lakes are the following: The Great Northern's new ore dock at Allouez, the foundation of the Pittsburg Coal Co.'s dock at West Duluth, the extension of the Zenith Furnace Co.'s dock, the extension of the Berwind Coal Co.'s dock at Superior, the foundation for the Hanna Coal Co.'s dock, heavy repairs to the property of the Northwestern Coal & Dock Co. and the dock for the Alger-Smith people at Knife River.

Options on right of way are being secured by the projected line of the Minneapolis Electric Short Line Ry. The projected line runs between Stahl and Belle lakes, its nearest point being only four miles from Hutchinson. T. D. Woodbury is chief engineer.

Advices from Mankato state that J. H. Diers, secretary and general manager of the Minnesota River Improvement & Power Co., has closed deals for the flowage rights where the various power dams are to be located. One dam is to be located at Ortonville, one at Redwood Falls and one at Lac qui Parle. The aggregate horsepower expected to be developed is 25,000.

Missouri Notes.

FROM CORRESPONDENTS AND OTHER SOURCES.

The Missouri Pacific Ry., E. F. Mitchell, Engineer of Construction, St. Louis, Mo., is preparing to have work started on the building of a locomotive and freight car repair shop in the East Bottoms at Kansas City. About $250,000 is to be expended for the purpose.

The Missouri Terminal Co. has been organized by Kansas City parties for the purpose of providing a railway entrance into the new Union Station at Kansas City from the South. Surveys have been made for a 4-track line from Martin City, which is just south of the city limits. The estimate of the construction cost is $7,000,000. The consummation of the plan is said to depend on the decision of four railways either to patronize or buy the proposed line.

The North Missouri Central R. R. Co., organized for the purpose of building an interurban electric road connecting Columbia, Mexico, Ashland, Cedar City and Jefferson City, has increased its capital stock from $600,000 to $2,500,000, and will have work on the road begun soon. The principal stockholders are O. F. Shaete, A. J. Estes, Turner S. Gordon and Jos. M. Estes, all of Columbia, Mo.

St. Louis Items.

BY A. B. KOENIG.

Harrington Bros., at Waverly, Ia., have 60,000 yards of machine work on the Waterloo Cedar Falls & Northern Railway to let. They want to place a 15 or 20 team outfit on this job.

J. J. McInerney got in on a nice piece of work on the Chicago, Milwaukee & St. Paul Railway at Gracehill, Ia.

Harry Fell of Petersen & Fell, the Boarding Contractors, reports opening several new camps on the Missouri Pacific R. R. during the past week.

Contracts for 927,000 cu. yds. of levee work were awarded at a special meeting of the board of Mississippi levee commissioners at Greenville, Miss., on April 27th. Roach & Stansell, of Memphis, were awarded the contract for work at Riverton, in Bolivar county, calling for 527,000 cubic yards at 21.25 cents per cubic yard. Dulaney & Foote will build in sections 1 and 2 at Shiloh. Their contract includes 252,000 cubic yards at 16 cents per cubic yard. Clarke, Gibson & Co. were awarded the contract for the work in section 3 at Shiloh. They will build 148,000 cubic yards at 16.40 cents per cubic yard.

McCann Bros. are about through with their work and have 26 teams idle at Murphysboro, Ill.

Hodges Downey & Co. have opened an office here in room 336 Pierce Bldg. Mr. W. D. Allen, who formerly was in the Principal Assistant Engineer's office of the Missouri Pacific R. R., is now with the above firm and in charge of this office.

Pat McCadden is at work at Gale, Ill.

The L. J. Smith Construction Co. bought two more big locomotives last week. This makes a total of 45 that they have at work on their contracts on the Missouri Pacific and Santa Fe R. R. This company probably has more locomotives at work than any one contracting company in the country at the present time.

Mike Conroy has moved his outfit to Stockton, Ill., where he is grading the G. W. yards. Mike says he has enough work there to hold him at least three months.

Col. T. J. Dolan, Secretary of the Steam-Shovel & Dredge, spent last Saturday in town. Dolan reports a scarcity of Steam-Shovel operators and wages going up. We have noticed the scarcity in St. Louis for over a month ourselves and it has been almost impossible to hire a steam-shovel man around this part of the country at any price. Steam-Shovel contractors bidding on new work want to bear this in mind.

Montana Notes.

FROM CORRESPONDENTS AND OTHER SOURCES.

Location surveys have been completed for the line of the Virginia City Southern Electric Ry. Co. from Virginia City to Alder, 9.6 miles. Grading work is to be started this month. George F. Douglas, Madison House Block, Virginia City, Mont., is chief engineer. The contract for the work is reported to have been let.

Advices from Lewiston state that S. W. Gebo will soon have work started on his proposed electric road to Kendall. He has adopted the survey made some six years ago by City Engineer O. F. Wahmansdorff of Lewistown, for John L. Bright.

John Capp, a grading contractor, who has been working on the line of the Gilmore & Pittsburg R. R., has removed his outfit to Three Forks, where he will commence grading on the proposed electric line from Three Forks to Salesville in the Gallatin valley.

New York Notes.

FROM CORRESPONDENTS AND OTHER SOURCES.

The Jay Street Connecting R. R., of Brooklyn, proposes to extend its route for a distance of 1,453 ft. in that city.

The state legislature has passed the bill regarding the New York city debt limit. This bill makes $47,000,000 available for new subways in New York City.

The Advisory Board of Consulting Engineers for the New York State Barge Canal has considered favorably the plans for these proposed contracts for barge canal construction: Contract 62, for constructing 14 miles of canal in Orleans and Monroe counties, estimated cost $2,150,000. Contract 79, for highway bridge at Oswego, estimated cost $40,000. Contract 50, for construction of big dam for Hinckley reservoir at West Canada Creek, area of reservoir six miles, estimated cost, $1,076,000.

Ohio Notes.

FROM CORRESPONDENTS AND OTHER SOURCES.

The Commercial Club of Marion has appointed a committee, of which J. E. Phillips, Marion, is chairman, to raise a fund of $1,000 as its share towards having surveys made for an interurban line from Mt. Vernon to Marion and Mt. Gilead. The Roberts & Abbott Co. Engineers, Cleveland, O., will be in charge of the surveys.

The Inland Waterways Improvement Co., of Ashtabula has been incorporated with a capital stock of $10,000, the incorporators being Harry Allehin, W. L. Vance, V. E. Davis, A. S. Baker and Walter S. Sapp. This company has been awarded the contract for improving Ashtabula Creek at Ashtabula. The contract price was $281,000, as noted in our last issue.

A considerable amount of tunnel work is proposed for the Hocking Valley R. R., which is now controlled by the Chesapeake & Ohio Ry., H. Pierce, engineer of construction, Richmond, Va. The first of these will be 2,200 ft. long and will be built in the vicinity of Wellston.

The Lake Shore & Michigan Southern Ry. has begun work at Amherst on the fourth track between Elyria and Vermilion. The four tracks between Elyria and Vermilion are expected to be in operation by April, 1911. About five of the nine miles of fourth track has already been built. Workmen are also making preparation to extend the four tracks from Vermilion to Sandusky.

Reports state that work is to be resumed shortly on the construction of the Lorain & Ashland line and it is said that the prospects are favorable that the road will be extended from Wellington to Ashland. This line was promoted by Joseph Ramsey, Jr., 212 Broadway, New York.

The Minster-Loramie Ry. Co., which proposes to build a three-mile extension of the Western Ohio Electric Ry. from Minster to Loramie, has decided to issue $45,000 worth of bonds. The citizens of Loramie have subscribed for $5,000 of these bonds and it is

expected that Minster and New Bremen will take up the rest. Surveys have been made and the track will be laid by fall.

A public hearing was held at Lorain on April 28 by the U. S. Engineer, Col. John Willis, on the request of the B. & O. for the right to extend its property 500 ft. square by filling in the lake just west of the west government pier at Lorain. The company plans to make extensive improvements and to use this made land for storage purposes.

Engineers have been making estimates as to the cost of rebuilding the Maumee-Waterville line of the Maumee Valley Railway & Light Co., which was badly damaged by an ice jam the latter part of February. Nearly one-half the road is said to have been practically destroyed, and the expense of rebuilding, at best, will be very heavy. No decision will be made as to the rebuilding until the engineers have completed their work. Albion E. Lang, Toledo, O., is President.

J. C. Rothery, general manager of the Ohio Valley scenic route, comprising the East Liverpool Traction & Light Co., the Steubenville & East Liverpool Railway and Light Co., and the Ohio River Passenger Railway Co., has resigned to accept a position as general manager and manager of constrction of new electric railway properties to be constructed in South America.

The stockholders of the Chesapeake & Ohio Ry. have authorized an increase of the capital stock to $100,000,000. The stockholders also authorized an issue of $37,200,000 20-year 4½ per cent convertible bonds. The bonds are issued, it was stated, to provide funds for the acquisition of a majority of the common capital stock of the Hocking Valley Ry. Co. and of a substantial interest in the capital stock of the Kanawha & Michigan Ry. Co., and for general improvement purposes.

Work, it is reported, will be started on the double tracking of the Oil City branch of the Lake Shore railroad from Andover to Franklin, O. The first section to be constructed will be 28 miles in length, from Polk Junction to Sand Lake, for which an appropriation has already been made.

Oklahoma Notes.

FROM CORRESPONDENTS AND OTHER SOURCES.

Engineers of the Wichita Falls & Northwestern Ry., R. A. Thompson, chief engineer, Wichita Falls, Tex.. have completed their survey in Comanche and Tillman counties and have been ordered from Frederick to Hollis, where they will take up and finish a survey of the line to Wellington, Tex. The old Kentucky roadbed from Altus to Hollis will be used, with a few slight changes from Hollis to Wellington. In Comanche County the final survey gives a direct line into Lawton.

According to a statement of President J. M. McDonald, Kansas City, Mo., grading work on the proposed Denver, Kingfisher & Gulf Railroad is to begin out of Oklahoma City early this month. It is planned that the interurban service between Oklahoma City and Kingfisher shall be in effect by January 1, 1911, and that the entire road will be completed by January 1, 1912. The shops are to be located four miles west of Oklahoma City and will occupy a tract of 480 acres of land.

Officials of the Fort Smith & Western R. R. have been over the route of the proposed extension to the southwest from El Reno, Okla. The stockholders of the road have approved the extension and it is said that actual construction work will be started shortly. W. M. Bushnell, Fort Smith, Ark., is general manager.

The Gulf Pipe Line Co., John S. Fisher, General Superintendent, Bartlesville, is considering building a 52-mile extension of its pipe line into the fields of Northern Oklahoma.

Work is now under way on the interurban switch which will place Haileyville, Okla., on the main line of the McAlester-Hartshorne Ry.

According to advices from Watonga, Okla., surveyors of the Mountain, Valley & Plains R. R. Co. have completed a preliminary survey for the line between Fountain and Kingfisher and are now running another line between the two points, in order to find a lower grade than the first, which is considered too high for railroad purposes by the engineer of the company.

Advices from Waynoka, Okla., state that the Santa Fe terminals and shops will be moved from La Junta, Colo., to that place and that work will be started at once to make that place one of the finest division points on the road southwest.

Work has been started on the construction of the Kansas, Lawton & Gulf R. R. Company's projected line from Oklahoma City to Wichita Falls, Tex.

The Atchison, Topeka & Santa Fe Ry. Co. has work well under way ballasting and raising the track on the line between Cherokee and Kiowa, Okla.

The recent sale of $3,000,000 of the Missouri, Oklahoma & Gulf Rys. bonds in Paris, France, is said to assure the extension of the line from the present terminus at Wagoner, Okla., to Kansas City, Mo. At present the road is operating a line about 200 miles long through Oklahoma. The company is constructing a track from Durant, Okla., the present southern terminus, to Dennison Tex., about 28 miles south, and it is expected trains will be running on the new extension by Aug. 15. J. J. Harrison, Durant, Okla., is Chief Engineer.

As a result of the recent meeting of the Atchison, Topeka & Santa Fe R. R. directors in Chicago, Ill., an appropriation of $300,000 was made for the construction of yards and terminals in Oklahoma City, Okla., and actual work will be commenced shortly. The capacity of the yards will be increased from 900 to 2,000 cars. J. M. Meade, Topeka, Kan., is Engineer of the Eastern Lines of the Santa Fe.

Oregon Notes.

FROM CORRESPONDENTS AND OTHER SOURCES.

The surveys of the Albany & Interurban electric line from Albany to Sweet Home by way of Lebanon and the South Santiam Valley have been completed and the surveyors have begun the survey of the line to Sweet Home by way of Brownsville and the Calapoola River Valley. The work of securing rights of way is progressing steadily.

The City Council of Marshfield is planning to order all the lowlands in South Marshfield filled. Many blocks in the south part of the city are on what was tidelands, the buildings being erected on piling.

H. C. Henry, Seattle, Wash., has been awarded the contract for grading the Oregon Trunk Line from Madras to the north boundary of the Klamath Indian reservation. The contract calls for completion by Jan. 1, 1911. The grade will be 123 miles in length and runs over comparatively smooth ground. A few bridges will have to be put in, but the large bridge across Crooked river will be built by the railroad company under supervision of Engineer Ralph Modjeski of Chicago, Ill. The bridge will be a steel arch.

The Pacific & Eastern Ry., of which John R. Allen is president and Wm. Gerig, chief engineer, Medford, Ore., has offered to build a railroad to the Blue Ledge Mine, 30 miles southeast of Jacksonville, if the Commercial Club of Jacksonville would secure a right of way.

The Portland, Eugene & Eastern Ry. Co., operating a street railway line in Eugene, Ore., has made a proposition to the members of the Northwestern Eugene Improvement Club to build a loop two miles in length to the western end of the city for a bonus of $12,000.

Over 1,000 men are now employed on the extension of the Pacific & Eastern Ry. through Rogue River Valley, and it is expected to increase the force to 5,000, if the men can be secured, so as to get the road completed across the Cascade Mountains before the next winter season is on. Grading camps are strung all along from Eagle Point to within 2½ miles of Butte Falls, a distance of 23 miles. and the right of way is cleared to Butte Falls. Two large steam shovels are a part of the equipment, and as no heavy rock work is being encountered and there is no tunnelling to do, it is expected to have the road completed to Butte Falls by June 15. Wm. Gerig, Medford, Ore., is chief engineer.

The Southern Oregon Railroad & Power Co. has been organized and is to build an interurban line through the Rouge River Valley. Wm. Gerig, Medford, Ore., is reported to be interested.

The Tri-State Railway & Power Co., of Portland, has been incorporated with a capital stock of $10,000, the incorporators being W. D. Riddell, R. B. Candage and T. M. Peters.

Advices from Sweet Home, Ore., are to the effect that work on the railroad between Albany and Cascadia has begun at Albany. The line as projected will pass through Sweet Home.

Pennsylvania Notes.

FROM CORRESPONDENTS AND OTHER SOURCES.

Plans have been completed by the West Penn Railways Co. of Pittsburg for the building of a branch line from Greensburg to the Jamison coke works and thence to Latrobe, a distance of 10 miles. The West Newton & Hunter line will be built during the coming summer. P. O. Fritsch of Connellsville is chief engineer.

The Cumberland Valley R. R., G. C. Coons, engineer, Chambersburg, has been making several surveys through and around Shippensburg, and this has led to the report that the railroad intended to enter the town by another route.

Advices from Butler, Pa., state that the Slippery Rock and Grove City Street Railway Co., projecting a line between Slippery Rock and Grove City, Pa., has filed a mortgage for $250,000 to finance the work.

The Council's Committee on steam railways of Philadelphia has approved the plans of the Reading Railway Co. for the construction of a low-level single line of freight track paralleling the company's New York division road for a distance of about one mile between Wayne Junction and Logan Station. The new track is to relieve this section of the New York division of the heavy freight from the Wayne Junction freight yards. Wm. Hunter, Philadelphia, is Chief Engineer.

The Stone & Webster Engineering Corporation, Boston, Mass., is to determine upon a route for a connection of the line of the Philadelphia & Western Ry., and the Lehigh Valley Transit Co. Both roads are controlled by E. B. Smith & Co., Philadelphia.

An ordinance is before the Councils of Scranton, to permit the street railway company to extend the Swetland St. line north on Bromley Ave. to Pettebone St., west on Pettebone St. to Rebecca Ave., and possibly north on Rebecca Ave. to Schlager Boulevard.

The Lowe Construction Co. of Bristol, Tenn., has been awarded a contract by the Doe River Light & Power Co. which is to supply the Bristol Gas & Electrical Co. with current, for the construction of a concrete dam across the atauga River in the Horseshoe Bend in Carter county. The dam will have a base 48 ft. in width and will be 50 ft. in height and 300 ft. in length. The contract price is said to be $250,000.

Texas Notes.

FROM CORRESPONDENTS AND OTHER SOURCES.

Good progress is being made by the committees of the Commercial Clubs of Greenville and Wolfe City in securing right of way for a projected interurban line between the two towns. J. B. Murphy, Greensville, is interested.

R. T. Gunn, representing Chicago capitalists, has made a proposition to the city of Waco for building an interurban line between Waco and Temple. James B. Baker of Waco, acting as chairman of the Business Men's Club, has offered right of way from Waco to the county line, and a similar offer has been made by Temple.

W. A. Frisby, Beeville, promoter of the proposed Beeville-to-the-West railroad, has made a new proposition to the citizens of Beeville. He now offers to make a guarantee

bond with a Philadelphia bank to complete the construction to the Rio Grande, 175 miles, inside of 48 months, or forfeit all claim to the bonus and other conditions demanded of Beeville.

The Myrick Brothers Shell Co., Port Arthur, has contracted to furnish the Kansas City-Southern Ry. 50,000 yds. of oyster shells. The track is to be ballasted with these shells to the Sabine river and all the yards at Beaumont and Port Arthur and the Port Neches switch. New ties are being placed in readiness for the work. Beyond the Sabine river the ballasting will be continued with gravel.

The Atchison, Topeka & Santa Fe Ry. has plans under way for increasing the capacity of its yards at Cleburne so that they will hold 20,000 cars. About $400,000 will be expended there.

The Austin Dam & Suburban Ry. Co., T. J. Freeman, Houston, president, contemplates the construction of a motor line from Austin to the dam site near that city.

The New Orleans, Texas & Mexico R. R. (Frisco system), M. C. Byers, Chief Engineer, St. Louis, Mo., is to construct a branch line from Kingsville to the town of Riviera on the Gulf of Mexico.

The Quanah, Acme & Pacific Ry., C. E. Ensminger, General Manager, Quanah, mentioned in our last issue, has engineers in the field surveying the route for the proposed extension to Roswell. It is now announced that construction work will be started from Paducah the latter part of this month.

The town of Eola has raised a bonus of $34,000, which will be increased to $75,000, for the purpose of securing a railroad from San Antonio.

Citizens of Anson, Tex., are taking the matter into consideration of subscribing a bonus amounting to $40,000 and furnishing the right of way for the construction of a railroad from Anson to Hamlin, Tex.

Reports from Asherton, Tex., are to the effect that the Asherton & Gulf R. R. Co., is considering the extension of its line from that city to Eagle Pass, Tex., a distance of 75 miles. R. H. Gresham, Artesia, Tex., is Chief Engineer.

Arrangements have been completed for the financing of the Bartlett-Florence railroad extensions: One from Florence to Pampasas, 25 miles, and the other from Bartlett southeast to a point near Houston, 160 miles. G. D. Fairtrace, Bartlett, Tex., is Chief Engineer of the company.

Track has been laid at Haskell to Hemphill park for the street railway. It is said to be the intention of Promoter Hemphill to continue the system into a belt line.

The Paris & Mount Pleasant R. R. has let a contract for 25 miles of new 60 lb. rails. Nearly all of the grading has been completed and it is proposed to have the track laid to Sulphur by Sept. 1.

Plans and drawings for the proposed extension of the car lines in the southeast portions of Houston have been forwarded to the Boston headquarters of the Stone & Webster Engineering Corporation for approval and are expected back in Houston about May 20.

Plans are under consideration for reclaiming the plat at Morgan's Point, near Houston, and bringing it up to grade preparatory to establishing a summer resort there. It is said that $100,000 will be spent in grading and improving the land. Joseph F. Meyer, Houston, is interested.

The Gulf, Colorado & Santa Fe Ry. has awarded contracts for the erection of two of the bridges necessary to the building of the Lometa-Brady extension of the road in West Texas. The successful bidder was the Union Bridge & Construction Co. of Kansas City, Mo., and the work will be started at once. The contracts call for concrete and steel construction, one being across the Colorado River 14 miles west of Lometa.

Contracts have been signed providing 50 miles of right of way for the proposed branch line of the Kansas City, Mexico & Orient Ry., from San Angelo to Allende, Mex. It is expected that right of way and liberal bonus will be donated to the company for the 75 miles of line to be constructed across the Mexican Territory. The road will cross the Rio Grande River at Del Rio, where a large international bridge will be constructed. Plans for the work have already been made. C. H. Webster, Sweetwater, Tex., is Chief Engineer of the company.

Work has been started laying steel on the projected line of the Enid, Ochiltree & Western R. R., out of Dalhart, Tex. It is thought that no further interruption will delay the work.

Millersview, Tex., has been called upon to subscribe a bonus of $40,000 to aid in the construction of the proposed Santa Fe branch line from Ballinger south to that town, a distance of 25 miles.

The Stephensville North & South Texas R. R., operated as part of the St. Louis Southwestern System, has filed an amendment to its charter providing for the construction of three extensions and branch lines as follows: One from Hamilton to Gatesville, 32 miles; from Stephensville to Thurber, 26 miles; from Hamilton to Comanche, 35 miles. Surveys for the new work will then begin. B. C. Cage, Stphensville, Tex., is President of the company.

Utah Notes.

FROM CORRESPONDENTS AND OTHER SOURCES.

The Western Pacific Ry. has been making surveys for a line around the south end of the Great Salt Lake. This line starts at Grant's and skirts the dry land on the edge of the lake to the old salt mill of Thomas Weir, thus cutting out the five miles or more most susceptible to damage from high winds on the lake. The breakwater will also be built and the present line is being quickly repaired.

Construction work has been started on the proposed extension of the Utah Light & Railway Company's extension to Midvale and it is expected that the track will be laid complete by June 1.

The Beaver Irrigation & Power Co. is planing to put 50,000 acres of land in Beaver county under irrigation and will expend about $1,000,000 for installing reservoirs in the Beaver river. B. F. Walling & Co., Chicago, Ill., and St. Paul, Minn., are interested.

Virginia Notes.

FROM CORRESPONDENTS AND OTHER SOURCES.

The Lynchburg, Amherst & Northern Ry. is to have preliminary surveys started shortly, for its proposed trolley line from Lynchburg, Va., northward through Amherst county and into Nelson county. The line will start at the northern end of the James river bridge at Lynchburg and it will touch Sweet Briar College, Amherst Courthouse, going in a northerly direction to the Nelson county line and probably into the Crabtree Valley. The incorporators of the road are: H. L. Page, president; J. T. Bonny, secretary; H. C. Joyner, J. E. Bowman, C. A. Jubert, Stickley Tucker, W. Ward Hill, C. L. Scott and C. J. Campbell, of Amherst, Va.; Wallace A. Taylor, of Lynchburg, Va., and W. E. Walker, of Sweetbriar, Va.

The Norfolk Southern R. R. Co., has been chartered with a capital stock of $16,000,000 and has taken over all of the lines, equipment and other property of the old Norfolk & Southern Railroad Co. The road was purchased for $8,500,000 under a judgment of sale issued by the United States circuit court.

The Maryland, Delaware & Virginia Ry. Co., W. Thomson, General Manager, Baltimore, Md., is making arrangements to build a new and larger wharf at Tappahannock, Petersburg.

The Norfolk & Western Ry. Co. has awarded the contract to build an underground crossing at Lynchburg Ave., Roanoke, Va., to the Vaughan Construction Co. The work is estimated at $40,000.

Surveyors of the Richmond & Chesapeake Bay R. R. Co., engaged in surveying a route from Fredericksburg, Va., to Washington, have passed Occoquan and are making rapid progress toward Alexandria.

Washington Notes.

FROM CORRESPONDENTS AND OTHER SOURCES.

The Sound Construction & Engineering Co. of Seattle, has been incorporated with a capital stock of $200,000, the incorporators being C. C. Cawsey, John Hastie, James M. Douglas and H. Lohse, Jr.

Residents of the Stuck and Puyallup Valleys have instructed the State River Commission to expend $25,000 in directing the Stuck River into a permanent course to follow the tracks of the Chicago, Milwaukee & Puget Sound Ry. from a point south of the King county line to about two miles above its present confluence with the Puyallup River. Mayor R. R. White, Sumner, is a member of the Commission.

Good progress is being made with the concreting of the Great Northern Ry. tunnel near Everett. Over 800 ft. of the 2,340 ft. of the bore have already been lined. At the present rate the job will be completed in about nine months.

H. C. Henry, Seattle, has construction work well along on the nine miles of new line of the Chicago, Milwaukee & Puget Sound Ry., between Moncton and North Bend.

The Chicago, Milwaukee & Puget Sound Ry. is said to be securing a new right-of-way from Cosmopolis to Willapa Harbor and thence to Portland. It is said the company is following the North and Little North rivers by easy grade in a southwesterly direction to Willapa Harbor and thence south to Portland.

The Inland Waterway & Canal Co., recently mentioned in these columns, is reported to have secured a large part of the $250,000 necessary for the construction of its proposed canal between Grays Harbor and the Columbia River by way of Willapa Bay. The canal is to be 18 miles long and of the 13 miles between Grays Harbor and Willapa Bay, part will follow a chain of small lakes and the route has been surveyed. More than one-half of the right-of-way has been obtained. The highest point in the entire route is 1.7 ft. above tide level. The canal will be 30 ft. wide and 12 ft. deep in the center. J. H. Marshall, South Bend, Wash., is interested.

Lewis A. McArthur, R. D. Greer and H. D. Hanna have incorporated the Walla Walla Valley Railway Co., and propose to construct and operate a street railway from Walla Walla to Milton, Oregon. The capital stock is $500,000.

The Puget Sound & Alaska Powder Co. is having plans prepared for and in a few days will commence the construction of a deep-water dock at its plant near the southern limits of Everett, to facilitate shipments to Alaska and South Coast points.

The Centralia-Chehalis Interurban Co. has applied to the State Railroad Commission for permission to cross certain highways in Lewis county and the streets of Chehalis and Centralia.

The Oregon & Washington R. R. (Harriman Lines) is said to have completed arrangements for having work started in the construction of a large freight yard at Centralia which will be used for handling business from the Gray's Harbor branch.

Wisconsin Notes.

FROM CORRESPONDENTS AND OTHER SOURCES.

The Chippewa Valley & Northern Ry., J. Z. Arpin, Manager, Atlanta, Wis., is having surveys made for an extension from Buce, Atlanta and Exeland, in a northeasterly direction to Radisson. It is said that the grading work will be started at Exeland.

Announcement has been made by the mayor of Monasha, Wis., that the elevation of the Chicago, Milwaukee & St. Paul tracks to the grade level on Depere St., will be started at once.

The steel railway system at Janesville is to be rebuilt to meet the needs of the projected interurban service.

Board of Directors of the Badger Short Line recently organized to construct a railroad from Prairie Farm to Menominee, Wis., have

met to prepare incorporation papers for fillng the same with State Secretary. Actual construction work will then be taken up.

Advices from Oxford, Wis., state that the Johnson-Carey Construction Co., is making fine progress on the Northwestern line on the east side of the ridge in Oxford. Steam shovels are being used on the work.

The Chicago & Wisconsin Valley Ry. Co. has asked for a franchise at Madison.

Canadian Notes.

FROM CORRESPONDENTS AND OTHER SOURCES.

A committee appointed by the City Council and Board of Trade of Belleville, has looked over the proposed route of the Canadian Northern Ry. through the city and has reported in favor of the plan of survey submitted by the company.

The Canadian Minister of Railways has approved the projected line of the Alberta Central Ry., of Red Deer, Alberta, from Red Deer east to Sounding Creek, a distance of 150 miles. The actual surveys are now in progress. At the last meeting the company secured the approval of its line west from Red Deer 70 miles and construction work on this section will begin immediately.

The city of Montreal has a plan under consideration to have the Grand Trunk Ry. abolish level crossings between Montreal and St. Henri, a suburb. A new viaduct suggested would be four miles long. Plans are not ready yet and the city commission may be asked to co-operate with the railroad company in its successful carrying out. It is estimated that the plan would cost the Grand Trunk about $8,000,000.

The Canadian Northern Ry. has under contemplation an expenditure of between $3,000,000 and $4,000,000 in Montreal in the near future, in connection with the establishment of suitable passenger terminals in that city.

The Temiskaming & Northern Ontario Ry., S. B. Clement, Chief Engineer, North Bay, Ont., is having over 100 miles of its line resurveyed with a view to rebuilding in order to be prepared for heavy traffic. This is the first section from the Grand Trunk terminus at North Bay to New Liskeard which was built for local traffic before there was any mines at Cobalt and Gowganda and before the Grand Trunk Pacific was contemplated.

Nat Boyd has been awarded the contract for extending the Greenway and Wakopa Branch of the Canadian Northern Ry. to Deloraine.

The Goose Isle branch of the Canadian Northern is to be pushed on 25 miles north, paralleling the C. P. R. line to Teulon. It will be eventually pushed on to Fisher River, affording an outlet for the country lying along the Washow and Fisher rivers, which is now being rapidly settled up. Engineers are now out locating the line.

The Pacific Coast Mining & Development Co. has been formed to develop the mines in the Portland Canal District in British Columbia controlled by D. D. Mann, vice president of the Canadian Northern Ry. The development work will be in charge of H. E. Knobel. Mr. Knobel and H. A. Grant, who will have charge of the proposed 20-mile railway to be built from tidewater at Stewart, B. C., have gone to Stewart preparatory to beginning work.

Advices from Edmonton, Alta., state that Jean Revillon, Paris, France, rival of the Hudson Bay Co., of North Canada, has applied to the Alberta Legislature for a charter to construct a railroad from Edmonton to Grand Prairie, on the Peace River, via Sturgeon Lake, a distance of 250 miles.

The Canadian Public Works Department has awarded the Dominion Dredging Co., Ottawa, a $60,000 contract for dredging in Quebec. Other successful bidders at different points were: L. Cohen & Son, W. J. Poupore and the General Construction Co.

Plans have been filed by the Canadian Pacific Ry. Co. at the city registry office at Ottawa, Ont., involving an outlay of about $1,000,000 for an underground line through the city connecting the Central station near the foot of the Rideau canal with the company's Union station in the northwestern part of the city. The company proposes to acquire from the dominion government the bed of the Rideau canal from the "deep cut" to Sapper's bridge, a distance of about half a mile, and after diverting the water in the canal to the Rideau river to run its railway line along the course of the waterway, paralleling the present railway entrance to a point opposite the new station. From there it is proposed to construct an underground tunnel from near the postoffice under the same to a point on Wellington street near the waterworks aqueduct property and thence on the street level to a connection with the C. P. R.'s present lines at the Union station.

Mexican Notes.

FROM CORRESPONDENTS AND OTHER SOURCES.

The National Railways of Mexico have commissioned J. S. Hall to prepare plans for a large general office building and terminal station to be erected in the City of Mexico. It is proposed to make this terminal station the largest and finest south of St. Louis. At present the several railroads entering Mexico City belonging to the National Railways of Mexico have their own stations and terminals. These include the old National, the Mexican Central, the Interoceanic and the Hidalgo and Northeastern. It is claimed that by concentrating these several terminals into one great station and directing the affairs of the several lines composing the system from one set of general offices a great saving in cost of operation and maintenance can be had. The location for the proposed central station and terminals is said to have been selected, but pending a final deal for the property public announcement of its situation is withheld. The architect also prepared the preliminary plans for the terminal buildings that are being erected at Vera Cruz by the Vera Cruz Terminal Co. at a cost of about $6,000,000.

Work is to be started shortly on the construction of the gas plant and distributing system at Guadalajara for the Guadalajara Gas Co., a holding corporation of the Gas Operation & Construction Co., of Los Angeles, Cal. George H. Eckert, of San Francisco, and W. A. Aldrich, of Grand Rapids, Mich., gas engineers, are now in Guadalajara to take charge of the work of installing this system.

The Mexico Northwestern Ry. Co. has made a survey of a line for a branch road from San Antonio station to Cusihuiriachic. B. H. Bryant, Casas Grandes, Chihuahua, Mexico, is Chief Engineer.

The Arizona, Mexico & Gulf of California R. R., has been incorporated and proposes the construction of a railroad to Port Lobos, on the Gulf of California from a connection with the Southern Pacific in Arizona by way of the Snora Alter District. The line will be about 200 miles in length. Benjamin P. Cheney, Boston, Mass., is interested in the project which is capitalized at $13,500,000.

The Minneapolis, St. Paul & Sault Ste. Marie Ry. is reported to be planning to build a line from Ryder, N. Dak., to Elbowwoods on Fort Berthold reservation, 40 miles distant. Application has been made to the government for permission to enter the reservation.

The Wheeling Rapid Transit Co. is reported to have awarded a contract to MacArthur Bros. Co., New York and Chicago, for the construction of its projected electric railway to Wheeling, W. Va., construction work on which must be started by May 15 under the terms of the franchise.

An ordinance is before the City Council of Hastings, Neb., to grant a franchise to the Omaha, Western & Lincoln Interurban Co. for the use of certain streets for street railway purposes. The Omaha, Western & Lincoln is a reorganization of the Omaha & Nebraska Central, which went through a receivership several months ago. The latter road had secured right of way for almost the entire distance and some grading had been done when the company dissolved. Frank E. Scharff, Lincoln, Neb., is interested.

BIDS ASKED.

Bridges.

Bids are asked on following work, the notes being arranged alphabetically by states:

Greenfield, Ind.—Until 10 a. m., June 20, by County Commissioners, for the construction of a steel bridge over Blue River. C. H. Troy is Auditor of Hancock County.

Jeffersonville, Ind.—Until 11 a. m., June 6, by County Commissioners, for the construction of a bridge over Logan Creek. Peter Nachand is Auditor of Clark County.

Cleveland, O.—Until 11 a. m., May 21, by County Commissioners for constructing, according to report No. 2603, new bridge abutments on the River road in Mayfield township.

Cleveland, O.—Until 11 a. m., May 25, by Board of County Commissioners, for the construction of bridge, per Report No. 2615, extension on Columbia Road, Olmsted Township.

Cleveland, O.—Until 11 a. m., May 21, by County Commissioners, for constructing, per report No. 2611, a concrete bridge over the river on the River road in Brecksville township.

Cleveland, O.—Until 11 a. m., May 21, by Board of County Commissioners, for the construction, according to report No. 2602, of a concrete bridge on the River road in Brecksville township.

Cleveland, O.—Until 11 a. m., May 21, by Board of County Commissioners, for the construction of a bridge, per report No. 2601, on River road in Brecksville township. The structure will be of concrete.

Philadelphia, Pa.—Until noon, May 17, by Director of Public Works, for the construction of bridge on the line of Fox St. over Norristown branch of Philadelphia & Reading Ry. It will be a steel I-beam structure, incased in concrete on concrete abutments and piers, 60 ft. wide, and will have one 30-ft. and two 18-ft. spans. George R. Stearns is director.

Spartansburg, S. C.—Until May 25, by D. M. Miles, County Supervisor, for the construction of a steel bridge over the Enoree River, known as the Van Patton bridge.

Spartansburg, S. C.—Until 10 a. m., May 18, by D. M. Miles, Supervisor, for the construction of a bridge over Lawson's Fork, near Drayton Mills. Bids will be received for both steel and wood structures.

Lyons, Wis.—Until May 18, by Town Clerk, for the construction of a bridge across the Baraboo River at Metcalf's mill, about one mile above this place.

Winnipeg, Man.—Until 11 a. m., June 28, by Chairman, Board of Control, for the construction of concrete piers to be completed on or before the 15th of November, and for the erection of the steel superstructure and floors, with two lines of street railway tracks, to be completed on or before June 1, 1911.

Toronto, Ont.—Until noon, May 17, by G. R. Geary, chairman, Board of Control, for the construction of two reinforced concrete foot bridges, 34 ft. clear span, crossing over Chippewa Ave., Centre Island.

Buildings.

Bids are asked on following work, the notes being arranged alphabetically by states:

San Francisco, Cal.—Until 3 p. m., June 15, by James Knox Taylor, Supervising Architect, Treasury Department, Washington, D. C., for the installation of a heating plant, pumps, well, vacuum cleaning plant, electric wiring, alterations to building, etc., for the United States custom house and appraisers' stores building at San Francisco, Cal.

Washington, D. C.—Until 2 p. m., May 20, by Treasury Department, U. S. Life Saving Service, Washington, D. C., for the construction of improvements to the life saving station at Manistee, Mich.

Washington, D. C.—Until 2 p. m., May 17, by S. I. Kimball, General Superintendent, Treasury Department, U. S. Life Saving Department, Washington, D. C., for constructing two life saving stations, one at Chicamacomico, N. C., and the other at Kitty Hawk, N. C.

Key West, Fla.—Until noon, June 15, by J. R. Curry, Jr., Chairman, Board of County Commissioners, for the erection of an addition and repairs to the county jail building.

Fort Des Moines, Ia.—Until 3 p. m., June 3, by Constructing Quartermaster, for the installation of a steam heating plant in the hospital at Fort Des Moines, Ia.

Chicago, Ill.—Until 1:30 p. m., May 16, by Board of County Commissioners, for making certain changes in the boiler room at the Cook County Hospital, covering the labor and material necessary for the installation of a water heater, boiler feed, pumps, piping, etc. William McLaren is Superintendent of Public Service.

Brownstown, Ind.—Until 8 a. m., June 18, by Board of County Commissioners for remodeling, improving, and erecting additions to the county court house, located at this city. H. W. Wacker is Auditor of Jackson County.

Brownstown, Ind.—Until 8 a. m., June 18, by County Commissioners, for remodeling, improving and erecting additions to court house; also separate bids for heating, plumbing, and elec-

trical appliances. H. W. Wacker is Auditor of Jackson County.

Baltimore, Md.—Until 11 a. m., May 18, by Board of Awards, President, J. Barry Mahool, for alterations and improvements in south court of city hall.

Peru, Ind.—Until 2 p. m., June 20, by County Commissioners for the metal furniture and fixtures for new court house. Charles Griswold is Auditor of Miami County.

Peru, Ind.—Until 2 p. m., June 21, by County Commissioners for chairs, desks, tables, etc., for new court house. Charles Griswold is Auditor of Miami County.

La Moure, N. Dak.—Until 2 p. m., June 7, by C. J. Alister, County Auditor, for decorating the new court house for La Moure County.

Asbury Park, N. J.—Until 3 p. m., June 14, by James Knox Taylor, Supervising Architect, Treasury Department, Washington, D. C., for the construction complete, including plumbing, gas piping, heating apparatus, electric conduits and wiring, of the United States Post Office at Asbury Park, N. J.

Elizabethtown, N. Y.—Until 4 p. m., May 21, by R. B. Dudley and committee for the reconstruction and repair of the Essex County buildings at Elizabethtown, N. Y.

Middletown, N. Y.—Until 3 p. m., June 9, by James Knox Taylor, Supervising Architect, Treasury Department, Washington, D. C., for the construction complete, including plumbing, gas piping, heating apparatus, electric conduits and wiring of the United States Post Office at Middletown, N. Y.

Cleveland, O.—Until noon, May 26, by H. F. Jordan, Clerk, Board of Education, 605 Euclid Ave., East Cleveland, for furnisihng labor and material for the construction of a two story school building, of brick.

Shamokin, Pa.—Until 3 p. m., June 13, by James Knox Taylor, Supervising Architect, Treasury Department, Washington, D. C., for the construction complete, including plumbing, gas piping, heating apparatus, electric conduit and wiring of the United States Post Office at Shamokin, Pa.

Charleston, S. C.—Until 11 a. m., June 11, by Bureau of Yards and Docks, Navy Department, Washington, D. C., for the construction of a water front substation, building No. 20, U. S. Navy Yard, Charleston, S. C.

Winnipeg, Man.—Until May 11, by Frank Lee, Division Engineer, for the construction of Canadian Pacific freight sheds at Brandon.

Toronto, Ont.—Until 9 a. m., May 25, by Hydro-Electric Power Commission of Ontario, Continental Life Bldg., Toronto, Ont., for the construction of transformer station building superstructure at Port Arthur, Ont.

Roads and Streets.

Bids are asked on following work, the notes being arranged alphabetically by states:

Wilmington, Del.—Until noon, May 24, by Francis A. Price, County State Highway Commissioner, for building a macadam road in the county of New Castle and the state of Delaware. The work includes the following roads: State Road, commencing at the Kent County line and extending northward 2 miles; road from Mt. Pleasant to the Maryland line, a distance of 3.82 miles; road from Boyd's Corner easterly towards Port Penn, a distance of 1.51 miles; Naman's Creek Road from Casey's bridge to Philadelphia Turnpike, a distance of 3.194 miles.

Centerville, Ia.—Until 2 p. m., May 13, by Hall & Adams, City Engineers, for the construction of 25,930 sq. yds. of brick paving and 20,910 ft. curb and gutter.

Boise City, Idaho.—Until 8 p. m., May 28, by Board of Public Works, Karl Paine, President, for paving with either asphalt, bitulithic, vitrified brick, concrete or granitoid (with oil macadam along street car tracks) in the streets and parts of streets in Paving District No. 15, including approximately 160,000 sq. yds., with necessary excavation and gutters.

Coeur d'Alene, Idaho.—Until 4 p. m., May 16, by H. B. Wright, City Engineer, for the improvement of streets. The city's share of the work will cost $27,000.

Crawfordsville, Ind.—Until 10 a. m., June 7, by County Commissioners, for the construction of improvements on the highway in Madison township. Bennett B. Engle is Auditor of Montgomery County.

Fowler, Ind.—Until 1 p. m., June 6, by County Commissioners, for the construction of a road in Union township. Lemuel Shipman is Auditor of Benton County.

Lebanon, Ind.—Until 1 p. m., June 6, by Board of County Commissioners, for the construction of a gravel road in Eagle township, brick paving through Zionsville. B. F. Herdrich is Auditor of Boone County.

Peru, Ind.—Until noon, June 8, by County Commissioners for the construction of five gravel roads in Jefferson, Erie, Washington and Pipe Creek townships. Charles Griswold is Auditor of Miami County.

Vernon, Ind.—Until 11 a. m., June 6, by County Commissioners, for the construction of 1 1-5 miles of pike road in Geneva township. T. L. Thomas is Auditor of Jennings County.

Vernon, Ind.—Until 11 a. m., June 6, by County Commissioners, for the construction of 2 1-6 miles of pike road in Campbell township. T. L. Thomas is Auditor of Jennings County.

Tipton, Ind.—Until 10 a. m., June 6, by County Commissioners, for the construction of six gravel roads in Madison, Jefferson, Prairie, Liberty and Wildcat townships. J. F. Barlow is Auditor of Tipton County.

Wabash, Ind.—Until 1 p. m., June 7, by County Commissioners for the construction of six gravel roads in Wabash County. J. P. Noftzger is Auditor.

Williamsport, Ind.—Until 1 p. m., June 7, by County Commissioners for the construction of a gravel road in Medina Township.

Williamsport, Ind.—Until 1 p. m., June 7, by County Commissioners, for the construction of a gravel road in Pine township. Robert L. Winks is Auditor of Warren County.

Williamsport, Ind.—Until 1 p. m., June 7, by County Commissioners, for the construction of a gravel road on the Jordan-Steuben Township line. Robert L. Winks is Auditor of Warren County.

Williamsport, Ind.—Until 1 p. m., June 7, by County Commissioners, for the construction of a gravel road on the Pine-Liberty township line. Robert L. Winks is Auditor of Warren County.

Williamsport, Ind.—Until 1 p. m., June 6, by County Commissioners, for the construction of a gravel road in Steuben Township. Robert L. Winks is Auditor of Warren County.

Ironwood, Mich.—Until 5 p. m., May 24, by Jacob Nelson, City Clerk, for necessary grading and for furnishing all necessary labor and materials for the paving of portion of McLeod Ave., Aurora St., Norfolk St. and Ayer St. with tar macadam.

Jackson, Mich.—Until 3 p. m., June 7, by B. H. Klyce, City Engineer, for the construction of approximately 39,000 sq. yds. of pavement and 10,000 lin. ft. of curb. Official advertisement will be found elsewhere in this issue.

Augusta, Me.—Until 2 p. m., May 24, by Paul D. Sargent, State Commissioner of Highways, for the construction of a trunk line from Rockland to Rockport, Me., a distance of 5 4-10 miles.

Baltimore, Md.—Until 11 a. m., May 18, by Board of Awards, for grading, curbing, guttering and paving Grove St. from Edmondson Ave to Westwood Ave. Eugene F. Rodgers is Secretary, Board of Commissioners for Opening Streets.

Baltimore, Md.—Until noon, May 19, by State Roads Commission, Union Trust Bldg., Baltimore, Md., for the construction of sections of state highway aggregating 50½ miles in the following counties: Talbot—On the road between Skipton and Wye Mills, a distance of about 3.49 miles, in one section; stone macadam. Queen Anne's — On the road between Starkey's Corner and Church Hill, in one section of 1.97 miles, and one section on the road from Church Hill toward Chestertown, a distance of about 3.50 miles; stone macadam. Kent—On the road from Kennedyville to Locust Grove, in one section, a distance of about 3.23 miles; stone macadam. Baltimore—On the Belair road, from the city limits to Overlea, in one section, a distance of about 3.41 miles, and one section from Overlea to Necker, a distance of about 2.59 miles, and one section from Necker to Perry Hall, a distance of about 2.54 miles, stone macadam. Prince George's—On the Marlboro pike, from the District of Columbia line, in one section, a distance of 5.20 miles, to Meadows, including the repairs to the existing stone macadam road of about 6,900 ft. Charles —On the road between White Plains and the Prince George's County line, near Mattawoman, in one section, a distance of about 6.25 miles; gravel. Washington—On the National pike, from 2 miles west of Conococheague bridge toward Indian Spring, a distance of about 4.29 miles, in one section; stone macadam. Allegany—On the National pike between Standard Oil warehouse and the Pennsylvania railroad crossing, in one section, a distance of about 0.53 mile, and on the National pike between Six-Mile House and Allegany Grove, in one section, a distance of about 1.02 miles; stone macadam. Garrett—On the National pike, in Garrett County, from the Allegany County line toward Piney Grove, in one section, a distance of about 2.38 miles; stone macadam. St. Mary's—On the Mechanicsville-Leonardtown road, from Hellen toward Leonardtown, in one section, a distance of about 5.20 miles; bids will be received both for grading, bridging, and draining only, and for macadam construction. Carroll—On the road between Eldersburg and Gamber, in one section, a distance of about 5 miles; stone macadam. Harford—From the end of the stone road at Kalmia to McCann's Corner, a distance of 2.22 miles, in one section; stone macadam.

Baltimore, Md.—Until 11 a. m., May 11, by Board of Awards, for 645 yds. of vitrified brick pavement at Gay St. yard of the Water Board. Alfred M. Quick is Water Engineer.

Agricultural College, Miss.—Until 2 p. m., May 17, by D. W. Brown, Professor Civil Engineering, Agricultural College, for constructing a modern macadam road from Starkville to this place. According to plans the road will be 1½ miles, covered with broken stone, 24 ft. wide and 6 ins. deep.

St. Louis, Mo.—Until May 13 by Board of Public Works, for the pavement of 16 streets with asphalt, brick, granite, bitulithic, telford and wood blocks.

Webb City, Mo.—Until 5 p. m., May 16, by A. J. McKinzie, City Engineer, for the construction of about 16,000 sq. yds. of asphalted macadam pavement.

Billings, Mont.—Until 8 p. m., June 21, by J. D. Matheson, City Clerk, for creating Special Improvement District No. 53. The work includes aproximately 59,856 sq. yds. of creosoted block pavement. Official advertisement will be found elsewhere in this issue.

Laurinsburg, N. C.—Until noon, May 23, by Town Clerk, for the construction of about 2,500 sq. yds. of concrete sidewalk paving, with curb and gutters, according to plans and specifications. M. J. John is Mayor.

Concord, N. H.—Until 1 p. m., May 20, by H. C. Hill, State Highway Engineer, for the construction of 6,400 ft. of trap rock road in Keene, N. H.

Raymond, N. H.—Until 1 p. m., May 20, by H. C. Hill, State Highway Engineer, Concord, N. H., for the construction of a 2,000-ft. native stone road in this place.

Tilton, N. H.—Until 1 p. m., May 20, by H. C. Hill, Concord, N. H., State Highway Engineer, for the construction of a native stone road 8,000 ft. in length in this town.

Newton, N. J.—Until noon, May 12, by Loren T. Cole, Director of Board Chosen Freeholders, for grading and macadamizing public road located in Sandyston Township, Sussex County—Sec. 1, from Tuttle's Corner to Pine Hill and village of Layton, 2.36 miles; Sec. 2, from first section, Pine Hill, toward village of Bevans, .91 of a mile, to the Flatbrook bridge.

Montvale, N. J.—Until 8:30 p. m., May 28, by Mayor and Council for the grading and macadamizing of Grand Ave., Middletown Road and Blue Road, a total distance of 1.301 miles. Fred C. Linderman is Mayor and John B. Hering is Borough Clerk.

Montvale, N. J.—Until 9 p. m., May 28, by Mayor and Council for the grading and macadamizing of a portion of Magnolia Ave., a distance of about 1 mile. John B. Hering is Borough Clerk.

Montvale, N. J.—Until 9:30 p. m., May 28, by Mayor and City Council for the grading and macadamizing of Summit Ave., a distance of 4,100 ft. Fred C. Linderman is Mayor.

Somerville, N. J.—Until 10:30, May 26, by Board of Chosen Freeholders of the county for grading and macadamizing 7 roads in county aggregating 15 miles in length. Thomas E. Gibson is director of the board, Somerville, N. J.

Albany, N. Y.—Until 1 p. m., May 27, by S. Percy Hooker, chairman, State Highway Commission, for the improvement of the following highways:

County.	Road Number.	Approximate Miles.
Albany	849	1.10
Cattaraugus	5,066	2.94
Chautauqua	5,067	1.06
Chenango	5,057	.51
Clinton	5,056	2.28
Clinton and Essex	859	1.24
Cortland	5,058	2.01
Cortland	738	6.51
Delaware	145-R	1.00
Erie	5,061	1.08
Erie	525-A	.59
Erie	862	.97
Erie	863	1.06
Erie	866	2.01
Erie	751	7.07
Fulton	5,065	2.43
Herkimer	5,060	.77
Herkimer	5,064	1.57
Montgomery	864	.90
Niagara	5,063	2.50
Oneida	5,059	1.60
Orange	414	5.54
Orleans	393	3.61
Saratoga	5,062	2.74
Saratoga	611	6.64
Warren	843	.17
Warren	5,068	1.48
Wayne	860	3.48
Wayne	861	1.58
Westchester	865	3.01

Dunkirk, N. Y.—Until May 14 (postponement of date from May 3) by Common Council for paving Swan and Fox Sts

Cincinnati, O.—Until noon, May 20, by Board of County Commissioners for the improvement of the Biddinger Pike from Harrison to Butler County line in Harrison Township. Stanley Struble is president of the board.

Cleveland O.—Until 11 a. m., May 25, by Board of County Commissioners for the improvement of Independence Road No. 2 from Harvard Road to the property line between Henry Krapf and Peter Schmidt, a distance of 8,910 ft. The work includes grading and draining.

Delaware, O.—Until noon, May 21, by W. F. Whittier, County Surveyor, for the construction of Wheeler Road, in Brown and Oxford townships, and extending from Leonardsburg north to the Shoemaker Road, about 1½ miles long. The work includes grading, macadamizing and draining.

Delaware, O.—Until noon, May 21, by W. F. Whittier, County Surveyor, for the construction of Sherwood Road in Oxford and Troy townships from the Steam town road to Horse Shoe Road, a distance of about 1½ miles.

Galveston, Tex.—Until May 16, by County Auditor, John M. Murch, for the ditching, grading, culvert and surfacing and paving with rock

ENGINEERING-CONTRACTING

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CONTENTS.

EDITORIAL:

Grout Wash a Protection Against Frost....443

The Position of the Los Angeles Aqueduct Work in the Argument for the Superiority of Day Labor Construction of Engineering Works....443

CONCRETE SECTION:

Some Notes on Methods of Constructing Concrete Lined Shafts....441

Method of Constructing Concrete Slope Paving Under Water, Lachine Canal Canada....446

EARTH AND ROCK SECTION:

A Central-Control, Electrically-Operated Car Haulage for Canal Work with Some General Costs....449

Method of Constructing Shield Driven Cast Iron Lined Tunnels Under the North River with Itemized Records of Labor Force, Wages and Time of Various Operations....449

ROADS AND STREETS SECTION:

Methods of Resurfacing Worn Out Macadam Roads in New Jersey....456

Notes on Road and Street Work....456

Sand Clay Road Construction in Kansas and Some Data on Its Cost....457

WATER-WORKS AND SEWER SECTION:

Day Labor vs. Contract Work on the Los Angeles Aqueduct....459

Method of Lining an Irrigation Canal with Cement Plaster, with a Discussion on Cement Plaster Versus Lime and Cement Plaster....460

Method and Cost of Constructing Two 18-in. Cast Iron Water Mains by Day Labor for the Fort William, Ontario, Water Supply....461

GENERAL SECTION:

Condensed Facts on the Panama Canal....462

Cost of Crushing Stone for Concrete Lining Pennsylvania R. R. North River Tunnels....464

Review Index....464

COMING TECHNICAL MEETINGS....465

PERSONALS....465

CATALOGS WORTH HAVING....465

Grout Wash a Protection Against Frost.

The interesting statement is made in an article by Mr. W. D'Rohan in another column of this issue that: "A thick coat of grout wash is sufficient protection for concrete or plaster against a fairly heavy frost." Mr. D'Rohan bases his conclusion on experience with ditch lining of cement mortar laid at temperatures varying from 0° to 40° F. A coat of 1:3 grout ⅛ in. thick brushed over the surface of the plaster prevented injury from frost, although the grout coat itself was frozen and destroyed. The experience is new to us and we should be glad to hear from any of our readers who have data which bear out or tend to disprove Mr. D'Rohan's conclusion.

The Position of the Los Angeles Aqueduct Work in the Argument for the Superiority of Day Labor Construction of Engineering Works.

There have been few engineering works done by day labor under as competent and unhampered engineering direction as the Los Angeles Aqueduct. We make this statement advisedly. The men directing this work as chief and assistant chief engineers are acknowledgedly administrators of exceptional ability—this makes their reputation even more than does their technical ability and that ranks high. Both are confessedly economists in construction work. They have not been hampered by politics in their work, and more than this they are intolerant of political interference and by rank and attainment are independent of any necessity of deferring to, and, in large measure, free from demands to defer to, considerations of political subserviency or expediency.

We make these statements frankly and honestly for two reasons: First the record of these men on the Los Angeles Aqueduct work has been exploited by a contemporary well known for its predelection toward paternalism in public affairs as a fair proof of the economic merit of the principle of doing construction work generally by day labor; second in these statements lies not the proof of the merit of this principle but a most crushing proof of its general economic deficiency.

In another column of this issue we reprint a published defense by the assistant chief engineer of the aqueduct of the day labor plan of doing the bulk of the construction work and, incidentally, an argument in general support of the day labor system. In reading this article the query naturally arises as to how far its preparation was influenced by a demand to counteract popular inquiry aroused by a previously published article evidencing the expensiveness of day labor construction and as to how far it was a call to make public a great economic truth. However, the publication was justifiable for either reason. So much of this article as unqualifiedly evidenced the superior economy of day labor work was published in *Engineering News* of April 28, 1910, and used by that journal as a peg upon which to hang an iteration of its belief in the economic soundness of day labor work as "amply shown by the Panama Canal construction work."

Returning to the consideration of Mr. Lippincott's article in its entirety as published by us, there are a number of points that warrant comment. It is perhaps a little wide of the facts to assert that the report of Metcalf & Eddy was "extensively reviewed by engineering publications." Except for isolated fragments published here and there those parts of the report of Metcalf & Eddy, which bore on the relative cost of day labor and contract work, were extensively reviewed in only one engineering publication. ENGINEERING-CONTRACTING did extensively review the report, believing it to be a very important document on construction economics. Noting that Mr. Lippincott credits Metcalf & Eddy as engineers in "good standing" we pass the inference of the following clause and point out that their conclusions were confirmed by the independent studies of Mr. Samuel Whinery and of the commission which investigated the refuse disposal problem. Our issues of Dec. 22 and 29, 1909, and of April 6, 1910, furnish the details.

These several investigations, it will be noted, do not leave Metcalf & Eddy unsupported in their finding that force account work is the more expensive "in certain New England cities." New England cities do not stand alone, however, in supplying evidence of this kind. An investigation of day labor sewer work in Chicago by the Commission on City Expenditures (Eng.-Contg., Feb. 23, 1910) showed an excess cost of work of some 65 per cent. Reports of doing street work by force account and city plant in New Orleans, in Baltimore, in Brooklyn, and in Indianapolis have been published within a twelvemonth showing excessive costs of day labor work. Even the Panama Canal costs regarded as so noteworthy by the *Engineering News* are open to most successful criticism as being extravagant.

The kernal of Mr. Lippincott's argument for the superior economy of day labor work is in the comparative figures which he presents. We accept, as we must of course, these figures as correct. It will be noted that the comparison of day labor actual costs is made with contractors' bidding prices. The difference is $13.13 per foot for tunnels and $3.85 per foot for conduit. If the contractor could have done the work as cheaply as did the city forces, these amounts would have been his profits. Now a profit of $988,675 on a, say, $3,000,000 job—a profit of 33 per cent—is, to put it mildly, out of the usual run of "good things" that fall to the contractor's lot. No intelligent contractor bidding in open competition and with a fair knowledge of the conditions of the work would dare to figure on such a profit if he hoped to get the contract. To our mind the comparison of actual costs and bidding prices made by Mr. Lippincott indicates but one of two things, either inexperienced bidders or that these bidders were compelled to "go it blind" in making their bids. Mr. Lippincott indicates that the bidders were capable men in their line of business. Naturally, otherwise the comparison would have failed.

Did the bidders on this work know reasonably well the conditions that would be encountered? Did Mr. Lippincott know them? If they did then we beg leave to dispute Mr. Lippincott's opinion that the bidders who submitted prices fairly represented the skill and ability of the contracting business. If they did not know them, where is the fairness of the comparison and what is to be said of a preliminary engineering study which does not admit of estimating within 33 per cent of the cost of a $3,000,000 job? We have the aqueduct engineers' statements that exceeding care has been exercised in making studies leading to construction economies. Were these studies available to the contractors who bid on the work? If they were not, wherein is the fairness of using the contractor's bidding prices in comparison? They were not as the concluding paragraphs of Mr. Lippencott's article clearly shows. The *Engineering News* reads merit into this circumstance and sapiently remarks that "as the progress of excavation shows up the character of the material changes in design often become desirable." Verily, make the contractor bid a price for which he will build such a structure as may be designed when "the character of the material shows up," and then hold up that price as a horrible example when the engineer adopts a design which the contractor did not guess.

The bidding prices given by Mr. Lippincott show nothing more than that contractors were bidding in the dark on this work. They do not show at what cost the contractor could have done the work under the conditions as developed, nor do they show what prices he would have bid had he been able to forecast these conditions with reasonable assurance.

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The actual figures of cost which have been published are few. A study of them does not show a single instance which cannot be met with contract costs as cheap or cheaper. We shall not take space to present the proofs at this time but anyone can find them by collating the costs of contract work published in this journal.

Turning to another feature of the article by Mr. Lippincott we call attention to his third paragraph. Mr. Lippincott says: "There is no reason why a municipality with large financial resources, capable of buying adequate equipment and paying reasonable salaries should not obtain as high-grade machinery and superintendents as any contractor." Theoretically there is not, but practically it is done so rarely that the exception proves the rule. This is a patent fact and Mr. Lippincott has indicated why in the opening sentences of the paragraph from which we quote.

It is not "superfluous" to discuss the question. The influence of politics, the accumulation of inefficients, the stagnation coming from irresponsibility of action and the want of the spur of oversight sharpened by danger to financial life are the conditions under which day labor work must ordinarily be done, and if discussion is "superfluous" at all it is superfluous as relating to such ideal conditions as Mr. Lippincott names for the Los Angeles aqueduct work.

But let us suppose that there is no reason why a municipality should not "obtain as high a grade of machinery and superintendents as any contractor," there remains the fact that the city cannot purchase the vital influence toward efficiency that arises from the knowledge that compensation depends directly on the money saved by increasing efficiency, that financial ruin may be the price of any lack of foresight and of alertness in watching expenditures and output. These are the vital influences of contract work. Pride in one's work, honesty and honorableness, desire for reputation and rank are not such vital influences toward efficiency with the rank and file of men who do and direct our engineering works. Few professional men take a less sordid view of their work than do engineers, but the "bubble reputation" is none the less iridescent when viewed with the eye of solvency.

The records of day labor work almost invariably show it to be more costly than contract construction. In the rare instances where it has not been more costly or in the still more rare instances where it has been less costly it has been due to the employing of contract business methods and management and the elimination of every factor and influence that ordinarily characterize day labor construction. Such success as day labor work on the Los Angeles aqueduct will show is due to this fact alone.

Concrete and Reinforced Concrete Section

Note: This section is devoted to methods and cost of constructing concrete and reinforced concrete structures. It will cover the selection, testing and proportioning of concrete materials; laboratory tests of concrete; concrete mixing, transportation and placing; fabrication and placing of reinforcement, and form construction and erection. It will also contain articles on new and interesting developments in the design of reinforced concrete.

Some Notes on Methods of Constructing Concrete Lined Shafts.

Concrete has been used successfully for lining both circular and rectangular shafts mostly for mine workings. It provides a fireproof, reasonably water-tight and very permanent lining and is a quick and economic construction. Methods of construction vary, depending on the method of sinking which is influenced by the nature of the material penetrated and the amount and depth of water encountered. The following are methods that have been employed successfully.

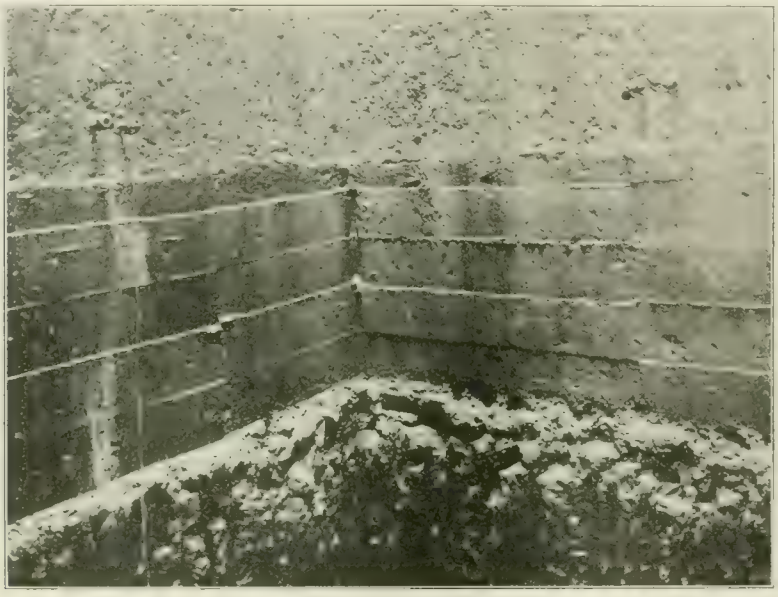


Fig. 1.—View Inside Smith Shaft Showing Seal Between Concrete Lining and Ledge Rock.

Smith Shaft, Cleveland-Cliffs Iron Co.—Diamond drill borings showed 60 ft. of water bearing quicksand, gravel and boulders overlying ledge rock. The requirements were a water-tight plumb shaft and a water-tight joint at ledge level. The decision was to sink to ledge rock by the pneumatic process a reinforced concrete caisson, the walls of which would constitute the shaft lining. The outside dimensions of the caisson were 21⅓x 17⅓ ft., and its walls were made 3 ft. thick at the bottom and 1½ ft. thick at the top. The concrete was started on a shoe of two layers of 12x12-in. timbers beveled on the inside and shod with heavy angle iron. The shoe timbers were heavily bolted vertically and horizontally and the shoe was anchored to the concrete by 1 to 1¼-in. square rods passing from the bottom up through the shoe and the concrete walls and spaced about 18 ins. apart. These anchor rods formed the vertical reinforcement of the walls, the horizontal reinforcement consisted of similar rods spaced 6 to 8 ins. apart vertically. The horizontal reinforcement was designed to take the earth and water pressure and the vertical reinforcement to anchor the sections of wall from pulling apart during sinking. At a point 6 ft. above the cutting edge the concrete walls were notched inside to receive a working chamber roof of 12x12-in. timbers. Steel working shafts and air locks were provided.

The method of sinking was as follows: The timber shoe was first assembled in position on the surface and the inside forms built on top to a height of 10 ft. All other forms were built apart from the shaft in interchangeable sections 6 ft. high; the material was 2x8-in. tongue and grooved plank. The walls were built to a height of 18 ft. before sinking was begun; sinking was done without air to a depth of 5 ft., then water was encountered and compressed air was used. The method of sinking proper was the usual pneumatic caisson method. As fast as the caisson sunk the walls were built upward; it was endeavored to keep the walls always 18 ft. above the surface to permit the use of three sections of forms, the lower section being removed as it reached the ground and placed on top. The caisson went down the first 40 ft. by its own weight, it was then loaded as necessary by piling sand on the working chamber roof. The caisson was sunk to rock in one month; the rock was found to have a slope of 3½ ft. in 20 ft.; to level this off and go down 2 ft. further to escape a seam required another month.

When level rock was reached the top inside timber of the shoe was cut away and the wall concrete carried down to the rock. This concrete was allowed to set under air pressure for 3 days, then pressure was gradually removed. There was no leakage at the joint; the total leakage of the walls was 650 gals. per 24 hrs. Figure 1 is an inside view of the shaft showing the joint concrete. The shaft was built by the Foundation Co., Chicago, Ill.

Kidder Shaft Cleveland Cliffs Iron Co.—This shaft penetrated waterbearing quicksand, gravel and clay overlying a broken and seamy ledge rock at a depth of 104 ft. It was decided to sink a circular shaft and to this end plans were drawn for a cylindrical reinforced concrete caisson 24 ft. in diameter mounted on a steel shoe of the same diameter.

The shoe construction deserves notice and is indicated by the sketch Fig. 2. On the outside of the bottom there is a ⅝-in. steel plate 30 ins. high. To this were fastened 12 brackets carrying a conical inside sheeting. This conical inside sheeting extended up about 10 ft. until the diameter contracted to 10 ft. and on this opening was built a 10-ft. cylindrical steel shaft. This shaft was built up as the sinking progressed as was the outside wall of reinforced concrete which formed the shaft lining. Inside and outside forms were used for the concrete wall. The outside forms consisted of three rings 24 ft. in diameter and each 5 ft. high. Each ring consisted of six sections, each made up of ½-in. steel plate with angles in all four edges all curved to the proper arc. Bolt holes in the angles permitted the six sections to be connected up to form a complete ring and, also, the rings to be connected to each other. The inside forms were

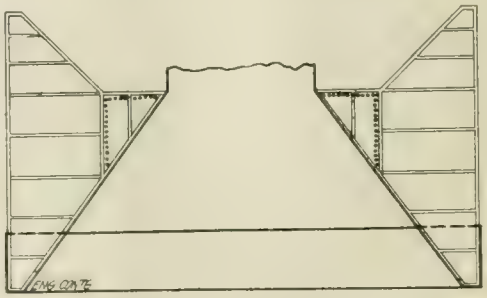


Fig. 2.—Sketch Showing Steel Shoe for Kidder Shaft Caisson.

also made in three rings, but the sections were built of 2x6-in. tongued and grooved pine lagging fastened to three curved 4x4½-in. steel angles and the diameters of the rings varied with the thickness of the walls at different heights. These wall thicknesses were as follows:

Depth, feet.	Thickness. Ft	Ins
0 to 17	4	0
17 to 50	3	6
50 to 82	3	0
82 to 113	3	6

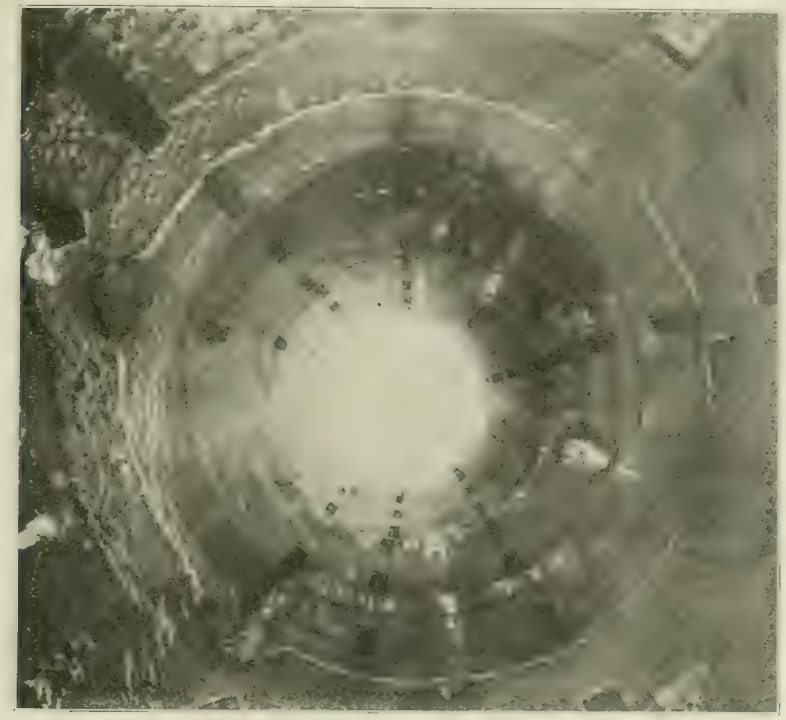


Fig. 3.—View Looking Up Through Concrete Lined Circular Kidder Shaft.

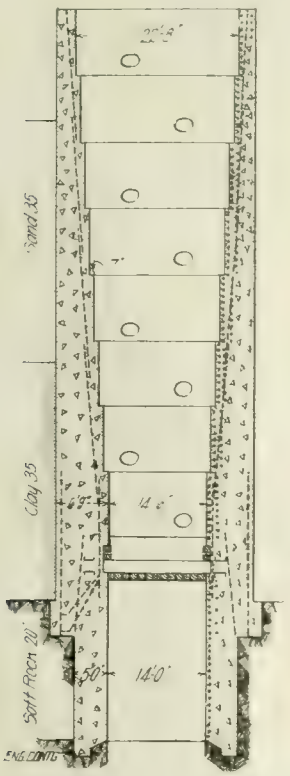


Fig. 4.—Transverse Section of Woodward Colliery Shaft.

The wall was reinforced with horizontal rings and vertical bars.

The method of sinking was as follows: The shoe was set up with two sections of steel shaft riveted to the top of the arm and the outside wall built up to a height of 15 ft. A clam-shell bucket was then operated inside the steel shaft and the caisson sunk by its own weight, the walls being kept built up well above ground. Dredging continued to a depth of 87 ft. where a stratum 2 ft. thick of hard clay was encountered. After dredging for several hours this clay stratum was pierced in one place and through this opening the underlying quicksand rushed in, causing a slump which extended to the surface and threw the caisson some 6 ins. out of plumb. A steel roof was then bolted to the top of the shaft, an air lock was placed and sinking continued by the pneumatic process until solid rock was met at a total depth of 113 ft., or 103 ft. below water level. An air pressure of 45 lbs. was required at the greatest depth and two 40-min. shifts were a day's work. The joint between concrete and rock was made by filling in the wedge with concrete. Figure 3 is a view looking up through the Kidder shaft. The total time of sinking this shaft was from Aug. 15, 1908, to Jan. 15, 1909, or five months, or at the rate of 22.6 ft. per month, including lining. The shaft was built by the Foundation Co., Chicago, Ill.

Woodward Colliery Shaft, Wilkesbarre, Pa.—This shaft penetrated quicksand, gravel and clay overlying sand-slate rock at a depth of 79 ft. Water level was normally 15 ft. below the surface, but highwater in the nearby Susquehanna River raised it to surface level. The plan adopted was to sink a reinforced concrete caisson with a steel cutting edge. Figure 4 is a transverse section of the caisson, which was 59½ ft. long outside. Two transverse partitions of reinforced concrete divided the shaft into three compartments. The caisson had its corners rounded to a radius outside of 6⅓ ft. The shoe consisted of a circumferential plate 32 ins. high and ¾ in. thick set vertically. At a height of 8 ins. above the bottom edge of this plate an inside horizontal shelf plate was connected by angles and brackets to the vertical plate. The method of construction was as follows:

A pit was excavated to a depth of 15 ft. with scrapers and on its level bottom was erected the steel shoe. Using three rings of outside forms and three corresponding rings of inside forms the concrete walls were then built to well above the timber deck level as shown by Fig. 4. Sinking was then begun by excavating in the open inside the caissons the water amounted to a maximum of 1,200 gals. per minute until clay was entered, after which no water was encountered until rock was reached when highwater in the river gave enough additional head to cause a flow under the edge of the caisson which required a large pumping plant to handle.

The sinking was done in two 10-hour shifts per 24 hours, working a foreman and 16 men in each shift. The spoil was loaded into buckets and hoisted by derricks on top. An excavation of 90 to 100 cu. yds. per shift was considered good progress. No serious trouble was had, but care had to be exercised, in keeping the caisson plumb. No use was made of the wood deck, which had been planned for in case sinking by compressed air had to be resorted to.

When rock was reached and after lowering

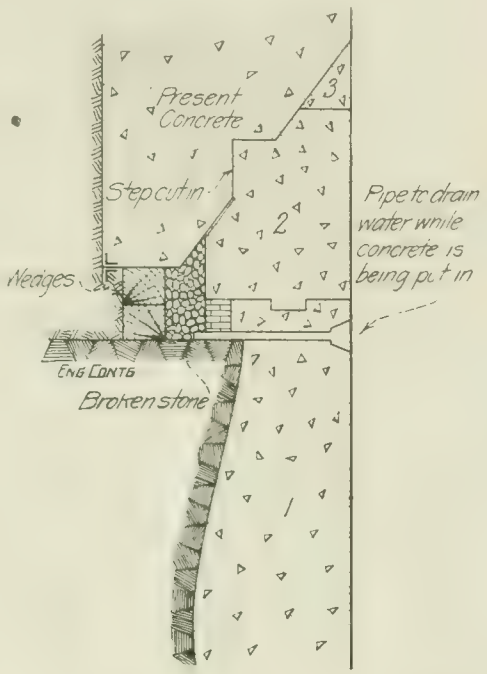


Fig. 5.—Details of Seal, Woodward Colliery Shaft.

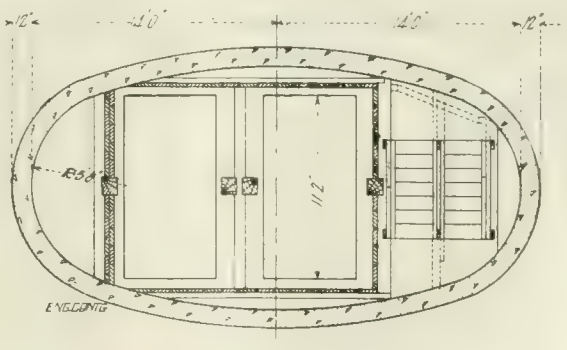


Fig. 6.—Section of Mine Hoisting Shaft, Filbert Mine.

the flood water previously mentioned, the first task was to seal under the cutting edge. This was accomplished by means of blocks and wedges as shown by the detail Fig. 5. The next step was to take out the rock for a depth of some 20 ft. below the cutting edge of the caisson and build the underpinning wall

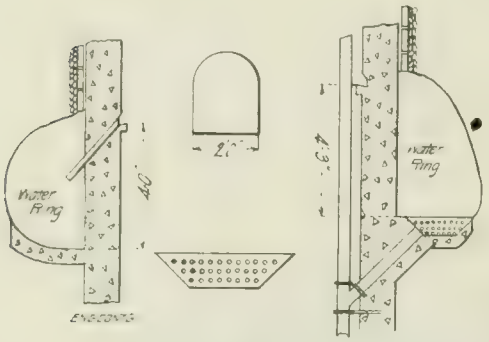


Fig. 7.—Details of Water Ring in Ventilating Shaft, Filbert Mine.

shown by Fig. 4. A channel cut 5 ft. deep all around the edge was first made. This permitted the core to be blasted out without danger of jarring the wood packing loose or breaking back underneath it. Ordinary blasting methods were then employed, taking out the rock in 5-ft. benches, until the level of the bottom of the underpinning wall was reached, when a second channel cut 5 ft. deep was made and the core removed. This permitted the underpinning wall to be started on a dry bench which was not likely to be broken down by subsequent shaft sinking.

In starting the underpinning wall the rock bench or shelf was recessed as shown by Fig. 4 and carefully cleaned. The wall was then carried up and the seal between it and the caisson concrete was made as follows: The brick dam and vent pipes were constructed as shown and the wall carried up to the level shown. Next the ring of concrete marked 2 in Fig. 5 was put in. After this concrete had set grout was pumped into the pipes shown until everything was tight. Then the joint between the concrete ring 2 and the caisson concrete was caulked and the closing ring 3 of concrete was put in. The work as described was done by the Foundation Co. of New York City, as contractors.

Filbert Mine Shafts, H. C. Frick Coke Co.—Two shafts of the general form shown by Fig. 6 were sunk through rock. The main shaft had the cross-section shown by Fig. 6 and was 550 ft. deep with a 15-ft. sump. The ventilating shaft is 14x34 ft. inside the lining and is 581 ft. deep with a 9-ft. sump. The tops of both shafts have copings of massive concrete which form foundations for head frames. This copings extend down to rock some 19 ft. The general method of construction was to sink the shaft a certain depth and then construct the lining upward, then sink another lift and line it upward, repeating the operation till the shaft was completed.

The sinking was done using 60 per cent gelatine and firing maximum shots of from 150 to 200 lbs. The cut or sump holes were 12 ft. deep and those of the side rounds were 10 ft. deep. The muck was hoisted by derricks, the good stone for crushing picked out and the remainder taken in dump cars to spoil banks. An average of 5 men on top and 12 men on the bottom working 8-hour shifts was employed.

In concreting the successive heights hitches were cut in the rock walls about 10 ft. above the bottom and in them were placed dead logs to support the forms. The first ring of forms was set up, the buntons placed, a platform built at the level of the top of the form and the concrete placed. A second ring of forms was then erected on the first, the working platform was raised and concreting resumed. This process was repeated until the lining was completed. Three rings of forms were used, the lowermost being removed and placed on top as the work advanced. A 1:2.5:1½ in. stone concrete was used. Concreting was started in the main shaft when it had reached a depth of 65 ft. and in the ventilating shaft when it had reached a depth of 115 ft. Afterward the lining was placed in 50-ft. sections. The average time for completing a 50-ft. section was six 24-hour days, working 9 men at the top and 4 men at the bottom. When concrete was placed in cold weather warm mixing water was used and the sand and stone were heated with steam jets.

To make the joint between the top of one section and the bottom of the completed section above the following procedure was employed. In beginning each section the floor at the bottom of the form ring was not set horizontal but was laid with a down pitch of 45° toward the rock side of the shaft. The top of the section below was brought up to within 6 ins. of the sloping bottom of the section above and this 6-in. ring was concreted with a special mixture of cement, screenings and crusher dust in the proportions of 1½:2. Grout wash was used to perfect the bond between the old and new concrete. The thickness of concrete lining varied from 12 to 33 ins.

The forms were of steel and were made by the Blaw Collapsible Steel Centering Co., Pittsburg, Pa. They were made in rings 5 ft. high and each ring was divided into convenient sections for handling. To allow for the placing of buntons notches were cut in the top edge of each ring. A force of 4 men on top and 6 men on the bottom was required to handle the forms. Forms were left in place a minimum of 72 hours.

A feature of the work was the provisions for handling water during and after construction. To handle the water after construction a water ring was constructed in each shaft. Figure 7 shows the details of the water ring for the ventilating shaft. A circumferential nich was cut in the rock wall as shown and lined with concrete to have a trough-shaped bottom having a fall right and left around the wall to a low point, where a drainage pipe was inserted through the lining. To bring the water coming from the rock to the water ring vertical tile pipes were placed behind the lining. To collect the water flowing down the face of the lining a circular groove was molded in the face just above the water ring, as shown by Fig. 7; a pipe through the lining into the water ring caught the water from the low point of the groove.

The following is a summary of the quantities and progress: From both shafts 50,000 cu. yds. of materials measured loose were taken; the increase over the calculated yardage in the solid was 135 per cent. The materials required for the 650 cu. yds. of concrete were: 8,217 bbls. of cement, 4,410 tons of crushed stone and 2,528 tons of sand. It is interesting to compare the calculated and actual yardages of concrete required per vertical foot of shaft. They were as follows:

Thickness of wall, ins.	Calculated amount Cu. yds.	Actual amount Cu. yds.	Percentage. Increase.
	Main Shaft.		
12	2.66	4.6	73
15	3.36	5.0	49
18	4.08	6.4	57
24	5.56	9.0	62
	Ventilating Shaft.		
12	3.10	5.40	74
15	3.92	5.62	43
18	4.74	5.84	23
24	6.45	9.50	47

The progress of work, including excavation and lining complete, was as follows: The main shaft requiring 565 ft. of excavation and 539 ft. of lining was completed in 46 weeks, making an average progress of 48 ft. per month. The ventilating shaft requiring 591.2 ft. of excavation and 561 ft. of lining was completed in 62 weeks, making an average progress of 37.2 ft. per month. The following summary gives the principle figures regarding the work on both shafts:

Item.	Main shaft.	Ventilating shaft.
Total depth, ft.	565	591.2
Total weeks worked.	46	62
Av. depth sunk per week.	..	9.5
Av. depth lining placed per week.	12.3	9.1
Av. depth completed per month..	48	37.2
Inside dimensions, ft.	..	14x34
Area, sq. ft.	..	390
Av. thickness lining, ins.	16	17
Av. concrete per 5-ft. ring, cu yds.	28	33

Conclusion.—We are indebted for the information from which the above description has been prepared to the Foundation Co., Chicago and New York, for the Smith, Kidder and Woodward shafts, and to an article by A. F. Allard and H. S. Patterson in *Mines and Minerals*, April, 1910, for the Filbert mine shaft. An article describing the method and cost of constructing a concrete lined shaft was published in ENGINEERING-CONTRACTING for March 2, 1910.

Method of Constructing Concrete Slope Paving Under Water Lachine Canal, Canada.*

The work described comprises 5 miles of concrete slope wall constructed under water by means of a special plant designed for this purpose. It was part of the Lachine Canal improvement in Canada. Originally this canal had been slope paved with stone taken from the excavation as shown at A Fig. 1. Owing to disintegration of some of the stone and increased wave action due to steam propulsion, large sections of this wall were destroyed. In 1908 work was begun replacing this old wall with a wall of heavier courses of limestone, starting with a bottom thickness of 3 ft. and decreasing in thickness 1 in. per 1 ft. of slope. The construction is shown at B Fig. 1. As this wall had to be built in the dry and as only about 3 weeks in April each year were available for dry work, the progress was slow. To hasten reconstruction a plan was devised in 1904 to use concrete as shown at C Fig. 1 and by Fig. 2. This plan was to use a belt of concrete 8 to 12 ft. wide and about 1 ft. thick, placed in the middle section of the wall leaving in any rip-rap below which was in good condition and running the concrete

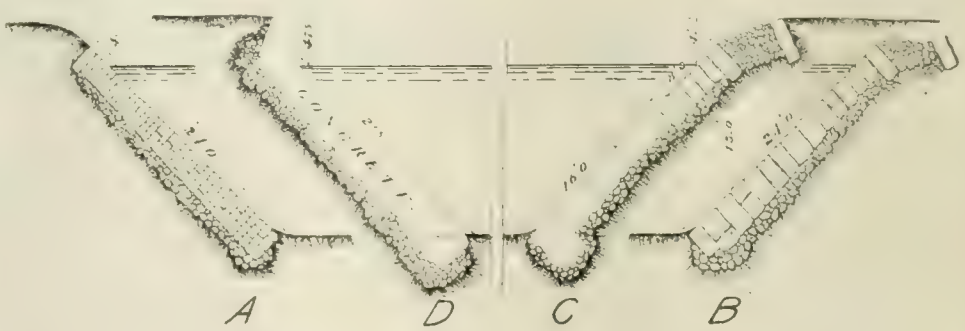


Fig. 1.—Sketches Showing Successive Forms of Slope Paving for Lachine Canal.

all the way down to firm foundations in columns 5 ft. wide at intervals of about 24 ft. c to c as shown by Fig. 2. From the concrete belt upward the limestone rip-rap as originally designed was to be used. This construction gave a good wall and more of it in a limited time, but not enough to meet the demands.

The method of doing the work in the dry

*Rearranged and condensed from a paper by H. R. Lordly presented to the Canadian Society of Civil Engineers, March 17, 1910.

had proved too slow, and some more rapid system had to be devised. It was then proposed that the walls should be laid entirely in concrete, except the revetment, and that the whole work should be done without unwatering the canal and during the period of navigation. Under-water-concrete work had already been done in some minor cases on the canal, but in lining the prism walls below water with concrete a different problem arose.

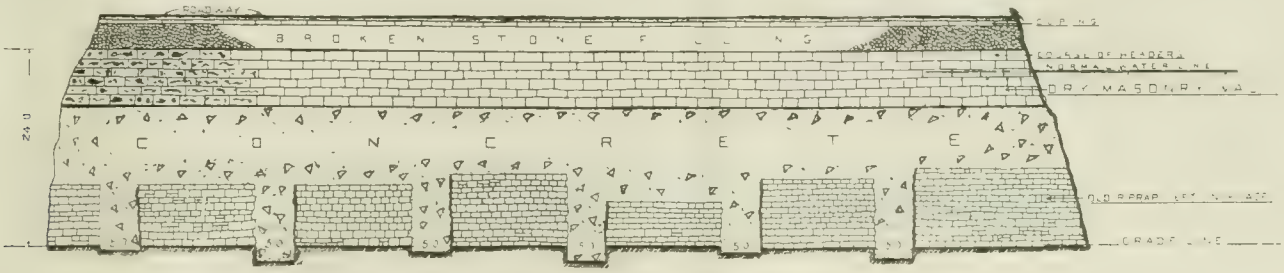


Fig. 2.—Elevation of Slope Wall Having Midheight Band of Concrete Supported by Columns.

Navigation was to be maintained; the current in the canal of about one mile per hour and the wash of passing vessels had to be provided for. The face of the wall is 24 ft., slope 1 to 1. The thickness of concrete required 18 ins., and, as mold boards would have to be used, there was a danger of the concrete clogging between the form and the projections of the old masonry wall, thus creating large voids. A method of preventing the clogging and forcing the concrete down in place had to be devised.

After some preliminary discussion, the contractors for the original work, Messrs. Haney, Miller, Quinlan & Robertson came forward with an offer to do the work under the above conditions, and agreed to build the following plant: Six molds, or forms, 100 ft. by 24 ft. face; a mixing plant, with a ram and box that would carry the concrete down between the wall and the forms; a lifting scow; a diving plant, etc., etc. The plant was calculated to do 200 yds. per day.

It was proposed to prepare the toe of the walls during the spring unwatering. The forms were to be floated to the work, during the period of navigation, placed by the aid of the lifting scow and divers, and heavily loaded at the bottom to remain in position. Each form would be kept in place until the concrete was set sufficiently hard to permit of its removal, and would then be moved to the head of the line in order to continue the work. The designing of the forms and plant was placed in care of Mr. A. T. Gibson, the chief assistant engineer for the contractors. While erecting and removing the forms was also required. In designing the mixing and laying plant, which was to be on scows, some important points had to be considered.

(1) The scows must be narrow and lay parallel (longitudinally) to the banks in order not to obstruct navigation.

(2) The ram carrying the box with movable bottom to deposit the concrete required to be operated on a slope of 45°.

(3) Its tendency to move with the wave undulations had to be overcome.

(4) The ram had also to be so designed that it could be moved past any obstructions on the banks, electric current poles, telegraph poles, etc.

(5) The operating machinery of the ram required to be under perfect control and but little agitation of the water behind the forms created by its action.

In addition to the above, a supply bin, an automatic hoist and measure, to feed the mixer, had to be designed to suit the requirements of the work. A diving outfit and lifting scow, anchors for the molds, etc., were also required. It will be thus seen that the conditions were many and somewhat difficult to overcome.

Molds.—The molds were constructed of heavy timber, each mold being 100x22 ft., additional width being added at the top by placing longitudinal plans on the part out of the water. Figure 3 gives a good idea of the method of construction and the details of the longitudinal trusses to give stiffness to the framework. The heavy timbers were British Columbia fir. A platform or cradle was provided about 5 ft. from the bottom of the mold to hold iron rails for ballast. The entire plan was carefully carried out, and, as will be seen later, the molds were perfectly successful and rigid enough to be kept in nearly perfect alignment.

Mixing and Depositing Plant.—Figure 4 gives the general arrangement and details of the mixing plant. The plant is shown in place and ready for operation. It will be noticed that the scow is a narrow one, and that the overhang platform carrying the mixer and receiver hopper is partly counterbalanced by the stone and sand bin. The bin had both a sand and stone compartment, the material being taken from the barges alongside by a clam operated by a stiff leg derrick placed at the other end of the scow.

Measuring Car.—The measuring car, about 32 cu. ft. capacity, is shown in three positions, and its method of operation is well worth a careful examination. After being fed by the chute while in its lowest position, the cement being placed in from the side by hand, the car ascends the double-rail track and turns completely upside down. (See position 2 and 3). The intermediate position between 2 and 3 would show the rear wheels, first in the air, free from any rail, and next engaging the rail, which carries it while dumping. This apparatus, as designed by Mr. A. T. Gibson, was one of the most efficient parts of the plant.

The feed car dumped into the mixer hopper, and, after the materials were mixed, the concrete was dumped into a receiving hopper, from which the box on the ram was supplied. This supply hopper held about three batches of concrete, and allowed the mixer to be run almost continuously without depending on the speed of the ram, which was at times likely to be irregular.

The face mold is shown in place, in this sketch, with its loading ballast and lower layer of concrete in process of filling in. The ram is in its highest position, the box being ready to receive its supply, about 12 cu. ft., from the hopper. It will be noted that the strain on the ram arm is taken by a wire cable, operated with block and tackle by means of a winch from the frame above the mixer. A part of the frame is omitted from the sketch in order to show the measuring car.

Ram and Guide.—It will be remembered that one of the problems of this undertaking was to place the concrete between the old masonry wall and the forms for the concrete facing without clogging up the space near the top, and thus creating voids at the bottom of the wall. Had the thickness of the new wall been greater, or the surface of the old masonry

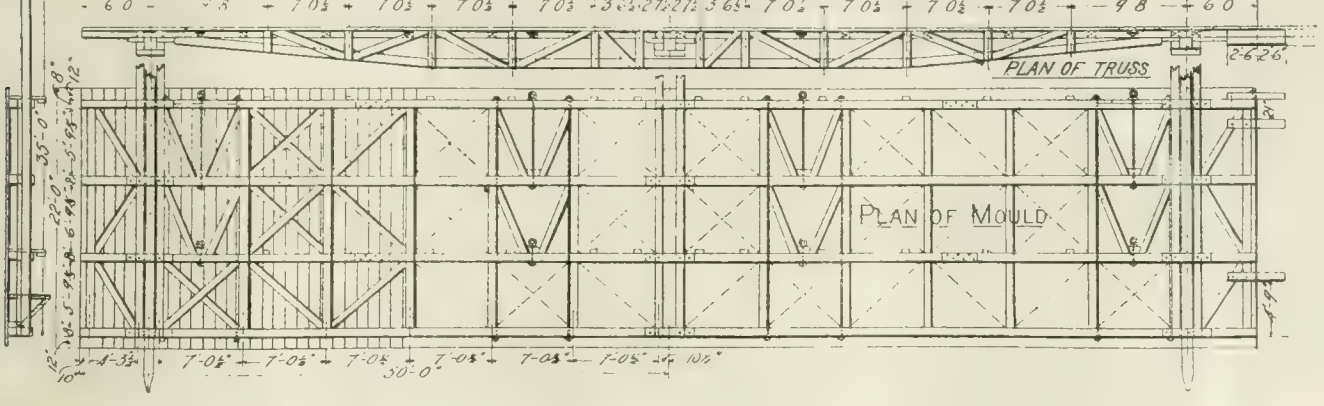


Fig. 3.—General Plans of Molds for Concrete Slope Walls.

the resultant pressure behind the forms would not be great, their large size, the flotation to be overcome and the force of the wash from passing steamers was sufficient to make the problem of their design and retention in place a difficult one. A special lifting scow for

wall, or the bank, been smoother, this difficulty would not have occurred. As a matter of fact, as results proved, there were places where the ram was not required.

In most of the work the guide was maintained at an angle of 45°, but it could be

adjusted to work nearer the vertical if required. The ram frame was made of timber, and the guide of 15-in. steel channels. The latter was carried in a gudgeon bearing attached to the inclined post support. The ram and box would drop by gravity, and was drawn back or controlled by a steel cable operated from the hoist.

The Plant in Operation.—The entire plant was ready for work early in June, 1907. In April the canal was unwatered for a portion of the month and gangs of men put on to prepare the slope wall, on the south side, for the new facing. All the loose stones were removed and the toe of the wall made ready to receive the bottom of the mold. Photographs were taken of any sections presenting unusual irregularities, and all the necessary data provided as to the condition and slope of the bank.

Placing the Molds.—The first section was started on the south bank, a few hundred feet above the Cote St. Paul Bridge, a location which, in so far as agitation of the water and limitation of working room were concerned, was the worst possible. The molds were floated opposite the site, raised up by the slings with the lifting derrick and lowered down in front of the bank. The diver then descended and checked the distance from the wall to the mold, guided the rail-ballast to place, and saw the toe properly braced with large flat stones lowered down for that purpose. The top of the mold was placed in alignment by setting off the given distance from the base line. In some places the top of the bank or revetment wall was so badly washed that it was not possible to take a line from it. The top of the mold was secured to the bank by timber braces and cables to anchor blocks placed at convenient points.

Operating the Ram.—After the molds were ready, the mixing scow was floated into place, the arm run out over the bank and moored at rest over the longitudinal beams arranged to slide it forward on, when the scow was moved. Tests were now made in lowering and raising the ram, and, beyond the usual stiffness expected in new machinery, everything worked satisfactorily.

Results of the Work.—An examination of the work, after unwatering the canal on the April following the first season's operations, showed satisfactory results, and several points are worth noting. First, that the placing of the concrete had been continued too late in the fall (to Oct. 24), and as a result of the condition of the water (its low temperature) the concrete of this section, compared with the other concrete, was found to be quite weak. The concrete placed in September had set up hard, and withstood the action of the ice when the water was let out of the canal in April, but the wall placed late in October had grooves cut into it by the ice sliding down, and on this account cost the contractors a considerable sum to refinish the surface.

Second, while some portions of the wall near the water-line had been acted upon by the wash of the waves from passing steamers, and looked rough, it was very hard and firm. The projecting stone from the ballast, particularly those pieces longer than 2 in., had secured such a grip in the wall that it was impossible to dislodge them. The lower portion of the face was quite smooth, but the slope made by each section of concrete laid, as the scow was moved ahead, was discernible. It showed that sections of over 8 ft. before moving the plant were too long. The top surface, usually flooded for a portion of the time after being finished, showed no signs of scumming, but a portion finished late in October one year, followed by rather severe cold in November, was found, after the snow had melted in the following spring, to have peeled to some extent. The warm sun of April, when the canal was unwatered, had the effect of hardening up any portions of the wall that had been delayed in hard set by the coldness of the water. Laitance, or scumming, of the concrete surface had not been found to any extent on this work, either in the locks, basins or in the general foundation work.

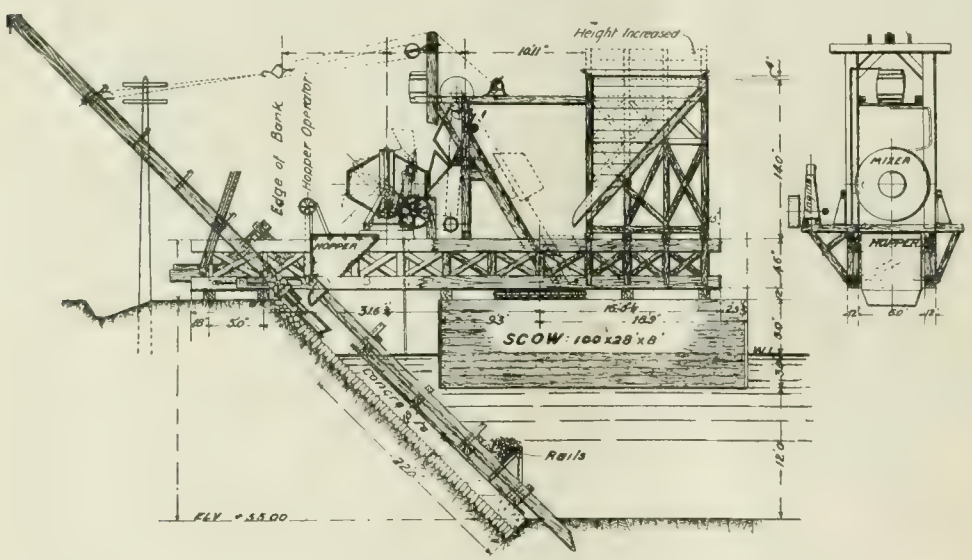


Fig. 4.—Plan Showing Plant for Constructing Concrete Slope Walls.

The information thus gained was made use of during the second season of the work. The scow was moved ahead about every 8 ft. and additional precautions taken to prevent the steamers creating such heavy wave action by making them slow down at a greater distance from the plant. The work was discontinued earlier in October, instead of waiting till the water had become too cold.

On examining the second season's operations on the following April, good results were found all along the wall, and the finish at the bottom was remarkably smooth. The ice had no injurious effect. The stone ballast was exposed in portions of the face, but only slight repairs were required. The action of the ice is one reason for making the concrete facing on the Lachine Canal so thick. About one mile of the concrete facing on the north side was laid with a view to stopping a heavy leakage through the bank. The result was entirely successful.

Cost of Operating the Plant.—An analysis of the cost of the work, to be of value to an engineer, must cover the details of the operating gangs required for each part of the plant, and give the results, the combined units accomplished, in a given time. The cost of materials, sand, stone, coal, oil, etc., will depend more or less on local circumstances, and need not be considered here. The general experience is that a large plant requires a number of extra men, not usually provided for when the plan is designed. It must also be remembered that the time spent in getting ready and laying up, if the operations go over more than one season, must not be overlooked, as in many cases this is an expensive item, and unusually so with a floating plant in this country. The gangs employed on this plant were as follows:

Lifting Scow:
1 foreman.
4 cranesmen.
1 driver.
2 assistants.

8 total.

Mixing and Depositing Plant:
1 hoist runner.
1 fireman.
3 trimmers for stone and sand barges.
1 mixer operator.
1 measuring and feeding materials to car.
1 car operator.
2 handling cement from barge to scow
1 opening cement bags.
1 feeding cement to car.
1 operator for ram.
1 operating door of bucket.
1 collecting empty cement bags.

15 total.

Men Employed on Bank and Scows:
1 carpenter.
4 helpers.
1 leveling concrete surface.
1 foreman sand, stone and cement barges.
10 laborers sand, stone and cement barges.

17 total.

Supervising Staff:
1 general superintendent.
1 master mechanic.
2 assistant mechanics.
1 carpenter foreman.

5 total.
55 grand total.

The transportation plant consisted of two tugs, eight or nine barges, including covered-in barges or scows for cement storage, and a barge for coal. The cost of this part of the outfit would be probably charged up to the cost of supplies, etc., and need not be considered here. A small repair gang was generally required, and kept on call for repairing the floating plant. This latter item is one that should be carefully considered and allowed for on similar plants. Some contractors, the author has observed, neglect this, but it was not so with the contractors for this work. One good carpenter and three or four helpers should be provided for the maintenance of a plant of this kind, even if new at the start.

The capacity of the plant averaged about 200 cu. yds. per day of 10 hours. This was sufficient to fill in behind about one length and a third of the forms used—that is, about 130 ft., lineal, of finished wall surface each day. The record is about as follows:

	Cu. yds.
1907, from June 5th to Oct. 24th	20,000
1908, from May 15th to Oct. 17th	30,000
1909, from May 12th to June 21st (finish)	6,000
Total	56,000

The time from the 1st of May in each year till the date of beginning work was spent in getting the plant in commission. This bears out the remarks previously made regarding the cost of getting ready and laying up floating plants.

On the completion of the work on the Lachine Canal the plant was removed to the Soulanges Canal, where the contractors had secured a contract for a similar piece of work. The slope of the walls, however, in the latter case was flatter than those on the Lachine Canal, but with some slight changes, the author is informed, highly satisfactory work was done.

Conclusions.—The three seasons' experience in laying concrete under water is sufficient to show that there is practically no limit to this class of work, provided the space can be confined and heavy currents overcome.

The "mix" should be, in the majority of cases, what might be termed a "wet putty mix," and experience shows that more washing out will occur if the "mix" has a tendency to be too dry rather than too wet. A few tests will show what percentage of water is best suited to the grade of materials used.

The author is indebted to Mr. A. T. Gibson, Toronto, the engineer for the contractors, and to Messrs. Haney, Miller, Quinlan & Robertson for permission to use the original drawings of the plant. The work was carried on under the supervision of the Department of Railways and Canals, through Mr. E. Marceau, the superintending engineer of the Quebec canals, and the author as engineer in charge of the Lachine Canal. Mr. Angus W. Robertson was the direct representative of the contractors on the site.

Earth and Rock Section

Note: This section is devoted to methods and costs of excavating earth and rock and building embankments. It will cover the grading of roads and railroads, diking and canal work, dredging, building reservoirs and earth dams, sewer and water pipe trenching, quarrying, etc.

A Central-Control, Electrically-Operated Car Haulage for Canal Work with Some General Costs.

A considerable part of the clay excavated from the North Shore Drainage Canal, Chicago, will in time be used by the National Brick Co. for making brick. This company has the contract to remove the spoil banks for a part of the canal through the city of Evanston, Ill., and also has a contract for excavating another part of the canal known as Section 8A. At present the work of excavation is going on at a rate required by the brick company to obtain only as much clay as it uses for the manufacture of brick. After the canal is completed the company will concern itself with the removal of the spoil banks left on other sections.

For the work of excavation proper, two 70-ton steam shovels are used and these are worked side by side in the cut and up against the dead end of the canal section. The distinctive feature of the plant is that the clay is hauled by motor-driven dump cars, moving in a continuous circuit and operated by a central-control electric haulage system. Car movements are controlled, except during dumping, by one man located in a tower in such a position as to command a general view of the work. This is one of the first applications of this system on contract work. It is claimed that the cost is not more than that of a haulage system of equal capacity equipped with locomotives (which latter would require at least three times the number of cars), while the cost of operation is materially lower than that for the locomotive haulage system. The equipment for this work consists of a power plant, 10 cars, and about a mile of narrow-gage track.

View on North Shore Channel Showing Spoil Car Operated by Central-Control Electrical Haulage.

The power plant consists of a 55-KW. generator belted to a 60-HP. engine. This plant supplies current for lights and for power. The current is carried on a third rail, of 12 lbs. section, which is placed in the center of the track. The tracks are of 30-lb. rail and 3-ft. gage.

The cars are of 3 cu. yd. capacity and their weight, when empty, is about 4,400 lbs. Each car is equipped with a single motor of about 12 HP. capacity and with contact shoes taking current from the third rail. The motors are of special design, and each has in connection with it a solonoid brake which forms a part of the electric control system. The brakes and controlling mechanism are operated by current taken from the third rail at a reduced voltage from that for normal propulsion.

The track arrangement on which these cars are operated is merely a double track with a cross-over at each end. At the loading end the track ends in a 30-ft. stub lying between the steam shovels. The loaded cars pass from here for a short distance on level grade, but in rising out of the canal cut the track is on a temporary trestle laid at a 12 per cent grade. The tracks pass along the bank of the canal to the brickyard and up again onto a trestle, where they are dumped by hand. A view of a car, taken in the early part of the canal work, is shown by the accompanying cut.

The novel feature of the haulage system is the control of all the cars by one man from a central point. The control of the cars consists of, starting them from the shovel, bringing them up the incline and along the top of the canal bank to the dumping platform and starting them on their downward trip. In case of emergency a car may be stopped or started on any portion of the track, but ordinarily the operation is continuous. Upon the down-grades the car is automatically governed as to speed, usually requiring no attention from the operator. The car by its momentum, on down-grade, becomes its own motive power and the motor becomes a generator. The motors are series wound and it is only necessary to reverse the armature connection to make them act as generators. A certain amount of resistance is mounted upon the car and so adjusted as to form sufficient electrical load upon the motor, working as a generator, to hold the car to a certain calculated speed. This operation forms the "dynamic brake" and will never allow a car under and condition to attain a greater speed on down-grade than this set speed. The conductor rail is divided into sections (separated by insulated joints), each section having independent connection with the controlling apparatus at the tower, or control station. Thus the cars on each section can be controlled independently of those on any other section. With more than one car on a section, however, all these cars are controlled as a unit. It is the duty of the tower man to keep the shovels supplied with an empty car at all times and so to distribute the empty cars on their return to the shovels that there will be continuous operation without "bunching" the cars.

The advantage of the operation of individual cars over that of trains is quite apparent. When one car is loaded it is not compelled to wait for the other cars to be loaded, as is the case where cars are hauled in trains. A car loaded at the shovel will be 1,000 ft. on its way before the next car is loaded. This makes it possible to keep all the cars working all the time and avoids keeping more than one car waiting for loading or unloading at any one time. It is claimed that this system operates with only one-third of the cars required when trains are used. Another advantage is that these cars, on account of their light weight as compared to a dinky engine required for a train, do not require as heavy rails nor so much labor to keep tracks in condition and ballasted as is required where engines are used.

The outlay for this equipment was about $28,000. During the first year the maintenance cost was abnormally high, due to the fact that no electrical man had been employed to look after the equipment. During the second year, however, a careful cost was kept on the maintenance and the cost given amounted to $505 for the entire year. The system used is the invention of Mr. F. E. Woodford, President Woodford Engineering Co., Chicago, Ill.

Method of Constructing Shield Driven Cast Iron Lined Tunnels Under the North River With Itemized Records of Labor Force, Wages and Time of Various Operations.*

The description relates to the construction of 12,255 ft. of circular cast iron lined tunnel driven by shields and compressed air. The main ruling type adopted for the tunnels under the river, and in the soft water-bearing ground for some distance on the shoreward side of the river lines, consists of two parallel metal-lined tunnels, circular in cross-section, each tunnel being 23 ft. outside diameter, and the two tunnels 37 ft. apart from c. to c. The metal lining is of cast iron (except for a few short lengths of cast steel) and of the usual segmental type, consisting of "rings" of iron, each ring being 2 ft. 6 ins. in length, and divided by radial joints into eleven segments, or "plates," with one "key," or closing segment, having joints not radial but narrower at the outside circumference of the metal lining than at the inside. The whole structure is joined, segment to segment, and ring to ring, by mild-steel bolts passing through bolt holes in flanges of all four faces of each segment. The joints between the segments are made water-tight by a caulking of sal-ammoniac and iron borings driven into grooves formed for the purpose on the inner edges of the flanges. The clearances between the bolts and the bolt holes are also made water-tight by using grummets or rings of yarn smeared with red lead, having a snug fit over the shank of the bolt and placed below the washer on either end of each bolt. When passing through ground more or less self-sustaining, the space outside the iron lining (formed by the excavation being necessarily rather larger than the external diameter of the lining itself) was filled with grout of 1:1 Portland cement and sand forced by air pressure through grout holes in each segment. These holes were closed with screw plugs before and after grouting. Table I shows the chief quantities of work in the river tunnels.

Methods of Construction.—First, it may be well to point out the sequence of events as they developed in this work. These events may be divided into six periods: (1) Excavation and iron lining: June, 1903, to Nov., 1906; (2) Caulking and grummeting the iron lining: Nov., 1906, to June, 1907; (3) Surveys, tests and observations: April, 1907, to April, 1908; (4) Building cross-passages and capping pile bores: April, 1908, to Nov., 1908; (5) Placing the concrete lining: Nov., 1908, to June, 1909; (6) Cleaning up and various small works: June, 1909, to Nov., 1909. The tunnels were under an average air pressure of 25 lbs. per sq. in. above normal for all except periods 5 and 6, during which times there was no air pressure in the tunnels. All the work will be described in this paper except that under Period 3.

Manhattan Shield Chambers.—The Manhattan shield chamber construction will be first

*From a paper by H. B. M. Hewett and W. L. Brown, Proceedings American Society of Civil Engineers, Vol. XXXVI, p. 690.

TABLE I. QUANTITIES OF WORK IN SUBAQUEOUS TUNNELS.

Description, Quantity, Length, Etc.		Type. Manhattan shield chambers.	Cast iron, ordinary pocketless.	Cast iron, ordinary pocket.	Cast iron, heavy pocketless.	Cast steel, ordinary pocketless.	Total.
Length, in feet.		50.00	4,374.99	2,146.3	5,522.05	152.66	12,235.00
Excavation, in cubic yards.	Total	1,884	67,344	33,038	85,001	2,349	189,616
	Per linear feet	31.9	15.4	15.4	15.4	15.4	.....
Cast iron tunnel lining, in pounds.	Total	847,042	39,643,120	19,715,405	61,559,845	.....	121,765,412
	Per linear feet	14,357	9,061	9,186	11,148	.....	.....
Cast steel tunnel lining, in pounds.	Total	.....	1,544,962	757,938	2,730,905	1,549,711	6,583,516
	Per linear feet	.....	353.1	353.1	494.5	10,151.4	.....
Steel bolts and washers, in pounds.	Total	23,627	1,475,991	724,095	2,935,455	51,266	5,210,434
	Per linear feet	400.46	337.37	337.00	531.59	335.82	.....
Rust joints, in linear feet.	Total	3,376	170,755	83,935	218,656	5,996	482,718
	Per linear feet	57.2	39.0	39.1	39.6	39.3	.....
Concrete, in cubic yards.	Total	766	20,030	9,827	25,282	713	56,618
	Per linear feet	12.98	4.58	4.58	4.58	4.58	.....
Steel beams, plates, etc., in pounds.	Total	12,346	83,774	41,098	105,738	7,432	250,388
	Per linear feet	2,092.5	19.1	19.1	19.1	48.7	.....
Steel bolts, hooks, etc., in pounds.	Total	1,328	36,980	18,142	46,675	1,471	104,596
	Per linear feet	22.5	84.5	84.5	84.5	96.4	.....
Expanded metal, in pounds.	Total	594	2,215	1,086	2,795	62	6,752
	Per linear feet	10.07	0.506	0.506	0.506	0.406	.....
Vitrified conduits, in duct feet.	Total	2,560	235,903	115,728	297,752	7,757	659,700
	Per linear feet	43.49	53.92	53.92	53.92	50.81	.....

described. During the progress of excavation the location of the New York shield chambers was moved back 133 ft., and when the location had been finally decided, there was a middle top heading driven all through the length now occupied by the shield chamber. Narrow cross-drifts were taken out at right angles to the top heading, and from the ends of these the wall-plate headings were taken out. Heavy timbering was used, as the rock cover was only about 6 ft., and the whole span to be covered was 60 ft. The process adopted was to excavate and timber the north side first, place the iron lining, and then excavate the south side, using the iron of the north side as the supports for the north ends of the segmental timbering of the south. The only incident of note was that on Oct. 20, 1904, the rock at the west end of the south wall-plate heading was pierced. Water soon flooded the workings, and considerable disturbance was caused in the New York Central railroad yard above. The cavity on the surface was soon filled in, but to stop the flow of mud and water was quite a troublesome job.

The excavation was begun on May 24, 1904, and finished on May 15, 1905. The segments were placed by an erector consisting of a timber boom supported by cross-timbers running on car wheels on longitudinal timbers at each side of the tunnel. Motion was transmitted to the boom by two sets of tackle, and the heavy (5,000-lb.) segments were easily handled. The erection of the lining was started on Feb. 4, 1905, and finished on June 14, 1905.

While the shield chambers were being excavated, bottom headings were run along the lines of the river tunnels and continued until the lack of rock cover prevented their being driven further. These were afterward enlarged to the full section as far as possible. The typical working force (ten-hour shifts) in the shield chambers was as follows:

Drilling and Blasting:	
1 Foreman at	$3.50
6 Drillers at	3.00
6 Drillers' helpers at	2.00
1 Blacksmith at	3.50
1 Blacksmith's helper at	2.25
1 Powderman at	2.00
1 Waterboy at	2.00
1 Nipper at	2.00
1 Machinist at	3.00
1 Machinist's helper at	1.80
Mucking:	
1 or 2 Foremen at	3.00
16 Muckers at	2.00

Erection of Shields.—The tunneling shields consist essentially of two parts, the structural steel work and the hydraulic fittings. The former was made by the Riter Conley Manufacturing Co., of Pittsburg, Pa., and put up by the Terry & Tench Co., of New York city; the hydraulic fittings were made and put in by the Watson-Stillman Co., of New York city.

On the New York side, the shields were built inside the iron lining of the shield chambers, hence no falsework was needed, as the necessary hoisting tackle could be slung from the iron lining; at Weehawken, however, the erection was done in the bare rock excavation, so that timber falsework had to be used. The assembly and riveting took about two weeks for each shield; the riveting was done with pneumatic riveters, using compressed air direct from the tunnel supply.

After the structural steel had been finished, the shields, which had hitherto been set on the floor of the chambers in order to give room for working over the top, were jacked up to grade; this involved lifting a weight of 113 tons. While the hydraulic fittings were being put in the shields were moved forward on a cradle, built of concrete with steel rails embedded, on which the shield was driven for the length in which the tunnel was in solid rock.

The installation of the hydraulic fittings took from 4 to 6 weeks per shield. The total weight of each finished shield was about 193 tons. The typical force (ten-hour shifts), working on shield erection was as follows:

Shield Erection. (Terry & Tench.)	Per day.
1 Superintendent at	$15.00
4 Foremen at	5.50
1 Timekeeper at	2.50
2 Engineers at	4.50
34 Iron workers at	4.50
7 Laborers at	2.25
Hydraulic Work: (Watson-Stillman Co.)	
4 Mechanics at	4.00
General Labor: (O'Rourke Eng. Cons. Co.)	
1 Inspector at	4.00
1 Foreman at	4.00
8 Laborers at	2.00
1 Engineer at	2.50

After the shield was finished and in position, the first two rings of the lining were erected in the tail of the shield. These first rings were then firmly braced to the rock and the chamber lining; then the shield was shoved ahead by its own jacks, another ring was built, and so on.

The description of the actual methods of work in the shield-driven tunnels can now be given; this will be divided generally into the different kinds of conditions met at the working face, for example, Full Face of Rock, Mixed Face, Full Face of Sand and Gravel, Upper River Bulkhead, and Full Face of Silt. The last heading is the one under which by far the longest length of tunnel was driven, and, as not much has hitherto appeared descriptive of the handling of a shield through this material, considerable space will be devoted to it.

Full Face of Rock.—As much as possible of the rock excavation was done before the shields were installed. On the New York side, about 146 ft. of tunnel was completely excavated, with 71 ft. of bottom headings beyond that, and at Weehawken, 58 and 40 ft. of tunnel and heading beyond, respectively. This was chiefly done to avoid handling the rock through the narrow shield doors. Test holes were driven ahead at short intervals to make sure that the rock cover was not being lost, but nevertheless, at Weehawken, on Feb. 14, 1905, a blast broke through the rock and let the mud flow in, filling the tunnel for half its height for a distance of 300 ft. from its face.

Throughout the rock section the shield traveled on a cradle of concrete in which were embedded either two or three steel rails. In the portion in which the whole of the excavation had been taken out, it was only necessary to trim off projecting corners of rock. In the portion in which only a bottom heading had been driven, the excavation was completed just in front of the shield, the drilling below axis level being done from the heading itself, and above that from the front sliding platforms of the shield. The holes were placed near together and drilled short, and very light charges of powder were used, so as to lessen the chance of knocking the shield about too much. In this work the small shield doors hampered the work greatly, and it might have been well to have provided a larger bottom opening which could have been subdivided or partly closed when soft ground was met; on the other hand, the quantity thus handled was small, owing to the fact that the greater part of the rock was excavated before the shields were installed. The space outside the lining was grouted with a 1:1 mixture of Portland cement and sand. Large voids were hand-packed with stone before grouting. The details of grouting will be described later.

A typical working gang is given herewith. Two such gangs were worked per shield per 24 hours, 10 hours per shift. All this work was done under normal air pressure.

General:	Per mo.
½ Tunnel superintendent at	$200.00
	Per day.
1 Assistant tunnel superintendent at	$5.00
1 General foreman at	5.00
½ Electrician at	3.50
½ Electrician's helper at	3.00
½ Pipefitter at	3.00
½ Pipefitter's helper at	2.75
Drilling:	
1 Foreman at	5.50
3 Drillers at	4.00
3 Driller's helpers at	3.00
1 Nipper at	2.50
½ Waterboy at	2.50
½ Powderboy at	2.75
Mucking:	
1 Foreman at	3.50
8 Muckers at	2.75
Erecting Iron and Driving Shield:	
1 Erector runner at	4.00
3 Iron workers at	3.00

The duties of such a gang were as follows: The tunnel superintendent looked after both shifts of one shield. The assistant or "walking boss" had charge of all work in the tunnel on one shift. The general foreman had charge of the labor at the face. The electricians looked after repairs, extensions of the cables, and lamp renewals. The pipefitters worked in both tunnels repairing leaks in pipes between the power house and the working faces, extending the pipe lines, and attending to shield repairs, and in the latter work the erector runner helped. The drillers stuck to their own jobs, which were not subject to interruption as long as the bottom headings lasted. One waterboy and one powderboy served two tunnels. The muckers helped the iron men put up the rings of lining, as well as doing their own work. The iron men tightened bolts, whenever not actually building up iron. The list does not include the transportation gang, which will be described under its own heading.

The rate of progress attained was 4.2 ft. per day per shield where most of the ex-

cavation had been done before, and 2.1 ft. where none had been done before. When the shields had got far enough away from the shield chamber, and before rock cover was lost, the first air-lock bulkhead walls were put in.

The specifications required these walls and all their fittings to be strong enough to stand a pressure of 50 lb. per sq. in. Accordingly, all the walls were of concrete, 10 ft. in thickness, except the first two, which were 8 ft. in thickness, and grouted up tight. There were three locks in each bulkhead wall capable of holding men, namely, the top or emergency lock which is set high in order to afford a safe means of getting away in case of a flood; this lock was used continuously for producing the lines and levels into the tunnels. It was very small and cramped for this purpose, and a larger one would have been better, both for lines and emergencies. This lock was directly connected with the overhead platform (also called for in the specifications) which ran the whole length of the tunnels. Side by side, on the level of the lower or working platform of the tunnels, were the man lock and the muck lock. In addition a number of pipes were built in to give access to the cables and for passing pipes, rails, etc., in and out.

After each tunnel was about 1,200 ft. ahead of the first walls, a second wall was built just like the first, and no others were put in, so that altogether there were eight walls. This second wall not only gave an added safeguard to the tunnel, but enabled the air pressure at the working face to be divided between the two walls, and this compression or decompression in stages, separated by a spell of walking exercise, was found to be very good for the health of those working in the air.

Mixed Face.—When the rock cover became so thin that it was risky to go on without the air pressure, the air pressure was turned on, starting with from 12 to 18 lb. which was enough to stop the water from the gravel on top of the rock. At first, when the surface of the rock was penetrated, the soft face was held up by horizontal boards braced from the shield until the shield was shoved. The braces were then taken out and, as soon as the shield had been shoved, were replaced by others. As the amount of soft ground in the face increased, the system of timbering was gradually changed to one of 2-in. poling boards resting on top of the shield and supported at the face by vertical breast boards, in turn held by 6 by 6-in. walings braced both through the upper doors to the iron lining and from the sliding platforms of the shield. The latter were in their forward position before the shield was shoved, the pressure being turned off and the exhaust valves opened just before the shove began. As the shield went ahead, the platform jacks gradually exhausted and thus held enough pressure on the face to keep it up. Fig. 1 is a sketch of this method.

In driving through mixed ground a typical working gang was about as follows:

General:	Per mo.
⅓ Tunnel superintendent at	$300.00
	Per day.
1 Assistant tunnel superintendent at	$5.00
1 General foreman at	5.00
½ Electrician at	3.50
½ Electrician's helper at	3.00
½ Pipefitter at	3.25
½ Pipefitter's helper at	3.00
Drilling:	
1 Foreman at	5.00
2 Drillers at	3.25
2 Drillers' helpers at	3.00
Timbering.	
2 Timbermen at	3.50
2 Timbermen's helpers at	2.00
Mucking:	
1 Foreman at	3.50
6 Muckers at	2.75
Erecting Iron and Driving Shield:	
1 Erector runner at	3.25
3 Iron workers at	3.00

The average rate of progress was 2.6 ft. per day. In this case there were three such gangs, each on an 8-hour shift.

Full Face of Sand and Gravel.—This condition of affairs was only met at Weehawken. Two systems of timbering were used. In the first system, Fig. 1, the ground was excavated 2 ft. 6 ins. ahead of the cutting edge, the roof being held by longitudinal poling boards, resting on the outside of the skin at their back end and on vertical breast boards at the forward end. When the upper part of the face was dry, it was held by vertical breast boards braced from the sliding platform and through the shield doors to cross-timbers in the tunnel; the lower part, which was always wet, was held by horizontal breast boards braced through the lower shield pockets to cross-timbers in the tunnel. This system worked all right as long as the ground in the top was sandy enough and had sufficient cohesion to allow the polings to be put in, but, when the upper part was in gravel, thus making it impossible to put in the longitudinal polings or the vertical breasting, the second system came in. Here the excavation was only carried 1 ft. 3 ins. (half a shove) ahead of the cutting edge, and the longitudinal polings were replaced by transverse boards supported by pipes which were placed in the holes provided in the shield to accommodate some telescopic poling struts which had been designed but not made. These pipes acted as cantilevers, and were in two parts, a 2½-in. pipe wedged tight into the holes and smaller pipes sliding inside them. After a small section of the ground had been excavated, a board was placed against it, one of the pipes was drawn out under it, and wedges were driven between it and the board. These polings were kept below the level of the hood, so that when the shield was shoved they would come inside of it; in addition, they were braced with vertical posts from the sliding platforms. The upper part of the face was held by longitudinal breast boards braced from the sliding platform by vertical "soldier" pieces. The lower part of the face was supported by vertical sheet-piling braced to the tunnel through the lower doors. Sometimes two rows of piling were used, but generally one, as shown in Fig. 1. Notwithstanding the fact that the breasting was only 1 ft. 3 ins. ahead of the hood, the shield was moved its full stroke of 2 ft. 6 ins. the ground around the cutting edge of the hood being scraped away by men working bars in the place from which the temporary breast boards at the circumference had been removed. The back pressure on the sliding platform jacks, when the exhaust valves were only partly open, offered a good deal of resistance, and held the face as long as the movement of the shield was continuous.

On one occasion, when for some reason the shield was stopped with the shove only partly done, and the exhaust valves had not been shut off, the platforms continued to slide and allowed the face to collapse; the shield platforms and doorways, however, caught the falling sand and gravel and the flow choked itself.

As soon as the rock surface was penetrated and the sand and gravel were met,

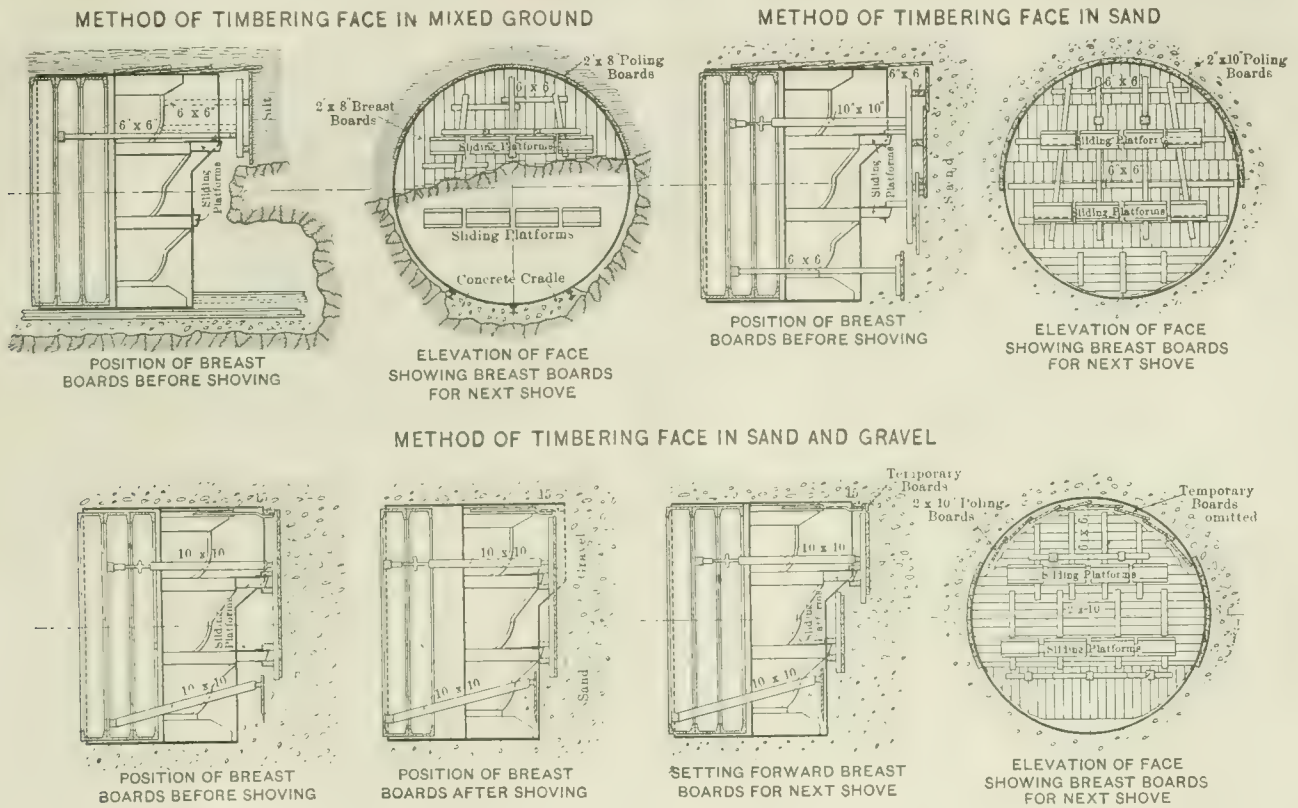
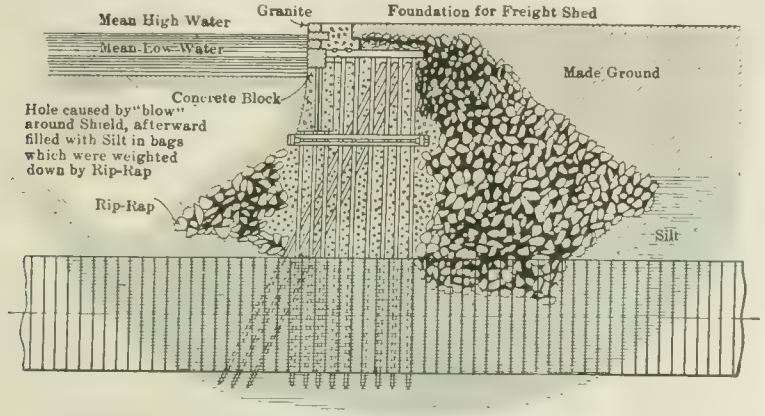

METHOD OF TIMBERING FACE IN MIXED GROUND
METHOD OF TIMBERING FACE IN SAND
2"x 8" Poling Boards
2"x 8" Breast Boards
Sliding Platforms
Concrete Cradle
POSITION OF BREAST BOARDS BEFORE SHOVING
ELEVATION OF FACE SHOWING BREAST BOARDS FOR NEXT SHOVE
2"x10" Poling Boards
METHOD OF TIMBERING FACE IN SAND AND GRAVEL
Temporary Boards
Temporary Boards omitted
POSITION OF BREAST BOARDS AFTER SHOVING
SETTING FORWARD BREAST BOARDS FOR NEXT SHOVE

Fig. 1.—Diagrams Showing Methods of Timbering Tunnel Faces in Various Materials.

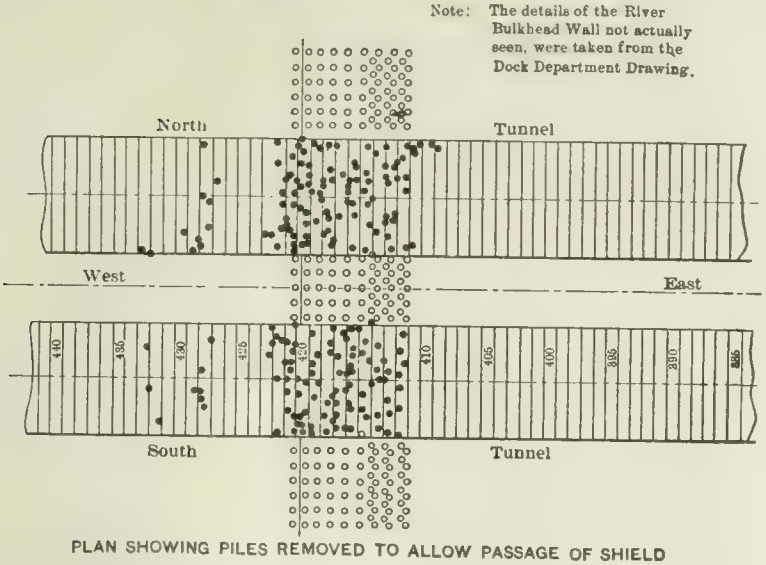
TABLE II.—SHIELD-DRIVEN TUNNEL WORK. TOTAL NUMBER OF RINGS ERECTED AND SHIFTS WORKED BY ALL FOUR SHIELDS IN CONTRACTS GY-WEST AND GL-AND THE AVERAGE SIZE OF GANG. AMOUNT OF EXCAVATION AND TIME TAKEN PER RING FOR THE VARIOUS OPERATIONS INVOLVED IN BUILDING TUNNEL IN EACH OF THE SEVERAL KINDS OF GROUND ENCOUNTERED; ALSO THE EXTENT AND NATURE OF ALL THE UNAVOIDABLE DELAYS.

| | | |

tions were not nearly as good. The heavy masonry bulkhead was supported on piles and rip-rap, as shown in Fig. 2. The line of the top of the shield was about 6 ft. above the bottom of the rip-rap, the spaces between the stones of which were quite open and allowed a free flow of water directly from the river. As soon, therefore, as the cutting edge of the shield entered the rip-rap there was a blow, the air escaping freely to the ground surface behind the bulkhead and to the river in front of it. Clay puddle, or mud made from the excavated silt, was used in large quantities to plug up the interstices between the stone in the working face, the air pressure being slightly greater than



CROSS-SECTION OF RIVER BULKHEAD WALL ON AXIS OF NORTH TUNNEL



PLAN SHOWING PILES REMOVED TO ALLOW PASSAGE OF SHIELD

Fig. 2.—Sketch Showing Method of PassingTunnels Under Bulkhead Walls.

that needed to keep out the water holding it in place. The excavation of the rip-rap was a tedious affair, for it had to be removed one stone at a time and the spaces between the newly exposed stones plugged with mud immediately. One man stood ready with the mud while another loosened the stones with a bar. When the shield had advanced its own length in the rip-rap, another point for the escape of the air was exposed at the rear end of the shield. This loss was closed at the leading end of the last ring with mud and cement sacks.

As long as the shield was stationary it was possible, by using these methods and exercising great care and watchfulness, to prevent excessive loss of air; but, while the shield was being shoved ahead, the difficulties were much increased, for the movement of the shield displaced the bags and mud as fast as they were placed, and it was only by shoving slowly and having a large number of men looking out for leaks and stopping them up the instant they developed that excessive loss of air could be prevented. In erecting the iron lining, as each segment was brought into position it was necessary to clean off the leading surface of the previous ring and the adjacent portion of the tail of the shield; this was always accompanied by a slight "blow," and for some time the air pressure in the tunnel dropped from 25 to 20 lbs. that is, from greater than the balancing pressure to less, every time a segment was placed, and on two occasions the "blow" became so great that the tunnel pressure was reduced considerably further, and in consequence the water from the river rushed in and was not stopped until it had risen about 4 ft. in the tunnel invert. On such occasions the surface of the river was greatly disturbed, rising more than 20 ft. in the air in a sort of geyser. A large quantity of grout (about 2,500 bbls. of cement and a similar quantity of sand in the North Tunnel and 1,000 bbls. in the South Tunnel) was used at this point; it was forced through the tunnel lining immediately behind the shield, greatly reducing the loss of air and helping to bind the rip-rap together.

When the shield had traveled 25 ft. through the rip-rap, the piles which support the bulkhead were met. One hundred of these which were spaced at 3-ft. centers in each direction, were cut out of the path of each shield in a distance of 35 ft. The presence of the piles caused considerable extra labor, as each pile had to be cut into several pieces with axes to enable it to be removed through the shield doors, otherwise they presented no difficulties. It was not necessary to timber the face, as the piles supported it most effectively.

When the river line had been passed, the "blow" still continued, and as there was no heavy ground above the tunnel the light silt was carried away into the water by the escaping air. At one time the cover over the crown of the tunnel was reduced to such an extent that for a distance of 30 ft. there was less than 10 ft. of very soft silt, and in some places none at all. Therefore, the shield was stopped and the air pressure reduced until it was less than the balancing pressure; the blow then ceased, and about 28,000 cement bags filled with mud were dumped into the hole (the location made it impossible to dump them *en masse* from a scow). They were then weighted down with rip-rap. This sealed the blow, and the work was continued without any further disturbance from this source. Just before the blow reached its maximum it was found that two of the piles which had been encountered were directly in the path of one of the proposed screw-piles. It was therefore decided to pull these, and this was done with two 40-ton hydraulic jacks supported by the upper sliding platforms and acting on a horizontal timber which was connected to the piles by tie-rods and chains. The working force here was similar to that employed in the sand and gravel section previously described.

In Full Face of Silt.—A full face of silt was first met under the New York Central Railroad freight yard on the New York side. Up to this point the ground passed through had been either solid rock or a mixed face of rock and gravel. In both of these the full excavation had to be taken out before the shield could be shoved, and the soft ground had needed timbering. When the rock, gravel, and hardpan gave place to a full face of silt, the timber was removed, all the shield doors were opened, and the shield was shoved into the ground without any excavation being done by hand ahead of the diaphragm. As the shield advanced, the silt was forced through the open doors into the tunnel. After the work had gone on in this way for some time, taking in about 90 per cent of the full volume of the tunnel excavation per foot forward, the air pressure was raised from 20 to 22 lbs. The result was that the silt in the face got harder and flowed less readily through the shield, and the amount taken in fell to about 65 per cent of the full volume. This manner of shoving at once caused a disturbance on the surface and the railroad tracks above the tunnel were raised, so that the pressure was lowered to 16 lbs. then the muck got softer and the full volume of excavation was taken in; after a while the pressure was again raised to 20 lbs.

The forcing of the shield through the silt resulted in a rising of the bed of the river, the amount that the bed was raised depending on the quantity of material brought into the shield.

If the whole volume of excavation was being brought in, the surface of the bed was not affected; when about 50 per cent was being taken in, the surface was raised about 3 ft.; if the shield was being driven blind, the bed was raised about 7 ft.

The number of open doors was regulated so as to take in the minimum quantity of muck consistent with causing no surface disturbance. On the average, in the North Manhattan Tunnel, all the doors were open, but in the South Tunnel there were generally only five or six out of the total nine.

In front of the bulkhead wall at Manhattan the tunnels were under Pier No. 72. This structure was supported on wooden piles, some 80 ft. or more in length, which came down below the tunnel invert. The piles which lay directly in the path of the tunnels, with a few exceptions, had been pulled. In driving the tunnels through this section, great care had to be taken not to disturb the piles on either side of the tunnels, as they supported a heavy trestle used in disposing of the excavation from the open cut in the terminal yard. To avoid such disturbance, a large portion of the total excavation had to be taken through the shields.

The first shield which passed the river bulkhead was the south one at Weehawken. As soon as this line was crossed the silt was found to be much softer than behind the wall, in fact it was like a fluid in many of its properties. The fluidity could be changed by varying the tunnel air pressure; for example, when the air pressure was made equal to the weight of the overlying material (water and silt), the silt was quite stiff, and resembled a rather soft clay; but when the air pressure was from 10 to 15 lbs. per sq.

it lower, it became so liquid that it would flow through a 1½-in. grout hole in the lining, in a thick stream, at the rate of from 10 to 50 gals. per min. as soon as the plug was taken out. This was the point to which the contractor had long looked forward, as he expected to be able to close all his shield doors and drive the rest of the way across without taking in a shovelful of muck, as had just been done under the Hudson River, on the South Tunnel of the Hudson and Manhattan Railroad Company's Tunnels between Morton Street, New York City, and Hoboken, N. J. The doors were shut and the shield was shoved; the tunnel at once began to rise rapidly, notwithstanding that the heaviest possible downward leads that the clearance between the iron and the shield would allow were put on. At the same time, the pressures induced in the silt by the shield shouldering the ground aside caused the iron lining to rise about 2 in. as soon as the shield left it, and also distorted it, the horizontal diameter decreasing and the vertical diameter increasing by about as much as 1¼ in.

gang per shift of 8 hours per shield was as follows:

	Per mo.
General:	
⅓ Tunnel superintendent at	$300.00
	Per day
1 Assistant tunnel superintendent at	$6.00
1 General foreman at	5.00
½ Electrician at	3.50
½ Electrician's helper at	3.00
1 Foreman at	4.00
2 Pipefitters at	3.50
2 Pipefitters' helpers at	3.25
Mucking:	
1 Foreman at	4.00
6 Muckers at	3.00
Erecting Iron and Driving Shield:	
1 Foreman at	4.00
1 Erector runner at	3.50
4 Iron workers at	3.00
3 Laborers at	3.00

Three such shifts were worked per day and the air pressure averaged 25 lbs. per sq. in.

The increase in the number of pipefitters was due to the greatly increased speed, and also the steadily increasing length of completed tunnel. The three laborers in the erection gang spent their whole time tightening bolts. The rate of progress in the silt under the river per ring of 2½ ft. was 3 hrs. 21

tunnels in silt, a short description will be attempted, this description falling into three main divisions, namely, Shoving the Shield, Pushing Back the Jacks, and Erecting the Iron Lining.

Shoving the Shield.—This part of the work is naturally very important, as the position of the shield determines within pretty narrow limits the position of the iron built within it, hence the shield during its forward movement has to be guided very carefully. On this work certain instructions were issued for the guidance of the foreman in charge of the shield. These instructions were based on results of "checks" of the shield and iron's position by the engineering corps of the Company, and comprised, in the main, two requirements, namely, the leads that were to be got, and the quantity of muck to be taken in. The "lead" is the amount that the shield must be advanced further from the iron, on one side or the other, or on the top or bottom, as measured from the front face of the last ring of iron lining to the diaphragm of the shield. These leads are not necessarily

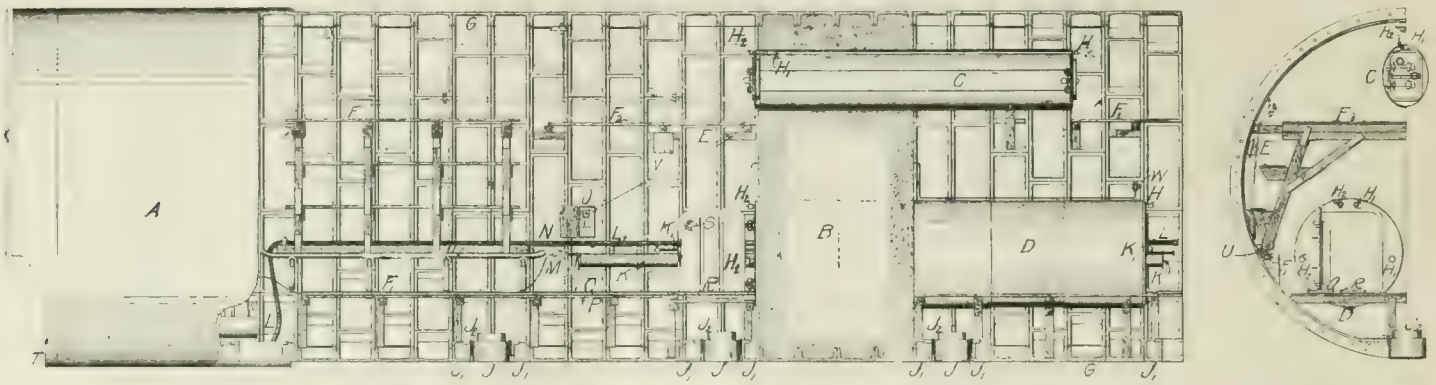


Fig. 3.—Sections Showing Shields, Lining, Bulkheads and Working Platforms and Appliances in Position for Work.

A Shield; B, Concrete Bulkhead; C, Emergency Air Lock; D, Material Air Lock; E, Electric Light and Power Lines; F, Trailing Platform; F_1, Trailing Platform Bracket; F_2, Emergency Platform Planks; G, Cast Iron Tunnel Lining; H, Outlet Valves; H_1, Inside Intake Valve; H_2, Outside Intake Valve; J, Bore Plug; J_1, Bore Segment; J_2, Plug Cover; K, Low Pressure Air; K_1, Low Pressure Air; L, Blow Pipe; M, High Pressure Water; N, Hydraulic Supply Pipe; O, Telephone; P, Working Platform Plank; P_1, Working Platform Center Supports; Q, Industrial R. R. Tracks; R, Portable R. R. Tracks; S, Glass Bull's Eye; T, Cast Steel Cutting Edge; U, Inverted Rail for Trailing Platform; V, Electric Light Box; W, Pressure Gage; X, Movable Hood.

An anxious discussion followed these phenomena, as the effects had been so utterly unexpected, and a good many different theories were advanced as to the probable cause. It was thought that the hood of the shield might have something to do with the trouble. The shield was stopped, the hood removed, the doors were shut, and the driving continued. The same trouble was found, and it was impossible to keep to grade. Work was stopped, and the question was thoroughly debated; finally, on Jan. 31, 1906, the chief engineer directed that one of the shield doors be opened as an experiment and 50 per cent of the excavation taken in.

The effect was instantaneous, the shield began to come down to grade at once, and it soon became necessary to close the door partially and reduce the quantity of muck taken in in order to prevent the tunnel from getting below grade. The other troubles from distortion, etc., ceased at the same time.

It was soon found that a powerful aid in the guidance of the shield was thus brought to hand, for, if high, the shield could be brought down by increasing the quantity of muck taken in, if low, by decreasing it. From this time forward, the quantity of muck taken in at each shove was carefully regulated according to the position of the tunnel with regard to grade and the nature of the ground. The quantity varied from nothing to the full volume displaced by the tunnel, and averaged 33 per cent of the latter.

To regulate the flow, the bottom middle door was fitted with two steel angles behind which were placed 6 6-in. timbers. In this way the opening could be entirely closed or one of any size left. The muck flowed into the tunnel in a thick stream, and, by regulating the rate of shove, it could be made to flow just as fast as it could be loaded into cars.

In driving through the silt, the typical

min., exclusive of all time when work was actually suspended. For a considerable part of the time only two 8-hour shifts were worked, owing to a shortage of iron caused by the change in the design of the lining, whereby the original lining was changed to a heavier one, and, as the work was also stopped for experiments and observations, the average of the actual total time, including all the time during which work was suspended, was 5 hours 32 min. per ring, or 10.8 ft. per day.

The junction of the shields under the river was made as follows: When the two shields of one tunnel, which had been driven from opposite sides of the river approached within 10 ft. of each other, the shields were stopped, a 10-in. pipe was driven between them, and a final check of lines and levels was made through the pipe. Incidentally, also, the first through traffic was established by passing a box of cigars through the pipe from the Manhattan shield to that from Weehawken. One shield was then started up with all doors closed while the doors on the stationary shield were opened so that the muck driven ahead by the moving shield was taken in through the other one's doors. This was continued until the cutting edges came together. All doors in both shields were then opened and the shield mucked out. The cutting edges were taken off, and the shields moved together again, edge of skin to edge of skin. The removal of the cutting edge necessitated the raising of the pressure to 37 lbs. As the sections of the cutting edges were taken off, the space between the skin edges was poled with 3-in. stuff. When everything except the skins had been removed, iron lining was built up inside the skins, the gap at the junction was filled with concrete, and long bolts were used from ring to ring on the circumferential joint. Finally, the rings inside the shield skins were grouted.

In order to make clear the nature of the work done in building these shield-driven

true leads from a line at right angles to the center line, as the iron may have, and in fact usually does have, a lead of its own which is known and allowed for when issuing the requirements for the shove.

The foreman, knowing what was wanted, arranged the combination of shield jacks which would give the required leads and the amount of opening on the shield door which would give the required amount of muck. To see how the shield was going ahead, a man was stationed at each side at axis level and another in the crown. Each man had a graduated rod in which the marks were so distinct that they could be read by anyone standing on the lower platform. These rods were held against the shield diaphragm, and, as it advanced, its distance from the leading end of the last ring could be seen by the man in control of the jack valves. If he found that he was not getting the required leads, he could change the combination of jacks in action. As the time of a shove was often less than 10 min., the man had to be very quick in reading the rods and changing the jacks. If it was found that extensive change in the jack arrangement was wanted, the shove could be stopped by a man stationed at the main hydraulic control valve; but, as any such stoppage affected the quantity of muck taken in, it was not resorted to unless absolutely necessary.

If the quantity of muck coming in was not as desired, a stop had to be made to alter the size of the opening, and if, while this was being done, the exhaust valves were not closed quite tight, the silt pressure on the face of the shield would force it back against the iron. This fact was sometimes taken advantage of when a full opening did not let in the desired quantity, for the shield could be shoved, allowed to return, and shoved again.

The time taken to shove in silt varied greatly with the quantity of material taken in; for shoving and mucking combined, it

averaged 66 min., with an average of 13 cu. yds. of muck disposed of, or about 5 mins. per cu. yd. of material.

Pushing Back the Jacks.—This was a simple matter, and merely consisted in making the loose push-back connection to each jack as it had to be sent back. Some of the jacks became strained and bent, and had to be taken out and replaced. Where there was silt pressure against the face of the shield, the hydraulic pressure had to be kept on until the ring was erected. In such cases, only two or three jacks could be pushed back at a time, and only after a segment had been set in position, and the pressure taken on it, could the next jack be pushed back, and so on around the ring. The time between the finish of the shove (hydraulic pressure turned off) and the placing of the first segment, was occupied in pushing back the bottom jacks and cleaning dirt off the tail of the shield, and averaged about 14 min.

Erecting the Iron Lining.—As soon as the shove was over, the whole force, when in silt, set to work at building up the iron and then tightening the bolts so that the shield could be shoved again. A section of the tunnel with bolting and working platform is shown on Fig. 3.

In the early part of the work, when the ground was being excavated ahead of the shield, the whole force, with the exception of those working in front of the shield, was engaged in erecting the iron, but, as soon as this was done, most of the men returned to the mucking, and only the iron workers continued to tighten up bolts. On the other sections, where the shield was shoved into the silt without excavating ahead, as soon as the shove was completed, the whole force was engaged in the erection of the iron and the tightening of the bolts, until they were so tight that the shield could be shoved again for another ring.

The iron was brought into the tunnel on flat cars, two segments to the car, and was lifted from the car and lowered into the invert of the shield by a block and fall and chain sling. The bottom three or four segments were pushed around into position with the erector, the head simply bearing against the longitudinal flange without being attached to the segment; the upper segments, however, were attached to the erector, by using the expanding bar and the erector head designed by Mr. Patrick Fitzgerald, the Tunnel Superintendent. This was found to be a most convenient arrangement.

The single erector attached to the center of the shield was able to erect the iron as fast as it could be brought into the tunnel, and even when the weight of the segments was increased 25 per cent (from 2,060 to 2,580 lbs.) it always proved equal to its task, although occasionally one of the chains in the mechanism broke and delayed the work for an hour or so; but the sum of all the delays from this cause and from breaks and leaks in the hydraulic line only averaged 13 min. per ring. The operating valve which was first used was a four-spindle turning valve, but this was replaced by a sliding valve which was found to be much more satisfactory, both in ease of operation and freedom from failure.

As the iron was put into place, two of the middle bolts in each longitudinal flange and two in each circumferential one were pulled as tight as possible, and the others put in loosely; then, as soon as the ring was in position, as large a force as could be conveniently worked at one time was engaged in tightening the bolts. The shape of the tunnel depended on the thoroughness of the tightening of the bolts, and the shield was never shoved until the bolts in all the longitudinal flanges had been thoroughly tightened. In addition, all the bolts in the circumferential flanges below the axis were tightened, and at least three of the six in each segment above. After the shield had been shoved ahead, the bolts were found to have slackened, and, where the daily progress was four rings, or more, it was necessary to have a small gang of men always at this work.

In order to get at the bolts, special platforms were necessary, and throughout the greater part of the work, a traveling platform was used. This enabled the men to reach handily all parts of the seven leading rings. This platform was supported and moved forward on wheels fixed on brackets to the tunnel, and was pulled forward by connecting chains every time the shield was shoved. In the early part of the work it was not possible to use platforms, because, in order to maintain the correct circular shape of the iron lining, it was necessary to put in temporary horizontal turnbuckles at axis level. These, however, were very convenient for supporting the planks which were used as a temporary bolting platform for the sides of the tunnel, and a temporary platform resting on 6 6-in. timbers across the tunnel enabled the bolts in the crown of the tunnel to be reached, while the 6 6-in. timbers were left in to support the emergency platform previously described, which extended the entire length of the tunnel.

The time taken to erect the iron lining became shorter and shorter as the tunnel organization became more perfect and the force better trained, so that, whereas, in the early part of the work, it frequently took 6 hours to erect a ring, in the latter part, when the work was nearing completion, it was a common occurrence to erect a ring in 30 min. The average time in the "heavy iron" section, which included the greater part of the work under the river, was 1 hour 4 min. for the erection of the ring and 40 min. for tightening the bolts after that had been completed, so that the total time spent by the whole gang on erection and bolting averaged 1 hour 44 min. per ring, exclusive of the time spent by the small gang which was always engaged in tightening the bolts. The average time spent in erecting and bolting, for the whole length of the tube tunnels, was 2 hours 15 min. per ring.

The average time taken for each operation at all the working faces is given in Table II. The work has been subdivided into the different kinds of ground encountered. The progress, as shown by the amount of work done each month by each shield, is given in Table III.

Air Pressure.—The air pressure varied from 17 to 37 lbs. Behind the river line it averaged 17 lbs. and under the river 26 lbs. Behind the river lines the pressure was generally kept about equal to the water head at the crown, except where at Weehawken, as previously described, this was impossible. In the silt the pressure was much lower than the hydrostatic head at the crown, but if it became necessary to make an excavation ahead of the shield, for example at the junction of the shields, the air pressure required was about equal to the weight of the overlying material, namely, the water and the silt, as the silt, which weighed from 97 to 106 lbs. per cu. ft. and averaged 100 lbs. per cu. ft., acted like a fluid.

A ½-in. air line was taken direct from the working chamber to the recording gages in the engine-room, which enabled the engine-room force to keep a constant watch on the air conditions below. To avoid undue rise of pressure, a safety valve was set on the air line at each lock, set to blow off if the air pressure rose above that desired. The compressor plant was ample, except, as before described, when passing the gravel section at Weehawken.

Records were kept of the air supply, and it may be said here that the quantity of free air per man per hour was in general between 1,500 and 5,000 cu. ft., though in the open gravel where the escape was great it was for a time as much as 10,000 cu. ft. For more than half the silt period it was kept between 3,000 and 4,000 cu. ft., but when it seemed proved beyond doubt that any quantity more than 2,000 cu. ft. had no beneficial effect on health, no attempt was made to deliver more, and on two separate occasions for two consecutive weeks it ran as low as 1,000 cu. ft. without any increase in the number of cases of bends.

The amount of CO_2 in the air was also measured daily, as the specifications called for not more than 1 part of CO_2 per 1,000 parts of air. The average ranged between 0.8 and 1.5 parts per 1,000, though in exceptional cases it fell as low as 0.3 and rose to 4.0. The air temperature in the tunnels usually ranged from 55° to 60° F., which was the temperature also of the surrounding silt, though at times, in the earlier parts of the work when

TABLE III.—MONTHLY PROGRESS OF SHIELD-DRIVEN TUNNEL WORK.

MONTH	NORTH MANHATTAN. Number of rings erected: For month	To date	Station of leading ring	Lin ft for month	SOUTH MANHATTAN. Number of rings erected: For month	To date	Station of leading ring.	Lin ft for month	NORTH WEEHAWKEN. Number of rings erected: For month	To date	Station of leading ring.	Lin ft for month	SOUTH WEEHAWKEN. Number of rings erected: For month	To date	Station of leading ring.	Lin ft for month	Average progress per Shield, lin ft per month
1905. May	26	26	200+83.7	63.7	...	.....	.....	.....	...	.....	.....	.....	...	.....	.....	.....	15.9
June	26	52	201+49.0	65.3	...	.....	.....	.....	24	24	260+76.6	59.3	12	12	260+70.6	30.0	38.6
July	28	80	202+19.2	70.2	...	.....	.....	.....	12	36	260+46.6	30.0	15	27	260+32.4	37.6	34.4
Aug.	26	106	202+84.3	65.1	...	.....	.....	.....	15	51	260+09.1	37.5	16	43	260+07.4	25.0	31.0
Sept.	21	127	203+36.8	52.5	31	31	200+96.4	76.4	1	52	260+06.0	2.5	18	61	259+47.2	60.2	47.9
Oct.	25	152	203+99.4	63.6	45	76	202+09.2	112.8	10	62	259+81.5	25.1	20	81	258+97.2	50.0	62.9
Nov.	31	183	204+76.9	77.5	31	107	202+86.5	77.3	29	91	259+09.0	72.5	39	120	257+99.7	97.5	81.2
Dec.	59	242	206+24.6	147.7	34	141	203+71.8	85.3	46	137	257+94.0	115.0	77	197	256+07.1	192.6	135.1
1906. Jan.	94	336	208+59.8	235.2	27	168	204+39.4	67.6	77	214	256+01.4	192.6	73	270	254+24.6	182.5	169.4
Feb.	78	414	210+54.9	195.1	64	232	205+99.6	160.2	133	347	252+68.6	332.8	165	435	250+11.7	412.9	273.2
Mar.	56	470	211+95.2	140.3	96	328	208+39.9	240.3	142	489	249+13.3	355.3	111	546	247+34.0	277.7	253.4
April	119	589	214+93.0	297.8	84	412	210+50.1	210.2	32	521	248+33.3	80.0	78	624	245+38.9	195.1	195.7
May	129	718	218+15.7	322.7	70	482	212+25.3	165.2	121	642	245+30.6	302.7	2	626	245+33.9	5.0	198.9
June	218	936	223+60.9	545.2	140	622	215+75.5	350.2	162	804	241+25.3	405.3	157	783	241+41.1	392.8	423.4
July	155	1,091	227+48.5	387.6	82	704	217+80.7	205.2	113	917	238+42.4	282.9	118	901	238+45.9	295.2	292.7
Aug.	145	1,236	231+11.2	362.7	134	838	221+15.8	335.1	138	1,055	234+97.1	345.3	140	1,041	234+95.8	350.1	348.3
Sept.	89	1,325	233+34.1	222.9	168	1,006	225+35.8	420.0	55	1,110	233+59.5	137.6	177	1,218	230+52.8	443.0	305.9
Oct.	...	.....	.....	.....	105	1,111	227+98.6	262.8	1	1,111	233+57.0	2.5	94	1,312	228+16.8	236.0	125.3
Nov.	...	.....	.....	.....	7	1,118	228+16.8	18.2	9	1,120	233+34.1	22.9	...	.....	.....	.....	10.3

grouting extensively in long sections of the tunnel in rock, it varied from 85° to 110° F.

Grouting.—Grout of one part of Portland cement to one part of sand by volume was forced outside the tunnel lining by air pressure through 1½-in. tapped and plugged grout holes formed in each segment for this purpose, wherever the ground was not likely to squeeze in upon the metal lining as soon as this was erected. That is to say, it was used everywhere up to the river line; between river lines it was not used except at the New York bulkhead wall in order to fill voids in the rip-rap, and at the point of junction of the shields where the space between the metal lining and the shield skins outside it was grouted. Cow Bay sand was used, and it had to be screened to remove particles greater than 1/10 in. in diameter, which would choke the valves. For later grouting work, namely, in the top of the concrete lining inside the metal lining, Rockaway Beach sand was used. This is very fine, and did not need screening; it cost more, but the saving of screening and the non-blocking of valves, etc., resulted in a saving.

The grout pipes were not screwed directly into the tapped hole in the segments, but a pipe containing a nipple and valve was screwed into the grout hole and the grout pipe screwed to the pipe. This prevented the waste of grout, enabled the valve to be closed and the grout pipe disconnected, and the pipe to be left in position until the grout had set. In the full rock section, 20 or 30 rings were put in without grouting; then the shield was stopped, the last two or three rings were detached and pulled ahead by the shield, a masonry stopwall was built around the outside of the last ring left in, and the whole 20 or 30 rings were grouted at one time. In the landward silt and gravel each ring had to be grouted as soon as the shield had left it, in order to avoid the flattening caused by the weight coming on the crown while the sides were as yet unsupported. The grout was prevented from reaching the tail of the shield by plugging up the space with empty cement bags, assisted by segmental boards held against the face of the leading ring by U-shaped clamps, fitting over the front circumferential flange of the ring and the boards, and tightened by wedges. The air pressure varied between 70 and 100 lbs. per sq. in. above normal.

The force consisted of one pipe fitter and one or two laborers employed part of their time. When a considerable length was being grouted at a time, as in the full rock section, many laborers were employed for a short period.

National Fire Protection Association.—The fourteenth annual meeting of the National Fire Protection Association will be held at the Hotel La Salle, Chicago, on May 17, 18 and 19. On the first date the reports presented for discussion will be those of the committees on manufacturing risks and special hazards, devices and materials, automatic sprinklers, fire protection coverings for window and door openings, hose, hydrants and valves, pumps, private fire supplies from public mains, and standard hose couplings and hydrant fittings. On the second day the committee reports for discussion will be those on signaling systems, cold storage warehouses, automobile garages, building codes and fireproof construction. On the third day the committees reporting will be those on theater construction and equipment, pneumatic conveyors of stock and refuse, and high-pressure fire service systems. There will also be a number of addresses at this meeting by architects and delegates to various conventions interested in fire protection work.

According to announcement reported to have been made by R. S. Lovett, President, Phoenix & Eastern Ry., construction work will be resumed on the gap between Winkleman and Carlos, Ariz., as soon as the Secretary of the Interior approves the plans for the construction of the line through the Box or Gila Canyon.

Roads and Streets Section

Note: This section is devoted to methods and costs of road and street construction. It will cover road building in all its details, the construction of pavements, sidewalks and gutters, the testing and use of paving materials and the machinery and tools used in road building and paving.

Methods of Resurfacing Worn Out Macadam Roads in New Jersey.

During the past year the Commissioner of Public Roads of New Jersey has given special attention to the repair of old macadam roads. In the recently issued report of Frederick Gilkyson, Commission, Mr. E. M. Vail, Assistant State Supervisor of Public Roads, describes the methods employed, as follows:

The method giving the best general satisfaction is to sweep the loose dirt from the stone bed to the shoulders, scarify or break up the surface of the upper course of stone, then spread and shape the old material to form a proper crown of the same curvature as the surface of the finished road, using a little new material where necessary.

Old roads are usually worn more in the center than at the edges of the stone bed; hence when the loosened stone is raked toward the center to form the crown, a shoulder of dirt is formed for the new stone which is to be added later. The shoulders are then cleaned and shaped for their entire width, the gutters properly attended to and the shrubbery and overhanging limbs of trees trimmed to at least twelve feet above the road at all points. It is especially necessary that this work be done in advance of the spreading of the new stone, so that the new work may be kept clear of dust and dirt of all kinds.

The roadway, having been thus prepared, is ready to receive whatever kind of resurfacing the specifications call for. One method is to spread a cushion of clean, sharp sand, followed by new, clean 1½-in. stone, cubical wooden blocks being used to insure a uniform depth. After rolling once, hot asphaltum binder is applied, followed by a light coat of clean ¾-in. stone, enough to keep the roller from picking up the stone. This first application of binder and ¾-in. stone is sometimes followed by another applied in the same manner.

In cases where the old material is properly rolled and shaped, as explained above, no depressions or irregularities appear in the new work, but the 1½-in. stone shows on the surface with just enough ¾-in. stone and asphaltum oil to fill the voids and bind the whole together.

It is frequently necessary to take up an excess of binder appearing on the surface by spreading a light layer of ¾-in. stone and screenings, carefully broadcasting it with shovels where needed. If sand is used to fill a part of the voids between the stones, it is very important that it be shaken down out of sight before the asphaltum binder is applied or the binder will not adhere to the stones.

Some local engineers and supervisors do not yet realize the importance of having each course of stone uniform in size and the same depth in all parts, and therefore allow the contractor to dump the new stone on the hard, dusty surface of the old road where it will not properly bind.

If the loose dirt has not been swept away or scarified and rattled down among the old stone by rolling, it mingles with the new stone and prevents the asphaltum binder from adhering.

The additional stone necessary to build up a crown on an old flat surface costs more than scarifying and reshaping, because the depth of the new stone varies, perhaps, from 1 to 6 ins.

The amount of asphaltum binder required varies according to the depth of loose stone to be treated. When too little is applied, dust will soon work in and render it impossible to properly bind the stone even with an additional amount of binder. An excess of binder will result in soft, spongy spots, from which melted asphalt will ooze on a hot day. It will therefore be readily seen that in a section varying from 1 to 6 ins. in depth it is almost impossible to determine the amount of binder required. In some cases only enough extra dirt is borrowed from the side of the road to form a narrow shoulder for the new stone instead of reshaping the entire shoulder to the gutter line as suggested. This causes an abrupt drop from the edge of the stone, which is liable to upset a vehicle.

The process just described is what is known as the penetration method, and gives very good results when exactly the proper material is obtained, heated and carefully applied in the right quantity. On account of the extreme care necessary from start to finish with the penetration method, it has been thought advisable on some of the more important roads to adopt the mixing method, even after considering the additional first cost.

For the mixing method the foundation and shoulders, or box, as it is commonly called, is formed in exactly the same manner as for penetration. Coarse stone, thoroughly coated by some one of the various mechanical methods, is then spread, cubical wooden blocks being used to aid in getting a uniform thickness before rolling, for when the roller has passed once over it, the material has set firmly together and it is difficult to fill up any slight depressions or roll down bumps.

This first course is followed by a thin second course of small stone coated in the same way, which is intended to fill up any spaces between the coarse stone and make a watertight road. In some processes even a third coat, consisting of treated stone dust, is lightly scattered or broomed on to make a finished surface.

Since most of the work to be performed, with money apportioned the various counties from the motor vehicle fund, will be by contract, it will be necessary for contractors who would successfully compete for this work, and, in fact, all state aid work, to provide themselves not only with standard 10-ton rollers, the regular wide-tired wagons and small tools, but a scarifier and a suitable outfit for asphaltum work. One roller and one scarifier have occasionally been made to do the work for two or three small jobs located in the same district. While we should encourage small contractors in every possible way, it is not fair to county or state to put up with the annoyances and delays consequent upon such work, and every contractor is now expected to set apart a full set of tools for each particular job contracted for.

Notes on Road and Street Work.

Effect of Moisture on the Wear of Macadam Roads.—At Valley Forge Park, near Philadelphia, there is no water supply for sprinkling purposes, and as a result the five miles of telford and macadam roads in the park are dependent upon precipitation for moisture. The rate of speed in the park for motor cars is ten miles per hour. In the woods where the roads never become entirely dry the effect of the motor traffic is not serious except at sharp turns, but out in the open, where there are stretches of road that are entirely without shade from sunrise to sunset, the motor cars even at that low speed are doing a great deal of damage.

Telford-Concrete Road.—The Pennsylvania State Highway Commission has put in several sections of concrete roads in locations where the road bed was liable to be subjected to washing by floods or high water. In one case a cloud burst tore off a section of the road leaving the telford exposed, and to meet such

a condition should it occur again, a concrete surfacing was applied. The concrete was made in a 1-3-5 mixture and was applied on top of the telford to a depth of 4 ins. It was then rolled and tamped until the slush came on top; ¼-in. to ¾-in. rock screenings free from dust were applied on top, and tamped until about half the stone was embedded in the slush. After this the surface was covered with screenings containing about 5 per cent of dust. On one portion of the road there was expansion joints; while on the other portion there was none. Mr. J. W. Hunter, State Highway Commissioner, states that the section without expansion joints is today the better section of the two.

Repairing and Resurfacing Tar Treated Roads.—The Metropolitan Park Board of Massachusetts has done much work in repairing and resurfacing roads that had previously been treated with tar preparations. Some of the roads in the Metropolitan Park District of Boston, particularly the Revere Beach Drive, have been re-treated three times, and the last surface has proved very satisfactory. Successful work seems to depend on preventing an excess of the tar compound collecting in the worn spots and depressions in the surface. The method used by the Metropolitan Park Board is to fill the holes or depressions with ¾-in. stone before applying tar compounds. This size stone will fill holes as shallow as ½ in. very nicely. After the road has been swept thoroughly, a sufficient quantity of ¾-in. stone is put in each little depression, care being taken that an excess of stone is not used. Considerable care is required to prevent this, as there is always a tendency with an untrained man to put in too much.

Tar-Construction for Residential Streets, Having Light Traffic.—The following method of Construction was adopted last summer at Cheltonham, England, for several miles of road carrying a light but continuous traffic in main residential thoroughfares. The road was scarified and a coat of new broken stone spread in the usual manner. This was steam-rolled with the application of a little water to bring up the binding material from the old road below in order partially to bind the new macadam. When the metal presented a clean and even surface and before the binding material from below reached the top, a thin layer of ¼-in. tarred chippings was spread over and swept into the interstices, and the road was again steam-rolled until thoroughly consolidated. A layer of tarred shippings, ¾-in. to ¼-in. gage, about ¾-in. thickness, was then spread and rolled to a finished surface. This was afterwards tar-painted with a view to making the road practically waterproof. The cost over and above the ordinary water-bound macadam road was at 19 cts. per square yard. Most of the roads made in this manner have been tolerably clean during the winter months and they are practically dustless. In one or two cases this method of construction proved unsatisfactory, but the work as a whole proved satisfactory during the trying winter months. The above note has been taken from an article by Mr. J. S. Pickering, Borough Surveyor, in a recent issue of The Surveyor.

Repairing a Road Curve With Large Size Stone.—In a recent discussion of a paper before the Western Society of Engineers Mr. W. H. Dean gave the following description of a method used by the Board of Local Improvements of Chicago in repairing a worn macadam surface. The work was done on Evanston Ave., at Devon Ave., Chicago, about a quarter of a mile west from the lake. The street has a limestone macadam surface. Automobiles come down from the north, from Evanston, at a high rate of speed, and at Devon Ave. turn a sharp corner. There are street car tracks on a curve on the southwest side of the street, leaving only a narrow roadway in which to turn, and the road is subject to hard usage. The limestone macadam surface was worn through very considerably about the curve, into a deep hole, and a great amount of dust was raised. To repair this, a large size of crushed granite, 3 or 4-in. size, was put in, bonded with gravel and loam. It was put in at a difficult time of year in this respect, in that it was freezing weather. It has been down about two years and has worn splendidly. There is scarcely any dust there and almost no sign of wear. It is a little bit rough, but otherwise it has made a splendid corner. On the rest of the road, except where it has been resurfaced, the limestone has been worn very considerably.

Road Work in Connecticut in 1909.—During 1909 a total of 82.9 miles of gravel and macadam state roads were completed. Of this total 29.19 miles were gravel roads, the average width paved being 14 to 16 ft. and the average thickness of the completed pavement being 8 in. The average cost per mile for the gravel roads was $5,591.42. A total of 53.71 miles of macadam and telford macadam roads, 14 to 16 ft. average width, were completed in 1909. The average thickness of the completed pavement was 7 in. and the average cost per mile was $9,625.44. In addition there was 16.31 miles of grading completed in 1909. The average width was 14 to 16 ft., and there was 6 in. hardening, the average cost per mile being $5,681.28. Mr. James H. MacDonald is State Highway Commissioner. The above costs include all grading, culvert and bridge work, etc. The state road work unfinished and under contract at the beginning of the year was as follows:

	Miles.	Cost.
Macadam	62.55	$594,448
Gravel	32.16	238,395
Grading	20.04	110,675

The work projected for this year is as follows:

	Miles.	Estimated cost.
Gravel	50	$275,000
Macadam and telford macadam	100	950,000
Grading	50	275,000

Comparative Bidding Prices on Plain and Bituminous Macadam.—The following comparative bidding prices on plain and bituminous macadam are taken from the recently issued report of the Commissioner of Public Roads of New Jersey:

Road.	Depth macadam, ins.	Ordinary macadam. Per sq. yd.	Bituminous macadam. Per sq. yd.
			Mixing method.
Walnut Ave., Union Co.	8	$0.75	$1.10
Gladstone, Morris Co.	.	.62	.95
Brownes Corner, Camden Co.	.	.90	1.17
			Penetration method.
Beattystown, Warren Co.	.	.56	$0.62
Plainsboro, Middlesex Co.	6	.73	.90
Jamesburg, Middlesex Co.	8	.73	.85

It will be noted that the average additional cost of this type of construction is 31⅓ cts. per square yard, or $2,570 per mile, for a 14-ft. road when the material is mechanically mixed before application to the road, and 12½ cts. per square yard, or $1,000 per mile, for a 14-ft. road when the bituminous material is applied by the pentration method. It is estimated that these roads will cost little or nothing for repair and maintenance during their first two years, and after that period the cost of maintenance will not exceed $250 per mile, while the average yearly cost for the proper maintenance of a macadam road is $400 per mile.

Berm Ditches for Surface Drainage.—In many places along a road berm ditches are of very great assistance in maintaining the highway. This is an open ditch, usually at the top of the bank, alongside the road, the object being to intercept surface water coming from territory beyond the ditch, and preventing it from soaking into or washing down the face of the bank. The sliding of banks, especially those of a clayey nature, is a frequent source of trouble, and in many instances a very expensive one. This sliding is in nearly all cases caused by the material of which the bank is composed becoming saturated with water from the lands lying back of it, and by cutting off this surface water by means of a berm ditch before it reaches the bank, troubles of this kind are in many instances entirely obviated. Instances are rare where it will be found necessary to dig a berm ditch deeper than 3 ft., and in very many cases 2 ft. is sufficient. When the underlying soil is hard-pan, hard clay, or any other impervious material, the ditch must be cut down to, and a little way into, the hard material in order to effectually prevent water passing to the face of the bank. The above note has been taken from a recently issued bulletin of the Bureau of Town Highways of the New York State Department of Highways.

Laying Macadam on a Soft Foundation.—In the construction of a macadam road on clay subsoil small material is sometimes placed at the bottom. This was done in the case of macadam road built in Chicago; the method employed was described by Mr. A. C. Schroder in a recent discussion of a paper before the Western Society of Engineers. The foundation of the street to be improved being entirely of clay, a portion of the roadway was covered with stone, ranging in size from 2 to 2½-in. in the largest dimension—the intention being to finish the macadam roadway in the manner customarily followed in Chicago. The frequent rainfalls during the progress of the work caused the clay foundation to become quite soft, so that the rolling of the surface with the steam roller proved entirely unsatisfactory, as it simply churned up the materials to such an extent that the roadway could not be brought to a surface sufficiently unyielding to receive the finishing material of granite macadam. To obviate the difficulty and to allow the work to be completed without delay, the experiment was made of using a layer of cinders 4 to 6 ins. in depth, spread over the clay, and forming a subgrade. Upon this the crushed stone was spread and rolled in the usual manner, and it was possible to finish the work satisfactorily and without delay. The cinders apparently acted as a mattress, directly overlaying the clay and preventing the churning up of the clay and stones. In the same discussion Mr. L. W. Page described an experience of the Massachusetts Highway Commission with quicksand. About 14 or 15 years ago, when the commission was building a road on the Island of Martha's Vineyard, they struck quicksand, and dumped load after load of rock into it which disappeared. Finally, one of the commissioners suggested that unbleached cotton be spread over the quicksand and the stone put on top of it. Accordingly several bolts of unbleached cotton were spread over the quicksand, and the division lines covered with another layer, after which a load of stone was dumped on it. It settled down about 0.75 to 1 in. and stopped. More stone was dumped and it was rolled by a steam roller. The road has been in use for 15 years and no settlement has occurred.

Sand-Clay Road Construction in Kansas and Some Data on Its Cost.*

In the construction of a sand-clay road it is a difficult problem to select a proper clay for the binding material; laboratory tests will assist in determining what to expect from different clays, but it is much better to check your laboratory test by building only a few miles of road at a time until you have a chance to see the practical test demonstrate the worth of the clay. The properties of clay, which are of the greatest importance in road construction, are plasticity and the property of slaking when they first become wet after having been uncovered. The most plastic of these materials are technically called "ball clays." A lump of such clay immersed in water will usually preserve its form a long time.

*Abstract of a paper by W. S. Gearhart, State Highway Engineer of Kansas, read at the 1910 meeting of the Missouri Highway Engineers' Association.

Non-slaking clays, although they are very sticky when wet, generally readily mix with water. There are other clays, however, which will immediately fall to pieces when immersed as a lump of quicklime will do. This is due to the rapid absorption of water in the porous structure of the clay. These are known as slaking clay and are more easily mixed with other materials than the more plastic ball clays and this is of course to their advantage for road building but, on the other hand, they often have inferior binding powers.

There is still another physical characteristic of clay of great importance in the construction of roads. Many clays shrink when dry. This shrinkage is the measure of their expansion and expansion renders the sand-clay mixture unstable. When water removed by evaporation is restored to the sand-clay mixture, its entrance is accompanied by a simultaneous expansion which separates the grains of sand. This property is inherent in the clay and cannot be overcome, but by using less clay its destructive action can be modified in a measure. The best kind of clay for this construction is one which slakes sufficiently easily to enable the lumps to be readily broken up and which, at the same time without being too plastic, has sufficient binding power to cement the grains of sand and form a smooth impervious road surface.

The available materials should also be tested in order to secure a clay having the least possible shrinkage. The best method is to examine the roads in which this material is found. The best wearing surface of the sand-clay road is obtained when the voids in the sand are entirely filled with a good binding clay. Any excess of clay above the amount required to fill the voids in the sand is a detriment.

In constructing a sand-clay road on a sandy subsoil, adequate permanent drainage should be provided and the road well crowned. Shoulders should be thrown up to confine the clay as it is deposited. The work should begin at the end of the road nearest the supply of clay and the clay deposited in layers from 6 to 12 ins. deep and from 10 to 18 ft. wide, depending upon the volume and kind of traffic to be carried. The large lumps should be broken up while dry and the whole surface smoothed up and 2 to 4 ins. of sand placed on top. The sand and the clay should then be thoroughly mixed and puddled with water by plowing and harrowing with a disk harrow. If the water is not available it is well to wait until after a prolonged rain to do the mixing and puddling. Dry mixing has generally been unsuccessful.

If sufficient funds are not available to do the mixing and puddling by machinery it may be left for the traffic to do it. If this method is followed a muddy road will result for some time, however, and it will require probably two years to get the road in good condition. When the clay balls, add more sand and if the surface loosens during the dry weather add more clay, or better use a clay with good binding power.

A first-class sand-clay road on a clay subsoil can be constructed in the following manner: After the road has been graded and properly crowned and ample drainage provided, 4 ins. of the surface for the width to be treated should be pulverized by plowing and disking and then a layer of sand 6 to 8 ins. deep placed upon it and the sand and clay thoroughly mixed comparatively dry by plowing and harrowing. After a prolonged rain puddle the road with a harrow and shape it up well while wet, stop the traffic if necessary until the surface has become dry, but the road should be thrown open to use as soon as practicable. No sand-clay road is in proper condition when first constructed and it will require careful attention for two years. It should be dragged after every rain.

The sand-clay road is more resilient than an ordinary macadam road and generally costs less to construct and maintain than any other except an earth road.

So far as I have been able to learn, the first sand-gypsum road in Kansas was constructed in 1892 near Kinsley in Edwards County by John DeMain. In this county gypsum is found in large quantities in the flats and sand hill beds. Its composition is about 1 part of gypsum to from 3 to 5 parts sand. In appearance it resembles a sand lime mortar of the same proportions. In some of the beds large deposits of gravel are found with the gypsum which add very much to its road making value.

In 1892 five miles of sand-clay road were constructed; in 1898, five miles; in 1902, five miles, and since that time ten miles more have been completed, making a total of 25 miles. These roads were all built 16 ft. wide. The gypsum was placed 8 ins. deep in the middle and about 6 ins. at the sides. The average haul of the gypsum was ½ mile. Three dollars per eight-hour day was paid for teams. The traffic was left to do the mixing and the cost has been $350 per mile, or 3.72 cts. per square yard, and the cost of maintenance with a King drag is $10 per mile per year. For the original construction there was no doubt a large amount of labor donated which is not reported. Before the roads were treated 50 bus. of wheat was the maximum load for four horses. Now 100 bus. can be hauled with ease. I was recently over these roads in an automobile and in a good many places the cyclometer registered 40 miles per hour.

In 1905 and 1906 4½ miles of sand-gypsum road was constructed south of Syracuse in Hamilton County. This road is 16 ft. wide and the gypsum was placed 8 ins. deep. Three dollars and fifty cents per day was paid for teams and the average haul was three miles. The traffic did the mixing of the sand and gypsum and the cost was $500 per mile, or 5.3 cts. per square yard, and the cost of maintenance with the King drag is $5.50 per mile per year. On account of the long haul and the low cost, I believe there must have been considerable labor donated, but none is reported. In dry weather the surface grinds up some and blows away. From my observations of the sand-gypsum roads I believe that this trouble can be overcome by treating the surface with a good grade of road oil.

Immediately after a rain the road is a little slippery and this can practically be eliminated by placing a little sand on the surface. A 1,000 lb. was a big load over this sand road before it was improved, but now 3,000 lbs. is a very ordinary load.

During the summer of 1906 Prof. Albert Dickens, of the Kansas State Agricultural College, oiled one mile of very bad sand road in Finney County, south of Garden City. The amount of oil required varied from 3.7 to 6.06 gals. per square yard. This road has proven very satisfactory, even though it has been sadly neglected.

In 1909 five miles of sand-gypsum road was constructed two miles on the north end and three miles on the south end of the oiled road. On the north end a very heavy clay was used which contained about 20 per cent of gypsum and 15 per cent of gravel, and it has made a very fine road. The south end of the road was constructed with what is called gypsum, but it is really a silt very much like the Arkansas river sediment. It lacks binder and is mushy when wet and blows away when dry.

TABLE I IS A SUMMARY OF THE COST OF THE ROAD FOR THE DIFFERENT MILES.

TABLE I.

	Width, feet	Depth of gypsum, inches	Average haul, miles	Cost per sq. yd., cents.	Cost per mile
1st mile	12	8	1¼	7.92	$ 510
2nd mile	8	10	1¼	18.72	880
3rd mile oiled	18			11-19	*1,480
4th mile	8	10	2½	37.45	1,760
5th mile	8	10		18.72	880
6th mile	8	10		15.00	704

*Average.

The road was left for the traffic to mix the materials and $50 per mile has been spent in dragging, shaping up and repairing the weak spots. The road is dragged after every rain and high wind. A 6,000 lb. load on a wagon with 2-in. tires is often seen on this road. It used to be a three-hours drive over these six miles with two horses in a buggy.

At Ashland in Clark County along the Cimarron River there was four miles of sand road which was one of the worst stretches of road in the state. This sand was so fine and there was so much of it that in a dry time it was a heavy drag for a team with an empty wagon and to get through it at all with a load necessitated not less than four hours, and the journey had to be made by very slow stages and the horses rested every few hundred yards. A toll road company was incorporated a number of years ago with a capital of $5,000 to construct a sand-clay road through these sand hills. A good quality of clay was found at distances ranging from a 100 yds. to a mile from the work. The road was well crowned and from 8 to 10 ins. of clay placed upon it and well dragged down. The weather was very dry during the construction and for some time trouble was experienced with chuck holes cutting through the clay, but after the first good rain no further trouble was experienced.

The road is maintained by collecting tolls of 5 cts. per mile for automobiles, 2¾ cts. per mile for wagons, 2 cts. per mile for light vehicles and 2 cts. per mile for cattle per head. A man and team is constantly employed to drag and refill the worn places and collect the tolls. After every rain the road is dragged with a King drag one or more times, which keeps the surface smooth and the road well crowned.

The work of preparing the road bed, hauling and distributing the clay and putting the road in good condition costs from $800 to $1,000 per mile. A great deal more than this per mile has been spent for bridges, toll house, tools and other accessories, but the traffic is heavy and the tolls collected not only pay the expenses of upkeep and maintenance, but will ultimately reimburse the company for the outlay in first cost.

Tests of Hollow Concrete Blocks.—The Maryland Geological Survey has conducted a series of tests for the National Hydraulic Stone Co., of Baltimore, on hollow concrete blocks made in proportions of 1 part cement to 8 parts of aggregate, the latter consisting of unscreened sand and crushed stone. The blocks were made in the factory of the above company on a Fisher hydraulic stone press, manufactured by the Fisher Hydraulic Stone & Machinery Co. This press rams the blocks under a pressure of 200 tons. The tests were made in one of the laboratories of Johns Hopkins University and in general followed the tests prescribed in the standard regulations for hollow concrete blocks of the National Association of Cement Users.

Absorption tests were made on two samples of faced and two of rough blocks. These were immersed, face down, in ½ in. of water, and weighed after being immersed 30 minutes, 4 hours and 48 hours. The absorption is expressed as per cent of weight of water to the weight of the dry block. The specimens each weighed about 3,000 grams when dry. The absorption was as follows:

Immersion	30 min.	4 hours.	48 hours
1. Faced block	1.3	2.6	3.9
2. Faced block	2.4	3.3	4.2
3. Rough block	0.3	1.1	1.8
4. Rough block	0.3	0.9	1.4

Transverse tests were likewise made upon four specimens. The dimensions of the specimens, the maximum load carried, and the

TRANSVERSE TESTS.

Specimen	b	d	l	W	R
1	9	3	6	4,780	531
2	9	3	6	6,041	671
3.	9	3⅛	6	7,440	762
4.	9¼	3¼	6	5,650	917

modulus of rupture are given in the accompanying table. The modulus of rupture was figured from the formula $R = 3Wl \div 2bd^2$, in which l is the distance between supporting knife edges in inches, W the maximum load in pounds, b the width, d the depth, and R the modulus of rupture. All dimensions are given in inches.

Water-works and Sewer Section

Note: This section is devoted to methods and costs of constructing sewers and water-works. It will cover the construction work for all details of water supply and sewerage, including sewage purification and water filtration.

Day Labor Vs. Contract Work on the Los Angeles Aqueduct.*

Editor *Pacific Outlook*.

Dear Sir:—In your issue of December 11, 1909, you publish a copy of an article which appeared in ENGINEERING-CONTRACTING reviewing a report by Metcalf and Eddy, consulting engineers of Boston—this report having been made to the Boston Finance Commission on the relative economy of doing public work by contract or by municipal day labor, called "force account." The finding is that force account work is the more expensive method in certain New England cities.

The entire tenor of the article is to the effect that all public work should be done by contract. The report by Metcalf and Eddy has been extensively reviewed by engineering publications. The firm of Metcalf and Eddy are engineers in good standing, but it should be remembered that ENGINEERING-CONTRACTING is a paper that is devoted to the interests of the contractors of the United States.

Much municipal work has been done in the past without adequate supervision and economic management, men of low efficiency often gradually accumulating in a permanent organization. When public work is performed politically, there is no limit to the extravagant costs that may result, just as there would be under contract work resulting from collusion, and a discussion thereof is superfluous. The question, therefore, resolves itself into one of whether municipal work can be organized on business principles. There is no reason why a municipality with large financial resources, capable of buying adequate equipment and paying reasonable salaries, should not obtain as high grade machinery and superintendents as any contractor. Manufacturers take pride in selling their equipment to a municipality or to the federal government, and advertise such sales extensively. Most young men, and particularly ambitious young engineers seeking experience and reputation, desire connection with large public organizations in an official capacity, provided the job is clean, and they are usually willing to work at less wages than they would for an individual.

Let no one think that the engineering direction of public work under contract is a flowery bed of ease. It requires as much detailed supervision and vigilance as if the work were carried on by an organization reporting directly to the engineer. Often when contractors encounter great difficulties and unexpected expenses, the municipality and the engineer are left to finish the work. This was illustrated in the case of the Outfall Sewer in Los Angeles and at the Laguna Dam which was started for the Reclamation Service by one of the largest contracting firms in the United States. Conversely, if the work proves unexpectedly easy, the municipality would not share in the resulting good fortune. It is often a case of "heads I win and tails you lose."

There is more temptation for a contractor, no matter how honorable he may be, to skimp his work for which he is paid a fixed sum, than for a municipality to slight its own work under the force account system. Pieces of work on which the costs are very uncertain, such as tunnel driving and foundation work, are those best suited to the force account system, because a good contractor must assume all unfavorable conditions as occurring, and bid accordingly.

When public work is let by contract, it must be as the result of advertising and the law usually compels the award to the lowest bidder or to the lowest responsible bidder. In our own street work, it must be the lowest bidder or all bids must be rejected. The lowest bidder may be a bidder with bad judgment as to probable costs, and while his bid may be protected by bond, the bond is of little practical value. I have never known of collection on a contractor's bond.

The greatest advantage that the contractor enjoys is that he can purchase materials and employ men quickly, whereas municipal officers are seriously incumbered with formalities, designed to prevent fraud, but which are an expensive handicap to an honest administration.

The Los Angeles Aqueduct is in charge of a non-partisan and most efficient board of public works. About 95 per cent of the work is being done by force account. There is not a political appointee in the entire organization. The engineers are energetic young men, ambitious to make reputations and are promoted on merit. The bonus system is applied where possible, and the results so far obtained have been most satisfactory.

The Jawbone Division is 22 miles in length and is the heaviest on te Aqueduct. Consequently, it was one of the first to be opened for construction. In order to determine whether this work should be done by contract or by force account, bids were called for; these were compared with the engineers' estimates and finally all bids were rejected and the engineering department ordered to construct the work by force account. Mr. A. C. Hansen was placed in charge as division engineer.

The Jawbone Division is now 80 per cent completed. It is possible, therefore, to make a comparison between the cost of the work done by the municipality and the prices bid by the contractors. It will be appreciated, however, by any person who has had experience in construction work that the unknown elements of the cost for "extra work" done by the contractor are most important ones, which do not appear in a bid but which are covered by the force account cost figures which are here presented.

These "cost figures" are reliable; each piece of work is made the subject of detailed study. All charges for general expense, equipment, housing, sanitation, administration, etc., are included. The analysis was made by Mr. O. E. Clemens, in charge of the cost-keeping department of the Aqueduct.

Of the 217 miles of Aqueduct, including three hydro-electric plants and one cement plant, all work is being done by force account with the exception of 11 miles of valley work.

One feature of this work which has been effective in securing good results is the issuing of monthly cost and progress bulletins covering every structure. These show unit costs of similar work at different places, giving credit to those in immediate charge and advertising their results, whether good or bad, throughout the entire organization each month.

COST ANALYSIS.

Five bids were received July 27, 1908, for the construction of the Jawbone Division, as provided in Specification No. 33. These bids, with the exception of the lowest, were submitted by large and experienced contracting firms from various parts of the United States. The unit prices of the low bidder are shown under the tables of costs.

As stated elsewhere, the estimated quantities shown on the original specifications have been somewhat modified to meet conditions developed during construction, the tunnel footage having been materially increased and conduit footage decreased. The comparisons of costs have been based on the quantities as now established. The estimated cost of engineering, in case the work has been let by contract, has been added to the contractor's bid. This expense under the force account system has also been included in the costs shown.

The following plant, according to Specification No. 33, was to be installed or built by the city for the free use of the contractor. The cost of this has been eliminated from this analysis:

Compressor plants.
Main water pipe lines.
Roads and trails.
Power lines and transformer stations.
Main telephone lines.

The charges for electric energy which would have been made to the contractor have been included in force account costs. The comparison of costs is made on tunnel and conduit work, the cost of culverts being disregarded, as they represent a very small percentage, and have averaged less than the bid.

Total Quantities in Lin. Ft.:

	Tunnel.	Conduit.	Total.
Section 1	19,636	23,809	43,445
Section 2	21,332	5,326	26,658
Section 3	22,830	10,088	32,918
Total	63,798	39,223	103,021

Contractor's Bid.

Completed and Lined Tunnels.

	Feet.	Rate per ft.	Total.
Section 1	19,636	$22.50	$ 441,800.00
Section 2	21,332	36.70	782,884.40
Section 3	22,830	33.30	760,239.00
Total	63,798	Av. $31.11	$1,984,923.40

Conduit Excavation:

	Ft.	Av. yardage.	Price cu. yd.	Total.
Section 1	23,809	5.9	$1.066	$149,744.32
Section 2	5,326	5.2	1.625	45,004.70
Section 3	10,088	5.0	1.175	59,267.00
Total	39,223	Av.	$6.48	$254,016.02

Conduit Lining and Cover:

	Feet.	Rate per lin. ft.	Total.
Section 1	23,809	$6.721	$160,020.29
Section 2	5,326	7.00	37,282.00
Section 3	10,088	6.876	69,363.09
Total	39,223	Av. $6.80	$266,665.38

Under the specifications, cement, tunnel timbers and reinforcing steel were to be furnished to the contractor free, at the nearest railroad station. This represents a cost to the city as follows:

Cement, per lin. ft. of tunnel and conduit	$2.70
Tunnel timbers, per lin. ft. of tunnel	.62
Steel, per lin. ft. of conduit	.27

In case the work had been let by contract, it would have been necessary to maintain an engineering staff with clerks and inspectors, at the expense of the city, for the period of 2½ years involved in the contract. This cost would have been $3,715 per month, equal to a total of $111,450, or an average cost per foot of aqueduct of $1.08. The total cost of engineering and supervision, under the force account system adopted, is included in the unit costs given.

ESTIMATED COST OF WORK TO CITY OF LOS ANGELES, IF DONE BY CONTRACT.

Tunnels:	
Bid per foot completed	$31.11
Timbers per foot	.62
Cement per foot	2.70
Engineering and inspection	1.08
Total per foot	$35.51
Conduit:	
Bid—Excavation per foot	$ 6.48
Lining per foot	6.80
Cement per foot	2.70
Steel per foot	.27
Engineering and inspection	1.08
Total per foot	$17.33

Above costs do not allow anything for depreciation on instruments and equipment used by the city on this work.

ACTUAL COST BY FORCE ACCOUNT.

The total amount of work to be done, and footage completed to Jan. 1, 1910, is as follows:

	Total footage.	Amount done.	Pct. done.
Tunnel excavation	63,798	61,515	96½
Tunnel lining	63,798	33,805	53
Conduit excavation	39,223	33,868	86
Conduit lining	39,223	16,100	41

Detail of Tunnels:

Class of Work:	Total expended.	Amount built. Ft.	Unit cost.
Excav. and timbering	$780,360.00	61,515	$12.76
Lining	229,727.00	33,805	6.80
Total per foot of completed tunnel			$19.50

*Reprinted from a communication from J. B. Lippincott, Assistant Chief Engineer Los Angeles Aqueduct, to the "Pacific Outlook" of April 2, 1910.

Detail of Conduit:

Class of Work:	Total expended.	Amount built. Ft.	Unit cost.
Excavation	$121,521.50	33,868	$ 3.60
Lining	117,561.50	16,100	7.30

Total per foot of completed conduit.....$10.90

Equipment, Pipe Lines, Etc., for the Entire Footage:

Miscellaneous equipment, exclusive of compressor plants, main pipe lines, main telephone lines and roads	$150,000.00
Branch pipe lines total cost	20,000.00
Local telephone system, total cost	4,000.00
Buildings, including wiring for lights	53,000.00
Total	$227,000.00

Assuming no salvage on this plant, we have $227,000 divided by 103,021 equals $2.20, average cost per foot for entire division.

MAINTENANCE AND OPERATION TO JAN. 1.

The general maintenance and operation charges on water supply, roads, telephones and division administration amounts to 3½ per cent of total construction charges, or 68 cts. per ft. for tunnels and 38 cts. per ft. for conduit. The charges for the field engineering and supervision are included in the construction costs given.

TOTAL COSTS BY FORCE ACCOUNT.

Tunnels:	
Excavation	$12.70
Lining	6.80
Maintenance and operation	.68
Equipment	2.20
Total	$22.38
Conduit:	
Excavation	$ 3.60
Lining	7.30
Maintenance and operation	.38
Equipment	2.20
Total	$13.48

COMPARISON.

Tunnels:	
Cost by contract	$35.51
City costs	22.38
Saving per foot	$13.13
Conduit:	
Cost by contract	$17.33
Saving per foot	$ 3.85
City costs	13.48
63,798 feet x $13.13	$837,667.00
39,223 feet x 3 85	151,008.00
Estimated total saving on Jawbone Division	$988,675.00

This estimated saving is conservative, as the work to be completed will cost less per unit than that done previously, owing to the nature of the ground and the improvement in the organization. Salvage values of plant, also extra work which we have done and charged to construction (which would have been billed as "extra work" by any contractor) would have a tendency to increase this estimate.

One of the most advantageous features of force account work is the opportunity that it affords to make changes in the location of the line or in the design of the various structures, things which are very difficult to do when a municipality is bound by rigid contract. The economic studies that are made as the work progresses constantly offer suggestions for a change in route or changes in the detail location. The character of the materials which are encountered frequently demands a complete change in the design of a structure to be built. It is thus possible, under force account with good cost-keeping, to obtain the most economical results and the most stable work.

This change in construction is vividly illustrated by the fact that the first location of our line called for 28 miles of tunnels, whereas the line as it is now being built will contain 43 miles of tunnels.

Very truly yours,

J. B. Lippincott.

Method of Lining An Irrigation Canal With Cement Plaster, With a Discussion on Cement Plaster Versus Lime and Cement Plaster.

BY W. D'FOHAN.*

The Intake of Community Ditch, a canal of 650 sec. ft. capacity, is situated at Eldorado Springs, a favorite summer resort 29 miles from Denver, Colo. The ditch, some 45 miles long, is part of the Standley Lake System. It irrigates the lands lying directly north of Denver, and also acts as a feeder for Marshall, West and McKay Lakes, and other reservoirs of the Standley project.

From the headgates to the tunnel, a distance of 2,640 ft., and directly above the summer residences of Eldorado Springs, the ditch was lined with masonry, 6 ft. bottom, with sides sloping on an average of ½ to 1, to a height of 9 ft. The masonry work which was completed in March, 1909, was so carelessly done and without proper supervision that in September the ditch was practically useless. An examination of the work showed that the foundations for the masonry had not been prepared in any way whatsoever, the wall for the most part being laid on filled dirt without tamping. A 4-in. tile drain supposed to carry off all the seepage water from the various springs with which the ground abounds was laid as a switch back, while the masonry proper was pointed with mortar—in spots.

The results were, the wall settled, showing unsightly cracks, the seepage and spring water found its own way out underneath the floor which broke down, and the escaping water took the greater part of the pointing from between the stones. A spasmodic attempt was made to repair the worst places by using a lining of reinforced concrete 3 ins. thick, but as the shale excavated from the tunnel was used and it disintegrated on the application of water, the cure was as bad as the disease.

The reconstruction was begun in the latter part of September, 1909. Mr. J. G. Wood, Assistant Chief Hydraulic Engineer in charge, with Mr. W. D'Rohan, Superintendent of Construction. For the repairs, four plans were suggested and discussed: (1) A 3-in. reinforced concrete lining; (2) cleaning and repointing masonry; (3) plastering with lath reinforcement, and (4) plastering with cement plaster.

Owing to the very poor foundation it was deemed inadvisable to put any additional weight on it, thus disposing of the reinforced concrete lining. The masonry work was in such bad shape that repointing was out of the question, and finally since the plaster was to be subject only to slight compression, it was decided to use plain cement plaster.

The announcement of this decision was the cause of a lively discussion among the members of the engineering staff of the Denver Reservoir Irrigation Company, and many outside engineers were drawn into the argument. The main bone of contention was the advisability of substituting lime for part of the cement, but in the end the cement advocates prevailed, and cement plaster without the addition of lime was used.

The supporters of the lime theory advanced the argument that lime added to the plaster made a denser mixture, practically waterproof, was easier worked, more uniform in color and possessed greater adhesive strength and was much cheaper. In addition to the acknowledged universal practice, extensive quotations were made from reports of recent constructions where lime was added not alone to plaster but to concrete, with an idea of increasing the ultimate strength and making it waterproof. Among other authorities quoted was H. A. Reid, "Concrete and Reinforced Concrete Construction," p. 857. Dealing with concrete blocks, the author says:

Lime.—Lime is sometimes used to replace a portion of the cement. The most convenient form of lime for use in block-making is the dry-slaked or hydrate lime, now a common commercial article. No great saving results from its use, but its addition in the proportion of from one-quarter to one-half the cement used will cause the blocks to set more rapidly, make them lighter in color, and make the concrete denser and more impervious to moisture. In sand mixtures with the proportion of 1 to 4 or 1 to 5, at least one-third of the cement may be replaced with slaked lime without loss of strength.

The argument against the use of lime was substantially as follows: There are no hydraulic limes manufactured in the United States (Reid, pp. 7 and 8), while the commercial lime of the United States is "quicklime," which is chiefly calcium oxide (CaO), about which Trautwine says (p. 925, 1908):

General Remarks on Mortar and Lime.—On too great a proportion of public works, the common lime mortar may be seen to be rotten and useless, where it has been exposed to moisture; which will be carried by the capillary action of earth to several feet above the natural surface; or as far below the artificial surface of embankments deposited behind abutments, retaining-walls, etc. The same will frequently be seen in the soffits of arches under embankments. Common lime mortar, thus exposed to constant moisture, will never harden properly. Even when very old and hard, it absorbs water freely. Cement also does so, but hardens.

Most writers on cement testing, after relating numerous troubles from free lime in cement in the way of dangerous cracks, advise as follows:

Novices should make at least a score of boiling tests before they should consider themselves competent to pass upon a sample of cement. It is also recommended that they secure some quick lime, powder it very finely and mix it in varying proportions with a sample of cement of tested high grade. These mixtures will develop some of the troubles described above and will give the beginner experience in recognizing cement of actual poor quality.—Dragon Cement, p. 73.

In composition, hydraulic lime is practically the same as cement, and the best known American hydraulic lime is "Rosendale Hydraulic Cement."

Against the assertion that the addition of lime made a denser mixture, the specific gravity of hydraulic lime lies between 2.5 and 2.8, while that of Portland cement varies from 3.00 to 3.25 (Candlot's, "Ciments et Chaux Hydrauliques," p. 26, 1898), and since both are pulverized to the same degree of fineness, it is clear that any additional density can be more easily obtained by the addition of more cement than lime; while for waterproofing it is generally admitted that a rich and wet mixture properly proportioned gives a water-tight result.

A reinforced concrete water tank, 10 ft. inside diameter and 43 ft. high, designed and constructed by W. B. Fuller at Little Falls, N. J., has some remarkable features. It is 15 in. thick at the bottom and 10 in. thick at the top. The tank was built in 8 hours, and it is a perfect monolith, all concrete being dropped from the top, or 43 ft. at the beginning of the work. The concrete was mixed very wet, the mixture being 1 part cement, 3 parts sand, and 7 parts broken stone. No plastering or waterproofing of any kind was used, but the tank was found to be absolutely water-tight, although the mixture used has not generally been found or considered water-tight.—Gibson & Webb, p. 41.

The assertion of greater adhesive strength is thoroughly upset by the following table taken from Hodgson, "Cement Plaster":

ADHESIVE STRENGTHS OF LIME AND CEMENTS.

		Lbs. per sq. in.
Fat lime and sand	1 to 3	4¼
Common lias lime and sand	1 to 3	9
Common lias lime and sand	1 to 4	6¾
Portland cement and sand	1 to 4	23
Portland cement and sand	1 to 6	15½

This table shows the force required to tear apart bricks bedded in mortar made with the usual proportions of sand at the end of 28 days. The following table by Redgrave needs no comment:

COMPARATIVE STRENGTH OF GREY LIME AND PORTLAND CEMENT MORTAR, ALSO PORTLAND CEMENT MORTAR WITH THE ADDITION OF LIME AND MORTAR.

		Proportions.					
No.	No. of tests.	Sand.	Cement.	Lime.	Water.	Breaking strain on 2.25 sq. in. in lbs.	Breaking weight per sq. in. in lbs.
1	17	2.00	...	1.00	1.33	61.06	27.13
2	27	2.00	...	1.00	1.33	106.07	47.09
3	27	2.00	...	1.00	1.33	82.00	36.44
1	15	6.00	1.00	...	1.25	233.53	103.79

*634 22d St., Denver, Colo.

2	20	8.00	1.00	...	1.66	154.80	68.80
3	35	10.00	1.00	...	2.00	112.88	50.16
1	70	6.00	1.00	0.50	1.50	165.31	73.47
2	74	8.00	1.00	0.66	2.00	132.62	58.94
3	85	10.00	1.00	0.83	2.50	95.27	42.34
			Loam				
1	21	6.00	1.00	0.50	1.00	136.80	60.80
2	25	8.00	1.00	0.66	1.33	86.48	38.43
3	19	10.00	1.00	0.83	2.00	64.50	28.66

The question of cheapness is easily disposed of by consulting the market quotations. ENGINEERING-CONTRACTING of April 6, 1910, quotes cement f. o. b. Chicago, $1.05 per bbl. and lime in job lots under 500 bbls. f. o. b. New York, $1.00 to $1.85 per bbl.

A most interesting article in ENGINEERING-CONTRACTING Dec. 30, 1908, on Methods and Cost of Lining Ditches and Canals, after mentioning several instances of successful lining with cement plaster from ¼ in. to 1 in. in thickness, in California, makes special mention of the Gage Canal, which was lined with cement mortar, 1 to 4, ¾ in. thick at a cost of 3¾ to 4 cts. per sq. ft.

Mr. Irving, former Engineer of the Gage Canal Co., states in his report that after a test of ten years the lining more than justified their expectations. The cost of repairs after four years' use was very small, less than ½ of 1 per cent of the capital cost in four years.

The conditions for lining Community Ditch were more than favorable. Good sharp, clean sand was found just across the creek, and was brought into the ditch in ½ cu. yd. cars, at a cost of 25 cts. per cu. yd., and was used without screening. Cement which cost $1.36 per bbl. was brought by rail to within 500 yds. of the ditch, and the piped water supply for the cottages of Eldorado Springs lay along the ditch and needed only a few connections to attach a hose. The tracks and cars had not been moved, and were replaced in the ditch at a cost of $100, or less than 2 cts. per sq. yd. of plaster. The mortar was mixed in a ¼ cu. yd. Ransome mixer with gasoline power, gasoline costing 40 cts. per day, and a first-class mix was obtained. The engineer of the mixer, who was also timekeeper, received $3 per day.

The joints were first picked out, then the wall was thoroughly washed with the hose, when the joints were repointed with 1 to 3 mortar thoroughly rammed with chisel shaped sticks. The first coat of ¾-in. mortar, 1 to 3, was applied, care being taken to have the wall well wetted; this was put on with plasterers' and masons' trowels, then floated with wooden floats to insure absolute contact and drive out all air. After the first coat had its initial set, which varied from 4 to 6 hours, the second and final coat was applied and floated in the same manner, whatever rubbed off being gathered up and mixed with the next batch. The plaster was kept wet for two or three days afterwards.

Owing to the great difficulty in obtaining cement, 1909 being a banner year for the local cement factories, this work, which took little over four weeks' actual labor, was delayed until frost and snow intervened. The temperature varied from zero to 40° F. and the only protection used was a thick wash of cement and sand, 1 to 3, applied with a brush, about ⅛ in. thick. This peeled off in 8 or 10 days, leaving the plaster in first class shape.

Owing to the severe snow storms, work was abandoned in December, with the sides finished, and a ½-in. concrete coping intended to prevent any moisture getting in back of the plaster coat was but partially completed. The holes in the bottom were patched with 1:2:4 concrete, with the intention of renewing repairs after the irrigation season of 1910.

During the enforced stoppages in plastering, the laborers were employed in putting in stone drains to carry the seepage under and into the ditch.

Italian unskilled labor was used entirely. The men had no previous experience, and were encouraged by an offer of 25 cts. extra per day for the best workers, with the result that the plastering cost a total of 50 cts. per sq. yd. for everything. Of this, 4 cts. per sq. yd. mixed and conveyed to the plasterers, washing walls 1 ct. and track 2 cts.

An inspection on May, 1910, showed the ditch in splendid condition after five months' hard wear. The plaster shows no signs of pulling away and is especially strong where used on 900 ft. of concreting. Five contraction cracks have appeared at points of tangent and these have silted up. No expansion joints were used, as there were none in the masonry.

The conclusions to be drawn from the writer's experience on this and similar works, the very useful articles along similar lines in ENGINEERING-CONTRACTING, Dec. 2 and 30, 1908, and the discussion previously mentioned are:

(1) The addition of lime,—hydraulic, hydrated or otherwise—to cement plaster or concrete is neither economical nor beneficial.

(2) Cement plaster is the cheapest and most satisfactory method of lining and water proofing earthwork or masonry ditches.

(3) Cement plaster can be made permanent on masonry or concrete no matter how old by (1) thoroughly washing the surface to remove all dust and dirt; (2) having surface well soaked; (3) thoroughly floating to get plaster as dense as possible and insure good contact by expelling all air.

(4) With skilled superintendence common labor gives good results.

(5) No need for acid washes to insure a good bond.

(6) A thick coat of grout wash is sufficient protection for concrete and plaster against a fairly heavy frost.

Method and Cost of Constructing Two 18-in. Cast Iron Water Mains by Day Labor for the Fort William, Ontario, Water Supply.*

Supply Main to Reservoir.—The line, which was 10,200 ft. in length, was located to avoid solid rock as far as possible; 8,400 ft. was in a marly clay with occasional boulders, 6,000 ft. in muskeg and 1,200 ft. in solid rock. The grade line was kept at a minimum depth of 4 ft. 6 ins. to insure at least 3 ft. of cover. In the muskeg sections clay, on which the pipe was laid was found at a depth of about 4 ft.

One 18-in. gate valve was placed near the middle of the line and a second close to the reservoir. A check valve was also placed 50 ft. back from the reservoir and two 18-in. valves in the two bye pass lines leading from the supply main parallel to the east wall and past the reservoir to the two 18-in. pressure mains. A cluster of three 1-in. Brook's air valves at every summit and a 6-in., off 18-in., blow off at every depression, a drainage ditch on a 5-10ths grade being executed at each. Manholes of dry rubble were built over each air valve cluster and over the gate valves. The pipes were of standard specification, the limits of weight being from 1,800 to 1,950 lbs. per 12-ft. lengths.

The entire work was done by day labor, with Mr. Frank Stewardson as superintendent and general foreman. Wages paid were as follows:

Superintendent, per mo.	$150.00
Sub-foreman, per hr.	.40
Blacksmith, per hr.	.35
Calkers, per hr.	.30
Laborers, per hr.	.25

The cost of the work was as follows:

Item.	Total.	Per lin. ft.
Cleaning and grubbing	$ 160	$0.045
Trenching and backfilling rock, labor	1,698	
Materials	193	
Total	$ 1,891	$0.186
Earth, labor	4,504	
Tools and materials	725	
Total	$ 5,229	$0.512
Pipelaying, labor	1,065	0.105
Lead, yarn, tools	1,632	0.160
Total	$ 2,697	$0.265

Cast Iron Pipe:		
760,858 tons at $40	$30,691	....
13,812 sleeves, specials at 3 cts.	414	....
Total	$31,105	....
Less credits	183	....
Net total	$30,922	$3.030
Hauling pipe	2,130	0.209
Manholes, labor	162	....
Materials	54	....
Total	$ 216	$0.021
Valves	652	0.064
Grand total	$44,198	$4.332

Pressure Main From Reservoir.—This line was 12,520 ft. long, including bye-passes. Six inch, off 18-in., "blow-offs" were placed every half mile, as well as at depressions in order to facilitate emptying the pipe line for repairs. Three clusters of three 1-in. Crispin automatic air valves were placed about 4,000 ft. apart. This air valve is apparently an ideal one for its purpose. When the pipe is empty the ball float rests in a seamless brass cup, suspended by brass strips within the outside iron cylinder. There is ample clearance between the side of the cup and the inside of the cylinder. The inlet is at the bottom of the cylinder through an inch pipe, and the outlet at the top is fitted with a treated leather valve seat to form a tight seat for the ball when it floats, and so closes the valve. There are two small drip holes, which drain the cup and permit the ball to sit below the effect of any air rush, and also prevents the collection of sediment. The presence of this cup and the ample surrounding area removes any possibility, even with great air pressure, of the ball being raised to its seat until all the air has escaped. The cylinder being closed entirely, the valve can be kept below frost line and the air permitted to escape through a pipe attached to the outlet. One-inch globe valves were placed on the inlet pipe, between the main pipe and the air valve, to facilitate repairs to the air valves.

The pipe used was 18-in. diameter cast-iron pipe of standard specification, from 1,900 lbs. to 2,000 lbs. for all heads over 200 ft., and 1,800 lbs. to 1,900 lbs. for all heads less than 200 ft., excepting across the property of the Grand Trunk Pacific Ry., where no pipe of less than 2,050 lbs. was used. The pipes were manufactured at the new plant of the Canadian Iron Corporation in Fort William. The line was cut into three sections by two 18-in. geared gate valves.

As there was greater possibility of the territory through which this line passed becoming inhabited, the minimum depth for the invert of the pipe was fixed at 6 ft., but in deference to the wishes of the Grand Trunk Pacific Railway Co. the grade line across their property averaged a depth of 12 ft. A 12-in., off 18 ins., cross was placed for the future water requirements of the Grand Trunk Ry. A small Indian village having been established on the lower portion of the pipe line, three ½-in. fountains, discharging through a masonry head wall into a basin formed from a 2-ft. section of 18-in. pipe, were installed for public use.

It was decided that the sand and swamp portions of the line could be laid more economically during the winter, as at that season the movement of the sub-soil water is more sluggist and the depth of frozen ground obviated the use of sheet piling. These advantages were considered to more than compensate for the cost of shoveling snow and the difficulty of excavating frozen ground. Seven thousand feet of pipe were laid south from the river in February and March of the present year, at an average rate of 372 ft. per day. The upper section of the pipe was laid during May and June.

No unusual features developed during the progress of the work, the cost of which was as follows:

	Per lin. ft.	Total.
Clearing right of way	$0.008	$ 103.50
Excavating trench labor	0.423	5,294.10
Tools	0.028	356.25
Backfilling and tamping	0.104	1,297.34
Total		$ 7,051.19

*Rearranged from an elaborate paper by H. Sydney Hancock, Jr., presented to the Canadian Society of Civil Engineers on the new water supply system costing $500,000 for the city of Fort William, Ontario.

Cast iron pipe (18-in.)	$3.060	$38,310.87
Inspection at foundry	0.021	267.63
Pig lead	0.147	1,832.90
Yarn	0.003	37.15
Specials	0.041	541.56
Hauling material	0.048	607.20
Total		$41,570.61
Skidding and laying pipe, labor	$0.258	$ 3,228.02
Tools, lumber, plant	0.043	537.19
Accident	0.004	52.00
Total		$ 3,817.21
Culverts and road repairs	$0.021	$ 262.81
6 gate valves	0.080	1,007.00
8 blow off valves	0.015	186.43
9 air valves	0.012	151.08
Total		$ 1,344.51
Manholes, fountain, head walls, etc.	$0.057	$ 702.76
Engineering and supt.	0.090	1,131.20
Total cost of pipe line	$4.463	$55,880.29
Repairs and alterations at river crossing		$ 1,015.40
Total cost, Section IV		$56,895.69

In the above work common labor was paid 22½ to 25 cts. per hour, calkers 30 cts. per hour and a superintending foreman $150 per month. Cast-iron pipe cost $36.75 per ton at the local foundry, and specials $65 per ton. Pig lead cost $3.80 per 100 lbs., and yarn 8½ cts. per lb. Nearly half a mile of the line was inaccessible to teams, and as a consequence the cost of skidding and handling pipe was high.

Method of Repairing Steam Shovels on the Panama Canal.

There are 100 steam shovels in use, or ready for use on the Panama Canal work. From 40 to 50 of these are at work in the dry excavation of the Culebra cut. The repairs to this class of machinery are so extensive and the number of shovels here is so large that a machine shop at Empire was built for the especial purpose of repairing steam shovels.

In this shop all the work of repairing is done which is not possible to do in the field or which can be done by way of making ready for the field repairs at night. This shop employs on an average, 28 boilermakers, 10 blacksmiths, 88 machinists, and 202 negro laborers.

For night repairs a regular gang is organized and in the Culebra cut,—which is a stretch of 9 miles with 40 to 50 shovels,—this gang averages 31 boilermakers, 8 machinists and about 10 blacksmiths and 30 laborers. This cut is divided into three sections and the men are distributed according to the demands for that section.

One of the evolutions of the field repair work is a traveling machine shop, which is mounted on a car and hauled from place to place by a locomotive. This shop contains a forge, a drill, a shaper, and a lathe, all driven by compressed air, which is supplied by an air main at whatever point repair work is necessary.

The equipment further includes pneumatic drills and hammers that can be handled by one man, complete sets of machinists' and boilermakers' tools, and a 30-ton locomotive crane.

The largest single field repair made is changing boilers. This operation usually takes all night, but is done in time so that steam may be raised and the shovel ready to dig at starting time in the morning.

The most frequent big repair job done in the field, however, is changing a dipper stick. This is also completed without loss of time. A swing circle, or an A-frame can be put in between sunset and sunrise without taking the shovel from the bench, or trench in which it is working.

The jobs done, of course, require different lengths of time. This field repair gang works all the way from 3 to 13 hours a night, the average being about 7 hours. The work is done in all kinds of weather. By way of systematizing the repair operations it is possible to utilize most of the time of the men. Sometimes a gang will work from 5 to 7 p. m. on a shovel and then on other shovels till midnight or later. Meanwhile the crane will do its work at the first shovel, and after it has left, the men will return to finish the job.

Unclassified and General Articles

Note: This section is devoted to methods and cost articles on construction work not properly coming under any of the preceding classifications.

Condensed Facts on the Panama Canal.

The following assembled facts and statistics of the Panama Canal are worth recording for the convenience of those who haven't the time or means to consult the more extensive descriptions and records. They give the very latest figures and are compiled on the authority of the Isthmian Canal Commission.

The Panama Canal.—The entire length of the canal from deep water in the Atlantic to deep water in the Pacific is about 50½ miles. Its length on land is about 40½ miles. In passing through it from the Atlantic to the Pacific, a vessel will enter a channel with a bottom width of 500 ft. in Limon Bay, follow this for about seven miles to Gatun, where it will enter a series of three locks in flight and be lifted 85 ft. to the level of Gatun Lake. It will sail at full ocean speed through this lake, in a channel varying from 1,000 to 500 ft. in width, for a distance of about 24 miles, to Bas Obispo, where it will enter the Culebra Cut. It will sail through the Cut, a distance of about nine miles, in a channel with a bottom width of 300 ft., to Pedro Miguel. There it will enter a lock and be lowered 30⅓ ft. to a small lake, at an elevation of 54⅔ ft. above sea level, and will sail through this for about 1½ miles to Miraflores. There it will enter two locks in series and be lowered to sea level, passing out into the Pacific through a channel about 8½ miles in length, with a bottom width of 500 ft. The depth of the approach channel on the Atlantic side, where the tidal oscillation does not exceed 1½ ft., will be 41 ft. at mean tide, and on the Pacific side, where the maximum oscillation is 23 ft., the depth will be 45 ft. at mean tide.

Gatun Dam.—The Gatun Dam, which will form Gatun Lake by impounding the waters of the Chagres and other streams, will be nearly 1½ miles long, measured on its crest, nearly ½ mile wide at its base, about 400 ft. wide at the water surface, about 100 ft. wide at the top, and its crest, as planned, will be at an elevation of 115 ft. above mean sea level, or 30 ft. above the normal level of the lake. The interior of the dam will be formed of a natural mixture of sand and clay, dredged by hydraulic process from pits above and below the dam, and placed between two large masses of rock and miscellaneous material, obtained from steam shovel excavation at various points along the canal. The top and upstream slope will be thoroughly riprapped.

The spillway is a concrete lined opening, 1,200 ft. long and 300 ft. wide, cut through a hill of rock nearly in the center of the dam, the bottom of the opening being 10 ft. above sea level. During the construction of the dam, all the water discharged from the Chagres and its tributaries will flow through this opening. When construction has sufficiently advanced to permit the lake to be formed, the spillway will be closed with a concrete dam, fitted with gates and machinery for regulating the water level of the lake.

Dams on Pacific Side.—The water level of Gatun Lake, extending through the Culebra Cut, will be maintained at the south end by an earth dam connecting the locks at Pedro Miguel with the high ground to the westward, about 1,700 ft. long, with its crest at an elevation 105 ft. above mean tide.

A small lake between the locks at Pedro Miguel and Miraflores will be formed by dams connecting the walls of Miraflores locks with the high ground on either side. The dam to the westward will be of earth, about 2,700 ft. long, having its crest about 15 ft. above the water in Miraflores Lake. The east dam will be of concrete, about 500 ft. long, and will form a spillway for Miraflores Lake, with crest gates similar to those at the spillway of the Gatun Dam.

Gatun Lake.—Gatun Lake will cover an area of 164 square miles, with a depth in the ship channel varying from 85 to 45 ft. Throughout the first 16 miles from Gatun, the width of the channel will be 1,000 ft.; then for 4 miles, it will be 800 ft., and for 4 miles more 500 ft., when the entrance to Culebra Cut, at Bas Obispo, will be reached. The water level in the cut will be that of the lake, and the bottom width of the channel will be 300 ft.

The Canal Zone.—The Canal Zone contains about 448 square miles. It begins at a point three marine miles from mean low water mark in each ocean, and extends for five miles on each side of the center line of the route of the canal. It includes the group of islands in the Bay of Panama named Perico, Naos, Culebra, and Flamenco. The cities of Panama and Colon are excluded from the Zone, but the United States has the right to enforce sanitary ordinances in those cities, and to maintain public order in them in case the Republic of Panama should not be able, in the judgment of the United States, to do so.

Of the 448 square miles of Zone territory, the United States owns about 322 square miles. Under the treaty with Panama, the United States has the right to acquire by purchase, or by the exercise of the right of eminent domain, any lands, buildings, water rights, or other properties necessary and convenient for the construction, maintenance, operation, sanitation, and protection of the canal, and it can, therefore, at any time acquire the 126 square miles within the Zone boundaries, which are now owned by private persons.

The Locks.—There will be 12 locks in the canal, all in duplicate; three pairs in flight at Gatun, with a combined lift of 85 ft.; one pair at Pedro Miguel, with a lift of 30⅓ ft., and two pairs at Miraflores, with a combined lift of 54⅔ ft. at mean tide. The dimensions of all are the same—a usable length of 1,000 ft., and a usable width of 110 ft. Each lock will be a chamber, with walls and floor of concrete, and water-tight gates at each end.

The side walls will be 45 to 50 ft. wide at the surface of the floor; will be perpendicular on the face, and will narrow from a point 24⅓ ft. above the floor until they are 8 ft. wide at the top. The middle wall will be 60 ft. wide, approximately 81 ft. high, and each face will be vertical. At a point 42⅓ ft. above the surface of the floor, and 15 ft. above the top of the middle culvert, this wall will divide into two parts, leaving a space down the center much like the letter U, which will be 19 ft. wide at the bottom. In this center space, which will be 44 ft. wide at the top, will be a tunnel divided into three stories, or galleries. The lowest gallery will be for drainage; the middle, for the wires that will carry the electric current to operate the gate and valve machinery, which will be installed in the center wall; and the upper will be a passageway for the operators. The lock chambers will be filled and emptied through lateral culverts in the floors, connecting with main culverts, 18 ft. in diameter, in the walls, the water flowing in and out by gravity.

The lock gates will be steel structures 7 ft. thick, 65 ft. long, and from 47 to 82 ft. high. They will weigh from 300 to 600 tons each. Ninety-two leaves will be required for the entire canal, the total weighing 57,000 tons. Intermediate gates will be used in the locks, in order to save water and time, if desired, in locking small vessels through, the gates being so fixed as to divide the locks into chambers 600 and 400 ft. long, respectively. Ninety-five per cent of the vessels navigating the high seas are less than 600 ft. long. In the construction of the locks, it is estimated that there will be used approximately 4,500,000 cu. yds. of concrete, requiring about the same number of barrels of cement.

No vessel will be permitted to enter or pass through the locks under its own power. Electricity will be used to tow all vessels into and through the locks, and to operate all gates and valves, power being generated by water turbines from the head created by Gatun Lake.

The time required to pass a vessel through all the locks is estimated at 3 hours, 1½ hours in the three locks at Gatun, and about the same time in the three locks on the Pacific side. The time of passage of a vessel through the entire canal is estimated as ranging from 10 to 12 hours, according to the size of the ship, and the rate of speed at which it can travel.

Excavation.—The total excavation, dry and wet, for the canal, as originally planned, was estimated at 103,795,000 cu. yds., in addition to the excavation by the French companies. Changes in the plan of the canal, made subsequently by order of the President, increased the amount to 174,666,594 cu. yds. Of this amount, 89,794,493 cu. yds. were to be taken from the Central Division, which includes the Culebra Cut. Active excavation work on a large scale did not begin till 1907, when 15,765,290 cu. yds. were removed. In 1908, over 37,000,000 cu. yds. were removed, and in 1909, over 35,000,000, making a total for the two years of over 72,000,000 cu. yds., or a monthly average for those two years of 3,000,000 cu. yds. The total for these two years was nearly one-half of the entire excavation for the canal. On April 1, 1910, the excavation exceeded 103,000,000 cu. yds., nearly the entire amount called for in the original plan. Records of all excavation to April 1, 1910, are appended:

	Cubic yards.
By French companies	78,146,960
French excavation useful to present canal	29,908,000
By Americans—	
Dry excavation	63,785,629
Dredges	39,420,037
Total	103,205,666
May 4 to Dec. 31, 1904	243,472
Jan. 1 to Dec. 31, 1905	1,799,227
Jan. 1 to Dec. 31, 1906	4,948,497
Jan. 1 to Dec. 31, 1907	15,765,290
Jan. 1 to Dec. 31, 1908	37,116,735
Jan. 1 to Dec. 31, 1909	35,096,166
Jan. 1 to April 1, 1910	8,236,279

There have been expended for pavements, water works, sewers, etc., in the cities of Panama and Colon about $2,500,000, and work under an additional appropriation of $800,000 is now in progress in these cities, making $3,300,000 in all. This sum will be returned to the United States treasury by water rates collected by the United States during a period of 50 years.

Canal Force.—On March 23, 1910, the total force of the Isthmian Canal Commission and Panama Railroad Company, actually at work, was 38,732, divided as follows:

	Gold.	Silver.	Total.
Isthmian canal commission	4,499	26,217	30,716
Panama railroad company (proper)	557	3,336	3,893
Panama railroad relocation	158	3,000	3,158
Panama railroad commissary	215	750	965
Total	5,429	33,303	38,732

The gold force is made up of the officials, clerical force, construction men, and skilled artisans of the Isthmian Canal Commission and the Panama Railroad. Practically all of them are Americans. The silver force represents the unskilled laborers of the Commission and the Panama Railroad. Of these, about 5,000 are Europeans, mainly Spaniards, with a few Italians and other races. The remainder, about 28,000, are West Indians, about 4,000 of whom are employed as artisans receiving 16, 20, and 25 cts., and a small number, 32 and 40 cts., an hour. The standard rate of the West Indian laborer is 10 cts. an hour, but a few of these doing work of an exceptional character are paid 16 and 20 cts. The larger part of the Spaniards are paid 20 cts. an hour, and the rest 16 cts. an hour.

Old French Buildings.—The Americans acquired from the French 2,150 buildings of various kinds. Of this number 1,537 have been placed in use. Their estimated value at the time they were turned over to the Americans was about $2,000,000. The Commission has spent on these buildings about $890,000, making their value today about $2,890,000.

Subsistence Department.—The Subsistence Department is divided into two branches—commissary and hotel. It does about $7,000,000 worth of business a year, two-thirds of this through the commissaries, and one-third through the hotels. It feeds, clothes and provides with necessities, approximately 50,000 persons. The department is self sustaining.

The commissary system consists of 13 general stores in as many Canal Zone villages, and three camps along the re-located line of the Panama Railroad. No goods are sold for cash, only coupons issued to employes being accepted in payment for purchases.

The hotel branch maintains the Hotel Tivoli at Ancon, and also 18 hotels for white gold employes, at which meals are served for 30 cts. each; 18 messes for European laborers, who pay 40 cts. per ration of three meals, and 17 kitchens for West Indian laborers, who are charged 30 cts. per ration of three meals. There are served monthly in the hotels for white gold employes, 188,000 meals; in the messes, 269,000 meals; and in the kitchens, 180,000 meals. The supplies for one month cost about $90,000; labor and other expenses, $21,000. The monthly receipts, exclusive of the revenue from the Hotel Tivoli at Ancon, amount to $112,000.

A cold storage and ice making plant, bakery, coffee roaster, ice cream factory, and similar plants, and a laundry, are operated at Cristobal, and warehouses are maintained there near the wharves, at which goods from the States are delivered. Every morning a supply train takes ice and foodstuffs to the towns along the line of the canal, the perishable goods being conveyed in refrigerated cars.

TABLE I.—EXCAVATION BY DIVISIONS, MAY 4, 1904, TO APRIL 1, 1910.

Divisions.	Amounted Excavated. Cubic yards.	Total.	Estimated Amount Yet to be Excavated Cubic yards	Total
Atlantic—				
Dry excavation	6,791,280		2,770,631	
Dredges	17,574,568	24,365,848	15,940,831	18,711,462
Central -				
Culebra Cut	45,624,605		32,417,690	
All other points	8,655,533	54,280,138	3,096,665	35,514,355
Pacific—				
Dry excavation	2,714,211		3,216,369	
Dredges	21,845,469	24,559,680	14,018,742	17,235,111
Grand totals		103,205,666		71,460,928

TABLE II—CANAL APPROPRIATIONS AND EXPENDITURES.

Appropriations.	
Payment to the New Panama Canal Company	$ 40,000,000.00
Payment to Republic of Panama	10,000,000.00
Appropriation for 1902	10,000,000.00
Appropriation for 1906	11,000,000.00
Deficiency for 1906	5,990,786.00
Appropriation for 1907	25,456,415.08
Appropriation for 1908	27,161,367.50
Deficiency for 1908	12,178,900.00
Appropriation for 1909	29,187,000.00
Deficiency for 1909	5,458,000.00
Appropriation for 1910	33,638,000.00
Total to date	$210,070,468.58

Classified Expenditures to March 1, 1910.	
Department of construction and engineering	$ 63,143,128.14
Department of construction and engineering, plant	22,471,687.32
Department of sanitation	10,884,410.18
Department of civil administration	3,926,853.36
Panama railroad second main track	1,107,910.78
Panama railroad relocated line	4,354,137.56
Purchase and repair of steamers	2,555,009.17
Zone water works and sewers	3,270,248.92
Zone roadways	1,429,752.67
Loans to Panama railroad company	3,718,567.03
Construction and repair of buildings	9,574,865.12
Miscellaneous	3,960,658.21
Total	$136,397,228.44

TABLE III—SCHEDULE OF EQUIPMENT.

Canal Service.	
Steam shovels:	
103-ton	14
95-ton	32
70-ton	35
66-ton	7
45-ton	10
26-ton	1
Trenching shovel	1
Total	100
Cars:	
Used for unloading plows	1,806
Steel dump	1,800
General service	525
Total	4,131
Locomotives.	
French	119
American	160
Total	279
Unloaders	30
Spreaders	24
Track shifters	10
Cranes	35
Pile drivers	16
Dredges:	
Rebuilt French hidder	7
Dipper	3
Pipe-line suction	6
Sea-going suction	2
Total	18
Subaqueous rock breaker	1
Tugs	9
Towboat	1
Tender	1
Clapets	12
Barges	39
Panama Railroad.	
Locomotives	68
Cars:	
Coaches	56
Freight	1,495
Locomotive cranes	4
Pile drivers	2
Tugs	2
Crane boat	1
Lighters, steel	14

Relocated Panama Railroad.—The new, or relocated line of the Panama Railroad is 46.2 miles long, or about 1 mile shorter than the old line. From Colon to Mindi, 4.17 miles, and from Corozal to Panama, 2.83 miles, the old location is used, but the remaining 36 miles are new road. From Mindi to Gatun, the railroad runs in general parallel to the canal, and the maximum grade of the line, 1¼ per cent, is in this stretch, where the ascent from nearly mean sea level to 95 ft. above is made. At Gatun, the road leaves the vicinity of the canal and runs east along the valley of the Gatun River to a point about 4½ miles from the center line of the canal, where it turns southward again, and skirts the east shore of Gatun Lake to the beginning of Culebra Cut, at Bas Obispo. In this section there are several large fills, and the maximum elevation of the line is reached, 110 ft. above mean sea level. Through Culebra Cut, the road will run on a berm on the east

TABLE IV—GENERAL CANAL STATISTICS.

Length from deep water to deep water	50½ miles.
Length on land	40½ miles.
Bottom width of channel, maximum	1,000 feet.
Bottom width of channel, minimum, 9 miles, Culebra cut	300 feet.
Locks, in pairs	12
Locks, usable length	1,000 feet.
Locks, usable width	110 feet.
Gatun Lake, area	164 sq. m.
Gatun Lake, channel depth	85 to 45 feet.
Excavation, estimated total	174,666,594 c. y.
Excavation, amount accomplished April 1, 1910	103,205,666 c. y.
Excavation by the French	78,146,960 c. y.
Excavation by French, useful to present canal	29,908,999 c. y.
Concrete, total estimated for canal	5,000,000 c. y.
Time of transit through completed canal	10 to 12 hours.
Time of passage through locks	3 hours.
Relocated Panama railroad, estimated cost	$7,125,000
Relocated Panama railroad, length	46.2 miles.
Canal zone, area	about 448 sq. m.
Canal zone area, owned by United States	about 322 sq. m.
French buildings, number acquired	2,150
French buildings, number used	1,537
French buildings, net value when acquired	$1,959,203
Value of utilized French equipment	$1,000,000
Canal force, actually at work	about 39,000
Canal force, Americans	about 5,500
Cost of Canal, estimated total	$375,000,000
Work begun by Americans	May 4, 1904
Date of completion	Jan. 1, 1915

side, 10 ft. above the surface of the water. From the south end of Culebra Cut, at Paraiso, it will run practically parallel with the canal to Panama. The maximum grade between Gatun and Panama is 0.45 per cent, and the maximum curvature is 6°. Where the railroad crosses the Gatun River, a bascule steel bridge is to be erected, and a steel girder bridge ¼ mile long with a 200-ft. truss channel span, is in use across the Chagres river at Gamboa. Smaller streams are crossed on concrete culverts. Near Miraflores, a tunnel 736 ft. long has been built through a hill. The cost of the new line is estimated at $7,225,000.

Cost of Crushing Stone for Concrtee Lining of Pennsylvania Railroad North River Tunnels.*

The stone worked was the trap rock spoil from the Bergen Hill Tunnel. The plant consisted of a No. 6 and a No. 8 Austin crusher driven by an Annex, single cylinder, horizontal steam engine of 120 HP. and was capable of crushing about 225 cu. yds. of stone per 10-hour day. The crushers and conveyors were driven from a countershaft, in turn driven from the engine by an 18-in belt.

The process of crushing was as follows: The stone from the pile was loaded by hand into scale-boxes which were lifted by two derricks into the chute above the No. 6 crusher. One derrick had a 34-ft. mast and a 56-ft. boom, and was worked by a Lidgerwood steam hoister; the other had a 23-ft. mast and a 45-ft. boom, and was worked by a "General Electric" hoist. All the stone passed first through the No. 6 crusher, after which it was lifted by a bucket conveyor to a screen, placed about 60 ft. higher than and above the stone bin. The screen was a steel chute pierced by 2½-in. circular holes, and was on a slope of about 45°; in order to prevent the screen from choking, it was necessary to have two men continually scraping the stone over it with hoes. All the stone passing the screen was discharged into a bin below with a capacity of about 220 cu. yds. The stone not passing the screen passed down a diagonal chute to a No. 3 crusher, from which, after crushing, it was carried back by a second bucket conveyor to the bin, into which it was dumped without passing a screen. The No. 3 crusher was arranged so that it could, when necessary, receive stone direct from the stone pile. The cars in which the stone was removed could be run under the bin and filled by opening a sliding door in the bottom of the bin. A track was laid from the bin to connect with the contractor's surface railway in the Weehawken Shaft yard and on this track the stone could be transported either to the Weehawken Shaft direct, for use on that side of the river, or to the wharf, where it could be dumped into scows for transportation to New York. The cars used were 3-cu. yd. side-dump, with flap-doors, and were hauled by two steam Dinky locomotives.

The average force employed was:

	Per day
1 foreman supervising at	$3.00
24 laborers loading scale-boxes for derricks at	1.75
4 laborers feeding crushers at	1.75
2 laborers watching screens to prevent clogging at	1.75
1 engineer driving steam engine at	4.00
2 engineers on derricks at	3.50
1 night watchman, watching the plant at night.	

Owing to the constant break-down of machinery, chutes, etc., inseparable from stone-crushing work, there was always at work a repair gang consisting of either three carpenters or three machinists, according to the nature of the break-down.

The approximate cost of the plant was:

Machinery	$ 850
Lumber	3,305
Erection labor	3,999
Total	$13,154

The cost of the crushed stone at Weehawken amounted to about $0.91 per cu. yd., and was made up as follows:

Cost of stone	$0.22
Labor in operation of plant	0.31
Plant supplies	0.11
*Plant depreciation	0.27
Total	$0.91

The crushed stone at the Manhattan Shaft cost about $1.04 per cu. yd., the difference of $0.13 from the Weehawken cost being made up of the cost of transfer across the river, $0.08, and transport from the dock to the shaft, $0.05.

*Extract from a paper by B. H. M. Hewett and W. L. Brown. Proceedings American Society of Civil Engineers, Vol. XXXVI. p. 690.

*Assuming that the scrap value of derricks and engines is one-half the cost, crushers one-third the cost, and other items nothing.

Review Index.

The following items and reviews were for lack of space held out of the Monthly Review Index for May 11, 1910. As it is our practice to index all articles within as nearly as possible 30 days from their publication, we continue the omitted items here.

BOOK REVIEWS.

Dust Preventives and Road Binders.—By Prevost Hubbard. New York: John Wiley & Sons. London: Chapman & Holl, Ltd. Cloth, 6 x 9 ins. 416 pp. $3.

Two of the most important problems which at the present time confront road engineers are the prevention or suppression of road dust and the preservation of roads. At the first International Road Congress in 1908 it was brought out that the solution of these problems lies in the treatment of both old and new roads with chemical substances known as dust preventives and road binders. To supply specific information relative to the chemical and physical characteristics of these dust preventives and road binders, which will enable the road engineers to select and specify materials best suited to his needs, and also to give the best method of applying such materials, is the purpose of Mr. Hubbard's book.

The conclusions presented in the book are based upon experience which the author has acquired both in the laboratory and in the field in the past five years of his service with the U. S. Office of Public Roads. That Mr. Hubbard is well qualified to write on these subjects is shown by the fact that during his connection with the office of Public Roads he has had under his personal supervision the examination of practically all varieties of road binders and their use under varying conditions in many parts of the United States.

The book is divided into 15 chapters and an appendix. A brief summary of these chapters will perhaps show the scope of the book.

Chapter I deals with the problems of dust prevention and road preservation. The relations between the two problems are discussed and methods of solving them given. Chapter II describes the classification of dust preventives according to their use and chemical characteristics. In Chapter III and IV the inorganic dust layers and road binders are considered in some detail both as regards their chemical and physical characteristics, methods of application and examination. Chapter V treats of a number of organic non-bituminous materials such as animal oils and fats, waste sulphite liquors, etc., with reference to their use as dust layers and road binders. Chapter VI deals with the chemical composition and constitution of bitumens. In Chapter VII bituminous material, including native bitumens, pyro-bitumens and artificial bitumens are described and classified with special reference to their use as dust preventives and road binders. Chapter VIII reviews the production and characteristics of petroleums, together with the products of manufacture which are of interest from the standpoint of road treatment. In Chapter IX the physical and chemical characteristics of the semi-solid and solid native bitumens are considered with especial reference to their use as road binders. Chapter X deals in some detail with the surface treatment and construction of earth, gravel and broken stone roads with oil and oil products. The methods of doing the work in order to obtain the best results are quite fully described. In Chapter XI the characteristics of various tars with relation to the treatment of roads is discussed and the methods of preparing them described. This chapter should serve as a working basis for future investigations and should prove of some service to the road engineer in enabling him to form a correct idea of the properties most essential in tars that are to be used as dust preventives and road binders. In Chapter XII the author describes the application of various kinds of the macadam road surfaces and the construction of bituminous macadam roads in general. Chapter XIII describes various tests for bituminous road materials and the interpretation of the results, which should enable the road engineer not only to make an intelligent examination of materials which he has occasion to use, but should also enable him to judge from such an examination as to the value of any given material for a given purpose. Chapter XIV deals with the methods of examination of road materials proposed or adopted by the American Society of Testing Materials, and the American Society of Civil Engineers. In Chapter XV the author develops the principles which should govern the selection and specification of dust preventives and road binders.

Bridge and Structural Design.—By W. Chase Thomson. New York: The Engineering News Publishing Co. Cloth, 6 x 9 ins. pp. 192; illustrated. $2.

In its first edition this book was one of the most useful to the practical working students and draftsmen that had been published in recent years. The present second addition presents the same practically useful matter entirely rewritten and considerably extended. As it stands the work is one of the most satisfactory of any we know of to place in the hands of the draftsman and designer in the office or the engineer having occasional bridge work to do in his general practice. The examples of typical structures in the latter portions in which the stresses are analysed, the numbers proportioned and the details carefully worked out are particularly valuable in practical information. The examples given embrace, each in a separate chapter, an office building, a simple roof truss, a roof truss supported by steel columns, a plate girder, a 50 ft. Warren highway bridge, a pin connected Pratt truss highway bridge. A concluding chapter gives coefficients for stresses in various types of trusses. The first five chapters treat of the general principles of design. The publishers' work on the book is excellent.

Modern Location of Standard Turnouts.—By C. M. Kurtz, Construction Department Southern Pacific Co., San Francisco, Cal. Published by the author. Leather, 4 x 6½ ins. 51 pp.; illustrated. $1.25.

This little volume contains a very large amount of valuable information for the use of civil engineers, transit men and draftsmen for the purpose of planning and staking out almost any kind of turnout curve. The author treats the switch problems in a novel and comprehensive way, making the main curve beyond the frog tangent and the frog tangent important factors to be considered in the lay out of sidings and switching yards. Very complete instructions for the guidance of transitmen are given whereby to stake out correctly any required combination, the book giving the necessary tables from which to select the values already computed for the various cases. There are five chapters in the book of which the first explains the new methods of the author; the second treats on turnouts from tangents; the third on turnouts from curves; the fourth on symmetrical Y-tracks, and the fifth describes the traverse method of solving switch problems.

Municipal Franchises.—Vol. 1. By Delos F. Wilcox. Engineering News Book Department, New York, N. Y. Cloth 5¾x8 ins.; 710 pp.; $5.

This book is an analysis and description of municipal franchises as they exist in American cities. The author gives an introductory analysis of the modes of acquiring franchise rights, of the nature of franchises and of the various possible means of restricting public utility monopolies under private operations. The several classes of municipal franchises are then taken up in order. In most cases a sketch is given of the history and importance of the utility and the special ways in which it is related to the city. There follows a description of typical franchises in actual operation in different cities. As indicated in the title given above the volume before us is the first volume of a two-volume

treatise. The utilities discussed in this volume are electric light and power, telephone, telegraph, electric signals and conduits, water supply, sewerage, central heating, refrigeration, pneumatic tubes, oil pipe lines and artificial and natural gas. In the second volume which is to follow, the various classes of transportation and terrestrial franchises will be discussed. This second volume will also contain the author's conclusions in regard to the taxation and control of public utilities.

PUBLICATIONS RECEIVED.

Public Service Commission; Second District; State of New York.—Second Annual Report. 1908. Albany, N. Y. Published by the Public Service Commission. Cloth; 6 x 9 ins.; Vol. I. 933 pp.; Vol. II. 716 pp.; Vol. III. 9½ x 12 ins. 318 pp.

The commission has supervision over 851 corporations, municipalities and individuals engaged in serving the public and the report is interesting to statisticians. Volume II. deals with uniform systems of accounts.

Standard Specifications for Cast Iron Pipe and Special Castings.—American Water Works Association, Charleston, S. C. J. M. Diven, Secretary. Paper. 6 x 9 ins. 33 pp.

This pamphlet should be in the hands of every water works official.

Representative Cement Houses.—Universal Portland Cement Co., Chicago, Ill. Paper. 6 x 9 ins. 130 pp.; illustrated. 50 cts.

This book has a handsome cover in colors and contains on every page a view of an attractive concrete or stucco house. The text is descriptive of the houses in a general way.

Paving Practice with Respect to Crowns of Roadway Pavements and Concrete Foundations.—By George C. Warren. Boston, Mass. Warren Brothers Company. Paper, 6 x 9 ins. 16 pp.

This pamphlet contains a paper, with all the discussion thereon, read by the author before the 1909 Little Rock, Ark., convention of the American Society of Municipal Improvements and reprinted from the proceedings of the society.

Notes on Going Value and Method for its Computation.—By John W. Alvord, Chicago, Ill. The author, Hartford Building. Paper, 6 x 9 ins. 95 pp.

This pamphlet contains a paper, with full discussion thereon, read by the author before the 1909 Milwaukee, Wis., convention of the American Water Works Association and reprinted from the proceedings. A valuable paper on the valuation of public utilities plants.

INDEX ITEMS.

A New Theory for Earth Pressure.—R. R. Aggs. Gaz., April 15, 1910. 8½ pp.

From a paper presented at the Western Society of Engineers by Chas. K. Mohler, engineer for the Loop Protective Association of Chicago. He departs from the text-book theory that if a wall is designed so that the resultant of the forces acting on the base cuts the base inside the middle third the wall is safe from overturning. This is, he says, safe for only one condition, viz., on a rigid or solid rock foundation. Formulas and diagrams are given.

The Salmon River Dam and Irrigation Project, Idaho.—Eng. Rec., April 2, 1910. 5½ pp.

Illustrates and describes structural details of concrete dam 463 ft. long on the crest. Gives lengthy general description of construction plant and methods with some useful details on the form work.

Cement Mill Accounting.—By T. B. Cornell. Am. Rec., April, 1910. 1¼ pp.

A system of distribution of operating accounts of a cement manufacturing plant.

Unreliability of the Cold Plunge Test for Cement.—Cem. & Eng. News, April, 1910. 1¾ pp.

A paper presented by Arthur C. Davis before the Institution of Civil Engineers.

Plaster, Overburnt Gypsum and Hydraulic Gypsum.—By M. Glasenapp. Cem. & Eng. News, April, 1910. 4 pp. Continued from March.

An essay describing the various products obtained by heating and calcining of native gypsum, based upon an extensive microscopical research intended to throw light upon the excellent properties of some kinds of burnt gypsum and to end the confusion existing in the classification of gypsum products. Illustrated with numerous photographs of miscroscopic sections.

Concrete Reinforcement. A Unit Truss.—By E. White, C. E. Conc. Eng., April, 1910. 3 pp.

A description, illustrated, of a series of six tests to determine the practicability of the principal of turning up reinforcing bars in a beam to take diagonal tension.

Concrete Barges at Panama. — Conc. Eng., April, 1910. 1 p.

A description. Illustrated.

The Ideal Specification for Cement.—By E. P. Goodrich. Contr., April 1, 1910. 1 p.

An argument for limiting the requirements of the standard specifications for cement.

How a Pier Was Built and Its Cost.—Contr., April 1, 1910. 2¾ pp.

Article condensed from a paper by T. Howard Barnes, read before the American Society of Civil Engineers. It gives the details of construction and cost of a pier at Bocas del Toro, Panama, for the United Fruit Company.

Results of Tests for Leakage Under Pressure of a Reinforced Concrete Pipe. — Eng.-Contg., April 27, 1910. ⅓ p.

Describes method of testing 11-ft. reinforced concrete conduit and gives results showing amount of leakage at various pressures up to 125 ft.

Method of Constructing Reinforced Concrete Trestles for Railways, With Some Costs.—Eng.-Contg., April 27, 1910. 2½ pp.

Describes and discusses economics of reinforced concrete standard trestle construction employed on the C., B. & Q. R. R. Some general costs are given.

Methods and Cost of Constructing Concrete Lock on the Illinois and Mississippi Canal.—Eng.-Contg., April 27, 1910. 3¼ pp.

Describes construction of lock and subsidiary structures, giving full details of plant, layout and methods and itemized costs.

The North Shore Channel of the Sanitary District of Chicago; Methods and Some Costs on Sections Four and Six.—Eng.-Contg., April 27, 1910. 1¼ pp.

Describes methods of excavation with drag line scraper excavators with records of output and estimates of cost.

Relative Cost of Municipal Work Done by Day Labor and by Contract.—By Harrison P. Eddy, Consulting Civil Engineer, Boston, Mass. Can. Engr., April 8, 1910. 3¼ pp.

A careful study, with tables and diagrams, of the labor conditions obtained in the sewer and water departments of the city of Boston.

Cost of Generating Electric Power for Operating the Elevated and Subway Cars in Manhattan, New York City.—Eng.-Contg., April 27, 1910. ⅔ p.

Itemizes equipment and gives full unit operating costs.

Applications of Descriptive Geometry to Mining.—By Joseph W. Roe. Min. Wld., April 23, 1910. 4⅓ pp.

Some of the principals involved are used unconsciously by the engineer in his everyday work. The author attempts (and very well) to recall some of the college text-book principals and place them before the reader in terms of everyday use. Different problems are worked out, i. e., finding the strike, the dip, depth of shaft, length of tunnel, limits of an ore dump, location of ridge for maximum capacity and other interesting problems with diagrams.

Personals.

Mr. Carl E. Plum has been reappointed City Engineer of Elgin, Ill.

Mr. C. B. M. Craig has been appointed City Engineer of Hancock, Mich.

Dr. Harvey W. Wiley, Chief of the Bureau of Chemistry of the Department of Agriculture, has been elected president of the United States Pharmacopoeial Convention, to serve a term of ten years.

Mr. W. A. Bowden, heretofore Designing Engineer of the Department of Railways and Canals of Canada, has been promoted to the position of Chief Engineer, with headquarters at Ottawa, Ont.

Mr. A. W. Genet, for a number of years a Superintendent of Construction for the MacArthur Bros. Co., of New York and Chicago, has gone into the general contracting business at Pittsburg, Pa.

At a meeting of the Commercial Club of Kansas City, Mo., on May 8, Mr. R. E. McDonnell, of the firm of Burns & McDonnell, Consulting Engineers, delivered an address on the value of an adequate supply of pure water for Kansas City.

Mr. George M. Merrill and Mr. Robert M. Sears have entered into a partnership under the firm name of Merrill & Sears, with offices at 274 Main street, Springfield, Mass., and will continue the civil engineering and surveying practice of George N. Merrill & Co.

Dr. B. E. Fernow, head of the Department of Forestry at the University of Toronto, has been selected to represent the Canadian Conservation Commission at the International Association of Forest Experiment Stations at Brussels, Belgium. Dr. Fernow will also represent the commission at the International Congress of Geology to be held shortly at Stockholm, Sweden.

The following changes in the engineering department of the Chesapeake & Ohio Ry. have been announced: Mr. F. I. Cabell, Engineer of Maintenance of Way at Richmond, Va., has been made Chief Engineer of Maintenance of Way. Mr. C. W. Johns, formerly Assistant Engineer of Maintenance of Way at Hinton, W. Va., has been made Engineer of Maintenance of Way of the West Virginia general division. Mr. F. B. Isaacs and Mr. L. B. Allen, Division Engineers, have been appointed Engineers of Maintenance of Way of the Virginia and Kentucky general divisions, respectively.

Mr. A. L. Harris, who recently resigned from the U. S. Reclamation Service after seven years' service as Assistant Engineer, has opened an office at Phoenix, Ariz., where he will engage in practice of engineering connected with irrigation works, hydraulic developments and structural work. During his service with the U. S. Reclamation Service Mr. Harris spent practically the whole time on or about the Roosevelt dam, under Mr. Louis C. Hill, supervising engineer. He designed the Granite Reef Dam near Phoenix and other power plants and irrigation structures in connection with the Salt River project.

Among the addresses to be delivered at the meeting of the Kansas State Municipal League at Wichita, Kan., on May 18 and 19, are the following: An address will be made by David E. Heinman, president of the League of American Municipalities. Mr. R. E. McDonnell, M. Am. Soc. C. E., of the firm of Burns & McDonnell, will give an illustrated lecture on sewage disposal, giving illustrations of the principal sewage purification works in American and European cities. The State Board of Health of Kansas will be represented by Mr. Deocon, who will speak on the relation of the Health Department to municipal officers.

Mr. Morril B. Spaulding, a Consulting Mining Engineer of New York City, was badly injured last week in an accident in an abandoned gold mine at Cheraw, S. C. Mr. Spaulding's right led was so badly crushed when an elevator crashed down a shaft in the mine that surgeons on May 12 amputated the member in an effort to save Mr. Spaulding's life. The accident occurred while Mr. Spaulding and several workmen were ascending from the pit of the mine. The car fell 100 feet when a rope broke, and one of the workmen was crushed to death at the bottom of the shaft. Mr. Spaulding was rescued after several hours, and was brought to New York for an operation. The mine had recently been purchased by a syndicate, and Mr. Spaulding had been engaged to make an examination of the property to determine the extent of the vein and the value of the ore.

The U. S. Civil Service Commission, Washington, D. C., will hold an examination on June 15 to secure eligibles from which to make certification to fill at least 50 vacancies in the position of surveyor, at $1,400 per annum each, in the Philippine service, and similar vacancies as they may occur in that service. Field expenses are allowed appointees when absent on duty from their permanent station. It will not be necessary for applicants to appear at any place for examination. Their eligibility for the position will be determined upon the evidence furnished in application Form 375 concerning their education, training and experience. Applicants qualified as follows will be acceptable as surveyors: (a) Senior year students in civil engineering who are attending recognized technical schools or colleges, and whose records are satisfactory; (b) persons who have had not less than three years' good experience in general land and topographic surveying and in addition thereto a good general education. Applicants should at once apply to the United States Civil Service Commission, Washington, D. C., for application Forms 2 and 375.

Walter C. Kerr, President of Westinghouse, Church, Kerr & Co., died May 8 at Rochester, Minn., where he had gone to undergo an operation for cancer. Mr. Kerr was born in St. Peter, Minn., in 1858. He was graduated from the mechanical engineering department of Cornell University in 1879, remaining, however, at Sibley College, Cornell, an instructor and later as assistant professor until 1883. In 1884 when the firm of Westinghouse, Church, Kerr & Co. was organized he became one of its officers. At one time Mr. Kerr was vice-president of the Westinghouse Machine Co., and at the time of his death he was a director of the Electric Properties Co. He was a member of the American Society of Mechanical Engineers, the Canadian Society of Civil Engineers and the Franklin Institute and an Associate of the American Institute of Electrical Engineers. He was also a member of the Engineers' Club of New York City, the New York Railroad Club and several others. Since 1890 he had been a trustee of Cornell University. Mr. Kerr's residence for the past fourteen years was at Dongan Hills, Staten Island.

Contract News Section

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ENGINEERING-CONTRACTING

A Consolidation of Engineering-Contracting—Contract News—Engineering World—The Dirt Mover.

Containing Items of Interest to Railroad, Public Works and Other Contractors.

The Doings of the Week.

The Board of Water Supply of New York city is now calling for bids on one of the few remaining construction contracts in connection with the new Catskill water supply for New York city. This is Contract No. 80 and calls for the construction of the Breakneck tunnels, portions of the Hudson River division of the Catskill aqueduct, comprising about 710 ft. of plain concrete conduit, known as aqueduct in open cut or cut and cover aqueduct, 17 ft. high by 17 ft. 6 ins. wide inside, and a tunnel on the hydraulic gradient, about 1,055 ft. long, 17 ft. high by 13 ft. 4 ins. wide inside, connecting by a shaft about 590 ft. deep with a deep pressure tunnel 14 ft. inside diameter and about 700 ft. long. The work is located in the towns of Fishkill, Dutchess County, and Phillipstown, Putnam County, N. Y.—Congress has passed the bill establishing a bureau of mines and mining in the Department of the Interior The creation of the bureau was recommended two or three years ago by President Roosevelt and later by President Taft.—The city of Waterbury, Conn., is now calling for bids for the construction of a storage reservoir dam, which calls for a considerable amount of work. The principal items in the work are 30,600 cu. yds. of concrete masonry and 525,000 cu. yds. of rolled embankment. Bids are to be opened June 7.—Wenatchee, Wash., has just let a large sewer contract. Wetzel & Foster, Spokane, Wash., secured the contract at $227,000.—Several eastern railroads are about ready for bids on a considerable amount of construction work. Chief of these is the Boston & Albany R. R., which will be ready shortly to take bids for third tracking between Greenbush and Rensselaer, N. Y., and for constructing a tunnel at State Line.—A number of new steam and electric lines are planning to have construction work started soon. Among these may be noted the following: The Crosbyton-South Plains R. R., 120 miles of line, from Crosbyton, Tex., to Lubbock, Tex.; the Coeur d'Alene & Pend Areille Ry. for constructing 24 miles of branch lines for the Spokane International Ry.; the Scio-Lacomb & Jordan Valley R. R. of Scio, Ore., for about 15 miles of line; Prairie Farm & Southwestern Ry. for a number of miles of road from Prairie Farm, Wis., and the Southwestern New York Traction Co. for 15 miles of line from Bolivar to Wellsville, N. Y.—Among the railroad construction contracts let recently are the following: D. D. Morgan, for the grading and bridge building for the last 10 miles of the Laramie, Hahns Peak & Pacific R. R. at Hebron, Colo.; Lewis F. Shoemaker & Co., Philadelphia, Pa., for constructing a number of signal bridges in that city for the Philadelphia & Reading Ry.; the C. H. Sharp Contracting Co., Kansas City, Mo., for revising the grades of the Santa Fe Ry. between Temple and Coleman, Tex.; Donald Jeffry, for the construction of a section of the Chicago & Northwestern line between Tunnel City, Wis., and Raymore; the O'Boyle Construction Co., for the construction of 31 miles of railroad from Hawk Lake, Ont., to Hobon, which will connect the C. P. R. and the A. C. R.; P. V. Clark, Clinton, Ia., for building 15 reinforced concrete bridges for the Chicago & Northwestern Ry., four on the Anamosa division, one on the Iowa division and 10 on the Iowa and Minnesota; S. Dolman & Son, North Topeka, Kan., for building 2½ miles of line from Lawrence west for the Atchison, Topeka & Santa Fe Ry.,

The First "Waterproof" Roadway.

Asphalt pavements for streets were used in Paris as early as 1854, but there has always been more or less doubt as to when asphalt was first used in connection with highway construction. In a recent discussion of a paper before the Engineers' Club of Philadelphia Mr. T. Hugh Boorman stated that the first waterproofing application to an ordinary road was probably made in 1849 at the village of Travers in Switzerland. The discovery was made by accident: pieces of asphalt rock falling from carts traveling between the mines and the mastic works compressed under the wheels and produced a road surface so serviceable that it led to the construction of a macadam road of crude rock asphalt compacted with a roller, under the superintendence of Mr. Merian, a Swiss Engineer. This road was investigated in 1866 and found then to be in comparatively good condition. In the discussion of the same paper Mr. W. H. Fulweiler stated that he had found records that lead him to believe that the first "waterproof" road was made in the city of Nottingham, England, about 1842-44. The manager of the gas works at that place noticed that where the tar from the hydraulic main had been carried out by hand to the tar tank, the drippings which had spilled on the cinder walk had hardened, solidifying the path into an impervious pavement. He accordingly tried this method of mixing tar and clinker on a short stretch of road in front of his office. There is no information available as to how long this road lasted, but Mr. Fulweiler stated that there was a tar road built up in New Hampshire, in practically the same way as the Nottingham walk, with tar from a gas works, which had been down for about 28 years and was still giving pretty good service.

The New York 8-Hour Law and Its Working.

New York State, as is well known, has a somewhat drastic labor law, commonly called the 8-Hour Law, which prescribes the hours of labor, rate of wages, etc., for employees of contractors engaged in work for the state (including municipal corporations and commissions). The principal provisions of the law to be observed by the contractor are summarized in The Bulletin of the General Contractors' Association as follows: The contractor must pay the prevailing rate of wages for the locality where the work in its final form is situated, erected or used; he must employ only citizens of the United States, and where laborers are employed, preference must be given to citizens of the State of New York; he must pay his employees in cash and if the contractor be a corporation, the wages must be paid weekly for work performed up to a day, six days prior to pay day; the contractor must not permit or require a laborer, workman or mechanic to work more than eight hours in any one calendar day, except in cases of extraordinary emergency caused by fire, flood, or danger to life or property; he must not pay in scrip commonly known as "Store money orders"; he must not conduct a company store, if there be one at the time selling supplies within two miles of the place where the work is located. In the Annual Report of the State Department of Labor for 1909, the Commissioner of Labor reports on the working of the law as follows: "During the year the Department received and investigated 51 allegations of violations of the provisions limiting the hours of labor to eight a day. Of this number 29 were sustained and such action taken concerning them as the law directs. In 22 cases no violation was found. To establish a violation we must obtain proper and legal evidence in the shape of sworn statements from men who have been required or permitted to work in excess of eight hours in a given calendar day or days, or an admission from a person in authority representing the contractor or official engaged in the prosecution of the work under investigation. The law is observed quite satisfactorily upon the greatest public undertaking within our state, namely, the barge canal. An occasional complaint or rumor reached us that men employed by some contractors were working more than eight hours a day, but inquiry generally developed the fact that where excess labor had been performed, the work was clearly of an emergency character, or the violation so technical and incidental as not to justify any further action on our part."

Michael Elmore.

In the passing of Michael Elmore, president of the Elmore & Hamilton Co., the contracting profession loses one of its best known members. Michael Elmore was born in 1853 and had been in the contracting business for over 30 years. In the early part of his contracting work he had much to do with the construction of many of the principal railroads of the west, including the Union Pacific, Missouri Pacific, Northern Pacific and the Oregon Short Line. In 1903 he came east and was engaged for several years in building an extension of the Western Maryland R. R. to Cumberland, Md. He afterward engaged in construction work for the Delaware & Hudson and later he laid the four tracks of the Long Island R. R. from Long Island City, N. Y., to Jamaica, N. Y. The Elmore & Hamilton Co. at present is engaged in the construction of sections 15 and 53 of the Catskill aqueduct for the Board of Water Supply of New York city. Mr. Elmore was much interested in the breeding of fine cattle and horses, and owned a large ranch in Wyoming, where he bred cattle, and the Ben-Hur stock farm in Marshall, Mo., where he kept about 150 fine harness horses. Mr. Elmore died suddenly May 11 from stomach trouble, at his home in White Plains, N. Y. He left a widow, two sons and four daughters.

Some Inspection.

An assistant engineer in the Bureau of Highways in one of the boroughs of New York city recently inspected an asphalt pavement for final acceptance just prior to the expiration of its maintenance. The contractor had put the street in what he considered to be excellent condition, but the engineer opined that "there still existed waves of sufficient magnitude to make water *hesitate*."

Confirmed Reports by Engineers and Contractors

RAILROADS, POWER DEVELOPMENTS, LEVEES, DRAINAGE AND IRRIGATION WORKS.

Railroads—Steam and Electric.

ARIZONA.

The El Paso & Southwestern Ry. Co. has as yet made no definite plans for its proposed extensions. Surveys for the location of a route for an extension from Benson, Ariz., to Tucson and Phœnix have been made and reports stated that construction work would be started this summer.

COLORADO.

The Denver & Rio Grande R. R. has not as yet completed its plans for the construction of double track line between Pueblo and Walsenburg, Colo.

IOWA.

P. V. Clarke, General Contractor, Weston Bldg., Clinton, Ia., has been awarded the contract for building 15 reinforced concrete bridges for the Chicago & Northwestern Ry. Four of the bridges are on the Anamosa Branch, one on the Iowa Division and 10 on the Iowa and Minnesota.

The Sioux City & Eastern Traction Co. has practically completed its organization and has negotiations now under way with a number of engineering firms, one of which will be engaged to handle the whole engineering project, make the surveys, estimate the cost of construction and equipment, and the probable earnings, and oversee the building of the line when the construction stage is reached. The route of the road has not definitely been determined, owing to the rough nature of the country through which the line must run. Several routes are in contemplation. The only towns certain to be on the line are Sioux City, Denison and Climbing Hill. As projected the line is to extend from Sioux City through Climbing Hill and other towns to Denison, Ia. The offices of the company are at 520 F. L. & T. Bldg., Sioux City, Ia., and W. L. Harding is secretary.

KANSAS.

S. Dolman & Son, Topeka, Kan., have been awarded a contract by the Atchison, Topeka & Santa Fe R. R. for the construction of new track between Lawrence and Cameron's bluff to replace the portion of their tracks damaged by the flood and ice last winter. The contract calls for the laying of three miles of new track on a straight line between Lawrence and Cameron's bluffs, on higher ground to the south of the present line, away from the possibilities of damage from the Kansas river. Dolman & Son will probably sublet a portion of the work.

KANSAS.

Plans are not fully matured yet for beginning construction work on the Wichita, Kinsley, Scott City & Denver Air Line Ry. Necessary capital for construction is now being secured and the right of way is being obtained. The general contract for the construction of the line has been let to the Air Line Construction Co., Kinsley, Kan., of which W. F. Brown, Iuka, Kan., is president. The construction company will probably build from Wichita to Kinsley, Kan., during the coming months. The construction company has not decided as yet as to subletting any of the work. The construction company may want elevating graders and track laying machine.

MARYLAND.

We are advised that the Frederick R. R. Co. is contemplating making no extensions at the present time. Press reports stated that this company was planning to extend its line from Thurmont to Emmitsburg and then on to Gettysburg. Oscar B. Coblentz, Frederick, Md., is chief engineer.

MASSACHUSETTS.

The Boston & Albany R. R., F. B. Freeman, Chief Engineer, Boston, Mass., is planning to carry out work during 1910 which will cost approximately $2,000,000. A summary of the status of this work is as follows: The new station at Worcester is already under contract. The elimination of crossings at Worcester cannot be started for quite some time yet, as they are dependent on the work which the New Haven Road has to do. The work at East Cambridge, Natick, South Framingham and Westfield, are practically all track work which is to be done by company forces. The steel work for bridges is already let to the American Bridge Co. Plans for third tracking between Greenbush and Rensselaer will probably be ready for bids from contractors in about two weeks. The tunnel work at State Line will probably be ready at the same time. The larger portion of the work will be handled by company forces, so that there is not, with the exception of the third tracking and the tunnel work, much that is large enough to ask for contracts on.

MICHIGAN.

The Bean & Jones Construction Co., Benton Harbor, Mich., as previously noted, have been awarded a contract by the Dowagiac Ry. Co. for work at Eau Claire, Berrien County, Mich. The contract includes 140,000 cu. yds. of earth excavation and 750 cu. yds. of concrete masonry. Bean & Jones will probably sublet one cut of about 40,000 cu. yds.

NEW YORK.

The Southwestern New York Traction Co. is planning to have work started June 15 on its projected 15-mile line from Bolivar to Wellsville, N. Y. Construction contracts have not been let as yet. The traction company is in the market for supplies of all kinds. C. M. Van Curen, Bolivar, N. Y., is President.

OREGON.

The Scio-Lacomb & Jordan Valley R. R., recently incorporated, has made surveys for its projected line and has construction work under way on the first four miles of it. The projected length of the line is 15 to 30 miles and $50,000 of construction capital has already been secured. A. G. Prill, Scio, Ore., is President.

PENNSYLVANIA.

James H. Corbett has 30 miles of work for the Brookville & Mahoning R. R. This is heavy work and includes five tunnels and a bridge over the Allegheny River. Mr. Frank C. Wilson, R. F. D. No. 5, New Bethlehem, Pa., has charge of all the concrete work on the Mahoning end of the contract.

The Philadelphia & Reading Ry. has awarded the contract for constructing signal bridges from Green St. to Norris St., and 17th and Indiana Sts. to the Richmond Branch, at Philadelphia, to Lewis F. Shoemaker & Co., 15th and Walnut Sts., Philadelphia, Pa.

TEXAS.

The Crosbyton-South Plains R. R. Co. has made surveys for its projected line from Crosbyton to Lubbock. The capital for construction has been secured and construction contracts will be let June or July. The projected length of this line is 120 miles. John A. Knox, Crosbyton, Tex., is Chief Engineer, and Prentiss L. Coonley, 39th St. and Stewart Ave., Chicago, Ill., is President.

Surveys will be completed about June 15 for the first section of the American Central R. R., from Miami to Vernon, Tex., a distance of 100 miles, and construction work will be started in the fall. Maj. Geo. W. Angle, Chief Engineer, Vernon, Tex., will have charge of the work, and the contract for constructing the grade and track-laying has been let to the Central Construction Co. of Mobeetie, Tex. The work will be sublet in the fall.

A company is to be organized in the near future for building a railroad from Shreveport, La., to Waco, Tex. As projected the line will extend from Shreveport to Carthage and thence to Mount Enterprise, Rush, Palestine, Fairfield, Mexia and on to Waco. Jno. C. Whitney, President Carthage Commercial Club, Carthage, Tex., is interested.

WASHINGTON.

The Coeur d'Alene & Pend Oreille Railway Co. has been organized to build two short branches of the Spokane International Ry. The work is light and very likely will be done by forces of the Spokane International Ry. The entire mileage of both branches will not exceed about 24 miles. E. G. Taber, Spokane, Wash., is Chief Engineer of the Spokane International Ry.

WISCONSIN.

The Prairie Farm & Southwestern Ry. is making good progress with the preliminaries for its proposed line. The construction contracts have not been let to any contractor and possibly the road will not be placed under contract. Farmers along the route have been liberal stock subscribers and they have all been given the opportunity to work out their subscriptions with team and men. Actual grading work in this way has already been started. J. De Wilde, Prairie Farm, Wis., is Secretary and Treasurer.

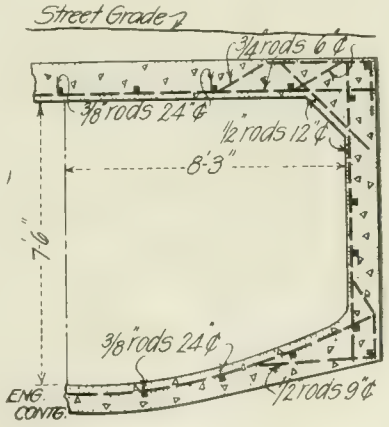
CANADA.

The Temiskaming & Northern Ontario Ry. has not as yet decided to rebuild its line from North Bay, Ont., to New Liskeard. The company has, however, made surveys to ascertain what improvements in grade and alignment it is possible to make between North Bay and New Liskeard. S. B. Clement, North Bay, Ont., is chief engineer.

Power Developments, Levees, Drainage and Irrigation Works.

CALIFORNIA.

Morve L. Weaver, City Engineer, of Visalia, Cal., has completed plans for 2,800 ft. of 16½-ft. reinforced concrete conduit, and contracts for the work will be let about June 1 to June 15. The conduit is to be constructed for the city of Visalia, the estimated cost being $83,000. The accompanying cut shows a cross section of the proposed conduit.



The Bear Valley Mutual Water Co. of Redlands, Cal., is to build by force account its Big Bear Valley Dam. The dam is to be one of the multiple arch type 85 ft. high and 327 ft. long, and is to be finished by fall. Plans for the dam were prepared by John S. East-

wood, C. E., Fresno, and it will be constructed under his direction.

FLORIDA.

The Board of Drainage Commissioners of the State of Florida, as noted in our last issue, are calling for bids until June 15, for excavating five drainage canals in the Everglades, requiring approximately 18,000,000 cu. yds. of earth excavation and 6,000,000 cu. yds. of rock excavation. The canals are to be constructed for the purpose of lowering the level of Lake Okeechobee and controlling its flood waters and for affording an outlet for draining the lands through which they pass. The canals are to be from 50 to 70 ft. wide and from 8 to 12 ft. deep, and in this excavation the contractor is to be allowed to use any kind of dredging machinery he chooses. The canals are to be completed within three years of the date of the execution of the contract. Monthly estimates are to be made and the contractor will be paid 90 per cent of the amount due each month, the remaining 10 per cent being retained by the Board until $50,000 has been reserved. The Drainage Board owns and is operating four dipper dredges, which the successful bidder will be required to take over either by purchase or lease. J. O. Wright, Tallahassee, Fla., is Chief Drainage Engineer. The accompanying tabulation shows the dimension, grade, velocity, discharge, and the approximate number of cubic yards of excavation in each section of the several canals:

No. Section.	Length in Miles.	Bottom Width.	Grade.	Velocity.	Depth of Flow.	Discharge.	Depth of Cut.	No. Cu. Yds. Excavation.
North New River.								
1	10	50	.38	1.80	7	630	10.00	977,770
2	10	55	.38	1.84	7	708	9.5	1,021,185
3	10	60	.38	1.88	7	790	9.5	1,091,200
4	10	65	.38	1.92	7	874	9.0	1,144,000
5	5	65	.38	1.92	7	874	8.5	540,220
South New River.								
1	10	50	.27	1.53	7	535	10.00	977,770
2	10	55	.27	1.55	7	597	9.25	994,880
3	10	60	.27	1.57	7	659	8.75	1,026,660
4	10	65	.27	1.59	7	723	8.25	1,045,000
5	5	70	.27	1.61	7	789	8.00	547,555
6	12	60	.27	1.67	7	659	8.00	1,263,920
Hillsboro River.								
1	10	50	.21	1.20	7	420	10.0	977,770
2	10	55	.21	1.24	7	447	10.0	1,075,550
3	10	60	.21	1.27	7	533	10.0	1,173,330
4	10	60	.40	1.85	7	770	11.5	1,349,330
5	10	60	.87	2.62	7	1,090	13.0	1,525,330
Miami Branch.								
1	10	50	.35	1.73	7	605	8.50	831,110
2	10	55	.35	1.81	7	697	8.25	887,720
3	6	60	.35	1.85	7	760	8.00	563,196
Gulf Coast Canal.								
1	10	40	.20	1.20	7	336	8.00	625,680
2	10	45	.20	1.22	7	384	8.00	703,890
3	10	50	.20	1.24	7	434	8.00	782,200
4	10	55	.20	1.26	7	475	8.25	887,330
5	10	60	.20	1.28	7	537	8.50	997,330
6	10	60	.20	1.28	7	537	9.00	1,056,000

IDAHO.

The Crane Falls Power & Irrigation Co. will immediately commence construction on the feed canal and head works of its power plant at Crane Falls, on the Snake River, about 15 miles southwest of the town of Mountainhome, Idaho. The plant will have a capacity of 14,000 HP., which will be mainly used for lighting and heating purposes in the southwest portion of the state of Idaho, and in connection with pumping water for the irrigation of lands along Snake River. Contracts have been arranged with desert-land entrymen in the vicinity of Grand View, Idaho, to furnish water for about 10,000 acres; and the company's future plans include the irrigation of about 10,000 additional acres in the same neighborhood. It is expected that further plans will provide for running transmission lines into the mining regions of Northern Nevada, as electric power has long been felt to be essential to the development of the mines in that section of the country. The development is being financed by Canadian capital from Toronto and Montreal; Smith, Kerry & Chace, of the former place, being the engineers and promoters. They have opened an office at Mountainhome, Ida., the engineer in charge being G. Vansittart. The plant will be ready for operation by the first of the year.

IOWA.

Bids will be received by C. O. Dixon, Rockwell City, Ia., auditor of Calhoun County, until 1 P. M., May 23, for the construction of Joint Drain No. 70 in Webster County and Drain No. 95 in Calhoun County. The work includes the following: Sec. 1, main line: 46,400 cu. yds., 26-ft. bottom; 36,300 cu. yds., 20-ft. bottom; 38,400 cu. yds., 18-ft. bottom; 236,500 cu. yds., 12-ft. bottom; 50,900 cu. yds., 8-ft. bottom; 30,925 cu. yds., 6-ft. bottom; 58,450 cu. yds., 5-ft. bottom. Sec. 2, Branch No. 4, 102,204 cu. yds., 5-ft. bottom; Sec. 9, Branch No. 1, 23,000 cu. yds., 5-ft. bottom Work is to be commenced on or before July 1, 1910, and is to be completed on or before Jan. 1, 1912. Payments on the work are to be made as provided by the Iowa law: 80 per cent on monthly estimates; balance on completion. It is probable that bonds will be sold and the contractor on this work paid in cash. G. P. Smith, Fort Dodge, Ia., is the Engineer in charge of construction.

C. J. McElheny, Lawton, Mich., has been awarded the contract by the Commissioners of Page County for the construction of the Coin-Blanchard drainage ditch. The contract includes 233,000 cu. yds. of earth excavation. The ditch is 28,000 ft. long and is to be constructed for the purpose of straightening Tarkio Creek.

Bids are asked by R. V. Innes, county auditor, Council Bluffs, Ia., until 9 a. m., June 5, for constructing the Pigeon Creek drainage ditch, 14 miles long. The work has been divided into seven sections as follows: Section 1, 80,480 cu. yds.; section 2, 58,520 cu. yds.; section 3, 74,550 cu. yds.; section 4, 75,450 cu. yds.; section 5, 83,400 cu. yds.; section 6, 77,800 cu. yds.; section 7, 28,000 cu. yds.

LOUISIANA.

Bids will be received by N. H. Lewis, Tallulah, La., secretary 5th Louisiana Levee District, at the office of the Board of State Engineers, Room 402 Cotton Exchange Bldg., New Orleans, La., until noon, May 25, for the enlargement of the following levees in East Carroll Parish, Mississippi River, right bank. Wilson Point Levee, approximate contents, 50,000 cu. yds.; deposit required $200; bond required $2,500. Elton Levee, approximate contents, 100,000 cu. yds.; deposit required $325; bond required $5,000. Wyly to Hollybrook levee, approximate contents, 125,000 cu. yds.; deposit required, $375; bond required $6,250. Wilton levee, approximate contents, 100,000 cu. yds.; deposit required $325; bond required, $5,000. Cash or certified check to the amount named as deposit must accompany each proposal. Terms of payment, cash.

TEXAS.

Bids are asked by Robert G. Johnson, Fort Worth National Bank Bldg., Fort Worth, Tex., chairman of the Fort Worth Improvement District No. 1, until 10 a. m., June 4, for constructing levees and ditches contemplated by the district. A bond issue of $250,000 has been made for the work.

PORTO RICO.

Bids are asked by B. M. Hall, chief engineer, Porto Rico Irrigation Service, Guayama, P. R., until 2 p. m., July 25, for the construction of the Carite Dam, 150,000 cubic meters of earth and loose rock; the Toro Negro dam, 15,000 cubic meters of earth and loose rock, and the Dona Juana canal, 1⅓ miles in length. The estimated total cost is about $160,000. After May 31 plans and specifications may be obtained from the Porto Rico office or from the office of the Commissioner of the Interior, San Juan, Porto Rico, or from the Bureau of Insular Affairs, War Department, Washington, D. C. Official advertisement will be found elsewhere in this issue.

Leroy W. Baldwin, President of the Empire Trust Co., of New York City, has secured several water rights along Otter Creek, north of Middlebury, Vt., and it is believed that the power is to be developed for an electric railway projected to run north from Rutland, Vt., surveys for which were made a year or two ago.

The Seaboard Air Line R. R. is now running a line of track from Early Bird to Dunnellon, Fla., a distance of 40 miles, and is also laying rails from Dunnelton to Hernando, Fla., 14 miles out. The railroad also has under construction a line between Newberry, Fla., and Clark, Fla.

The Foshee and McGowin interests of Brewton, Ala., and Foshee, are reported to be behind the movement to build the railroad from Andalusia to Pensacola, Fla., mentioned in our last issue. It is proposed that Pensacola men secure a franchise with water front rights, a site for a depot and turn all over to the Alabama men, who in turn agree to commence work on the road within 30 days and have it completed within two years.

Paternan & Lamro have begun work at Dallas, S. Dak., on their grading contract on the Dallas-Carter extension of the Chicago & Northwestern.

Richards & Gaston, Somerville, N. J., have been awarded a contract at $18,000 for the enlargement of the Central Railroad culvert at Hampton, N. J.

The International Elevated Ry. Co. has been incorporated with a capital stock of $50,000 for the construction of an elevated railway. The incorporators are Charles Guyer, Wilmington, Del.; Geo. C. Schroeder, Washington, D. C.; S. E. Becker, Wilmington, Del.

The Chicago & Northwestern R. R. is constructing the necessary bridges between Fremont, Nebr., and Arlington for the stretch of double track. Grading was completed last Summer and all that remains to be done is the laying of 8 miles of track.

The Belle Fourche Valley Ry. Co. has filed a plat with the Secretary of State changing the location of the line east from Belle Fourche, S. Dak.

The New Orleans, Mobile & Chicago R. R., B. V. Wright, Engineer Bridges and Buildings, Laurel, Miss., has asked the city council of Mobile, Ala., for franchises over certain streets. The company is planning a number of improvements for its terminals at Mobile.

The U. S. House District of Columbia Committee has made a favorable report on the bill seeking a charter for the East Washington & Suburban Ry. Co., which is said to be ready to spend $100,000 in the construction of a railway from Anacostia along the Good Hope, Bowen and Suitland roads to the Maryland border line, connecting with a line already existing in Prince George's county. Samuel E. Cox and Wm. A. Harrison, Suitland, Md., are interested.

The Denver, Laramie & Northwestern R. R. Co. has decided to construct its line according to the original plans, from Milliken to Laramie by way of Fort Collins, Colo.

At a mass meeting of the citizens at Pueblo, Colo., it was decided to extend the time granted the Kansas-Colorado R. R. for the construction of tracks from Santa Fe Ave. to the Arkansas River and to Turkey Creek Quarries.

Reports from Aberdeen, S. Dak., are to the effect that the Chicago, Rock Island & Pacific Ry. is considering the construction of a line from Watertown, S. Dak., to Winnipeg, Man.; and a branch from a point in North Dakota through Aberdeen, to Pierre, thence through Yankton and to Omaha, Nebr., crossing the Missouri River at Yankton.

Items Concerning Contractors and Their Work

RAILROADS, POWER DEVELOPMENTS, LEVEES, DRAINAGE AND IRRIGATION WORKS.

Arkansas Notes.

FROM CORRESPONDENTS AND OTHER SOURCES.

Good progress is being made with the construction of 10 miles of levee along the Arkansas River in Saline County for the Woodson Levee District. About 80 teams and 150 men are at work. The levee will cost $53,000. W. H. Brown, Woodson, Ark., is in charge of the work.

Work has commenced on the improvement of the St. Louis & San Francisco Ry. yards at Jonesboro. The work will include considerable grading and the construction of new tracks and sheds.

The Talley Timber & Tram Co., of Marmaduke, has been incorporated with a capital stock of $10,000 and purposes to operate sawmills and to construct and operate a steam tram railway. The incorporators are: W. E. Talley, John M. Gale and A. E. Bandol.

California Notes.

FROM CORRESPONDENTS AND OTHER SOURCES.

The Marysville & Colusa Ry. Co., has been organized with a capital stock of $1,500,000, of which $30,000 has been subscribed for the purpose of building an electric railroad from Marysville through Yuba City to Colusa, a distance of 30 miles. The new road will be a branch of the Northern Electric Ry. The incorporators include the following: Charles H. Hammon, Leon De Sabla, Samuel Lilienthal, San Francisco; George E. Springer, Piedmont; and Herbert W. Furlong, Pleasanton.

The Oakland Traction Co., Oakland, is planning to extend its Diamond car line through to Allendale and beyond to connect with the Mills College Line.

The Chino Land Water Co., has work underway at Chino on a new dam and reservoir. The reservoir will hold 45,000,000 gallons of water, which will be utilized in irrigating a large tract of land along the country road.

D. Donnegan, Los Angeles, has been awarded a contract at $8,850 by the Supervisors for grading approaches to a new bridge over the Tejunga Wash.

The Middle Yuba Hydro-Electric Power Co. is to begin operations shortly on its power scheme on the Middle Yuba below Graniteville. Flumes, ditches and reservoirs will be constructed, and also a power house. The company will supply Alleghany with light and power.

W. L. Courtright has applied to the town trustees of San Rafael for a franchise for an electric railway in 4th St. as far as the town limits toward San Anselmo. This is thought to be the initial step for building a line from San Rafael to Ross Valley towns.

Colorado Notes.

FROM CORRESPONDENTS AND OTHER SOURCES.

The City Council of Golden has granted a franchise to Rees C. Vidler to operate an electric railway on certain streets. This is part of a plan to operate an electric railroad from Golden to the foot of Lookout mountain, from which point a funicular line is to be built to the summit.

D. D. Morgan has been awarded the contract for grading and bridge building for the last ten miles of the Laramie, Hahns Peak & Pacific R. R. at Hebron.

Preliminary surveys have been completed for a railroad from Hotchkiss to the Crawford and Maher Districts, and to Red Canon. The line will be 30 miles in length and will develop deposits of almost pure gypsum in Red Canon. About $30,000 worth of stock has been subscribed in Crawford and the promoters state that as soon as $125,000 in stock is sold, work will be started. N. J. Olson, and George C. Harper, of Minneapolis, Minn., are promoting the project.

John A. McDowell Construction Co., has begun work at Lamar on its contract for constructing the first 15 miles of the Denver & Gulf R. R.

The Golden Cycle Mining Co., John T. Milliken, President, Colorado Springs, according to reports, is to build an aerial tram between the mill at Colorado City and the Golden Cycle mine in the Cripple Creek District. It will cost about $300,000.

The Santa Fe railroad officials have made arrangements for the improvement of the lines between Denver, Colo., and Pueblo. The work will include the construction of a number of new sidings and the straightening of the present track and is estimated to cost $1,000,000. F. M. Bisbee, La Junta, Colo., is Engineer Western Mines.

City Council of Paonia, Colo., is considering asking for bids for the construction of a concrete reservoir with a capacity of 1,000,000.

Joe Baum, Lamar, Colo., has been employed by the Two Buttes & Irrigation Co. to superintend the construction of their dam.

The Independent Construction Co., of Denver, has been incorporated with a capital stock of $50,000, the incorporators being Frank F. Cummings, Franklin T. White and E. George.

Idaho Notes.

FROM CORRESPONDENTS AND OTHER SOURCES.

The Caldwell Traction Co., of Caldwell, Idaho, has been incorporated with a capital stock of $250,000, of which $75,000 has been subscribed. The company has been formed for the purpose of making improvements to the present interurban line owned by W. R. Setree, Caldwell, who is the principal incorporator of the new company.

The Northwestern Engineering Co., Emmett, has begun work on its grading contract for extending the Payette Valley R. R. from New Plymouth to Emmett, a distance of 22 miles. Camp and commissary have been established at New Plymouth. Grading will be completed in 60 days.

Officials of the Oregon Short Line Ry. have definitely approved a new line to extend from Saline, on the main line of the Southern Pacific System, to Burley, Idaho, a distance of 175 miles. This line will shorten the distance between Salt Lake and Portland and other Oregon points fully 75 miles.

The Idaho Northern Ry., J. M. Clark, Chief Engineer, Nampa, Idaho, has filed in the U. S. Land Office at Boise a definite location map of the first section of the extension of the road from Emmett along the main channel of the Payette River to Horseshoe Bend, a distance of 25.07 miles. Actual construction work on this extension is to start just as soon as the plat for the extension can be approved by the department of the interior.

The Gilmore & Pittsburg R. R., now under construction to Salmon City, has completed surveys from that point to Lewiston, Idaho, a distance of 300 miles. This survey was started in May, 1909. In the passage from Salmon City to the mouth of the Salmon River, a distance of 260 miles, the river is crossed 13 times and four tunnels, ranging from 1,000 to 5,000 feet, have been located. T. H. Bacon, Machesney Bldg., Pittsburg, Pa., is Chief Engineer.

Nowlin & Sewell, Suburban Railroad promoters have returned to Idaho Falls, Ida., from a trip over the proposed route of railroad from this city east three miles, where a branch will run south through Ammon, Taylor, and Goshen and north branch will run through Lincoln, Iona, Willow Creek, Lorin, Popular and thence through to Heise's Springs.

Illinois Notes.

FROM CORRESPONDENTS AND OTHER SOURCES.

The Joliet and Southern Traction Co., H. A. Fisher, President, Joliet, has been securing property consents along Bluff Street at Joliet, between McDonough and Ruby Sts., with the intention of laying tracks along that street to connect its Rockdale line with its proposed line to Chicago, which will run north on the west side of the river from the end of the Ruby Street bridge. The new plan of the company is to build a new bridge across the river at Van Buren Street and run its cars from the present depot west to Bluff street and then turn south to Rockdale or north for Chicago.

The Caldwell Construction Co., of Chicago, has been incorporated with a capital stock of $10,000, and will engage in an engineering, contracting and construction business. The incorporators are Samuel W. Norton, R. Olmstead and Samuel Rothbum.

The W. H. Schott Co., of Chicago, has been incorporated with a capital stock of $2,500, and will engage in an engineering and construction business. The incorporators are James T. Jarrell, E. M. Claussen and A. M. Hayes.

The Chicago, Peoria & St. Louis Ry., W. A. O'Brien, Chief Engineer Maintenance of Way, Springfield, is to spend about $50,000 in track improvements during the present summer. Track sidings to the value of $10,000 will be constructed at Stohrs, Forest City, Oakford and Hop Hollow.

The Chicago & Northwestern Ry. is to move its yards, round house, turntable and freight depot at Barrington to a point west of the town.

The Chicago, Milwaukee & St. Paul Ry., D. J. Whittemore, Chief Engineer, Chicago, is to elevate its Bloomington Ave. tracks at Chicago, from Ashland to North Lawndale Avs., a distance of 2½ miles. The improvement, which has been agitated for ten years, will cost $1,500,000.

According to an announcement recently made at Monmouth, Ill., by the Rock Island & Southern Superintendent, all construction work will be completed between Rock Island and Monmouth by June 1.

Williams & Co., railroad contractors of Sterling, Ill., are reported to have a contract for the grading necessary for the Chicago & Northwestern yards at Fulton, Ill. It is estimated that the contract will involve about 200,000 cu. yds. of dirt. It is expected the company will put about 40 or 50 teams on the job and employ about 75 men.

Indiana Notes.

FROM CORRESPONDENTS AND OTHER SOURCES.

The Wabash & Northern Ry. Co., which projects an interurban line from Wabash to Fort Wayne, is stated to have been financed and proposes to have construction work started by July 1. J. A. Berry, Fort Wayne, Ind., is the promoter.

A company headed by Robert Wood, of Chicago, Ill., has applied to the Commissioners of Clinton County for a franchise to build an electric railroad from Logansport to Burlington in Carroll County, and then on by the way of Michigantown to Frankfort, the road to follow the old Michigan road to Michigantown and then alongside to right-of-way of the Clover Leaf to Logansport. The company promises to begin work on the road within two years or to forfeit the franchise. The aim of the new company is to connect with the Kokomo, Frankfort & Terre Haute line.

The Vincennes, Washington & Eastern Traction Co., of Washington, has been incorporated with a capital stock of $100,000 and proposes to construct and operate an inter-

urban line connecting Vincennes, Washington and Loogootee. The directors are: L. Ebner, A. F. Cabel, S. C. Eskridge, A. J. Padgett, J. B. Seal and E. J. Binford.

The Indianapolis, Columbus & Southern Traction Co., is reported to be planning to extend its line from Seymour to Bedford, passing through Brownstown.

Surveys have been started for the Wabash and Patoka levee which is to extend from Oakland City, in Gibson County, to New Harmony in Posey County. The levee will be built under the direction of the Commissioners of the counties named. It will cost about $325,000.

The Foster-Raiser Construction Co., of Union City, has started work on the construction of a reservoir for the city of Boonville.

Engineers of the Cleveland, Cincinnati, Chicago & St. Louis Ry. are making surveys for the construction of the proposed double track between Muncie and Anderson, Ind. C. W. Heuss, Indianapolis, Ind., is Engineer Maintenance of Way.

Iowa Notes.

FROM CORRESPONDENTS AND OTHER SOURCES.

The Commercial Clubs of Logan and Magnolia have appointed committees to consider the matter of building an interurban line between the two cities. It is proposed to build the line with local capital. F. D. Stevens, Logan, is secretary of the Commercial Club of that city.

Bowen & Son, Nashua, Ia., have the contract for constructing a concrete dam on the Cedar River near Waverly. The dam will be 14 ft. high and several hundred feet long.

The Union Mills Co., 2 Cedar Falls is planning to make improvements to its dams and buildings at Cedar Falls and Waterloo.

L. J. Highland, of Chicago, has been making surveys on the Iowa River near Columbus Junction for the purpose of constructing a dam to develop power there. The Commercial Association of Columbus Junction, has been promoting the project.

Forrestal & Downey, Milwaukee, Wis., have been awarded the contract at 7.97 cts. per cu. yd. for straightening Keg Creek between Glenwood and Mineola. The ditch will be eight miles long and will cost about $40,000.

Arrangements are being made for the construction of the Dakota & Kansas Southern R. R., from Sioux Falls, S. Dak., to Sioux City, Ia. Surveyors will, it is said, be in the field soon to outline the permanent survey. Fred Myern, Chicago, Ill., is interested.

Rumors are afloat in the vicinity of Mason City, Ia., that the Chicago, Rock Island & Pacific Ry. Co. is considering the construction of the line from Rockford to Mason City and on through Clear Lake to Forest City to connect the western division of the road with the line from the Twin Cities.

Advices from Waukon, Ia., state that the Missouri Iron Co. is purchasing right of way for the construction of a railroad from that place to the iron mines.

The Wabash R. R. is planning improvements at Moulton, Ia. A 5-acre tract of land was donated by the town and a 16-stall concrete roundhouse will be constructed, together with additional track. The work is estimated to necessitate an expenditure of $50,000.

Kansas Notes.

FROM CORRESPONDENTS AND OTHER SOURCES.

The Kansas District Court has decided in favor of the Shawnee County Commissioners, of Topeka, in making assessments on the proposed dike on the south side of the Kaw River. The dike will cost about $125,000.

Farmers near Muscotah in Jackson County, have organized a drainage district and propose to straighten Straight Creek to prevent the flooding of lands. It is proposed to cut out the turns for six miles, shortening the creek to 2½ miles. W. S. Gearhart, State Highway Engineer, Manhattan, Kan., is to make surveys, plans, and estimates.

The city of Topeka is to build a new levee around the Union Pacific trestle in North Topeka.

The Westinghouse, Church, Kerr & Co., Pittsburg, Pa., will start work at once on their contract for constructing the Kansas City, Mexico & Orient Ry. shops at Wichita, Kan. V. E. Stolbrand is superintendent of the construction company.

Ordinance has been introduced into the meeting of the City Commissioners providing for the construction of the Chicago, Great Western Ry., into the city of Leavenworth, Kan., from the east end of the Terminal bridge to the Missouri Pacific tracks at Short St. It is said that the Chicago, Great Western Ry. Co. is planning the construction of a $40,000 station at this place.

Kentucky Notes.

FROM CORRESPONDENTS AND OTHER SOURCES.

Steps are being taken by the business men of Owenton and Frankfort, Ky., to form a preliminary organization to have surveys made for an electric railway between the two cities. Col. Charles E. Hage, Frankfort, Ky., is interested.

The Clarksburg & Weston Traction Co., of Clarksburg, W. Va., has been chartered and proposes to build an extention of the Fairmont & Clarksburg Traction Co., from Clarksburg to Weston, a distance of about 24 miles, at a cost of about $750,000. The new company will be financed by the Fairmont & Clarksburg Traction Co.

The City Council of Covington has granted a right-of-way through this city to the Covington, Big Bone & Carrollton Traction Co. Work on the line is to be started soon.

The Baltimore & Ohio Southwestern R. R., J. B. Carothers, Chief Engineer Maintenance of Way, Cincinnati, O., according to reports, is to expend $300,000 for improving its terminal facility at Louisville.

Louisiana Notes.

FROM CORRESPONDENTS AND OTHER SOURCES.

Construction work is to be started on the projected Natchitoches & Southwestern Ry., which proposes line between Natchitoches, La., and Colfax. Surveys for the line were made some time ago. Charles Teal, Colfax, La., as mentioned in our last issue, is interested in this road.

The Kansas City Southern Ry., R. H. Gaines, assistant engineer, Mansfield, La., is said to have had surveys made from Leesville to Alexandria for a part of its proposed route into New Orleans.

The Algiers Railway & Light Co., of Algiers, La., is about to have work started on the extension of its line in Algiers and vicinity.

Steps are being taken to form a drainage district, comprising Concordia, Tensas, Madison and East Carroll Parishes. It is proposed to issue $1,000,000 of bonds, the proceeds to be expended for draining the lands. Jeff B. Snyder, Tallulah, La., is Chairman of the Committee.

Michigan Notes.

FROM CORRESPONDENTS AND OTHER SOURCES.

The Ann Arbor R. R., has offered to extend its line seven miles to New Lathrop, provided a bonus of $15,000 is raised. Jos. Wanbecq, Toledo, O., is Resident Engineer.

The Detroit United Rys. Co. is said to be considering the construction of a line from Muskegon to Flint, via Bailey, Belding and Owosso.

Plans have been formulated by the Grand Rapids & Indiana Ry. Co., for the improvement of terminals at Grand Rapids, Kalamazoo and Cadillac. The work will, it is estimated, cost about $3,000,000. E. H. Barnes, Grand Rapids, Mich., is Chief Engineer.

Minnesota Notes.

FROM CORRESPONDENTS AND OTHER SOURCES.

The County Commissioners at Minneapolis have awarded the contract for cutting the canal which will join Forest lake with the west arm of Lake Minnetonka to J. R. Johnson, for about $1,800.

The Duluth, Missabe & Northern Ry., H. L. Dresser, Chief Engineer, Duluth, Minn., has had surveys made for a cutoff south of London station, which will do away with the Clark Hill grade. The cutoff will commence at a point just south of the Gooseberry river and come out at a point near Alger Station on the Duluth & Iron Range Ry. It is said that the work will be done this summer.

The Minneapolis, St. Paul & Sault Ste. Marie Ry. Co., has filed articles with the Secretary of State of North Dakota providing for the construction of a 130-mile line from Drake in McHenry County and through Pierce, Benson, Ramsey, Grand Forks and Walsh counties, to Medford on the Thief River Falls, Minn., line.

Material is arriving at Barnesville, Minn., for the improvement of the Great Northern Ry. Company's line between Grand Forks, N. Dak., and Barnesville, Minn. All 75-lb. rails will be replaced with 90-lb. steel, involving an expenditure of about $1,000,000.

Duluth and the Ranges.

BY PETER E. MEAGHER.

Bernard S. Andrus, representing R. S. Blome Co., paving contractors, was a caller at this office recently. They were awarded a short while ago a paving job by the City of Eveleth, Minn., and the City of Grand Forks, N. Dak., and will start on the same immediately.

Pastoret & Lawrence, Contractors, were callers a few days ago, and purchased some new equipment for the various contracts they have under way at the present time.

Diffor & Riches, contractors, Superior, Wis., were awarded a contract for paving by that city, and have already started on the same.

The Foundation Co. of New York were awarded a contract for the sinking of a concrete shaft, by T. J. Walsh of Duluth, and have already started on the same. This shaft is to be constructed for the purpose of taking out ore from an iron mine.

John Runquist, railroad contractor, is quite busy at the present time. Besides several small contracts, he is working one shovel on the Duluth, Missabe Northern Ry.

C. J. A. Morris of Morris & Shepard, Contractors, St. Paul, was a caller at this office recently. He was up here looking over the several large dock contracts that they have here and at Superior, and said they were all in very good shape. He left here for his work on the Great Northern Railroad in North Dakota, where they are constructing about 145 miles of railroad for that company. He said the work was progressing out there in elegant shape, but they still could use two or three more good team contractors, preferring those who have grading machines.

Peterson & Holm were awarded a street paving contract by the City of Superior, Wis., and have already started on the same.

Eugene Fogg, General Superintendent for Petersen & Fell, boarding contractors, was a caller and said that they were very busy, and had a great many boarding outfits working, and that they looked forward to a very successful season in their line.

The Russell Construction Co. of Superior, Wis., were the successful bidders for a concrete curbing contract awarded by the city of Superior.

F. E. Paterson, representing the Brown Hoisting Machine Co., was a visitor at this office a few days ago. They have a sub-contract for the erection of the machinery to be used on the new Pittsburg Coal Dock at Duluth. C. J. A. Morris is the chief consulting engineer for this work.

Patrick McDonnell, the Duluth Contractor, came home for a day or two recently. He is very busy on the large sewer contract at Grand Forks, N. Dak., and is spending most of his time there.

The labor situation in Duluth is in a very good condition at the present time. There is a large demand for laborers, and there seems to

be about just enough men to fill the positions offered. However, as the season progresses, we look forward to a scarcity of laborers.

Contractors and others interested in the labor and equipment lines are invited to make the offices of Peter E. Meagher, 409 West Michigan St., Duluth, Minn., their headquarters when in this city. We are always glad to answer any correspondence pertaining to the contracting business in general in this vicinity.

Missouri Notes.

FROM CORRESPONDENTS AND OTHER SOURCES.

Surveys were started at St. Charles, Ill., early in May by W. W. Cauthorn, Chief Engineer of the Kansas City, St. Louis Electric Ry. Co. The survey will pass through Elm Point, St. Peters, St. Paul and strike the Lincoln County line at Old Monroe. Another corps of engineers started a survey from Warrenton, Warren County, and the two will join their surveys in Lincoln County. The company, as previously mentioned in these columns, has been organized for seven years and Eastern capital has lately been pledged for the enterprise. The direct line will pass through St. Charles, Lincoln, Warren, Montgomery, Callaway, Boone, Howard, Charlton, Carroll, Ray and Clay counties. There will be several branch lines, or feeders, in Northern Missouri counties.

Frederick Essen of St. Louis, Mo., acting for the promoters of the proposed electric railway for Olive St. at St. Louis has closed a deal with an engineering company whereby the latter will build the road. The new road will be fourteen miles long and will extend from Etzel Ave. and Hodiamont tracks along Olive Street road to both Creve Coeur lakes, each of which will be reached by branch tracks. The line will cost about $210,000.

Contracts for rails for the interurban line to be built from St. Joseph to Savannah, have been closed; and contracts for grading and tracklaying are said to be pending. The St. Joseph & Savannah Construction Co. has been organized to have general charge of the work. J. H. Van Brunt, St. Joseph, is Manager.

H. G. Horton, City Engineer, Springfield, has begun a resurvey of the Jordan Creek through the Jordan Valley at Springfield, preparatory to straightening the creek and cleaning it of rubbish and dirt.

Business men of Kirksville have engaged engineers to report on the development of power from the Chariton River. It is proposed to construct a dam which will furnish the power to pump the water six miles and to light the streets of Kirksville. It is estimated that such a power plant will cost $75,000 to $100,000.

The City Council of St. Louis has passed the bill requiring the Missouri Pacific, Wabash, Frisco and Terminal railroads to abolish the Compton Ave. grade crossing at St. Louis at their own expense. It places all the cost of construction and abutting property damages on the railroads, and requires that work begin in six months. The viaduct is to cost $400,000.

A bill has been introduced in the City Council of St. Louis to create a city plan commission, composed of 16 citizens and five city officials, and appropriating $25,000 for the work. The city officials are to be the presidents of the Council and the Board of Public Improvements, the speaker of the House of Delegates and the street and park commissioners. All are to serve without salaries, but the commission is permitted to employ legal, engineering, architectural and other counsel, and clerical help. It must finish its report by January 1, 1912. The purpose of the commission, as outlined in the bill, is to prepare a comprehensive city plan, after investigating the city's physical condition. The city plan is to cover river front improvements, extension of streets, opening of new sub-divisions, beautification of the Union Station vicinity, rapid transit, extension of car lines, playgrounds, parks, boulevard systems and grouping of public buildings.

Bills are to be introduced into the Municipal Assembly providing for the abolishment of all important grade crossings in St. Louis, Mo.

Montana Notes.

FROM CORRESPONDENTS AND OTHER SOURCES.

The Chicago, Milwaukee & Puget Sound Ry. Co., has filed first agreements for right-of-way for a line to be constructed from Musselshell, Mont., to Great Falls, a distance of about 200 miles.

The construction of an electric railway between Butte and Anaconda by way of Gregson Springs is reported under consideration, and the promoters are said to have already secured options on the Anaconda street railway and equipment and on Gregson Springs. I. A. Heilbronner, Main and Granite Sts., Butte Mont., and Charles F. Kelly, Butte, Mont., are reported to be interested.

The Great Northern Ry., A. H. Hogeland, Chief Engineer, St. Paul, Minn., has begun condemnation suits for right of way, and announcement has been made that the proposed 350 mile extension from Haucks, Mont., to Mondah will be constructed at once.

E. J. Anderson, White Sulphur Spring, Mont., is in receipt of information stating that a deal has been completed whereby a railroad will be constructed from Dorsey to the Springs. Work will be started, it is said, within a month.

Reports state that Donald McIntosh will start work soon on his contract for the construction of the Chicago, Milwaukee & Puget Sound cutoff from Lewistown to Melstone, and that the outfit will be in Lewistown, Mont., within 30 days.

New York Notes.

FROM CORRESPONDENTS AND OTHER SOURCES.

The Utica & Mohawk Valley R. R. Co., C. Loomis Allen, General Manager, Utica, is considering constructing this season a number of extensions to its trolley lines at Rome.

Residents of the towns of Cicero and Hastings have petitioned the Syracuse & South Bay Electric R. R. Co., Syracuse, to extend its lines from North Syracuse through Cicero village and Brewerton, to Central Square, in Oswego County.

The project for constructing a railroad from Deposit to Trout Creek, a distance of 17 miles has been revived, and it is believed that something will be done toward building the road. The Delaware & Southern R. R. Co., which proposes to build this line was incorporated five years ago to build the road, but nothing was done further than to secure authority to issue a mortgage on $400,000 and to obtain a certificate of necessity. George H. Perigo, Scranton, Pa., is interested.

The Business Men's Association, of Geneseo, has appointed a committee, of which E. Everett Doty is chairman, to consider the advisability of building a trolley line to connect the village with the Erie R. R. depot, which is located about one mile from the center of the town.

The G. B. Montgomery Co., of New York City, has been incorporated with a capital stock of $50,000, and will engage in general construction work, building bridges, railroads, etc. Geo. B. Montgomery, 1030 Hoe Ave., New York City, is principal incorporator.

The Elmira, Corning & Waverly Traction Co. of Elmira, has now practically secured all rights of way for the proposed extension of its line from Elmira to Corning, and it is expected that active work in construction of the line will begin soon.

A resolution is before the State Legislature to permit the New York & Canadian Pacific R. R. Co., of which Verplanck Colvin of Albany is the head, to continue and complete the construction of its proposed new standard gage steam railway, extending across the state from New York City to the Canadian line.

The State Public Service Commission has granted an extension of one year to the Hudson & Manhattan Railroad Co. (the McAdoo tunnels) for the completion of the subway in Sixth Ave. from 23rd to 33rd St., New York City. The time would have expired June 15. The extension also applies to the building of the spur under Ninth St. to Fourth Ave.

The Bayonne Subway & Development Co. has been formed at Port Richmond (L. I.), N. Y., for the purpose of having a tunnel built under the Kill von Kull from Bayonne, N. J., to Port Richmond. This tunnel, according to the plans of the promoters, is to connect with the Hudson tunnels and a system of electric roads on Staten Island. According to estimates the subway could be built for $600,000.

Officials of the Delaware & Eastern Ry., which is now in the hands of receivers, have been over the route, making an examination to ascertain whether the making of additional improvements will put the road on a paying basis. It is believed that these improvements will be made. O. F. Wagenhoist, Margaretville, N. Y., is General Superintendent.

Hearing is to be held June 8 on the petition filed by the Boston & Albany R. R., to condemn land in Richmond and Hinsdale for right of way to lay a third track.

Hearings are again being held by the Public Service Commission on the construction of the Buffalo, Rochester & Eastern R. R. Co. double track line from Buffalo to Troy. If permission is given to construct the road terminals will be constructed at a point north of the West Albany yard on the New York Central with a capacity of 3,030 cars and between Troy and Albany, with a capacity of 360 cars.

Chamber of Commerce of Syracuse, N. Y., is to take active steps toward securing the construction of branches from the Lehigh Valley and the New York, Ontario & Western R. R.'s to that place. The former is 20 miles distant and the latter 18 miles from Syracuse.

Ohio Notes.

FROM CORRESPONDENTS AND OTHER SOURCES.

The Dayton, Springfield & Xenia Southern Traction Co., has completed preliminary surveys between Xenia and Washington for a proposed traction line.

The Norfolk & Western Ry., C. S. Churchill, Chief Engineer, Roanoke, Va., has secured 8½ acres of land just north of Chillicothe, which will enable the company to change the course of a creek, cut out a grade and straighten the road so that the double tracking can be proceeded with.

The City Engineer of Alliance, has completed plans for the 5th St. subway in that city, and has plans well underway for the Arch Ave. subway.

Over $182,000 of stock for the proposed New Castle & New Wilmington Ry. Co.'s line is reported to have been subscribed. According to reports J. G. White & Co., of New York City, are to build the line if $300,000 of stock is subscribed.

The Pennsylvania R. R. is said to be ready to expend $3,000,000 on Whisky Island ore docks and appliances as soon as the city of Cleveland is ready to trade land at the north end of Bank Street, needed for a switchway.

Superintendent of Parks Madden of Dayton, is considering a plan for beautifying the trend of the Miami & Erie Canal, by a system of parking. The work will cost about $3,000.

A special committee at Marshfield, of which William Voegele, Sr., is chairman, is raising a fund of $1,000 to have preliminary surveys made for an interurban line to connect Marshfield with Mt. Gilead and Delaware.

The Norfolk & Western Ry., C. F. Losh, Assistant Engineer, Portsmouth, O., will expend about $35,000 for an underground crossing at Haverhill. The crossing will be 24 feet inside and 30 feet from the abutments. It is also proposed to make a 16-foot road, of stone, 15 in.

The Forest City Construction Co., of Cleveland, has been incorporated with a capital stock of $15,000, the incorporators being Harry A. Cone, Walter S. Raeder, Ferdinand A. Krauss, Gustav Shelds, G. P. Phillips.

The General Traction Development Co., of Cleveland, O., has been awarded the contract

for making surveys for the proposed electric lines from Marion to Mt. Vernon and Mt. Gilead to Mansfield and Delaware. The Roberts & Abbott Co., Cleveland, O., will make the surveys.

Oklahoma Notes.

FROM CORRESPONDENTS AND OTHER SOURCES.

Final surveys have been started for the projected interurban line between Morrison and Stillwater, and it is said that grading work will be started some time this month. This is the line promoted by L. J. Lampke. F. A. Brown, 806 Main St., Stillwater, Okla., is Constructing Engineer.

The West Tulsa Belt Line Ry., of Tulsa, which has recently been granted a franchise by the commissioners of Tulsa county, is planning to have construction work started shortly. The railway as projected will extend from Le Fevre of the Texas company's station on the Midland Valley, to Lost City on the Enid division of the Frisco, a distance of nearly eight miles. It will connect the three refineries in West Tulsa and will enter the sand quarries near Lost City. Surveys have already been made.

According to a statement recently made by William Kenefick, President of the Missouri, Oklahoma & Gulf R. R., at Phoenix, Ariz., actual construction work will be started about August, 1910, on the northern extension into Kansas City. As proposed the line will pass through Joplin and Pittsburg, Kan. Headquarters of the railroad are at Kansas City, Mo.

According to advices from Tulsa in regard to the proposed line of the Kansas City Tulsa & Southwestern, construction work will be resumed within a month. All surveys have been made and bonds amounting to a sufficient sum to build from Tulsa to Joplin have been disposed of. As proposed, the line will eventually extend to Paris, Tex.

The Choctaw, Newcastle & Western R. R., which at present has three miles of line in operation, is to build 11 additional miles to form a connection between the Rock Island track near Alderson and the Missouri, Kansas & Texas road at Savanna.

Oregon Notes.

FROM CORRESPONDENTS AND OTHER SOURCES.

According to a statement at Portland, of C. M. Atkinson, President of the recently incorporated Portland, Baker City & Butte electric road, surveys will be started soon. The plan is to build from Portland through Clackamas County to the head of Warm Springs to the junction of the Deschutes River, thence eastward to Baker City.

The Coos Bay Rapid Transit Co., W. P. Evans, President, North Bend, is negotiating for franchises in Marshfield and proposes to have the work in its proposed electric railway between Marshfield and South Bend started soon.

Announcement has been made that the main line of the Oregon Railway & Navigation Co. between Pendleton and Yoakum, Ore., is to be rebuilt. The distance is 14 miles and the improvement will cost $1,000,000. G. W. Boschke, Portland, Ore., is Chief Engineer.

The Astoria Southern Ry. Co. has been incorporated with a capital stock of $500,000 and proposes the construction of a line of railroad from Astoria, along the east bank of Youngs Bay and Youngs River south to points on Nehalem Bay and Tillamook County. The incorporators are Lester W. Humphreys, Warren Thomas and Otto J. Kraemer, all of Portland, Ore.

Committee of citizens of Jacksonville, Ore., have succeeded in securing practically all right of way necessary to insure the construction of the Pacific & Eastern R. R., from Blue Ledge Mine, near Hutton, on the California Line to Jacksonville, Ore. John R. Allen is President of the railroad company, and William Gerig, Medford, Ore., is Chief Engineer.

The Fir Lumber Co., Cottage Grove, Ore., has started work, it is said, upon the construction of a logging railroad from the terminus of the Oregon & Southern three miles into the forest reserve.

According to advices from North Bend, Ore., L. D. Kinney has subscribed $250,000 toward the construction of the proposed railroad of the Lane County Asset Company from Eugene, Ore., to Coos Bay, by way of Siuslaw. It is expected that construction work will be started shortly on the line.

The Beaver Construction Company has been incorporated with principal offices at Salem, Ore., and capital stock of $25,000. The incorporators are M. E. Ingraham, G. E. Walsh and I. G. Streit.

Pennsylvania Notes.

FROM CORRESPONDENTS AND OTHER SOURCES.

The Philadelphia & Western R. R. has applied to the West Conshohocken Town Council for a permit to lay tracks and operate cars in the borough from the western to the eastern boundaries, the route ending at the Schuylkill bridge leading to Conshohocken.

The Lehigh Coal & Navigation Co., of Mauch Chunk, will in the near future have work started on a line of railroad from Hauto to Coalport, 10 miles, to convey coal to the proposed power plant at James Run to serve as a feeder for the Lehigh Canal.

The Pittsburg & Lake Erie R. R. is said to be considering building an additional track up the Monongahela River from Pittsburg to Connellsville, making a 4-track line between those places.

The Kittanning Railroad Co. has been incorporated with a capital stock of $20,000 and proposes the construction of a railroad line 1.7 miles from the line of the Allegheny Valley Division of the Pennsylvania Railroad in Kittanning, Pa., to Montieth and Water Sts. in Wickboro. The incorporators are H. A. Colwell, J. D. Galbraith, Mont Bixler and W. V. Thorp, Kittanning; F. C. Neale, Pittsburg, Pa.

Connellsville & State Line R. R. Co. has been incorporated with a capital stock of $700,000 and proposes the construction of a line of railroad 68½ miles long from Connellsville to the Mason and Dixon line, one mile east of the boundary between Garrett and Allegheny counties, Maryland, extending through Somerset and Fayette counties. The incorporators include: W. A. Wilbur, South Bethlehem, President; G. S. Schmidt, York, Pa.; C. H. Early, W. H. Ruppel, C. F. Uhl, Jr., John N. Snyder, Josiah Swank, C. W. Walker, F. W. Biesecker, Connellsville, Pa.

As almost two-thirds of the preferred stock has been sold, the construction of the proposed line of the New Castle & New Wilmington Ry. Co. is reported to be assured.

The Juniata Valley Construction Co. has been incorporated with a capital stock of $50,000, and will engage in the construction of electric, steam and gasoline electric railroads. A. J. Starr, F. E. Seel, C. W. Fisher and B. F. Godard, all of Huntington, Pa., are interested.

Tennessee Notes.

FROM CORRESPONDENTS AND OTHER SOURCES.

The Chicago, Memphis & Gulf R. R. has filed its articles of incorporation at Frankfort, Ky., and proposes a line to extend from Dyersburg, Tenn., west to Memphis, and thence to St. Louis and north to Chicago, and from Dyersburg, south to Mobile, stretching across the United States from the lakes to the gulf in a direct line. The incorporators are: G. T. Weakley, John H. Watkins, 2 Wall St., New York; S. G. Latta, Dyersburg, Tenn.; E. Rice, J. C. Doyle, R. M. Hall, Charles A. Hall and W. H. Ruhe. The company now owns the Dyersburg Northern R. R., 31 miles long, which is now being operated under the name of the Chicago, Memphis & Gulf R. R.

Preliminary surveys for the proposed belt line around the city of Jackson, Tenn., have been made. The survey and estimates of costs were made by engineers of the Illinois Central R. R., and will be submitted to the other railroads entering Jackson for decisions as to whether they will finance the project.

A drainage district has been organized at Obion for the purpose of straightening the Obion River from the mouth as far as Rives, Tenn. B. E. Fletcher, Chief Engineer of the district, is now engaged in making maps and plans for this projected improvement.

Texas Notes.

FROM CORRESPONDENTS AND OTHER SOURCES.

The Northern Texas Traction Co., H. T. Edgar, Manager, Fort Worth, has been granted permission to double track its line on three streets in Fort Worth.

The Austin Electric Ry. Co., W. J. Jones, President, Austin, Tex., is to at once extend its car lines on a number of streets in Austin.

The Wichita Falls & Northwestern Ry., R. A. Thompson, Chief Engineer, Wichita Falls, has completed extensions to Elk City, Okla. Contract is to be awarded immediately for a 20 mile extension to Hammon, north of Elk City.

The City Council of Austin is to grant a franchise to C. V. Birkhead, of San Antonio, to build and operate a street railway in South Austin. The company is to be known as the South Austin Street Ry. Co.

The East Texas Traction Co. has submitted a proposition to the Chamber of Commerce of Dallas regarding the construction of an interurban line from Dallas to Terrell. The estimated cost of the line is $1,000,000 and Dallas is required to subscribe $150,000 as its share.

The McCullough Construction Co., St. Louis, Mo., has been awarded the contract at $30,000, for constructing the roundhouse and machine shops of the Wichita Falls & Northwestern Ry. at Wichita Falls. The coal chute and turntable will be constructed by the railway, of which R. A. Thompson, Wichita Falls, is Chief Engineer.

Press reports state George W. West, Oakville, Tex., owner of a ranch of 120,000 acres in Live Oak County, has offered to give $100,000 to any one who will build a railroad through the property. At present this ranch is situated more than 25 miles from the nearest railroad shipping point. Two or three propositions are being considered for building a railroad between Beeville and Eagle Pass, passing through Mr. West's ranch, but nothing definite along this line has as yet been done.

The C. H. Sharp Contracting Co., Kansas City, Mo., has the contract for revising the grades of the Santa Fe Ry. between Temple and Coleman. An appropriation of $300,000 has been made for the work.

Preliminary work is well under way for the new pleasure pier at Port Arthur. The engineering work is being done by P. H. Harris and D. K. Miller for the pier company, and F. F. Axtel for the government, and within the next few days their reports will be submitted. G. N. Bliss, Port Arthur, is Chairman of the Building Committee.

The City Council of Port Arthur has extended the franchise of the local traction company for 20 years. The company agrees to shell both sides of its track for 5 ft. from Seventh St. on Houston Ave., to Shreveport Ave. on Proctor, a distance of ten blocks and run its line on the side of Houston Ave. instead of the center from Seventh St. on Houston Ave. to Texas refinery.

The State Railroad Commission has granted the Houston & Texas Central R. R. permission to register bonds in the sum of $2,383,000, first mortgage thirtys at 6 per cent on its Mexico-Nelleva cutoff. The application for the issuance of an additional $484,393 was also approved, the amount to be used for the completion of the road, the bonds to be issued as the improvements call for.

E. L. Lancaster, who filed a petition with the Municipal Commissioners for privilege to construct an electric interurban line in East Dallas, Tex., from Fair Grounds through Mount Auburn, is urging them to take action in the matter.

First location survey for the proposed line of Gainesville, Oklahoma & Western R. R., from the city of Gainesville, Tex., to Bridgeport, has been completed by the crew under F. B. Truax, Chief Engineer of the company.

The final survey will be started soon and upon the completion of that grading will be commenced.

The Texas, New Mexico & Pacific Ry. company has filed a blue print plat of its proposed two-mile line from Las Cruces, N. M., to Agricultural College, with Nathan Jaffa, Territorial Secretary. Charles L. Post is Chief Engineer of the railroad.

Utah Notes.

FROM CORRESPONDENTS AND OTHER SOURCES.

George M. Miller of Huntington, Utah, representing the Twin Peaks Reservoir Association has filed with the United States land office an application for a right-of-way for the construction of a canal and reservoir in Emery and Carbox counties. It is proposed to construct a canal starting at Miller Creek in Carbon county, and running in a southeasterly direction through townships 15 and 16 south, range 9 east and into Emery county, to connect with the proposed reservoir. The canal it is estimated will be six miles in length and will carry the waters of Miller Creek to the reservoir. The length of the dam is given as 1,802.02 ft. and its height as 18 ft. The area of the reservoir will be 114.07 acres, and its capacity 550 acre feet.

The Snake Creek Mining & Tunnel Co. has been incorporated under the laws of Delaware with a capital stock of $1,000,000. Jesse Knight, Provo, Utah, is President and Geo. W. Lambourne, Salt Lake City, is Secretary.

Virginia Notes.

FROM CORRESPONDENTS AND OTHER SOURCES.

An ordinance is before the City Council of Norfolk, Va., in which the Norfolk & Portsmouth Traction Co. asks a number of concessions in return for which the company proposes to build a number of extensions to its trolley service.

Surveys are now being made for the projected line of the Emporia & Ahoskie Ry., which will connect with the Atlantic Coast Line at Emporia, Va., and will cross the S. A. L. at Margarettsville, N. C., then extend on to Pendleton, Murfreesboro and Ahoskie.

It is reported directors of the Norfolk & Western R. R. are considering the advisability of running the railroad from Fries, Va., to Ballon Mine. C. S. Churchill, Roanoke, Va., is Chief Engineer of the company.

Washington Notes.

FROM CORRESPONDENTS AND OTHER SOURCES.

The Hewes Construction Co., Chicago, Ill., has started work at Chehalis, preparatory to laying the rails for the electric line that is to connect Chehalis and Centralia. Grading work is under way all along the line. J. H. Clark, Chehalis, is representative of the constructors.

The Sciele Canal Co., of Wenatchee, has been incorporated with a capital stock of $10,000, incorporators being L. P. Nurton, E. Bohlme and DeVere Utter.

Plans for the Klickitat Irrigation & Power company's canal, by which it is proposed to irrigate Horse Heaven lands in Yakima, Klickitat and Benton counties, have been filled with the United States land office at North Yakima. The length of canals covered by these filings is 42 miles. Preliminary surveys carried as far as Glade show 110 miles of canals, and the line through Benton county is additional. This means the canals will be over 200 miles long. The intake is to be slightly north of the mouth of Pearl creek, on the Klickitat river. A storage dam will be constructed there 676 feet long and 26 feet high.

The Western Construction Co., of Spokane, has been incorporated with a capital stock of $100,000, the incorporators being George W. Shaeffer, John I. Fisher and H. P. Nichols.

The Seattle Electric Co., George P. James, Chief Engineer, Seattle, has announced final plans for the electrification of the Madison St. cable line between Broadway and Madison Park, and the selection of a site for the new cable line power house which will operate the cable cars between Broadway and the water front.

The Mount Adams Ry. Co., of White Salmon has filed its articles of incorporation announcing intention of building a line of railway in Klickitat county to connect the towns of White Salmon and Glenwood in the same county. The capital stock of the company is $50,000 and the incorporators are C. L. Coburn, Tunis Wyres, Rik Field, Rudolph Lauterbach, T. F. Sheppler, A. H. Jewett and W. W. Swan.

Announcement has been made by President Suksdorf, of the proposed Columbia River & Mount Adams Railroad Co., which projects a line up the White Salmon Valley, to the effect that capital has been secured and construction is now assured.

According to a dispatch from New York, the directorate of the Chicago, Milwaukee & St. Paul R. R. has appropriated $12,000,000 for the improvement and extension of the Chicago, Milwaukee & Puget Sound in the state of Washington and to construct lines north and south in the Pacific Coast states.

West Virginia Notes.

FROM CORRESPONDENTS AND OTHER SOURCES.

The Baltimore & Ohio R. R., is said to be planning to have construction work started at once on a branch line from the M. R. Division at Worthington, W. Va., up Teverbaugh to a new coal field. The branch will be several miles long and will be an expensive piece of construction.

The Baltimore & Ohio R. R., J. B. Carothers, chief engineer maintenance of way, Cincinnati, O., according to reports is to soon begin the construction of a 90,000,000 gallon reservoir at Clarksburg, W. Va., with a tunnel pipe line 50 miles long.

The Mannington & Smithfield R. R. Co., of Mannington, W. Va., has been incorporated with a capital stock of $25,000 and proposes to build a railroad from Mannington, in Marion county, to Smithfield, in Wetzel county. The incorporators include: Fred W. Bartlett, R. J. Abbaticchio and S. A. Hendrickson, all of Mannington.

Wisconsin Notes.

FROM CORRESPONDENTS AND OTHER SOURCES.

The Park Board of Milwaukee, Charles G. Carpenter, Superintendent, is to extend the Lake Shore drive about 600 ft. this season. This drive will be extended behind a revetment to protect it from the action of the waves.

The Chicago & Wisconsin Valley R. R., Allen T. Russell, General Manager and Chief Engineer, Chicago, Ill., will, it is stated, shortly let grading contracts for the interurban line between Portage and Madison. J. E. Jones, Portage, is Treasurer.

The Green Bay & Western R. R., J. A. Jordan, General Manager, Green Bay, Wis., is reported to be planning extensive improvements for its terminals at La Crosse.

Contract has been awarded Donald Jeffry for the construction of a section of the Chicago & Northwestern line between Tunnel City, Wis., and Raymore. Work will be started about June 1.

The Wisconsin R. R. Commission will hold hearings May 25 and 26 on the application of the Fox River Valley Co., for a certificate of convenience and necessity for the construction of the line from Cedarburg to Milwaukee, Wis.

The Milwaukee-Western Ry. Co. has secured options or purchased right of way from Sussex through the town of Lisbon and the village of Pewaukee to Waukesha and is contemplating extending its line south to Lake Geneva and ultimately to Chicago, Ill.

Wyoming Notes.

FROM CORRESPONDENTS AND OTHER SOURCES.

Preliminary surveys are to be started soon, it is said, for the proposed interurban line and street railways at Sheridan, Wyo., franchises for which have been granted to Emanuel & Sullivan, of Dayton, O. W. H. Scothorn, Hutchinson, Kan., is the engineer.

Canadian Notes.

FROM CORRESPONDENTS AND OTHER SOURCES.

The Nipissing Central Ry., which recently placed in operation an electric railway from Hailesburg, Ont., to Cobalt is considering extending the line to New Liskeard. Preliminary surveys were made some time ago and applications for a franchise are now before the Village Council.

The Private Bills Committee of the Upper House of the Canadian Legislature has passed the bill giving the Montreal Street Ry. Co. general powers to build underground lines at Montreal, Que. A clause in the bill provides that the company shall spend $2,000,000 on the subway within four years.

The Canadian Pacific Ry. has acquired $100,000 worth of land in the east end of London, Ont., near Quebec St. The land will be used for shops, roundhouse, station, office buildings, etc., which will be erected on the south side of the tracks on Quebec St. The company is also arranging for a downtown station. It is also reported that the C. P. R. will acquire the London & Port Stanley Ry.

The citizens of Regina, Sask., have voted against the granting of a street railway franchise to J. W. DeC. O'Grady of Winnipeg.

Residents in the municipality of St. Francois Xavier are endeavoring to induce the Street Ry. Co. to extend the Headingly lines a distance of ten miles.

The Toronto Railway Co. has submitted to the Ontario Railway and Municipal Board for approval the following list of new street car lines the company agreed to construct in Toronto: Teraulay St., from Queen to Agnes, west across University Av.; Anderson and St. Patrick to Bathurst; Victoria St., from Adelaide to Wilton east, across the new bridge to a point east of Broadview Av.; Shuter St. from Yonge to Victoria; Harbord St., from Spadina Av. to Ossington Av.; single track on Louisa St., Teraulay to James; single track on James St., Louisa to Queen.

The Canadian Pacific Ry. is planning to begin work in June on improvements at Toronto, Ont., which will include a subway on Yonge St., a new passenger station there, and extensive freight sheds. Yonge St. will be lowered considerably, and the company's tracks raised several feet. The latter will not make the viaduct ascent and descent so steep as at first intended. The purchase of the lands and the construction of the subway will cost the company nearly $600,000 or over.

Snyder Bros., Portage La Prairie, Man., have been awarded the contract at $40,528, for building a dam on the Little Saskatchewan River at Minnedosa, Man.

The stockholders of the Lake Superior Corporation have voted favorably on the proposal to issue securities of the Algoma Central & Hudson Bay Ry., a subsidiary of the Lake Superior corporation, to the amount of about $3,500,000, to finance the completion of the railroad to a connection with the main line of the Canadian Pacific. It is planned to complete the Algoma Central railroad from Saulte Ste. Marie to Josephine Junction, and thence to Hobon, where it will connect with the Canadian Pacific. C. N. Coburn, Sault Ste. Marie, Ont., is Chief Engineer.

The O'Boyle Construction Co. has been awarded a contract for the construction of 31 miles of railroad from Hawk Lake, Ont., to Hobon, which will connect the C. P. R. and the A. C. R. The contract calls for the completion of the road within a year's time. The O'Boyle Construction Co. is now engaged on the nine-mile branch, which will connect the Josephine mine with the Magpie River. A large force of men are hurrying the work through, and its early completion is assured. The O'Boyle company is also undertaking the completion of the gap on the Manitoulin & North Shore Ry., between Espanola and Little Current, which will connect the Georgian Bay with Sudbury, Ont.

Charters and subsidies having been obtained and English and French capitalists will

soon be asked for financial support in behalf of a new railroad, the Montreal, Kapatchawan & Rupert Bay, capitalized at $3,000,000, which is designed to link Montreal with the Grand Trunk Pacific or the Transcontinental. The project will involve the construction of 194 miles of line. E. J. Reambooth, Chief Engineer, is already making surveys.

The contract for constructing Sec. No. 6 of the Trent Valley Canal has been let to the Bishop Construction Co. of Montreal and Toronto. This contract takes in the section of about four miles from Crowe Bay to Healy Falls, the "missing link" of navigation from Campbellford to Georgian Bay.

The Canadian Pacific Ry. is reported to have purchased control of the Dominion Atlantic Ry. from Halifax to Yarmouth, N. S., together with the Midland branch between Windsor and Truro. In addition to reaching Halifax the C. P. R. has had in contemplation for some time the pushing of its line east to Sydney and Louisburg and the acquisition of the D. A. R. is believed to be preliminary to undertaking such an extension.

Jacobs, Davis & Forgie, Consulting Engineers, New York City, have been retained by the city of Toronto to prepare a preliminary report on subways in Toronto. City Engineer Rust of Toronto has estimated the cost of a subway on Yonge St. from Front St. to a point 500 ft. south of St. Clair Ave., at $1,400,000 per mile, or a total of $4,017,000. This does not include land damages, which, it is thought, will not be heavy. The equipment will cost about $300,000, and the maintenance $60,000 per year. The surface lines to be constructed in connection with the subway will cost $70,000 per mile.

Mexican Notes.

FROM CORRESPONDENTS AND OTHER SOURCES

The Mexico, Northwestern Ry., B. H. Bryant, Chief Engineer, Casas Grandes, Chihuahua, Mexico, is to have work started at once on its projected branch mentioned in our last issue. The branch is to run from San Antonio on the main line running west from Chihuahua to the town of Cusihuiriachic. The length of this branch will be 24 kilometers.

The National Railways of Mexico have placed an order with the Campania Industrial de Michoacan for 12,000,000 cross ties, to be delivered during the next ten years.

The Mexican Ry., Walter Morcorn, General Manager, City of Mexico, has assumed control of the mule traction line between Santa Ana Chiautempan and Tlaxcala, recently purchased by the Mexican Railway Co., from the estate of Mariano Fortuno. The line will probably be converted to steam traction and will probably be extended.

Over 1,200 men are now engaged in the construction of the first 50 kilometers of the Durango-Llano Grande Ry., which will be constructed to extend 100 kilometers west of the terminus of the International into the dense forest regions. The first half of this work will be done by the Compania Bancaria de Fomento y Bienes Raices de Mexico, S. A. of the City of Mexico. The second half will be done by Jack Phillips. F. V. Lister, of F. V. Lister & Co., City of Mexico, will manage the construction work on the railway.

Surveys have been started from Gulfport, Miss., for the new interurban railway from McComb to Godbold Mineral Wells, via Summit. J. E. Randall, of Gulfport, Miss., is the contractor in charge of the work, and S. D. Wilkinson, Gloster, Miss., is the engineer.

Advices from Pingree, N. Dak., state that actual construction work has been started upon the Pingree-Wilton extension of the Northern Pacific Railroad, and grading is well under way.

Two preliminary surveys have been made by Mark B. Kerr, Consulting Engineer for the proposed route of the Mono Lake railroad, in Nevada. It is planned to make a connection somewhere with the Tonopah & Goldfield line.

BIDS ASKED

Bridges.

Bids are asked on following work, the notes being arranged alphabetically by states:

Denver, Colo.—Until noon, May 28, by Charles W. Comstock, State Engineer, for the construction of a steel bridge across the Grand River near Lacy in Garfield County, Colo.

Highland Park, Ill.—Until 8 p. m., June 7, by City Council, for furnishing all labor and material necessary for the construction of 6 reinforced concrete girder type bridges. H. L. Bowen is Commissioner of Public Works. Official advertisement of the work will be found elsewhere in this issue.

Hammond, Ind.—Until noon, June 6, by Board of County Commissioners, for the construction of a steel bridge over the Grand Calumet River. Charles Johnson is Auditor of Lake County, Indiana.

Madison, Ind.—Until 1 p. m., June 7, by County Commissioners, for the construction and repair of bridges. G. F. Crozier is Auditor of Jefferson County.

Shelbyville, Ind.—Until 10 a. m., June 7, by County Commissioners for the construction of bridges and bridge repairs in Shelby County. G. W. Huntington is Auditor.

Farmington, Mo.—Until 1 p. m., June 7, by Thos. H. Holman, County Highway Engineer, for the construction of four steel bridges.

St. Louis, Mo.—Until June 21, by Board of Public Improvements, for the construction of foundations and concrete work for concrete viaduct with necessary approaches on Kings highway from Manchester Ave. to McRee Ave. Mazime Reber is President. Official advertisement of the work will be found elsewhere in this issue.

New York, N. Y. Until 3 p. m., May 26, by Park Board, Borough of Manhattan, New York City, for all labor and materials required for repairs to Washington Arch in Washington Square, Borough of Manhattan.

Smithfield, N. C.—Until June 6, by Sam T. Honeycutt, clerk County Commissioners, for the erection of iron bridge.

Dayton, O.—Until noon, May 25, by Department of Public Service, for the construction of a concrete steel bridge, Melan System, over Great Miami River at Stewart Street. The structure will consist of 7 86-ft. span arches; with 40 ft. roadway and 9-ft. sidewalks. F. J. Cellarius is city engineer.

Dayton, O.—Until noon, May 25, by William A. Budroe, Secretary, Public Service Department, for the construction of a new bridge at Stewart St. The estimated cost of the structure is $170,000. It will be 650 ft. long and will consist of 7 steel and concrete spans.

Troy, O.—Until 10 a. m., June 8, by County Auditor, A. E. Sinks, for the construction and material of the substructures of the following bridges: Bridge over the Miami River, one mile east of Tippecanoe City, O.; the Broadford bridge, over the Miami River, east of Troy, O.; the Short Street bridge, over the Miami and Erie Canal, Troy, O.

Warren, O.—Until May 23, by County Commissioners, for the construction of a bridge over Yankee Run on East Liberty St., in Hubbard. Fred T. Stone is County Auditor.

Warren, O.—Until 1 p. m., June 6, by Board of County Commissioners for the necessary labor and material for the construction of the superstructure of a bridge over Grand River about 1½ miles east of West Farmington. Fred Stone is Auditor of Trumbull County.

Lincoln, Neb.—Until 2 p. m., June 2, by H. E. Wells, County Clerk, for the construction of all bridges ordered in Lancaster County, Neb., for one year from date of contract.

Fort Sill, Okla.—Until 10 a. m., June 10, by Capt. David L. Stone, U. S. A., Constructing Quartermaster, for steel highway bridge across Cache Creek.

Lexington, S. C.—Until May 21, by County Commissioners for the construction of a steel bridge over the Saluda River at Wyse's Ferry, about 6 miles from this city.

St. Marys, W. Va.—Until 2 p. m., May 26, by R. L. Griffin, County Court Clerk, for the erection of the steel work and masonry for the proposed new wagon bridge over Middle Island Creek at Arvilla.

Buildings.

Bids are asked on following work, the notes being arranged alphabetically by states:

Birmingham, Ala.—Until noon, June 1, by Board of Education, for furnishing and installing three steam-heated mechanical blast heating and ventilating plants in public schools in Birmingham, Ala.

Crown Point, Ind.—Until 10 a. m., June 7, by County Commissioners, for the steel fixtures for the court house building at Hammond, Ind. C. A. Johnson is Auditor of Lake County.

New York, N. Y.—Until 11 a. m., June 11, by Bureau of Yards and Docks, R. C. Holcomb, chief, Washington, D. C., for an addition to female nurses' quarters at the U. S. Naval Hospital, New York, N. Y.

Plattsburg Barracks, N. Y.—Until 10 a. m., June 9, by Capt. Edward T. Hartmann, Constructing Quartermaster, Plattsburg Barracks, N. Y., for the construction of four sets of officers' quarters at Plattsburg Barracks, N. Y.

Whipple Barracks, Ariz.—Until 3 p. m., May 31, by Lieut. G. G. Bartlett, Constructing Quartermaster, for furnishing labor and material for the construction of quartermasters' storehouse at Whipple Barracks.

Washington, D. C.—Until 11 a. m., August 25, by Col. F. L. Denny, Quartermaster, U. S. Marine Corps, Washington, D. C., for the erection of a marine barracks, officers' houses and servants' quarters at the naval station, Pearl Harbor, T. H.

Columbus, Ind.—Until 3 p. m., June 20, by James Knox Taylor, Supervising Architect, Treasury Department, Washington, D. C., for the construction, complete, including plumbing, gas piping, heating apparatus, electric conduits and wiring, of the United States Post Office at Columbus, Ind.

Fort Des Moines, Ia.—Until 3 p. m., May 25, by Constructing Quartermaster, Fort Des Moines, Ia., for the construction of one fire apparatus building, one quartermaster stable, one hay shed, one coal shed and one shop building, including plumbing, electric wiring and fixtures.

Fulton, Mo.—Until 4 p. m., June 1, by Board of Managers State Hospital No. 1, for the general work of building a hospital building, including excavation, concrete, reinforced concrete, constructional and ornamental iron, brick work, plastering, mill work and glass, painting, cut stone, terra cotta, etc.

Holdredge, Neb.—Until June 13, by Board of County Supervisors, for the construction of a county court house building at this place. James McClymont is Chairman and C. L. Hedlund is County Clerk.

Fort Bayard, N. Mex.—Until 11 a. m., May 28, by Lieut. C. C. Winnia, Constructing Quartermaster, for the construction, plumbing, heating, electric wiring and electric light fixtures for one set of field officers' quarters.

Fort Meade, S. Dak.—Until 10 a. m., May 28, by Constructing Quartermaster, Fort Meade, S. Dak., for the construction of four double buildings for stable guard and shops, including electric wiring and fixtures.

Fort Sam Houston, Tex.—Until 11 a. m., May 28, by P. W. Guiney, Constructing Quartermaster, for the installation of plumbing fixtures in ward B, Post hospital, Fort Sam Houston, Tex.

Fort Sam Houston, Tex.—Until 11 a. m., June 9, by P. W. Guiney, Constructing Quartermaster, for the construction, plumbing, hot water heating and electric work of two four-set officers' quarters, one field officer's quarters, one guard house, one administration building, three single stable guards and shops and three artillery stables.

Cheyenne, Wyo.—Until 9:30 a. m., June 6, by Constructing Quartermaster V. K. Hart, for the construction of target butts, target houses and range office. Plan No. 266, at Fort D. A. Russell, Wyo.

Cheyenne, Wyo.—Until 9:30 a. m., May 23, by C. K. Hart, Constructing Quartermaster, for the construction, plumbing, wiring for electric motors and lights, electric fixtures, furnishing and installation of laundry machinery and equipment boiler, feed pump, etc., for one laundry. Plans No. 234-B, Fort D. A. Russell, Wyo.

Roads and Streets.

Bids are asked on following work, the notes being arranged alphabetically by states:

New London, Conn.—Until 11 a. m., May 30, by Capt. F. T. Arnold, Constructing Quartermaster, for the construction of approximately 2,900 ft. of macadam road and 2,500 ft. of road drains at Fort Terry, N. Y., and relaying 1,000 lin. ft. of sewers at Fort Mansfield, R. I. and for the construction of a band stand at Fort H G. Wright, N. Y.

Fort Screven, Ga.—Until 11 a. m., June 1, by Constructing Quartermaster, Fort Screven, Ga., for the construction of roads, walks, etc.

Osage, Ia.—Until 7:30 p. m., May 31, by City Clerk, for the construction of concrete pavement including the approximate quantities: 25,525 sq. yds. concrete pavement, 7,360 lin. ft. cement curb, 231 sq. yds. track pavement, 800 cu. yds. excavation, etc. Bids on above must be made on blank proposals furnished by city, and accompanied by certified check of $1,000.00. One improvement of 2,828 sq. yds. concrete pavement, 800 lin. ft. cement curb, 200 cu. yds. excavation. S. B. Gardner, Eldora, Ia., is Engineer.

Bloomfield, Ind. Until 2 p. m., June 7, by County Commissioners, for the construction of a gravel road in Fairplay Township. Peter M. Cook is Auditor of Green County.

Bloomfield, Ind.—Until 2 p. m., June 7, by County Commissioners, for the construction of a gravel road in Stafford Township. Peter M. Cook is Auditor of Green County.

Muncie, Ind.—Until 10 a. m., June 8, by County Commissioners, for the construction of a highway in Center Township. Joseph E. Davis is Auditor of Delaware County.

Gary, Ind.—Until 7 p. m., May 23, by Harry G. Moose, City Clerk, for the improvement of 16th Ave., from Broadway to George St. The work includes: 5,534 cu. yds. grading, 9,094 sq.

yds. macadam, 2,435 sq. yds. cement walk, estimated cost $13,776.00, 4,743 lin. ft. curbing.

Delphi, Ind.—Until noon, June 6, by County Commissioners, for the construction of a gravel road in Tippecanoe Township. M. G. Haun is Auditor of Carroll County.

Kentland, Ind.—Until 2 p. m., June 6, by County Commissioners, for the construction of a macadam road. Elmer R. Bringham is Auditor of Newton County.

Madison, Ind.—Until 1 p. m., June 7, by County Commissioners, for the construction of a gravel road in Madison Township. John Hoagland is Superintendent of Jefferson County.

Marion, Ind.—Until 2 p. m., June 7, by County Commissioners, for the construction of a stone road in Monroe Township and two vitrified brick highways in Center Township. A. Y. Stone is Auditor of Grant County.

Monticello, Ind.—Until noon, June 7, by County Commissioners, for the construction of a stone road in Union and Big Creek Townships. A. G. Fisher is Auditor of White County.

Mt. Vernon, Ind.—Until 2 p. m., June 7, by County Commissioners, for the construction of a gravel road in Black Township. Paul Maier is Auditor of Posey County.

Peru, Ind.—Until noon, June 15, by County Commissioners, for the construction of a macadam road in Peru Township. Charles Griswold is Auditor of Miami County.

Rushville, Ind.—Until June 7, by County Commissioners, for the construction of brick streets in Rushville and suburbs. J. M. Stone is Auditor of Rush County.

Vincennes, Ind.—Until 2 p. m., June 7, by County Commissioners, for the construction of a gravel road in Harrison Township. J. T. Scott is Auditor of Scott County.

Wabash, Ind.—Until 10 a. m., June 9, by County Commissioners for the construction of highway on line dividing Wabash and Huntington Counties. John W. Weaver is Auditor of Weaver County.

Augusta, Ky.—Until June 1, by J. T. McCracken, for the construction of 7,800 ft. of 14-ft. wide pike.

Fort Riley, Kan.—Until 10 a. m., June 1, by Capt. W. M. Whitman, Constructing Quartermaster, for the construction of approximately 4,500 cu. yds. of grading for roadways, 6,600 sq. yds. of macadam road surface, 3,900 lin. ft. of concrete curb and gutter, 110 ft. of concrete driveway curb, 6 concrete catch basins, 500 lin. ft. of 12-in. culvert pipe, 200 lin. ft. 10-in. culvert pipe, 8,000 sq. ft. concrete sidewalk, 950 sq. ft. of concrete walk road crossing, concrete steps, etc.

Independence, Kan.—Until 2 p. m., May 26, by T. S. Underwood, City Clerk, for the improvement of 11th St., from Main to Railroad St.; Myrtle St., from 14th to Missouri Pacific Ry.; Maple St., from Penn Ave. to 15th St. A. D. Stivers is City Engineer.

Boston, Mass.—Until noon, May 23, by Guy C. Emerson, City Street Superintendent, for the construction of wood block pavement on Milk St., between Pearl and Oliver Sts.; Pearl St., from Milk 148 ft. south; Oliver St., from Milk 158 ft. south.

Portland, Me.—Until 10 a. m., May 31, by Capt. C. F. Humphrey, Jr., Portland, Me., for the construction of roads and walks and other improvements at Fort McKinley and Fort Williams, Me.

Jackson, Miss.—Until 3 p. m., June 7, by Board of Aldermen, for the construction of approximately 29,000 sq. yds. of paving and 10,000 lin. ft. of curb. B. H. Klyce is City Engineer.

Trenton, Mo.—Until 8 p. m., May 25, by R. T. Preston, City Clerk, for the grading, paving and curbing of 16,000 sq. yds. of brick pavement on 4-in. concrete base, 1½-in. sand cushion and cement filler. Official advertisement of the work will be found elsewhere in this issue.

Fort Hancock, N. J.—Until noon, May 31, by C. J. Goodier, Constructing Quartermaster, for the construction of roads and walks at Fort Hancock, N. J.

Belvidere, N. J.—Until 2 p. m., May 28, by Board of Chosen Freeholders, J. R. Thatcher, Director, for macadamizing the public road beginning in Buttzville, 500 ft. west of the D. L. & W. Railroad crossing east of Buttzville, and extending to the town line of Belvidere, a distance of 19,418 ft.

Dunkirk, N. Y.—Until June 2 (readvertisement of bids asked May 14), by common council for paving Swan and Fox Streets.

New York, N. Y.—Until 11 a. m., May 18, by Borough of Brooklyn President, Room 2, Borough Hall, for 33 street improvement contracts, the largest ones including 11,590 sq. yds. of granite pavement, Class B, with tar and gravel joints (one year's maintenance); 20 sq. yds. of old stone pavement, to be relaid; 1,945 cu. yds. of concrete, for pavement foundation; 6,710 lin. ft. of new curbstone, set in concrete; 100 lin. ft. of old curbstone, reset in concrete; 635 sq. ft. of new granite bridgestones; 90 sq. ft. of old bridgestones, relaid.

New York, N. Y.—Until 11 a. m., May 25, by President Borough of Brooklyn, Room 2, Borough Hall, for 21 street improvement contracts. The largest calls for 9,253 sq. yds. of asphalt pavement, 1,293 cu. yds. of concrete pavement. The amount of security required for this contract is $4,900.

New York, N. Y.—Until 11 a. m., May 24, by Borough of Queens President, New York, N. Y., for the regulating and grading of William St., from Harris Ave. to Wilber Ave., and for curbing and flagging from Jane St. to Wilber Ave., First Ward. The work includes 3,800 cu. yds. of earth excavation, 11,200 cu. yds. of embankment, 1,080 lin. ft. cement curb, 5,400 sq. ft. of new flagstone sidewalk.

New York, N. Y.—Until 11 a. m., May 24, by President Borough of Queens, New York, N. Y., for repairing and maintaining sheet asphalt pavement in the Borough of Queens. The work includes 100 cu. yds. of concrete, 16,000 sq. yds. of sheet asphalt pavement; 1,000 sq. yds. of block pavement.

New York, N. Y.—Until 11 a. m., May 24, by President Borough of Queens, for regulating, grading, curbing and laying sidewalks and crosswalks in Prospect Ave., from Webster Ave. to Payntar Ave. The work includes 7,200 cu. yds. of earth excavation, 2,540 lin. ft. of cement curb; 13,350 sq. ft. of new flagstone sidewalk.

New York, N. Y.—Until 11 a. m., May 24, by President Borough of Queens, City of New York, for paving with asphalt blocks on a concrete foundation in Academy St., from Freeman Ave. to Webster Ave., First Ward. The work will include 100 cu. yds. of earth excavation, 265 cu. yds. concrete, 2,100 sq. yds. of asphalt block pavement.

Wadesboro, N. C.—Until 3 p. m., June 3, by Mayor and Commissioners of the town, for the improvement of streets including approximately 18,000 sq. yds. of 8-in. macadam, using tar or asphalt as a binder; 2,500 lin. ft. of combined concrete curb and gutter; 6,000 sq. yds. cement sidewalk; 4,000 cu. yds. excavation. White & Platt, Durham, N. C., are Engineers. Official advertisement of the work will be found elsewhere in this issue.

Laurinsburg, N. C.—Until noon, May 23, by M. L. John, Mayor, for about 2,500 sq. yds. of concrete sidewalk paving, with curb and gutters. F. F. Wetmore is engineer.

Fort Sam Houston, Tex.—Until 11 a. m., June 9, by P. W. Guiney, Constructing Quartermaster, for the macadamizing of roads, construction of concrete gutters, concrete walks, etc., at Fort Sam Houston, Tex.

De Pere, Wis.—Until 10 a. m., May 23, by Committee on Streets and Walks, for furnishing all materials and doing all work necessary to improve George St., from Broadway to Huron St. The work includes grading and the construction of concrete pavement and cement curb and gutter. E. X. Collette is a member of the committee.

Sewers.

Bids are asked on following work, the notes being arranged alphabetically by states:

Los Angeles, Cal.—Until July 1, by Board of Public Works, for the construction of 11 miles of riveted steel pipe ranging in diameter from 9 to 11 ft. and in thickness of plate from ¼ to 1 in. These syphons will be built along the line of the Aqueduct between Los Angeles and Owens Valley. Official advertisement of the work will also be found in this issue.

Brush, Colo.—Until 1 p. m., May 23, by S. N. Leerskov, Clerk of the Town, for the construction of a system of sewers for sanitary and storm drainage in the Brush Sewer Districts 1 and 2. The approximate quantities are 19,200 ft. 8-in. pipe sewer, 4,100 ft. 10-in. pipe, 1,300 ft. 12-in. pipe, 17,000 ft. 15-in. pipe, 48 ft. C. I. outlet, 55 M. H. 650 ft., 8 flush tanks, 50 M. H. 500 ft. and 1,600 ft. ½-in service pipe. Charles Meeker, McCook, Neb., is Consulting Engineer.

Washington, D. C.—Until 2 p. m., May 23, by District Commissioners, for the construction of sewers in the District of Columbia.

Waukon, Ia.—Until 7:30 p. m., June 1, (change of date), by S. M. Stone, city clerk, for the construction of a sewer system and sewage disposal plant. Iowa Engineering Co., Clinton, Ia., are the engineers.

Cedar Falls, Ia.—Until 7:30 p. m., May 20, by City Council, for the construction of a storm sewer on portions of Seventh and Olive Sts. The work includes 1,865 lin. ft. of No. 1, 24-in. salt glazed vitrified sewer pipe; 320 ft. of No. 1 12-in. salt glazed vitrified sewer pipe; 16 catch basins, and 5 manholes.

Cedar Falls, Ia.—Until 7:30 p. m., May 20, by City Council, for the furnishing of all necessary labor and material for the construction of sanitary sewers in portions of 9 streets. H. Jacob Pfeiffer is Mayor.

Chicago, Ill.—Until 11 a. m., May 28, by Department of Public Works, John J. Hanberg, Commissioner, for necessary labor and material for the alteration of the Chicago Avenue Pumping Station.

Gary, Ind.—Until 7 p. m., May 23, by Harry G. Moose, City Clerk, for the construction of Local Sewer No. 10, consisting of 746 lin. ft. 18-in, vit. pipe, 750 lin. ft. 15-in. vit. pipe, 1,046 lin. ft. 12-in. vit. pipe, 1,042 lin. ft. 12-in. vit. pipe, estimated cost $7,143; 312 lin. ft. 8-in. vit. pipe, 20 manholes, 4 catch basins. A. P. Melton is City Engineer.

Caldwell, Kan.—Until 3 p. m., June 1, by J. R. Swartzel, City Clerk, for the material and construction of a sewerage system. The bids will be received as follows: 1. For furnishing all materials and constructing a complete sewerage system and disposal plant. Certified check, $1,000.00. 2. For furnishing cast iron pipe and special castings, f. o. b. cars, Caldwell, Kan. Certified check, $500.00. 3. For furnishing hydrants and valves, f. o. b. cars, Caldwell, Kan. Certified check, $100.00. 4. For hauling and laying cast iron pipe and setting hydrants and valves. Certified check, $100.00.

Boston, Mass.—Until noon, May 20, by Guy C. Emerson, City Superintendent of Streets, for the construction of a sewerage works in Gainsborough and St. Botolph Sts., Roxbury.

Boston, Mass.—Until noon, May 24, by Guy C. Emerson, Superintendent of Streets, for the construction of a pipe sewer and appurtenances in Johnston Road, from Harvard St. 510 ft. easterly Dorchester.

Boston, Mass.—Drains.—Until noon, May 24, by Guy C. Emerson, Superintendent of Streets, for the construction of concrete and pipe surface drains and appurtenances in Lucerne, Claxton, Floyd and Stratton Sts., and in Colonial and Massasoit Aves., Dorchester.

Monroe, Mich.—Until May 29, by Board of Public Works, for the construction of a 10-in. glazed tile sanitary sewer in Riverview Ave., commencing at a point in the center of Riverview Ave., 50 ft. south of south line of Noble Ave., thence in a southerly direction in the center of Riverview Ave., to a point where the center lines of Riverview and Elm Aves. intersect, thence southerly on the same course to an entrance into the river basin.

Fort Missoula, Mont.—Until 9 a. m., June 6, by Constructing Quartermaster, Maj. A. B. Shattuck, for the construction of a sewer system, a water distributing system, furnishing and erecting a 300,000-gal. tank of steel and 100 ft. trestle, the construction proper of a reinforced concrete pumping station, supply and installation of all boilers, steam pumps, valves, etc.

Havelock, Nebr.—Until June 7, by C. A. Currie, city clerk, for the construction of a water works and sewer system. Grant & Cetton, Lincoln, Nebr., are the engineers.

Fargo, N. D.—Until 5 p. m., May 23, by City Auditor, E. R. Orchard, for the necessary labor and materials for the construction of a 12-in. lateral sewer on 4th St. north extending from 11th Ave., north to 12th Ave., north in Sewer District No. 1.

Fort Sill, Okla.—Until 10 a. m., June 10, by Capt. David L. Stone, Constructing Quartermaster, for the construction of a sewage purification plant and 500,000-gal. reservoir at Fort Sill.

Regina, Sask.—Until noon, May 30, by A. E. Chivers, city clerk, for the construction of storm water sanitary trunk sewers and disposal works. A. J. McPherson is consulting engineer.

Morristown, Tenn.—Until 1 p. m., May 24, by R. E. Smith, Secretary, Sewer Building Committee, for furnishing necessary materials for laying complete about 8½ miles of sewers varying in size from 6 to 24-in. in diameter. The work includes flush tanks, manholes, lamp holes and sewage disposal plant consisting of tanks, sprinkling filters and sedimentation tank. Official advertisement of the work will also be found in this issue.

Clarksburg, W. Va.—Until noon, June 15, by Water Works and Sewerage Board, Scott G. Highland, secy., for furnishing and laying cast-iron water pipe, valves and appurtenances in this city and vicinity. The work includes approximately 10,000 ft. of 16-in., 900 ft. of 12-in., 1,000 ft. of 10-in., 10,000 ft. of 8-in., 6,000 ft. of 6-in., 500 ft. of 4-in. cast-iron water mains, 50 gate valves from 4 to 16 in. in size, with valve boxes, and 35 hydrants.

Vancouver, Wash.—Until June 15, by city clerk, for the construction of the "B" St. lateral. The work, which is estimated to cost $7,000, includes 600 ft. of 10-in. and 2,000 ft. of 8-in. vitrified pipe and 11 manholes. Plans have been made by H. H. Lotter, engineer, Vancouver, Wash.

Water Supply.

Bids are asked on following work, the notes being arranged alphabetically by states:

Fort Logan H. Roots, Ark.—Until June 6, by Constructing Quartermaster, for the erection of a steel tank of 150,000 gals. capacity.

Waterbury, Conn.—Dam.—Until 8 p. m., June 7, by Board of Public Works, for furnishing labor and material for the construction of a storage reservoir dam. The work includes approximately: Concrete masonry, 1:3:6, 25,600 cu. yds.; concrete masonry, 1:3:5, 5,000 cu. yds.; concrete blocks, 2,960 cu. yds.; rolled embankment, 525,000 cu. yds.; crushed stone, 5,900 cu. yds.; paving, 8,900 cu. yds.; loaming on dam, 6,300 cu. yds.; loaming adjacent areas, 5,000 cu. yds.; sodding, 18,840 cu. yds.; drain gate house complete, exclusive of foundation; service gate house complete.

New Baden, Ill.—Until 7:30 p. m., June 1, by Public Improvement Committee, for furnishing necessary labor and material for the construction complete of water works system, including cast iron pipe, valves, fire hose and reel. A certified check for 5 per cent; bond full amount of contract. Plans and specifications are on file at the office of the Village President, George J. Munken, New Baden, Ill. Fuller-Coult Co., Chemical Bldg., St. Louis, Mo., are the engineers.

Danville, Ill.—Until noon, June 3, by Danville Water Co., Danville, Ill., for the improvement

of the water works. The work includes the reconstruction of the concrete dam. Official advertisement of the work will be found elsewhere in this issue

Boston, Mass.--Until 2:30 p. m., May 25, by Metropolitan Water and Sewerage Board, for laying 8,830 ft. of 60-in. cast-iron water pipe at Newton, Mass.

Willmar, Minn.—Until 8 p. m., May 23, by City Council, for necessary labor and material for the construction of approximately 4,500 ft. of 4-in. water mains and 6 fire hydrants. H Gunderson is City Clerk.

Fort Keogh, Mont. Until 1 p. m., May 20, by Capt. H. P. Howard, Depot Quartermaster, for sinking three 4-in. and one 6-in. artesian wells

New York, N. Y. Until 11 a. m., May 24, by Board of Water Supply, 165 Broadway, New York, for Contract 80, For the construction of the Breakneck Tunnels, portions of the Hudson River Division of the Catskill Aqueduct, comprising about 710 ft. of plain concrete conduit, known as aqueduct in open cut, or cut and-cover aqueduct, 17 ft. high by 17 ft. 6 in. wide inside, and a tunnel on the hydraulic gradient, about 1,055 ft. long, 17 ft. high by 13 ft. 4 in. wide inside, connecting by a shaft about 590 ft. deep with a deep pressure tunnel 14 ft. inside diameter and about 700 ft. long. The work is located in the Towns of Fishkill, Dutchess County, and Phillipstown, Putnam County, N. Y.

New York, N. Y.—Until 11 a. m., May 24, by Board of Water Supply, 165 Broadway, New York, for furnishing, delivering and installing six 6-ft. by 15-ft. sluice-gates, twenty-five 5-ft. by 13-ft. sluice-gates, four 5-ft. by 8-ft. back pressure sluice-gates, seven 5-ft. by 8-ft. sluice-gates, six 5-ft. by 6-ft. sluice-gates, three 4-ft. by 5-ft. sluice-gates, eight 3-ft. by 5-ft. sluice-gates, three 30-in. by 42-in. sluice-gates, two 18-in. by 24-in. sluice-gates, with operating mechanisms, 2 sets of drive-shafting and all appurtenances.

Mt. Pleasant, Tenn.—Until June 1, by city council, for necessary material and labor for the construction of a gravity system of water works. Bonds amounting to $40,000 have been sold for the purpose. Granbery Jackson, 1021 Stohlman Bldg., Nashville, Tenn., is engineer in charge.

Johnson City, Tenn.—Until May 19, by City Clerk, for the construction of a water supply system. The work includes among other items, 12 miles of 18-in. gravity main and a 5,000,000-gal. reinforced concrete reservoir. W. M. Dunlap, Johnson City, Tenn., is Engineer.

Clarksburg, W. Va.—Until noon, June 15, by Scott G. Highland, Secretary, Board of Water Works and Sewerage, for the construction of a mechanical filter plant and appurtenances. The work includes a mechanical filter plant of 3,000,000 gals. capacity, complete with a 200,000-gal. clear-water basin and 600,000-gal. coagulating basin built of reinforced concrete, with a brick and steel filter building, two 3,000,000-gal. low-lift centrifugal pumps, driven by high-speed engines, a 3,000,000-gal. multi-stage turbine high-lift pump driven by a steam turbine, two 200-hp. water-tube boilers, a new brick and steel boiler house, and a 1,000,000-gal. reinforced concrete reservoir, together with all steam and water piping connections and a new 16-in. cast-iron suction line.

Miscellaneous.

Bids are asked on following work, the notes being arranged alphabetically by states:

Fort Logan H. Roots, Ark. Water Heating.—Until June 6, by Constructing Quartermaster, for the construction or installation of a water heating system in barracks No. 1, Fort Logan H. Roots, Ark.

Whipple Barracks, Ariz.—Ice Plant—Until 3 p. m., May 31, by Lieut. G. G. Bartlett, Constructing Quartermaster, for furnishing labor and material required for the construction of an ice plant.

Washington, D. C.—Reels & Carts—Until June 1, by William Crozier, Brigadier General, U. S. Army, chief of ordnance, Washington, D. C., for the furnishing of 67 reels and 31 carts.

Fort Des Moines, Ia.—Heating Plant—Until 3 p. m., June 3, by Constructing Quartermaster, Fort Des Moines, Ia., for the installation of a steam heating plant in the hospital at Fort Des Moines, Ia

Portland, Me.—Electric Lighting System.—Until 10 a. m., June 2, by Capt. C. F. Humphrey, Jr. Constructing Quartermaster, for the construction and remodeling of an electric lighting system at Fort McKinley, Me.

Tompkinsville, N. Y.—Boat—Until May 27, by Engineer Third Light House District, Tompkinsville, N. Y., for furnishing a power boat for the Stratford Point Light Station, near Stratford, Conn.

Omaha, Neb.—Freight Elevators.—Until 11 a. m., June 11, by Capt. F. C. Bolles, Constructing Quartermaster, for installing two electric freight elevators in storehouse at Omaha Depot

Fort Meade, S. Dak.—Dam—Until 10 a. m., June 1, by Constructing Quartermaster, for the construction of concrete dam with clearing reservoir site in connection with Fort Meade, S. Dak., water system.

Vancouver Barracks, Wash. Plumbing.—Until 11 a. m., May 27, by Constructing Quartermaster, for the construction of the remodeling of plumbing in eight barracks and four water closet buildings at this post.

Milwaukee, Wis.—Natatorium—Until 10:30 a. m., May 20, by Board of Public Works, for the furnishing of all material and labor necessary for laying new cement floors in first story of natatorium, in toilet rooms, in the northwest side natatorium on the corner of 60th and North Ave.

Excavation, Earth and Rock.

Bids are asked on following work, the notes being arranged alphabetically by states:

Mobile, Ala.—Placing Soil—Until 11 a. m., June 7, by Maj. J. H. Jervey, U. S. Engineer, Mobile, Ala., for furnishing and placing top soil at Fort Morgan, Ala.

Council Bluffs, Ia.—Ditch Work.—Until 9 a. m., June 9, by Board of County Supervisors, for the construction of a drainage ditch along the course of Pigeon Creek in Neola, Boomer, Hazel Dell and Crescent Townships, approximately 14 miles in length. Work is also noted under confirmed reports in this issue.

Rockwell City, Ia.—Drain—Until 1 p. m., May 23, by county auditor, for the construction of Joint Drain No. 70 in Webster County and Drain No. 95 in Calhoun County. The work is also noted under Confirmed Reports.

New Orleans, La.—Levee Work—Until noon, May 25, by Board of State Engineers, 402 Cotton Exchange Bldg., New Orleans, La., for the enlargement of several levees in the Mississippi River, right bank. The work is also noted under Confirmed Reports in this issue.

New Orleans, La.—Dredging—Until 11 a. m., June 10, by Lancing H. Beach, Lt.-Col., U. S. Engineer, Custom House, New Orleans, La., for dredging at Chefuncte and in Bogue Falia Rivers, La.

Guayama, P. R.—Dams, Canal—Until 2 p. m., July 25, by B. M. Hall, Chief Engineer, Irrigation Service, Porto Rico, for the construction of the Carite Dam, 150,000 cu. meters of earth and loose rock; the Toro Negro Dam, 15,000 cu. meters of earth and loose rock, and the Dona Juana Canal, 1 1-3 miles in length. The estimated total cost of the work is $160,000. The work is also noted under Confirmed Reports.

Materials, Machines, Supplies, Etc.

Bids are asked on following work, the notes being arranged alphabetically by states:

Montgomery, Ala.—Fire Dept. Equipment.—Until noon, June 6, by Robert Tait, City Treasurer, for the installation of two steam fire engines Nos. 1 and 2; two combination chemical and hose auto cars; 6,000 ft. of 2½-in. rubber-lined hose.

Washington, D. C.—Wire & Cable—Until May 21, by Chief Signal Officer, War Department, Washington, D. C., for furnishing four miles of cable, type 213; 5,000 ft. cable, type 401; 5,500 ft. cable, type 403; 20,00 ft. cable core, rubber insulated; 1 conductor and 40,000 ft. antenna wire.

Washington, D. C.—Supplies—Until 2:30 p. m., June 1, by Capt. F. C. Boggs, General Purchasing Officer, Isthmian Canal Commission, Washington, D. C., for furnishing chain blocks, screw jacks, boiler clamps, cotters, cable, pliers, gauge glasses, leather belting, dredging sleeves, copper frames, etc.

Washington, D. C.—Steel Framing, Cast-Iron Mullions, Etc.—Until 10 a. m., June 9, by R. V. LaDow, Supt. of Prisons, Washington, D. C., for furnishing and delivering at the United States Penitentiary, Leavenworth, Kan., steel framing and cast-iron mullions, frames, sills, heads, etc., for the sun room and for the windows to dispensary, examination roof and operating room, in the north wing of the hospital building.

Washington, D. C.—Steel Framing, Cast-Iron Mullions, Etc.—Until 10 a. m., June 9, by Department of Justice, R. V. LaDow, Supt. of Prisons, Washington, D. C., for the furnishing and delivering at the U. S. Penitentiary, Atlanta, Ga., steel framing and cast-iron mullion frames, sills, heads, etc., for the sun room and for the windows to dispensary, examination room and operating room in the north wing of the hospital.

Fort Sheridan, Ill.—Boilers—Until noon, May 23, by Capt. M. E. Saville, Constructing Quartermaster, for the installation of 10 steam heating boilers and ten area entrances in officers' quarters at Fort Sheridan, Ill.

Chicago, Ill.—Fire Brick.—Until 11 a. m., May 21, by Department of Public Works for furnishing approximately 50,000 fire brick for boiler lining and delivering at city water pumping stations. B. J. Mullaney is Commissioner of Public Works.

Chicago, Ill.—Suction Hose.—Until 11 a. m., May 24, by James Horan, Fire Marshall, for furnishing the city of Chicago hose as follows: 10 lengths 3½-in. suction hose, 11 ft. long; 30 lengths 4-in. suction hose, 10 ft. 6 ins. long; 20 lengths 4½-in. suction hose, 11 ft. long; 10 lengths 5-in. suction hose, 11 ft. long.

Chicago, Ill.—Fire Hose.—Until 11 a. m., May 24, by James Horan, Fire Marshall, for furnishing the fire department with 2,000 ft. of 1-in. 4-ply rubber chemical hose, with special couplings.

Jeffersonville, Ind.—Fire Apparatus — Until May 21, by Maj. Joseph T. Davidson, Depot Quartermaster, for furnishing 22 fire extinguishers, 10 pairs roof hooks, 7 extension ladders and 5 single ladders.

Franklin, Ind.—Voting Machines.—Until noon, June 6, by County Commissioners, for voting machines. W. B. Jennings is Auditor of Johnson County.

Boston, Mass.—Stone—Until noon, June 6, by Lieut.-Col. Edward Burr, U. S. Engineer, Boston, Mass., for furnishing riprap stone in dike on Long Beach, Plymouth Harbor, Mass.

Newark, N. J.—Cast-Iron Pipe.—Until 3:30 p. m., May 19, by Board of Street and Water Commissioners, for furnishing: 48 short tons of 4-in. cast-iron water pipe; 553 short tons of 6-in. cast-iron water pipe; 85 short tons of 8-in. cast-iron water pipe; 38 short tons of 10-in. cast-iron water pipe; 24 short tons of 12-in. cast-iron water pipe; 200,000 lbs. of ordinary special castings; 15 short tons of 6-in. high pressure cast-iron water pipe; 37 short tons of 8-in. high pressure cast-iron water pipe; 431 short tons of 16-in. high pressure cast-iron water pipe. Morris R. Sherrerd is Chief Engineer of the board.

New York, N. Y.—Cement—Until noon, May 31, by George Cromwell, President of Borough of Richmond, for furnishing and delivering 300 barrels of Portland cement.

Wilmington, N. C.—Stone—Until noon, June 14, by Capt. Earl I. Brown, U. S. Engineer, Wilmington, Del., for furnishing 12,000 tons, more or less of riprap stone.

Philadelphia, Pa.—Ordnance Supplies—Until 1 p. m., May 13, by Commanding Officer, Frankford Arsenal, Philadelphia, Pa., for furnishing during the fiscal year ending June 30, 1911, smokeless powder; cloth, ropes, forage, steel and iron, sheet tin and zinc, pig lead, copper and tin, iron castings, cartridge metals, hardware, steam fitting and electrical supplies, leather belting and laces, lumber, fuel, chemicals, oils, paints, paper, binders' board, tools and miscellaneous articles

Fort Sam Houston, Tex.—Hardware, Etc.—Until May 20, by Capt. Fred H. Gallup, Quartermaster, for the furnishing of: 50 screw anchors, 3 outlet boxes, 24 bushings, 1 condulet, 150 ft. steel conduit, three covers, 150 ft. lamp cord, 12 couplings, 50 cleats, 3 lamp guards, 12 lock nuts, 1 gross screws, 3 sockets, 50 strap hangers, 2 pounds Manson tape and 150 ft. wire.

Fort George Wright, Wash.—Screens—Until 11 a. m., May 24, by Lieut. A. L. Sneed, Quartermaster, for furnishing wood frames for doors and windows and screens on one administration building, four sets captains' quarters and one bake house at Fort George Wright, Wash.

CONTRACT LET.

The following contracts have been let recently:

BRIDGES.

Rockport, Ind. Bridges.—A. E. & W. Construction Co., Evansville, Ind., at $9,150, for the construction of the Lake Drain bridge.

Princeton, Ind.—Bridges—County Commissioners awarded the following contracts for the construction of 15 concrete arches and 10 steel bridges: A. E. & W. Construction Co., Evansville, Ind., at $3,973, seven concrete arches; Frank Duncan, this city, at $9,500, eight concrete arches and five steel bridges; Vincennes Bridge Co., Vincennes, Ind., at $3,553, five steel bridges.

Owensboro, Ky. Bridge Vincennes Bridge Co., Vincennes, Ind., at $1,760, for the construction of a new iron bridge across north Panther Creek at Taylor's mill road.

Portland, Mich.—Bridge—Wynkoop Co., Toledo, O., at $9,444, for the construction of a single span steel bridge across the Grand River at Turner's ford, in Danby Township.

Hampton, N. J.—Culvert—Gaston & Richards, Somerville, at $18,000, for the enlargement of the Central Railroad culvert at this city.

Mt. Gilead, O. Bridges.—Following contracts have been awarded in N. Bloomfield Township: Brookville Bridge Co., West Sorrick bridge, $733; Eckles & Hoff, Seif bridge, $83; Brookville Bridge Co., Selover bridge, $83; Brookville Bridge Co., East Sorrick bridge, $733.

Corvallis, Ore.—Bridge—F. A. Erixson, at $6.90 per yd., for the construction of the piers on which the Mary's River steel bridge, at the south end of Third St. will rest. The total cost of the work will be about $5,000.

Aberdeen, S. Dak.—Bridge—A. Y. Bayne Co., Minneapolis, Minn., at $3,305, for the construction of a 42-ft. steel bridge in Riverside Township.

Motesano, Wash.—Bridge—Bradley & Whitlock, at $44,780, for the building of the new bridge over the Chehalis River, at this place. The bridge is to be of steel, with draw span of two clear openings of 100 ft. each.

Vancouver, Wash.—Bridge—Columbia Bridge Co., Walla Walla, at $13,540, is reported to have received the contract for the construction of a bridge across the Washougal River between the towns of Camas and Washougal and on the state road in Clark County.

Spokane, Wash.—Bridge—A. H. Stratton, at $10,350, for the construction of a county bridge just east of Trent. The two spans which are each 198 ft. long will be reconstructed.

ROADS AND STREETS.

New Haven, Conn.—Paving—Field, Barker & Underwood, Philadelphia, Pa., at $10,920, for the construction of granite concrete pavements on the grades in State St., near Water St., and in Congress Ave., from Temple to Lafayette St.

Anderson, Ind.—Paving—Lawson & Kinkead, Indianapolis, at $23,000, for the paving of Columbus Ave., with brick from Ohio Ave., south to the city limits.

Lafayette, Ind.—Road—Daniel H. Fatout, Indianapolis, Ind., at $5,573, for the construction of the Grant Cole gravel road in Wabash Township.

Marion, Ind.—Road—Alexander & Crosby, Bluffton, at $8,529, for the construction of the J. W. McKeever stone road on the line between Jefferson and Monroe Townships.

Mount Pleasant, Ia.—Paving—Burlington Construction Co., Burlington, at $2.095 per sq. yd., for the construction of paving in this city.

Glenwood, Ia.—Paving—E. E. Barber, at $2.04 per sq. yd., for paving the square in this city, and at $0.50 per ft. for curb and gutter. The cost of the work will approximate $12,000.

Ft. Dodge, Ia.—Paving—Bryant, Ford, McLaughlin Paving Co., Waterloo, for the paving of the following streets: Third Ave., north, from 13th to 15th Sts; Fourth Ave., north, from 12th to 15th Sts.; First Ave., north, from 12th to 15th Sts.; First Ave., south, from 12th to 17th Sts.; Second Ave., south, from 12th to 17th Sts.; Third Ave., south, from 12th to 17th Sts.; Fourth Ave., south, from 13th to 17th Sts.; Fifth Ave., south, from 12th to 15th Sts.; 13th St., from Sixth Ave., north to Central Ave.; 13th St., from First Ave., south to Sixth Ave. south; 14th St., from Fourth Ave., north to Fifth Ave., south; 15th St., from Sixth Ave., north to Fifth Ave. south; 10th St., from Second Ave., south to Third Ave south. The contract price is $1.98 per sq. yd.

Mason City, Ia.—Paving—George Gabler, at $1.25 per yd., for the construction of pavement on West 10th and West 11th Sts.

Elgin, Ill.—Paving.—Arwin E. Price, city, at $59,279, for paving in this city amounting to 31,530 sq. yds. of vitrified brick.

Clinton, Ia.—Paving—McCarthy Construction Co., for paving Tremont Ave., between Locust and High Sts.; Hydraulic Concrete Construction Co., paving the alley between 12th and 13th and Brady and Main St.

Brookville, Ind.—Road.—Thos. F. Wilson, city, at $13,200, for the construction of a macadam road in this county. Bids were opened May 12.

Bloomfield, Ind.—Road.—W. L. Campbell & Co., P. O. Solsberry, Ind., for the construction of a road in Center Township.

Cohasset, Minn.—Bridge. — Central States Bridge Co., Indianapolis, Ind., at $17,700, for the construction of a bridge across the Mississippi River.

St. Clair, Mich.—Sidewalks—Brinker & May, for the construction of about 20,000 sq. ft. of sidewalks in this city.

Cuyuna, Minn.—Road—Charles Lull, by the Rogers-Brown Ore Co., for the construction of a wagon road from this city to the mines, 18 ft. wide.

Monticello, Miss.—Bridge. — Memphis Bridge Co., Memphis, Tenn., at $2,005, for the construction of a bridge across the creek, Mt. Carmel road. The bridge will be one span of 80 ft. Bids were opened May 2.

St. Joseph, Mo.—Paving—Metropolitan Paving Co., at $1.50 per sq. yd., for the resurfacing of the brick pavement on Fourth St., Jule to Faraon.

St. Joseph, Mo.—Sidewalks—Beierle & Vogel, for the construction of artificial stone curbing and artificial stone sidewalks on Sacramento St., 28th to 30th St., at $0.35 per sq. ft. for curbing and $0.12½ per sq. ft. for sidewalks.

Kirksville, Mo.—Paving—S. L. Eggert, at $2.04 per yd., for the paving of North Mulanix St.

Winnemucca, Nev.—Bridge. — Reno Construction Co., Reno, Nev., at $14,469, for the construction of a reinforced bridge and two culverts. The bridge is to be built over the Humboldt River at this city. Bids were opened May 3.

Brooklyn, N. Y.—Paving—Following contracts were awarded at the borough hall in Long Island City: Hastings Paving Co., $14,471, paving with asphalt blocks Fifth Ave., from Broadway to Pierce Ave., first ward; Thomas A. Brown, $245, laying sidewalks on south side of Shelton Ave., from Alsop St. to Myrtle Ave., Jamaica; Henry J. Mullen, $2,270, laying sidewalks on Hoffman Blvd., from Fulton St. to Jefferson Ave., Jamaica; Peace Bros., $1,902, laying sidewalks in Cypress Ave., from Gates Ave. to Myrtle Ave., second ward; Henry J. Mullen, $138, laying sidewalk at the corner of Stanhope St., and Onderdonk Ave.

Schenectady, N. Y.—Paving—Union Paving Co., for paving Willett St. in this city.

Bowling Green, O.—Road—D. R. McArthur & Co., Canton, for the construction of the Mary J. Fry stone road on the line of Bloom Township and Montgomery Township, at $2.54 per cu. yd. for the stone and $0.18 per yd. for grading.

Alliance, O.—Paving—City council awarded the following contracts: J. C. Devine, at $5,309, paving North Park Ave., from Main St. to Ely St.; John Wilson, at $16,392, paving Hames Ave. with block; J. C. Devine, at $14,330, paving South Webb Ave., with block; John Wilson, at $8,954, for grading Seneca Ave. to State St.; John C. Devine, at $13,562, for paving North Webb Ave. with block.

Canton, O.—Paving—Philip Diefenbacher & Son, Massillon, at $24,627, for the improvement of the West Brookfield road. The road to be improved extends from the city limits of Massillon to West Brookfield, a distance of 1.55 miles.

Weston, O.—Paving.—H. S. Euck, Lima, O., for paving Taylor St. with vitrified brick. Bids were opened May 2.

Cincinnati, O.—Road. — William P. Flynn, Chase Ave., city, at $7,970, for the improvement of the Hamilton pike from the city corporation line to the North Bend road, in Millcreek Township.

Cleveland, O. Paving Charles A. Wright 3856 West 40th St., Cleveland, for the construction of brick pavement over the Belt Line bridge. The work includes stone curb and creosoted bottom. Bids were opened Apr. 30.

Buffalo, Okla.—Bridges.—W. J. Burke, Doby Springs, Okla., at $750, for the construction of three wooden bridges in Harper County.

Goldendale, Wash.—Road—N. D. Miller, at $35,200, for the construction of the road in local improvement district No. 1. The road will be 6½ miles in length.

Wenatchee, Wash.—Paving.—Allen & McNemey, city, at $71,117, for paving Mission St., in this city.

Superior, Wis.—Paving—J. B. Palmer, at $6,213, for the macadamizing of a section of Tower Ave., between 21st road and 58th St.; E. Hawarden, at $950, for the macadamizing of section of Stinson Ave., between West 12th and West 19th Sts.

Saskatoon, Sask.—Sidewalks. — Western Pavers, Ltd., Winnipeg, Man., for the construction of concrete sidewalks at the following prices: 17 9-10 cents per sq. ft. for sidewalk, 32 cents per lin. ft. for curbing and 17 9-10 cents per sq. ft. for crossings. Bids were opened Apr. 25.

SEWERS AND WATER SUPPLY.

Atlanta, Ga.—Sewers—It is reported that the city council has accepted the following lowest bids for the construction of the lateral sewers: C. W. Lane Construction Co., at $80,116, for the relief sewer in Loyd St.; B. F. Meks Construction & Equipment Co., at $80,171, for sections two, three and four.

Clinton, Ia.—Sewer—Patrick Conelly, for the construction of a sewer on LeClaire St., between Fairfield road and South Ave., near the city limits.

Missouri Valley, Ia.—Sanitary Sewers—Bids were opened May 4 by this city, Iowa Engineering Co., Clinton, Ia., Consulting Engineers, for the construction of a system of sanitary sewers, the contract being let to the Omaha Construction Co., Omaha, Neb., at the following bids: 18 in. c. i. pipe, 84 ft., $4.00; 12 in. c. i. pipe, 200 ft., $2.25; 18 in. vit. pipe, 4,704 ft., $1.03; 15 in. vit pipe, 390 ft., $0.77; 12 in. vit. pipe, 2,770 ft., $0.57; 10 in. vit. pipe, 7,774 ft., $0.54; 8 in. vit. pipe, 17,534 ft., $0.46; flush tanks, 26, $70; manholes, 64, $35; bulkhead, 1, $100. Total, $24,184.

Centerville, Ia.—Sewer—Guy E. Smith, at $3,020, for the construction of a sewer on south 15th and other streets.

Colfax, Ia.—Sewer—J. W. Turner Improvement Co., Des Moines, at $9,400, for the construction of a sewer in this city.

Laporte, Ind.—Sewer—Independent Construction Co., Terre Haute, Ind., at $133,000, for the construction of the new sewer outlet.

Manhattan, Kan.—Sanitary Sewer System.—Following bids were received May 3, by this city, C. M. Buck, City Engineer, for installing a sanitary sewer system (1) standing for W. W. Cook & Son, Junction City, Kan. (awarded contract); (2) for Katz-Craig, Omaha, Neb.; (3) for New State Co., Tulsa, Okla.; (4) for Bash & Gray, Joplin, Mo.; (5) for E. D. Reed, Clay Center, Kan.; (6) for McGuire & Stanton, Leavenworth, Kan:

	(1)	(2)	(3)	(4)	(5)	(6)
67,200 ft. furnishing and laying 8 in. vit. sewer pipe	$ 0.32	$ 0.38	$ 0.30	$ 0.39	$ 0.30	$ 0.38
1,700 ft. furnishing and laying 12 in. vit. sewer pipe	.40	.43	.45	.44	.45	.42
5,200 ft. furnishing and laying 15 in. vit. sewer pipe	.60	.60	.60	.68	.75	.70
5,300 ft. furnishing and laying 18 in. vit. sewer pipe	.90	.85	.80	.90	1.00	.85
1,300 ft. furnishing and laying 24 in. vit. sewer pipe	1.30	1.75	1.50	1.60	1.50	1.35
6,900 ft. tranching and backfill under 6 ft. depth	.22	.35	.20	.40	.28	.40
17,300 ft. trenching and backfill 6-8 ft. depth	.33	.40	.30	.43	.40	.45
38,800 ft. trenching and backfill 8-12 ft. depth	.60	.50	.60	.51	.55	.60
15,800 ft. trenching and backfill 12-16 ft. depth	.98	.70	.75	.70	.70	.70
1,000 ft. trenching and backfill 16-20 ft. depth	1.30	.90	1.20	1.10	1.00	.80
2,356 6 in. on 8 in. Y's, extra price each	.50	.50	1.00	.55	.60	.60
24 6 in. on 12 in. Y's, extra price each	1.00	.55	1.00	.65	1.00	1.06
200 6 in. on 15 in. Y's, extra price each	1.00	1.00	1.00	.90	1.50	1.80
48 6 in. on 24 in., extra price each	4.00	2.50	2.00	3.00	5.00	4.65
20 cu. yds. concrete	8.00	10.00	10.00	9.00	10.00	12.00
159 manholes 8 ft. to 18 ft. depth	45.00	40.00	55.00	43.00	70.00	.50
23 flush tanks	80.00	80.00	80.00	74.00	90.00	.80
300 ft. furnishing and laying 24 in. C. I. P. under railway	4.00	4.00	10.00	4.00	6.00	7.00
28 M. lumber left in trenches	30.00	35.00	30.00	30.00	40.00	40.00
1 pumping station	3,000.00	3,000.00	3,500.00	3,125.00	3,000.00	4,500.00
Total amount	$88,124	$92,421	$93,936	$95,008	$95,624	$101,687

Leavenworth, Kan.—Sewer—McGuire & Stanton, at $34,954, for the construction of sewers in the Ninth District.

Wichita, Kan.—Sewers—McIntyre & Teese, this city, for the construction of the following laterals to the College Hill sewer: District "A," lateral between Douglas Ave. and Kellogg St., and From Grove St., east to the city limits, $48,331; district "B," lateral between Second St. and Douglas Ave., from Grove St., east to the city limits, $14,620; district "C," lateral between Second St. and Central Ave., from Ash St. to city limits, $20,844; W. F. Hall, Clinton, Mo., for the construction of the following laterals to the College Hill sewer: District "E," main sewer, north on 11th St., $6,196; district "F," between Hillside Ave. and Wellesley st., from 12th St., to Fairmont Ave., $9,078; lateral "G," on Estelle and Hillside Aves., 11th and 14th Sts., $8,458.

Breaux Bridge, La.—Water Works—Following contracts have been awarded for the erection of a water works plant: United States Cast Iron Pipe & Foundry Co., pipe; Fairbanks Co., valves and hydrants; R. D. Cole Manufacturing Co., tower and tank; Platt Iron Works Co., pump; Walsh & Weidner Boiler Co., boiler; Ahrens & Ott Manufacturing Co., general supplies; A. C. Jones, Opelousas, La., is the engineer in charge.

Hancock, Mich.—Reservoirs—Wick O'Connell & Co., at $10,363, for the construction of the new million gallon concrete reservoir to be built for this city.

Albert Lea, Minn.—Sewer—Ilstrup & Olson, Minneapolis, at $5,450, for the construction of the proposed lateral sewer on Washington St., Mary's, Water and Cherry Sts., and in the east and west alley of block 4 in Morin's addition.

Kirksville, Mo.—Sewer—Lynch & Murphy, Moberly, for the construction of a sewer on South Franklin St. and Normal Ave.

Schenectady, N. Y.—Sewers—A. J. Kaltux, for the construction of sewers in Willett St., Holland road and Foster Ave.

Utica, N. Y.—Sewers—Perretta & Robertaccio, at $4,066, for the construction of a 24-in. sewer in Lafayette St., from Cornella St. to Broadway; Jeremiah F. Auger, at $433, for a 12-in. sewer in Roberts St., from Lincoln to Fay St.

Providence, R. I.—Sewers—Following contracts were awarded by the Board of Contract and Supply: Frank Gammino, at $1,747, sewer in Rill and Tell Sts.; Promenade St., at $2,361; Charles Crankshaw, at $2,321, sewer in Indiana and Vermont Aves.

Providence, R. I.—Sewers—Frederick E. Shaw, city, for the construction of the following sewers: In Blackstone blvd., $4,163; Sassafras and Woodman St., $1,856; Exchange place, $969; Lauriston, Brewster and Fourth Sts., $555; Raymond St., $738; Hart St., $547; Wayland Ave., $1,058.

Nashville, Tenn.—Sewer—G. V. Barnsfield, at $2,782, for the construction of a tile sewer in Glen Leven Ave.

De Pere, Wis.—Sewer—Urbin Titulaer, Green Bay, at $1.69 per lin. ft., for the construction of the Charles St. sewer and at $0.47 per lin. ft., for the construction of a sewer in an alley in block 31.

Elgin, Ill.—Sewer.—Sorensen, Tetens & Jorgensen, city, at $7,488, for the construction of the Locust St. sewer system.

Comstock, N. Y.—Sewage Disposal System.—Hudson Valley Construction Co., 30 Church St., Troy, N. Y., at $8,324, for the construction of the sewage disposal system at the Great Meadow Prison, this city.

Binghamton, N. Y.—Sewers.—T. B. Bidwell, at $3,191, for the construction of the James St. sewer at $686 for the construction of the Second St. sewer. Bids were opened May 12.

New York, N. Y.—Water Mains.—Fox, Hennessey Co., 81 E. 12th St., city, for laying water mains in the city. Bids were opened Apr. 28.

Klamath Falls, Ore.—Sewer.—Gladding, McBean Co., San Francisco, Cal., at $5,530, for furnishing 16,700 ft. of sewer pipe from 6 to 14 ins. in diameter; Chico Construction Co., Chico, Cal.,

at $16,990, for the construction of the sewer. Bids were opened Apr. 25.

Jackson, Tenn. Sewers — Newman Sewer Construction Co., Evansville, Ind., at $26,277, for constructing sanitary sewers to include 1,530 lin. ft. 6-in. terra cotta pipe, 16,428 lin. ft. 8-in. terra cotta pipe, etc. Bids were opened May 3.

Wenatchee, Wash. Sewer — Wetzel & Foster, for the construction of six miles of sewer. Bids were opened May 4.

EXCAVATION, MISCELLANEOUS, MATERIALS.

Boston, Mass.—Wharf.—W. L. Rendle & Son, East Boston, Mass., at $8,303, for the construction of coal pocket and wharf at Ft. Strong. Bids were opened Apr. 25.

Calidonia, Minn.—Pump. — Keystone Driller Co., Monadnock Block, Chicago, Ill., for the installation of a large size Downie double stroke deep well pump.

Atlantic City, N. J. — Generator and Switch Board.—Ft. Wayne Electric Co., Ft. Wayne, Ind., for furnishing the water department of the city with a 150 K. V. A. generator and switch board.

Youngstown, N. Y.—Engines, Pumps and Filters.—Fairbanks-Morse Co., Cleveland, O., at $2,311, for furnishing pumps and engines for the water works system. W. B. Scufe & Son, Pittsburg, Pa., at $1,300, for furnishing filters for the water works system. Bids were opened May 10.

Cincinnati, O.—Wall.—George Leonard, Glendale, O., at $2,988, for the construction of a reinforced concrete protection wall for bridge and roadway on Muddy Creek road at Selhorst's, in Delhi Township.

Winnipeg, Man.—Arc Lighting Equipment.—Following contracts have been awarded by the Board of Control for furnishing arc lighting equipment line wire and supplies: Canadian General Electric Co., city, at $9,190, section A, comprising three 50-light regulators, rectifiers and control panels, also 100 arc lamps, 6.6 ampere magnetite system; Northern Electric & Mfg. Co., city, at $2,011, for section B, insulated wire and cable; at $258, for mast arm parts; Canadian General Electric Co., at $3,450, for six panel switchboard, instruments, etc.

Livingston, Mont.—Building—Piper Construction Co., Billings, at $125,000, for the construction of the Miller block in this city. The structure will be three stories in height, covering a ground space of 140 by 200 ft.

Albany, N. Y.—Flushing Wagons—Barron & Cole Co., New York, at $2,000, for furnishing this city with two street flushing wagons.

Toronto, Ont.—Building—C. Hitch & Co., 100 Queen St., west, at $36,027, for the construction of a new poultry building on the Exhibition grounds.

PROJECTED WORK.

Bridges.

Items Arranged Alphabetically by States.

Yuba City, Cal.—Officials of the Northern Electric Co. and Board of Supervisors of Sutter and Colusa Counties are to make definite arrangements for taking borings of the Sacramento River at Meridian preparatory to constructing a joint wagon and railroad bridge.

Fort Morgan, Colo.—State Highway Commission is to take up the matter of constructing the proposed Bijou Bridge on the State Highway between this city and Denver, with County Commissioners. It is expected that plans and specifications will be approved and that bids will be asked for at once.

Wilmington, Del.—All bids received May 3 by Levee Court for the construction of the reinforced concrete bridge at Noxenmill Dam, Noxentown, Del., were rejected. James Wilson is County Engineer.

Joliet, Ill.—The Joliet & Southern Traction Co. is considering the construction of a new bridge across the Drainage Canal and Desplaines River at Van Buren St. H. A. Fisher is President of the company.

Quincy, Ill.—Deputy County Surveyor L. H. Richardson has completed plans for a steel bridge over Bear Creek in Riverside Township. The structure will have an 80 ft. span with 16 ft. approaches at both ends and will be supported on steel tubing filled with concrete.

Indianapolis, Ind.—The Railroad Commission has condemned the Wabash R. R. bridge over the Wabash River at Andrews and have ordered the construction of 5 new concrete piers and other improvements. The cost of the repairs is approximately $50,000.

LaFayette, Ind.—County Commissioners have adopted plans and specifications for the construction of a steel bridge over Burnett's Creek at Battle Ground. The structure will be 94 ft. long and will have 16 ft. driveway with concrete floor.

Rockville, Ind.—County Council has appropriated $10,000 for the construction of the proposed bridge at Coxville.

Vincennes, Ind.—County Commissioners have ordered J. S. Spiker, Bridge Engineer, to prepare plans and specifications for the construction of a new bridge to replace the Vollmer Bridge over Snapp's Creek on the Terre Haute Road and for an 80-ft. structure to replace the Wesley Ice Bridge.

Gillett Grove, Ia.—The Chicago, Milwaukee & St. Paul R. R. is to construct a bridge over its roadway about a mile south of this place.

Hutchinson, Kan.—Citizens of the district west of this place have petitioned the County Commissioners for the construction of a bridge across Salt Creek at 17th St.

Topeka, Kan.—Engineering Department of the Atchison, Topeka & Santa Fe R. R. are preparing plans for the extension of the company's bridge over the Kaw River. The work will include the installation of a 140-ft. steel span.

Shreveport, La.—All bids received for the construction of the steel traffic bridge over the Red River at Shreveport, La., were rejected. C. G. Rives, Comptroller.

Mayville, Mich.—The P. M. Railroad is planning the construction of a new steel bridge over the highway 1½ miles west of the village.

Superior, Minn.—Citizens have voted in favor of the construction of a new bridge across the Nemadji River in the Town of Superior. The work, it is estimated, will cost $2,000.

Miles City, Mont.—Auditor of Custer County O. E. Harper will sell bonds amounting to $35,000 June 1 for the construction of bridges.

Rensselaer, N. Y.—Common Council has passed a resolution approving the plans presented by the New York Central R. R. for bridge No. 222 at Akin Ave.

Rochester, N. Y.—Joint meeting of the Finance and City Property Committees was held to take up the matter of constructing a new Central Ave. bridge and widening the avenue from St. Paul to Mill St. As proposed the structure will be of steel and concrete and with the work necessary for widening the avenue is estimated to cost $200,000.

Dayton, O.—County Commissioners have adopted plans and specifications for a double box culvert bridge over the Dodds Ditch at West Carrollton and for a bridge over a road on the west side of the river at Miamisburg.

Piqua, O.—County Commissioners have secured permits from the State Board of Public Works for the construction of four bridges over the M. & E. Canal.

Portland, Ore.—Senate has passed a bill authorizing the Spokane-British Columbia R. R. Co. to construct a bridge over the Columbia River near the mouth of the San Poil River.

Portland, Ore.—County Commissioners have decided to reconstruct immediately one of the numerous bridges beyond Linntown on the county road running between Portland and St. Helens. The structure is 150 ft. in length.

Bethlehem, Pa.—Engineers have completed plans for the construction of the proposed trolley bridge across the Lehigh River at this place. The structure will be situated about 50 ft. from the present New Street Bridge. The estimated cost of the work is $100,000.

Harrisburg, Pa.—According to reports the Cumberland Railroad Company will construct double track from Hagerstown to the Potomac River, the work including the construction of a new steel bridge over the river at Falling Waters.

Jeannette, Pa.—City Council is agitating the construction of a new bridge over the railroad on Second St. The structure as proposed will be the width of the street.

York, Pa.—County Commissioners are soon to ask bids for the construction of a new bridge. George F. Bortner is President of the Commission.

Dallas, Tex.—County Commissioners' Court has been authorized to construct the Miller's Ferry viaduct across the Trinity River by the United States War Department.

San Antonio, Tex.—Plans for the Hays St. viaduct which will be built by the Southern Pacific R. R. Co. have been submitted to the Railway Committee of the City Council.

Richmond, Va.—Supervisors of Henrico and Chesterfield Counties are to take up the matter of constructing a new bridge over the James River from a point near the Westhampton Country Club.

Seattle, Wash.—A resolution has been introduced in the City Council by James Conway for the construction of a wide elevated crossing to open Lander St. through to the east waterway.

Kenosha, Wis.—Steps are being taken to secure the construction of bridges at Middle St., Bronson St. and Washington Island.

Calgary, Alta.—City Commissioners are considering the proposition of the Canadian Pacific for the construction of an overhead bridge over the new yards in East Calgary.

Brockville, Ont.—Town Council has inspected the plans and specifications for the construction of 6 new bridges and bids for the work will be asked soon.

St. Catharines, Ont.—Committee has been appointed to complete the stock subscription for the proposed high bridge across the Welland Canal from Grand Trunk Depot to St. Paul St. The estimated cost of the work is $150,000.

Roads and Streets.

Items Arranged Alphabetically by States.

Huntsville, Ala.—City Council has adopted an ordinance providing for the paving of Eustis St. from the public square to California St., a distance of one-half mile.

Coalinga, Cal.—A company of engineers, including F. E. Wallace, Louis Patrequin, Parkfield, Cal., and Clark McKay, Fresno. County Surveyor and Viewers have started over the route of the proposed Coalinga-Parkfield Road to determine the feasibility of the project.

San Rafeal, Cal.—Citizens and property owners in and around Kentfield, Escalle and Larkspur, have petitioned the Board of Supervisors for the construction of a road across the marsh from Escalle to Hotel Bon Air.

Venice, Cal.—A new boulevard is to be constructed in this city. It will extend for about two miles out of the city from what is known as St. Mark's Blvd., to a point the other side of the city hall, and will parallel the line of the Los Angeles-Pacific Railway Co.

Glendora, Cal.—At a meeting recently held in this city it was decided to build a road across the mountains from this city to the upper San Gabriel River. The estimated cost is $20,000.

Jacksonville, Fla.—Duval County Commissioners has instructed the County Engineer, Gail L. Barnard, to prepare grades and estimates for pavements to be laid on several county roads.

Peoria, Ill.—City Engineer Clay Belsley has been instructed to prepare an estimate of the cost of paving with brick, Fourth Ave. from Spencer St. to Seventh Ave., and further for the opening of an alley between Madison and Jefferson Aves. Property owners on North Orange St. presented a petition to the City Council for a brick pavement on a concrete foundation from Main St. to Chambers Ave.

Peoria, Ill.—Board of Local Improvements has approved an ordinance for the paving of Sandford St. with brick from Second to Glen Aves. The City Council has approved an ordinance providing for the paving with brick of the alley between Randolph and Crescent Aves. and running from Hamilton St. to Chambers Ave. Clay Belsley, City Engineer.

Marshall, Ill.—City Council has passed an ordinance providing for the construction of seven blocks of additional pavement in the city. The paving includes Main St. from Fourth St. to Michigan Ave.; Locust St. from Fifth St. to Michigan Ave.; and Fifth St. from Main to Locust. The estimated cost of this work is $19,661.

Marion, Ind.—Petition has been filed with the County Auditor asking for the construction of the county line road between Grant and Wabash, beginning at the Lago road on the east and extending west to the Mississippi River.

Gary, Ind.—County Commissioners have been asked to extend Fifth Ave. by short route into Chicago.

East Chicago, Ind.—Citizens have asked the County Commissioners to pave Canal St. and Chicago Ave. extended.

Newcastle, Ind.—County Commissioners have been petitioned for the paving of the National road for a distance east and west of Knightstown, and including the main street. The commissioners have also been petitioned to pave the Spiceland Pike, leading off Main St. in this city.

Bedford, Ind.—Plans and specifications have been prepared for the paving of 16th St. Bids will be advertised for about June 1. J. W. Malcott, City Engineer.

Vinton, Ia.—City Council has decided to pave 15 blocks in the business district of the city with brick.

Council Bluff, Ia.—Resolution has been introduced in the City Council providing for the paving of Fifth Ave. from 14th St. to 21st St.

Corning, Ia.—City Council has published resolution of necessity for 35,000 sq. yds. of brick paving. Theodore S. DeLay has been appointed Engineer in charge.

Des Moines, Ia.—Nate Frankel, Vice President of the Harris-Emery Co., is having plans prepared for the construction of a boulevard between Woods and Marsh drives. John Budd, City Engineer.

Council Bluffs, Ia.—Petitions are in circulation for the paving of Broadway and South Main St.

Jeffersonville, Ky.—County Commissioners will build a free gravel road from Henryville to the Washington County Line. Charles W. Kelly is the Engineer.

Calumet, Mich.—Calumet Township Board has instructed the engineer to prepare specifications for the building of a new piece of road in the Trap Rock River Valley District.

Virginia, Minn.—City Council directed that $12,500 be turned over to the Park Board for fitting up Chestnut St. Property owners requested that pavements be laid as follows. On Chestnut St. between Central and Virginia Ave.; Central Ave. from Willow to Sage St.; Maple St. from Railroad to Virginia.

Two Harbors, Minn.—County Commissioners will probably ask for bids for the construction of the road between this city and Knife River sometime during this month.

South St. Paul, Minn.—City Engineer W. A. Hunt has estimated the cost of the improvements on Concord St. contemplated for the coming summer at $8,160. This will cover the expense of grading, leveling and macadamizing the main thoroughfare to and from St. Paul for a distance of about 3,000 ft. from Annapolis St. south.

St. Louis, Mo.—Million Club of this city contemplates the construction of a saucer-type motor track. Charles F. Wenneker is President of the club.

Hollister, Mo.—A special road district is being organized between this city and Kirbyville for the purpose of constructing a wagon road between those points.

Indianola, Miss.—Indianola Dirt Road Construction Co. has been organized with a capital stock of $10,000 for the purpose of contracting for and building 100 miles of good roads in the territory adjoining Indianola.

Portsmouth, O.—Citizens from Washington Township have petitioned the County Commissioners for the widening and extension of the Portsmouth and Galena turnpike at a distance of two miles up Dry Run.

Columbus, O.—County Surveyor Hugh K. Lindsey has completed plans for the improvement of the road from Clintonville to Worthington and the road will be ordered improved by the County Commissioners. The distance is three miles.

Columbus, O.—Approximately 48 miles of highways in Franklin County will be improved during the coming summer at a cost of $246,000. The work will be done through the co-operation of the state, county, townships and property owners. Hugh K. Lindsey, County Surveyor.

Covington, O.—County Commissioners have authorized the General Superintendent of Roads to make plans and specifications for a number of roads and bridges throughout the county, especially the Banklick Bridge.

Sandusky, O.—County Commissioners have decided to repair the old plank road now known as Columbus Pike from the corporation line to the Seven Mile House.

Ashland, O.—J. F. Welty, Auditor of Ashland County, will sell bonds May 23 in the sum of $40,000 for road improvements.

Bellefontaine, O.—City Auditor U. L. Kennedy will sell bonds May 23 in the sum of $35,000 for the improvement of Main St.

Perry, Okla.—City will hold an election to vote on the issuance of bonds in the sum of $25,000 for public improvements.

Harrisburg, Pa.—Plans are well under way for the paving of Derry St. in the 13th Ward and part of Front St. north of Maclay St.

Harrisburg, Pa.—Supervisors of East Pennsboro Township have decided to communicate with the State Highway Department in regard to resurfacing the state road between Wormleysburg and the Northern Central Bridge, West Fairview.

Shamokin, Pa.—State will probably construct a new brick or asphalt highway from this city to Kulpmont. Joseph Hunter is State Commissioner of Highways.

Forest Lake, Pa.—Forest Lake Association has appropriated $3,000 to build a road from Mast Hope depot to the park.

Taylor, Tex.—Property owners on Main St. have agreed to pay for the paving of the center of the street. The City Council will order the paving of the entire street with vitrified brick soon.

San Marcos, Tex.—City will hold an election June 4 to vote on the proposition of issuing bonds in the sum of $20,000 for road improvements.

Ephraim, Utah.—State road commission will build a state road from the north state line to the Grand Canyon, running through Spanish Fork, Payson and Nephi. It is estimated that the road will cost about $6,000. Richard L. Lyman is vice-chairman of the commission.

Elbe, Wash.—Surveys are being made of the state road between this city and Alder preparatory to improving the same.

Montesano, Wash.—County Commissioners will construct the Elma cut off road reaching from Elma to the Thurston County Line. About $40,000 will be expended on this section of the Grays Harbor-Olympia Road. Bids are to be asked for at once.

Seattle, Wash.—State Highway Commissioner is having surveys made of the proposed route for the road to be constructed between Grays Harbor and Richmond.

Seattle, Wash.—A road 15 miles in extent across Snoqualmie pass will be rebuilt into a highway this summer.

Seattle, Wash.—Plans and specifications for the Yesler way regrade are being prepared by City Engineer R. H. Thompson. It is estimated that this work will cost $390,000. Contracts will soon be let for making a solid dirt street of Westlake Ave., from Fremont to the old Western mills, estimated to cost $127,000.

Granger, Wash.—Petition has been signed by citizens for a new highway between Granger and Alfalfa on the Northern Pacific Railroad, with a branch running to Toppenish. L. M. Hilton is interested.

Wenatchee, Wash.—Commercial Club of this city has asked for $20,000 in road funds available to Chelan county from the state aid road fund for the purpose of macadamizing Wenatchee Ave., from the city limits to the Wenatchee River bridge.

La Crosse, Wis.—County Highway Commissioners will take steps at a meeting to be held May 11 to expend $42,000 of county and town money in building good roads during the ensuing year.

Green Bay, Wis.—Brown County Commissioners have been petitioned for aid in improving highways, the amount asked by the towns aggregating $10,275.

Niagara Falls, Ont.—Queen Victoria Park Commissioners has asked for money for the construction this year of nine miles of the Fort Erie-Niagara Blvd. The road to be improved lies between Slavin Point and Miller's Creek.

Sewers.

Items Arranged Alphabetically by States.

Phoenix, Ariz.—City will hold an election May 23 to vote on the proposition of bonding the city in the sum of $33,000 for the construction of a sewer system.

Chico, Cal.—City will hold an election soon to vote on the proposition of bonding the city in the sum of $150,000 for the purpose of building a city hall, laying sewers, paving streets and fire equipment.

Sawtelle, Cal.—Citizens of this town are agitating the construction of a sewerage system. A bond issue will probably be authorized.

Los Gatos, Cal.—Board of Trustees has adopted the plans and specifications for the construction of a sewer on San Jose Ave., between Wheeler Ave. and the middle of the El Monte hill, a distance of 1,426.3 ft. Robert Chandler, city engineer.

San Francisco, Cal.—Board of Public Works has approved the specifications prepared by the city engineer for the North Point main sewer, and adopted a resolution asking the Supervisors to set aside from bond issue funds now on hand the sum of $165,000 for the construction of section A of the sewer.

San Francisco, Cal.—Street committee of the Board of Supervisors agreed to recommend that $170,000 be set aside to cover the cost of the new sewer to be put down in Seventh St., and which is to extend from Howard to Hubbell St.

Tulare, Cal.—City will hold an election May 19 to vote on the proposition of bonding the city in the sum of $80,000 for the construction of a sewer system.

San Francisco, Cal.—Plans are about completed for the $1,000,000 tunnel sewer system that it is proposed will drain the Sunset, Richmond, Parkside, Oceanside and Ingleside districts. The tunnel will be 16 ft. wide and 8 ft. high and nearly a mile in length. A system of large sewers have been planned to carry the sewage from the districts. The tunnel will be known as the Mill Rock tunnel.

Santa Clara, Cal.—An ordinance has been introduced in the city council providing for the sewering of the entire town.

Santa Ana, Cal.—City council has made known plans for building a new outfall for the Santa Ana sewer system. It will be constructed from the foot of Baker St. to the edge of the San Joaquin ranch at an estimated cost of $35,000.

Roseville, Cal.—City will probably hold an election May 28 to vote on the proposition of bonding the city in the sum of $80,000 for the purpose of building a sewer and a bridge over Dry Creek.

Lewiston, Ill.—City has voted in favor of the construction of a sanitary sewer system to cost $32,000.

Bushnell, Ill.—City has voted the issuance of bonds in the sum of $25,000 for the construction of a sewer system.

Champaign, Ill.—Board of Local Improvements passed a resolution providing for the construction of a storm sewer on West White St. The cost of the sewer is estimated at $13,500.

De Kalb, Ill.—Profiles and estimates for the proposed sewer system for this city have been prepared.

Elgin, Ill.—City Engineer Carl E. Plum is preparing plans for a sewer for the Dixon Ave. property. Connections will be made with a sewer on Grace St., and the whole lowlands of the neighborhood will be drained.

Lewistown, Ill.—City has voted to construct a $32,000 sanitary sewer system.

Marseilles, Ill.—City will soon vote on the proposition of giving the mayor and city council authority to issue city bonds in the sum of $27,000 for the purpose of constructing a sewer.

Peoria, Ill.—City Engineer Clay Belsley has prepared blue prints of a new sewer system for the territory between the bluff and the river from Cornhill St. to the city limits. This sewer will require about three miles of piping.

Peru, Ind.—Plans and specifications have been approved for a lateral sewer from Benton to Lincoln St., between Main and Fifth Sts. Bids will be received at once.

Hammond, Ind.—Board of Public Works has accepted the plans and specifications for the Huehl Ave. walks, the Ames Ave. sewer and the Walter Ave. sewer, section A.

Indianapolis, Ind.—City Engineer H. W. Klausmann has submitted to the Board of Public Works plans and specifications for a number of proposed street and sewer improvements.

Tama, Ia.—City council is taking steps toward starting the construction of a sewer system.

Clinton, Ia.—City will expend $90,000 on the completion of a sewer. R. C. Hart is city engineer.

Perry, Ia.—City council has voted to construct storm sewers on certain streets and an addition to the sanitary sewer on Willis Ave.

Clinton, Ia.—City council will probably take immediate action toward the construction of a big sewer extending from the corner of 8th Ave. and 4th St., to First Ave., emptying into the First Ave. main. The estimated cost of the sewer is $61,000.

Lake Charles, La.—An engineer has estimated the cost of the proposed sewerage system for this city at $160,000. The system will require 21 miles of pipe.

New Bedford, Mass.—The governor of Massachusetts has signed a bill authorizing this city to expend $1,600,000 for the purpose of building an intercepting sewer.

Kalamazoo, Mich.—City council has been petitioned for the extension of the sanitary sewer on Grand Ave., for about 12 rods.

Mt. Clemens, Mich.—City council has ordered the construction of a 12-in. crock lateral sewer on South Front St.

Mankato, Minn.—A storm sewer is to be constructed on Hickory St., from Fifth St. to Fourth St.

Albert Lea, Minn.—Plans are being prepared by City Engineer William Barneck for the construction of an extensive sewer system. Bids will be advertised for soon.

Duluth, Minn.—City council has been petitioned for the construction of a sanitary sewer in Gladstone St., from 40th to 45th Aves., west, and for the construction of a sewer in 59th to Grand Ave., Grand Ave. to 61st, and a connecting sewer from the alley on 61st Ave., west, to Grand Ave.

Springfield, Mo.—Citizens of the Eighth Ward are agitating the construction of a sewer in the northeast portion of the city, including most of the Eighth Ward.

Kansas City, Mo.—Plans are about completed for the building of the O. K. Creek sewer. The plans are being prepared by J. V. Hanna, chief engineer for the Kansas City Terminal Railway Co. The sewer is estimated to cost $600,000.

Tecumseh, Neb.—City Engineer Roscoe C. Gore has completed drawings of the proposed sewerage system for this city, also plans, specifications and estimates of cost. N. M. Davidson, city clerk.

Westwood, N. J.—Citizens of this town are agitating the construction of a sewerage system. Henry H. Goodwin, mayor.

Penn Grove, N. J.—Civil Engineer Clyde Potts, 30 Church St., New York, has been retained by this city to design sewers and sewage disposal works for the city. Fred A. Gentieu, mayor, Asa G. Justice, city clerk.

Geneva, N. Y.—Board of Public Works has decided to lay an extension of the sewer system through Coapland Ave., Hamilton and Ver Plank St., at an estimated cost of $1,600.

Rensselaer, N. Y.—Plans for the construction of a sewer to be built by the Hudson River Aniline Works have been approved by the mayor. The sewer will enter the river at the mouth of the dyke.

North Tonawanda, N. Y.—State Health Department has approved the plans prepared by City Engineer Smith, for the construction of the Rumbold Ave. sewer. An automatic lifting station will be installed. The system will cost about $30,000.

Brooklyn, N. Y.—Borough President Steers has ordered sewers constructed on the following streets: 65th St., from Fort Hamilton Ave. to Eighth Ave.; 18th Ave., from 86th St. to Benson Ave.; Montrose Ave., from Union Ave. to Broadway; Gravesend Ave., from Avenue J to Bay Parkway; 79th St., from 14th to 15th Aves., and 15th Ave., from 78th to 79th Sts.

Hamburg, N. Y.—City held a special election May 10 to vote on the proposition of appropriating $45,000 for the construction of sewers throughout the village.

Grand Forks, N. Dak.—City engineer has been instructed to prepare plans and specifications for extending the sewer on Forest and Elm Ave and on Brooklyn Blvd.

Minot, N. Dak.—City Commissioners have accepted the plans for a new sewer system, furnished by R. E. Wickam, assistant city engineer of Grand Forks. The work will be advertised at once.

Grand Forks, N. Dak.—City Engineer Lykken has been instructed to prepare plans and specifications for the extension of the sewer on Forest and Elm Aves. and on Brooklyn Blvd.

Ashland, O.—City council has been petitioned for the extension of the sanitary sewer on East Fourth St.

Delaware, O.—City council has declared it necessary to construct a sewer on Campbell St. from Central Ave. to Lincoln Ave., and Griswold St., from Campbell St., east to the end of the present sewer. W. E. Haas, mayor.

Cleveland, O.—Dugway Brook Improvement Association is agitating the construction of the new sewer for Dugway brook valley.

Kenton, O.—City council has declared it necessary to construct a sewer in the eastern sewer district. G. S. Binckley, city clerk.

Huntington, O.—City has voted the issuance of bonds in the sum of $275,000 for sewer and street improvements.

Zanesville, O.—City Auditor L. R. McCaddon will sell bonds May 28 in the sum of $27,000 for the construction of a sewer.

Hamilton, O.—City Engineer F. E. Weaver has prepared plans and estimates of the cost of the construction of a sanitary sewer on South Eighth St., from Hanover St. to Rigdon

St., and on Vine St. and Greenwood Ave. The sewers are estimated to cost $1,790 and $9,122, respectively.

Marblecliff, O.—State Board of Health has instructed this village to install a sewage disposal plant. Immediate action will be taken toward the installation of the plant.

Richwood, O.—City council has been petitioned for the construction of a sewer on London Ave.

Lebanon, Ore.—Survey of the proposed sewer system for this city has been completed. The cost of a 22-in. pipe for the sewer will be about $30,000, with an additional branch line from Isabella St., at a cost of about $10,000.

La Grande, Ore.—Civil Engineer Louis C. Kelsey, 402 Dooly Bldg., Salt Lake City, has been engaged as consulting engineer on the sewer system for this city, the approximate cost of which is $125,000.

Salem, Ore.—Plans and specifications have been prepared for the construction of the South Salem sewer system, which will serve the entire city south of South Mill Creek.

Lancaster, Pa.—City council has authorized the building of a sanitary and storm sewer on St. Joseph St., east from Filbert.

McKeesport, Pa.—City has engaged an engineer to prepare plans for the new sewerage system, with disposal plants.

Harrisburg, Pa.—City Engineer M. B. Cowden has completed the plans and specifications for the sewer improvements in the city, ordered by the decree of the state health commissioner.

Williamsport, Pa.—Engineer Osborne Congleton of New York has completed the plans for the sewage disposal plant for this city.

Altoona, Pa.—City Engineer Franz Engstrom has prepared plans for the construction of a sewage disposal plant.

Allentown, Pa.—City council adopted an ordinance increasing the city's bonded indebtedness by $34,500 for the construction of a sewer.

West Chester, Pa.—City will hold an election May 17 to vote on the proposition of issuing bonds in the sum of $200,000 for the construction of a sewer system.

Johnstown, Pa.—Johnstown municipal improvement committee, Dr. George W. Wagoner, chairman, has asked the city council to engage an engineer to prepare plans and specifications for the construction of a sewer system for the city.

Punxsutawney, Pa.—City is contemplating constructing a sewage disposal plant at an estimated cost of $100,000.

Bristol, R. I.—Citizens have voted to extend the sewer system in the town to completion, and have voted a bond issue of $35,000 for the payment of the extension.

La Follette, Tenn.—City will probably construct a sewer on Tennessee Ave. J. Will Taylor is mayor.

Morristown, Tenn.—Plans and specifications have been prepared for the construction of the proposed new $40,000 sewerage system, including a septic disposal plant. The work will be advertised at once.

Lampasas, Tex.—Surveyors have established grades of the streets in the city with a view to submitting proposals to the city council for putting in a sewerage system.

Spokane, Wash.—City Engineer Morton Macartney is engaged in preparing final plans for the $500,000 sewer system to be built in the Fourth and Fifth Wards.

Vancouver, Wash.—Plans have been made for the construction of the B St. lateral sewer at an estimated cost of $7,000. The work will include 600 ft. 10 in. and 2,000 ft. 8 in. vitrified pipe, and 11 manholes. Contract will be let about June 15. H. H. Lotter, engineer, city.

Spokane, Wash.—Plans and specifications for the construction of intercepting sewer No. 1, embracing the business district of the entire south side of the city and calling for an expenditure of $203,396, have been completed. Plans and specifications have also been completed for the construction of a sewer on Washington St., Sharp Ave., Cataldo Ave., Calispel St., and Boone Ave., to cost $28,428. J. C. Ralston, city engineer.

Wheeling, W. Va.—Survey has been made for the construction of a sewer on South Fourth St., between Jefferson and Monroe St.

Marinette, Wis.—City council has decided to expend $3,000 for the extension of the main brick sewer. The sewer will be extended on Lewis St., toward State St.

Janesville, Wis.—City engineer was ordered to prepare plans for a sanitary sewer on Clarence St., between Milwaukee and Court Sts.

Monroe, Wis.—City council has been petitioned to construct a sewer on Fulton St., running from the center of Russell St., south of the center of Washington St.

Wausau, Wis.—City council has been petitioned for the construction of the following sewers: East Jefferson and Muenchow St., on Seventh Ave. north from Stewart St., on Fourth St., from Forest St. to Division alley, on Fourth Ave., from Garfield to Stewart Sts., on Seventh St., north from Kickbusch, and on Garfield St.

Buffalo, Wyo.—City contemplates the construction of a sewerage system at an estimated cost of $50,000. Oliver G. Norval, mayor.

Prince Rupert, B. C.—Petition is in circulation at Prince Rupert asking the government to continue the construction of sewers in the new city until the $25,000 appropriation is exhausted.

Toronto, Ont. Provincial board has approved the plans for the sewage outfall works at New Toronto. The plans call for an expenditure of about $20,000.

Ottawa, Ont.—Provincial board has approved the plans for the west end sewage disposal for this city.

Wingham, Ont. Provincial board has approved the sewage purification plans of this city.

Ottawa, Ont.—City of Aylmer has agreed to pay half of the cost of installing a septi tank to prevent its sewage polluting the Ottawa River. City Engineer of this city will prepare plans and estimates. The cost will be about $5,000.

Water Supply.

Items Arranged Alphabetically by States.

Hartford, Ark.—City council has taken initial steps toward securing a water works system for the city. The system will probably be installed by a private company.

Waldron, Ark.—Plans are being prepared by E. W. Gantt of the Sequoyah Engineering Co., Fort Smith, for the construction of a water works for this city.

Visalia, Cal.—City has voted the issuance of bonds in the sum of $75,000 for the construction of a concrete aqueduct in Mill Creek.

Denver, Colo.—Board of Supervisors have passed an ordinance providing for the voting on the new water franchise.

Donaldsonville, Ga.—City has voted the issuance of bonds in the sum of $20,000 for the purpose of improving the water works and installing an electric light plant.

Sylvania, Ga.—City has voted the issuance of bonds in the sum of $40,000 for the construction of a water works, electric light and sewer system.

Belleville, Ill.—Belleville Water Supply Co. has elected the following officials: C. M. Horner, president; E. W. Clark, vice-president; H. P. Scanlan, secretary-treasurer. The work of laying the 16-in. water main from Second St. and Missouri Ave., East St. Louis, along State St. to the bluffs will be started at once. It is estimated that it will cost $500,000 to supply this city with water.

Joliet, Ill.—Stockyards Water Co. has been organized in this city for the purpose of constructing a private water works plant. The plant, the estimated cost of which is $1,500,000, is designed to furnish 75,000,000 gals. of water daily. Matt Berscheidt, city clerk.

Ottumwa, Ia.—City council has voted to offer the public water company of this city $265,000 for its property.

Lakeland, Ky.—It is proposed to construct a pipe line from Louisville Water Co. to the State Asylum at this city at a cost of $65,000. Engineer for the work has not yet been employed. Geo. B. Caywood, Frankfort, Ky., is secretary of board of control.

Baltimore, Md.—Board of Awards has rejected all bids for the construction of the new pumping station of the fire department pipe line. Noel Construction Co. of this city, at $115,000, were the lowest bidders.

Elkton, Md.—City will hold an election to vote on the issuance of $75,000 worth of bonds for the installation of electric lights and water works.

Hancock, Md.—Citizens have voted in favor of issuing $30,000 of bonds for the construction of water works.

Marquette, Mich.—Municipal authorities have recommended the extension of the intake pipe of the water system into deeper water in Lake Superior. An alternative proposition is the establishment of a new pumping station at Presque Isle at a cost of $205,000.

Ann Arbor, Mich.—Ann Arbor Water Co. is issuing bonds in the sum of $350,000 for improvements to its system.

Flint, Mich.—City has authorized the issuance of bonds in the sum of $5,000 for the construction of water main extensions.

Galesburg, Mich.—City has voted the issuance of bonds in the sum of $11,000 for constructing a water works.

Niles, Mich.—City contemplates purchasing the Barren Lake Water Co., at a cost of $30,000 to furnish water to the city. The system comprises 10 miles of cement, iron, tile and wood mains.

Saginaw, Mich.—City has located a new water plant to be constructed by a citizens' committee on Rust Park. Bonds in the sum of $400,000 are to be issued to construct filtration and pumping plant.

Anoka, Minn. City has voted down the proposition of bonding the city in the sums of $15,000 and $45,000 for the purpose of erecting two dams about seven miles from the city for supplying the city with water.

Duluth, Minn.—City will extend the water mains throughout the residence portions of the city.

Keewatin, Minn.—City contemplates installing a municipal water and light plant.

Pipestone, Minn. Citizens of the independent school district of this city have voted to empower the Board of Education to construct a complete waterworks system at the high school.

Raymond, Minn.—City has voted the issuance of $6,000 for the erection of a waterworks.

Stillwater, Minn.—City council has voted to offer the water works company $145,000 in bonds for its holdings; the purchase to become effective July 1.

St. Paul, Minn.—Water Board has issued orders to lay water mains in 10 streets, the aggregating length of which will be about two miles.

Palmyra, Mo.—City has voted to issue bonds in the sum of $35,000 for the construction of a water and electric light plant.

Hannibal, Mo.—City is contemplating the installation of a new water works system.

Kennett, Mo.—City has voted to issue bonds in the sum of $40,000 to build a system of water works. The system will include about nine miles of pipes.

Palmyra, Mo.—City will vote May 18 to decide whether the city shall own its waterworks. It is proposed to vote $35,000 to build or acquire a plant.

Tipton, Mo.—City will hold a special election soon to vote on a bond proposition for the purpose of installing a water works and electric light system.

Harlowton, Mont.—Town Clerk S. K. Campbell will sell bonds May 12 in the sum of $15,000 for the construction of a waterworks.

Laurel, Mont.—Town Clerk William Quest will sell bonds May 23 in the sum of $28,000 for water works, and in the sum of $15,000 for sewers.

Libby, Mont.—E. A. Bull of Chicago, Ill., has submitted a water works and electric light ordinance to the town council.

Miles City, Mont.—Plans are being prepared by Burns & McDonnell, Scarritt Bldg., Kansas City, Mo., for the construction of a municipal water works, sewers and electric lighting plant, for which the city recently voted $230,000. Water will be taken from the Yellowstone River, using settling basins and filtration. Bids will be asked for in about six weeks.

Fairbury, Neb.—City council has decided to call an election for the purpose of voting on the proposition of issuing bonds in the sum of $115,000 for the construction of a water works.

Beatrice, Neb.—City Attorney Sabin has rendered a decision that this city can spend $150,000 for the installation of a new waterworks. It is probable that the city will hold an election to vote on the proposition.

Beatrice, Neb.—City council has decided to call a special election May 31 to vote bonds in the sum of $70,000 for the erection of a water plant and an electric light plant. The water supply will come from wells sunk in the Paddock pasture north of the city.

Omaha, Neb.—City council committee has recommended for passage an ordinance providing for purer water.

Seward, Neb.—City council has decided to expend $4,400 in getting a new supply of city water.

Allenhurst, N. J.—City has voted the issuance of bonds in the sum of $12,000 for water works.

Atlantic City, N. J.—City council has authorized a bond issue, not exceeding $175,000, for an extension of the present municipal water system.

Camden, N. J.—Ocean Township Water Co. has been chartered with a capital stock of $100,000 for the purpose of constructing and operating a water works in Ocean township, Monmouth county; headquarters in this city. The incorporators are George Reynolds, Burlington; S. Howard Troth, Riverton; Ephraim Tomlinson, Camden; William H. Roth, Camden; George M. Bunting and H. Bayard Hodge, Philadelphia.

Plainfield, N. J.—Citizens have voted in favor of the construction of a municipal water plant.

New York, N. Y.—Deep Well Water Co. of the Borough of Queens has been incorporated with a capital stock of $1,000,000. The directors are W. G. Berryman, Watson B. Eilbick, George R. Shields and Glenn H. Mills of New York, and George J. Johnstone of Passaic, N. J.

La Salle, N. Y.—Village contemplates buying the plant of the private water works company. Frank Wilson is president of the village board.

Brooklyn, N. Y.—Great South Bay Water Co. is issuing bonds in the sum of $400,000 for extensions to its system. David A. Boody, this city, is president of the company.

Buffalo, N. Y.—State legislature has passed a bill permitting an increase from $3,500,000 to $5,000,000 in the bonds that can be issued for repairs and construction in the new water works system for this city.

Manchester, N. Y.—City will soon construct a waterworks system. It is probable that the system will be constructed jointly by the city and the Lehigh Valley Railroad.

Schenectady, N. Y.—Board of Trade is discussing the plan for increasing the water supply and storage of this city by the construction of a system of reservoirs.

Murphy, N. C.—City has voted the issuance of bonds in the sum of $25,000 for water works.

Franklin, N. C.—E. D. Franks, secretary of the town board, will sell bonds July 1 in the sum of $20,000 for the construction of a water works.

Spencer, N. C.—City has contracted with an Atlanta company to draw plans for a modern water works system for the town. Bonds were

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CONTENTS.

EDITORIAL:

A Statement of Doctrine....467
A Rational Method of Determining Reasonableness of Rates Charged by Public Service Corporations and a Discussion of the Theory of Profits....467
Cost of Concrete Balcony Floors of the Lockport Power House, Chicago Drainage Canal....469
Some Notes on the Effect of Sewage and Sewage Gases on Portland Cement Concrete....470
Method of Attaching Derrick Boom to Leg of Hoist Tower for Concrete Building Work....471
Plant Cost of Machine Mixed Concrete....472
Method and Cost of Constructing a Water Supply Tunnel Through Rock by Day Labor With Costs of Supplementary Structures....472
Modern Requirements of a Public Water Supply....478
Standardization of Tar for Paving Purposes....479
Equipment and Cost of a Fire Service Water Supply System at Winnipeg, Man.481
A Molded Fiber Conduit with Bell and Spigot Joints....482
Valuation of the Puget Sound Electric Railway....482
Spring Meeting of the American Society of Mechanical Engineers....486
Summer Courses for Engineers and Artisans at the University of Wisconsin....486
First Cost and Cost of Operating Power Plants for Driving North River Tunnels of Pennsylvania Railroad, New York City....487
Depreciation and Reserve Funds of Electrical Properties....487
The Opportunities for Engineering Employment in South America....489
"A Point of View"—Suggestions Regarding Modern Organization from a Story in McClure's Magazine, May, 1910....489
PERSONALS....490
CATALOGS WORTH HAVING....490

A Statement of Doctrine.

It happens that in this issue we give considerable space to records of day labor costs of doing construction work. We mention this because it suggests the opportunity for setting aright certain of our readers who have misconstrued our pronounced position in favor of contract work. It has been assumed that since this was our position we would be reluctant to present facts or figures tending to show it to be untenable, or, to be specific, to present data showing day labor work to be good and cheap. In view of all the costs of day labor work that we have published, this feeling is hard to understand. We cannot imagine it to be prevalent, but that it exists at all is reason sufficient for effort on our part to banish it. This journal believes in the economic soundness of the principle of doing construction work by contract, but it believes still more strongly in the principle that the truth should be sought always in engineering regardless of whatever person or precept is made to suffer in consequence. Instead of suppressing records and costs of day labor work, we are constantly seeking them. We have published all that we could find that were free to us to publish. We have paid and will continue to pay for the privilege of publishing all that are valuable. The doctrine of contract work has nothing to fear from truthful and complete records of day labor work or from honest discussion. When it has we shall revise our opinion, not suppress the records.

A Rational Method of Determining Reasonableness of Rates Charged by Public Service Corporations and a Discussion of the Theory of Profits.

Since America has entered upon an era of governmental regulation of public service corporations, it becomes a matter of extreme importance that the regulation shall not be of a kind that will drive new capital from this field or destroy existing incentives to reduce operating costs. Recent decisions of railway commissions, and, indeed, all important rate making decisions of the past, have been based upon the theory that there is some "reasonable" percentage of net income on invested capital—usually 6 or 7 per cent—and that rates should be so reduced as to permit no profit in excess of this "reasonable" percentage. This theory rests upon a fallacy, and is destined to work irretrievable harm, unless it shall be soon abandoned and a more rational theory adopted. Capital invested in any enterprise is obviously entitled to a return, but the return should be no more than the prevailing rate of interest on borrowed money, when well secured. Any return in excess of this rate is not a return on capital, but springs directly from the brains of the men who are managing the enterprise, and should be called profit. In all business operations involving the investment of capital and the use of a plant, we have the following items that go to make the total charge:

1. Operating expense, including taxes.
2. Amortization, or depreciation of plant.
3. Interest on invested capital.
4. Profit.

The cost of production is the sum of items 1 to 3. It is fundamentally erroneous to regard only items 1 and 2 as being the cost of production, yet this is commonly done, and in that case items 3 and 4 are erroneously regarded as "profit" on the investment.

Practically all large industrial operations are begun with borrowed capital. This capital is entitled to and must receive, its return of, say 4 or 5 per cent. The genius of the promoters of the enterprise is not shown by the use of as large quantities of this capital as possible. Precisely the reverse is true. If the promoters can build and equip a railway, for example, at a cost of $25,000 per mile, which will give the same service secured by competitors with a transportation plant costing $50,000 per mile, they have performed the function of an inventor and are entitled to an inventor's reward. But, according to the theory now in vogue, the promoters of the $25,000 line would actually be fined for their ability, because they would be allowed to earn only 7 per cent on the investment—exactly the same percentage, but half the annual sum, earned by their less able competitors with the $50,000 line.

If interest on invested capital is regarded as an element of the cost of production, as it certainly should be, we are left to consider profit (item 4) entirely unconfused by any relation to the money invested in the plant. A merchant estimates his annual profit, not in percentage of the value of the stock on hand, but in percentage of sales. This is clearly the only logical viewpoint for a manufacturer to take also, and it applies equally to all kinds of business undertakings. Let us assume, for illustration, that a public service commission were to regulate the price of dry goods sold by merchants. Applying the present theory of a "reasonable" return on the investment, they would allow, say 7 per cent return on the capital invested in stock, buildings and real estate. Hence the merchant with the most costly establishment would be entitled to secure the greatest net returns annually, while his more active or more intelligent rival who, in a less expensive building, carried a small stock which he "turned over" several times annually, would be fined for his ability to attract customers enough to secure the rapid "turnover." In other words the merchant having the greatest capital or the greatest borrowing capacity would be favored at the expense of the merchant having the least, and quite illogically so.

Let us go a step farther, and assume that all telegrams and telephone messages could be economically sent by "wireless." Manifestly the plant investment would be but a minute fraction of the present investment in pole lines, conduits and wires. But, according to the present theory of "reasonable return" on the investment, it would actually pay the present telegraph and telephone companies to buy the "wireless" patents and then speedily forget that they existed. Or, in case the patents could not be bought, we should have the spectacle of inventive genius receiving its reward in a 7 per cent return on a plant costing next to nothing!

It will be only a few years before public service corporations will fix the rates charged by express companies. The capital invested in the express business is nominal. The transporting plant upon which these companies depend is owned by railways. Aside from delivery wagons and office furniture, there is no plant owned by the average express company, yet an enormous business is transacted. Just as in our assumed case of a "wireless" plant so here, in fact, we have a nominal investment by corporations doing a business of great proportions. Shall they, too, be restricted to a 7 per cent profit on invested capital?

This *reductio ad absurdum* shows how untenable is the hypothesis that profits are a return on capital. Profits are, or should be, a return on the absence of capital and the presence of brains. Profits are not a function of money rental, but of mind rental. The man who lends his mind to the service of the public demands, and is entitled to a rental for its use, based not on the labor and capital that he expends, but on what he conserves. This elemental principle of polical economy is wholly ignored when the theory of "reasonable return on capital" is applied in regulating the rates of railways.

Upon what theory, then, shall rates be fixed? If we start with the principle that the return upon capital (item 3) is logically a part of the cost of production, we shall advance a long way toward a rational solution of the problem.

To illustrate a rational method of determining reasonable profits, let us take the steam railways of America, and let us assume that the capital invested in their construction and equipment is $45,000 per mile of roadbed. Then, according to data given in the Interstate Commerce Commission Report for the year, 1906, and upon this assumption of first cost, we have:

	Per Mile of Road.
Operating expense (including renewals)	$ 6,896
Taxes	337
Interest on $45,000 at 4½%	2,025
Total cost of production	$ 9,258
Operating revenue	$10,460
Deduct cost of production	9,258
Profit	$ 1,202

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This profit is about 11½ per cent of the operating revenue. It is not quite 2.7 per cent of the assumed investment of $45,000 per mile. Hence the total return on capital—viewing the matter from the old standpoint—is 2.7 per cent profit and +4.5 per cent interest = 7.2 per cent.

It may chance, therefore, that a 7 per cent "return on capital" invested in railways gives a true profit of 10 or 11 per cent on gross income, and that this return is reasonable in that such managerial ability is suitably rewarded by its 10 per cent profit; but there is no necessary relation between a 7 per cent "return on capital" and a 10 per cent return on income. This is well illustrated in the case of the express companies.

One of the great advantages arising from viewing profits as a percentage of gross income is that it enables us to make use of data as to profits from business operations other than those involving large investments of capital. We can then inquire what profit the large merchant or manufacturer makes on his annual sales, wholly regardless of its direct relation to the capital invested. An average of such data will indicate the *maximum* profit that a public service corporation should be permitted to earn.

A secondary, but none the less important, advantage of this method of considering profits lies in the fact that it concentrates attention upon their true character, namely that they are returns for services differing in no essential from the fee of an architect, for example.

Men who are able to borrow money for railway construction, and the like, are commonly spoken of as capitalists. In reality they are usually not capitalists, but business managers in whom capitalists have confidence. This confidence is great or small, according as these business managers have managed very well or only moderately well. The reputation of these managers is usually of slow growth, and is based upon performance. Their profits are their compensation for brain services. With this fact in mind we are less apt to err in our judgment as to the "reasonableness" of a 10 or 12 per cent margin of profit on gross income than if we cling to the fallacious theory that profits are a return upon cash.

The average public service corporation shows little or no real profit at first. Its subsequent profits arise mainly from two causes: (1) The growth of the community it serves, and (2) the development of more economic methods of production. In the first of these sources of profit it is evident that the public itself is entitled to a large share. Yet it is not possible to draw a clear line between the two sources of profit, for the second is often dependent on the first. More economic machinery, for example, is usually a consequence of the use of larger units necessitated by the larger traffic. Thus, the reduction of grades on a railway becomes economic as a consequence of increased traffic. Larger engines, larger cars, longer trains and all the concomitant elements of unit cost reduction follow from the existence of a larger population to be served; yet they do not follow as a matter of necessity. There must be an incentive to cause the owners of the railway to introduce these labor saving features, and that incentive is profit. The state-owned railways of Europe show conclusively what happens in the absence of such an incentive. They remain what they were a generation or more ago, whereas American railways show a wonderfully progressive development as tools for economic transportation.

It is self evident that the public is entitled to a share in the increasing profits of public service corporations, but it is equally clear that it should be only a share. There are several ways in which the public may participate, such, for example, as: (1) A large tax on gross income; (2) a progressive reduction of unit rates or charges; (3) improved service, and (4) public ownership of the plant which is leased to an operating company at fixed rates. Of these methods the second and fourth seem most likely to be extensively adopted.

A progressive reduction in rates should be so adjusted as to divide increased profits between the operators and the public. Thus only can an incentive to economic production be provided. The moment a railway operator finds that his efforts at economy of operation result in a corresponding cut in rates, his efforts will cease. This is precisely what will happen if the present theory of a "reasonable return" on invested capital is persisted in. Profits (item 4) must remain sufficiently liberal to attract men of the highest ability. Yet, the profits need not be as high a percentage of the gross annual income as exist in other lines of business, for public service corporations are guarded from competition, to a large extent, by the character of their service.

It will probably be the part of wisdom not to change general rates frequently, although minor changes should be permitted, provided they do not affect the average rate for a period of years. Thus, if a railway system were permitted to charge an average rate of seven mills per ton-mile for a period of ten years, its officials should be comparatively free to raise rates on certain classes or commodities, provided other rates were correspondingly lowered. This would often be necessary in order to result in filling the cars both ways, as nearly as possible. The duties of railway commissions would thus be greatly simplified, while railways would have a powerful incentive to work out transportation economies. At the end of a prescribed period of years—ten, for example—a new average freight rate would be adopted, permitting the public to share in the results of economies effected, but not depriving the railway entirely of the results of intelligent management.

The public ownership of public service plants is a practice of questionable economy, except, perhaps, for certain limited classes of plant. The ever present danger of this method of control—even where the plant is leased to operating corporations—is the tendency to extravagant construction, which seems almost inevitable when the public purse is directly available. At present there is a strong leaning toward municipal ownership of street railways, lighting plants, etc., but this tendency is likely to change in a marked degree when it is found that public service corporations can be effectively controlled without absolute municipal ownership of the plants.

The first step in such control is complete publicity of costs of production and rates charged. This involves, however, a detailed appraisal of the first cost of the plant, for, as we have shown, a true cost of production includes interest on the actual cash cost of the property. Moreover, such an appraisal is also essential in determining what amount shall be placed annually in amortization or depreciation funds to provide for plant redemption at the expiration of its useful life. It needs but little acquaintance with engineering economics to appreciate that annual depreciation can be accurately estimated only in terms of the first cost. Incidentally, it may be added, such appraisals will, in future, assure the investing public that money alleged to have been spent in construction and equipment has been honestly spent. This, in turn, will serve to attract capital to investment in the bonds of public service corporations, and will have almost the same effect in lowering interest rates on bonds as if the construction work were done by government itself.

It is, indeed, not beyond the bounds of possibility that public service commissions will require that there be a public letting of all construction contracts. Already the Public Service Commission for the First District of New York State (New York City) insists upon supervisory control of all contracts involving the purchase of rolling stock.

Elsewhere in this issue we print a very interesting article on the appraisal of an electric interurban line, and syllabus of the decision of the Railroad Commission of Washington as to the passenger rates charged by this electric railway.

The Second International Road Congress.—Under the initiative of the Belgian Government, the second International Road Congress will be held at Brussels this summer, in order to continue the studies taken up at Paris in 1908 regarding the construction and care of roads with a view to adapting them to new modes of locomotion. This congress, at which the governments of the different countries have been invited to be represented officially, will be opened on July 31 and will last for seven days. It is organized by the Permanent International Association of Road Congresses, formed at Paris in 1908, at the time of the first congress, and by a Belgian Organizing Commission. Information regarding the conditions of membership can be obtained from Mr. Logan Waller Page, director, Office of Public Roads, Washington. It is expected that a few entertainments will be arranged at Brussels. There will be visits to the principal quarries of the country and a few excursions will be taken, including one to Antwerp, one to Spa and one to the caverns of Han-sur-Lesse. These excursions will give an opportunity to visit specially constructed roads, or installations in the matter of their adaptation to the new modes of locomotion. The organization of the Congress will be as follows:

SECTION 1.—CONSTRUCTION AND MAINTENANCE.

Subsection A.—Construction and Maintenance Outside of Large Cities.

First Question.—Macadamized and paved roadways. Use of binding materials in the construction of macadamized roadways. Use of running tracks in paved roadways. Progress of the struggle against dust and wear and tear.

Second Question.—Foundation and drainage of roads. Methods of work.

Third Question.—Construction of local railways and of tramways on roads. Advantages and disadvantages. Influence on the mode and cost of maintenance.

Subsection B.—Construction and Maintenance Within Large Cities.

Fourth Question.—Cleaning and watering. Necessity or usefulness. Means used. Net cost. Comparison with other processes.

Fifth Question.—Choice of the method of surfacing.

Sixth Question.—Way of carrying on street work, lighting and water supply.

Communications of the First Section.

Communication 1.—Use of mechanical rollers driven by petroleum engines.

Communication 2.—Equipment for roads exclusive of mechanical rollers, machines for breaking up the surface, etc.

Communication 3.—Materials of all kinds used in the construction and maintenance of roads; qualities to be demanded, tests on reception, units adopted.

Communication 4.—Laying sidewalks in cities.

Communication 5.—Removal of snow and ice.

SECTION 2.—TRAFFIC AND WORKING.

Seventh Question.—Influence of the weight and speed of vehicles on works of art.

Eighth Question.—Rolling stock on roads. Conditions to be fulfilled by a vehicle moved by animal or mechanical power in order to circulate on roads without causing abnormal deterioration and without undergoing itself any special injury.

Ninth Question.—Conditions of operation of transportation in common by land and with vehicles other than tram cars. Advantages, disadvantages, capacities, net cost, etc.

Communications of Second Section.

Communication 6.—Road signals. Steps taken to carry out the decision of the Congress of Paris.

Communication 7.—Different kinds of flexible tires. Utilization, advantages, disadvantages, etc.

Communication 8.—Census of circulation, of tonnage and of traffic; means employed and results obtained; units adopted.

Concrete and Reinforced Concrete Section

Note: This section is devoted to methods and cost of constructing concrete and reinforced concrete structures. It will cover the selection, testing and proportioning of concrete materials; laboratory tests of concrete; concrete mixing, transportation and placing; fabrication and placing of reinforcement, and form construction and erection. It will also contain articles on new and interesting developments in the design of reinforced concrete.

Cost of the Concrete Balcony Floors of the Lockport Power House, Chicago Drainage Canal.

BY L. K. SHERMAN*

The reinforced concrete floors of the Lockport, Ill., Power House of the Sanitary District of Chicago were constructed by day labor under supervision of the writer, who was Resident Engineer of Construction.

The building, including the structural steel frame and columns of the balcony floors, was erected by contract and all of this work was practically completed at the time the reinforced concrete floor work herein described, was begun. There were two balcony floors, each 359 ft. long by 26.5 ft. wide. The steel supporting frame of the floors consisted of 18-in. I-beams, 26.5 ft. span, spaced from 4 to 10 ft. apart, with one end resting on the wall of the building and the other end supported by steel girders with columns at intervals of 38 ft.

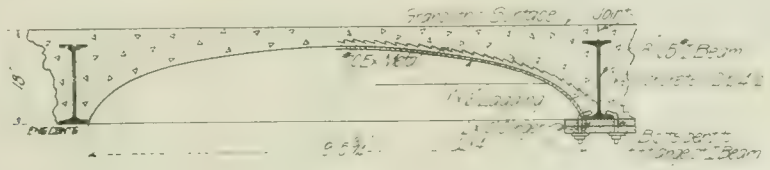


Fig. 1—Section of Balcony Floor Showing Forms, Lockport Power House.

Figure 1 shows a section of the floor, which is composed of concrete arches covering the spans between the 18-in. I-beams and supported by the lower flanges of the I-beams. The floor arches were 5 ins. thick at the crown, with elliptical intrados. The concrete was mixed in the proportion of 1 part Portland cement, 2½ parts limestone screenings under ⅛-in. size, and 4½ parts crushed stone ranging from ¼ to 1¼ ins. The floor surface was made with a "granolithic" finish of mortar composed of 1 part cement to 2 parts torpedo sand, placed from 1 in. to 1½ ins. thick. The granolithic surface was invariably placed before the concrete had an initial set, although this required night work of the finishers at times. Contraction grooves were cut in the floor above each I-beam.

The reinforcement consisted of 3-in. No. 10 expanded metal and was placed near the intrados of the arches.

The intrados, or ceiling, was pointed up, and given a wash of cement and limestone dust. The floors carry brick busbar compartments, heavy oil switches and the main switchboard. Openings were left through the floors for the passage of high voltage wires from the transformers. The total area of both floors is 19,000 sq. ft. The net area, deducting the openings, is 18,317 sq. ft.

Numerous lines of electrical conduit pipe were laid in the concrete floor during the work by the electrical contractors. This conduit work added materially to the cost of placing concrete and the necessity for co-operation with these contractors was one of the reasons for building these floors by day labor instead of by contract.

Forms.—Figure 1 also shows the form work. The elliptical ribs were made of 2-in. lumber and sawed out in the mill, and were placed at intervals not exceeding 3 ft. The lagging was 1x6 ins., dressed and matched flooring. Irregular openings were closed with sheet iron tacked onto the lagging. The ribs rested on stringers fastened to the bottom flanges of the I-beams by ¾x8-in. hook bolts. The forms for the entire first balcony were placed before any concrete work was started. After the first balcony had been concreted the forms were removed and used in the second balcony. The forms were made in sections 8 to 10 ft. in length. The following method was used in removing these sections from the first balcony and replacing them in the second balcony. A light scaffold was suspended under the form to be removed by four posts, each post being provided with ½-in. pulley block and tackle. A man stood at each post to operate the tackle. The scaffold was first hoisted up against the form. The hook bolts and supporting stringers were removed. The form then rested on the scaffold, which was lowered to the floor. The power house was equipped with a traveling electric crane, and with the crane the forms were hoisted on top of the finished floor of the first balcony. Then by means of the hoisting scaffold and posts, the forms were placed in position in the second balcony.

The final removal of forms from the second balcony was done by outside parties for the salvage on the lumber. An interior view of the Power House is shown in Fig. 3. The forms are in place in the first balcony.

Concrete and Finishing.—The mixed concrete (1-2½-4½) was purchased from the general contractor for the power house at $5 per cu. yd. at the mixer.

The concrete was hauled from the mixer to the elevator (see Fig. 2) in a 1½ cu. yd. Western dump car. The car was hoisted to the balcony floor, run out on a short piece of track and dumped on a receiving platform. The empty car then returned to the mixer. Concrete was carried from the receiving platform and placed in the work with wheelbarrows.

The mortar for granolithic surface was mixed in a box near the receiving platform. The cement finishers followed immediately after the concrete gang. The expanded metal reinforcement was placed on the forms and covered uniformly with about 2 ins. of soft concrete. The expanded metal was then pulled up from the form with hooks and shaken slightly, so that the mortar ran through the mesh and kept the reinforcing about 1 in. away from the lower surface.

The remaining concrete was then tamped in place. Some reinforcing bars were used about the floor openings. The work was done in February, March and April, 1907. Common labor received 17½ cts. per hour in February and March and 20 cts. per hour in April. During freezing weather heat was supplied with four salamanders burning coke. These fires were placed under the section of new concrete floor and canvass curtains were hung around, so as to confine the heat to the required section.

A typical force during the period of placing concrete work was as follows:

1 Foreman.
1 Motor man.
1 Car man.
1 Carpenter on reinforcing and minor form fitting.
1 Laborer on reinforcing and minor form fitting.
12 Laborers, wheeling and placing concrete.
2 Cement finishers on granolithic surface.
1 Mortar mixer on granolithic surface.
2 Mortar wheelers on granolithic surface.

Plant.—The hoisting and hauling was done with a Channon double purchase winch fitted with a 42-in. wood pulley and operated by belt from a 2 hp., 220-volt D. C. motor. Two motors were rented and one held in reserve in case of accident. A rather ingenious arrangement of hauling tackle was used. The ½-in. wire rope ran from the winch up to a snatch block located near the elevator (see Fig. 2) and back to the concrete car. The car was hauled from the mixer up an incline of 7 ft. rise and thence to the elevator landing. The car man then unhooked the car and pushed it onto the elevator and hooked the hauling line (which was removed from the snatch block) onto the end of the elevator hoisting rope. The hoisting winch was so placed that when the elevator was at the upper balcony landing then the coupling in the elevator cable was just drawn up to the drum of the winch. The hoisting rope was rigged to carry one-half the weight of the elevator. The speed of elevating was slow, but was sufficient to supply concrete as fast as it could be used.

Cost.—The cost of the work is given in the accompanying itemized tabulation. The total cost was $7,827.50, or 42¾ cts. per square foot. The engineer's estimate was $8,128. The only bid received was $11,000.

PLANT.

Elevator:	
Cage	$ 44.90
Guides, lumber	37.62
400 ft. ½-in. wire rope and fittings	26.25
3 16-in. sheaves	26.40
1 ½-in. snatch block	12.00
Labor	43.55
	$ 189.82

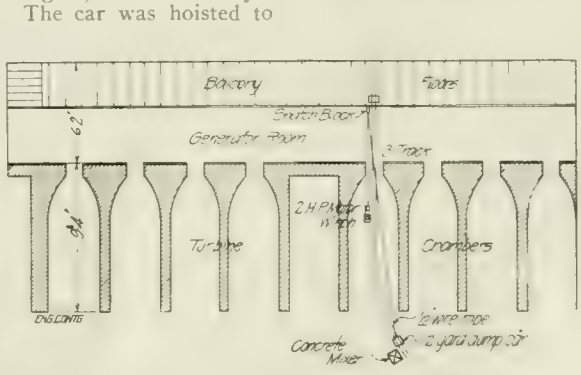


Fig. 2—Sketch Showing Lay-out of Concrete Plant.

Hoisting Winch:	
1 Shannon double purchase winch	$ 100.00
1 42-in. wood pulley	8.10
26 ft. 2½-in. rubber belt	2.86
Freight	7.00
Repairs and fittings	8.37
Labor placing	5.00
	$ 131.33
Salvage on winch	75.00
	$ 56.33
Electric Motor:	
Rent of motor, 2 hp. 220-volt D. C.	$ 25.94

*Assistant Chief Engineer, Sanitary District of Chicago.

Labor placing		5.71
Labor electrician		20.00
		$ 51.65
Electric Current: 6c hp. hour		76.58
Track:		
Rent of 300 lin. ft. rail, 30-lb.		$ 25.00
Labor on track		28.38
		$ 53.38
Grand total		427.76
Distribution of Plant Charge.		
To concrete, $427.76 × 85% =		$ 361.60
To granolithic surface, $427.76 × 15% =		66.16
Total		$ 427.76

COST OF BALCONY FLOORS.

Forms:	
Lumber.	
11,000 B. M. 1x6-in. D. & M. lagging at $25.00	$ 275.00
2,220 B. M. 2x10-in. S. I. S. stringers at $30.00	66.60
1,500 B. M. misc. rough lumber	28.19
316 ribs for 10-ft. span at 66c	208.56
99 ribs for 8-ft. span at 62c	61.38
48 ribs for 4-ft. span at 50.9c	24.42
	$ 664.15
Bolts, Tools, Etc.:	
1,000 ¾-in. hook bolts at 8c	$ 80.00
9 kegs nails	24.58
Sheet iron	15.15
Tools	9.85
	$ 129.58
Total form materials	$ 793.73
Labor.	
Building and Moving Forms:	
Foreman, 29 days at $4.00	$ 116.00
Carpenters, 39.5 days at $4.50	177.75
Carpenters, 51.1 days at $3.50	178.85
Carpenters, 110.2 days at $3.00	330.60
Laborers, 66 days at $1.75	115.49
Laborers, 17.3 days at $2.00	34.60
Craneman, 1 day at $2.50	2.50
	$ 955.79
Total, Forms	$1,749.52
Concrete:	
470 cu. yds. concrete mixed material in car at mixer at $5.00	$2,350.00
Tools	56.61
	$2,406.61
Labor Placing:	
Foreman, 33 days at $4.00	$ 132.00
Motorman, 45 days at $2.00	90.00
Laborers, 56.5 days at $1.75	98.83
Laborers, 180 days at $2.00	360.00
	$ 680.83
Plant Charge:	
See "Plant"	$ 361.60
Heating Concrete:	
4 Salamanders	$ 11.00
2,450 lbs. coke	12.24
6 12x30-ft. tarpaulins	54.60
	$ 77.84
Concrete total	$3,526.88

Reinforcing:	
19,734 sq. ft. 3-in. No. 10 expanded metal at 3c	$ 592.02
330 lbs. ½-in. cor. bars at 3c	10.51
585 lbs. ¾-in. rods at 2½c	14.63
Cutter and sledge	1.89
	$ 619.05
Labor:	
1 day, cement foreman at $5.00	$ 5.00
11 days, cement foreman at $3.50	38.50
2 days, motorman at $2.00	4.00
7.6 days, laborer at $2.00	15.28
	$ 62.78
Reinforcing total	$ 681.83
Granolithic Surface:	
Materials.	
260 bbls. cement at $1.72	$ 447.20
Cement hauling	21.33
90 cu. yds. sand torpedo	56.90
Sand freight	149.17
Tools	8.24
	$ 682.84
Labor:	
Cement finisher, 25.1 days at $5.00	$ 125.50
Cement finisher, 38.35 days at $3.50	134.22
Cement finisher, 20.05 days at $3.00	60.15
Cement finisher, 33.00 days at $2.25	74.25
Motorman, 11 days at $2.00	22.00
Laborers, 82 days at $2.00	169.00
Laborers, 46.4 days at $1.75	81.15
	$ 661.27
Plant Charge:	
See "Plant"	$1,866.16
Granolithic total	$1,410.27
Finishing Ceiling.	
Labor.	
Cement finisher, 49 days at $5.00	$ 245.00
Cement finisher, 57 days at $3.50	199.50
Cement and brushes	14.50
	$ 459.00

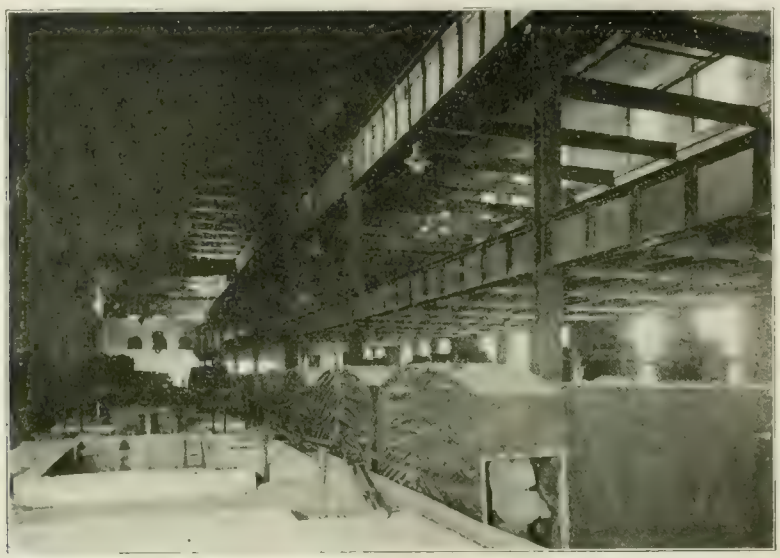


Fig. 3—Interior View of Lockport Power House Showing Balconies.

Some Notes on the Effect of Sewage and Sewage Gases on Portland Cement Concrete.*

The subject, the author stated, was one in regard to which it might be assumed that the available evidence was either inconclusive or of a more or less negative character. For, notwithstanding that cases were on record of destructive changes in tanks and sewers, the opinion tended to prevail that when the concrete construction was sound no marked disintegration need be anticipated, neither from sewage nor from its emanations. The author's experience did not support this view, and it was to the elaboration of this, the positive side of the question, that he desired to direct attention. During the last five or six years he had had very special opportunities for studying the problem.

In order to be in a position more fully to appreciate the disintegratory changes occurring at Hampton, and the deductions drawn from them, the author thought it was necessary to describe the installation in question, and to state the character of the sewage, as well as to outline the nature of the materials used in the construction of the tank and channels.

The Hampton Installation.—The nature of the sewerage system was water carriage, primarily flowing by gravitation, and, secondarily, raised by plenum pneumatic power. The sewerage was entirely and completely on the separate system. The installation consisted of a screening chamber, two detritus tanks, a hydrolytic tank, and triple-contact beds, and an air-purifying filter.

The sewage on its arrival at the works was delivered from the rising main into the screening chamber, and after passing through the screen, was conveyed by a channel to the detritus tanks. From these tanks the sewage entered the hydrolytic tank, which, together with the detritus tank, was installed in 1903. The disposition of the tank was such that the main bulk of the sewage—80 per cent—passed through at a comparatively high rate of flow, issuing in 4 hours as a clarified liquid, while the small volume—20 per cent—containing the deposited matters, was 16 hours in the tank. After flowing over the weirs of the first portion the liquid entered a channel which led to the second portion of the tank, consisting of four hydrolysing chambers arranged in sequence, and filled with large flint stones. The liquid having taken 3 hours in its passage through these four chambers, entered the lower channel, which conducted it to the contact beds.

The screening chamber, the tank, and the channels leading to and from the tank, as also the effluent channel of the primary contact beds, were covered in. The entire installation was ventilated by the hydro-mechanical system of sewer ventilation, and the withdrawn gases were purified by being passed through an air filter.

The sewage of Hampton was of a strong domestic character. It had undergone thorough disintegration by the lifting operations, and by the putrefactive changes occurring in the rising main. It was malodorous on its arrival at the screening chamber, where as it left the rising main, it evolved sulphuretted hydrogen and other bad-smelling compounds. The liberation of these gases constituted a nuisance necessitating the screening chamber, channels, and tank being covered in, and a means being provided for drawing a large volume of air through them before discharging the gases into the atmosphere.

The Concrete Used.—The whole of the tank and channels were constructed of Portland cement concrete. The walls of the tank are 6 ft. 6 ins. in thickness at the base, and 1 ft. 6 ins. at the top and are strengthened by tie-rods; the roof was 6 ins. in depth and was reinforced by "expanded metal," and the channels were covered by 2-in. "indurated" paving slabs. The work was executed by departmental labor, and the best materials were used.

The concrete was composed of 1 part of Portland cement properly mixed with clean water and 6 parts of balast thoroughly free from loam, clay, mud or dirt of any kind, and no material was allowed to be used larger than would pass through a 2-in. screen.

The makers of the "indurated" paving flags state that they are composed of Mountsorrel granite chippings, washed and crushed to pass through a ¼-in. mesh sieve, and heavy Portland cement made by themselves, the raw material for which is obtained from the Barrow-on-Soar blue lias beds. The materials are mixed in the proportion of 1 part of cement to 3 parts of granite.

Efflorescence.—Early in 1905, a few months

*Abstract in the "Surveyor" for April 29, 1910, of a paper by Sidney H. Chambers, engineer and surveyor to the Hampton Urban District Council, presented April 21, 1910, to the Concrete Institute.

SUMMARY.

	Total cost.		Cost in cents per sq. ft. of floor.	
Forms, material	$ 793.73		4.36	
Forms, labor	955.79	$1,749.52	5.21	9.57
Concrete, material and mixing	2,350.00		12.82	
Concrete, placing	1,176.88	3,526.88	6.42	19.24
Reinforcing		681.81	3.73	3.73
Granolithic surface, plant and materials	749.00		4.08	
Granolithic surface, labor	661.27	1,410.27	3.62	7.70
Finishing ceiling		459.00	2.51	2.51
Total, 18,317 sq. ft.		$7,827.50		*42.75

*Cents.

after the hydrolytic tank had been put into use, it was noticed that the roof and walls of the hydrolysing chambers above the liquid level were white or yellowish in appearance. This efflorescence was not crystalline in structure, but was of a chalky subsistence, and resembled distempered work on a damp wall. On examination it was found to be due to a thin covering of sulphur, which could be easily removed by rubbing. Later the face of the walls and the roof in the second part of the tank showed signs of peeling, and the concrete appeared to be disintegrating. A thorough inspection of the installation was thereupon made.

Disintegration.—At the screening chamber nothing appreciable was observed, neither at the highest water level nor on the underside of the roof. The concrete was sound, and when struck had a good ring. Immediately adjoining this chamber was the main sewage inlet channel, along which the whole of the gases pass to the main air duct leading to the air filter. At this point slots were made in the concrete to receive a dam; the concrete at the back of the grooves was found to have disintegrated, although the sides were perfectly sound.

Further along this channel it was observed that the greatest disintegration had taken place on the walls at the liquid level. Owing to variations in the flow of the sewage, the level of the liquid in the tanks and channels rose and fell; thus a certain area of the walls was constantly being immersed in the sewage, and then exposed to the air. This area was, consequently, even when not immersed, much wetter than the part of the walls which was always above the level of the liquid. The latter area at this point showed erosion, which, however, had not penetrated so deeply as that at the level of the liquid itself. At the liquid level there was a deep groove in the concrete, and above this the face of the work had bulged out and lost its nature.

The first portion of the tank—*i. e.*, the hydrolytic tank proper—appeared to have suffered very little. The walls and roof had only the slight sulphur deposit. At the liquid level, which varied less than in the channel, there was a slight erosion. The second part of the tank—*i. e.*, the hydrolysing chambers—was found to have suffered in places to a marked degree. It was observed on breaking though the erosion on the surface that the concrete at the back was moist, soft and gritty. Also, it was noticed that increased dampness constituted an important factor in the destruction of the concrete, for the lower parts of the vertical faces of the beams supporting the roof were more affected than the upper parts. The lower portions of the vertical walls of the tank also were more eroded than the upper. At the liquid level the concrete had been severely attacked, and a deep groove existed in it.

Analysis of Concrete in Hydrolytic Tank.—Two samples of surface concrete were taken above and below the liquid level, and the following was the result of the analyses:—

	Below liquid level Sound.	Above liquid level. Unsound.
Appearance	Grey	White
Texture	Hard	Soft
Ratio cement to sand	1 : 2	3 : 2
Sulphate of lime in cement	Trace	66 per cent

Considerable Deterioration.—The same pronounced effect was to be seen in connection with the concrete blocks, which were grooved to receive sliding boards and project above the liquid level; these blocks had in many instances crumbled away to such an extent as to be almost shapeless. Recently these chambers were emptied, and it was found that the concrete below the liquid level was perfectly sound and in a good state of preservation.

The lower channel conveying the liquid from the tank to the contact beds revealed the same characteristics as were observed in the upper channel, but the portion at the liquid level was very much more markedly affected.

Analyses of the Disintegrated Concrete in the Channels.—Samples taken of the lining of the sides and covering gave the following analyses:

	Ratio. Cement.	Sand	Sulphate of lime in cement. Pct.
1. Concrete at varying liquid level	1	1	76.26
2. Underside of slab forming covering	5	1	74.61

The air duct taking the gases from the effluent channel of the primary beds and communicating with the tank outlet channel was found to have a coating similar in appearance to that observed on the underside of the covering to the channels.

Analyses of Concrete in Air Duct.—Analyses of this coating were made, with the following results:

	Ratio. Cement.	Sand.	Sulphate of lime in cement.
Underside of slab forming covering of air duct	2	1	70.71

Conversion to Sulphate of Lime.—The point to observe in the above analyses was the conversion of the lime in the cement into sulphate of lime, the sulphur being obtained from the sewage flowing through the tank and channels, as well as from the gases expelled from the sewage, and contained in the air withdrawn from the several parts of the installation.

Suggested Explanation.—Much thought had been given to the explanation of the foregoing observations, and it had been concluded that the effects had arisen from the putridity of the sewage and the oxidation of the putrid products by the air supply. The main erosive effect was at the varying liquid level, and was there dependent upon the amount of sulphuretted hydrogen in solution in the liquid. The gas was comparatively small in amount in the incoming sewage and in the liquid in the hydrolytic tank, and increased as the liquid passed through the hydrolising chambers. The results of this were especially well shown in the two channels; the alternate wet and dry area of the upper channel conveying the sewage from the rising main was less markedly affected, while in the lower channel the corresponding area was severely attacked. So with the two parts of the tank; the first part into which the sewage was delivered, and wherein comparatively little putrefaction took place, had not been affected to anything like the extent that the second part or hydrolising chambers had.

When the level of the liquid fell it left the concrete which it previously covered wetted with a liquid containing sulphuretted hydrogen in solution. This wet surface was then exposed to the action of the air supply, which oxidised the sulphuretted hydrogen with the production of sulphur and sulphuric acids; these decomposed the concrete, the lime being converted finally into sulphate of lime. What the exact nature of the intermediate compounds was could not be stated, as none of them had been isolated, but it was probable that the active agent was sulphurous acid, as it was known that cement was insoluble in sulphuric acid. When the liquid rose again, the decomposed concrete was washed away either wholly or in part, and a fresh surface was exposed to action when the liquid fell again. It was the continuation of this cycle which led to the formation of the grooves at the varying liquid level.

Concrete Above the Liquid Level.—The erosive effects on the concrete above the liquid level were dependent upon the sulphuretted hydrogen evolved from the liquid and mixed with the air supply. Some of this gas was dissolved by the moisture which was present on the walls and roofs, from evaporation and condensation; it was then oxidised by the air, and decomposed the concrete as described above. In this case the decomposed concrete either remained as a coating on the surface, peeled off, or crumbled away.

Effect on Concrete Tubes.—In order to observe the phenomenon on concrete tubes, two 9-in. concrete tubes were selected, which were supplied by the makers of the paving slabs previously referred to, and were composed also of similar materials in the same proportion. One of the tubes was coated with Dr. Angus Smith's composition (coal-tar, pitch, linseed oil, and resin). They were placed side by side in the second part of the tank in such a position that they would be subjected to the rise and fall in the level of the liquid. At low level the tubes were not in contact with the liquid, and at high level the liquid rose to half the diameter.

After the tubes had remained in the tank for eight months they were taken out and examined. The coated tube did not appear to have been affected, other than at the highest liquid level, where a thin line could be observed, and when struck it was found hard and had a good sound. It was noticed that there were two areas on this tube without any coating, due no doubt to its having been placed upon two supports to allow it to dry; these areas were soft on the surface and similar to the uncoated tube. With these exceptions the tube appeared to be in as good a condition as when first placed in the tank. On the other hand, the uncoated tube had a distinct line at the highest liquid level, which was found to be soft, and when tapped with a chisel had a dull sound; the interior of the tube which had been immersed appeared soft and had a dull sound when struck; the portion of the tube above the liquid level was unaffected, and when struck had a clear ring.

Conclusions.—The deductions to be drawn from the investigations were that the gases in solution in sewage, and those expelled from it, arising from its decomposition, do act injuriously upon Portland cement concrete, notwithstanding the fact that the concrete is constituted of sound and good materials, when the following conditions prevail:

(1) A high degree of putrescence of the sewage.

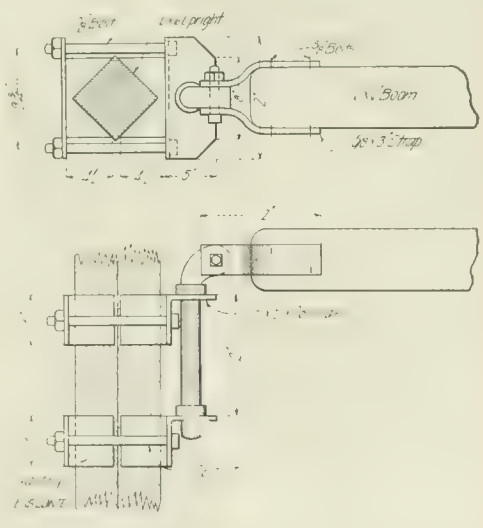
(2) A moistened surface, which held or absorbed the putrid gases.

(3) The presence of a free air supply.

Further, that in the absence of one or other of the above enumerated factors little danger from erosion need be feared.

Method of Attaching Derrick Boom to Leg of Hoist Tower for Concrete Building Work.

The use of towers for hoisting concrete from the ground to the various floors in con-



Sketch Showing Method of Shipping Derrick Boom to Tower Leg.

crete building construction is general practice. It involves, however, usually the provision of other means for hoisting form lumber, reinforcing steel, etc. In the construction of the large four-story buildings for the Pierce-Arrow Motor Car Co., of Buffalo, N. Y., this separate hoisting element was a derrick, constructed by shipping a boom to one of the vertical legs of the tower. The special boom seat employed is shown by the accompanying drawings. It was designed by the contractor, the Aberthaw Construction Co., Boston, Mass.

Plant Cost of Machine Mixed Concrete.

The figures in the accompanying tables are compiled from the books of the Aberthaw Construction Co., who run ledger accounts for each individual concrete mixer. Table I. represents the debit charges against four mixers, numbers 2, 3, 4 and 6, with date of purchase and yards mixed. The yardage is approximate, but very nearly correct. The charges consist of the original cost, interest on same compounded annually to January 1, 1910, and all repairs. The inventory value on January 1 is deducted from the total cost.

Table II. represents the credits which consist of the rental charged different jobs during the time the mixers were employed on same. The rental rate is fixed by what it would cost to lease the same machine instead of buying it. Table III. is a comparison of Tables I. and II.

A careful analysis of these tables gives some very interesting information showing when it is cheaper for a contractor to rent his mixer and when cheaper to buy. For instance, it shows that a mixer should be in use at least 50 per cent of the time to make it worth while to buy. That it should be used sufficiently to be relegated to the scrap heap in from 6 to 7 years. That it is cheaper to buy outright where a machine is to be used on comparatively small yardage taking a relatively long period to place—sand or reinforced concrete buildings, etc. It is left for the reader to draw further conclusions from his own analysis.

TABLE I.

Mixer Number.	2	3	4	6	Totoals and Ave.
1. Date of purchase	8-18-03	6-10-04	6-7-06	6-5-07	
2. Original cost	$ 625.00	$ 975.00	$ 975.00	$ 935.00	$3,510.00
3. Interest at 6% to Jan. 1, 1910	281.51	368.90	220.57	153.37	1,024.35
4. Repairs to Jan. 1, 1910	941.87	350.29	216.43	437.01	1,945.60
5. Total cost to Jan. 1, 1910	$1,848.38	$1,694.19	$1,412.00	$1,525.38	$6,479.95
6. Inventory value to Jan. 1, 1910	125.00	325.00	400.00	500.00	1,350.00
7. Net cost to Jan. 1, 1910	1,723.38	1,369.19	1,012.00	1,025.38	5,129.95
8. Total yards mixed	12,350	15,500	10,500	19,000	57,350
9. Plant cost per yard	$0.1395	$0.0883	$0.0964	$0.0540	$0.0894
	—4.1%	x15.25%	x44.8%	x14.7%	x18.72%

TABLE II.

10. Days owned to Jan. 1, 1910	2,325	2,029	1,302	939	6,595
11. Days rented to Jan. 1, 1910	827	578	816	536	2,997
12. Per cent of days rented	28.1%	28.3%	62.7%	57.0%	45.4%
13. Rental rate per day	$2.00	$2.25	$2.25	$2.25	.....
14. Total rental to Jan. 1	$1,655.00	$1,616.25	$1,835.25	$1,204.50	$6,311.00
15. Total yards mixed	12,350	15,500	10,500	19,000	57,350
16. Plant cost per yard	$0.1340	$0.1042	$0.1748	$0.0634	$0.1100

TABLE III.

Plant cost per yard I	$0.1395	$0.0833	$0.0964	$0.0540	$0.0894
Plant cost per yard II	0.1340	0.1048	0.1748	0.0634	0.1100
Per cent saving by owning plant	.....	x15.25%	44.8%	x14.7%	18.72%
Based on rental cost	—4.1%	.....	.....	.....	.....

Winnipeg Municipal Asphalt Plant.—Winnipeg has a municipal asphalt plant, established in 1899 at a cost of $14,000. Experimenting showed that the best mixture for wearing surface of an asphalt pavement was 10 to 12 per cent bitumen, 78 to 85 per cent sand, and 5 to 10 per cent pulverized limestone. The preparation for an asphalt pavement in Winnipeg is thoroughly made. The street is excavated 11 ins. Soft and spongy places are dug out and refilled with good earth, well rammed. Curbing is laid on grades and lines given by the engineer in trenches of the required depth, filled with broken, coarse, macadam stone. Upon the subgrade is laid a bed of Portland cement concrete 4½ ins. thick, made by first mixing dry and then making into a mortar one measure of cement equal to the best quality of Portland cement and three of sharp, clean sand. The binder course consists of broken stone and asphaltic cement, about fifteen gals. of cement to 1 cu. yd. of stone, the stone broken to ¾ in. The stone is heated by passing it through revolving heaters, and thoroughly mixed with the asphaltic cement. It is laid hot and rolled with hand and steam rollers. The average cost of paving the streets of Winnipeg with asphalt is about $2.30 per sq. yd. There are 58 miles of asphalt-paved streets in the city. During 1908 and 1909 extensive paving operations necessitated the maintenance of 125 men at the plant and 75 men on the street during the busy season.

Earth and Rock Section

Note: This section is devoted to methods and costs of excavating earth and rock and building embankments. It will cover the grading of roads and railroads, diking and canal work, dredging, building reservoirs and earth dams, sewer and water pipe trenching, quarrying, etc.

Method and Cost of Constructing a Water Supply Tunnel Through Rock by Day Labor With Costs of Supplementary Structures.*

The work described comprises a tunnel 4 ft. x 5 ft. 10 ins. in section and 4,819 ft. long, a gate house, intake pipe, and culverts and roads. All were constructed by day labor and from a part of the new $500,000 water supply works for the city of Fort Williams, Ontario. The several structures are shown by the drawings, Figs. 1 to — inclusive.

Construction Camps.—The main camp was located about midway between the tunnel portals, approximately 800 ft. south of the center line, at an elevation of 180 ft. above Loch Lomond. All buildings were constructed of a double thickness of 1-in. ship lap separated by tarred felt, and the roofs covered by three-ply pyroid roofing felt. Brick chimneys were used throughout. Wood burning box stoves were provided, and the stove pipes were conducted as far as possible within the buildings.

The main boarding and bunk house was of two stories, 86x18 ft., with a wing 32x29 ft. There were 64 bunks in two tiers, divided into 8 rooms, so that the various shifts could be kept separate and suffer a minimum of disturbance. A wash room and smoking room were provided for each floor. The dining room was 29x24 ft., and seated 50 men. Additional accommodation was provided for the kitchen staff. A 31x14-ft. stable, with hay loft, and an 8x16-ft. ice house were also provided. Adjoining the main boarding house, a compressor house was built, 38x18 ft., a portion of which was used as a machine repair shop. A bungalow was erected further up the hill near the camp, containing three rooms each 10x12 ft. for the accommodation of the engineering staff. Special care was taken as to the cleanliness of the camp. Garbage was burned periodically, and pail system latrines were built at the camp, at the shaft, and at the forebay. At both ends of the tunnel, blacksmith shops, 12x21 ft. were erected, as well as two drying houses for the accommodation of the men changing shifts. Each of the latter contained a room, 14x12 ft., surrounded by 12-seat lockers, 3x2x2 ft., and provided with drying racks, and a hot water boiler. Adjoining was a 12x7-ft. store room. Two magazines, 10x12 ft. were erected in near-by locations, shut off from the work by high bluffs. Small thawing "dugouts" were built close to the work. In each was placed a galvanized iron box of 26 gage metal, surrounded on all sides, except the front, which was provided with a door, by a 4-in. water jacket; the enclosed space was divided and bracketed for tiers of trays, on which the dynamite rested, accommodation being provided for two cases (100 lbs.). This box was mounted on a sheet-iron cylinder, in which was placed an electric heater, fed off the lighting circuit, which developed a heat sufficient to keep the water jacket at a temperature of 70° in weather 45° below zero. Thawing was more or less necessary during eight months of the year, and the heat was adjusted by increasing or decreasing the number of coils, in accordance with the season.

All buildings were lighted by electricity on a single phase, 110-volt circuit, transformed at three points by three 2½ kw. transformers.

A water system was installed throughout the main camp, and supplied through a 1-in. pipe by a small Fairbanks pump located on a creek about 500 ft. from the camp, and operated by compressed air tapped from the main receiver.

A magneto telephone system was installed with stations at the north portal, the main camp, and at the shaft. A switch in the main camp enabled either of these points to be directly connected with the switchboard in the City Telephone Exchange.

Power.—Steam was practically out of the question for this purpose. Coal must first come from Pennsylvania, and then be hauled seven miles over a road that took many months to get into passable condition, and had some hills with 15 and 20 per cent grades. The local supply of wood was limited, and although used only for heating purposes, had to be hauled more than three miles before the close of the work. Gasoline figured out at over $100 per hp. Electric power at $25 per hp. was available on the north side of the river, and it was decided to build a power line, although, unfortunately, the price of copper was at the time abnormally high. The current used was supplied by the Kaministiquia Power Co. from their hydraulic plant at Kakabeka Falls—at 2,200 volts, three phase, 60 cycles alternating current. Poles, 35 ft. in length, were secured from the surrounding country, and spaced 150 ft. apart. Two four-pin cross arms were used on each pole, the lower arm carrying telephone lines. The wire was No. 6 solid weather proof copper, running 112 lbs. per 1,000 ft. The river was crossed by a lead-covered submarine cable of No. 6 copper, laid just within the trench dredged for the west pipe crossing. This cable remained undisturbed for nearly two years, after which it was a constant source of trouble. The first break, early in November, 1908, was caused by a dragging ship's anchor, and nearly five weeks elapsed before a new cable could be secured. The cable was so buried that only 100 ft. could be salvaged, after three days' work with scow and diver. The following temporary expedient was adopted to replace it. Three lines of ordinary W. P. stranded copper wire, heavily taped, were bound together. The cable thus formed, was passed through eight lengths of 2½-in. fire hose, and lowered to the bottom with fish plates, lead pipe, and other weighty debris. This worked well for two weeks, when another boat hooked the hose and punctured the rubber. It was taken up and dried, and again laid for a further run of five days. This performance continued until the arrival

*Rearranged from a paper by H. Sydney Hancock, Jr., presented to the Canadian Society of Civil Engineers.

of the new cable, shortly before the close of navigation. On the opening of navigation during 1909, the water level of Lake Superior and the Kaministiquia River was about 2 ft. below normal, and the first boat down the river scraped the cable so that it had to be raised and dried. About two weeks later one wire went dead, and it was thought inadvisable to attempt to dry it again; consequently, one of the taped wires previously used in the fire hose, was strung through a 1-in. lead pipe and connected at the shore ends. No further trouble has been experienced.

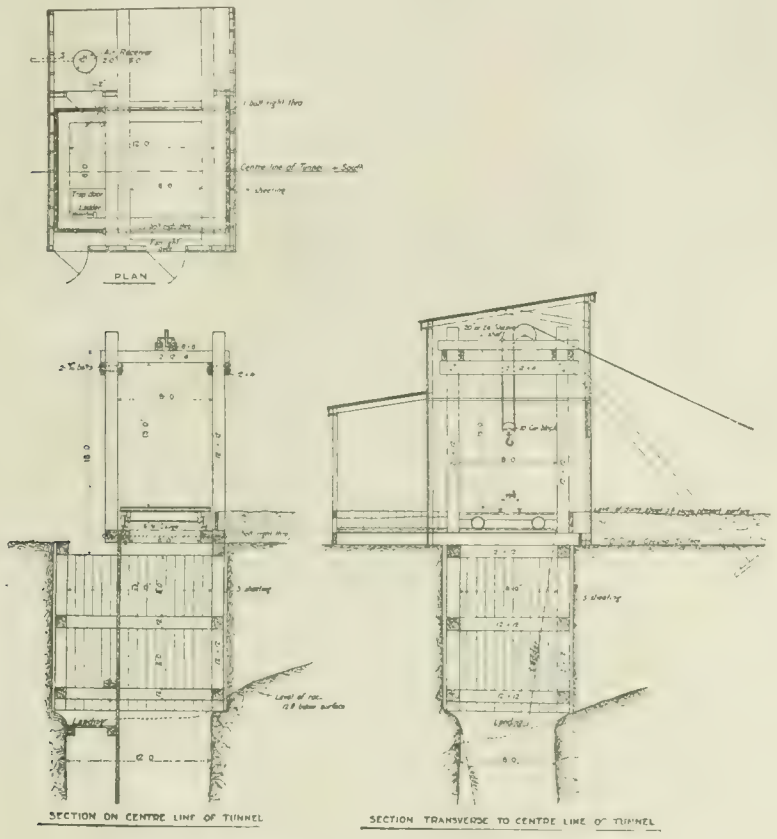


Fig. 1—Details of Shaft Construction.

The cost per mile of the transmission line, excluding telephone, was as follows:

3 miles, 1,770 lbs., No. 6 wire, at 28 cts.	$495.60
35 poles in place, at $5	175.00
35 4-pin cross arms, at 41 cts.	14.35
105 birch pins, at 2½ cts.	2.62
35 cross braces, at 8 cts.	2.30
105 double petticoat insulators, at 4 cts.	4.19
Freight, at $1.20 per 100 lbs.	24.00
Labor stringing wire	30.00
Total per mile	$748.47

The total expenditure on the line was as follows:

7 miles completed line, at $748.47	$5,239.29
Cable and work at river	358.20
Alterations and repairs	317.00
Repairs and renewals on cable	580.00
Total	$6,394.49

The alterations were due to the necessity of three times changing the four-pole construction crossing the C. P. R. property to accommodate increased trackage, and of moving the line from the vicinity of a particularly heavy rock cut in the second pressure main.

Plant.—A class E straight-line belt-driven Rand air compressor, capable of compressing 282 cu. ft. of free air per minute to a pressure of 100 lbs. per sq. in., was erected at the main camp. This compressor was operated by a 50 hp. Westinghouse induction motor, through three 15 kw., 2,200 volts to 550 volts, transformers. A 4-in. air pipe, fed by a 36-in. 8 ft. receiver erected in the compressor house. From this air receiver 3-in. wrought-iron pipes, with a union joint every 200 ft., led to the shaft and north portal. At these points were placed 24 in. x 6 ft. air receivers, from which 2-in. pipes served the various headings. The 3-in. pipe was carried on the surface of the ground, blocked up where necessary to secure a continuously falling grade. Serious trouble from frost not being anticipated, the expense of excavation in a rocky country was avoided. During continuously cold weather, with temperatures near the zero mark, no trouble occurred, but, at almost every mild spell, work was temporarily stopped by frozen air pipes, a cold night, after a comparatively warm day, being the chief cause. It was not feasible to cover the whole line with snow, owing to its height above the ground when crossing small ravines. To overcome this difficulty, drip cocks, threaded to take a small pressure gage, were placed every 300 ft. along the line, and a supply of wood and coal oil kept at numerous points. When a block occurred, a gage inspection revealed the 300-ft. strip affected, and an hour's work or less usually sufficed to thaw it out.

The drills used were No. 43 Rand "Little Giant" drills, with 3-in. cylinders, mounted on 6-ft. double screw mining columns, and fed through 50 ft. of 1-in. Monarch hose. Black Diamond steel, with regular cruciform bits, were employed at the commencement of the work in the comparatively soft rock, but the change to the hard black basalt necessitated the use of the best grade drill steel, manufactured by the Jessop and Edgar Allen Companies.

The track was of 50 cm. gage, 12-lb. rails, 15 ft. long, laid on 4x6x30-in. ties, spaced 30 ins. c to c. The curves and switches were made of Koeppel portable track on steel ties. The four cars at the north portal heading were Koeppel all-around dump cars of 18-cu. ft. capacity, and at the shaft headings eight detachable body-side dump roller-bearing Koeppel cars of similar capacity were used. A five-inch double cylinder Jenckes hoist, operated by compressed air, with a 6x24-in. drum winding a ½-in. steel wire rope, was erected at the shaft. The shaft sump was drained by a Cameron pump, with a 3-in. suction and 2-in. discharge, rated at 100 imperial gallons per minute and operated by compressed air. Buffalo forges were used at each end, but the centrifugal blowers were replaced by a compressed air nozzle.

Ventilation was secured by two belt-driven blowers, with 12-in. blades operated by 2 hp. Westinghouse motors, fed from the lighting circuit and delivering air through a 5-in. pipe made up into 20-ft. lengths of 24-gage galvanized iron. The dry, hard nature of the rock in the north shaft heading caused much inconvenience from dust, and necessitated the use of a spray, which was furnished from the shaft pump through a ¾-in. wrought-iron pipe.

Light was provided by a single-phase 110-volt circuit, through No. 12 weather-proof wire, from which 16 c. p. lights, protected by wire guards, were dropped every 75 ft. The "breast" work was lighted by a heavily guarded 32 c. p. lamp, furnished with socket handle and hook, and attached to 100 ft. of rubber-covered extension wire.

Tunnel.—The smallest cross-section, consistent with reasonable progress during construction, being more than sufficient for the contemplated water supply, the minimum finished dimensions were specified to be 4 ft. x 5 ft. 10 ins., carried at a grade of 1 in 1,000. It was the original intention to line the whole tunnel with concrete, varying in thickness with the nature of the material excavated, but, finally, only those portions showing any sign of weakness were so treated. The generally close, hard nature of the rock removed all fear of seepage or erosion, and the use of a very high coefficient of roughness still brought the delivering capacity of the tunnel considerably over any possible discharge that could be secured from the watershed.

The rock was excavated on a minimum cross-section, 6 ft. 6 ins. high by 5 ft. wide, and all weak sections lined with 1:2½:5 concrete, leaving a clear waterway, 4 ft. wide and 5 ft. high, to the springing line of a segmental arch of 4 ft. span and 10-in. rise. Work was carried on at three headings with three machines, two working north and south from the shaft and one working south from the north portal.

Shaft.—The shaft was 60 ft. in depth and 12 ft. x 8 ft. inside dimensions. Four sets of 12 x 12 in. timber, 6 ft. c. to c., backed by 3-in. sheeting, brought the excavation to solid rock. The shaft was divided into two compartments by 2-in. plank casing, the hoisting compartment being 8 ft. x 8 ft., and the ladder, pipe, and wire compartment 3 ft. 9 in. x 8 ft. Three "rollers" or landing platforms were provided in the latter, making three 16-ft. stages and one of 12 ft. The shaft was sunk by hand labor, prior to the arrival of the machines, at an average rate of 1 foot per shift. An ordinary "jack roll" was used as a hoist.

The head gear was carried on four 12 x 12 in. posts, braced against the hoist by 12 x 12 in. struts. A 24-in. sheave was supported on two 8 x 8 in. timbers, bolted to four 4 x 12 in. cross-timbers, which were again supported by four 4 x 12 in. timbers, secured to the posts by ¾-in. bolts, and a shaft house of 1-in. lumber covered the erection at the collar of the shaft. Stringers, 12 x 12 in., to each of which was spiked a 40-lb. rail, formed a track of 6 ft. 9 ins. gage, on which ran a platform car fitted with a section of track 19⅝-in. gage of 12-lb. rail.

The cars used in the shaft drills were the Koeppel steel side roller-bearing dump cars with detachable bodies. To the hook of the gin block was attached the Koeppel crane attachment. When the cars were brought to the shaft, the bodies were hoisted clear of the trucks to the pit head. A duplicate truck was then run in on the platform car over the shaft, the body car lowered into position, and the platform car run clear to a point where the dump track joined the platform track. The full dump car was then pushed on to the dump track and replaced by an empty car standing on the adjoining "empties" switch, the platform run over the shaft, and the empty car body attached to the crane. On the removal of the platform, the car body was lowered to the vacant truck awaiting it. The full car was then dumped by the "lander" and returned to the "empties" switch. Under ordinary circumstances, this method would have proved cumbersome, but the uniform hardness of the rock in both shaft headings reduced the quantity of material to be handled to the capacity of one "mucker," and as the "landers" soon became "speedy" at their

work, this method of hoisting rendered satisfactory service.

The alinement was transferred down the shaft on an 11-ft. base line by 12-lb. plumb bobs attached to fine piano wire and resting in buckets of water. A transit was then set up in line with the wires and the line produced. This operation was repeated several times whilst the drifts each made 200 ft. of progress, and, finally, a centre line 300 ft. in length was established on the mean of the five middle readings.

When the south heading was driven through, the alinement was checked by setting up on a hub near the shaft and back sighting 700 ft. to a hub set from the surface at the south portal. The error at the breast of the drift heading north was found to be 1¼ ins., and was corrected by subsequent operations.

At the north portal Koeppel steel all-round dump cars of 18 cu. ft. capacity were also used, the steep hillside affording ample dumping ground for the whole work within a haul of 200 ft. from the portal.

The cars were all pushed by one man, and over distances of approximately 1,000 ft. Bye-passes were excavated and a switch installed so as to reduce the haul of the mucker at the breast to that limit. A small Koeppel flat car was provided for handling machines and tools for each drift.

Owing to the scarcity of capable machine men, the work was at first carried on by two 10-hour "shifts," but as men became available, three 8-hour "shifts" were organized. A "shift" consisted of one machine man and his helper, and from one to three muckers, depending on the length of haul and character of the work. Two blacksmiths, one at either end, each worked from 10 to 14 hours, varying with the hardness of the rock and the quantity of outside work. The hoistmen and landers at the shaft, as well as the compressor men, worked in two "shifts" of 12 hours. The track-laying, pipe-laying, light extensions, machine and general repair work was handled by two men working usually 10 hours.

The first 1,200 ft. of the north heading consisted of a compact blue volcanic ash slate that drilled and broke well, and through which good progress was made. The remainder of the tunnel was through a tough, hard trap, containing numerous diorite dykes of phenomenal hardness, the specific gravity of which frequently reached 3.4.

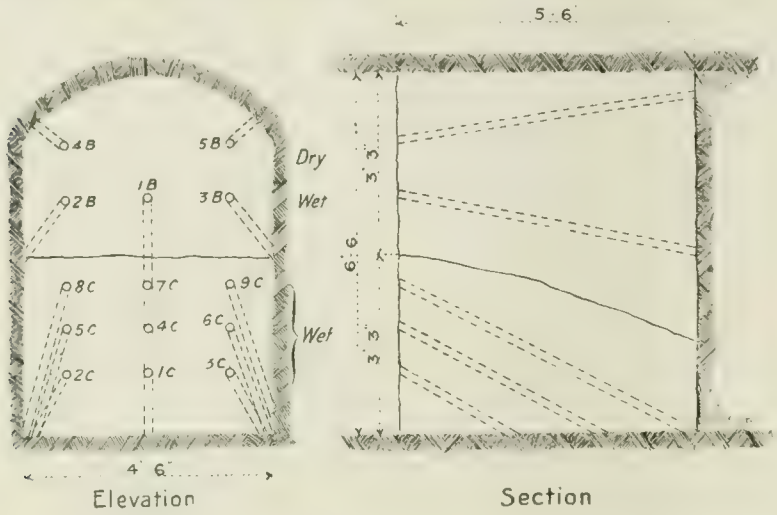


Fig. 2—Arrangement of Drill Holes in Average Rock.

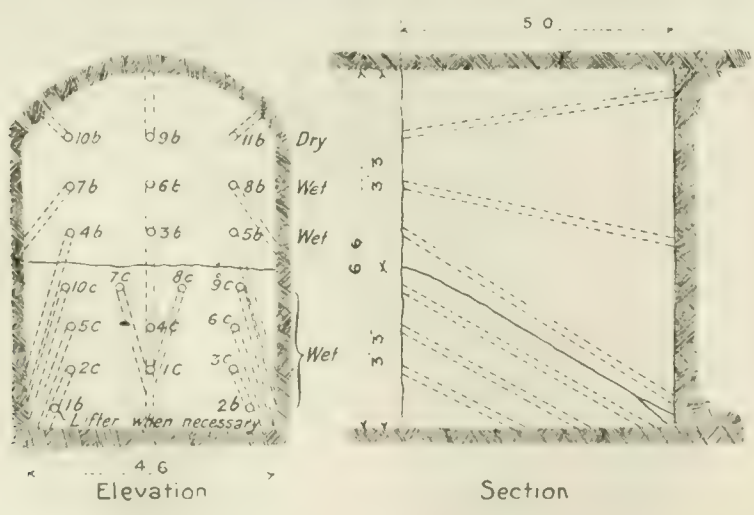


Fig. 3—Arrangement of Drill Holes in Hard Rock.

Progress through the latter rock was painfully slow, although air was delivered to the machines at from 80 to 85 lbs. pressure. Bits of the best steel, tempered to a pitch that would notch a file, were worn smooth and useless without crack or flaw after drilling less than 3 ins. It frequently took over three hours to drill a 5-ft. 6-in. dry back hole.

The machines were mounted on standard vertical mining columns with two jack screws, the small size of the drift preventing the use of a horizontal bar.

The average advance made by each cut was 4 ft. 6 ins. In the slate rock eight 5-ft. holes sufficed, the whole breast being fired in one blast, but the tenacious nature of the hard rock sections necessitated from 17 to 22 holes, in order to break the full cross-section. The holes were arranged as shown in the sketch (Fig. ..) and the lower nine holes forming the "cut," were fired first with a fuse, timed to explode in the order shown. After the "muck" had been cleared, the "back" holes were similarly fired.

The upper five holes in the back were practically "dry" holes, and proved a very hard drilling proposition in this rock. Two lifters were sometimes used at the bottom of the face to serve the double purpose of striking to the bottom of the cut, and lifting the "muck" away from the face, thus facilitating the speedy erection of the columns for the next attack.

Work commenced with 60 per cent dynamite, manufactured by the Ontario Powder Co., but the fumes proved too much for the miners, who were constantly being overcome by gas, and 40 per cent dynamite was substituted with satisfactory results. When the very hard rock was encountered, the writer believed that a stronger explosive would be advantageous, and Nobel's 75 fumeless gelignite was adopted. After some trouble in getting it properly thawed, and the holes intelligently loaded, the results secured were good, but its odor, to which the "copper country" miners, who were in the majority, were unaccustomed, caused much vomiting and the experiment had to be abandoned. In the slate rock, about 6 lbs. of 40 per cent dynamite were used per foot of completed tunnel, but in the hard rock it was necessary to use from 12 to 18 for the same distance.

In the slate rock firing by battery was more or less successful, but in the hard rock, time fuse gave infinitely better results. The "Bennet" fuse was used throughout the work and proved of uniform excellence.

Two accidents marred the success of the work. One on June 21, 1907, and the second on June 21, 1908. On the first date the two shaft drifts had each been driven less than 40 ft., the ventilating fans not being then in position. Immediately after the midnight blast the two miners in charge of the shifts went down to recharge a missed hole, expecting to get away before becoming affected by the fumes. The air hoses were coiled on

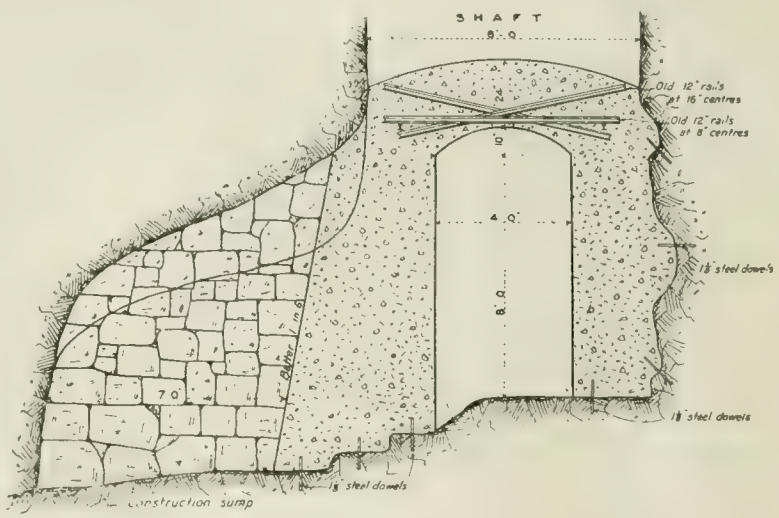


Fig. 4—Construction of Tunnel at Foot of Shaft.

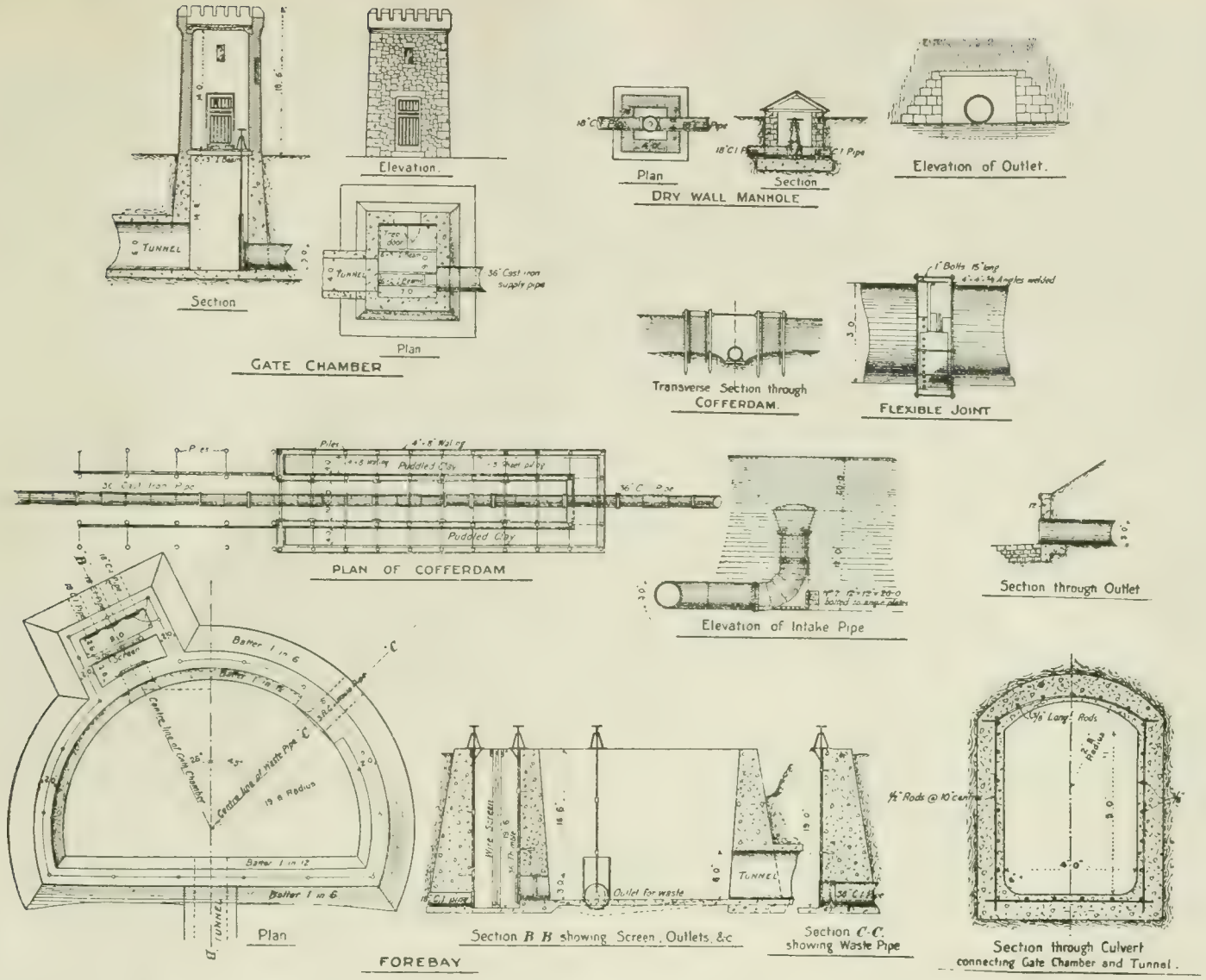


Fig. 5—Details of Gate House, Intake Pipe, Forebay and Culvert.

the lower "soller," and the precaution of blowing out with compressed air was not taken. Apparently both men were overcome immediately on reaching the bottom ladder, as one sustained a broken arm from the fall. A rescue party of two men from the surface placed the unconscious miners in the bucket, and then attempted to climb out, but both collapsed on the lower "soller." The casing had not been completed in the ladder compartment, so they were hoisted to surface by the bucket. One man, and he the most active of the rescue party was already dead from the effect of the fumes and the effort of carrying a collapsed comrade up the first ladder. His name was Jos. Chichester, the son of Colonel Chichester, a distinguished British veteran of the Indian Mutiny.

Within a few minutes of one year later, a mucker in the north heading, while cleaning up in preparation for the blast, turned up a small piece of dynamite 8 ft. from the face. On being advised, the man left his machine and began to search with a pick for further fragments, thereby immediately causing an explosion. Both the machine man and his helper were killed and one mucker was permanently blinded, the other standing beside his car, 6-ft. away, was uninjured. The amount of dirt moved did not exceed 1 cu. ft., but the whole quantity was apparently received in the faces and chests of the victims. Neither the air hose nor the light wire were damaged, and the incandescent globe hanging from the column, only 5 ft. away, was uninjured. Subsequent examination pointed to the probability that the explosion of No. 3 cut hole had cut off No. 6, drilled in this case a few inches below grade, and leaving an inch or two of dynamite in the bottom of the latter hole. An extraordinary feature of the case was that this was the third time the hole had been mucked over, and as half of it showed plainly on the side of the drift it had been examined two days previous to the accident.

The machines commenced work on June 4, 1907, and the two long headings met on May 24, 1909. The closing error in alinement amounted to ⅜-in., and the difference in elevation was 0.05 ft.

After the tunnel had been cleared out and concreted where necessary, the shaft was covered 8 ft. above grade line by a 24-in. slab reinforced by old 12-lb. steel rails, supported on walls 4 ft. apart keyed into rock at the sides with 1⅛-in. drill steel. At the sump, the wall was made 3 ft. wide on top, battering on the outside at 1 in 6. The whole shaft was then filled to the surface with earth.

The monthly progress in the three drifts was as follows:

Month,	North Portal Drift.	North Shaft Drift.	South Shaft Drift.	Total
1907.	ft.	ft.	ft.	ft.
May	48	..	..	48
June	141	43	47	231
July	128	87	98	321
August	142	72	85	299
September	130	105	80	315
October	162	111	64	337
November	160	82	75	317
December	209	103	77	389
1908.				
January	137	97	72	306
February	*57	55	51	163
March	68	81	80	229
April	65	70	37	172
May	73	76	..	149
June	62	66	..	128
July	69	71	..	140
August	73	69	..	142
September	71	63	..	134
October	76	80	..	156
November	139	†45	..	75
December	51	66	..	117
1909.				
January	50	58	..	108
February	64	60	..	124
March	70	70	..	140
April	76	74	..	150
May	53	76	..	129
Totals	2255	1798	766	4819

The wages paid on the tunnel were as follows:

Tunnel superintendent, per month	$150.00
Machine men, per shift	3.50 to 4.00
Helpers, per shift	3.00 to 3.50
Muckers, per shift	2.50 to 2.75
Landers, per shift	2.50
Hoistmen, per hour	.25
Blacksmiths, per hour	.35 to .40
Blacksmiths' helpers, per hour	.25
Compressor men, per hour	.25
First mechanic, per hour	.40
Mechanics' helper, per hour	.30

*Half month lost by power cable troubles.
†Labor and machine troubles.

The cost in detail was as follows:

North Portal Drift (labor), 2,225 ft.	Per ft.	Total.
Machine men	$ 3.02	$ 6,816.55
Helpers	2.48	5,587.95
Muckers	2.84	6,404.30
Blacksmiths	2.06	4,655.22
Mechanics	.40	895.45
Tracklaying and trestles	.77	1,725.55
Powder and miscellaneous	.35	787.91
Total	$11.92	$26,873.53
North Shore Drift (labor), 1,798 ft.:		
Machine men	$ 3.41	$ 6,137.65
Helpers	2.72	4,893.37
Muckers	2.34	4,207.89
Landers	1.47	2,640.61
Hoistmen	1.44	2,598.94
Blacksmiths	2.07	3,715.13
Mechanics	.47	839.75
Track and trestle	1.04	1,866.38
Powder man and miscellaneous	.57	1,028.91
Total	$15.73	$27,928.63

South Shaft (about 766 ft.)		
Machine men	$ 2.93	$ 2,248.30
Helpers	2.32	1,780.92
Muckers	1.95	1,495.79
Landers	1.95	727.56
Hoistmen	.99	759.84
Blacksmiths	1.67	1,278.83
Mechanics	.30	229.85
Track and trestle	.74	561.87
Miscellaneous	.37	282.66
Total	$12.23	$ 9,369.62
General Tunnel Maintenance (labor), 4,819 ft.:		
Compressor men	$ .85	$ 4,102.75
Mechanics	.32	1,541.75
Wood thawing, etc.	.37	1,762.60
Miscellaneous labor	.36	1,733.35
Total	$ 1.90	$ 9,140.45
Grand total	$15.42	$73,312.23
General Tunnel (material):		
Drill steel	$ .46	$ 2,240.00
Explosives	2.14	10,302.50
Fuse	.13	640.20
Caps	.04	173.00
Lumber	.11	529.69
Coal	.12	579.59
Dues on timber	.02	108.15
Fan, motors, electric supplies	.18	847.85
Machine repairs	.67	3,234.78
General hardware, pipe and comp. rep., etc.	1.54	7,397.96
Total	$ 5.41	$26,053.63
General Tunnel Charges:		
Power	$ .56	$ 2,693 37
Power line	1.32	6,394.49
Teaming supplies	.50	2,406.55
Employers' liability insurance	.61	2,933.63
Accident expense	.06	296.50
Sinking shaft	.69	3,328.55
Plant and machinery hauled and erected	3.38	16,300.00
Camp buildings	.83	4,019.00
Fire insurance	.06	301.21
Trimming and cleaning out tunnel	.61	2,919.20
Concreting shaft and shattered sections	.22	1,069.45
Sundries, livery, scavenging, etc.	.09	447.00
Total	$ 8.94	$43,108.95
Superintendent, time keeping, etc.	$ 1.45	$ 6,974.09
Engineering	.70	3,370.00
Legal, by-laws, etc.	.08	390.00
Total	$ .78	$ 3,740.00
		$ 79,876.67
Total	31.80	153,188.90
Less salvage plant	1.50	7,200.00
Net cost 4,819 ft.	30.30	145,988.90

The whole cost of the camp buildings has been charged to the tunnel, although the boarding camp was partly used by men on other work. This other work, however, did not justify such a building, and at times the men so engaged were accommodated in tents, as everything was subordinated to the interests of the tunnel.

Captain John King, of Hancock, Mich., was engaged as tunnel superintendent in March, 1907, and continued in that capacity until the completion of the work.

Roads.—About 4½ miles of road were constructed in connection with the tunnel section through difficult country, embracing rock, swamps, muskeg, and steep sidehill work. A road 14 ft. in width was finally constructed with a smooth gravel surface, but to secure this result sufficient material for an average fill of 15 ins. throughout its length had to be hauled from four gravel pits, located at intervals of about 1 mile along the road, and a surface ditch 2 ft. in depth excavated on the upper hillside. Some 500 ft. of corduroy were necessary, as well as two small bridges of 16-ft. span and numerous log culverts. About one mile was macadamized with rock from the tunnel spoil bank.

With labor at 25 cts. per hour and teams at 50 cts., the cost of this work was as follows:

Team work	$1,140.00
Labor	5,268 10
Bridges and culverts	350.00
Total	$6,858.10

Concrete Culvert.—The south portal of the tunnel was located at Station 1+90, from which point an open cut was excavated to the gate house at Station 0, some 50 ft. from the lake shore. The excavation consisted largely of solid trap rock and very large boulders, with various strata of sand, quicksand, and gumbo. A creek, discharging after rain as much as 5 cu. ft., crossed the line at Station 1+00, and was diverted by an extensive channel change parallel to, and 50 ft. distant from, the center line.

A culvert of reinforced concrete was then constructed, connecting the tunnel with the gate house, the dimensions conforming to that of the lined tunnel, viz., 4 ft. in width inside dimension, with vertical walls 5 ft. high to the springing line of a segmental arch of 2 ft. 8 ins. radius. The floor and walls were 10 ins. thick at the crown. Transverse reinforcing of ½-in. round steel, spaced 10 ins. c to c., was used throughout, the ends being bent so that the wall reinforcing hooked into the ends of the floor rods, and, in turn, the curved arch rods hooked into the ends of those in the walls. Longitudinal reinforcing of ⅜-in. steel rods, spaced 10 ins. c to c., was wired to the transverse reinforcing in arch and floor. The foundation was largely rock, intersected by pockets of sand, gumbo, and quicksand, and where the latter were too extensive to be filled with rock, the walls were supported by a reinforced foundation slab 9 ft. in width and 12 ins. thick.

The concrete was proportioned as 1:2:5, Star Portland cement being used. Sufficient sand was secured on the adjoining lake shore by team or boat haul, and stone of from ½-in. to 2-in. size was secured, after double screening, from the spoil bank at the shaft.

When completed, the excavation was backfilled to natural ground level, and a space of about 2 acres in extent, adjoining the gate house, graded level. The excavated material was used to fill about half an acre of swamp, at the original outlet of the creek, to an elevation of 3 ft. above high-water level. The sides of the creek channel change were riprapped, and the whole space sown with grass seed and trees planted along the outer edge. The cost of this work was as follows:

Excavation labor (450 cu. yds. earth, 520 loose rock, 1,160 solid rock)	$3,890.00
Depreciation of tools	187.00
Powder, 1,470 lbs.	235.00
Cement, 190 bbls. at $2.50	475.00
Reinforcing steel	120.00
Lumber	235.00
Hauling rock, 165 yds.	180.00
Hauling sand (boat and team), 85 yds.	160.00
Handling and screening rock (labor)	113.00
Labor on concrete, reinforcing, etc.	668.00
	$6,263.00
Backfilling and grading, 7,320 cu. yds. at 36½ cts.	2,670.42
Total	$8,933.42

Gate House.—The gate house at Station 0 was built of concrete to a height of 14 ft. above the grade line of the culvert. It is rectangular in form, the inside dimensions being 7 ft. x 9 ft., and its long axis at right angles to the center line. The walls were 20 ins. thick at the top battering on the outside at 1 in 12. The concrete floor slab was 15 x17 ft. and 12 ins. thick, reinforced with a grid of ½-in. steel, 10 ins. c to c., the foundation being a firm, coarse sand. The outlet to the culvert was of the same cross-section as that structure.

Provision was made for the entry of two 36-in. intake pipes, one of which was constructed with the present installation. Four inches of this pipe protruded through the concrete, and a 36-in. coffin sluice gate was bolted to its flange. The invert was set 6 ins. above the floor level and 9 ft. below the normal level of the loch.

The house was built to a further height of 18 ft. 6 in. above the concrete in uncoursed rubble of red granite, broken from glacially deposited boulders collected from the surrounding hills. The walls were 18 ins. thick, and the general treatment was that of an embattled tower. Two feet below the battlements, a roof of reinforced concrete was placed, draining through 1-in. pipes at the four corners. In the center of the roof a concrete block held a socket for the support of a 20-ft. flagpole.

At the top of the foundation concrete a floor of 2-in. plank is carried on 3-in. x 6-in. joists notched into 40-lb. T-rails. On this floor is bolted the base of the sluice gate wheel stand, and access to the lower floor of the gate house is gained by means of a trapdoor and steel ladder.

Backfilling was carried to the base of the granite superstructure, forming a berm 10 ft. in width, sloping at 1½ to 1, to the general elevation of the graded and cleared space 3 ft. below the berm level.

An oak door, 3 ft. x 6 ft. 8 ins., with ornamental wrought-iron hardware, furnishes entrance from the berm on the east side of the building. Above the door is a vertical ventilating opening, 30x6 ins., protected by copper wire cloth of 4x4 mesh. Built into the center of the south wall is a polished black granite date stone, 5 ft. x 3 ft., with V-cut gilded lettering.

The cost of this work was as follows:

Excavation, 150 cu. yds.	$ 115.90
Substructure, 50 cu. yds., at $12.65	632.55
Teaming and collecting boulders	350.00
Masonry, 38 cu. yds.	547.18
Valves and ladders	280.00
Flooring, rails and joists, etc.	18.32
Door	38.00
Date stone in place	102.00
Flagpole, etc.	37.00
Total	$2,120.95

Intake Pipe.—The specifications on which bids were asked contemplated 500 ft. of 36-in. steel intake pipe, ending in 22 ft. of water. The invert was to be at no point less than 6 ft. below the low-water level of Loch Lomond. Before construction commenced, however, the intake was increased to 750 ft., ending in 42 ft. of water, with the invert at no point less than 9 ft. below the normal level of the loch. The pipe was manufactured by the James McNeil Bros. Co., of Pittsburg, of ¼-in. plate and 36-in. internal diameter.

The material used in the construction of this pipe was of soft open-hearth steel of an ultimate tensile strength between 55,000 and 65,000 lbs. per sq. in., and an elastic limit of not less than half the ultimate strength. Elongation, 22 to 25 per cent, and reduction of area, 50 per cent. Bending test of 180° to a diameter equal to thickness of pieces tested, without fracture on outside of bent portion. Variations in thickness or dimensions of pieces were not to exceed 5 per cent, and variations in cross-sections were not to exceed 6 per cent.

Both longitudinal and circular seams were single riveted with rivets of ⅝-in. diameter, with heads clean and cup-shaped, both inside and outside, and a pitch of 1⅝ ins., c. to c. All rivets were of the best Lowmoor, or equal quality iron, with an ultimate strength between 50,000 and 60,000 lbs. per sq. in.

Flanges on the end of each length were of rolled angles, 3x3x½ ins. in thickness, of the same quality steel as the plates, welded into solid rings. Special care was taken that the butt end of these flange joints made perfect contact, being machine faced and accurately leveled on a block before being drilled or riveted to the pipe. Holes in flanges, both for riveting to plates and for bolting together, were drilled; those for jointing were accurately pitched, 32 in number on a bolt circle of 40½ ins., to take ¾-in. bolts. The back and face of the angle flange were made perfectly parallel to give perfect bearing for the heads and nuts of the bolts. The faces were tested by rolling between two fixed points to insure their being at right angles to the axis of the pipe. The pipe was made in alternate parallel rings, the small rings being of 36 ins. internal diameter, and the end angles or flanges were placed on the smaller rings of plates, each ring being in one plate, with seams on alternate sides of the pipe. The edges of all plates were planed to a suitable bevel for Conway's style of caulking, all seams being caulked both inside and outside.

The ¾-in. bolts had the thread turned off and the ends rounded for about half an inch from the end, each bolt being 4 ins. long from under the head to the point. Nuts and heads were hexagonal, and one wrought-iron flat washer was used with each. A lead joint ring formed the gaskets.

The length of each pipe was 30 ft., made up of 5 plates. Every 60-ft. joining the second and third plates of every alternate pipe was a McNeil flexible and expansion joint, which gave ample flexibility within the required limits of about 2°. The drawing shows clearly the construction, but, briefly, the plate on the part of the pipe with a small pipe ring extended about 9 ins. beyond the heel of a 4x4x13/16 in. welded L. A plate

ring from the abutting pipe, but riveted to the outside of the large pipe ring, around which was first welded a 4x4x13/16 in. L, formed a sleeve over the first projection and partly over the foot of the first L. A gasket of ½-in. lead pipe between the two projecting pipe rings permitted some flexibility of motion and still held the joint tight, being prevented from slipping off on the inside by a 3x3/16-in. band riveted to the end of the small projecting pipe ring. Twelve 1x15-in. bolts joined the flange angles and completed the joint.

When completed, and before coating, each pipe was tested to 25 lbs. to the sq. in., all leaky rivets being cut out and replaced, and all seams showing leakage, were recaulked until a satisfactory test was secured.

After testing, the pipes were thoroughly dried and cleaned, and heated in an oven to a temperature of 300° F., after which they were thoroughly coated by dipping in a bath of mineral rubber asphalt, manufactured by the Assyrian Asphalt Co., of Chicago. The bath being heated by steam to a temperature of 300° F.

On receipt of the pipe at the city dock, all places from which the coating had been knocked or rubbed, were cleaned and temporarily vaselined. They were hauled to the work when winter had set in, on sleighs with bunks specially prepared, in the form of cradles, lined with old rubber fire hose at all points of contact, to prevent abrasion of the pipe coating.

At the outer end of the intake, a quarter bend supported by knee and foot plate, was provided finishing 6 ft. above the invert of the pipe. Attached to the bend was a 3-ft. length of pipe surmounted by a circular strainer, 4 ft. in height and 4 ft. in diameter at the top, the top covering curving to a 6-in. rise at the center. Top and sides were punched with holes 1 in. in diameter, 2 ins. c. to c.

To secure the required depth of 9 ft. for the invert of the pipe, it was necessary to construct a cofferdam to a point 277 ft. from the gate chamber. It was proposed to lower the remaining 473 ft. from the ice in one piece.

Prior to the commencement of the work, the ice was kept comparatively clear of snow to insure rapid thickening, and operations began during the first week in January, 1908, with an ice thickness of 24 ins.

All the pipe was first examined for scratches and holes in the coating, and the steel thus exposed carefully cleaned of all rust by scrubbing with a stiff brush and dilute hydrochloric acid, followed by a mopping with a saturated solution of soda to remove the acid. After all rust had been removed the alkali was washed off and the plate thoroughly dried. In the case of scratches and very small holes, the coating was replaced by pressing over the adjoining coating with a very hot flatiron immediately after the preceding treatment. Where the exposed surface was too large to be covered by this method, it was painted with three coats of mineral rubber field paint manufactured for the purpose by the patentees of the original coating.

A detailed examination of the lake bottom was made by divers, who removed the few snags and logs found on the located line. For about 200 ft. from the shore line a firm sand beach bottom was found, after which the sand was overlaid by about 1 ft. of mud.

The outer eight lengths of pipe (480 ft.), were bolted together in position on the ice and the quarter bend, over which was bolted a tight blind gasket, was attached. To the foot plate, two timbers, 12x12x18 ft. were bolted. At intervals of 60 ft. along the pipe line a pair of 6-in. guide poles were let through the ice and driven into the lake bottom. These poles were 10 ft. apart at the ice level and 4 ft. at the lake bottom. Several ropes of the proper length were carried from the pipe to 12-in. poles let through the ice and frozen in to insure that the shore end of the pipe rested in correct position. During the progress of this work the temperature did not rise above 0° F., and occasionally fell to 40° F.

A trench, 4 ft. 6 ins. wide, along the entire length of the pipe, was then cut through the ice, which was at this time upwards of 3 ft. thick. The pipe was then temporarily supported on timbers extending across the trench. As it was the intention to drop the pipe into the water and to permit it to fill slowly through the shore end, a perforated gasket was fitted at that point. The timber footing under the quarter bend was loaded to make it very slightly heavier than the rest of the pipe line.

Four men were then stationed every 30 ft., two on either side of the pipe, and using long poles as levers held the pipe in place while the temporary cross timbers were cut away. On signal the pipe was gently lowered until it floated and the water gained entry through the perforated gasket. The ropes, previously placed and looped under the pipe, controlled its descent so that the top of the perforated gasket was the last to disappear. Failure on the part of some of the men to obey the starting signal, however, caused a slight unevenness in the lowering operations, and the two bolts on one flexible joint, and one on another, were broken. These were replaced by a diver and the accident apparently had no injurious effect on the pipe. Two hours and twenty-two minutes elapsed from the cutting of the last temporary cross-brace until the pipe rested on the bottom of the lake.

This somewhat crude method of laying the pipe avoided the necessity of hauling special machinery to a location which was difficult of access. The necessary labor was available at the cofferdam and other portions of the work.

It was originally intended to lay the pipe in cradles, but it was decided that the foot or eighteen inches of mud overlying the sand bed would serve as an effective natural cradle.

The inshore portion of the pipe, previously laid, was inclosed by a cofferdam, the blind gasket at the inlet having excluded the water during the process of pipe laying inside the dam.

The cofferdam provided an inside width of 10 ft. Two double rows of 10-in. x 20 ft. round piling were first driven seven feet apart on both sides of the pipe, and 12 ft. c. to c., for 152 ft., until the water reached a depth of 5 ft., after which the longitudinal spacing was 8 ft. c. to c., for a further 80 ft. Up to the aforesaid 5 ft. in depth, a single line of 3-in. sheeting, 14 ft. long, was driven back of a 4x8-in. through waling. The inside piles were tied to the outside piles by ¾-in. x 8 ft. 6 in. bolts, thus avoiding the necessity of inside bracing, and the clay filing was dumped on the outside of the sheeting, the ice preventing all possibility of wave wash. The 3-in. sheeting was 10 ins. wide sloped 45° at the foot, and tongued and grooved by inch squares screwed every 12 ins.

All piling was driven with a small steam driver, provided with a 1,000-lb. hammer and 36-ft. leads.

The portion of the cofferdam in a greater depth of water than 5 ft., was double sheeted in a similar manner, but a 4x8-in. waling was run on both sides of each row of pilings and the sheeting driven on the inside of the waling next the core, which was composed of puddled clay. The round piles were similarly tied together by ¾-in. rods, but it was found necessary to carry struts across the top of the trench at every pile. The coffer-

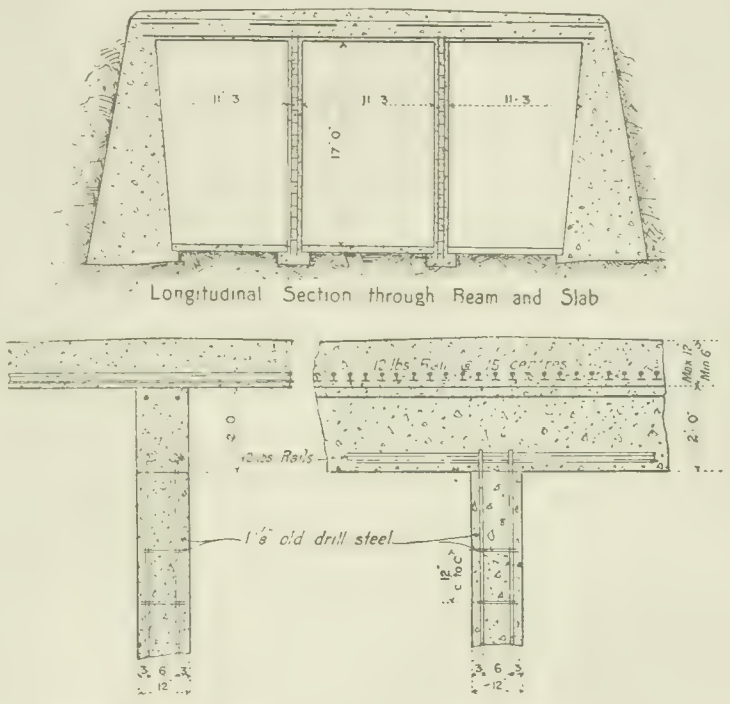


Fig. 6—Details of Reinforced Concrete Roof of Forebay.

dam was made tight at the outer end containing the pipe by forming the sheeting and dumping a considerable quantity of clay at the outer side.

A 500-gal. per minute centrifugal Lawrence pump with 6-in. suction and 5-in. discharge directly coupled to a 5 hp. Westinghouse 550 volt A. C. induction motor, unwatered the cofferdam.

The excavation revealed 1 ft. of beach sand overlaying a stratum of very porous wet sand 18 ins. deep, under which was a fine quicksand. During the progress of excavating and laying, there were no less than five breaks, four of which were caused by the presence of a buried log at the outer end. A combination of baled hay and clay enabled operations to be resumed after delays varying from a few hours to two days.

When the pipe laying had been carried to the gate house and the sluice valve installed, a diver removed the blind gasket from the outer end and placed the 3-ft. length of pipe and strainer. A large quantity of concrete was placed around, under and over the foot plate and timbers at the bend.

Before the spring thaw moved the ice from the lake, back filling had been carried within about 100 ft. of the outer end of the cofferdam. As no danger was anticipated, operations ceased until work could be carried on to better advantage. During the summer, however, it was noticed that there was a hump in the middle portion of the pipe, that had not been backfilled, within the cofferdam. As an inch air pipe had been placed in this portion, it did not seem probable that an ac-

cumulation of air could have raised the pipe to the point of buoyancy, and it was thought that the pressure of the quicksand gradually raised the pipe, especially as the portion backfilled remained true to grade.

During the following winter the cofferdam was again unwatered. The only leakage of any moment was from the joint just inside the end barrier. The pipe was lowered to grade and the joints made tight. To avoid any chance of a recurrence of the trouble, 8x8-in. timbers were bolted across the pipe at every pile bent, and the pipe protected from abrasion by old rubber fire hose placed under each timber. Struts were also run down at an angle of 45° from the top of the piles to the center of the cross-brace. The backfilling was then completed with sand and a layer of rock from the tunnel waste spread over the whole to a depth of one foot.

The cost of this portion of the work was as follows:

750-ft. steel intake pipe with strainer and joints	$ 7,068.20
Unloading and treating pipe	144.90
Hauling pipe	204.40
Cutting ice, connecting and laying pipe	780.00
Lumber in cofferdam	2,278.35
Iron in cofferdam	255.21
Hauling clay for core	240.00
Tools and material	253.50
Hire of pile driver	201.60
Pump, motor and transformers installed	740.00
Labor on cofferdam, cutting piles and tamping clay	1,532.00
Excavation, including breaks and pumping	2,253.60
Lowering raised pipe	1,197.90
Backfilling, 960 cu. yds.	750.95
	$17,900.00

Forebay.—At the north portal of the tunnel 20 ft. of open cut, concreted in the same manner as the south portal culvert, led to the forebay. The natural slope of the hillside at this point was very steep, necessitating benching into the hill to secure a satisfactory site for this structure. A bench was cut approximately 6 ins. below the tunnel grade line for a distance of 60 ft., affording a solid rock foundation for the waste pipe and backfilling, as well as for the forebay walls.

The general plan of the forebay is segmental, with an inside diameter of 36 ft., the rise being 24 ft. The chord is at right angles to the center-line of the tunnel, which bisects it. The concrete walls have a width of 2 ft. at top, and are carried up to a height of 18 ft. above grade with a batter on the inside of 1 in 12, and on the outside of 1 in 6. An 8x6-ft. gate chamber was placed in the circular wall, on a radical line leading to the supply pipe line to the reservoir. The walls are vertical on the inside, 2 ft. wide on top and battering on the outside 1 in 6. Two center pilasters, 1 ft. x 1 ft. 6 ins., were grooved to receive a 5-ft. screen of a 4x4 copper wire cloth mounted on three frames, 6 ft. high, of 1-in. galvanized iron pipe. Each section has a center vertical brace of 1-in. pipe. All joints and bends were made with elbows or tees, and a ⅞-in. bar which projected 8 ins. from the lower corners of the top and middle sections, fitted into the open end of a T at each of the upper corners of the middle and lower sections.

One 36-in. coffin sluice gate, bolted to a thimble set in the concrete wall, admits water from the forebay to the gate chamber, the floor of which is 1 ft. lower than the forebay. Three 18-in. sluice gates, bolted to thimbles, provide outlets to the supply mains leading to the reservoir, one of which is now in use. Three lengths of pipe were attached to each of the other gates, in order to clear the toe of the backfilling slope.

Sixty degrees east, on a similar radial line, three lengths of 36-in. cast-iron waste pipe were installed, operated by a sluice gate rising with a vertical buttress from the inside of the forebay. The outer end of the pipe was set in a 12-in. concrete head wall, with 10-in. coping projecting 3 ins., and a sunk wall carried down 4 ft. to shale rock foundation.

The walls rested on solid rock, in which a trench about 6 ins. deep was excavated to receive them. Within the trench numerous holes were drilled about 6 ins. into the rock to receive dowels of 1⅛-in. scrap drill steel from 12 to 24 ins. in length. Three inches from the inside face, expanded metal reinforcing was placed to take up temperature and contraction stresses.

The concrete floor varied in thickness from 6 to 15 ins., and was laid to drain to the waste pipe, the invert of which was 9 ins. below the tunnel grade. A large number of rock "fillers" were used up to within 6 ins. of floor level.

It was originally intended merely to fence in the forebay, but it was subsequently decided to construct a reinforced concrete cover containing a manhole, etc.

This cover was supported on two columns 12 ins. square, each reinforced with four bars of 1⅛-in. old drill steel on a footing 24 ins. square, carried from a solid rock foundation. The columns divided a line drawn parallel to the segmental chord, and 12 ft. distant therefrom, into three equal bents. A beam, 12x20 ins., was carried across the columns in the same parallel line, and was reinforced with two lines of old 12-lb. steel rails, placed 2 ins. from the bottom. Two 7-ft. lengths were also placed at the top of the beam above each column to provide against shear.

The cover extended to the outer edge of the walls, and had a minimum thickness of 6 ins., including the granolithic finish. It was reinforced at 10-in. centers with old 12-lb. steel rails, carried from walls to beam and finished with a 1-in. layer of granolithic, compounded of 1 part cement, 1 part sand, and 3 parts granite chippings. The surface was trowelled smooth and even, marked and rolled, with a grade of 6 ins. from the center to the walls. In the center of the cover was placed a 5x3 ft. red granite date stone.

The concrete used throughout was a 1:2:5 mixture, handmixed to the same specification as adopted for the south end culvert. The sand was practically all Isle Royale sand, hauled from the river bank 6 miles distant. A 3x2 ft. manhole was provided ot the southeast corner, with steel ladder and ventilating cover.

The gate chamber was covered with a 2-in. plank floor, protected by 26-gage galvanized iron, resting on and bolted to 40-lb. T-rails. Trapdoors, 2x2 ft., were provided, one on each side of the screen with an additional narrow trap, 1x6 ft., to permit the screen to be hoisted. Two steel ladders were provided, and fixed to afford means of descent for purposes of examination.

The walls were constructed during the summer of 1908, when a 7x7 ft. opening was left in the outer wall to furnish exit for the dump cars from the tunnel. This opening was filled in during June of the present year, 24 crossbars of ½-in. steel being placed as reinforcing, and holes drilled in the concrete to receive their ends. The face of the old concrete was "roughed," thoroughly washed, and painted with a neat cement grout immediately prior to running the new concrete. This process secured a perfectly tight joint.

When filling this opening a ¾-in. galvanized iron pipe was carried through the forming from the forebay to a hole drilled in a granite boulder set on the head wall over the waste pipe. A ½-in. copper goose neck discharges a constant stream from the boulder.

To secure backfilling, a borrow pit was opened in the adioining hillside, and the whole forebay backfilled to the base of the cover, forming a minimum berm of 8 ft., from which the embankment slopes at 1½ to 1, the toe being retained by a dry wall 3 ft. in height. The cars and rails from the tunnel were used for the conveyance of backfilling. Care was taken to have the surface of the berm and slopes covered with at least 3 ins. of good loam, which was afterwards sown with grass seed. The cost of this portion of the work was as follows:

Forebay and Flume:	
Excavating 1,400 cu. yds. solid rock	$ 1,570.00
Powder, 2,050 lbs.	302.50
Steel, tools, fuse, etc.	85.00
Total	$ 1,981.00
Labor on concrete, 472 yds. (including forming)	$ 2,512.00
Sand, 160 yds., at $1.25	200.00
Hauling sand, 160 yds., at $2.50	400.00
500 bbls. cement on the work, $2.50	1,250.00
Teaming and screening rock, 480 yds.	818.00
Lumber for forming 29,600 f.b.m., at $25.00	740.00
36-ft. 36-in cast-iron waste pipe in place	271.00
Sluice gates	710.00
Reinforcing	56.50
Total	$ 6,957.50
Cover and Piers (22 cu. yds.)	
Labor, mixing, forming (old lumber), and placing	$ 148.35
Old steel, 4 tons, at $25.00	100.00
Cement, 25 bbls., at $2.50	62.50
Sand, 10 cu.-yds., at $3.75	37.50
Rock, 25 cu.-yds., at .60	15.00
Tool depreciation	18.75
Date stone	77.00
Total	$ 459.10
Backfilling, 1,850 cu. yds.	782.35
Grand total	$10,182.95

Modern Requirements of a Public Water Supply.—The opinion of sanitary engineers, sanitarians, and in general those who are familiar with the proper development of water supply interests, has now become fairly well crystallized with respect to the requirements which a water supply should fulfill. These requirements are sanitary, aesthetic, commercial and protective in their nature. The writer has summarized them as follows:

(a) Requirement of Quality.

(1) Primarily the water supply must be free from pathogenic or disease-producing organisms. More than this, it should be free from those allied organic forms which may not as yet be recognized as accompanying disease, but which may, nevertheless, not be conducive to health. This condition of safety must prevail continuously and the supply must not be subject to what may be termed "accidental" contamination.

(2) The water must be uniformly clear and free from turbidity, both that which may be produced by suspended mineral matters, and also that which may be due to suspended organic (vegetable and animal) growths or impurities.

(3) The water must not be discolored by dissolved vegetable matters to such an extent that it may be objectionably apparent when employed for table use or in the arts.

(4) The water must at all times be free from both tastes and odors, either those produced by dissolved gases or those which may be due to the growth and decay of micro-organisms (minute plants and animals frequenting lakes, reservoirs and rivers, but usually prevailing to the least extent in the last named source).

(5) As far as possible the water should be cool and palatable.

(b) Requirement of Quanitity.

(6) The supply must be abundant and unfailing, but for economic reasons must be conserved in such manner that all preventable waste shall be eliminated.

(c) Requirement of Physical Safety and Dependableness.

(7) The pressure under which the water shall continuously act in the distribution pipes must be ample to serve the various districts according to their specific character and needs.

(8) The system of works must be one in which design and construction may be executed in such a way that they will successfully meet conditions imposed by the natural phenomena occurring or likely to occur within the region in question.

(9) The various structures in connection with these water works should be so located, arranged, built and protected that they may not be unduly exposed to fires or other accidents befalling neighboring structures.—Charles Gillman Hyde in the *California Journal of Technography*

At the last meeting of the City Council of Phoenix, Ariz., it was decided to grant right of way through the city for the proposed Buckeye railroad, a Southern Pacific feeder

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Advices from Ely, Nev., state that the Waasatch Construction Co. has been awarded the contract for the construction of the washed out portion of the Eureka & Palisade Ry.

Roads and Streets Section

Note: This section is devoted to methods and costs of road and street construction. It will cover road building in all its details, the construction of pavements, sidewalks and gutters, the testing and use of paving materials and the machinery and tools used in road building and paving.

Standardization of Tar for Paving Purposes.*

Interesting though it be, and indeed necessary for those who would go into the question of tar-bound road construction in a thorough manner, it is not possible in this instance to go fully into the question of tar production and the causes that lead to great variability, but it is accepted that there is great variation in the quality of tar. The matrix is the crux of the whole question of bituminous-bound macadam roads, and brings one to the very important question of standardization of tar for paving purposes.

DESCRIPTION OF TESTS APPLIED.

Comparatively recently the author had the opportunity elsewhere of describing certain means that he had taken to ensure a uniform and standard tar for paving purposes. Among other qualities which needed, in his opinion, to be considered were the following—viz., volatility, viscosity, power of adhesion to aggregate, specific gravity, free carbon and restriction and regulation of amount of distillate at various temperatures.

Tars of various descriptions and from various sources were taken in their crude state, were distilled to a comparatively uniform specific gravity and the residual soft pitches or tars of uniform specific gravity were subjected to various tests. For instance:

For Volatilization.—This appears to be an important one, for to a diminishing degree the constitutents will be volatilizing from the day that the tar-macadam is first laid, and such volatilization cannot go on to a very great extent without impoverishing the surface and tending to disintegration.

For this test the various samples were taken and placed, in layers of ⅜-in. in thickness and not more, into open dishes and exposed to a temperature of 60° F., for one week, and then the percentage of loss by volatilization was ascertained. The residue from this test was then exposed to a temperature of 110° F., for one week, and the loss by volatilization at this temperature was recorded.

For Viscosity.—The necessity for a high viscosity must be readily apparent, although, of course, of itself its determination in tar-macadam would be valueless, for it would show that hard pitch, with its undesirable brittleness, would be the most advantageous fraction of tar to be utilized. However, in order to ascertain the comparative viscosity, samples of the aforementioned soft pitches were taken. The method of testing was as follows: The various descriptions of tar were put into small tins, about 2¼ ins. in diameter by 1½ ins. deep, and these were placed in water contained in a tin tray about 14 ins. by 14 ins. by 2 ins. deep, the water being heated by means of a Bunsen burner, and to prevent it becoming unevenly heated the burner was kept continually moving over the entire area of the tray bottom and the water continually stirred. Water lost by evaporation was constantly replenished, so that the same level was retained in the tray. Observations were taken when the temperature of the water was recorded at 62° (atmospheric temperature), 78°, 90°, 110° and 120° F. At each of the before mentioned temperatures, circular copper discs, 1 in. in diameter and 5.715 grammes in weight, were laid flat upon the surface of the tar and the time required for the complete covering of the disc by the tar was recorded.

Determination of Free Carbon.—It must be obvious that a large percentage of free carbon is to be avoided, but a certain amount must necessarily be admissible. The samples previosuly referred to were subjected to the following test to ascertain the percentage of free carbon in the soft pitch—viz., ten grammes of the sample were successively extracted with hot benzine, alcohol and carbon bisulphide until the extractive liquid was no longer discolored. The residue was dried at 100° C. and weighed.

Adhesion.—For this important test the author devised a machine for ascertaining the tensional strain required to sever briquettes that had been previously joined by the various samples of tar of which the adhesive properties were required to be known. The principal parts of this apparatus are: A spring balance with a large metal dial graduated in single ounces up to 50 lbs. (which would have been better increased to 100 lbs.) and fitted with a maximum hand: the jaws which hold the briquettes, one in each pair; the screw employed to pull them apart. The double briquette, joined with the tar compound, is placed in the two pairs of jaws, which are made from stout brass castings and suitably shaped to receive it, and rests on rollers attached to the base which are provided to reduce the friction. When the briquettes are in position the wheel attached to the screw is turned so as to pull on them and thus on the spring balance, and this is continued until the briquettes break apart at the junction—the maximum force used being registered by the second pointer of the balance. First—there were made some hundreds of briquettes in a special mould, similar to an ordinary mould for making cement briquettes, save that it made half briquettes only, and made such briquettes with a cross sectional area of 4 sq. ins. These briquettes were made with cement and plaster of Paris, and great care was taken to get a perfectly uniform face. They were then dried for a considerable time. Then were taken various samples of soft pitch to be tested, and these were raised to a predetermined temperature, 250° F. A number of these half briquettes were then dipped into this heated tar, the surfaces being rubbed together for the expulsion, so far as possible, of any imprisoned air, and then firmly pressed together by hand pressure and stood in a vertical position to cool. For the testing of each particular sample there were taken four complete briquettes (8 halves) at a temperature of about 60° F., and the same number heated (before being dipped in the tar) to a temperature of 100° F. After they had cooled in a room of even temperature of approximately 55° F., the tar-jointed briquettes were broken as one would break ordinary cement briquettes, either upon the ordinary double lever cement testing machine (for strains over 50 lb.) or upon the special machine previously described. Where the tensional strength was considerable, the cement-testing machine answered the purpose quite well, but where the adhesion was small (under 50 lb.) it needed to be recorded upon the more delicate instrument that was specially made. After the briquettes were broken and results recorded, the briquettes were carefully and evenly pressed together again by hand pressure (the tar being cold) and left for 24 hours and again tested. The complete results of these tests were tabulated and considered.

From the result of numerous distillations of crude tar and of the resultant soft pitches, and with the subsequent tests for volatilization, viscosity, etc., an attempt was made to lay down certain standards.

The question of standardization depends greatly upon local requirements, but, generally speaking, it appeared to the author that there are required to meet the varying climatic conditions and to meet methods and materials of construction for tar concrete, at least two standards of matrix, which may be described as "moderate" and "heavy." The times and opportunities for the use of each particular grade must be more or less a matter to be decided locally.

SUGGESTED STANDARDS FOR MATRIX FOR TAR CONCRETE.

It is suggested that the "heavy" grade tar should comply with the following specification:

The tar or soft pitch shall be produced by the distillation of tar derived exclusively from bituminous coal, and must contain no impurities. The specific gravity, as determined by a tar specific gravity bottle, should be approximately 1.220 at 15.5° C. On distillation (the bulb of the thermometer being placed in the vapor at a point where it enters the side tube of the distillation flask) it must not yield more than 10 per cent of distillate below 289° C., and not more than 25 per cent below 350° C. The free carbon determined as specified in the tests described must not exceed 16 per cent by weight. When thoroughly mixed with water and kept for some time at a temperature of 110° F., the water shall contain not more than 23 grains per gallon of total solids. On exposure to an atmosphere of approximately 60° F., for one week, in a layer not exceeding ⅜ in. in thickness, the tar must not lose more than 1.5 per cent of its weight, and the residue from this test must not lose more than 3.5 per cent of its weight on exposure to a temperature of 110° F., for one week. Its viscosity shall be such that when tested in the manner described the disc shall not be covered in a less time at 60° F. than 5½ mins., nor in less than 10 seconds at 110° F. There shall be recorded an adhesive strength upon the 4 sq. ins. ends of the briquette, from experiment conducted in manner described, a result of at least 75 lbs. with the cool briquette, and the re-adhesion shall comply with the like test.

Now, for the "moderate," tar there must be the following amendments from the figures specified for the "heavy" grade—viz., the specific gravity to be reduced from 1.22 to 1:195; there must be not more distillate below 350° C. than 35 per cent as against 25 per cent; the volatilization tests to be 2 per cent for the first week and 8 per cent for the second week, as against 1.5 per cent and 3.5 per cent for the "heavy" grade. The viscosities to be 30 seconds and 2 seconds at the two temperatures of 60° and 110° F. The adhesive strength to be reduced in each case from 75 lbs. to 45 lbs., but otherwise the specification is to remain the same.

LIVERPOOL STANDARD FOR MATRIX FOR PITCH-MACADAM.

Now for "pitch-macadam," a much heavier matrix is desirable and permissible, and in this connection the author begs to quote from "Dustless Roads," where the matrix for "pitch-macadam" is fully dealt with as follows:

The specification for the matrix as prepared by Mr. John A. Brodie, City Engineer, Liverpool, who was, so far as the author knows, the first to seriously and scientifically standardize the matrix, is as follows:

Pitch.—(1) The pitch must yield no matter volatile below 270° C., when subjected to dry distillation, and its total volatile organic matter must not fall below 30 per cent.

(2) It must not contain more than 80 per cent of its weight of matter insoluble in petroleum spirit of 0.700 specific gravity (boiling), and must be free from extraneous matter such as sand and grit.

(3) It must twist fairly after immersion for two minutes in water at 60° F., but not under 55° F.

Creosote Oil.—(1) The creosote oil shall be obtained exclusively by the distillation of coal tar and not more than 6 per cent shall redistil below 240° C.

(2) The oil as obtained by the distillation of coal tar shall not be treated in any way, either by the addition of any coal tar product or by the extraction of any of its constituents, excepting such extraction as may be

*From an article by J. Walker Smith, City Engineer of Edinburgh, in The Surveyor.

necessary to comply with the following requirements.

(3) It shall contain no solid matter at 15° C., and shall have a specific gravity of not less than 1.060 (taking water as 1.000 at 15° C.).

(4) It must contain not less than 25 per cent of its constituents that do not distil over below 320° C., and the 75 per cent which does distil over below 320° C., shall contain 10 per cent of tar acids to be extracted by soda, specific gravity 1.125 (water 1.000).

The hot pitch and oil shall be tempered in a pitch boiler until it complies with the following practical tests: The mixture, when cooled in water, at 60° F., should stretch at least 3 ft. before breaking, and the threads so formed should pull out very finely indeed. It should also, when doubled into a length of about 1 ft., bear hitting hard on an iron or stone surface without showing sign of cracking.

It may not be out of place if the author at this point briefly indicates the reasons for those specified requirements.

Mr. Brodie had found that the tar distillers and merchants were not supplying him with a thoroughly good paving pitch, and what was worse, it was not uniformly mediocre, but was variable in a very high degree, so that he, very wisely as the author thinks, worked from an excellent pitch which he had procured from some paving taken up after 20 years' wear, which pitch was found to be practically as fresh, tenacious and full of life as when first laid, and he consequently worked back from this time-proven sample and practically determined his standard from analysis of it. Now perhaps a brief explanation of the meaning of and reasons for this specification as they appear to the author may be permitted.

REASONS FOR SPECIFIED REQUIREMENTS.

Pitch.—(1) "The pitch must yield no matter volatile below 270° C., when subjected to dry distillation."

The compliance with this clause would result in no light oils being present, and would practically ensure that distillation had been carried to that point at which most of the naphthalene had been removed. It would, in fact, have ensured the elimination of much that it is inadvisable to retain in the form of light oils, and the removal of a considerable amount of naphthalene, which has a high vapor tension and general physical characteristics which are undesirable for good paving work. If there were no such provisions the result of the distillation might be, as it frequently used to be, that the tar had been distilled down to hard pitch and revivified with such light oils as were not required. This would result in a pitch that had not the same elastic and agglomerating qualities that a good soft pitch should have. The hard pitch, of course, would not be revivified with the lightest oils because these are commercially of the most value. For instance, 90 per cent benzol has about five times the value of pitch, so that the distiller would not be likely to revivify with this fraction, but he would revivify with considerable percentages of creosote and naphthalene. Then as to the specified requirements that "the total volatile organic matter must not fall below 30 per cent." It would, perhaps, be better if there were some definite temperature fixed, such as 350° C.

The idea appears to be that of obtaining a pitch that is bereft to a reasonable extent of its light oils and naphthalene without any encroachment being made upon the heavy creosote and anthracene oils.

(2) It is self-evident that freedom from extraneous matter, such as sand and grit, is desirable; the point in this which requires some comment is the desire for a certain percentage of matter soluble in petroleum spirit of a given specific gravity. The author does not think, as the clause stands, that it is of very great value, inasmuch as almost any tar would satisfy this clause if treated with an unlimited quantity of solvent (boiling). But apparently the idea has been to retain as great a proportion of creosote and tar acids as possible, as these substances are highly soluble in petroleum spirit. It does not, however, appear to the author to be a very important clause.

(3) This is a practical physical test aimed at providing a certain amount of ductility or elasticity, combined with high viscosity at normal temperatures.

Creosote Oil.—Generally the whole of these clauses are very stringent, and one fears may not be practical with all tars suitable for paving purposes.

(1) This proviso is clearly intended to prevent a large addition of the useless portions of light oils, probably the residuals from the second distillation of the lighter oils.

(2) This aims at the retention of the anthracene and all the oils normally present as the result of distillation of tar, and provides against the elimination of any of them.

(3 and 4) There would appear to be some difficulty in full compliance with clause 3, if one has to read it with No. 4, which requires the retention of 10 per cent tar acids, with which it would be a specific gravity of 1.06 and at the same time have no solid matter at 15° C.

Personally the author does not appreciate the retention of the 10 per cent tar acids mentioned in clause 4, which are the homologues of carbolic acids—viz., cresols and xylenols—and have the same antiseptic properties. Of course, they would be useful for timber preservation, but their special utility for tarmacadam is for the moment not quite apparent.

SUGGESTED STANDARD TAR AS MATRIX FOR PITCH MACADAM.

Alternative Specification.—It may be mentioned that in his excellent pioneer work of standardization Mr. Brodie had much difficulty in getting tar distillers to try to supply a standard article, and it redounds greatly to his credit that in the face of trade opposition he has succeeded in obtaining supplies which invariably, in all essential details, comply with his standard specification, and while that is most satisfactory, it is in the author's opinion found simpler, and the same purpose is achieved with less trouble, and at least equal certainty, by the use of standard distilled tar, which should comply with the following specification:

The pitch shall be produced by the distillation of tar derived exclusively from bituminous coal and must contain no impurities.

The specific gravity, as determined by a tar specific gravity bottle, should be approximately 1.278 at 15.5° C. On distillation (the bulb of the thermometer being placed in the vapor at a point where it enters the side tube of the distillation flask) it must not yield more than 3 per cent of distillate below 280° C., and not more than 18 per cent below 350° C. The free carbon determined as specified in tests previously described must not exceed 16 per cent by weight.

When thoroughly mixed with water and kept for some time at a temperature of 110° F., the water should contain not more than 23 grains per gallon of total solids. On exposure to the atmosphere of approximately 60° F. for one week in a layer not exceeding ⅜ in. in thickness, the pitch must not lose more than 1 per cent of its weight, and the residue from this test must not lose more than 2 per cent of its weight on exposure to a temperature of 110° F. for one week

Its viscosity shall be such that when tested in the manner previously described the disc shall not be immersed to a greater depth than 3-16 in. in a less time, at 110° F., than five mins. There shall be recorded an adhesive strength upon the 4 sq. ins. ends of the briquette from experiment conducted in the manner previously described, at least 230 lbs. with the cool briquette. After heating up to 250° F., and cooling in water at 60° F., the pitch should stretch at least 3 ft. before breaking, and the threads so formed should pull out very finely indeed. It should when doubled into a length of about 1 ft bear hitting hard on an iron or stone surface without showing signs of cracking.

TAR SPECIFICATION AS SUGGESTED BY THE BUREAU OF RESEARCH OF THE NEW YORK STATE.

Certain questions may, and probably will, arise in working to, extending or improving tar standards.

The very full, complete and scientific manner in which the State Departments of America standardize their bituminous material for asphalt work should be an object lesson to British road engineers, and at least the State of New York have now adopted a standard for tar to be used in connection with their bituminous bound roads. Their standard reads as follows:

(1) The tar shall contain no water and not more than 0.5 per cent of mineral matter or dirt.

(2) It shall be uniform in character, appearance and viscosity.

(3) It shall not contain over 1.5 per cent of water soluble materials.

(4) It shall have a specific gravity between 1.20 and 1.29 at 25° C.

(5) It shall contain no body that distils at a lower temperature than 225° C.; not over 9 per cent by weight shall distil below 270° C., and it shall contain at least 60 per cent by weight of pitch remaining after all bodies up to 360° C. have been distilled.

(6) On extraction with benzol it shall contain from 12 to 21 per cent free carbon.

(7) A ½-in. roll of the crude material, 6 ins. in length, cooled to a temperature of 15° C., shall permit a torsional test of at least three complete turns without breaking or cracking, and shall stretch at least 3 ft., forming at the center a very fine thread before rupture occurs.

This had been submitted to the author by the State of New York, and certain queries have been submitted to him by them and by the American Tar Co., there being a difference of opinion between these two bodies as to the practicability of the standard proposed to be adopted.

In consideration of the questions submitted the author collaborated with Mr. Joseph Race, F. I. C., of Burnley.

A few comments upon this American specification may not be out of place.

Nos. 1 and 2.—These seem to be in order.

No. 3.—The allowance of 1.5 per cent of water soluble materials appears to be somewhat generous to the tar distiller, and the figure might with advantage be made rather more stringent by reducing it to about 0.5 per cent. There ought to be some statement as to the manner in which this test should be applied, especially as to the amount of water to be used for a given volume of tar, and also the temperature at which the test is to be made.

No. 4.—This clause appears to the author to be somewhat loose. The limit allowed is much too great. There is such a considerable physical difference between tar with a specific gravity of 1.29 and one with a specific gravity of 1.20 and it is thought to be better that there should be three grades or standards between 1.2 and 1.29, each having over and above the distillation requirements certain physical requirements to comply with, each arranged to be suitable to a particular class of work.

No. 5.—This seems to be generally upon all fours with the standard which the author suggests.

No. 6.—This clause seems to be open to considerable discussion, and it is thought that additional research will be required. The author preferred to leave the clause restricting the amount of free carbon, and the restricted amount was suggested at 16 per cent by weight.

The question now arising is as to the benefit that will be derived from at least 12 per cent of free carbon. Is it beneficial in itself or is it included in order to provide against some contingency or possible dilution? It does not seem probable that free carbon is desirable in itself, as in compression or torsion it would disintegrate to a powder and render the matrix less homogeneous. Tests

for free carbon with tar from various sources resulted as follows:

Description of Tar.	Specific gravity.	Percentage of free carbon.
Tarmite	1.180	10.8
Blast furnace	1.195	16.9
Distilled (North Lancashire)	1.195	11.7
Coke oven (Wigan)	1.210	14.1
Carburetted water gas	1.210	0.36
Carburetted water gas	1.226	0.23
Coal gas (Burnley)	1.215	12.4
Coal gas (Burnley)	1.231	13.6
Tarvia	1.245	11.6

From this it may appear that the reason for the American desire for the 12 per cent of free carbon is to exclude all water gas tar, but whether or not the soft pitches resulting from carburetted water gas tar should necessarily be excluded is open to very grave doubt.

No. 7.—This simple physical test is one that does not need comment.

One of the points upon which the Bureau of Research of the State of New York were in doubt and in conflict with the tar distillers was as to the method of making the distillation test. The State Bureau of Research method was as follows: The distillation test of coal tar is made by weighing 700 grains of the tar into an Eimer & Amend iron retort 4521, with a capacity of 4 pints, the retort being fitted with a tee-outlet and 36-in. delivery tube. The thermometer is so placed that the upper end of the mercury bulb is opposite the outlet of the retort. The thermometer used to have a nitrogen chamber to insure accurate readings at high temperatures. It is necessary to use paper gasket between cover and retort and three Bunsens for heating. At the breaking points viz., 225° C., 270° C., and 360° C.—the flame is removed and the temperature allowed to drop about 20°; the flame is then replaced and the temperature brought to the "breaking point." This is repeated until all is over that will come at that temperature. The temperature is then carried to the next "breaking point," and the method of breaking repeated. The distillates for the different breaking points are caught, weighed and per cent of distillate of tar taken for analyses, figured for the various temperatures."

For this method they appear to find authority, but the companies who manufacture the tar which they wish to purchase claim that their distillation test is too severe, and that they cannot at a reasonable price commercially manufacture tar which will meet the requirements.

The tar distillers require that the distillation should be run through continuously with either no pause or with a slight pause at the breaking point.

It appeared to the author that a little confusion had arisen with reference to the "breaking point." There is no "breaking point" in the distillation of refined tar such as is under consideration. The "breaking point" is only obtained with a crude tar containing ammoniacal liquor, for it is when the water is finally got rid of that the drop of temperature occurs. The heating is continuous, and this break is a natural one, and is explained by the mixture of the two liquids having a lower vapor tension than the sum of the vapor tensions of the constituent liquids.

The following is a description of the method of distilling refined tar as adopted by Mr. Joseph Race in the distillations which he carried out for the author for the purpose of establishing a standard.

Capacity of flask to side tube = 675 c.ccms.

The thermometer should be nitrogen filled, and the flask and air condenser made from the best Bohemian glass. Jena glass is not necessary, better results being obtained with good Bohemian.

Test.—300 c.ccms. (at 15.5° C.) are placed in the flask, which should be protected from draughts and the distillation commenced. The rate of the distillation is regulated so as to obtain as far as is practicable a uniform rate of discharge of the distillate. The process should be a continuous one, the temperature not being held at any particular point or allowed to drop.

The distillates are cooled and measured, all percentages being by volume

Water-works and Sewer Section

Note: This section is devoted to methods and costs of constructing sewers and water-works. It will cover the construction work for all details of water supply and sewerage, including sewage purification and water filtration.

Equipment and Cost of a Fire Service Water Supply System at Winnipeg, Man.*

In the year 1905, the city of Winnipeg was subject to very excessive fire insurance charges, due largely to the fact that the development of the water works system had not kept pace with the extraordinary growth of the city. As a means of relief, and to place the city in the highest class of fire risks, the city council, backed by the board of trade, had a thorough investigation made of fire fighting water works.

Committees of the council with the city engineer made several visits to the principal cities in the United States and Canada, where special systems were in use, and after a careful consideration, determined that the gas engine pumping plant offered, for the conditions of Winnipeg, the most economical and satisfactory solution of the problem of fire protection.

It was essential, from the fire underwriter's point of view, that any plant adopted should be provided with two independent sources of power. Electricity would have been an ideal power, if the above condition could have been fulfilled. Steam was, on account of the heavy standby losses, out of the question. It may be explained that the pumping station of the domestic water works system is about two miles from the business center of the city, and from the bank of the Red River, from which the water for fire protection was to be obtained. Had it been possible to use the steam plant of the domestic system with adidtional boiler capacity, it is probable that steam would have been adopted as the motive power.

Steam and electricity being out of the question, gas power, filling all the requirements, was finally adopted. For alternative sources of power, there are available, producer gas and city gas, in addition to a large reserve of producer gas in the holder.

Standby losses in fuel in this system are practically nothing.

The first of the pumping units was placed in service in November, 1907, and has been available for fire protection since that time. The remaining units were completed, and placed in service between that time and July, 1908, when the whole plant was practically completed, and its operation taken over by the city.

The distribution is made by eight miles of mains from 10 to 20 ins. in diameter, and 85 fire hydrants. It covers the central, closely built, business section of the city.

Pumping Station.—The pumping station is situated on the bank of the Red River and contains the following equipment: 4 Crossley, 2 cylinder tandem gas engines of 540 h.p. each; 2 Crossley, 2 cylinder tandem gas engines of 250 h.p. each; air compressing starting plant in duplicate: 1 producer gas main supplying all engines; 1 city gas main, in reserve, supplying all engines. The engines above described drive six triplex double acting pumps. The pumps are furnished with suction and discharge mains, twenty inches in diameter, in duplicate, all pumps being connected with both mains, either main being of sufficient capacity for the whole plant. The pumps take their water from a well, which is divided into two compartments, either of which will supply the whole plant. The water is conducted to the well by an intake pipe three feet in diameter, which extends for a distance of four hundred and twenty-five feet from the well to the deep water in the river, where in ends in a stone ballasted crib.

Producer Gas System.—The gas producer plant consists of four Crossley type producers; two of 500 h.p. each 8 ft. 6 ins., in diameter, by 18 ft. in height, and two of 1,000 h.p. each 11 ft. in diameter by 18 ft. in height, with necessary platforms, hoppers and piping. This plant has an overload capacity of 50 per cent with selected coal, and readily makes gas from anthracite, lignite or any noncaking bituminous coal. The coal for use in the plant is delivered on track adjoining the building, and unloaded into a hopper having a capacity of one hundred tons. An elevator fitted with a rotary feeding gear to ensure regular feed without choking, raises the coal to a horizontal conveyor placed above the producer hoppers. The elevator and conveyor are operated by an eight h.p. steam engine.

Two air superheaters 18 ft., 10 ins. by 5 ft., 3 ins., and two 18 ft., 10 ins. by 4 ft., 3 ins., with gas and air connections and dust collectors, are attached to the producers. Each unit is supplied with a hot gas tubular boiler. Four wet scrubbers, each 30 ft. high by 5 ft. in diameter, fitted with tar sieves and filled with coke, remove the condensable hydro carbons from the gas. Three centrifugal tar extractors 5 ft. in diameter complete the removal of the tar from the gas. Two sawdust scrubbers, 9 ft. by 22 ft., either of which is capable of removing any remaining impurities from the gas, are placed near the inlet to the gas holder. In addition to the above, centrifugal circulating pumps and Root air blowers are provided.

The cleaning plant is operated by two 18 h.p. Crossley type gas engines, either of which is of sufficient capacity to drive the whole plant. The plant is provided with all piping, valves, shafting, pulleys and belting necessary for its operation.

An important feature of the installation is that there is a spare unit of each type of machine, so that in case of a breakdown, the plant can still be operated to its rated capacity.

Two steam boilers, of about 50 h.p. each, furnish what additional steam is required for the producer, and also drive the elevator and blowing engines, and supply steam for heating the buildings.

The gas holder and pumping station are connected with the city gas mains by a special 12-in. pipe. If, for any reason, the producer gas system should be out of service, a full supply of city gas may be at once conducted to the holder, or directly to the engines, by a special main provided in the pumping station for that purpose. A gas holder of 250,000 cu. ft. capacity stores a reserve of gas, either producer or city gas, sufficient to operate the whole plant for from one and one-half to five hours. This will give ample time to fire additional producers, or to make provision for the use of the city gas, in case of a long continued fire. It is not likely that more than half the capacity of the plant will be required except in extraordinary cases.

The Distribution System.—Two 20-in. mains lead from the pumping station to Main street by different routes, connecting with submains on the way. Either of these mains, in case of accident to the other, is sufficient to take the water from the pumps when working at their rated capacity. The mains are designed to withstand the ordinary working pressure of 300 lbs. per sq. in., and water hammer. They were tested to 700 lbs.

*Extracts from a paper by N. H. Ruttan, City Engineer, Winnipeg, Man., presented to the American Water Works Association, April 26-30, 1910.

per sq. in. at the foundry, and after being laid were tested to from 500 to 700 lbs. The pipes were provided with extra heavy hubs and two lead grooves. These joints have given entire satisfaction.

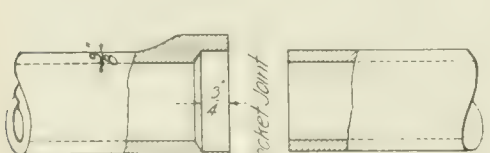
The hydrants are connected to the mains by 8-in. flanged pipes. They are provided with 4½-in. hose nozzles with independent gates. These nozzles are, when required, reduced to 3½ and 2½ ins. by suitable reducers, 3½ ins. being the largest hose now used. The hydrant valve is 8 ins. in diameter, and is provided with 1-in. pilot valve to fill the hydrant before opening the main valve against the pressure. Both the valves are operated by the same stem. Each hydrant connection is provided with a gate valve so that the hydrant may be cut out from the system in case of necessity.

The buildings, intake, foundations, and distribution system, were constructed by the city, by day labor, and the cost of the several branches of the work were as follows:

Land			$ 58,549.80
Buildings: Comprising about 840,000 bricks, 7,500 cubic yards concrete, 15,000 cu. yds. excavation, 132 tons structural steel, roofing, millwork, cranes, heating, etc.			179,144.11
Intake from river and well: Excavation, 3,500 cu. yds.; concrete, 600 cu. yds.; Wooden conduit, 425 ft.			28,912.80
Machinery, including gas producer plant			396,003.47
Distribution System:			
8-in. pipe, 285 ft.	$ 3.00	$ 855.00	
10-in. pipe, 18,261 ft.	3.47	63,366.71	
12-in. pipe, 16,290 ft.	4.50	73,307.25	
20-in. pipe, 3,196 ft.	9.20	29,403.20	
8-in. flgd., 1,390 ft.	8.70	12,093.00	
Asphalt, 13,414 ft.	1.30	17,438.46	
8-in. valves, 79	33.00	2,607.00	
Hydrants, 79	200.00	15,800.00	
10-in. valves, 41	45.00	1,845.00	
12-in. valves, 26	68.00	1,768.00	
20-in. valves, 4	180.00	720.00	
Miscellaneous		6,851.92	
			226,055.54
Miscellaneous:			
Preliminary expenses		$ 3,003.57	
Printing, etc.		1,405.55	
Tools and plant		325.03	
Spur track		84.48	
Emergency gas main		3,518.71	
Contingencies		1,174.02	
			10,311.36
			$898,977.08
Engineering and interest, estimated			44,948.00
Total			$943,925.08

A Molded Fiber Conduit with Bell and Spigot Joints.

The accompanying cut shows the construction of a new form of fiber conduit that possesses several noteworthy features. This conduit is made of indurated fiber, a material which has been used very extensively for insulating purposes, such as third-rail coverings, controller linings, battery boxes, etc. In



Section of Fiber Conduit With Ball and Socket Joint.

making conduit, the fiber is molded into shape under high temperature and pressure, and is entirely without grain or laminations. This process gives each length of conduit a solid ⅜-in. one-piece wall.

The most interesting feature of this new conduit lies in the bell joints shown above. One end of each section is molded to an enlarged size—belled out—with an opening as large as the outside diameter of the opposite end of the next section. Thus, any two sections fit together without any reduction in the wall thickness of either section at the joint. Tests made of this conduit with ⅜-in. thickness of wall show that it has an average puncture voltage of 40,800 dry and 33,000 volts after 40 hours immersion in water. This conduit is made by the H. W. Johns-Manville Co., New York city.

Railway Section

Note: This section is devoted to methods and costs of constructing railways. It will cover road-bed and track construction, contractor's plant and organization, surveying methods and permanent way structures.

Valuation of the Puget Sound Electric Railway.

BY HENRY L. GRAY, ASSOC. M. AM. SOC. C. E.*

The Puget Sound Electric owns and operates a line between the cities of Seattle and Tacoma, and in addition, branch lines extending to Renton, a smaller city having extensive coal mining and ceramic industries; the Orting branch extending to Puyallup, the center of a large berry and fruit district, and a short feeder serving the packing house district of Tacoma, known as the Tide Flats line. The company also owns the East P. Street line in the city of Tacoma, and what is known as the old Puyallup line, but as both of the latter are leased and operated by the Tacoma Railway & Power Co., they are not considered part of the system. The company also owns several lighting franchises in cities along the line, as well as a large tract of timber land, and a saw mill which is operated for commercial purposes. This road, as well as the street railway systems of Seattle and Tacoma, are owned by Stone and Webster, with their associates, being managed by the former.

The main line extends from the city limits of Seattle to the city limits of Tacoma, a distance of 32.01 miles, entrance to the business centers of the cities being obtained over the tracks of the Tacoma Railway & Power Co. and the Seattle Electric Co. The track mileage owned and operated was as follows on June 30, 1909:

Main Track:	Miles.
First track, main line	32.01
Second track, main line	10.91
Orting branch	6.94
Renton branch	2.96
Tide Flats line	0.58
Total main track	53.40
Sidings, etc.:	
On main line	8.24
On Orting branch	0.60
On Renton branch	1.38
On Tide Flats line	0.13
Total sidings, etc.	10.35
Grand total	63.75

On the main line, between Seattle and Tacoma, consisting of 42.92 miles of first and second track, there are 7.30 miles of curved track. The total ascent is 356 ft., and the total descent is 409 ft. About 7 miles of the line was built on trestles.

The main line and Renton branch were built in 1902, the Tide Flats line in 1904, the Orting branch in 1908, and the second track over a period from 1904 to 1909. The population of Seattle is about 250,000, Tacoma, 150,000, while the country tributary to the line contains approximately 15,000 people, many of whom own small tracts adjacent to towns, working in Seattle and Tacoma, going to and from their work each day. All of the larger towns on this road are also served by two steam roads charging 3 cts. per mile, while Seattle and Tacoma have boat service at intervals of two hours, the boat fare being 35 cts. one way or 50 cts. for the round trip.

The rates inaugurated by the Puget Sound Electric Ry. ranged from 1½ cts. to 2 cts. a mile, the rate between Seattle and Tacoma being 60 cts. one way or $1 for the round trip, in addition to which, transfers were given and accepted at each end of the line. Hourly service was maintained between all points, with an extra 30 minute service morning and evening. Under these conditions the valley traversed by this line settled rapidly, many small towns and villages springing up.

*Engineer, The Railroad Commission of Washington, Olympia, Wash.

The land became quite valuable for small fruit raising, truck gardening and dairying, the values ranging from $100 to $1,000 per acre. Real estate firms acquired large tracts and disposed of them in smaller tracts of from one to five acres, selling them on monthly payments to clerks and artisans employed in the terminal cities, whose intention it was to use their spare time building up small vegetable or berry gardens and ultimately devoting their entire time to such work.

On Oct. 17, 1909, shortly after the close of the successful A. Y. P. Exposition, the company put into effect a new schedule of rates, charging a flat rate of 2 cts. a mile between all points and a round trip rate of $1.25 between Seattle and Tacoma. Almost immediately after the new tariff was filed, complaint was made to the Railroad Commission of Washington, alleging that the increased rates were unreasonable and excessive, that they were confiscatory in as much as the patrons of the road could no longer afford to live at such a distance from their work, but would be compelled to dispose of their property at a loss and move into the cities. It was also charged that a great many people had been induced to settle in the small towns along the line by the representation that the rates would never be raised, and it was further charged that the officials of the company had stated publicly that instead of raising the rates, they intended to lower them. Whereupon a citation was issued challenging the increased rates, making the company defendant, and an investigation was begun to determine the value of the property used by the defendant as a common carrier. The laws of Washington provide that in fixing the value of a railroad, the Railroad Commission shall give due consideration to the cost of construction, cost of reproduction, depreciated value, amount and market value of stocks and bonds, probable earning capacity, density of population, physical characteristics and any other matters that may effect the value. The writer had charge of the investigation, particularly of the determination of the original cost, cost of reproduction and depreciated value. The methods employed were practically the same as those used during the appraisal of the steam roads and, as a description of that work has appeared in these columns, the writer will not describe the manner of conducting the work in question in great detail.

As in the case of the valuation of the steam roads, finding the actual cost consumed the major portion of the time. It is an astonishing fact that, with one exception, there has never been a railroad under investigation by the Railroad Commission of Washington which could readily give the cost of construction, and, in many cases, little or no record of such cost existed. Fortunately, however, there are other records besides books or company records, and this important item has invariably been determined to the satisfaction of all concerned. In the present case the property account represented only the face value of stocks and bonds which had been issued in payment for the construction of the road, the records of the original construction being missing from the general offices in Tacoma and there being some doubt as to their existence. Acting upon the theory that no help was to be had from the Boston office, every vault and out of the way place in the Tacoma office was carefully explored. Several old letter files, found in a dark corner of an unused vault, proved to be mines of information, one of them con-

taining a complete itemized statement of the cost of the road at the time it was turned over to the operating department. The rest was easy, and was made even more so by the arrival of a similiar statement from the Boston office, checking the statement found in Tacoma. The writer mentions this incident for the reason that it is a parallel to the manner in which the original cost was obtained for almost every railroad in the State of Washington.

Similar conditions existed in the engineering department. Owing to the general scheme of construction, which contemplated payment for work with stocks and bonds, no quantities or final estimates were available. A thorough examination was made of the entire line, cross sections were taken where the profile could not be relied upon to indicate the grading quantities; material in cuts was classified, buildings and bridges measured up and examined, and in short, all data possible were compiled in the field. The existing office records were compared with the field notes and a fairly close check resulted. The grading quantities were obtained partly from a profie estimate and partly from the cross sections taken in the field. The material in the cuts was classified according to the field inspection and the over-haul computed from the profile. The statement of track material was taken from the office records, which checked the field notets closely. The bridge and building lists were compiled from the field notes, as the office records were not complete. Ballast was the subject of much discussion and was a source of disagreement. An itemized statement of the transmission and distribution systems prepared by the Superintendent of Power was of great assistance, checking the field notes closely. The Master Mechanic provided a list of equipment which was of great aid. Except in the case of grading and ballast, no difference existed between the statements of quantities compiled by the engineers of the railway and those of the Commission, while every disposition was shown to aid the latter.

Proceeding upon the theory that what a thing cost is at least good evidence of what it might cost again, the records of the auditor's office were closely examined and all improvement requisitions scrutinized. The purchasing agent was in great demand, for while the engineers engaged in this work were, from much experience, familiar with the cost of material, yet prices fluctuate and it is frequently the case that a small road is compelled to pay more for its supplies than a larger one, and these things should be taken into consideration. A great deal of information was obtained from the old letter files previously referred to; for instance, they contained an itemized statement of the cost of track laying. Officers of the company were freely consulted, as it was the desire to compile a fair statement of quantities involved, and to show the actual prices which would prevail should the road be reconstructed.

The cost of reproducing the right of way and real estate was arrived at in exactly the same manner as in a condemnation suit. Lists were prepared, with the necessary maps, and furnished to real estate experts, who walked over the line valuing each piece of right of way on the basis of the value of the contiguous property, regardless of the fact that the presence of the railroad lent value to such property. These lists, with the alloted value shown thereon, were introduced as evidence. Testimony was then taken as to the value of such property for railroad purposes, which showed clearly that it was necessary to multiply the land value by a factor, in order to arrive at the cost of repurchasing the property for railroad purposes. This factor ranged from 1 to 5, depending altogether upon the location and value, city property requiring a factor of about 1½, first-class farm property, about 2½, while land which was practically worthless, required a factor nearer 5. The smaller the value of the land, the higher the factor. After considering the testimony of the experts on both sides, and reviewing possible consequential damages, the cost of reproducing the right of way and real estate was fixed. As the road owns very little city property, practically all of the sum shown as the cost of reproduction of right of way and real estate, represents the former, so that the average cost of reproduction per acre was about $1,250. As the average value of the contiguous property was about $500, the average factor was approximately 2½. It is a commendable fact that the estimate made by the railroad officials was smaller than that made by the real estate experts employed by the Commission.

During the appraisal of the steam roads, of the state, it was established that 3½ per cent of the total cost of construction was an ample allowance for engineering, and that 1 per cent of such cost was sufficient to cover expenditures for legal and general expense. But as the construction of this road presented no difficult engineering problems, it was considered that, in this case, 3 per cent would be a liberal allowance for engineering; but it developed that in addition to the sum expended for local engineering, Stone and Webster had received an additional 10 per cent as an engineernig commission. The matter of an engineering commission had not presented itself before, the steam roads, who were not supposed to over-look anything, contending for a total allowance of only 5 per cent for engineering. It was a well known fact, however, that such a charge was by no means unusual, but it was apparent that such a commission was not a strictly "engineering commission," but really covered the cost incident to purchasing supplies and expenses of management during construction, and was in a way a fee for procuring the funds for the construction, so that the only doubt was under which head to include such commission, which was finally shown under the account "Fiscal and Physical Supervision and Management." In accordance with the usual custom, 1 per cent was allowed for "Legal and General Expense" and 5 per cent for "Contingencies." The latter item was a source of much contention, the railway claiming that 10 per cent should be allowed. It was held, however, that, as the quantities were known, and as prices were very liberal and had been fixed after due consideration of the cost, and that as allowance had been made for extra work, and for other items of expense which could not be estimated, many of the contingencies which might be met with had been taken care of in the estimate, so that 5 per cent was a fair allowance in such a case.

The amount of cash and the approximate value of the stores on hand at the time of the inquiry were allowed under the account "Stores and Working Capital," the same being approximately 10 per cent of the estimated cost of reproduction, which was the percentage recommended by the writer. Interest at 5 per cent per annum was allowed, it being considered that 1½ years would be required in which to construct the road. This item amounted to 7½ per cent on the cost of reproducing the right of way and one-half of this, or 3¾ per cent on the remaining construction items, as the sum invested in the latter would only be required for an average of one-half the time. The lighting system, both physically and financially, was so closely interwoven with the railway, that it was deemed inexpedient to attempt to separate them, so it was allowed as representing part of the cost of reproducing the system. The locomotives and motor car had been purchased second hand, hence the cost of reproducing them second hand was allowed, rather than the cost of reproducing them new.

Probably the most thoroughly contested point was "Discount," the railroad engineers contending that 10 per cent of the total estimated expenditure should be allowed to cover this item, and should be included in the cost of reproduction. It was shown that the bonds had sold at 85 while stock was given with the bonds as a bonus, but the Commission held that when a railroad was built entire from the sale of bonds, it ceased to be an investment, and became a speculation; that in such a case it was doubtful if the stock was entitled to *any* return. Testimony was introduced showing that if 25 per cent of the stock of a legitimate enterprise was paid up; that the bonds would without question sell at par, while the entire expense in connection with the sale of such bonds would not exceed 5 per cent; hence 5 per cent of 75 per cent of the total estimated expenditure was allowed as "Broker's Fees."

The depreciated value was arrived at by the combined use of mortality tables and by field inspection, and represents the cost of reproduction less depreciation. The cost of reproducing the different items, for example, pile bridges, was determined, and the average life and age being known, the depreciation in dollars was easily obtained. The possible scrap value of material was taken into account, as in the case of rails, which were assigned a life of 20 years, with a scrap value of 40 per cent, or an annual depreciation of 3 per cent. Trolley wire was assigned a life of 10 years, during which time it was considered that it would wear 25 per cent, having a scrap value of 60 per cent, hence the actual scrap value would be only 45 per cent, and the annual depreciation 5½ per cent. Substation equipment was carefully inspected, and found to be practically new after seven years use, but as obsolescence and inadequacy are forms of depreciation and may be expected to play a part, an annual depreciation of 5 per cent was allowed for this item.

The statement of original cost and the estimated cost of reproduction and depreciated value were prepared by the writer with the assistance of one engineer and a stenographer, the time required being about two months. Four real estate men were also engaged about ten days. The actual cost of the work to the state was approximately $2,000, divided about equally between the engineers and the real estate experts. The cost per mile of road is not representative, as to the length of a railroad is no measure of the cost of appraising it. It costs very little more to appraise a long road than a short one, but it is the number of different estimates that count. In this case it was deemed expedient to prepare a detailed estimate, not only of the Puget Sound Electric Ry. proper, but also for the Lighting System, the East P. Street line and the old Puyallup line, although the last two were not considered part of the system; hence four estimates were made instead of one, for roads aggregating only 65 miles, while the 500 miles owned by the Oregon Railway & Navigation Co. within the state, were appraised for approximately $4,000. It is also possible to handle several roads at the same time at a cost considerably less than the aggregate cost of handling each separately.

The actual original cost of the road was found to be $3,647,018, which included $407,234, advanced for working capital and $305,929 of discount, leaving a net cost of $2,933,855.

In fixing the cost of reproduction the Railroad Commission regards its engineer simply in the light of a witness, and is not bound by his testimony, hence it is not uncommon for quantities or prices to be increased or decreased after hearing to the testimony of the defendant's witnesses. Many questions are simply matter of opinion and depend upon the point of view. The following table includes all items and shows the total estimated cost of reproduction and depreciated value as made by the engineers and the sum fixed by the Commission in their findings:

	Engineer Railroad Com.	Engineer Railroad Company.	Allowed by Railroad Com.
Cost of reproduction	$3,943,750	$5,123,173	$4,157,558
Depreciated value	3,352,463	4,424,395	3,598,232

TABLE I.—COST OF REPRODUCING NEW THE PUGET SOUND ELECTRIC RY.

(June 30, 1909.)

1. Right of Way and Real Estate	$417,733
2. Engineering and Superintendence: 3% of Items 4 to 27	53,336
3. Fiscal and Physical Supervision: Amount expended	186,955

4. Grading:
610,000 cu. yds. common excava., at 0.25 152,500
47,500 cu. yds. common long haul, at 0.095 4,512
150,000 cu. yds. hard pan, at 0.45 67,500
1,150 cu. yds. solid rock, at 1.10 1,265
700,000 cu. yds. overhaul 100 ft. at 0.01 7,000
133 acres clearing at 60.00 7,980
580 stations grubbing at 15.00 8,700
200 dangerous trees cut at 2.00 400
Ditching and miscel. 2,000
Total grading $251,857

5. Ballast:
46.35 miles gravel at 1,100.00 $ 50,985

6. Ties
157,857 ties (6X8X8) at 0.35 $ 55,207
16,636 ties (6X8X9) at 0.40 6,658
Total ties $ 61,865

7. Rails, Fastenings and Joints:
5,292.8 tons 30-ft. steel rails at 39.50 $209,066
1,409.1 tons 60-ft. steel rails at 41.50 58,478
14,584 Weber joints (60 and 70-lb.) at 2.50 36,460
1,327 American continuous joints at 2.10 2,859
106,596 lbs. angle bars (56 and 60-lb.) at 0.03 3,198
25,240 lbs. fish plates (30, 40 and 42-lb.) at 0.025 631
10,304 lbs. track bolts (¾x3¾) at 0.0325 335
2,574 lbs. track bolts (⅝x2½) at 0.0325 85
269,206 lbs. spikes (9 10x5½) at 0.0225 8,325
2,000 braces at 0.10 200
3,010 lin. ft. guard rail at 0.50 1,505
Total rails, fastenings and joints $321,136

8. Frogs and Switches:
66 spring frogs (70-lb.) at 50.00 $ 3,300
22 rigid frogs (70-lb.) at 30.00 660
22 rigid frogs (60-lb.) at 30.00 660
16 rigid frogs (50-lb.) at 25.00 400
13 rigid frogs (40-lb.) at 20.00 260
72 split switches complete (70-lb.) at 40.00 2,880
12 split switches complete (60-lb.) at 35.00 420
1 split switch complete (50-lb.) at 25.00 25
6 split switches complete (40-lb.) at 15.00 90
8 sets head chairs at 4.00 32
8 sets tie bars at 10.00 80
59 high stands at 25.00 1,475
2 low stands at 18.00 36
20 ground throws at 10.00 300
139 guard rails at 10.00 1,390
47 loose tongue switches at 50.00 2,350
3 derails at 6.00 18
59 switch lamps at 5.00 295
61 switch locks at 0.50 31
5 crossing frogs at $300.00 1,500
Total frogs and switches $ 16,201

9. Laying:
1,096,630 ft. B. M. fir planking at 16.00 $ 17,546
140 kegs wire spikes at 3.00 420
40,000 ft. B. M. wood filler at 24.00 960
600 cu. yds. broken stone at 1.50 900
Total paving $ 19,826

10. Track Laying and Surfacing:
63.75 miles track at 700.00 $ 44,625
119 frogs and switches placed at 25.00 3,475
5 crossing frogs placed at 25.00 125
Total track laying and surfacing $ 48,225

11. Tunnels:
180 lin. ft. timber lined at 65.00 $ 11,700

12. Bridges, Trestles and Culverts:
210 lin. ft. span bow steel truss (on cylinder piers) at 100.00 $ 21,000
72 lin. ft. span deck girder (pile abuts.) at 50.00 3,600
60 lin. ft. span I-beam (pile abuts.) at 30.00 1,800
220 lin. ft. span combination (2 spans of 110 ft. cylinder piers) at 55.00 12,100
150 lin. ft. span combination (pile abuts.) at 45.00 6,750
150 lin. ft. span combination (cylinder piers) at 47.00 7,050
200 lin. ft. span Howe truss draw (on pile crib) at 65.00 13,000
190 lin. ft. span Howe truss draw (on pile crib) at 65.00 12,350
120 lin. ft. span Pony Howe truss (pile abuts.) at 30.00 3,600
80 lin. ft. span Pony Howe truss (pile abuts.) at 25.00 2,000
87 line ft. span Pony Howe truss (pile abuts.) at 27.00 2,349
60 lin. ft. span Pony Howe truss (pile abuts.) at 20.00 1,200
361,612 lin. ft. piles in place at 0.25 90,403
39,256 lin. ft. piles cut off at 0.10 3,925
4,889,386 ft. B. M. timber in trestles at 28.00 136,903
166,451 lbs. wrt. iron in trestles at 0.035 5,826
121,515 lbs. cast iron in trestles at 0.035 3,645
150 lin. ft. of 12-in. vitrified pipe at 1.00 150
272 lin. ft. of 14-in. vitrified pipe at 1.25 340
659 lin. ft. of 15-in. vitrified pipe at 1.35 889
802 lin. ft. of 16-in. vitrified pipe at 1.50 1,203
1,364 lin. ft. of 18-in. vitrified pipe at 1.45 1,977
42 lin. ft. of 24-in. vitrified pipe at 2.90 122
8,382 ft. B. M. timber in wooden boxes at 25.00 210
8,281 lin. ft. logs in culverts at 0.12 994
River bank protection, Black River, cost 1,857
Fill and dam, Puyallup River, cost 4,000
2,000 cu. yds. riprap at 1.25 2,500
Total bridges, trestles and culverts $344,553

13. Crossing, Fences, Cattle Guards and Signs:
82,615 ft. B. M. timber in crossings at 20.00 $ 1,652
146,233 ft. B. M. timber in inclines to grade crossings at 27.00 3,948
1,074 lbs. wrt. iron, in inclines, at 0.035 38
210 lbs. cast iron, in inclines, at 0.035 6
30 kegs wire spikes, in inclines, at 3.00 90
9,650 ft. B. M. timber in farm crossing inclines, at 25.00 241
3 kegs wire spikes in ditto at 3.00 9
54 single miles board fence at 450.00 24,300
8 single miles comb. woven and wire fence at 300.00 2,400
1,960 lin. ft. tight board fence at 0.56 1,097
150 board gates at 3.00 450
82 cattle guards, Trackman, at 25.00 2,050
207 cattle guards, Bartlett, at 20.00 4,140
13 danger signs at 2.00 26
196 warning signs at 2.00 392
28 railroad crossing signs at 5.00 140
3 station signs, single, at 10.00 30
35 electric rail signs at 3.00 105
38 "stop, look, listen" signs at 1.00 28
4 yard limit signs at 4.00 16
3 city limit signs at 1.00 3
31 whistle posts at 1.00 31
19 S. posts at 1.00 19
Total crossings, fences, etc. $ 41,508

14. Interlocking and Signal Apparatus:
38 platform stop signals at 8.00 $ 304
3 train order signals at 20.00 60
2 block light sets at 275.00 550
Total interlocking and signal $ 914

15. Telegraph and Telephone Lines:
53 cedar poles, 45-ft., at 4.50 $ 238
66 cedar poles, 40-ft., at 3.80 251
1,675 cross arms (4 pin) with hardware at 0.80 1,340
316 cross arms (6 pin) with hardware at 1.00 316
15,312 lbs. telephone wire No. 10 copper at 0.18 2,756
13,300 lbs. telegraph wire No. 9 bare iron at 0.06 798
1,750 lbs. telegraph wire No. 10 W. P. at 0.07 122
5,886 double petticoat insulators with pins at 0.07 412
11 telegraph keys at 1.05 12
10 telegraph sounders at 5.25 52
14 telegraph relays at 4.20 59
6 telegraph box relays at 4.25 25
12 telegraph cut outs at 1.25 15
Telephone switchboard, cost 275
Telephone storage battery, cost 25
Labor 2,500
Total telegraph and telephone lines $ 9,196

16. Poles and Fixtures:
1,544 transmission poles, 50-ft. cedar, at 5.50 $ 8,492
28 transmission poles, 70-ft. cedar, at 11.25 315
603 trolley poles, 30-ft., at 2.55 1,538
324 trolley poles, 40-ft., at 3.80 1,231
1,635 transmission cross arms, 2 pin, with hardware, at 0.70 1,144
1,572 feeder cross arms, 4 pin, with hardware, at 0.80 1,258
316 feeder cross arms, 6 pin, with hardware, at 1.00 316
57 guy wire clamps, galv., 3-bolt, at 0.12 7
14 line anchor clamps, mal. galv., at 0.50 7
82 anchor rods at 0.50 41
Labor 14,979
Total poles and fixtures $ 29,328

17. Transmission System:
25,050 lbs. transmission line wire, bore 1-0, at 0.18 $ 4,509
6,516 lbs. transmission line wire, bore No. 1, at 0.18 1,172
54,534 lbs. transmission line wire, bore No. 4, at 0.18 9,816
3,425 insulator pine at 0.40 1,370
1,607 pole brackets at 0.40 643
5,025 insulators at 1.50 7,538
Miscel. material 500
Labor 4,000
Total transmission system $ 29,548

18. Distribution System:
72 cut out switches, 50 amp. Q. B., at 9.00 $ 648
66,598 lbs. 3d rail crossg. cables W. P. 500 M. C. M. at 0.18 11,888
2,353 lbs. 3d rail crossg. cables W. P. 300 M. C. M. at 0.18 424
765 lbs. 3d rail feed taps W. P. 500 M. C. M. at 0.18 138
371 lbs. 3d rail feed taps W. P. 300 M. C. M. at 0.18 67
300 lbs. 3d rail feed taps W. P. 100 M. C. M. at 0.18 54
74,470 lbs. overhead feeders, bare, 500 M. C. M. at 0.18 13,405
137,529 lbs. overhead feeders, bare, 300 M. C. M. at 0.18 24,755
9,119 lbs. overhead feeders, W. P., 500 M. C. M. at 0.18 1,641
4,787 lbs. overhead grounds, W. P., 500 M. C. M. at 0.18 862
900 lbs. overhead grounds, W. P., 300 M. C. M. at 0.18 162
613 lbs. cross bars, frogs and switch jumpers, W. P., 500 M. C. M. at 0.18 110
1,142 lbs. ditto, W. P., 300 M. C. M. at 0.18 206
335 lbs. ditto, W. P., 4-0 M. C. M. at 0.18 60
16,900 running rail bonds main line at 0.50 8,450
1,200 running rail bonds 212 B. B. at 0.44 528
304 running rail bonds "A" 4-0 at 0.37 112
6,745 third rail bonds at 1.28 8,634
16,863 third rail insulators at 0.88 14,839
2,935 tons third rail (30-ft., 100-lb.) at 39.50 115,933
252 third rail noses at 2.00 504
504 nose fish plates at 0.70 352
12,800 third rail fish plates at 0.24 3,072
32,000 lbs. third rail bolts at 0.03 960
55,432 lbs. trolley wire 4-0 at 0.18 9,978
11,290 lbs. trolley wire 2-0 at 0.18 2,032
4,880 lbs. trolley wire 1-0 at 0.18 878
38,000 ft. Siemens-Martens steel cable, 7/16-in., at 0.0315 1,197
2,000 ft. Siemens-Martens steel cable, ⅜-in., at 0.027 54
3,000 ft. Siemens-Martens steel cable, ¼-in., at 0.025 75
16,000 ft. signal strand, ¼-in., at 0.0083 133
32,650 ft. signal strand 5/16-in., at 0.011 359
1,000 ft. signal strand, ⅜-in., at 0.013 13
1,639 eye bolts at 0.12 197
1,542 wood strain insulators, G. E., at 0.23 355
80 wood strain insulators, home made, at 0.25 20
240 single curve hangers at 0.51 122
180 double curve hangers at 0.57 85
588 straight line hangers at 0.51 300
1,888 cable insulators with pine at 0.23 434
659 ears, 2-0, at 0.30 198
165 ears, single 0, at 0.25 41
171 ears, 4-0 at 0.35 60
35 trolley frogs at 3.50 123
339 T bar pole brackets at 2.50 848
16 Richmond flexible pole brackets at 2.50 40
53 steady bar bracket attachments at 3.40 180
3,997 messenger clips, ⅝-in. mal. galv., at 0.06 240
3,956 Detroit "Form 2" clamps, ⅝-in. mal. galv., at 0.10 360
46 Detroit "Form 5" clamps, ⅝-in. mal. galv., at 0.20 9
46 strain collars, ⅝-in., at 0.038 2
645 steel hanger rods, galv., ⅝x13½, at 0.03 19
18 steel hanger rods, galv., ⅝x13½, at 0.075 1
645 hangers, galv., ⅝x4, 120 ft. span, at 0.032 21
616 hangers, galv., ⅝x5½, 120 ft. span, at 0.038 23
645 hangers, galv., ⅝x7½, 120 ft. span, at 0.045 29
645 hangers, galv., ⅝x9¾, 120 ft. span, at 0.053 34
645 hangers, galv., ⅝x12¾, 120 ft. span, at 0.066 43
29 hangers, galv., ⅝x5½, 120 ft. span, at 0.047 1
31 hangers, galv., ⅝x7½, 100 ft. span, at 0.053 2
16 hangers, galv., ⅝x8¾, 100 ft. span, at 0.059 1
16 hangers, galv., ⅝x10½, 100 ft. span, at 0.065 1
16 hangers, galv., ⅝x13½, 100 ft. span, at 0.075 1
18 hangers, galv., ⅝x11¾, 60 ft. span, at 0.07 1
18 hangers, galv., ⅝x12¾, 60 ft. span, at 0.073 1
92 wood brake strain insulators, 1¼x14, at 0.18 17
18 Crosby clips, ⅜ in., at 0.08 1
57 Crosby clips, 7/16 in., at 0.09 5
15 trolley wire connections, brass, 2x⅞, 4-0 grvd., at 1.10 17
339 porcelain messenger insulators, 10,000 v., 1¾ pin hole, at 0.15 51
4 overhead switches at 12.50 50
100,165 ft. B. M. timber, cable boxes, at 10.00 1,002
Miscellaneous material 500
Labor 25,000
Total distribution system $253,065

19. Substation Buildings:
122,708 cu. ft. brick bldg., at Kent, at 0.125 $ 15,338
28,940 cu. ft. frame bldg., at Kent, at 0.10 2,894
87,030 cu. ft. brick bldg., at Milton, at 0.125 10,879
28,940 cu. ft. frame bldg., at Milton, at 0.10 2,894
84,820 cu. ft. brick bldg., at Puyallup, at 0.125 10,602
Total substation buildings $ 42,607

20. Shops and Car Houses:
8,568 sq. ft. corrugated iron car sheds, at 0.45 $ 3,855
19,248 sq. ft. frame car sheds, at 0.50 9,624
2 sets track scales, at 1,300.00 2,600
Total shops and car houses $ 16,080

21. Stations and Miscellaneous Buildings.
Brick and frame station, Tacoma $ 4,000
2,850 sq. ft. frame station, 2 story, at 2.00 5,700
5,728 sq. ft. frame stations, bungalow type, at 1.25 7,160
8,318 sq. ft. frame stations, old standard, at 1.00 8,318
108 sq. ft. open sheds, at 0.50 54
2,396 sq. ft. frame freight sheds, at 0.90 2,156
1,060 sq. ft. corrugated iron freight sheds, at 0.50 530
478 sq. ft. miscellaneous frame sheds, at 0.50 239
216 sq. ft. telephone shacks, at 0.50 108
306 sq. ft. tool sheds, at 0.50 153
372 sq. ft. section house, at 0.50 186
64,111 sq. ft. low passenger platforms, at 0.10 6,411
5,875 sq. ft. high passenger platforms, at 0.15 881
4,562 sq. ft. freight platforms, at 0.15 684
3,909 sq. ft. milk platforms, at 0.20 782
8 water closets, at 50.00 400
Total stations and miscel. bldgs. $ 44,211

22. Substation Equipment:
3 lightning arresters, 50,000 volt, 3 pole, at 621.00 $ 1,863
5 oil switches, 50,000 volt, type H, at 1,600.00 8,000
212 Thomas insulators, 50,000 volt, at 1.85 392
36 disconnecting switches, 50,000 volt, at 41.50 1,494

494 lbs. bare copper wire, at 0.18	89
7 oil cooled transformers, 200 k. w., at 2,300.00	16,100
4 oil cooled transformers, 180 k. w., at 1,000.00	4,000
4 current transformers, 50,000 volt, at 150.00	600
3 inducting motor generator sets, 300 k. w., with non-automatic, double pole oil switches, 2,300 volts and 600 volt, generator panels (1 slate and 2 marble), at 8,500.00	25,500
2 automatic oil switches, 4 pole st. 300 ampere with slate slabs and 2 current transformers, at 140.00	280
3 H. E. Ind. volt meters, with potential transformers, at 85.00	255
6 railway feeder panels, marble, at 200.00	1,200
1 lightning panel, marble 16 in.	100
1 lightning panel, marble 24 in.	300
2 C. R. regulators at 315.00	630
2 booster transformers, 3 k. w., at 47.50	95
2 booster transformers, 5 k. w., at 66.50	133
1 polyphase recording watt meter, 300 amp., and two 200 watt potential transformers, and 2 current transformers 300-5 amp.	200
1 T. R. watt meter, 800 amp., 600 volt	175
1 induction motor panel, 2,300 volts	290
40 ft. lead covered insulated cable, 500 M. C. M., at 0.91	36
400 ft. lead covered insulated cable, No. 2, at 0.90	360
80 ft. lead covered insulated cable, No. 4, at 0.30	24
147 ft. weather proof cable, 800 M. C. M., at 0.60	86
509 ft. weather proof cable, 500 M. C. M., at 0.45	229
540 ft. rubber covered cable, No. 2, at 0.08	40
26 ft. rubber covered cable, 500 M. C. M., at 0.65	17
2 50,000 volt, 150 to 50 current transformers, at 300.00	600
1 motor panel, 24 in. marble, 2,300 volt, with automatic oil switch, 300 amp., 4 pole st.	290
1 T. R. watt meter, polyphase, 300 amp., with 2,300 to 5 current transformers	200
1 T. R. watt meter, 800 amp., 600 volt	175
5 oil switches, 3 pole, 30,000 volts, at 400.00	2,000
9 disconnecting switches, 30,000 volts, at 20.00	180
30 Westinghouse air brake jacks and slabs, at 8.00	240
30 marble barriers for same, at 30.00	900
3 lightning arresters, 3 pole, 30,000 volts, at 100.00	300
3 generator panels, slate 16 in., at 200.00	600
3 slate slabs and switch handles, at 20.00	60
6 feeder panels, 16 in. plate, at 50.00	300
1 slate slab with synchronizer	55
2 front connected feeder switches, at 20.00	40
10 current transformers, 30,000 volt, at 125.00	1,250
8 potential transformers, at 150.00	1,200
1 compensator for 180 k. w. transformers, 17½ k. w.	275
318 lbs. bare copper wire, at 0.18	57
Miscellaneous equipment	500
3 air compressors and receiving tanks with 4. h. p. motors, at 300.00	900
Labor of installing transformers and generators in 3 substations	3,400
3 storage battery sets consisting of chloride accumulators (288 cells of 15 plates per cell; 288 cells of 17 plates per cell; 288 cells of 17 negative plates per cell); 428 ft. lead covered rubber insulated cable, 3 booster sets, 35 k. w.; 6 marble battery panels; including freight and installation	106,149
Total substation equipment	$182,159
23. Shop Equipment:	
1 sharper, 20 in.	$ 250
1 radial drill, 24 in.	150
1 metal lathe, 20 in. x 12 ft.	570
Miscellaneous hand tools	30
Total shop equipment	$ 1,000
24. Water Stations:	
2 box tanks, 6x7x16 ft., at 100.00	$ 200
Pumping plant and pipe	200
Total water stations	$ 400
25. Engineering Instruments and roadway tools	$ 1,500
26. Legal and General Expanse:	
1% of items 4 to 25	$ 17,779
27. Interest During Construction:	
7½% of item 1, and 3¾% of items 2 to 26	$145,181
28. Contingencies:	
5% of all above items, exclusive of items 1, 3 and part of 27 (interest on right of way)	$ 96,266
29. Stores and Working Capital:	
Cash and stores on hand June 30, 1909.	$ 300,000
Total construction	$3,495,154
30. Cars (exclusive of electric equip.):	
9 combination baggage and coach, at 6,206.60	$ 55,860
5 passenger cars, at 4,160.00	20,530
4 motor trailers, at 5,500.00	21,000
11 trailers, at 5,025.50	55,280
4 observation cars, at 10,290.00	41,160
4 race track cars, at 2,625.00	10,500
22 box cars, freight, at 729.50	16,050
25 hopper cars, freight, at 675.00	16,875
14 gondola cars, freight, at 668.00	9,350
97 flat cars, freight, at 558.00	54,126
2 freight motor cars, box type, at 3,000.00	6,000
3 freight motor cars, cab type, at 2,500.00	7,500
1 derrick car	1,200
1 pile driver	1,500
1 steam shovel	10,000
Total cars, etc.	$326,931
31. Locomotives:	
1 Baldwin, No. 1 steam, second hand	$ 2,500
1 Manchester, No. 2 steam, second hand	2,500
1 Hinkley, No. 3 steam, second hand	2,500
Total locomotives	$ 7,500
32. Electric Equipment of Cars:	
8 General Electric No. 66, 4 motor equipments, at 7,575.00	$ 60,600
4 General Electric No. 66, 2 motor equipments, at 4,000.00	16,000
2 General Electric No. 205, 4 motor equipments, at 7,000.00	14,000
4 General Electric No. 90, 4 motor equipments, at 3,200.00	12,800
4 Westinghouse Electric No. 49, 2 motor equipments, at 1,200.00	4,800
5 General Electric No. 66, freight motor equipment, at 7,500.00	37,500
Total electric equipment of cars	$145,700
33. Miscellaneous Equipment:	
1 Packard touring car, second hand	$ 2,000
Total equipment (items 30 to 33)	$ 482,131
Total construction and equip.	$3,977,285
34. Lighting system	$ 30,000
35. Brokerage Fees:	
5% of 75% of above	$ 150,273
Grand total	$4,157,558

Item 35 was allowed on the assumption that if bankers had to provide only 75 per cent of the cash used in construction and equipment (the balance being furnished by the promoters), a reasonable brokerage fee would be 5 per cent of the cash thus secured.

Item 31, "Locomotives," relates to locomotives worth $8,000 new, but purchased second hand.

TABLE II.—DEPRECIATED VALUE OF THE PUGET SOUND ELECTRIC RY.

(June 30, 1909.)

1. Right of way and real estate	$ 917,775
2. Engineering and superintendence	53,336
3. Fiscal and physical supervision and management	186,955
4. Grading (incl. 10% appreciation of roadbed)	275,135
5. Ballast (15% depreciation)	43,337
6. Ties (70% depreciation)	18,559
7. Rails, fastenings and joints (15% deprec.)	272,966
8. Frogs and switches (20% deprec.)	12,961
9. Paving (56% deprec.)	9,913
10. Track laying and surfacing (30% deprec.)	33,753
11. Tunnels (5% deprec.)	11,115
12. Bridges, trestles and culverts (48% deprec.)	179,168
13. Crossings, fences, cattle guards and signs (46% deprec.)	22,414
14. Interlocking and signal apparatus (35% deprec.)	594
15. Telegraph and telephone lines (30% deprec.)	6,437
16. Poles and fixtures (43% deprec.)	16,717
17. Transmission system (no deprec.)	29,548
18. Distribution system (7% deprec.)	235,350
19. Substation buildings (10% deprec.)	38,346
20. Shops and car houses (20% deprec.)	12,864
21. Stations, waiting rooms, etc. (19% deprec.)	35,811
22. Substation equip. (27% deprec.)	132,976
23. Shop equipment (50% deprec.)	509
24. Water stations (60% deprec.)	169
25. Eng. insts. and tools (50% deprec.)	750
26. Legal and general expense	17,779
27. Interest during constr.	145,181
28. Contingencies	96,266
29. Stores and working capital	300,000
Total construction	$3,106,669
30. Cars (35% deprec.)	$ 212,505
31. Locomotives (4% deprec.)	7,200
32. Elec. equip. of cars (35% deprec.)	94,705
33. Miscel. equip. (16% deprec.)	1,680
Total equip. (items 30 to 33)	$ 316,090
Total construction and equip.	$3,422,759
34. Lighting system (16% deprec.)	25,200
35. Brokerage fees	150,273
Grand total	$3,598,232

TABLE III.—COST OF REPRODUCTION NEW PER MILE OF TRACKWAY.

(53.4 miles of trackway.)

1. Right of way and real estate	$17,182
2. Engineering and superintendence	999
3. Fiscal and physical supervision	3,502
4. Grading	4,717
5. Ballast	955
6. Ties	1,159
7. Rails, fastenings and joints	6,015
8. Frogs and switches	304
9. Paving	370
10. Track laying and surfacing	903
11. Tunnels	219
12. Bridges, trestles and culverts	6,454
13. Crossings, fences, cattle guards and signs	777
14. Interlocking and signal appar.	17
15. Telegraph and telephone lines	171
16. Poles and fixtures	549
17. Transmission system	554
18. Distribution system	4,741
19. Substation buildings	797
20. Shop and car houses	302
21. Stations and miscel. buildings	828
22. Substation equipment	3,411
23. Shop equipment	19
24. Water stations	7
25. Eng. insts. and roadway tools	28
26. Legal and general expense	331
27. Interest during construction	2,718
28. Contingencies	1,805
29. Stores and working capital	5,618
Total construction, etc.	$65,452
30. Cars	6,123
31. Locomotives	140
32. Electric equip. of cars	2,729
33. Miscel. equipment	37
Total equipment	$ 9,029
Total construction and equipment	$74,481
34. Lighting system	562
35. Brokerage fees	2,815
Grand total	$77,858

The above costs are per mile of trackway (53.40 miles), but since there are 63.75 miles of all tracks, or 1.194 miles of track per mile of trackway, each of the above items must be divided by 1.194 (nearly 1.2) to ascertain the cost mile of track.

[An analysis of the findings of Railroad Commission indicates the following actual cost of this railway property, as taken from the accounting records of the company up to June 30, 1909:

1. Single track interurban line, up to April 1, 1903	$1,942,658
2. Subsequent expenditures on the original contract	11,064
3. Interest during construction	92,289
Total	$2,046,011
4. Additions and betterments	1,279,562
5. Working capital	407,489
Total	$3,733,062
Total	$3,713,374
Deduct construction of "P street line	19,688
Total	$3,713,374

Item 1 includes $186,955 paid Stone & Webster for "the engineering and supervising and acting as purchasing agents and managers during construction." Item 1 embraces the original 32.01 miles of single track line between Seattle and Tacoma, and the 2.96 miles of the Renton branch, a total of 34.97 miles of trackway.

The Commission inferred from the evidence presented, that the actual net cost of constructing and equipping the line, up to June 30, 1909, had been $2,933,864, for the Commission refused to include Items 2, 3 and 4 of the following schedule:

1. Construction and equipment	$2,933,864
2. Discounts on bonds, etc.	305,924
3. Damage due to floods after construction	44,099
4. Working capital	407,234
Total	$3,691,126

The total of this record schedule does not check exactly with the total of the first schedule just given, doubtless due to the elimination of some other items than those embraced in the "P Street line." It would appear that in the first schedule, Item 4, "Additions and Betterments," includes Item 2 of the second schedule, namely "Discounts on Bonds."

It will be noted that in the first schedule Item 3, "Interest During Construction," was not quite 5 per cent of the construction cost.

The Commission appraised the right of way and real estate at $917,733, as of June 30, 1909. The Commission states, however, that this is $770,000 in excess of what it actually cost the railway company.

It will be observed that no power plant is included in the appraisal. The railway company purchases its power, for which it "pays $2.23 per kilowatt per month for the full amount of 4,750 kilowatts delivered on the right of way." This, we take it, is based on a 24-hour service, and is therefore equivalent to 3.05 cts per. k. w. hr.; for $2.23 × 12 = $26.76 per year, and $26.76 ÷ 8,760 hrs. = 3.05 cts. If the railway operates on a "load factor" of 50 per cent (12 hrs. out of the 24), it follows that a power plant of 2 × 4,750 = 8,500 k. w. would be required.

The Commission states that on June 30, 1909, the railway reported $103,367 cash on hand, and $171,257 worth of materials and supplies and bond; hence its allowance of $300,000 as a reasonable sum.

We shall not abstract the Commission's discussion of what constitutes a reasonable return on the investment, but refer the read-

er to their bulletin No. 76, dated Feb. 26, 1910. The Commission ruled that a 7 per cent net return on the investment is liberal, and cited the case of Wilcox v. Consolidated Gas Co., 212 U. S. 19, before the Supreme Court of the U. S., as being such that "we would not be justified in allowing a less sum." Our own opinion, as expressed editorially elsewhere in this issue, is that it is not logical to determine reasonable profits by using the capital invested as the basis for such a determination.

The Commission held that $162,137 (or 25 per cent of the gross earnings) should be expended, or set aside from operating expenses, to cover the annual cost of maintenance and replacement. The actual amount spent in 1909 was $102,125. The Commission says: "The defendant company insists that not having provided a depreciation fund in the past it is entitled out of the traffic now moving to charge rates that will not only care for the average depreciation, but in addition make up the deficiency in this depreciation account accruing in the past." The Commission, however, did not uphold this contention, as will be seen in the syllabus that follows. We are of the opinion that their decision on this point will not be sustained if carried into the courts. In the absence of any previous governmental control of the accounting and managerial policy of this railway company, it certainly was free to elect any reasonable method to maintain its capital unimpaired. It chose to provide no sinking fund, which is the common practice among all railways, and it chose to meet the increasing maintenance expenses when actually called upon to do so, by the destruction of any part of its plant. If the company is now to be required to establish a sinking fund, there cannot be much doubt that it should be permitted to provide out of income for all future renewals of existing plant, regardless of the extent of its present depreciation. Otherwise, there can be no escape from permitting the company to make its renewals in lump sums, as fast as they must be made, charging such renewals to operating expenses, for that has been the immemorial custom of all American railways. Indeed, it may be soundly contended (see Gillette's "Handbook of Cost Data," second edition, Section I.) that a sinking fund is not a justifiable device where the number of units to be renewed is large.—Editors.]

The investigation resulted in a reduction in rates for the suburban districts extending from Tacoma to a point approximately twelve miles north, and from Seattle to a point approximately twelve miles south. The following is a syllabus of the opinion rendered by the Commission:

Common Carriers—Amount of Return.—Provided a public service corporation charges no more than each particular service is worth to its patrons, it is entitled to receive from rates and fares a fair return on the value of its property used in the public service.

Carriers—Return, How Estimated.—Generally a reasonable return for a public service corporation is such as is expected and generally realized in the locality upon investments for a somewhat similar nature with regard to the risk attending them.

Carriers—Interurban Road—Return, Entitled to.—Where an interurban railroad connects two large growing cities but 31 miles distant, traversing rich and fertile valleys with numerous towns, the future population of which valleys it is conceded will be dense, where the surroundings are ideal for an interurban road and where little or no risk is involved in the enterprise, a lower rate of return would be expected than if the undertaking was hazardous or involved risk. Held, under the facts in this case, 6 per cent return on the then value of the property is sufficiently remunerative.

Discounts—Expenses of Financing Bonds—Well-Secured Bonds.—The expense necessary to be paid a reputable broker for making a full and complete investigation into the cost and prospects of an inviting public service enterprise and a reasonable compensation for inducing his clientage to invest in well-secured bonds and securities of such corporation is a legitimate and proper item of expense. Well-secured bonds are such as have behind them the guarantee of a solvent independent road or where a substantial amount of the investment is procured independent of the mortgage bonds. Where all the investment, including costs of organization and preliminary surveys, are derived from the sale of bonds, the loan is not a financial business transaction, but is a financial speculation. Discount paid under such circumstances is not a proper item to be considered in valuing the property. Held, under the facts in this case, that 5 per cent of 75 per cent of the cost of reproducing the road is a proper and ample sum to cover the costs of financing the enterprise.

Capital to Remain Unimpaired—Depreciation—Obsolescence.—A public service corporation is clearly entitled from its operating revenues to not only earn a reasonable return on the value of its property so used, but to maintain unimpaired its capital. While during the first few years of the life of the railroad there is practically no call for renewals, the property is nevertheless daily growing older, and the traffic then being moved should bear its portion of the burden dependent upon depreciation and obsolescence and not throw this full burden upon the traffic moving when heavy renewals become necessary. In such cases there should be charged to operation a sum sufficient to care for such renewals and obsolescence as they become necessary and a fund should be maintained for such purpose. Traffic of today should pay enough to secure a fair return on the property and maintain unimpaired the capital, but cannot be called upon to bear burdens that should have been borne by traffic in the past.

Particular Rate—When Reasonable.—In no event can a carrier charge more than the particular service is worth to the shipper. The value of the service is to be considered and not exceeded, subject to the qualification that the charge must at least equal the moving cost. Where mechanics, laborers and clerks have been induced by a long continuous rate to settle in suburban towns and where approximately all of the heads of families in such towns are such laborers and clerks dependent for their livlihood on employment in the cities, an advance in the rates to such an amount that such persons cannot live and pay the rates, but must abandon their homes for localities where cheaper transportation prevails, is unreasonable, irrespective of the return received by the company, excepting that the company cannot be called upon to render the service at a loss.

Schedule or Rate—When Reasonable.—Many features must be considered in determining whether a rate is or is not reasonable. The whole schedule must be considered when judging its fairness to the company, and if from all its revenues it receives but a fair return and the patron is charged no more in each particular case than the service is worth, per se the rates cannot be said to be unreasonable.

Comparison of Rates.—A comparison of the rates charged generally for a specific service by other roads under normal conditions, together with a comparison of the relation of such rates both to the carrier and the shipper, furnishes a good test to judge of the reasonableness of such particular rate. Held, that as the rates generally charged by electric lines to points not suburban are at least two cents per mile and such rates are generally deemed reasonable, and the carrier in this case not receiving under the rates so advanced a sufficient return, no reason exists why the rate to points not suburban and between intermediate stations should be reduced below two cents per mile. As residents of Seattle and Tacoma have the advantage of water competition at exceedingly low rates, no peculiar circumstances exist calling for a reduction of the through rate.

Discrimination — Suburban Rates—Commutation Rates.—The fact that an occasional traveler from points not suburban might be compelled to pay a greater rate per passenger mile than the constant traveler from suburban points does not subject him to unjust discrimination. He is entitled to be carried at a reasonable rate, but not necessarily as cheaply as the residents of the more favored districts. The public is interested in the building of suburban towns, thus aiding the territorial growth of cities, relieving their congested districts.

Spring Meeting of the American Society of Mechanical Engineers.

The spring meeting of the American Society of Mechanical Engineers will be held in Atlantic City, N. J., May 31-June 3. This is the regular semi-annual meeting of the society. The local committee, chosen from the vicinity of Philadelphia, under the chairmanship of James M. Dodge, past president, is making provision for the entertainment. The headquarters of the meeting will be the Marlborough-Blenheim. The registration office will be located in the hotel, on the board walk floor, and the professional sessions will be held in the solarium on the office floor. The following is the program:

Papers on Machine Construction and Operation.—"The Shockless Jarring Machine," by Wilfred Lewis; "A Comparison of Lathe Headstock Characteristics," by Prof. Walter Rautenstrauch; "The Strength of Punch and Riveter Frames Made of Cast Iron," by Prof. A. L. Jenkins; "Improved Methods in Finishing Stay Bolts and Straight and Taper Bolts as Used in Locomotives," by C. K. Lassiter.

Gas Power Section.—Business meeting and reports of committees. Papers: "A Regenerator Cycle for Gas Engines using Sub-Adiabatic Expansion," by Prof. A. J. Frith; "Gas Engines for Driving Alternating-Current Generators," by H. G. Reist; "Two Proposed Units of Power," by Prof. Wm. T. Magruder; "Some Operating Experiences with a Blast Furnace Gas Power Plant," by H. J. Freyn.

Miscellaneous Papers.—"The Mechanical Engineer and the Textile Industry," by H. L. Gantt; "The Elastic Limit of Manganese and other Bronzes," by J. A. Capp; "The Hydrostatic Chord," by R. D. Johnson; "The Resistance of Freight Trains," by Prof. Edw. C. Schmidt.

Papers on Power Transmission.—"Improvements in Lineshaft Hangers and Bearings," by Henry Hess; "Experimental Analysis of a Friction Clutch Coupling," by Prof. Wm. T. Magruder; "An Improved Absorption Dynamometer," by Prof. C. M. Garland; "Critical Speed Calculation," by S. H. Weaver.

Summer Courses for Engineers and Artisans at the University of Wisconsin.—The tenth annual session of the Summer Schools for Engineers and Artisans, under direction of the College of Engineering of the University of Wisconsin opens June 27, continuing for six weeks. Advanced courses are offered in direct and alternating currents, hydraulics, machine design, descriptive geometry, applied mechanics, shopwork, steam and gas engineering and surveying. Elementary courses for artisans, and those not having preparation for the advanced work, are offered in applied electricity, engines and boilers, fuels and lubricants, mechanical drawing, machine design, materials of construction, shopwork and surveying. The teaching staff is taken from the regular instructional force, and all laboratory equipment of the engineering college is available for students. For bulletin or further information address F. E. Turneaure, Dean, College of Engineering, Madison, Wis.

Surveys have been completed for the construction of the proposed connecting link between the Tonopah & Tidewater and the Western Pacific and bonds for the construction of the line are being negotiated in the East. As projected the line will be from Goldfield, Nev., to Ely, and will necessitate an expenditure of $5,000,000. The link will pass through the mining districts of Golden Arrow, Silver Bow, Horseshoe, Rattlesnake, Clifford Belle Hellen, Tybo and Reveille, and will tap an extensive farming country, especially in Ho Creek valley and Railroad valley.

W. P. Richardson & Co., Jacksonville, Fla., has been awarded the contract for the construction of terminals for the Clyde Line at that place. The work, it is estimated, will cost $500,000 and includes the construction of three piers.

Unclassified and General Articles

Note: This section is devoted to methods and cost articles on construction work not properly coming under any of the preceding classifications.

First Cost and Cost of Operating Power Plants for Driving North River Tunnels of Pennsylvania Railroad, New York City.*

Two power plants were constructed, one on each side of the river. The plants contained in the two power-houses were almost identical, there being only slight differences in the details of arrangement due to local conditions. A list of the main items of the plant at one power-house is shown in Table I. A summary of the first cost of one plant is given in Table II.

In order to give an idea of the general cost of running these plants, Tables III and IV are given as typical of the force employed and the general supplies needed for a 24-hour run of one plant. Table III gives a typical run during the period of driving the shields, and Table IV is typical of the period of concrete construction. In the latter case the tunnels were under normal air pressure. Before the junction of the shields, both plants were running continuously; after the junction, but while the tunnels were still under compressed air, only one power-house plant was operated.

TABLE I.—PLANT AT ONE POWER-HOUSE.

Description of Item.	Cost.
3 500-hp water-tube Sterling boilers	$15,186
2 feed pumps, George F. Blake Manufacturing Company	749
1 Henry R. Worthington surface condenser	6,539
2 electrically-driven circulating pumps on river front	5,961
3 low-pressure compressors, Ingersoll-Sergeant Drill Company	33,780
1 high-pressure compressor, Ingersoll-Sergeant Drill Company	6,665
3 hydraulic power pumps, George F. Blake Manufacturing Company	3,075
2 general electric company's generators coupled to Ball and Wood engines	7,626
Total cost of main items of plant	$79,572

TABLE II.—SUMMARY OF COST OF ONE PLANT.

Total cost of main items of plant	$ 79,572
Cost of four shields (including installation, demolition, large additions and renewals, piping, pumps, etc.	103,560
Cost of piping, connections, drills, derricks, installation of offices and all miscellaneous plant	101,818
Cost of installation, including preparation of site	39,534
Total prime cost of one power-house plant	$324,484

TABLE III.—COST OF OPERATING ONE POWER-HOUSE FOR 24 HOURS DURING EXCAVATION AND METAL LINING.

Labor.	Rate per day.	Amount.
6 Engineers	$3.00	$ 18.00
6 Firemen	2.50	15.00
2 Oilers	2.00	4.00
2 Laborers	2.00	4.00
4 Pumpmen	2.75	11.00
2 Electricians	3.50	7.00
1 Helper	3.00	3.00
Total per day		$ 62.00
Total for 30 days		$1,860.00
Supplies:		
Coal (14 tons per day)	$3.25	$ 45.50
Water	7.00	7.00
Oil (4 gal. per day)	0.50	2.00
Waste (4 lb. per day)	0.07	0.28
Other supplies	1.00	1.00
Total per day		$ 55.78
Total for 30 days		1,673.00
Total cost of labor and supplies for 30 days		3,533.00

TABLE IV.—COST OF OPERATING THE ONE PLANT FOR 24 HOURS DURING CONCRETE LINING.

Labor	Rate per day.	Amount.
2 Engineers	$3.00	$ 6.00
2 Firemen	2.50	5.00
2 Pumpmen	3.00	6.00
1 Foreman electrician	6.00	6.00
1 Electrician	3.00	3.00
1 Laborer	2.00	2.00
Total per day		$ 28.00
Total for 30 days		$840.00
Supplies:		
Coal (14 tons per day)	$3.15	$ 44.10
Oil (4 gal. per day)	0.50	2.00
Water	13.00	13.00
Other supplies	2.00	2.00
Total per day		$ 61.10
Total for 30 days		1,833.00
Total cost of labor and supplies for 30 days		2,673.00

*Extract from a paper entitled "The New York Extension of the Pennsylvania R. R. North River Tunnels," by B. H. M. Hewett and W. L. Brown, Proceedings American Society of Civil Engineers, Vol. XXXVI, p. 690.

Depreciation and Reserve Funds of Electrical Properities.*

Every company operating an electric light and power property, a street railway property, or a telephone property, or contemplating entering into any such field of activity, must take into account certain expenses that cannot be appropriately included in the day by day operating and office costs or in the current maintenance expenses of the property, if its accounts are to show in full the actual cost of performing the services required.

I refer to the sums of money that must be set aside to cover depreciation replacements and to provide a reserve fund to care for extraordinary costs as hereafter explained.

The term *depreciation* as here used may be divided into two parts:

1. Decrepitude—Which covers the gradual wearing out of the apparatus from the effects of use and of age, which cannot be overcome by current repairs, and which results eventually in ending the operative life of the apparatus.

2. Obsolescence—Which takes into account the reduction in the useful life of apparatus, on account of advances in the art whereby otherwise operative apparatus is made uneconomical for further use.

The term *reserve fund*, as here used, may also be divided into two parts:

1. Required Reconstruction—Which takes into account reconstruction costs made necessary by municipal or other legislative requirements.

2. Special Insurance—To cover expenses that cannot be forecast with any degree of certainty, caused by extraordinary occurrences such as unusual storms, explosions, great conflagrations, acts of strikers, etc.

In considering *depreciation* it is well to clearly separate in one's mind the annual depreciation of the plant as an average whole and that of the component parts making up the plant. To obtain the true amount of the annual depreciation in the value of any property, it is necessary to estimate a sum of money which represents the yearly depreciation of each of the component parts of the plant, and the aggregate of these sums of money for all parts of the installation gives the annual depreciation for the plant. This may be converted into a percentage on the total value of the installation which is subject to depreciation. Any method of arriving at the amount of annual depreciation that does not take into account the individual depreciations of the component parts of a plant, must be an approximation at best, even though it may be based upon results obtained in a correct manner for other similar plants, and it may be very far from accurate.

This division of a plant into its component parts for purposes of determining its annual depreciation is usually a simple matter. It requires that each of the component parts shall be such that when it has reached the end of its useful life the part in its entirety will be discarded, and that it shall be possible to intelligently determine its probable salvage value as a whole. If these requirements are not fulfilled the part should be divided until they are.

If we consider the overhead distribution lines of an alternating current electric light plant, the lines may be divided into the following parts: bare wire, weatherproof wire, rubber covered wire, transformers, lightning arresters, insulators, and poles and cross arms with their hardware; and in some cases there may be further divisions. The poles and cross arms with their hardware can usually be considered together as one part, as cross arms and hardware generally outlast the poles but seldom are used again when their corresponding poles are discarded, so that a pole and its fittings may be considered as having useful lives of equal length. It will be seen how impossible it would be to determine a fair amount for the depreciation of poles and wires without thus analyzing the aggregate, owing to the widely differing useful lives of the two kinds of plants and the great difference in the proportions of their salvage values. Or again, consider electric railway track; there are the ties with short life and no salvage; there are the rails with medium life and good salvage; there are the frogs and switches with short life and low salvage, and there is the electrical bonding which may be considered as having the same life as the rails and to have medium salvage. It would be impossible to determine a fair annual depreciation for track considering all of these parts together, but it is possible to obtain the fair average depreciation by taking the aggregate of the amounts found by considering the several parts individually.

The total amount of depreciation to be annually charged against any part of the installation should be equal to the first cost of the part installed ready for service plus the cost of removal, less any salvage obtainable for the part when discarded, divided by the years of probable life of the part.

The estimation of what is the fair useful life for any part of a plant presupposes a thorough knowledge of the nature of the service demanded of the part, a broad acquaintance with the general experience respecting like kinds of plant, a studied survey of the probable effect of local conditions upon the useful life, and a keen knowledge of the past and present progress of the art for the purpose of making an intelligent forecast of the rate of depreciation caused by approaching obsolescence. A fair determination of the useful life is thus based upon several independent variables, and the result must be reached by judgment after duly applying what seems to be due weight to each of the factors involved.

In estimating the fair salvage value to be assigned to any part of an installation, it is often possible to fix it by some relation to the actual junk value of the materials comprising the part. For instance, the salvage value of a lead-covered paper insulated cable that has finished its useful life will be substantially the residue of the junk value of the lead melted off, and of the copper with the paper burned off after the cost of withdrawing the cable from its place of service and preparing the junk has been deducted, though sometimes cable rejected for use in one kind of service may be used in another, in which case its value when discarded from its original use may be the value of cable that would ordinarily be used in the second service, assuming good engineering judgment in the construction and operation of the property. The matter is not so simple with buildings and machinery. With the former it will frequently be found that the cost of removal will equal the junk value, and the salvage value is therefore zero; while with the latter the price that can probably be obtained from a second-hand dealer for the machinery in place may sometimes be considered as the salvage value, and in other cases the salvage value is the price that can be obtained from an old metal or junk dealer for the machinery in place.

The factor of obsolescence entering into the question of useful life of plant, whether

*A paper by Mr. B. Jackson presented to the Western Society of Engineers, April 27, 1910.

of buildings, machinery, or other plant, is a disturbing one. This has the effect of reducing the estimated useful life of many parts of most plants below that which would be indicated by the ravages of decrepitude, and it likewise affects the probable salvage. Where the factor of obsolescence is estimated as likely to terminate the useful life of a part before decrepitude would be likely to cause its rejection, the former factor must determine the useful life. Consequently, the factor of obsolescence may be the determining factor in fixing the length of the useful life of some parts of a plant, and decrepitude may be the determining factor in fixing the length of useful life of other parts. In other cases these two factors may jointly influence the length of life. The factor of obsolescence has been an exceedingly important one in the several kinds of properties under consideration, and especially so in connection with all kinds of switchboards and other controlling apparatus. But its effect is very apparent, even when considering what we think of as the most stable parts of an electric generating plant, though revolutionary effects are not so apparent today as they have been in the past. Let us consider a large high grade engine-generator set for alternating currents. Few of us would be willing to place at less than fifty years the period during which such a machine should be physically capable of doing, under good care and management, the particular work for which it was designed; but no conservative engineer would allow, when estimating depreciation, that such a machine will have, in ordinary commercial electric service, a useful life of fifty years, because advances of the art would inevitably affect its usefulness. In consideration of the great changes that have taken place in the past in apparatus for the generation and distribution of electric power, and the probable changes that will take place in the future, such a piece of apparatus cannot appropriately be allowed an estimated useful life of over twenty to thirty years. Local conditions also may influence to a considerable degree the length of the useful life that may be allowed.

Most public service companies are forced to make large expenditures by ordinances of municipalities or by other legislative action. These are required changes, such as changes from overhead construction to underground construction, relocation of distribution lines on account of new street surveys, changes from wooden poles to iron or steel poles, changes in track construction owing to paving of streets, etc. The costs of such changes up to the value of the original construction should not be made an addition on capital investment and they cannot appropriately be considered as a part of current maintenance, but they should be provided for by a *required reconstruction* fund. An adequate estimate of a suitable yearly contribution, on account of required reconstruction, can only be accomplished after a careful study of what expenditures have been made in the past on account of required changes in the plant under consideration, accompanied by a study of the district served by the plant with the view of forming a judgment of what requirements are likely to be imposed in the future. In the case of changes from overhead to underground line construction that are likely to be required, it is sometimes possible to make quite definite estimates of the cost of such changes for many years to come by a study of the character and probable rate of development of the territory covered by the company's lines, from which an estimate can be made as to what will normally become underground territory year by year. And in some cases a regular schedule of such changes is determined by city ordinances.

The question of what annual charge should be made on account of *special insurance* is also difficult to solve with exactness, but it is one of which sight should not be lost. The ordinary maintenance expenses should not be expected to include such costs as those occasioned by the destruction of a power house roof by a wind storm, the annihilation of a boiler-room by a boiler explosion, the razing of a pole line by sleet and storm, etc. It is, therefore, appropriate that an annual amount be laid aside for each part of the plant, except, of course, land, to create a fund to remedy such damages which come once in a while to every plant. The element of chance must enter very largely here, but chance is not such a fickle factor in operations when its effects are distributed amongst many parts of a plant.

These factors of *required reconstruction* and of *special insurance,* which I have considered under the heading *reserve fund,* are quite different in their characteristics from depreciation, but a plant will just as surely get into the breakers if its reserve fund, or some equivalent to meet these expenses, is not kept in good shape as when no provision is made to take care of depreciation.

If replacements are taken care of by capital account, a property becomes burdened by an imaginary capital investment in physical property which is almost sure to be a serious handicap when the company desires to reduce rates or make improvements. Where replacements are permitted to be taken care of by capital account, the capital account becomes something like the wallpaper in a room (to use a homely comparison) which has been put on layer upon layer, the old not having been removed when the room is newly papered. The papering is not worth more than the last effective layer, and in fact the lower layers sometimes prove the destruction of the whole, and so it may be with an inflated capital account.

By capitalizing replacement costs, the burden of carrying these costs is thrown upon the future without limit of time in cases of unlimited franchises, when this burden should have been borne by the past, except during the period in which a company is still in process of building up its business to a remunerative one.

Most plant managers have not yet come to a full appreciation of the dire straits a plant must come to sooner or later if the depreciation appropriations or their equivalent are not systematically and intelligently attended to. We may consider, for example, a property having a large investment in pole lines. This may amount to as much as 10 per cent of the value of the plant. For the first ten years comparatively few replacements of poles will be required, but during the next two years most of the poles may have to be replaced. Thus an average amount of money equal to almost 5 per cent of the plant investment may need to be expended each of these years for pole replacements alone, and other parts of the plant are surely and irrevocably coming to the same condition. Thus, if there has not been due regard given to a depreciation fund, or the plant is not extraordinarily prosperous, great difficulty will be encountered in obtaining the necessary money for replacements when their need begins to be acutely felt.

A third division is sometimes made in depreciation, called *inadequacy.* This factor covers costs which are occasioned by the necessity of discarding otherwise serviceable plants on account of growth of business. For example, if an electric plant is operating with three small dynamos, and it is found necessary to increase its capacity, it may be best to displace one small dynamo by a larger one, even though the small dynamo may be far short of having operated during its entire useful life, estimated from the standpoint of depreciation. The fund accumulated on account of depreciation for this dynamo, plus the salvage, would likely not cover the loss occasioned by discarding the apparatus at that time. This difference might be made up by a contribution to the depreciation fund on account of inadequacy. This factor should be of small importance in a plant planned and operated with excellent engineering judgment, and it is so closely allied to obsolescence that it does not seem necessary to add a third division to depreciation. It may be properly considered as a part of obsolescence wherever it enters as an appreciable factor in any consideration of depreciation.

The expenses that are considered in the foregoing pages are as real as the pay-roll and other daily operating expenses of a plant, but the ravages of depreciation frequently do not show to a noticeable degree until several years after the beginning of the operation of a plant, and there are also likely to be long periods during which it is unnecessary to make much, if any, outlay on account of required reconstruction and special insurance. For these reasons there is serious danger of overlooking the importance of these expenses in promoting a new enterprise, or in the early days of the operation of a public service company. But if the earnings of a company, after it has become well settled in its business, are not sufficient to cover a fair appropriation annually to the depreciation and reserve funds, as well as to cover the regular operating expenses and a reasonable return on the investment, that company is one that conservative investors should shun. If the conservatively estimated earnings of a new project do not show that they will provide such returns, it should not be considered an attractive project.

Having considered the general question of depreciation and reserve funds, let us now consider how the principles involved should be applied.

Few kinds of apparatus depreciate in value by equal yearly increments, but nevertheless the final effect of decrepitude or obsolescence is to eventually wipe out of the true assets of the company the value of the part less the amount saved by salvage. Such being the case, it will be readily seen that as a piece of apparatus having a useful life of n years, for example, will be in service just n years, each year of service will reduce its serviceableness to the owner one nth part. Its depreciation should, therefore, be based upon equal yearly increments of one nth, in determining the annual contribution that should be made toward the depreciation fund.

Therefore an annual contribution to the depreciation fund should be made such that in n years it will accumulate an amount equal to the first cost of the part installed ready for service minus the net salvage, net salvage being defined as the junk value less the cost of removing the part and preparing it for sale, that is, as the net sum recovered. But the annual contributions should draw interest at the usual trust rate for the state in which the plant is located, and the annual contribution to the depreciation account is, therefore, less than one nth of the first cost of the part. Thus, if the trust rate is 4 per cent and n is 10 years, the actual percentage of the cost that need be set aside annually would be 8.33 per cent of the first value of the part minus estimated net salvage. In this way the annual contribution to the depreciation fund for each part, or group of parts having the same useful life, may be determined, taking into due account the differences in life and salvage of different parts, and the sum of these several amounts gives the annual contribution to the depreciation fund for the entire plant. With this amount known, the proportion which the annual contribution to the depreciation fund has to the total cost of the plant subject to depreciation is at once available, and the percentage of annual depreciation is known.

This statement may be qualified to a certain extent by the fact that every plant will take some time to obtain a paying business, and that during this period of upbuilding it is not expected that the earnings should cover a depreciation fund. Such being the case the annual appropriation to the depreciation fund would be omitted during this period (which should not be long) and correspondingly increased for the later years of operation.

In case of reconstruction and special insurance, the average amount of expenditure that is likely to occur must be determined as closely as possible in the manner already described, but here no trust interest can be considered, for, while at times the fund may show an accumulation, at other times it may be negative, so that interest received at times of accumulation may be considered as offsetting interest paid during times of borrowing.

The accumulation of these funds is for

specific purposes and the money should be used only for those purposes. Also, those purposes should be supported solely from these funds. Thus, when property must be replaced on account of its depreciation, the cost of doing this (less salvage on the discarded plant) should be defrayed out of the depreciation fund, and when an underground line must be substituted for a useful overhead pole line, on account of municipal legislation, only the difference between the first costs of the underground and overhead lines should become a capital charge, and the remainder of the expenditure (less salvage) should come from the accumulated funds. It is obvious that the depreciation fund will accumulate in the earlier years after a plant has been established, because the replacements during the earlier years will be few; but after a plant is fifteen or twenty years old, the expenditures for replacements and the contributions to the funds will somewhat nearly balance when averaged over several year intervals. In all but the very largest and most comprehensive plants, the expenditures for replacements and required reconstruction will vary greatly from year to year, but the amount contributed to the fund each year should follow the computed average figure; and the sum maintained in the funds may therefore vary.

Sometimes depreciation funds are put into new plant instead of into accumulated funds. There is some question as to the advisability of this. Unless the books of a company are kept with extraordinary care, or the plant represented by the depreciation fund is kept distinct from the remainder, it is difficult to keep track of what plant represents capital investment and what represents depreciation. This difficulty is magnified, as the plant representing depreciation itself depreciates, thus introducing an additional factor that must be taken care of in the bookkeeping, and eventually the concern is likely to lose the enviable situation of having its books show the actual facts regarding its property.

It may be said that an old plant worked down to its ultimate operating condition will have an annual expenditure for replacements which remains approximately uniform, so why permit the depreciation fund to lie as a trust fund when it might be actively used in additional plant? If the depreciation fund is put into plant, the company is likely to lose its ability to show the relation of its physical property to its capital investment, and it cannot then show a true relation between earnings and the physical value of its plant. The fact cannot be ignored that the people of this country today expect public service companies to be in a position to show that their service is satisfactory and supplied at a reasonable cost, and it, therefore, seems necessary that such companies should be able to know their actual investment in property which represents capital invested.

The coming of public service commissions, having power to regulate the rates of public service companies, has raised the question whether the depreciation of a plant should have an influence upon the earning power of the company. It seems patent that a company should be permitted to earn a fair return on a full, reasonable, unimpaired capitalization regardless of depreciation, so long as it supplies equally good service. This question would not seem to me to be open to doubt were it not sometimes a subject of serious discussion, and were it not that some respected publicists seem to hold that the net earning power of a public service company should be less after its plant has been subject to depreciation than when brand new, even if it gives equally good service and the stockholders have received back no part of their invested principal, but only fair returns in interest.

With a properly conducted property the fact that the property has suffered depreciation, which is unavoidable in any electric plant, should not have the effect of injuring the quality of its service or of impairing its capital, which would be the case if its recognized earning capacity were expected to decline proportionally with the increase of its depreciation fund.

If a fair figure has been estimated for the annual contribution to the depreciation fund, this fund will always carry sufficient money to make replacements when required, and as the income from the depreciation fund is used to help build the fund, the owners of the property will not receive returns on their money twice. The investment in the property does not diminish as the plant depreciates, and I do not understand that any one claims that an amount equal to the depreciation may appropriately be distributed to the security holders of the company and thereby reduce the capital outlay in physical property. If the security holders are permitted to receive interest and dividends based upon a fair return on the investment in their property during the first years of its operation, I am unable to see how this basis may be fairly changed during later years, so far as investment is concerned, after the plant has depreciated, as the investment has remained unchanged.

There is another phase of depreciation I would like to touch upon before closing.

The tendency of today is to make sweeping changes in plant and methods, to permit of less expensive or of improved service. On this account many excellent plants in good operating condition are shut down and the requisite power received from other sources. A company cannot well charge off of its capital account the value of such plants which may be comparatively new when they are put out of commission. In fact I have in mind a plant of 1,000 kw. capacity, which is of modern design with steam turbine-generators not over two years old, which with several other plants is being shut down, owing to the possibility of obtaining power from another source at less cost than it can be produced in these plants. The question is, what should be done regarding the capital value of such plants? Unless it is necessary to retain the plants in reserve, I believe they should be dismantled and the capital of the company reduced by the amount received from the sale of discarded machinery and other property. Then the difference between the amount received from their sale and their actual capital value to the company may still be continued as a true asset of the company, and that value be gradually charged off at the normal depreciation rate of the plants discarded, the capital of the company being reduced each year by actual liquidation of that amount. In other words, the situation is one wherein the regular depreciation appropriation is made on account of the property until the full cost of the discarded property is returned to the security holders. After this no further appropriation should be made on account of depreciation of the property concerned, as no replacements would have been made on the property, and consequently it would have been depreciated out of existence. The economies derivable from abandoning the discarded machinery should be sufficient to extinguish in this way the capital value of the abandoned plants, or else the transaction is not an advisable one.

In conclusion I will say that, where electrical properties have been failures in the past, a goodly proportion of the failures may be traced to lack of provision for depreciation expenses and for extraordinary expenses. The reserve fund, besides covering such extraordinary expenses as are mentioned in the foregoing discussion, must be sufficient to care for losses occasioned by any recession of income which may come in the train of the physical results of the extraordinary occurrences discussed. The proper organization of a depreciation fund in conjunction with the reserve fund will also fortify a company against difficulties on account of reduced net earnings during lean years, which every company must expect, and which lean years will be offset by good years.

All of you will appreciate that it is impossible to figure the expenses considered in the foregoing to a high degree of exactness, but they may be figured logically and intelligently, and it may be said that a company which follows the principles here laid down regarding depreciation and reserve funds is likely to travel along an untroubled path so long as its field of operations provides sufficient earnings to warrant the company's existence.

The Opportunities for Engineering Employment in South America.

Sirs: Will you kindly send me whatever information you can regarding Engineering in South America; Esperanza, Sonora, Mexico.

April 6, 1910. F. S.

(Our best answer to your letter appears in the issue of April 27 in the form of an article on construction work in Peru. Our advice to any engineer seeking work in South America is to secure his position before going there, as the best positions are all secured in that way. While in Peru, the writer met several engineers and others who had made the mistake of going there in search of a position, and almost invariably had been compelled to begin work under poor circumstances. Changes in the staff of companies are frequent, however, and good men are in demand. A better contract can always be made before going. All malarial districts, of course, are to be avoided, especially by foreigners not used to tropical climates. Too many men of strong physique and excellent health have considered themselves immune to change of climate and conditions only to become inoculated with the malaria. A knowledge of Spanish is useful and at times is essential, but in general it may be acquired after going there. All along the western coast and in Colombia much mining work is being done and this industry employs most of the engineers on this coast. Much municipal work is also going on, and the several railroads which cross the Andes employ foreign engineers almost exclusively. On the east coast much more agriculture is carried on and industries vary from those west of the mountains accordingly. As to the further information which is sought, we would advise our correspondent to correspond with W. R. Grace & Co., New York City. This company operates a line of ships all around South America and is heavily invested in nearly every South American country. The Bureau of American Republics, Washington, D. C., is also in a position to furnish valuable information.—Editors).

"A Point of View"—Suggestions Regarding Modern Organization from a Story in McClure's Magazine May, 1910.

Sirs: The following is not a literal quotation, being transformed into terms of industrial organization rather than the military organization of the magazine article.

"Those who are responsible for a modern organization, whether it be industrial or military, should be aware that this organization is an instrument to be played upon and not, as it has often been miscalled, a machine which works with regularity; it is an instrument in which, from top to bottom, allowance has continually to be made for the weakness of human nature and therefore has very little resemblance to a machine. Consequently the material and psycological aspects of the art of production and the action and the reaction of the one upon the other must be fully recognized. From the humblest employee to the chief, for every human being liable to stress, every effort must be made to mitigate the results of such stress.

This principle must be carried out consistently through the entire organization, but it reaches its highest development in reference to the chief. In value he does not represent an individual or any group of individuals. He represents the underlying principle—who can estimate his value? If he is the right man in the right place, his brain, his character and his influence are the greatest assets of the organization. It must be recognized as essential that the chief be in the best physical condition and it is no part of the scheme that he should share in any of the hardships of the organiza-

tion or in any other hardships whatever. Even at the risk of the sneers of the thoughtless and the ignorant—even against his own natural tendencies—he must be preserved from every avoidable danger and discomfort, whether mental or physical, which might impair his health and so affect his judgment.

It must be recognized that the day when any one man can by personal observation keep in his grasp the progress of all and every entire operation, is gone. Modern operations cover many details and much distance and no one man can hope to obtain by visual observation more than a small portion of the information that is necessary in the conduct of large affairs. If he is at the front he is dependent for any comprehensive view of events upon intelligence conveyed to him from other divisions of the organization. Indeed, the closer he is at the front the less he would see, although what did come within his view might be very clear—probably far too clear. In such conditions he would be liable to be influenced unduly by the proximity to minor events and details of which he should happen to be the eye witness, influenced perhaps to the detriment of the main issue.

Indeed, there are many recorded cases where the chief of an organization who should have been thinking in large units, has allowed his judgment to be warped by a near view, which only embraced the small details actually witnessed. It is better, therefore, that a well trained chief should receive his information and be placed in a position where he can reduce it to a common denominator, uninfluenced by personal knowledge of any separate portion. It is a question of mental optics—for the larger picture, the longer focus is required. Retirement from the front does not mean isolation from information which information can usually be better acted upon if received in an undisturbed place.

Again, the actual presence of a chief upon the ground has not the moral value that it had before time, where he dealt individually with his employees, for today his presence can be known only to a few. What is required by an organization today is victories organized by the chief and the men will worship him if he secures these victories to them, whether they see him personally or not. There is, however, one objection to this theory of the detachment of the thinking brain from the actual detail of the organization, and that is, when this brain is linked to a highly strung temperament, it may be and probably is, more disturbed by the pictures evoked by the imagination than anything that could actually be seen.

The problem that the chief must solve is purely a human one and in order to solve this problem efficiently he must be a humanitarian in the broadest sense of the word. The physical and technical problems which he must meet and overcome he can study in advance and he should so protect himself by a close study of his subject that when the time for action arrives, the human problem will be the only one which can confront him, for it must be realized that although he does not fight great actions every day, he must be fully prepared to fight any great action at any time.

The mind, therefore, of the chief is under a continuous strain. Indeed, to keep away from the front in times of stress is in itself a great strain. It needs far more moral courage to remain in the rear than to lead an action under influence of enthusiastic emotion. Therefore a chief must realize that a very large part of his duties lies in keeping himself fit and calm and loyally trying to keep his mind detached ready for big questions, even though this is at great effort to himself. Everything must be arranged as far in advance as possible and the time for the action of the chief should not come except when the enthusiasm of the organization begins to flag or an added incentive to a necessary, immediate action is required. Therefore, a fussy chief who interferes in details and districts the attention of his subordinates from the main issue will not usually be able to keep the instrument upon which he plays to its highest pitch of effectiveness."

C. H. EGLEE, Gen. Mgr.,
Ambursen Hydraulic Construction Co.
Boston, Mass., May 18, 1910.

irectory of Principal Civil Engineering Societies.

American Railway Bridge and Building Association—Secy., C. H. Lichty, 215 Jackson Blvd., Chicago, Ill.

American Railway Engineering and Maintenance of Way Association.—Secy., E. H. Fritch, Monadnock Block, Chicago, Ill.

American Society for Municipal Improvements.—Secy., A. Prescott Falwell, 239 West 39th St., New York, N. Y.

American Society for Testing Materials.—Secy. Edgar Marburg, Univ. of Pa., Philadelphia, Pa.

American Society of Civil Engineers.—Secy. C. W. Hunt, 220 W. 57th St., New York, N. Y.

American Society of Engineering Contractors.—Secy. Daniel J. Hauer, Park Row Building, New York, N. Y.

American Street and Interurban Railway Association.—Secy. B. V. Swenson, 29 W. 39th St., New York, N. Y.

American Water-Works Association.—Secy. J. M. Diven, Charleston, S. C.

Boston Society of Civil Engineers.—Secy. S. E. Tinkham, 60 City Hall, Boston, Mass.

Canadian Society of Civil Engineers.—Secy. Clement H. McLeod, Montreal, Can.

Engineers' Club of Philadelphia.—1317 Spruce St., Philadelphia, Pa.

Engineers' Club of St. Louis.—Secy., A. S. Langsdorf, Washington University, St. Louis, Mo.

Engineers' Society of Western Pennsylvania.—Secy., E. K. Hiles, 803 Fulton Bldg., Pittsburg, Pa.

National Association of Cement Users.—Pres., Richard L. Humphrey, Harrison Bldg., Philadelphia, Pa.

New England Water-Works Association.—Secy. Willard Kent, Narragansett Pier, R. I.

Roadmasters and Maintenance of Way Association.—Secy., W. E. Emery, P. & P. U. Ry., Peoria, Ill.

Society for the Promotion of Engineering Education.—Secy., Henry H. Norris, Cornell University, Ithaca, N. Y.

Technical Society of the Pacific Coast.—Secy., Otto Van Geldern, 865 Pacific Bldg., San Francisco, Cal.

Western Society of Engineers.—Secy., J. H. Warder, Monadnock Block, Chicago, Ill.

Coming Meetings.

American Society for Testing Materials.—Annual meeting, Atlantic City, N. J., June 28-July 2.

American Society of Civil Engineers.—Annual Convention, Chicago, Ill., June 21-24.

Society for the Promotion of Engineering Education—Annual Meeting, Madison, Wis., June 23-25.

Personals.

Mr. A. O. Wheeler, head of the Topographical Survey of the Canadian Government, has resigned his position.

Mr. J. Antonisen, City Engineer of Port Arthur, Ont., has been appointed manager of the Public Utilities of that city. He will have control of the water-works, telephone, electric light, electric power and trolley lines.

Samuel E. Weber, a civil engineer superintending the construction of a state road between Orangeburg and Sparkhill in Rockland County, New York, was instantly killed May 21 at Nyack, N. Y., in a collision between his automobile and a passenger train.

Consider B. Carter, a contractor who had done much work in Chicago and vicinity, died May 23 at White Plains, N. Y. He built the bridewell, the Chamber of Commerce buildings before and after the fire at Chicago, Ill., and a section of the Illinois and Michigan canal. He was born in New York seventy-seven years ago and with his brothers organized the contracting firm of Carter Bros. in Chicago in 1855.

Mr. Henry S. Jacoby, Professor of Bridge Engineering in the College of Civil Engineering of Cornell University, has been granted a sabbatic leave of absence for the first half of the next academic year. He expects to leave home on July 1, and to devote the following seven months to travel in the United States and Canada; to visit the bridge departments of various railroads and municipalities, and to inspect some important bridges and other structures.

Capt. J. R. Ellinwood, an early railway engineer, died recently at Ringwood, Okla. Capt. Ellinwood is said to have made the original survey of the Santa Fe R. R. from Atchison, Kan., to Santa Fe, N. M. He established many of the towns along that line, the town of Ellinwood, Kan., being named for him. He also surveyed the Santa Fe line south through Wichita, which town he surveyed and located, and was later connected with the engineering departments of the Rock Island and Frisco roads.

Prof. Alexander S. Langsdorf has been appointed Dean of the Engineering School at Washington University, St. Louis, Mo., succeeding Mr. Calvin S. Woodward. Prof. Langsdorf was graduated from Washington University in 1898 with the degree of B. S. and received the M. M. E. degree from Cornell in 1901. From 1901 to 1904 he was Assistant Professor of Electrical Engineering at Washington University, and in 1904 was elected to full professorship. He will continue to be professor of electrical engineering as well as dean of the Engineering School.

Mr. Frederick Maynard Mann, for the past eight years Professor of Architecture at Washington University, has been appointed Professor of Architecture in charge of the department at the University of Illinois. Professor Mann prepared for college at the Minneapolis High School and graduated from the University of Minnesota, receiving the degree of Bachelor of Civil Engineering in 1892. After graduating he entered the Massachusetts Institute of Technology, receiving the degree of Bachelor of Science in Architecture in 1894 and Master of Science in Architecture in 1895. He received the degree of Civil Engineer from the University of Minnesota in 1898. He traveled abroad for the study of architecture during the summers of 1896 and 1897. After leaving the Institute Professor Mann was for several years in professional practice with Peabody and Stearns of Boston, with Cope and Stewardson of Philadelphia, and later in independent practice for himself in the latter city. He was Instructor in Architecture at the University of Pennsylvania from 1895 to 1900. Since 1902 he has been Professor of Architecture at Washington University.

Col. Richard Price Morgan, one of the notable early railway engineers of the United States, died on May 19. Colonel Morgan was born in Stockbridge Plains, Mass., Sept. 17, 1828. He emigrated to Illinois at the age of 21 and has been a citizen of that state for 61 years. His death recalls memories of Abraham Lincoln with whom he became acquainted in 1856 and was closely associated from then until the time of Lincoln's death. Colonel Morgan was chairman of the Livingstone County delegation to the state convention in 1860 when Lincoln was first declared the choice of Illinois for the Presidency. The Colonel was connected with the Chicago & Alton R. R. at first as an engineer and at the age of 25 was made superintendent of that road. He designed and perfected the first plans for the double track elevated railway in New York city. Several years ago the University of Illinois conferred upon him the degree of Doctor of Engineering. He resided for 50 years previous to his death in the town of Dwight, Ill., of which town he was the founder. He is survived by two sons, both of whom are prominent engineers, Edward R. Morgan of Bloomington, Ill., and Dwight C. Morgan of Kittanning, Pa. The funeral was held on Sunday, May 22, at Dwight, Ill.

Catalogs Worth Having.

Engineers and contractors should have on file the latest catalogs of machines, tools and supplies that they use. In sending for catalogs reviewed or advertised in this paper, you will confer a favor on us if you will write directly to the advertisers and state that you saw the catalog mentioned in ENGINEERING-CONTRACTING. If you are in the market for tools, machinery or supplies, tell us and we will notify promptly the leading manufacturers.

Metal Culvert Time Book.—Paper, 4⅛x6⅝ ins.; 44 pp. The Penn Metal Ceiling & Roofing Co., Ltd., Boston, Mass.

This book devotes several pages to a description of the above named company's product and the balance is made up to use as a weekly time book.

Studebaker High Pressure Street Flusher.—Paper, 9x12 ins.; 4 pp. Studebaker Bros. Mfg. Co., South Bend, Ind.

An illustrated description of a new high pressure water wagon designed to cleanse as well as to sprinkle streets.

Plumbing.—Paper, 4½x6 ins.; 20 pp. The Potteries Selling Co., Trenton, N. J., and Standard Sanitary Mfg. Co.

This is a paper presented by T. T. Cosgrove at the fifth convention of the American Society of Plumbing and Sanitary Engineers and deals with floor connections for water closets and slop sinks.

Asbestos Cement Roofing Slates and Century Shingles. Paper, 5x8 ins.; 76 pp. Keasby & Mattison Co., Ambler, Pa.

This catalog gives illustrations and descriptions of these fireproof roof coverings and it also gives applications and illustrations of the many other uses to which the products of asbestos are put. There are price lists.

"Clipper" Blast Hole Drilling Machine.—Folder, 8x11 ins.; 4 pp. Loomis Machine Co., Tiffin, Ohio.

Gives illustrations showing the use of this machine for quarry work.

Remington Kerosene Oil Engines.—Paper, 5½x7½ ins.; 32 pp. The Remington Oil Engine Co., Stamford, Conn.

This is a well gotten up catalog of the marine and stationary engines built by this company. It contains half tone cuts of the different types of engines and also of parts of engines; also some price lists.

Water Pipe and Casings.—Two booklets, 3½x5½ ins.; 12 pp. each. The Michigan Pipe Co., Bay City, Mich.

Illustrations and descriptions of pressure pipes, mine culm and acid pipes and some facts regarding the construction. Also the casings for prevention of condensation and heat loss in steam pipes.

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Containing Items of Interest to Railroad, Public Works and Other Contractors.

The Doings of the Week.

Aside from the several large irrigation and drainage contracts noted elsewhere on this page, the chief feature of the past week has been the number of railroad construction contracts let. Among these may be noted the following: Utah Construction Co., Ogden, Utah, two double tracking contracts for the Denver & Rio Grande Ry. in Colorado, one 10½ miles in length, the other 1¾ miles in length; H. S. Payne, Iron Mountain, Mich., for constructing several short spurs for the Northwestern Ry. in the Stanburgh Iron River district of the Menominee Range, Michigan; the Toronto Construction Co., Toronto, Ont., a $500,000 contract for constructing the Canadian Pacific line from Coldwater to Atherly Junction to give direct communication to Orilla; the Cleveland Construction Co., Citizens' Bldg., Cleveland, O., for constructing 17 miles of double track on the Chicago, Lake Shore & South Bend Ry., from Pullman to Gary, Ind.; Davis & Blair, Joplin, Mo., for grading for the first section of the Laclede, Dallas & Western Ry., which is to build from Phillipsburg, Mo.; Hoose & Person Construction Co., Iron Mountain, Mich., for building three miles of track in the Michigamme district for the Chicago & Northwestern; M. Cassidy, Oklahoma City, Okla., for the construction of the first ten miles of the Denver, Kingfisher & Gulf R. R. from Oklahoma City; the Utopia Construction Co., for the completion of the grade of the Glen Rose & Walnut Springs R. R. into Walnut Springs, Tex.; the Shattuck-Edinger Construction Co., Los Angeles, Cal., for grading the Buckeye R. R. from Buckeye, Ariz.; the L. Clemens Construction Co., North Judson, Ind., for constructing the first 16 miles of the Arkansas & Northwestern R. R. in Arkansas; the Walsh Construction Co., Davenport, Ia., for double tracking the Arkansas division of the Missouri Pacific from Altamont to Bald Knob, Ark.; Jackson & Goldie, Winnipeg, Man., for ditching work along the line of the Canadian Pacific Ry. from Fort William, Ont., to Winnipeg, Man.; and Alfred De Mayo & Co., New York city, for constructing 9.25 miles of track for the Slippery Rock & Grove City Street Ry. Co. from Slippery Rock, Pa.—Events of the past week make it more than likely that the Mackenzie & Mann interests will shortly let contracts for the construction of the Duluth, Winnipeg & Pacific Ry., a 70 mile line into Duluth, Minn., by which the Canadian Northern will establish a through connection with the Chicago & Northwestern Ry. This contract has been hanging fire for some time.—Construction work on the Western Maryland R. R. extension from Cumberland, Md., to Connellsville, Pa., will soon be under way. The Carter Construction Co. of Chicago, Ill., which has the general contract, according to press reports, on May 20 awarded ten sub-contracts on the work. The first 20 miles of the line will be built by the Carter Co. and the rest, as noted above, will be sublet.—The Sinking Fund Commission of New York city has approved the plan for the improvement of the west end of Jamaica Bay, which includes dredging a channel and the construction of docks that will be owned by the city for trans-Atlantic vessels.

The New York State 8-Hour Law Again.

Two cases of more than ordinary interest regarding the working of the New York State 8-hour labor law are cited in the recently issued report of the State Commissioner of Labor. A brief summary of these cases and the comments of the Commissioner on them follow. The first case occurred in Albany where a sub-contractor was engaged in laying actinolite roofing on the state armory. Investigation of a complaint established the fact that the laborers and mechanics were required or permitted to work more than eight hours a day. A notice directing attention to the violation was duly served upon the State Board of Armory Commissioners. The board immediately took cognizance of the matter and ordered an inquiry. The inquiry developed the fact that the general contractor had warned the sub-contractor involved to observe faithfully the requirements of the law and his contract in respect of the hours of labor of workmen. It also established beyond any question that there had been no pretense of complying with the law, and the board decided that the sub-contract should be cancelled and that the state should not pay for any work upon which the law had been violated. The work was measured and the estimated value thereof was deducted from the amount of the general contract. Commenting on this case the Commissioner states: "While the amount of money involved was not large, the principle established in this proceeding is very important, for it holds the general contractor civilly liable to a certain degree for all violations of the eight hour law committed by a sub-contractor. A violation by the contractor himself, or connived at by him, would result in the cancellation of his contract and consequent inability to obtain payment in the ordinary way for work done. Whether the courts would sustain this construction and application of the law is, of course, problematical. It must be admitted that it would be unjust to the general contractor to cancel his contract because of the wilful violation of law committed by a subcontractor; on the other hand it is entirely right that the law be enforced by deducting from the general contract price the full value of the work done upon which the violation occurred, for it is obvious that if this course is not adopted, violations by subcontractors would become common and would go unpunished. But if the general contractor knows that a violation by one of his sub-contractors means a definite financial loss to him, he is going to see that no such violation occurs." The other case was in Schenectady and arose on a small contract for the laying of a strip of concrete pavement, the value of which amounted, all told, to but a few hundred dollars. The contractor required or permitted his workmen to work more than eight hours a day. Complaint was filed and promptly investigated. The facts were as alleged, but it was found that the Deputy Commissioner of Public Works had authorized the contractor to work his employes on said contract more than eight hours in each calendar day. The Department of Labor immediately served the notices required by law, taking the ground that the action of the Department of Public Works in authorizing the contractor to disregard the law was unwarranted and unlawful. Payment of the contract price was withheld for a time, but eventually the Deputy Comptroller of the city audited and authorized payment of the sum due to the contractor. An attempt was made to secure the consent of the Commissioner of Labor to such payment, but without avail. Commenting on this the report says: "The responsibility for this particular violation of law rested primarily upon the official who apparently did not recognize the difference between an exigency and an emergency, as defined in the statute governing hours of labor on public work. The contractor, on the face of the facts, acted in good faith and was entitled to receive payment for work done. The penalty for infraction of law should be visited upon the official who stupidly vetoed an act of the Legislature."

Irrigation and Drainage Work.

A number of dirt moving jobs, which seem to merit more than a passing notice, have been let the past week. The largest of these is the contract for the extension of the Canadian Pacific Ry. Co.'s irrigation system into the eastern section of the irrigation block in the province of Alberta, Canada. This contract—by the way, one of the largest awarded in western Canada in recent years—calls for the moving of some 28,000,000 cu. yds. of earth. The contract price was about $5,230,000, which was practically $250,000 under the company's estimate. The work is to be started at once and is to be completed in five years. The system will provide for the irrigation of some 540,000 acres and will require a reservoir with a storage capacity of 300,000 acre feet. In passing it may be noted that the resulting lake is to be called Lake Newell, in honor of F. H. Newell, director of the U. S. Reclamation Service. The successful bidder for the work was James McDonnell & Co., with whom are associated Winter, Boomer & Hughes and Grant Smith & Co., all of Spokane, Wash. Another contract of interest was the one awarded at East St. Louis, Ill., for the construction of the Cahokia Creek diversion channel. This is the first contract in a comprehensive scheme for levee and drainage work involving the expenditure of $5,000,000 or $6,000,000 which the East Side Levee and Sanitary District of East St. Louis is to install. The contract just let involved 1,427,900 cu. yds of excavation. The contract was secured by S. R. H. Robinson & Son Contracting Co. of St. Louis, Mo., at a total of $259,153. Two large drainage contracts were also let during the past week, G. A. McWilliams, 702 Royal Insurance Co., Chicago, Ill., securing both contracts. The first contract calls for the construction of ditches to drain 20,000 acres of land in Dodge county, Wisconsin, for a land company. The work consists of 20 miles of main ditch, 80 to 110 ft. top width and 8 ft. deep, and 40 miles of lateral ditches, 25 to 30 ft. top width and 7 to 8 ft. deep. The total excavation amounts to 800,000 cu. yds. The other contract is the initial piece of work for draining a 1,000,000 acre tract of land in Louisiana. The contract calls for the drainage of 50,000 acres of land and requires the construction of 138 miles of drainage canals and 120 miles of navigation canals. This work is also to be done for a private company.

Confirmed Reports by Engineers and Contractors

RAILROADS, POWER DEVELOPMENTS, LEVEES, DRAINAGE AND IRRIGATION WORKS.

Railroads—Steam and Electric.

ARKANSAS.

The Missouri Pacific Ry. has awarded the grading contract for double tracking the Arkansas Division from McAlmont to Bald Knob, Ark., to the Walsh Construction Co., of Davenport, Ia.

The South West Texas Construction Co., Keener, Ark., has the contract for constructing the Arkansas & Northwestern R. R. The L. Clemens Construction Co. has the contract for constructing the first 16 miles. The contract includes 100,000 cu. yds. of earth excacation and 50,000 cu. yds. of embankment. Of the road 3½ miles have been graded and seven miles of right of way cleared. The objective points of the road are St. Louis, Mo., and Paris, Tex. T. A. Morton, Keener, Ark., is Chief Engineer.

CALIFORNIA.

The Humboldt & Eastern Ry. Co. is projecting a 175 mile electric line east from Eureka, Cal. Surveys have not been made as yet nor has the construction capital been secured. The chief engineer has not been selected as yet. W. S. Clark, Eureka, Cal., is president.. H. L. Jackman, Eureka, Cal., is also interested.

COLORADO.

The Denver & Rio Grande Ry. has awarded the contract for double tracking 10½ miles of line from Goodnight to Swallows to the Utah Construction Co., Ogden, Utah. The contract includes 125,000 cu. yds. rock excavation and 355,000 cu. yds. embankment. The Denver & Rio Grande Ry. has also awarded the contract to the Utah Construction Co. for 1¾ miles of double track from Pando tunnel to Pando. This contract includes 35,000 cu. yds. of rock excavation and 20,000 cu. yds. of embankment. The contracts include the following bridges, all for double track: Three 16 ft. and eight 24 ft. I beam bridges, two 80 ft. through girders and one 86 ft. through girder. The contracts also include about 5,000 cu. yds. of concrete masonry.

LOUISIANA.

The Natchetoches East & West Ry. has completed surveys for its projected 38-mile line from Natchitoches to Colfax, La., down Cane River. The capital for construction has not been secured as yet. Construction contracts are to be let as soon as the capital is secured. Harry Percy, Natchitoches, La., is Chief Engineer and C. H. Teal, Colfax, La., is President.

NORTH DAKOTA.

The Boone Contracting Co., Stanley, N. Dak., is working two grading machines on its contract on the Stanley branch of the Great Northern, and will complete its work in about a month. The company is in the market for more work to move onto at once. Other subcontractors at work on the Stanley branch include the following: Kimball Bros. have moved on the work with two machines, two engines and 30 teams, and are piling up big estimates. Stanley Bros have taken work north of Powers Lake and are moving in with their outfit. Colby Smith is working a good size machine outfit on the line, and J. Nueville is working 60 teams on a mixed outfit of car gang machine, wheeler and slip outfit.

OHIO.

The Roberts & Abbott Co., Consulting Engineers, Cleveland, O., have been employed to make a report on a projected line radiating from Mt. Gilead to Mansfield, Mt. Vernon, Marion, Delaware & Galion. The projected length is 107 miles. The company to build and operate the road has not been organized as yet.

OKLAHOMA.

The Oklahoma Public Service and Interurban Lines now has surveys under way for 100 miles of line, radiating from Stillwater, Okla. The capital for construction has been secured and contracts for the Morrison division, calling for 13 miles of interurban line, are to be let today (May 25). L. J. Lampke, Stillwater, Okla., is president and R. G. Sturgeon, Stillwater, Okla., is chief engineer.

PENNSYLVANIA.

Preliminary surveys have been made for the Ephrata & Lebanon Street Railway, a charter and rights of way obtained, and the company is now engaged in endeavoring to secure the necessary finances to build the road. F. H. Shaw, Lancaster, Pa., is Engineer.

TEXAS.

The Wichita Falls route has now under construction an extension from Elk City, Okla., north to Hammon, Okla., a distance of 18 miles. Grading contracts are let by the company in short sections to sub-contractors. The bridging, building and track laying will be done by the company. J. A. Kemp is president, Frank Kell vice president and general manager, Wichita Falls., Tex., and R. A. Thompson, Wichita Falls, is chief engineer.

UTAH.

The Utah Construction Co., Ogden, Utah, has work well under way on its contract for constructing the Bingham & Garfield R. R., a 17-mile line in Salt Lake County, Utah, between Bingham and Garfield. The contract includes 300,000 cu. yds. of earth excavation, 800,000 cu. yds. of rock excavation, 1,000,000 cu. yds. of embankment, 6,200 lin. ft. of rock tunnels, 7,000 cu. yds. concrete masonry and three steel and concrete bridges of 500 to 800 ft. The subcontractors on the work are as follows: Boyer Bros., R. Palfreyman, D. Palfreyman, Taylor Bros., W. M. Smith, Wasatch Constructing Co., Stephen Rockish, and F. Meyers & Co., all of Utah.

WASHINGTON.

The Walla Walla Valley Ry. Co., recently mentioned in this paper, has been formed to take over the railroad property of the old Northwestern Corporation. The company has 24 miles of line extending from Walla Walla, Wash., to Milton and Freewater, Ore. No new construction is contemplated at the present time. Guy W. Talbot, Portland, Ore., is president.

CANADA.

Jackson & Goldie, Winnipeg, Man., have been awarded the contract for ditching work along the line of the Canadian Pacific Ry. from Fort William, Ont., to Winnipeg, Man. Bids for this work were opened May 2, at Winnipeg, by Frank Lee, Division Engineer.

The O'Boyle Bros. Construction Co., Sault Ste. Marie, Ont., has been awarded the contract for the clearing, grading and bridge work on a 31 mile extension of the Algona Central & Hudson Bay Ry. from Hawk Lake Junction to Hobon. Bids for the work were opened April 30 by C. H. Coburn, chief engineer, A. C. & H. B. Ry.

Bids are asked by A. J. McGee, 25 Toronto St., Toronto, Ont., Secretary-Treasurer of the Temiskaming & Northern Ontario Ry., until noon, June 8, for clearing, grading, embankment protection, driving of piles, building of culverts and laying of tile that may be required in connection with the construction of a branch line for the Temiskaming & Northern Ontario Ry., between North Bay and Nipissing Junction. Plans and specifications may be seen at the office of S. B. Clement, Chief Engineer, North Bay, Ont., and the Secretary-Treasurer, 25 Toronto St., Toronto.

Power Developments, Levees, Drainage and Irrigation Works.

ILLINOIS.

Bids are asked by C. W. Brown, Engineer Drainage District, Room 12, Scott Block, Jacksonville, until 11 a. m., June 2, for 100,000 cu. yds. of levee work and 74,000 cu. yds. of ditch work in the Meredosia Lake drain and levee district in the west part of Morgan and Scott counties, Illinois.

Bids are asked until 10 a. m., June 9, by Commissioners of Union Drainage District No. 1, towns of Vance and Catlin, Vermilion county, Ill., at Fairmont, Ill., for the following work: Excavating dredge ditch two miles long, total amount of yardage estimated at 50,822 cu. yds. Furnishing and laying 400 ft. of 30-in., 1,650 ft. of 27-in., 4,600 ft. of 20-in., 4,180 ft. of 18-in., 1,350 ft. of 16-in. 2,400 ft. of 12-in. standard shale tile.

Bids were opened May 16, by the East Side Levee and Sanitary District, of East St. Louis, Ill., for the construction of the channel for the division of Cahokia Creek, the contract being let to the S. R. H. Robinson & Son Contracting Co., 905 Chemical Bldg., St. Louis, Mo., at $259,153. The itemized bids received on this work were as follows: (1) standing for S. R. H. Robinson & Son Contracting Co.; (2) for Shaw, Foohey & McGinnis, Bement, Ill., and Fort Wayne, Ind.; (3) for Lorimer & Gallagher Co., Chicago, Ill.; (4) for James O. Heyworth, Chicago, Ill.; (5) for E. M. Graves, Cleveland, O.; (6) for Scott, Hannon & Hickey, St. Louis, Mo.; (7) for Yale & Reagan, Chicago, Ill.; (8) for R. A. Brown, Washington, Ind.; (9) for W. W. Brown Construction Co., East St. Louis, Ill., and (10) for the Hercules Co., New Orleans, La.:

BIDS RECEIVED MAY 16 AT EAST ST. LOUIS, ILL., FOR THE CONSTRUCTION OF CAHOKIA CREEK DIVERSION CHANNEL

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
Excavation, 1,437,000 cu. yds.	$ 0.1695	$ 0.17	$ 0.18	$ 0.178	$ 0.1942	$ 0.195	$ 0.189	$ 0.25	$ 0.2475	$ 0.293
Overhaul, 7,357,000 cu. yds.	.01	.015	.01	.02½	.01	.01	.02	.01	.02	.011
Grubbing, 5 acres	100.00	100.00	200.00	150.00	500.00	50.00	300.00	100.00	50.00	22.00
Cast iron pipe, 30-in., 60 ft.	5.97	7.50	10.00	9.00	9.00	15.00	10.00	4.50	7.00	6.50
Cast iron pipe, 24-in., 96 ft.	4.86	5.00	8.00	6.00	5.00	12.00	9.00	4.00	6.25	4.75
Reinforced concrete, 70 cu. yds.	16.00	19.00	20.00	15.00	15.00	15.00	12.00	11.00	8.50	20.00
Concrete at pipe end, 22 cu. yds.	12.00	12.00	10.00	10.00	10.00	12.00	10.00	10.00	8.50	12.00
Sluice gate, 30-in. pipe	405.00	100.00	300.00	350.00	200.00	180.00	250.00	240.00	175.00	300.00
Sluice gate, 24-in. pipe	330.00	90.00	200.00	200.00	150.00	140.00	200.00	220.00	150.00	250.00
Sluice gate, 4 ft. and 5 ft. culvert	592.75	400.00	800.00	900.00	100.00	650.00	500.00	450.00	300.00	700.00
Totals	$229,153	$266,122	$275,087	$288,100	$294,115	$296,253	$300,701	$373,106	$382,686	$436,893

IOWA.

Bids are asked by H. B. Frase, County Auditor, Des Moines, Ia., until noon, June 20, for the construction of a drainage ditch in Drainage District No. 11, in Elkhart Township, Polk County, requiring the moving of 53,471 cu. yds. of earth. Work is to be completed on or before Nov. 1, 1910.

The following bids were received by the Supervisors for Des Moines County Drainage District No. 1, at Burlington, Iowa, on May 11th, for the pumping station building and Station Engineer's dwelling: Traut & McCarthy, Beardstown, Ill., $48,480; Jansen & Zoeller, Pekin, Ill., $55,800; Harney Bros., Aledo, Ill., $48,800; H. A. Beck, Burlington, Ia., $53,900; Brewster & Evans, Peoria, Ill., $49,500; John Thye, Burlington, Ia., dwelling only $4,156. The contract was awarded to Traut & McCarthy. The Harman Engineering Co., Peoria, Ill., are the engineers for the Drainage District.

Bids are asked by the County Auditor, Burlington, Ia., until 2 p. m., June 9, for the construction of the following ditches and tile drain work: 6,900 ft. of 80 ft. ditch, 98,500 cu. yds.; 140,400 ft. of 60 ft. ditch, 1,298,500 cu. yds.; 8,300 ft. of 40 ft. ditch, 53,500 cu. yds.; 3,500 ft. of 20 ft. ditch, 5,800 cu. yds.; 45,200 ft. of 10 ft. ditch, 103,150 cu. yds.; 900 ft. of 8 ft. ditch, 9,100 cu. yds.; 49,350 ft. of tile drain, ranging in size from 10 in. to 24 in. Plans and specifications are on file and may be seen at the office of the County Auditor in Burlington, Ia., and at the office of the Harman Engineering Co., 120 Fredonia Ave., Peoria, Ill. Official advertisement will be found elsewhere in this issue.

LOUISIANA.

Bids are being asked by Lt.-Col. Lansing H. Beach, U. S. Engineer, New Orleans, La., until 11 a. m., June 10, as noted in our last issue, for dredging at Chefuncte and in Bogue Folia Rivers, La. The work calls for dredging sand, clay and mud for a channel through the bar at the mouth of the Chefuncte River, and the dredging of a channel through shoals in the Bogue Falia River. About 30,000 cu. yds. of dredging will be required.

G. A. McWilliams, 169 Jackson Blvd., Chicago, Ill., has been awarded the contract for draining 50,000 acres of a 1,000,000 acre tract near Lockport, recently purchased by interests identified with Trowbridge & Niver Co., Chicago. The land is in Terre Bonne parish, east of Bayou Lafourche and 50 miles west of New Orleans. The initial drainage contract calls for 138 miles of drainage canals and 120 of navigation canals. The developers will construct roads, install pumping plant, transmit electricity for farm use, etc. The work outlined will require two years for completion and it is understood that this initial development will be followed by others of equal size until the entire 1,000,000 acres are developed.

Bids are asked by Lt. Col. Lansing H. Beach, U. S. Engineers, New Orleans, La., until 11 a. m., June 15, for building lock and dam and lockkeeper's dwelling on Bayou Teche, La. The site of the proposed work is 3½ miles below St. Martinville, La., which is on a branch line of the Southern Pacific R. R. The work consists in furnishing all the plant, materials and labor necessary to construct a concrete lock on pile foundations with wooden gates and all accessories; a timber-crib dam on pile foundation, with concrete abutment; making the excavation necessary for widening stream above and below the dam; placing all bank protection; and building one lockkeeper's dwelling. The work includes the following approximate quantities: Excavation, 40,000 cu. yds; foundation piles, 48,260 lin. ft.; guide piles, creosoted, 6,100 lin. ft.; sheet piles, wooden, 166,250 ft. B. M.; sheet piles, steel (alternative bid), 18,475 sq. ft.; back filling and embankment, 7,469 cu. yds.; concrete, 8,480 cu. yds.; concrete, reinforced including steel (wing walls), 138 cu. yds.; reinforced concrete including steel (abutment, alternative bid), 191 cu. yds.; valves, cylindrical, No. 4; structural steel, 14,510 lbs.; steel reinforcement (lock floor), 252,394 lbs.; bolts and special irons, 30,702 lbs.; cast iron, 41,750 lbs.; timber in permanent construction, 132,490 ft. B. M.; timber, creosoted, 96,389 ft. B. M.; timber in gates, 36,254 ft. B. M.; timber shoring, 10,000 ft. B. M.; riprap filling, 2,614 cu. yds.; bank protection, riprap, 500 sq. yds.; gauge tile (4 gauges), 76 lin. ft.; mattress protection, 2,011 sq. yds.; lockkeeper's dwelling, complete, No. 1; tile drain, 350 lin. ft.; walks and concrete paving, 90 sq. yds.; capstans, No. 2.

MASSACHUSETTS.

Bids were received April 25 by the Metropolitan Park Commission, John R. Rablin, Engineer, for excavating a new channel for Alewife Brook, Spy Pond to Mystic River, Belmont, Cambridge, Arlington and Somerville, the contract being awarded to the Eastern Dredging Co., Boston, at the following bid: Spypound to Arlington Branch, B. & M. R. R., 50,000 cu. yds., at 59 cts.; Arlington Branch, B. & M. R. R., to Massachusetts Ave., 2,500 cu. yds., at 87 cts.; Massachusetts Ave., to Broadway, 22,000 cu. yds., at 77 cts.; Broadway to Mystic River, 3,500 cu. yds., at 87 cts.; total, $51,660.

MINNESOTA.

Bids are asked by L. P. Larson, County Auditor, Redwood Falls, Minn., until 1 p. m., June 2, for constructing Ditch No. 12 of Redwood county, the estimated cost of which is as follows: Tile work, $39,992; dredge excavation, 251,159 cu. yds., $20,036; concrete work on main ditch, $592.

Bids are asked by J. B. Lemire, County Auditor, Aitkin, Minn., until 10 a. m., June 6, for the construction of Aitkin county ditch No. 14. The main ditch is 5½ miles long, 4 ft. wide at bottom, average depth 6 ft., slopes 1 to 1, requiring excavation of 70,532 cu. yds. excavation of clay and loam. In addition there will be one open lateral 2,800 ft. long, 4 ft. wide at bottom, 6 ft. deep, containing 5,571 cu. yds.

NORTH CAROLINA.

The Lower Creek Drainage Co. of Lenoir, N. C., has placed an order for a 1¼ yd. dipper dredge and will dig a canal 12 miles long requiring the excavation of 360,000 cu. yds. The work will take about 12 months. A. A. Kent, Lenoir, N. C., is secretary of the executive committee.

UTAH.

The city of Provo, Utah, is planning to erect a hydro-electric plant, to cost $110,000. The city is also to construct water works to cost $90,000. An election to vote on issuing bonds for the above work was held May 24. L. C. Kelsey, 402 Dooly Bldg., Salt Lake City, Utah, is consulting engineer for both pieces of work.

WASHINGTON.

The Secretary of the Interior has rejected all bids received April 22 for the contract for excavation of 40 miles of sub-laterals on the Tieton unit of the Yakima project and has authorized construction by force account. J. S. Conway, North Yakima, Wash., is project engineer.

WISCONSIN.

The Rock River Valley Land Co. of Racine, Wis., has contracted with G. A. McWilliams, 702 Royal Insurance Bldg., Chicago, Ill., for the construction of a system of ditches to drain 20,000 acres of the company's lands in Dodge County, Wisconsin. The work will consist of 20 miles of main ditch, 80 to 110 ft. top width and 8 ft. deep, and 40 miles of lateral ditches, 25 to 30 ft. top width and 7 to 8 ft. deep. The total excavation amounts to 800,000 cu. yds.

CANADA.

The contract for the construction of Section No 6 of the Ontario-Rice Lake Division of the Trent Canal has been awarded to Messrs. Haney, Quinlan & Robertson, address care of M. J. Haney, C. E., Home Bank Bldg., Toronto, Ont.

Joseph J. Fallon, Vincent L. Fallon and Thomas D. Fallon, composing the firm of Fallon Bros., Cornwall, Ont., as noted in a previous issue, have been awarded the contract for improving the upper entrance to Lock 17, Cornwall Canal at Cornwall, Ont. The contract includes 38,000 cu. yds. of earth excavation, 2,500 cu. yds. rock excavation, 20,000 cu. yds. dredging, 620 ft. crib work, requiring 600,000 ft. B. M., 4 ft. x 12 in. timber, 1,960 cu. yds. plain concrete and 1,025 cu. yds. stone masonry. Subcontracts on the dredging were to be let at once.

The Southern Railway and the Georgia & Southern & Florida Ry., are planning the improvement of terminals at Jacksonville, Fla., through the St. Johns River Terminal Co. The work includes enlarging freight yards north of Bay St., between Catharine and Marsh Sts.; also enlarging and complete rearrangement of the tracks south of Bay St. along the river front between Catharine and Main Sts., with a view of modernizing the yards for the quicker handling of traffic and for the expeditious handling of the traffic of the Clyde Steamship Company, which is to erect giant piers and terminals along the river front of the Terminal Company, between Market and Washington Sts., plans for which have been completed. W. C. Shaw, Jr., Macon, Ga., is Chief Engineer.

All right of way through Phoenix, Ariz., for which the Buckeye Railroad has been contesting, has been secured and the construction of the road will be continued at once, under direction of the Arizona Eastern. L. H. Long, Tucson, Ariz., is Assistant Chief Engineer of the latter company.

Advices from Pioche, Nev., are to the effect that H. S. Wanamaker, General Manager Mountain, Valley & Plains R. R., Amistad, New Mex., is securing data as to traffic for the proposed extension of its line through Pioche and Lincoln Counties. It is understood the company is planning to eventually extend the line from Cimarron, New Mex., to the Pacific Ocean.

The Fernwood & Gulf R. R. now operating between Fernwood, Miss., at Tylertown, is stated to have let contracts for additional trackage, with the idea of ultimately extending the road to the Gulf. F. B. Enochs, Fernwood, Miss., is General Manager.

It is reported that W. A. Wall, Honolulu, Hawaii, is planning the construction of a 60-mile railroad in Hawaii and a bill authorizing the work has just been introduced into the Federal House Committee on Territories.

An announcement has been made by Ogden Mills, President of the Virginia & Truckee R. R. Co., at Reno, Nev., that no immediate extension of the line would be built. Surveys are, however, being made in the direction of Bridgeport and Mono Lake.

According to a statement reported to have been made by James Douglas, President, El Paso & Southwestern Ry., New York City, matter of constructing a line to Tucson, Ariz., from Benson, and from there to Port Lobos, Mex., is under consideration.

The Shattuck-Edinger Construction Co., Los Angeles, Cal., has been awarded the grading contract for the Buckeye R. R., from Buckeye, Ariz.

The City Council of Summit, Miss., has granted a franchise to the Summit-McComb Motor Line Co., for a right of way within the corporate limits for the street car line, which is being built to connect Godbold Mineral Wells, Summit and McComb.

Paternan & Lamro, contractors of the Northwestern, are preparing to start active work at once on the Dallas-Carter extension in South Dakota at once.

Items Concerning Contractors and Their Work

RAILROADS, POWER DEVELOPMENTS, LEVEES, DRAINAGE AND IRRIGATION WORKS.

Arkansas Notes.

FROM CORRESPONDENTS AND OTHER SOURCES.

City Council of Hope, Ark., has been considering a proposition of J. H. Black, Jr., Texarkana, Ark., for a street railway franchise.

Heavier steel is being laid on a short railroad line leading out to a lumber mill eight miles from England, Ark., and it is said that the road is to be extended to Stuttgart, 26 miles from England. Two other surveys have been made to different points, one to Pine Bluff and the other to Hazen on the Rock Island.

Walter J. Miller of Lamar, Mo., associated with St. Louis capitalists, is said to be preparing to extend the Valley Railroad into Pine Bluff. It is Mr. Miller's purpose to build the road north from McCreaner, Ark., to Searcy, where it will feed the Missouri and North Arkansas, and thence south from McCreaner to Pine Bluff, via Robroy over the Arkansas River, where it will connect with the Cotton Belt. J. A. Watkins of Little Rock is receiver of the road.

California Notes.

FROM CORRESPONDENTS AND OTHER SOURCES.

The United Railroads, of San Francisco, has been requested to construct a car line on 15th ave., at San Francisco, south from San Bruno ave. to Railroad ave., giving the Mission district another cross-town line and connecting the Bay View and Potrero districts with the Mission.

The field work has been practically completed for an extension of the 22nd St., Oakland, line of the San Francisco, Oakland & San Jose Ry. through East Oakland, Dimond, Allendale, Melrose Heights, Elmcrest and East San Leandro. The road is ultimately to be built to San Jose.

Hallwood Irrigation Co., of Marysville, rejected bids on all but one section of its irrigation canal. This section, requiring the removal of 8,800 cu. yds. of earth was awarded to J. Wise, at 12 cts. per cu. yd. The other sections will be readvertised. Leslie B. Crook is engineer.

The Chamber of Commerce of Long Beach is advocating a recommendation that the city build and maintain its own railroad around a portion of the harbor.

Advices from Santa Monica, Cal., state that the Los Angeles-Pacific Ry. will be extended out Seventh St., from Oregon to the San Vicente Blvd., over 14th St., and along Montana back to 7th.

Track laying on the Holton Interurban extension west of El Centro, Calif., to New River, is about to start. The line is the easterly connection of the San Diego & Arizona R. R., now under construction. It is expected to finish the work by July.

The Stockton Terminal & Eastern Ry. Co., has been granted a franchise by the City Council of Stockton, Cal., for entrance to that city from Jenny Lind, on Roosevelt Ave., at East St., to Union, thence to Fremont, along Miner Channel by trestle to American west on Miner to Center, thence south to Stockton channel.

The Vallejo & Northern R. R. Co. has instituted suit to condemn right of way through a tract of land in Jameson Canyon between Cordelia and Napa Junction on the county line of Solano and Napa Counties. It is the only available route for the construction of a line across the range of hills. T. T. C. Gregory is President of the company.

The City Council of Los Angeles has granted the petition of Robert Marsh for a street railway franchise on 39th St., from Vermont Ave. to Western Ave.

Sharp-Hauser Construction Co., Germain Bldg., Los Angeles, Cal., are to start work shortly on their contract for the construction of the Wahtoke branch extension of the Santa Fe. A rock crushing plant is now being installed at Santa Fe to prepare rock for the roadbed.

According to reports from Fruitvale, Cal., the 22d St. line of the San Francisco, Oakland & San Jose Ry. through Dimond, Allendale, Melrose Heights, Elmcrest and East San Leandro will be constructed soon. Surveyors have practically finished laying out the right of way.

Repair work on the line of the San Pedro, Los Angeles & Salt Lake R. R., is nearly completed and it is expected the road, which was recently washed out by high water, will be thrown open to traffic within 30 days. The cost of the work is estimated at about $4,000,000. E. G. Tilton, Los Angeles, Cal., is Chief Engineer of the company.

Colorado Notes.

FROM CORRESPONDENTS AND OTHER SOURCES.

Advices from Las Animas state that the Rule Creek Reservoir Co. has awarded a contract to the Kaw Construction Co., Kansas City, Mo., for the construction of a large dam to water about 20,000 acres of land lying along Rule creek from four to ten miles southeast of Las Animas. W. A. Howard, Dr. Loub and R. A. Bonita are the principal holders in the company.

The Montrose Chief Canal & Reservoir Co., of Montrose, has been incorporated with a capital stock of $10,000, the incorporators being J. V. Lathrop, John I. Newland and Robert K. Humphrey.

The Meadows Reservoir project, the filing for which was made about a year ago by E. E. Udlock, Grand Junction, is reported to have been purchased by C. C. and G. J. Magenheimer, who are just completing the construction of the Orchard Mesa ditch. The Meadows Reservoir project contemplates the construction of a reservoir in the meadows above Collbran in the Plateau Valley, the irrigation of a large tract of land including the Sunnyside project, the erection of a power plant with a capacity of 10,000 hp., and the building of an electric railroad from the Plateau Valley to Grand Junction via Orchard, Mesa, will be built.

Surveys for the Stove Prairie Reservoir of the Laramie-Poudre Reservoir & Irrigation Co., of Fort Collins, have been completed and bids will be asked soon. The dam will be one of the highest in the state, about 250 ft. The capacity will be 35,000 acre-feet. The cost will be $500,000, while engineering supervision, road building and other incidentals will bring the total to $600,000. It will be located 20 miles west of Fort Collins, on the Cache la Poudre River.

Denver capitalists represented by George W. Vallery and J. H. Lumsden and J. H. Vickery of Grand Junction, closed a deal for a 5,000-acre tract on Hunter's mesa near Rifle and the construction of a reservoir and irrigation ditches to cost $500,000. All the land will be irrigated for fruit. Work will be started without delay.

D. W. Gill, right of way agent, Colorado Railroad Co., has closed contracts for nearly all right of way necessary for the construction of a connecting link between the Colorado & Southern and the Burlington yards at Cheyenne, Wyo.

Carmon Layton of the Paradox & Pacific R. R. is reported to have announced at Montrose, Colo., that a feasible route had been found for the construction of the line from Montrose to Bedrock over the Horefly range of hills and that a preliminary survey preparatory to laying out the final line will be run at once.

The Denver, Laramie & Northwestern R. R. has filed a mortgage to the Manhattan Trust Co., New York City, to secure a bond issue of $22,500,000 for the construction of a line through to Seattle, Wash., and the north Pacific Country. E. A. Buck, 511 E. & C. Bldg., Denver, Colo., is Chief Engineer of the company.

Georgia Notes.

FROM CORRESPONDENTS AND OTHER SOURCES.

The Brinson Ry. Co. has been chartered with a capital stock of $1,500,000 and headquarters at Savannah, Ga. The new company will take over the Brinson Ry., at present operating 72 miles of line, and will build extensions. The charter calls for 180 miles of line running from Savannah in a northwesterly direction to Athens. G. S. Burtchael, Springfield, Ga., is Chief Engineer of the Brinson Ry.

The Rome & Northern R. R. which has just placed in operation an extension from Rome to Shackleton, 17 miles, has surveys under way for an extension north, and it is expected that the road will ultimately be extended to Knoxville. H. M. Smith, Rome, Ga., is Chief Engineer.

Surveys are to be started shortly for the projected line of the Fitzgerald, Ocilla Electric Ry. & Power Co. The first section of the line to be constructed will be between Fort Valley, Ga. and Jacksonville. As proposed, the line will be 210 miles long. B. B. Gray, Pinebloom, Ga., is President. The project is being promoted by S. Tilden Holtzendorff, 61 Fifth Ave., New York City.

Idaho Notes.

FROM CORRESPONDENTS AND OTHER SOURCES.

Surveys have been completed and arrangements made for the construction of the proposed line of the Idaho Central R. R., paralleling the Oregon Short line from a point west of Pocatello, Ida., through Richfield and Camas Prairie. The new line will be 200 miles in length.

Work is progressing rapidly on the Metaline extension of the Idaho & Washington R. R. The work includes the construction of several tunnels, considerable side hill cut and a 300 ft. bridge across Box Canyon on the Pend Orielle River. W. C. Smith, Spirit Lake, Idaho, is Chief Engineer of the Idaho & Washington Northern.

The Boise & Interurban Ry. Co. of Boise has announced that work on the proposed extension of its line to the East side addition or a point near the Natatorium, would commence at once, the first step to be the electrification of the Idaho St. line east from 7th St. to Ave. B. for which the rails were laid at the time of the original construction.

Illinois Notes.

FROM CORRESPONDENTS AND OTHER SOURCES.

The Egyptian Traction Co. has applied to the City Council of Carterville for a franchise through that city. This company, as previously noted, proposes to build a line from Mt. Vernon, Ind., through Eldorado, Harrisburg, Marion, Carterville, Carbondale and to Murphysboro, connecting the McGowan system in Indiana with the McKinley system in Illinois. R. B. Clark, Harrisburg, Ill., is Chief Engineer.

The Chicago & Northwestern Ry. has been purchasing a considerable amount of land in Proviso, a suburb of Chicago, with a view, it is said, of establishing freight yards and roundhouses there. The plans are said to contemplate making a through freight terminal which will be capable of accommodating 10,000 freight cars and a roundhouse wherein can be stalled fully 90 locomotives.

The Western Indiana Construction Co. has begun work on the first section of the Oil &

Coal Belt Ry. This first work consists of resurfacing the old railroad from Dorrisville to Galatia. This is being put in shape for operating, a construction train hauling the material for the loop line and extensions. The Galatia line is to be working within four months.

The Chicago, Milwaukee & St. Paul R. R. Co. has acquired about 514 acres of land in the Township of Leyden, a suburb of Chicago. The company has in all about 800 acres of land at that place, which will be utilized for freight yards.

The Chicago, Milwaukee & St. Paul Ry. is reported to be negotiating with the Chicago & Milwaukee Electric Ry. Co. for the purchase or lease of a portion of the right of way from Highwood to Milwaukee in order to enter into competition with the North-Western road. The Milwaukee road, it is said, seeks an entrance to Lake Forest, Waukegan and other cities, but especially desires to obtain business at Fort Sheridan and the United States Naval Training station. Alterations are now being made in the line of the Chicago-Milwaukee company at Highwood so that the Milwaukee road may build a track from Rondout to that point.

The Illinois Valley Gas & Electric Co. recently chartered, is said to be planning to build a $2,000,000 power plant at Streator, and the company is reported to have contracts and franchises to light the cities of Streator, Morris and Ottawa and twelve towns in La Salle, Grundy, Marshall and Woodford counties, and may extend farther south and west. The company was organized by Samuel Insull, C. A. Munroe, C. H. Randle and Frank G. Logan, all of Chicago.

Press reports from Bushnell state that work will be started soon in Lamoine township, McDonough county to protect several hundred acres of good farming lands from overflow. It is proposed to dam the Colmar branch of Crooked creek and turn its waters into the main stream through an artificial channel.

Business men of Quincy are investigating the possibilities of an interurban road from Quincy to Paris, passing through Springfield, Shelbyville, Mattoon and Charleston. James K. Lauher, Paris, Ill., may be interested.

Announcement has been made that the Tri-Cities & Northeastern interurban line, surveys for which are now under way, will be completed through to Morrison, Ill., the western terminus to be Silvis. The estimated cost of construction is $1,500,000. It is stated that all arrangements for financing the project have been made. J. W. Crowley, President of the People's Construction Co., Moline, Ill., is a director of the Tri-Cities & Northeastern.

The stockholders of the proposed Decatur, Sullivan & Mattoon Interurban line have again taken up the matter of building the line from Mattoon. W. A. Steel, Sullivan, Ill., is interested.

The Chicago & Alton R. R. is planning to spend $1,000,000 in Bloomington if the residents of that city raise $165,000 for the necessary land, adjacent to the present yards. Of this amount $750,000 will go for the enlargement of shops, $75,000 for viaducts, $50,000 for a third main track and the $75,000 for a passenger station.

Advices from Peoria, Ill., state that the grading work is well under way for the ⅛ mile line of the Peoria Ry. Co., from Seiberling Ave., to Grand View Drive and that track laying will be complete about June 15. The cost of the work is estimated at $15,000.

Indiana Notes.

FROM CORRESPONDENTS AND OTHER SOURCES.

The commissioners of Marshall county have granted a franchise for an interurban line from Bremen north to the county line. The interurban, which is to connect Bremen and Mishawaka, is being promoted by Omer F. Neff, Milford, as previously noted in these columns.

The Cleveland Construction Co., Citizens' Bldg., Cleveland, O., is reported to have been awarded the contract for the construction of double track on the Chicago, Lake Shore & South Bend Ry., from Pullman to Gary, Ind., a distance of 17 miles.

The Vandalia R. R., M. P. Tucker, Assistant Engineer, Terre Haute, is to spend $25,000 in straightening the road just west of Terre Haute, by which the line will be shortened one mile.

The Chicago, South Bend & Northern Indiana Ry. Co. is planning to lay double tracks on West Second St., in Mishawaka.

The Chicago, South Bend & Northern Indiana Railway Co., is planning the construction of a number of improvements in South Bend, Ind. The work includes the laying of double track on several of its lines.

The Pennsylvania R. R. has received bids for its track elevation work in Fort Wayne. The Wabash R. R. will do its track elevation work in the city with its own forces.

Iowa Notes.

FROM CORRESPONDENTS AND OTHER SOURCES.

Work is to be started shortly on the improvement of the Albia & Centerville R. R. of Centerville, which was recently purchased by W. A. Boland, of New York city. The road is to be transformed into an interurban line.

The Albia Traction Co., of Albia, is making arrangements for building a line from Albia to Buxton, and possibly a stub line to Ward.

The Waterloo, Cedar Falls & Northern R. R., T. E. Rust, Chief Engineer, Waterloo, Ia., has planned improvements to its lines at Waterloo which will involve the expenditure of $150,000. The most important part of the plan is double-tracking the Cedar Falls line from Broadway to Electric park, the erection of freight house and shortening the Denver line by eliminating the semi-circular swing around the Litchfield factories.

Contracts for furnishing rock and brush for the use of the government fleet improving the Dubuque division of the Mississippi River have been let as follows: Rock: Thomas Welsh, Cuba City, Wis., 10,000 cu. yds. at 70 cts.; Charles Pape, Wapello, Ia., 2,000 cu. yds. at 76 cts.; Le Clair Stone Company, Le Clair, Ia., 6,000 cu. yds. at 80 cts. Brush: Thomas Welsh, Cuba City, Wis., 18,000 cu. yds. at 17 cts.; Granke & Rich, Stoddard, Wis., 18,000 cu. yds. at 17c.

Preliminary surveys are to be started at once by an engineer from Des Moines, Ia., for the proposed Norfolk, Neb.-Newman Grove Electric Railway. The Commercial Club of Norfolk, Neb., is promoting the project.

Engineers of the Chicago Great Western R. R. Company have completed a preliminary survey for the construction of a line from Denver Junction to Waterloo, Ia., connecting the Oelwein-Hampton Division and the Oelwein-Kansas City Division of the road. As projected, the route will be from Denver Junction southeast to the northern edge of the Blackhawk country, thence southward to the western boundary of Bennington township and along Ellsworth creek to the East Waterloo township, to an entrance to the city near the Rapid Transit tracks. W. H. Chadbourn, Chicago, Ill., is Engineer of the Great Western.

The Anamosa-Oxford Junction Light & Co. of Anamosa, is considering the advisability of building an interurban line from Anamosa to Olin. The company has two power houses on the Wapsie River, one at Oxford Junction and the other at Anamosa, which could supply the electric power to operate such a line, and the road could be built along the Wapsie River, with but little grading.

Kansas Notes.

FROM CORRESPONDENTS AND OTHER SOURCES.

Residents of Montgomery county held a meeting at the rooms of the Independence Commercial association at Independence, and appointed a committee consisting of E. P. Allen, J. H. Brewster and J. M. Anderson, to take steps for clearing and straightening the Verdigris River for a distance of about 40 miles. About 19,200 acres of land are affected by overflow.

The Atchison, Topeka & Santa Fe Ry., J. W. Meade, Engineer, Topeka, has appropriated $76,000 for the construction of a reservoir south of Chanute. The reservoir will cover 200 acres with a wing north and south nearly a mile long, and wing east and west lacking 500 ft. of being a mile long. The company is now obtaining its water from a small pond on the land and the city.

Advices from Atchison state that W. A. Parker, Chief Engineer of the Grand Island R. R., has started a survey between Atchison and St. Joseph. The survey line was made along the old Hall road from Doniphan to Wathena, 11 miles.

An engineering corps under supervision of J. Van Ensaeller, is making preliminary surveys for the construction of the proposed electric road from Arkansas City, Kan., to Tulsa, Okla. As proposed the line will pass through Pawhuska, Hominy and other towns between the two terminals.

Kentucky Notes.

FROM CORRESPONDENTS AND OTHER SOURCES.

The new owners of the Owensboro City Ry. Co., of Owensboro, Ky., are planning to extend the street railway lines. The construction of interurban lines is also proposed. The new owners are stockholders in the Evansville Rys. Co. of Evansville, Ind., and are also directors in the Rockport and Mt. Vernon Traction companies. The same parties have also purchased the electric lines at Henderson, Ky.

Surveys are under way for a new railway in Crittenden county. According to advices from Marion, Ky., the survey has been completed for a line to the Commodore mines, eight miles from Marion. Col. Jno. W. Wilson, Marion, is reported to be interested.

It is reported that the Chicago, Burlington & Quincy R. R., which is now building a short line to Metropolis, Ill., will continue the line to Paducah to a connection with the Nashville, Chattanooga & St. Louis R. R.

Louisiana Notes.

FROM CORRESPONDENTS AND OTHER SOURCES.

A bill has been introduced in the Louisiana Legislature by State Senator McCulloch to grant a right of way over the two sugar farms below Baton Rouge to the New Orleans & Baton Rouge electric line. It is stated that a right of way has been obtained all the way from New Orleans to Baton Rouge except through the property at Oakly and Monticello, owned by the State.

Michigan Notes.

FROM CORRESPONDENTS AND OTHER SOURCES.

The Boyne City, Gaylord & Alpina R. R., W. H. White, President, Boyne, Mich., is said to be planning to construct about 25 miles of new main line track this season. Surveys are under way east of Gaylord for the extension.

The Detroit United Rys. Co. is continuing to secure right of way for the proposed double track between Mt. Clemens and Detroit. The greater part of the right of way has been secured and it is said that by the end of the year the company will be in possession of a continuous strip of land 33 ft. wide, on the east side of the Gratiot road from the Clinton river bridge to Leesville. It is possible that grading and track laying may be commenced before the entire strip is secured.

H. S. Payne, Iron Mountain, Mich., has started work on several contracts in the Stambaugh Iron River district of the Menominee range for the Northwestern road. The largest contract is for the construction of a track two miles in length leading to the Tully mine. At the James a spur will be built about half a mile in length and at the Baker mine a short rockpile track.

The Hoose & Person Construction Co. of Iron Mountain, which is stripping the Portland mine at Michigamme, has been

awarded a contract for building 3 miles of track in the Michigamme district for the Chicago & Northwestern road. The new branch will traverse a rough country requiring much filling. It is the intention of the construction company to make use of the earth stripped from the Portland mine formation.

G. A. Skinner, Mount Clemens, has been securing land on the Little Muskegon River, south of Morley, for a proposed power dam to be erected at that place

The Grosse Isle Ry. Co. of Wayne, has been incorporated with a capital stock of $40,000.

Minnesota Notes.

FROM CORRESPONDENTS AND OTHER SOURCES.

The Hibbing Street Ry. Co., recently incorporated, has applied for a franchise at Hibbing and is planning to have construction work started on its street railway as soon as the franchise is secured. H. C. Hanson, Hibbing, Minn., is President and J. A. Redfern, Hibbing, is Secretary.

The Duluth Street Ry. Co., Herbert Warren, Manager, is considering extending its tracks in the Second ward at Duluth.

The Gulbranson brothers have a contract at Foxboro for the Great Northern Ry. Co.

The Northwest terminals of the Northern Pacific Ry., W. L. Darling, Chief Engineer, St. Paul, at Minneapolis, are to be enlarged and a round house and shops built.

Missouri Notes.

FROM CORRESPONDENTS AND OTHER SOURCES.

Surveys are under way for a proposed route for a ditch to straighten Grand River, from the Grundy County line to the Chariton County line. Owners of 140,000 acres of bottom land in Livingston County, are back of the project which will cost about $1,000,000. A. H. Bell, Bloomington, Ill., is making the surveys.

All engineering plans for the Union station and terminals at Kansas City, of the Union Station & Terminal Co. have been completed and contracts are to be let at once. The building of the Belt Line, the freight house and the station itself, will be awarded separately, in order to hasten the work. The steel for replacing the tracks of the old Belt Line has arrived and the work of laying it has been started.

The Missouri Valley Transportation Co., W. K. Kavanaugh, President, St. Louis, Mo., is selecting sites on the Mississippi River for docks for its barge line. It is probable that the first dock will be built at Cape Girardeau.

Davis & Blair, Joplin, Mo., have been awarded the contract for the grading of the Laclade, Dallas & Western, a new steam railroad recently chartered to build from Phillipsburg, a station on the main line of the Frisco, 194 miles southwest of St. Louis, to Buffalo, Mo., the county seat of Dallas. Work will be commenced at once.

It is rumored that the Chicago, Milwaukee & St. Paul Ry. Co. contemplates building a line from Chillicothe, Mo., to Des Moines, Ia., to secure a direct line from Kansas City to Des Moines.

Advices from Shelbyville, Mo., state that the court of Shelby County, as a result of a recent hearing, has decided to drop the proposition of organizing a drainage district on the Salt River.

The Mississippi River Commission will hold a hearing at 10 a. m., June 23, at its offices in the Ligget Bldg., St. Louis, Mo., to consider levee construction and other river improvements below Cape Girardeau.

Montana Notes.

FROM CORRESPONDENTS AND OTHER SOURCES.

The City Council of Billings, Mont., has granted a franchise for an electric street railway to John A. Connelly, Muskogee, Okla. An election will be held June 20 to vote on approving the franchise. The franchise provides that actual work of construction must begin within 30 days from the time the ordinance passed is accepted by the applicant, and that at least four miles of track must be completed within 15 months, and the company agrees to put up a $10,000 bond, which will be forfeited to the city unless these provisions are complied with.

The City of Billings, Mont., has granted a franchise to Carl Schroeter for supplying gas to the residents of that place.

E. H. Begemann, a Holland capitalist, has announced at Spokane, Wash., where he was the guest of R. Insinger, Manager of the Hypothee Branch of Spokane, that the company of Holland capitalists he represents has decided to build an electric railway line from Lewistown to Kendall, Mont. This is the line for which the residents of Lewistown have agreed to subscribe $100,000 to $1,500,000 required to finance the project.

Right of way is being secured in the vicinity of Bozeman by the Northern Pacific Ry. for the postponed new double track between Bozeman and Logan. D. W. Driscoll, Engineer, has established headquarters at Bozeman, for the construction work.

C. A. Gibson, Fromberg, Mont., C. E., will start work upon surveys at once for the construction of a proposed street railway system in Lewiston. S. W. Gebo is promoter.

According to an announcement, reported to have been made by Howard Elliot, President of the Northern Pacific, the company is planning the construction of a cutoff from Glendive, Mont., to Helena. As projected, the line will pass through the counties of Dawson, Fergus and Meagher, a distance of 350 miles. The estimated cost of the work is $10,000,000. W. L. Darling, St. Paul, Minn., is Chief Engineer of the company.

New York Notes.

FROM CORRESPONDENTS AND OTHER SOURCES.

The State Public Service has been holding hearings on the application of the Frontier & Western R. R. Co. for a certificate of convenience and necessity and for permission to exercise franchises. This company proposes to extend the line of the Buffalo Frontier Terminal R. R. to the International Bridge. The Frontier Terminal road was recently granted permission by the Public Service Commission, to build a steam freight belt line around Buffalo, a few miles outside of the city limits. The present proceedings before the commission are for the purpose of securing permission to build a connection between the proposed belt line and the Grand Trunk tracks of the International Bridge Company in Black Rock. The proposed branch will be about 4 miles long, and the estimated cost including necessary land, is $1,400,000. George A. Ricker, 702 Ellicott Sq. Buffalo, is the Engineer.

The Hoboken Railroad Warehouse & Steamship Connecting Co., operated by the Hoboken Manufacturers R. R. Co., of Hoboken, N. J., has applied to the Common Council of Hoboken for a franchise giving the company authority to extend its tracks across the city to the western boundary. It is reported that this action represents an effort on the part of the big trunk line railroads having terminals in Jersey City and adjoining riverside towns, to attain an entry for their cars into Hoboken, and through that city to the big steamship piers, thus establishing a direct route for freight from the piers to any point on the railroad line. The council will give a hearing on the application on May 27.

M. A. Talbott & Co., Baltimore, Md., have the contract for relocating the New York Central tracks through Rome, N. Y. The same company also has the barge Canal contract No. 43, extending through Rome. The two contracts amount to about $2,000,000.

The Pennsylvania, Lackawanna & Erie Connecting R. R. Co. has been incorporated under the laws of New Jersey with a capital stock of $250,000, the incorporators being William D. Braidwood, Brooklyn, N. Y., William T. Tamilton, New York City, Franklyn Doe, Brooklyn, N. Y., Henry McMath, Brooklyn, N. Y., Henry Roeber, Brooklyn, N. Y., Albert Ashton, Brooklyn, N. Y., Tilghman F. Chauncey, Bayonne, N. J.

The Public Service Commission of New York City has passed resolutions calling on the Chief Engineer to report on the feasibility of constructing a subway from Battery Park to 59th St., thence into Queens over the Queensboro bridge. The line would extend under Greenwich St., West Broadway, Varick St., 7th Ave. and 59th St., Manhattan.

The Long Island R. R., it is said, has begun active work on the electrification and double tracking of the north shore division. The branch between Winfield Junction and Whitestone Landing will also be double tracked. P. H. Woodward is Secretary and Ralph Peters is President of the railroad and J. R. Savage, Jamaica, N. Y., is Chief Engineer.

North Dakota Notes.

FROM CORRESPONDENTS AND OTHER SOURCES.

An ordinance has been introduced into the city council of Fargo, N. Dak., authorizing the Great Northern to construct its Fargo-Surrey line across the streets of that city from 17th to 24th St.

The Minneapolis, St. Paul & Sault Ste. Marie R. R., has purchased 12 acres of land at Kenmare, N. Dak., for the construction of extra tracks. Construction has already started on a double track from Kenmare to Portal, N. Dak., to avoid the construction of a bridge across Des Lacs Lake. Thomas Green, Minneapolis, Minn., is Chief Engineer of the company.

Advices from Devils Lake, N. Dak., state that the surveyors of the Minneapolis, St. Paul & Sault Ste. Marie R. R. have finished the line between Medford and that place and that right of way agents are expected in a few days to take up the options which were recently secured in the city property.

Work will soon be started, it is said, upon the projected Carrington-Turtle Lake branch of the Northern Pacific R. R., in North Dakota. As projected the line will pass through Turtle Lake township and Malcolm township, thence westerly about the center of McGibs township, the center of Platt township, thence in the direction of Berthold reservation and the flat where the old post office was located, about 6 miles south of the present town of Ryder on the Soo. W. L. Darling, St. Paul, Minn., is Chief Engineer of the company.

Ohio Notes.

FROM CORRESPONDENTS AND OTHER SOURCES.

Unofficial reports state that the Hocking Valley R. R. has practically decided on the route for its proposed railroad from Wellston or Jackson to the Ohio River and a connection with the Chesapeake & Ohio. It is stated that the extension will start from Jackson and run down the valley of the Little Scioto River to Sciotoville, five miles above Portsmouth. The river will be bridged at Sciotoville, which is said to be the most available site for a crossing, as the river bottoms are wide, giving good approaches and there is a solid rock foundation on both sides of the Ohio. It is also said that the surveys show that this route is 9 miles the shortest of any being considered.

Officials of the Mahoning & Shenango R. R. Co. have been over the route of the electric belt line which the company proposes to construct at Niles.

The Central Ohio Promoting Co. has been organized at Columbus, with A. E. Boone as President, for the purpose of securing the construction of an electric railroad from Columbus to Zanesville.

The Marietta, Columbus & Cleveland R. R. is stated to have completed surveys and to have secured the necessary capital for the construction of an extension from Palos Junction, the present northern terminus to Athens, where a connection will be made with the Hocking Valley. Construction work is to be started soon, it is said. J. C. Riddell, Marietta, O., is General Manager.

The Cleveland Ry. Co. of Cleveland, has applied to the City Council of Cleveland for

authority to establish a crosstown line on W. 65th St.

The Cincinnati Union Depot & Terminal Co. of Cincinnati, has been incorporated for the purchasing of depot grounds and locating, conducting, maintaining and operating a common union station house, passenger and freight depot and terminals and a union railroad, by two or more tracks connecting the various companies for business purposes. Plans for the terminal have been prepared. The project contemplates the expenditure of about $25,000,000. The incorporators include Archibald S. White, Louis G. Hauck, F. R. Williams, General Lewis Seasongood and C. B. Matthews, all of Cincinnati.

Commissioners of Huron County have held a meeting at the County Court House at Norwalk, preparatory to having work started on the New Haven Marsh ditch. The estimated cost is about $30,000. The entire ditch is to be an open one, and in places it will be 25 ft. wide at the bottom. The construction of the ditch will commence in Huron County, at New Pittsburg, near the dividing line between this and Richland Counties, and is to run south and then east to the Huron River, into which it will empty about 1½ miles east of New Haven village.

Work is to be started at once on the improvements to the dock and ore handling facilities of the Baltimore & Ohio R. R. at Lorain. James Stewart & Co. of New York have the contract to erect the docks, machinery for handling the ore and build the storage yard, and the Great Lakes Dredging Co. of Cleveland, will do the dredging. The ore handling machinery will be supplied by the Brown Hoisting Co. The power house, which will be larger than originally, will be constructed by P. Farrell of Cincinnati.

City officials of Alliance are considering the plans of the Pennsylvania R. R. for the abolishment of three grade crossings in the city. The work will cost about $100,000.

The Erie R. R. is reported to have about completed negotiations for a new entrance into Pittsburg. It is stated that the proposed Ohio River & Northern R. R., extending from the Westpoint coal fields of the Pennsylvania state line via Wellsville and East Liverpool, O., is now on a firm financial basis, and it is expected that the construction work will be completed this summer.

The City Council of Lorain is to call for bids at once for dredging requiring the removal of about 100,000 cu. yds. of material. C. M. Osborne, Lorain, is City Engineer.

Oklahoma Notes.

FROM CORRESPONDENTS AND OTHER SOURCES.

Preliminary surveys are under way for an interurban line though Pawhuska and Hominy from Arkansas City to Tulsa. Jacob Van Ransaeller, Pawhuska, Okla., is reported to be the Engineer.

The Gulf Pipe Line Co., F. A. Loevy, General Manager, Bartlesville, is to have work started at once on extending its Oklahoma pipe line into Osage County. The extension starts from Glenn Pool field and extends to Lot 52 in Osage County, a distance of 52 miles.

The Tulsa Street Ry. Co., of Tulsa, is to make improvement to its lines in that city. The company will double track on Main St. from Third to Frisco tracks and from Fifth to Eighth.

S. H. Owens, Okmulgee, Okla., has been awarded the contract to furnish 40,000 ties to be used in the construction of the Kansas City, Sapulpa & Southwestern Ry. between Sapulpa and Tulsa, the first section to be built. The road is to run to either Collinsville or Skiatook, thence southward through Nowata, crossing the Frisco at Miami and running thence to Joplin, where it will connect directly with the Kansas City Southern. No bonus money is to be paid by the towns until the line is completed and running as far as either Collinsville or Skiatook.

Advices from Oklahoma City, Okla., are to the effect that contracts were let recently to M. Cassidy, Oklahoma City, Okla., for the construction of the first 10 miles of the Denver, Kingfisher & Gulf railroad from Oklahoma City, and that the line will be let as far as Piedmont at once. Right of way has been secured, it is said. J. C. Gilmore is Chief Engineer and J. M. McDonald is President of the new company.

The Kansas, Oklahoma & Panama Ry. Co. has been chartered with a capital stock of $1,000,000 and headquarters at Sayre, Okla., and proposes to construct a line from Liberal, Kan., south to Sayre, in Beckham County, Okla., with a branch east from Sayre to Oklahoma City. Ohio and Indiana capitalists and business men of Sayre and other Western Oklahoma towns are backing the enterprise. Bonuses have been raised by a number of towns, among them Sayre, which will give $40,000. Richard W. Ruflin of Hamilton is the principal promoter, and he has been working up the project for three years and has recently completed negotiations for sale of bonds in the East. Others among the directors are John W. Lytle and W. F. Crawford of Indianapolis; D. R. Richardson, J. A. Whitehurst, G. L. Bennet and D. W. Mann of Sayre.

Oregon Notes.

FROM CORRESPONDENTS AND OTHER SOURCES.

The Coos Bay Rapid Transit Co., W. P. Evans, President, North Bend, has secured its franchise at Marshfield to operate an electric street car line in that city. The company has secured also in North Bend a franchise. The road is to be built to the city limits of Marshfield within four months and the work in the city finished within two months, thereafter.

J. F. Mounce, a railroad contractor of Eugene, has applied to the City Council of Eugene for a franchise to build a railroad through that city. He proposes to build a line from Eugene to the Coast, and already has had some surveys made and has secured much right of way. It is stated that construction contracts will be let as soon as 25 miles of right of way is signed up.

The Portland Railway, Light & Power Co. of Portland is securing right of way for its proposed line from Oregon City to Oswego, and it is said that as soon as the required rights are obtained actual construction will be commenced.

The City Council of Eugene has granted the local street railway company a franchise providing for the College Hill loop, which will add about six miles to the present street-car system of Eugene.

Material is now being shipped to The Dalles, Ore., for the construction of the proposed extension of the Oregon Railroad & Navigation Company's line from Big Eddy to that place. It is expected that the line will be ready for operation by Fall.

An announcement is reported to have been made by James J. Hill, President of the Great Northern R. R., that the proposed east to west railroad across the state of Oregon would be built and that construction work will be started soon.

Pennsylvania Notes.

FROM CORRESPONDENTS AND OTHER SOURCES.

Good progress is being made with the promotion work for the Lebanon-Ephrata Street Ry. Co., which proposes to build a trolley line between the places named. George D. Krause, Lebanon, Pa., is President.

The Hummelstown & Campbellstown Street Ry. Co. is to extend its line 1¾ miles from the site of the old Greiner school house, Hershey, northward on the road from Spring creek to Horseshoe turnpike, across the Philadelphia & Reading by an overhead bridge to a point within the lands of M. S. Hershey.

The City Council of Norristown is considering the application of the Philadelphia and Western Ry. for a franchise to build an electric line through the city to connect with the Lehigh Valley Transit lines.

The Johnstown Passenger Ry. Co., of Johnstown, has decided to extend its system from a point where the Roxbury line crosses Cheney run in the Eighth ward to the new town of Southmont in Upper Yoder township, a distance of nearly two miles. Work of building the extension is to be completed by Aug. 15.

The Slippery Rock & Grove City Street Railway Co. have awarded the contract for 9.25 miles of track between Slippery Rock and Grove City to Alfred DeMayo & Co., of New York for $173,000. Work has been started and the road is to be ready for operation Nov. 1. The company will use gasoline motor cars exclusively and orders have been placed for the equipment, consisting of four passenger and two combination passenger and baggage cars. Freight cars will be ordered in the fall.

City Council of McKeesport is considering application of the Pittsburg, McKeesport & Westmoreland Street Ry. Co., for a franchise for an extension of its lines to 5th Ave., McKeesport, along Lincoln Way.

Surveys are under way for the new electric railway from Coopersburg to Rieglesville by way of Passer.

The Philipsburg & Susquehanna Valley R. R., at present operating 16 miles of line, is to extend its road from its present terminus at Fernwood to Utahville, a distance of 4 miles. J. O. Reed, Philipsburg, Pa., is General Manager.

The Connellsville & State Line R. R. recently chartered, is to have work started shortly on its projected 68-mile line. It will be the connecting link between the Western Maryland and the Pittsburg & Lake Erie. From State line to Cumberland, Md., where connections with the Western Maryland proper will be made, another syndicate has been formed to build that portion of the new road. This latter road has just been incorporated under the laws of Maryland. Warren A. Wilbur, South Bethlehem, Pa., is President. This is the extension of the Western Maryland, contract for which has already been let to the Carter Construction Co. of Chicago, Ill.

Construction work is to be started shortly on the extension of the Hanover & McSherrystown, from McSherrystown to Conewago Chapel. At the latter place the proposed new road will branch, the one line coming to Gettysburg and the other to New Oxford.

Subcontractors in charge of L. T. Herndon, Chief Engineer of the Carter Construction Co., 184 LaSalle St., Chicago, Ill., which has the contract for building the 87-mile connecting line between the Western Maryland and the Pittsburg & Lake Erie Railroads, have been going over the proposed route from Connellsville to Ohiopyle.

Tennessee Notes.

FROM CORRESPONDENTS AND OTHER SOURCES.

Surveys are stated to have been made for an extension of the Greenville & Knoxville R. R. from Greenville, S. C., to Knoxville, Tenn. The road at present is in operation between Greenville and Cleveland, S. C., and the company proposes to extend it through the mountains to Knoxville, probably by way of Asheville, Canton, Wayneville and through the Pigeon river gap of the Smokies. W. H. Patterson, Atlanta, Ga., is President.

The Bristol Belt Line Ry. Co., of Bristol, has acquired the Holston Valley R. R., a line which has been operated as a lumber road between Bristol and Holston Mountain. The company will convert it into an electric line and operate summer cars its entire length of twelve miles, establishing a park on the Holston river bank, ten miles from Bristol.

Texas Notes.

FROM CORRESPONDENTS AND OTHER SOURCES.

H. H. Fielder and L. J. Gould, representing eastern capitalists, have made a proposition to the citizens of Somerville for the construction of a railroad west to Taylor. The road will be known as the Somerville & Taylor Short Line, and will connect the two towns on an air line of 60 miles. The proposed route will pass through Lexington and Dime

Box, and bring in some rich country through Burleson, Lee and Williamson counties.

J. G. Kelso, Galveston, Tex., has been awarded the contract for the drainage work in the Alvin Drainage District, bids for which were opened May 16 at Angleton, Tex. The contract price was 10½ cts. per yard for dry excavation and 16½ cts. for wet and $300 per mile for clearing the timber from the right of way.

Engineers are reported to have been making estimates of the cost of filling in the lower portions of the peninsula at Morgan's Point, near Houston, with a view to establishing a summer resort there. The plans are said to call for the expenditure of about $100,000. Joseph F. Meyer, Houston, is interested, it is said.

It is believed here in Houston that the Santa Fe will make an attempt to purchase the International Great Northern at the receiver's sale. Should the Santa Fe purchase this property, it is reported that it in turn will sell the Fort Worth & Houston line to the Frisco and will build from Temple to the International & Great Northern at some point most convenient, probably Marlin.

The San Antonio & Tampico R. R. Co. has been in conference with the State Railroad Commission relative to the issuance of $1,440,000 of bonds on 90 miles of the proposed road. It is reported that the railroad has been graded a distance of 18 miles. It is hoped that at least 45 miles of the road will be in operation by the time cotton begins to be moved in the fall.

M. R. Hoxie, of Lexington, Tex., has made a proposition to the Board of Trade of Taylor for the construction of the long proposed Taylor, Somerville & Gulf Ry., of which James A. Thompson of Taylor is President. The right of way of this route was surveyed and donated by property owners several years ago. It is now thought that the actual building of the proposed line will be undertaken. The idea is to extend when the line is completed from Taylor to Somerville, on to Houston.

Detailed plans have been prepared by F. L. Dormant, Consulting Engineer, Houston, for converting Buffalo bayou, between Smith and Travis Sts., into a public street, by covering it with a reinforced concrete viaduct.

The U. S. War Department has ceded a strip of its reservation on Pelican spit at Galveston, to the government health department for a site for the new quarantine station to be built for Galveston. The site embraces an area of 25.2-110 acres, being 1,400x800 ft. on the northeast corner of Pelican spit in the triangle formed by the Galveston and Texas City channel, and convenient to the Bolivar channel. The site is under water about 4 to 8 ft., and will have to be bulkheaded and filled to grade. It is understood now that the site has been determined upon that construction will begin in the near future. There is about $200,000 available for the quarantine station

Good progress is being made with the construction of the Houston-Galveston Interurban line. At the end of last week the status of the work was as follows: The hydraulic fill on Galveston island was about three-fourths completed. This consists of 120,000 cu. yds. of fill, and is being done by the North American Dredging Co. Other portions of the work, two sections of embankment work on the mainland were about 10 per cent completed. These two jobs are being done by J. C. Kelso of Galveston and Harty & Ford. The former is working the section between a point about two miles beyond Texas City junction to Clear creek, and the Harty & Ford contracting firm that section of the right of way between Clear creek and Brays bayou, at Harrisburg. Between these two, the causeway approach and the first mainland section, and between Houston and Brays bayou, there are three short sections of work. The upper two are embankment work, while the section near the causeway probably will be a hydraulic fill and embankment composite.

The Atchison, Topeka & Santa Fe Ry. has awarded the contract for two bridges on its Lometa-Brady-San Saba extension to the Union Bridge & Construction Co., of Kansas City, Mo. One of the bridges to be built over the Colorado River and the other over the San Saba River. The bridge across the Colorado River will be located 14 miles west of Dometa. It will be a structure of concrete and steel. There will be three concrete piers, built on a rock foundation, with the shaft of each pier 64 ft. in height. On the east bank of the river will be erected one concrete abutment, also on a rock foundation. There will be no necessity of driving foundation piles in consequence of the solid rock that lies below the surface. The steel work will consist of one 200-ft. truss, one 100-ft. dock girder and one 60-ft. dock girder. On the west approach to the bridge there will be a trestle approach 1,000 ft. in length. The high bank on the east side, however, obviates the necessity of any trestle construction at that point. The concrete piers will be built on the same general principle as those on the Galveston causeway, with a broad foundation and a straight shaft. In the entire bridge there will be 3,500 cu. yds. of concrete used. The San Saba bridge, which will be located 4 miles northwest of the town of San Saba and 27 miles west from Lometa, will also be of concrete and steel. There will be 1 concrete abutment and two concrete piers, also on a rock foundation. The amount of concrete used in this construction will come to 900 cu. yds. The steel work will consist of 1 100-ft. through girder and one 60-ft. through girder. This bridge will have a trestle approach of 800 ft.

Chief Engineer Dozier, Temple & Northwestern Ry., Temple, Tex., reports much activity along the line now under construction. The Santa Fe has awarded the contract for the construction of a 1½-mile track from its yards in the northern portion of Temple to the grade of the new railway in order that materials may be delivered by freight.

The citizens of Beeville have raised over $30,000 of the $50,000 bonus required to secure the Beeville & Eagle Pass R. R.

The Southern Pacific Ry., according to reports, has engineers in the field making surveys for a line from Bryan to San Antonio.

The Kansas City, Mexico & Orient Ry., it is said, is about ready to start preliminary work on the proposed extension of its line to tide water at Corpus Christi, Tex. W. W. Colpitts, Kansas City, Mo., is Chief Engineer.

Engineers of the Abilene & Southern Ry. are now running lines for the construction of the road from Abilene via Anson, Tex., to Hamlin. Construction work will be started shortly on the section of the line from Anson to Hamlin and the other section between Abilene and Anson will be taken up later. Percy Jones, Abilene, Tex., is Chief Engineer of the company.

Citizens of Brownwood, Tex., have succeeded in raising $40,000 of the required $50,000 bonus asked by the Brownwood Southwestern Railroad.

The New Orleans, Texas & Mexico R. R., the Gulf Coast Line of the Frisco R. R., is planning the construction of a branch line from Kingsville, Tex., to the Shore of Baffin's Bay at Riviera, where a new harbor will be constructed. B. F. Yoakum, New York, N. Y., is Chairman of the Board of the Frisco.

Committee of Tucumcari, New. Mex., Chamber of Commerce, is taking up the matter with Julian M. Bassett, Vice-President, and General Manager, Crosbyton & South Plains R. R., of extending the line from Spurr, Tex., to Tucumcari. John A. King, Hereford, Tex., is Locating Engineer of the company.

According to reports H. L. Mitchell, representing the North & South Railway, has submitted a proposition to the citizens of Alvord, Tex., to cross the Fort Worth & Denver R R., at that place providing suitable depot grounds will be donated with $8,000 cash bonus or 10 miles of right of way.

The Glen Rose & Walnut Springs R. R. Co., according to reports, has awarded the contract to the Utopia Construction Co., for completing the grade of the proposed line into Walnut Springs, Tex. It is expected that work will be rushed to completion and steel laid within a short time.

Farmers along the proposed route of the Santa Fe Railroad's projected Texico-Coleman Cutoff are offering a large bonus of about $200,000 for the immediate completion of the work. The last section, which is about 89 miles in length is on level prairie and will require only $1,450,000 for its construction.

An announcement recently made by an official of the Cotton Belt Railroad, at Waco, Tex., is to the effect that contract has been let to some St. Louis, Mo., firm for the construction of the extension from Gatesville, Tex., to Hamilton. A portion of the survey has already been made; an engineer will complete the work at once.

Grading work on the construction of the Missouri, Oklahoma & Gulf R. R., into Denison, is being pushed and three grading camps have been established between Denison and the crossing on Red River. It is expected that the road will reach Denison by Aug. 15

The San Angelo Street Ry. Co., of San Angelo, has offered to extend its street car system to the Junior College at San Angelo, if the citizens would raise a $15,000 bonus.

Utah Notes.

FROM CORRESPONDENTS AND OTHER SOURCES

The East Warm Creek Irrigation & Canal Co. has filed its articles of incorporations at Provo. The company has been formed to control and distribute the waters of East Warm Creek, near Goshen, for irrigation and domestic purposes. The capital stock is $9,000. N. W. Nelson is President; Charles Samson, vice-president; John B. Thomas, secretary and treasurer.

The Salt Lake & Ogden Ry. Co., Simon Bamberger, President, Salt Lake City, is planning to have work started in the late fall on an electric line to form a loop from Layton to Ogden, and taking in Syracuse, Hooper and Kanesville.

Virginia Notes.

FROM CORRESPONDENTS AND OTHER SOURCES.

Engineers of the Richmond & Chesapeake Bay Ry. have completed surveys for the projected electric line from Fredericksburg to Washington, D. C., and have started work on another route from Fredericksburg by way of Manassas. They will also survey another line from Occoquan by Mount Vernon to Alexandria, thence to Washington. Wm. Northrop, Richmond, Va., is General Manager.

J. P. Pettyjohn & Co., Lynchburg, have commenced work on the construction for the erection of a roundhouse and repair shops for the Virginia Ry. at Roanoke, Va.

West Virginia Notes.

FROM CORRESPONDENTS AND OTHER SOURCES

The Stockholders of the Cheat River & Monongahela Valley R. R. Co. and the Atlantic Northern R. R. Co. met at Kingwood, W. Va., and perfected the organization of the companies. Julius K. Monroe was appointed manager of both companies. The line of the Cheat River & Monongahela Valley R. R. will run from Albrightsville, on Cheat River, following down the general course of the river, crossing the Monongahela at a point below Point Marion to a point in Pennsylvania not yet definitely decided upon. The line of the Atlantic Northern R. R. Co. will run from Rowlesburg following up the general course of Cheat River, intersecting the Western Maryland Railroad at Parsons, W. Va.

The Kanawha & Michigan Ry., R. P Black, Division Engineer, Charleston, W Va., is stated to have awarded a contract for raising its tracks and building a bridge over the tracks of the Hocking Valley at Point Pleasant, W. Va., at an estimated cost of $100,000.

Washington Notes.

FROM CORRESPONDENTS AND OTHER SOURCES.

Advices from Port Townsend state that F. J. Bailey has been awarded the contract to enlarge the present wharf at Irondale. The dock when completed will be extended about 50 ft. further out into the bay and will have a frontage of 400 ft.

Right of way agents of the Oregon & Washington R. R. have been busy securing options on the right of way in Cowlitz Valley near Mayfield and Silver Creek, Wash., for the construction of a line for which surveys have already been made. J. R. Holman, Seattle, Wash., is assistant General Manager of the company.

Winston Bros. & McDougall, contractors of Minneapolis, Minn., who have the contract for double tracking the joint Hill-Harriman main line between Kalama, Wash., and Tenino, are making rapid progress on the work. The company is also bidding on the Point Defiance line of the Northern Pacific.

W. L. Darling, Chief Engineer, Northern Pacific Ry., St. Paul, Minn., is reported to have stated that bids were received for the construction of the company's water grade line from Tacoma, Wash., via Point Defiance and the Narrows to Tenino through the eastern portion of Thurston County, and that construction work will begin June 15.

An announcement has been made that the Chicago, Milwaukee & Puget Sound R. R. officials that a branch line would be constructed through the North River country to Centralia, Wash., with Portland, Ore., as the ultimate terminus. Contract for six miles of the road has been let to Andrew Peterson, Aberdeen, Wash.

Right of way has been secured, it is said, from Beverly to Hanford, Wash., for the branch line of the Chicago, Milwaukee & Puget Sound R. R., and construction work will be started soon. E. J. Pearson, Seattle, Wash., is Chief Engineer of the company.

Wisconsin Notes.

FROM CORRESPONDENTS AND OTHER SOURCES.

The Wisconsin & Northern R. R. has secured about 50 acres of land at Appleton for terminal purposes. The railroad, which is in operation between Crandon and Shewano, is to be completed to Appleton during the coming summer, it is said.

The R. Connor Co. has purchased the land and timber owned by the Mosinee Land Co. in the town of Emmet and will extend its logging road so as to haul the logs to Stratford to be sawed into lumber. The land comprises some 3,000 acres of virgin forest.

The State Railroad Commission will hold a hearing at Madison, on June 6, on the application of the Soo, for authority to build a line into Superior and through that city to its ore docks on St. Louis bay to enable it to compete with the Great Northern and the Northern Pacific in the ore carrying business. Including the ore docks and other facilities in that connection the 6.38 mile extension is estimated to cost $780,000.

Council Harbor Committee of Racine has reported in favor of making an appropriation of $5,000 for dredging the harbor.

Rapid progress is being made on the double track work of the Chicago, Milwaukee & St. Paul R. R., between Wabasha, Minn., and La Crosse, Wis. A dredge boat has been stationed near Whitman and proves very serviceable for building up the right of way by pumping sand from the bottom of the river to the new track through a pipe. The completion of this stretch of double track will give the company a double track line from LaCrosse, Wis., to St. Paul, Minn.

At a meeting recently held at Patch Grove, Wis., Carson Scott, Engineer, stated that 19 miles of track would have to be constructed on the proposed line between Patch Grove and Mt. Hope, and that the cost including the right of way would be about $200,000. Both towns are to vote bonds. W. E. Lewis, Patch Grove, Wis., and Jay F. Morse, Mt. Hope, are interested.

Canadian Notes.

FROM CORRESPONDENTS AND OTHER SOURCES.

The Canadian Pacific Ry. is planning to replace many of its wooden snow sheds through the Rocky Mountains with steel structures. Plans for the new structures have been prepared.

The Great Northern Ry., according to reports, is to double track its line from Portage La Prairie, Man., to Grand Forks, N. Dak.

The Toronto Construction Co., of Toronto, Ont., has been awarded the contract for the construction of the line which the Canadian Pacific will build from Coldwater to Atherly Junction, to give direct connection with Orillia. The contract is said to amount to about $500,000.

Mackenzie & Mann secured in Europe for use in the development of the interests of the company the sum of $40,700,000. Of this money $5,000,000 are for debentures of the Canadian Northern R. R. One million is to go to develop the Winnipeg Street Railway, three millions for steamships, seven and a half millions will be used in the recently-acquired timber mill and timber rights in British Columbia by the Western Canadian Lumber Co., fourteen millions will be expended on the Dunsmuir collieries in the same Province, six millions are to be used in the Brazeau coal fields and railway in Alberta, and the balance, $4,700,000, will be utilized for the building of the Duluth, Winnipeg & Pacific Railway from Virginia Mines, 70 miles, into Duluth, to establish a through connection with the Chicago & Northwestern Railway into Chicago. Wm. Mackenzie and D. D. Mann, Toronto, Ont., are the heads of the above interests.

The National Transcontinental Railway Commission reports that active construction work has now been started on the only gap in the line not hitherto under way—namely, the section between Nepigon and Abitibi. Construction is now being pushed along the whole line from Moncton west to Superior Junction, and the commission expects the road will be ready for operation between Winnipeg and Moncton for the wheat-carrying season of 1912. The completed portion of the line from Winnipeg to Superior Junction will be in active operation by the time the wheat begins to move next September.

The Grand Trunk Pacific has purchased the north end of Courtenay bay for terminals at St. John, N. B. Borings are at present in progress, with the view of necessary dredging to provide a harbor in the bay.

The following summary of the work to be done this year by the Canadian Northern Ry. was given by D. D. Mann, at Winnipeg: Upwards of $4,000,000 will be expended on new equipment this year, and 600 miles of steel will be laid. The work of relaving the old track with heavier steel from Port Arthur to Gladstone will be completed and millions will be expended in putting the roadbed of the company in first classs condition. Almost all the wooden bridges which remain on the line between Winnipeg and Port Arthur will be cut out and replaced with permanent steel structures. A dump of solid rock will be built for a mile and a half across Rainy Lake, and next season the company will have a double track on this piece of road.

The application of the Toronto Ry. Co. for permisison to lay tracks on certain streets of the city of Toronto, has been granted by the Ontario Railway and Municipal Board. The company propose to lay rails on Victoria St., Wilton Ave., Shuter, Teraulay, Agnes, Anderson, St. Patrick and Harbord Sts., and University Ave.

The Canadian Pacific R. R. has awarded the contract for an extension of its irrigation system into the eastern section of the irrigation block to James McDonnell & Co. of Vancouver, B. C., with whom are associated Winter, Boomer & Hughes and Grant, Smith & Co., all of Spokane, Wash. The contract is for $5,230,000, and includes canals calling for excavation of 28,000,000 cu. yds. of earth. The contract price is about $250,000, under the estimate of the C. P. R. and carries a time limit of five years. The work is to be started immediately and will irrigate 540,000 acres.

Haney, Quinlan & Robertson, of Toronto and Montreal, have been awarded the contract for section 6 of the Trent Valley Canal north of Campbellford. The contract price is about $600,000.

Tracklaying on the mountain division of the Grand Trunk Pacific out of Prince Rupert has been commenced, and it is expected 100 miles will be completed to Copper River by the end of July.

Mexican Notes.

FROM CORRESPONDENTS AND OTHER SOURCES

The Mexican Government has signed the concession for the construction of a railroad from the Isthmus of Tehuantepec to connect with the United Railroads of Yucatan at the City of Campeche. This is the concession granted to William Prim Wood, City of Mexico, noted previously in these columns. The road is to be built by the Vera Cruz, Tabasco & Campeche Ry. Construction Co., the officers of which are as follows: Donato Chapearpuge, president; William Prim Wood, vice-president; J. J. Lemmens, treasurer; A. L. Van Antwerp, secretary. The location of the proposed road is not complete, but the company expects to send out an engineering party at once and have the route completed and agreed on before the expiration of the six months' time limit. Two routes have been suggested, the first for the road to keep close to the foothills, thus avoiding much of the lowlands to the north, at the turn of the Yucatan peninsular. The other is to penetrate the lowlands further to the north, the road thus passing through some of the biggest and most important cities in the hot country, between the isthmus and the peninsular.

The Pacific Improvement Co., A. D. Shepard, San Francisco, Cal., owner of the Guatemala Central R. R. is to extend the railroad to the Mexican border where it will form a connection with the Pan-American R. R. The extension will be about 20 miles long.

The contract entered into between Leandro Fernandez, representing the department of communications and public works, and Lic. Francisco Alfaro, representing A. B. Adams, Incorporated, for the construction of a railroad starting at Puebla, Mex., and passing by the mines of coal at Tezcatlan and Tlaxiaco, Oaxaca, and ending at Lake Chacahua on the Pacific coast, has been approved in all its parts. The Puebla & Pacific Railroad Co., of Mexico, has been incorporated in Wilmington, Del., with a capital stock of $25,000,000 and proposes the construction of the railroad. The incorporators are as follows: Alfredo B. Adams, New York City; C. Melton A. Astley, London, England; Alexander M. Vandeleur, London, England.

The Mississippi Central R. R., R. K. Smith, General Manager, Hattiesburg, Miss., is to construct large piers at Mobile, Ala. The railroad will enter Mobile over the tracks of the New Orleans, Mobile & Chicago R. R.

Dr. D. W. Day, of Hartselles, owner of Clear Creek falls in Winston county, has been with a civil engineer looking over the ground preparatory to making a survey for the railroad from Decatur to the falls, a distance of 80 miles.

The Bell Lumber Co. of Minneapolis, Minn., has been awarded the contract for poles, ties, etc., for five miles of street railway to be built at Aberdeen, S. Dak., by the Aberdeen Street Ry. Co., of which C. N. Herreid, Aberdeen, is Manager. Construction contracts are to be let at once, it is said.

The Carter Construction Co., Chicago, Ill., is stated to have begun construction work on its contract for building the Western Maryland extension from Cumberland, Md., to New Haven, Pa. The Carter Construction Co., will itself build the section from Cumberland to Savage Tunnel, a distance of

20 miles. Savage tunnel is about one mile beyond the Mason and Dixon line in Pennsylvania. It will be the longest tunnel on the extension—about 3,200 ft. There will be three tunnels in Maryland and two in Pennsylvania.

The Southern Power Co., owner of water powers in South Carolina and North Carolina, has filed a $10,000,000 mortgage, to cover improvements and extension of the company's power system in the two states and in addition supply funds for building an electric railway from Anderson, S. C., to Charlotte, N. C., via, Spartanburg and Greenville. Of the amount, $3,000,000 is to be immediately available, the remaining $7,000.000 in bonds to be issued from time to time as required. James B. Duke is President.

The New York, New Haven & Hartford R. R. has petitioned the Connecticut Railroad commissioners for permisison to eliminate 21 grade crossing in the town of Newton, Conn.

The Chicago, Memphis & Gulf R. R. Co. has filed articles of incorporation in all the states through which it will pass.

Officials of the New York Central Lines and C. W. Hotchkiss, General Manager of the Chicago, Indiana & Southern Ry., have been inspecting terminal properties at Port St. Joe, Fla., and this has given rise to the rumor that the New York Central is contemplating the construction of a southern line, with a view to handling traffic passing through the Panama Canal. It is said that the road for some time has been negotiating for valuable water frontage at Port St. Joe.

Capt. R. G. Ross, Jacksonville, Fla., has been awarded the contract for building up the shore end of the north jetty at the entrance of Biscayne Bay, Miami, Fla. The contract calls for about 500 yds. of Florida lime rock and the contract price was $3.40 per yd.

Eyre-Shoemaker, Inc., Arcade Bldg., Philadelphia, Pa., are preparing to begin work on their contract for the construction of the new Sand Patch tunnel near Cumberland, Md., for the Baltimore & Ohio R. R. The Baltimore & Ohio also let to the same firm the contract for the third tracking of the line from Yoder's Station to Philson's.

A bill is before Congress directing the Secretary of the Navy to construct a single track siding to the navy yard along the Anacostia River at Washington, D. C., at a cost of $200,000, in addition to whatever amount may be required to pay for land taken. The line is to be constructed to the Navy Yard at Washington.

BIDS ASKED

Bridges.

Bids are asked on following work, the notes being arranged alphabetically by states:

Salinas, Cal.—Until 2 p. m., July 6, by T. P. Joy, Clerk of the Board of Supervisors, for the construction of a bridge across the Salinas River near Metz, in King City Road District, Monterey County. Lou. G. Hare, Salinas, Cal., is County Surveyor.

Brazil, Ind.—Until 11:30 a. m., by County Commissioners, for the construction of two bridges, one two-span concrete, 25 ft. each span, and one 60-ft. span steel superstructure. James L. Burns is Auditor of Clay County.

Newport, Ind.—Until 10 a. m., June 6, by County Commissioners, for the construction of a 40-ft. steel girder bridge, including abutments and retaining walls. H. T. Payne is County Auditor.

Hasting, Minn.—Until 10 a. m., June 8, by P. A. Hoffman, County Auditor, for the construction of a steel and concrete approach to the Cedar Ave. bridge located in Dakota County, Minn., crossing the Minnesota River.

Vicksburg, Miss. — Until noon, June 7, by Chancery Clerk, for the construction of wooden bridge or aprons near W. C. Mallett's place, in Red Bone Bottom. J. D. Laughlin is Clerk.

Marysville, Mo. — Until June 8, by County Commissioners, for the construction of about 50 bridges throughout the county.

Smithfield, N. C.—Until June 6, by Samuel T. Honeycutt, Clerk, County Commissioners for the construction of an iron bridge.

Massena, N. Y.—Until 2 p. m., June 4, by Town Committee, for furnishing all necessary labor and material for the construction of 600-ft. highway suspension bridge over the River de Grasse, Massena Center, N. Y. Barney S. O'Neill is Chairman of the Committee.

Syracuse, N. Y.—Until 1:30 p. m., May 31, by Board of Contract and Supply, for furnishing labor and material necessary for the erection of a steel plate girder bridge over Onondaga Creek at West Brighton Ave., Syracuse, N. Y. John J. Halloran is Secretary of the Board.

Fargo, N. Dak.—Until noon, June 2, by Arthur G. Lewis, County Auditor, for the construction of five bridges, repair of 6 bridges and the construction of 7 culverts.

Jamestown, N. Dak.—Until 2 p. m., June 6, by Andrew Blewett, County Auditor, for the construction of a concrete wall on the Main St. bridge in the city of Jamestown, N. Dak.

Wahpeton, N. Dak.—Until 2 p. m., June 6, by F. A. Burton, Auditor of Richland County, for the construction of three pile bridges. Separate bids will be received in wood or steel.

Cleveland, O.—Until 11 a. m., June 22, by Board of County Commissioners, for the construction of a culvert on the Center Ridge Road in accordance with Report No. 2629. John F. Goldenbogen is Clerk of the Board.

Steubenville, O.—Until 1 p. m., May 27, by J. M. Reynolds, County Auditor, for the construction of sub and superstructure of bridge No. 30, Smithfield Township.

Philadelphia, Pa.—Until noon, June 1, by Director of Public Works (readvertisement of bids called for May 17) for the construction of a bridge on the line of Fox St. over the Norristown branch of the Philadelphia & Reading Ry. It will be a steel I-beam structure, incased in concrete on concrete abutments and piers, 60 ft. wide and will have 1 30-ft. and 2 18-ft. spans. Willis Theble is Chief Clerk, Department of Public Works.

Arcadia, Tex.—Until 8:30 a. m., May 31, by B. F. Johnson, Secretary, Galveston County Drainage District No. 1, for the construction of between 50 and 100 bridges. R. W. Luttrell is Engineer of the District.

New Castle, Wyo.—Until noon, June 7, by Board of County Commissioners, for the construction of a bridge over the Stockade Beaver Creek near Owens side tracks on the M. W. road. J. W. Howell is County Clerk.

Greenock, Narva, Ont.—Until 3 p. m., May 26, by Thos. H. Purdy, Clerk, for the construction of two span flat arch bridge, 80 ft. long, at Stark's mill, Paisley.

Buildings.

Bids are asked on following work, the notes being arranged alphabetically by states:

Golden, Colo.—Until 9 a. m., June 9, by Board of Trustees, for concrete floors, suspended concrete floors, reinforced concrete building walls and wood roofing and composition covering for experimental ore dressing and metallurgical plant at the Colorado School of Mines. James T. Smith is Secy. of the Board.

Washington, D. C.—Until 11 a. m., June 6, by Col. F. L. Denny, Quartermaster, U. S. Marine Corps, Headquarters, Washington, D. C., for furnishing and installing mechanical equipment in the extension to marine barracks Navy Yard, Philadelphia, Pa.

Washington, D. C.—Steam Heating Plant—Until 2 p. m., June 14, by Department of Interior, Office of Indian Affairs, Washington, D. C., for furnishing the necessary materials and labor to construct and complete a central steam heating plant at the Wahpeton School, North Dakota.

Greenville, Ind.—Until 3 p. m., June 30, by James Knox Taylor, Supervising Architect, Treasury Department, Washington, D. C., for the construction, including plumbing, gas piping, heating apparatus, electric wiring and conduits of the U. S. Post Office at Greenville, Ind.

Francisco, Ind.—Until noon, June 4, by Trustee of Center Township, for the construction of two-story eight-room brick school house. Stanford Witherspoon, Township Trustee.

Boston, Mass.—Until 10 a. m., June 16, by Capt. A. M. Miller, Constructing Quartermaster, for the construction, including plumbing, heating, electric wiring and fixtures of an addition to the guardhouse at Fort Strong, Mass.

Minneapolis, Minn.—Until 3 p. m., June 27, by James Knox Taylor, Supervising Architect, Treasury Department, Washington, D. C., for the construction, including plumbing, of the United States Post Office at Minneapolis, Minn.

Clinton, Mo.—Until 3 p. m., June 23, by James Knox Taylor, Supervising Architect, Treasury Department, Washington, D. C., for the construction complete, including plumbing, gas piping, heating apparatus, electric conduits and wiring, of the United States Post Office at Clinton, Mo.

Plattsmouth, Nebr.—Until 3 p. m., June 28, by James Knox Taylor, Supervising Architect, Treasury Department, Washington, D. C., for the construction, complete, including plumbing, gas piping, heating apparatus, and electric conduits and wiring of the United States Post Office at Plattsmouth, Nebr.

Bayonne, N. J.—Until 8:30 p. m., June 9 by Board of Education, Bayonne, N. Y., for necessary labor and material for the conustruction of Public School building No. 11, between West 23d and West 24th Sts. W. J. Tomlin is Secretary of the Board.

Elmira, N. Y.—Until 5 p. m., June 13, by Daniel Sheehan, Mayor, for the reconstruction and restoration of the City Hall.

Fort Porter, N. Y.—Until 11 a. m., May 31, by Lieut. Benj. F. Castle, Constructing Quartermaster for addition and alteration to guardhouse at Fort Porter.

Fort Porter, N. Y.—Until 11 a. m., June 4, by Lieut. Benjamin F. Castle, for construction including plumbing, heating, and electric wiring of one gymnasium and post exchange building.

Madison Barracks, Sacket Harbor, N. Y.—Until 2 p. m., June 9, by Constructing Quartermaster, Madison Barracks, Sacket Harbor, N. Y., for remodeling and replacing old plumbing in barracks for four companies at this post.

Cincinnati, O.—Until 2 p. m., June 15, by Lieut. Col. J. G. Warren, U. S. Engineer, Cincinnati, O., for constructing office building at dam No. 37, Ohio River.

Aiken. S. C.—Until 3 p. m., June 24, by James Knox Taylor, Supervising Architect, Treasury Department, Washington, D. C., for the construction, including plumbing, heating, gas piping, heating apparatus, electric conduits and wiring, of the United States Post Office at Aiken, S. C.

Ottawa, Ont.—Until 5 p. m., June 14, by Napoleon Tessier, Secy., Department of Public works, for the construction of an addition to the eastern Departmental Building, Ottawa.

Roads and Streets.

Bids are asked on following work, the notes being arranged alphabetically by states:

Quincy, Cal.—Until July 8, by County Clerk, for the construction of a wagon road from the Denton ranch in Mohawk Valley to the boundary line between Plumas and Sierra Counties, near Gold Lake.

Fort Barrancas, Fla.—Until 11 a. m., June, 15, by Constructing Quartermaster, Fort Barrancas, Fla., for resurfacing the roadway from Bayou Grande to the Barrancas National Cemetery.

Clarksville, Ga.—Until 8 p. m., June 2, by J. H. Hicks, Mayor and Board of Councilmen for furnishing necessary labor and material for the construction of 8,000 sq. yds. of macadam pavement, 9,000 sq. yds. brick or concrete walk and 6,000 lin. ft. of curb and gutter. H. S. Jaudon is Engineer.

Boise, Idaho.—Until 2:30 p. m., June 11, by Constructing Quartermaster, for the construction of about 1,600 lin. ft. of macadam road, 20 ft. wide at Boise Barracks, Idaho.

Chicago, Ill.—Until 11 a. m., June 1, by Board of Public Improvements, for 24 contracts for street paving and improving.

Palmyra, Ill.—Until June 1, by Board of Commissioners of Highways, for the construction of hard road in this town. H. M. Gilbert is Town Clerk.

Bloomfield, Ind.—Until 2 p. m., June 7, by County Commissioners, for the construction of a gravel road in Stafford Township. Peter M. Cook is Auditor of Greene County.

Bluffton, Ind.—Until 1 p. m., June 9, by County Commissioners, for the construction of four gravel roads. O. D. Garrett is County Auditor of Wells County.

Brazil, Ind.—Until 11:30 a. m., June 6, by County Commissioners, for the construction of a gravel road 8,308 ft. in length. James L. Burns is Auditor of Clay County.

Greensburg, Ind.—Until 1 p. m., June 7, by County Commissioners, for the construction of macadamized roads in Sandcreek, Adams, Washington and Marion Townships. Frank E. Ryan is Auditor of Decatur County.

Kentland, Ind.—Until 1 p. m., June 6, by County Commissioners, for the construction of a macadam road in Jefferson Township. Elmer R. Bringham is Auditor of Newton County.

Mishawaka, Ind.—Until 6 p. m., June 20, by James W. Haverly, City Engineer, for paving North Mill St., from Second St. to Water St., with brick asphalt, bitulithic or creosoted wooden block, laid on 5 in. gravel foundation. The work includes 4,550 sq. yds. of pavement.

Mishawaka, Ind.—Until 6 p. m., June 6, by James W. Haverly, City Engineer, for improving the North side of West Second street, from a point 70 feet west of the West line of Alabama street, to a point 140 feet West of Logan street, by grading and paving that part not already paved and which is occupied by the Street Railway Tracks, with Vitrified Paving Blocks laid on a 6-inch gravel concrete foundation, tearing out the combination curb and gutter on the north side from Reddick street to a point 280 feet East of the East line of Milburn Place Addition, and constructing a 6x16 inch cement curb along the North side of said Second street from a point 70 feet West of the West line of Alabama street to a point 140 feet West of the West line of Logan street.

Rockville, Ind.—Until 1:30 p. m., June 7, by County Commissioners, for the construction of three gravel roads in Raccoon Township. H. A. Henderson is Auditor of Parke County.

Southport, Ind.—Until 7:30 p. m., June 6, by Board of Trustees for the construction of ce-

ment sidewalks on Church St. in said town. A. L. Barnes is Clerk of the Town.

Valparaiso, Ind.—Until noon, June 7, by County Commissioners, for the construction of a macadamized road in Porter and Liberty Townships, also one in Liberty Township. S. P. Corboy is Auditor of Porter County.

Winamac, Ind.—Until noon, June 7, by County Commissioners, for the construction of a road. Ellis S. Rees is Auditor of Pulaski County.

Albert Lea, Minn.—Until 5 p. m., June 7, by William Barneck, City Engineer, for the paving of Main St., with creosoted wood block, brick, mineral rubber or sandstone. The work includes 12,423.86 sq. yds. pavement and 4,388 cu. yds. of excavation.

Deerwood, Minn.—Until 1 p. m., June 1, by H. O. Skatrud, Town Clerk, for the construction of over 1 mile of grading work.

Billings, Mont.—Until 8 p. m., June 21, by J. D. Matheson, City Clerk, for the paving of certain streets in this city. The work includes approximately 9,856 sq. yds. of creosoted wood block pavement.

Kearney, Neb.—Until noon, June 10, by County Judge, for the improvement of several dirt roads in Thornton township. J. H. Dean is County Clerk.

Albany, N. Y.—Until June 6, by Board of State Highway Commissioners, for 39 road repair contracts. S. Percy Hooker is Chairman of the Board.

Brooklyn, N. Y.—Until 11 a. m., June 1, by President of Borough, Room 2, Borough Hall, City of New York, for thirteen street paving contracts, the largest being for regulating and repaving with asphalt pavement, concrete foundation, Henry St., from Atlantic Ave. to 4th Place. The contract includes the following approximate quantities: 14,200 sq. yds. of asphalt pavement, outside railroad area (five years' maintenance); 20 sq. yds. of asphalt pavement within railroad area (no maintenance); 40 sq. yds. of old stone pavement, to be relaid; 1,970 cu. yds. of concrete, for pavement foundation outside railroad area; 3 cu. yds. of concrete, for pavement foundation within railroad area; 7,940 lin. ft. of new curbstone, set in concrete; 250 lin. ft. of old curbstone, reset in concrete; 45 noiseless covers and heads, for sewer manholes; 14,110 sq. yds. of present pavement to be removed.

Dunkirk, N. Y.—Until June 2, by Common Council, for resurfacing with sheet asphalt West Fourth St. and paving Swan and Fox Sts., in this city. The work includes approximately 19,000 sq. yds. of pavement. R. H. Heppell is City Clerk.

New York, N. Y.—Until 11 a. m., May 26, by President Borough of Queens, City of New York, for seven sewer contracts, the largest being for sewer in Academy St., from Washington Ave. to Graham Ave., including the following approximate quantities, 700 lin. ft. 12-in. vitrified salt-glazed pipe sewer; 655 lin. ft. 15-in. vitrified salt-glazed pipe sewer 115 lin. ft. 12-in. vitrified salt-glazed culvert pipe; 1,512 lin. ft. 6-in. vitrified salt-glazed pipe sewer for house connections; 7 manholes, complete; 5 receiving basins, complete; 125 cu. yds. rock, excavated and removed; 2,000 ft. (B. M.) timber for bracing and sheet piling.

New York, N. Y.—Until noon, May 31, by President, Borough of Richmond, Borough Hall, New York City, for four street improvement contracts, the largest including the following approximate quantities: 15,000 sq. yds. of bituminous concrete pavement, with five (5) years' maintenance; 735 sq. yds. of vitrified brick pavement, including sand bed, and laid with cement grout joints, with five (5) years' maintenance; 11,400 sq. yds. of old foundation, prepared; 1,060 cu. yds. of concrete foundation; 1 cu. yd. of brick masonry; 8,010 lin. ft. of new 5-inch by 16-inch bluestone curbstone, furnished and set; 6,400 sq. ft. of old sidewalk, relaid; 30 sq. ft. of new flagstone, furnished and laid; 10 sq. ft. of new 3-inch bluestone coping, furnished and set; 15 sq. ft. of grating, reset; 100 lin. ft. of roof leader outlets, relaid.

Waterford, N. Y.—Until 8 p. m., May 26, by Town Superintendent, W. H. Conerty, at the office of Town Clerk, for the construction of an addition to the Hudson River road.

Carrollton, O.—Until noon, June 23, by A. K. Rader, Clerk of Village, for the construction of pavement of several streets throughout the village. The work includes the following approximate quantities: 6,415 cu. yds. of extra excavation; 18,904 sq. yds. vitrified block pavement; 14,504 lin. ft. of straight curb; 1,220 lin. ft. of circle curb; 760 lin. ft. of headers; 304 lin. ft. of 12-in. storm sewer complete; 2,610 lin. ft. of 18-in. storm sewer complete; 500 lin. ft. of 24-in. storm sewer complete; 11 catch basins complete; 11 inlet basins complete; 8 sewer manholes; 15 land monument covers.

Cleveland, O.—Until May 25 (readvertisement of bids asked April 20) by Board of County Commissioners, for grading, draining and improving the Independce Road No. 2 from Harvard Road to the property line between Henry Krapf and Peter Schmidt, about 8,910 ft. south of Harvard Road, in Newburg Heights Village. John F. Goldenbogen is Clerk.

Pittsburg, Pa.—Until noon, May 31, by County Controller, for the permanent improvement of Clifton and Bridgeville road and Library Extension Road No. 2. The first road will be paved with brick and the latter with macadam.

Fort Bliss, Tex.—Ice Plant.—Until Noon, May 31, by Capt. William H. Waldron, Constructing Quartermaster, for the construction of an ice

Sewers.

Bids are asked on following work, the notes being arranged alphabetically by states:

Perry, Ia.—Until 7:30 p. m., May 31, by Charles Wilson, City Engineer, for the laying of 1,050 ft. of 24-in. pipe, 635 ft. of 18-in. pipe, 250 ft. of 12-in. pipe, 700 ft. of 8-in. pipe and 600 ft. of open ditch, together with manholes and other necessary attachments.

Chicago, Ill.—Until 11 a. m., May 28, Department of Public Works, for furnishing necessary labor and material for the construction of sewers in 51st St. and 56th St., between Cornell Ave. and Lake Michigan. The work includes approximately: 825 lin. ft. of concrete invert in 51st St. sewer; 60 lin. ft. of 24-in. D. S. tile pipe sewer in 51st St.; 385 lin. ft. of 2½-ft. brick sewer in 56th St.; 385 lin. ft. of 18-in. D. S. tile pipe sewer in 56th St.; 305 lin. ft. of 12-in. tile pipe sewer in 56th St. B. J. Mullaney is Commissioner of Public Works.

Waukegan, Ill.—Until 8 p. m., May 26, by Board of Local Improvements, for two sewer contracts, known as Docket No. 356 and Docket No. 355. Alvah L. Rogers is Secretary and Fred Buck is President of the Board.

Portland, Me.—Until 10 a. m., June 4, by Capt. C. F. Humphrey, Constructing Quartermaster, Portland, Me., for the construction of additions to the water and sewer systems at Fort Williams, Me.

Ridgewood, N. J.—Until 8:30 p. m., May 31, by J. Blauvelt Hopper, Village Clerk, for the construction of a storm water sewer about 2,042 ft. of reinforced concrete construction and 3,430 ft. of vitrified pipe with necessary manholes, catch basins, etc. E. J. Harder is Village Engineer.

Fort Wingate, N. Mex.—Until 11 a. m., June 1, by Constructing Quartermaster, for the construction of a sewer system at the post.

Middleton, O.—Until Noon, June 7, by Charles C. Dell, Director Public Service, for the construction of concrete sewers including the following approximate quantities: 5 ft. 6 in. x 6 ft. 6 in., 1,992 ft.; 6 ft. 0 in. x 7 ft. 6 in., 2,808 ft.; 6 ft. 6 in. x 8 ft., 2,050 ft.

Youngstown, O.—Until noon, May 27, by Director of Public Service, for the necessary labor and materials for construction of sewers and grading Hiram St., between Caledonian St. and Union St. W. H. McMillin is Clerk.

Chattanooga, Tenn.—Until 2:30 p. m., June 7, by Board of Public Works, for the furnishing and installing of machinery and for the construction of a sewage pumping station. H. F. Van Dusen is Chairman of the Board.

Belton, Tex.—Until 8 p. m., June 14, by Belton Sanitary Sewer Co., for furnishing necessary labor and material for the construction of a system of sanitary sewers and sewage purification plant. The work includes as follows: The sewerage system, approximately 4,017 ft. of 12-in., 718 ft. of 10-in., 18,680 ft. of 8-in. vitrified pipe sewers, 67 manholes, 10 flush tanks. The sewage purification plant includes approximately 3,556 cu. yds. earth excavation, 366 cu. yds. rock excavation, 118 cu. yds. reinforced concrete, 80 cu. yds. plain concrete, 500 cu. yds. broken stone, piping and accessories. Charles B. Smith is Secretary of the company.

Huntington, W. Va.—Until 1 p. m., June 9, by Board of County Commissioners, for the construction of the lateral sewer in the alley between Washington and Virginia Aves., from 12th to 14th Sts. John Coon is Commissioner of Streets and Sewers.

Delavan, Wis.—Until 11:30 a. m., June 1, by E. H. Gormley, Chairman Committee on Streets for the construction of sewers in sundry streets.

Water Supply.

Bids are asked on following work, the notes being arranged alphabetically by states:

Corydon, Ia.—Until 7:30 p. m., June 6, by J. J. C. Bower, Town Clerk, for drilling an artesian well. A certified check for $300 must be filed with each bid. Iowa Engineering Co., Clinton, Ia., are the Engineers.

Chicago, Ill.—Until 11 a. m., June 1, by Board of Public Improvements, for six water service pipe contracts. Albert F. Keeney is President of the Board.

Dodge City, Kan.—Until 1 p. m., May 31, by P. I. Trebilcock, City Clerk, for furnishing material and labor for the construction of a water works plant. J. S. Worley Co., Reliance Bldg., Kansas City, Mo., are Engineers.

Savage, Minn.—Until June 5, by M. F. Zeller, Village Clerk, for the construction of four combination wells and cisterns for fire protection. Cisterns are to be 8 ft. wide and 10 ft. deep. Wells 20 ft. deep with 4-in. pipe.

Petersburg, Neb.—Until 4 p. m., June 10, by Village Board, for the construction of a water works system. William Ganiard is Mayor. Archer, Rollins & Co., Beals Bldg., Kansas City, Nebr., are Engineers.

Athens, Tex.—Until May 30, by City, for the necessary labor and material for the construction of complete water works system including pipe, valves and hydrants, tank and tower, water works pumps, air compressor, boilers, feed water heater and boiler feed pump.

Miscellaneous.

Bids are asked on following work, the notes being arranged alphabetically by states:

Hot Springs, Ark.—Electric Elevator.—Until 11:30, June 8, by Constructing Quartermaster, for the installation of a new electric elevator in the old Administration Building Army & Navy General Hospital and installation of a new electric elevator in the old hatchway.

Fort Barrancas, Fla.—Wharf.—Until 11 a. m., June 15, by Constructing Quartermaster, Fort Barrancas, Fla., for constructing an extension to the quartermaster's wharf at Fort Barrancas, Fla.

Springfield, Ill.—Tank & Tower.—Until Noon, June 8, by Board of Administration, Springfield Ill., for the construction of a tank and steel water tower at the Kankakee Hospital, Kankakee, Ill. Frank D. Whipp is Fiscal Supervisor. Official advertisement will be found elsewhere in this issue.

New Orleans, La.—Locks, Dam, Etc.—Until 11 a. m., June 15, by Lt. Col. L. H. Beach, U. S. Engineer, for the construction of a lock and dam and lock keeper's dwelling on the Bayou Teche, La. Work is also noted under confirmed reports.

Boston, Mass.—Electric System.—Until 10 a. m., June 6, by Capt. A. M. Miller, Constructing Quartermaster, Boston, Mass., for the construction of an electric lighting system at Fort Andrews, Mass.

Minneapolis, Minn. — Tunnels.—Until noon, May 31, by Board of Regents of the University of Minnesota, for the construction of about 3,600 lin. ft. of tunnel under the University Campus, together with five vertical shafts from the tunnel to the ground surface.

Omaha, Neb.—Steam Heating Plant.—Until 11 a. m., June 10, by Capt. F. C. Bolles, Constructing Quartermaster, for the installation of a steam heating plant in store house at Omaha Depot.

New York, N. Y.—Test Borings.—Until 4 p. m., June 2, by New York and New Jersey Interstate Bridge Commissions, 115 Broadway, Borough of Manhattan, New York, for making test borings at a proposed site of the Hudson River bridge over the Hudson River, at or about west of 109th St., and at or about West 179th St., New York City, to suitable points on the opposite shore in New Jersey.

Stillwater, Okla.—Railroad Work.—Until 10 a. m., May 25, by Chief Engineer Oklahoma Public Service and Interurban Lines, Stillwater, Okla., for the construction of approximately 13 miles of interurban line. Same to include separate bids on earth and bridge work. plant at this post.

Wheeling, W. Va.—Pier Work—Until 11 a. m., June 15, by Capt. F. W. Altstaetter, U. S. Engineers, for the construction of Poire dam foundations and extension of piers for Dam No. 13, Ohio River.

Ottawa, Ont.—Pier Extension—Until 5 p. m., June 3, by Napoleon Tessier, Secy., Department of Public Works, Ottawa, Ont., for the construction of an extension to the pier at Colchester, Essex County, Ont.

Toronto, Ont.—Railroad Work—Until Noon, June 8, by A. J. McGee, Secy.-Treas., Temiskaming & Northern Ontario Ry. Commission for clearing, grading embankment protection, driving of piles, building of culverts and laying of tile that may be required in connection with the construction of a branch line between North Bay and Nipissing Junction. Work is also noted under confirmed reports.

Toronto, Ont.—Chimney.—Until Noon, May 31, by G. R. Geary, Chairman, Board of Control, for the construction of a chimney at the pumping station of the filtration plant at the Island.

Excavation, Earth and Rock.

Bids are asked on following work, the notes being arranged alphabetically by states:

Washington, D. C.—Earthwork.—Until 10 a. m., June 8, by Department of Interior, U. S. Reclamation Service, for the enlargement of the Main South Side Canal near Boise, Idaho. Work includes about 342,000 cu. yds. of material.

Burlington, Ia.—Ditch Work.—Until 2 p. m., June 9, by County Auditor, for the construction of ditches in Des Moines County Drainage District No. 1. Harmon Engineering Co., Peoria, Ill., are the engineers. Work is also noted under Confirmed Reports. Official advertisement will be found elsewhere in this issue.

Des Moines, Ia.—Drainage Ditch.—Until Noon, June 20, by Board of County Supervisors, for the excavation and construction of drainage ditch located in Drainage District No. 11 in Elkhart Township. The work includes the moving of 53,471 cu. yds. of earth. H. B. Frase is County Auditor. Work is also noted under confirmed reports.

Chicago, Ill.—Concrete Work—Until 10 a. m., June 20, by Maj. Thos. H. Rees, U. S. Engineers, for the concrete superstructure, pile clumps, and interlocking steel sheeting in Michigan City Harbor, Ind.

Chicago, Ill.—Drains—Until 11 a. m., June 1, by Department of Public Improvements, for 11 contracts for the construction of drains. Charles V. Standish is Secretary.

Fairmont, Ill.—Drainage Work—Until 10 a. m., June 9, by Commissioners of Union Drainage District No. 1, G. W. Chenvront, Commissioner, for constructing a dredge ditch two miles long, requiring 50,822 cu. yds. of excavation; also for 7,930 ft. of tile work. Work is also noted under confirmed reports.

Jacksonville, Ill.—Levee Work—Until 11 a. m., June 2, by C. W. Brown, Engineer, Drainage District, Room 12, Scott Block, Jacksonville, Ill., for the construction of levees and ditches. Work is also noted under confirmed reports in this issue.

Aitkin, Minn.—Ditch Work—Until 10 a. m., June 6, by J. B. Lemire, County Auditor, for the construction of county ditch No. 14. The work is also noted under confirmed reports in this issue.

Redwood Falls, Minn.—Ditch Work—Until 1 p. m., June 2, by L. P. Larson, County Auditor, for the construction of Ditch No. 12. Work is also noted under Confirmed Reports.

Granite Falls, Minn.—Ditch Work—Until 10 a. m., June 1, by S. O. Tjosvold, County Auditor, for the construction of County Ditch No. 7, Yellow Medicine County. The work includes approximately 4,500 cu. yds. of material.

Fort Worth, Tex.—Levees, Etc.—Until 10 a. m., June 4, by Commissioners of Fort Worth Improvement District No. 1, of Tarrant County, Tex., at office of Robert G. Johnson, Chairman, Fort Worth National Bank Bldg., for the construction of levees and other improvements in the district. The work is also noted under Confirmed Reports.

Materials, Machines, Supplies, Etc.

Bids are asked on following work, the notes being arranged alphabetically by states:

Washington, D. C.—Dredge.—Until 10:30 a. m., June 27, by Capt. F. C. Boggs, General Purchasing Officer, Isthmian Canal Commission, Washington, D. C., for the furnishing of a twin screw steel ladder dredge having a hopper capacity of 1,200 tons of spoil.

Washington, D. C.—Steel, Iron, Bronze, Etc.—Until 10:30 a. m., June 9, by Capt. F. C. Boggs, General Purchasing Officer, Isthmian Canal Commission, Washington, D. C., for the furnishing under Canal Circular 585, the following materials: Steel, iron, bronze, copper, steel and copper tubing, pipe and fittings, exhaust valves, stovepipe, wire cable, rivets, bolts, nuts, taps, reamers, dies, bits, files, jacks, diaphragm pumps, boiler tube expanders, machinists' clamps, engine lubricators, oilers, gauge glasses, garbage cans, steam whistles, gaskets, leather fillet, leather belting, cardboard, etc.

Washington, D. C.—Lumber, Piles, Chain, Etc.—Until 10:30 a. m., June 17, by Capt. F. C. Boggs, General Purchasing Officer, Isthmian Canal Commission, Washington, D. C., for furnishing according to Canal Circular 584, lumber, piles, and Vanadium Steel Chain.

Jeffersonville, Ind.—Motors—Until 10 a. m., June 1, by Quartermaster, for furnishing motors for depot use as follows: One 2-H.P.; one 5-H.P.; two 10-H.P.; one motor, 15 horse power and one triplex pump.

Jeffersonville, Ind.—Lumber—Until 10 a. m., May 31, by Depot Quartermaster, for furnishing lumber as follows: 30,000 ft. B. M., sap gum seasoned; 15,000 ft. No. 1 common; 15,000 ft. No. 2 common; 20,000 ft. B. M., cottonwood, seasoned.

Fort Leavenworth, Kan.—Boilers—Until 11 a. m., June 7, by Capt. William D. Davis, Constructing Quartermaster, for the installation of six new boilers and overhauling the central heating plant at Fort Leavenworth, Kan.

Tompkinsville, N. Y.—Oil—Until 2 p. m., June 10, by Lighthouse inspector, Tompkinsville, for furnishing mineral and lard oils of the quality required for lighthouse service for fiscal year ending June 30, 1911.

Philadelphia, Pa.—Boilers—Until May 26, by Inspector, Fourth Lighthouse District, Philadelphia, for furnishing two Scotch boilers for Fenwick Island Shoal Light vessel, No. 52.

Seattle, Wash.—Screens—Until 11 a. m., May 26, by Capt. E. C. Long, Constructing Quartermaster, 482 Arcade Annex, Seattle, Wash., for furnishing and installing certain window and door screens in nine buildings at Ford Ward, Wash.

CONTRACT LET.

The following contracts have been let recently:

BRIDGES.

Decatur, Ala.—Bridge.—Southern Bridge Co., Birmingham, Ala., for the construction of a steel bridge over Cotace Creek, Morgan County. The bridge will have a span of 85 ft., and a 12-ft. roadway on tubes.

Clinton, Ill.—Bridges—Decatur Bridge Co., at $1,575, for the construction of the Murphy bridge over Ten Mile creek, two and one-half miles north of Clinton, and at $1,700, for the construction of the Sprague bridge, three miles southwest of Clinton.

Elkinsville, Ind. — Bridge — Pan-American Bridge Co., Newcastle, at $2,600, for the construction of a steel bridge across the Muddy Fork of Salt Creek near this city.

Danville, Ind.—Bridges.—Gill & Stokes, North Salem, Ind., and Ira H. Martin, city, for the construction of bridges in the county.

Anamosa, Ia.—Bridge—Clinton Bridge & Iron Works, Clinton, at $7,650, for the erection of a new steel bridge across the Wapsipinicon river near the boundary line of Hale and Oxford townships; V. L. Hansen, Monticello, at $2,300, for building the abutments to the bridge.

Federalsburg, Md.—Bridge—Luten Bridge Co., York, at $16,000, for the construction of a reinforced concrete bridge over the northwest fork of the Nanticoke river, this city.

Mankato, Minn.—Bridges—County commissioners have awarded the following bridge contracts to Hennepin Bridge Co., of Minneapolis: In Danville, at $1,435, 50 ft. span; in Pleasant Mound, at $673, 24 ft. span over Marble creek; in Danville, at $650, 28 ft. span in section 30; in Mapleton, at $1,070, three 16 ft. spans in section 26; in Mapleton, at $1,694, 60 ft. span over the Maple river; in Pleasant Mound, at $2,118, 60 ft. span over Willow creek.

Rome, N. Y.—Bridge—Frank W. Tuthill, at $3,437, for the construction of the abutments and wing walls of the proposed E. Bloomfield St. bridge across Mohawk River.

Jacksonville, Pa.—Bridge—P. J. McGovern, at $9 per cu. yd., for the construction of the concrete bridge over Altman's run in this city.

Ridgeway, Pa.—Bridge—Will Dickinson, city, for the construction of a 92 ft. span bridge across Elk Creek, three miles east of this city, on the Ridgeway & St. Marys road. The bridge will be of concrete throughout, requiring 15 tons of twisted steel bars for reinforcement and will be of the arch girder type, with a 16 ft. roadway.

Lancaster, Pa.—Bridge—Nelson Merydith Co., Chambersburg, at $3,519, for the construction of a bridge over the Conestoga Creek at Rupp's Mill, West Earl. The bridge will be of reinforced concrete.

Galveston, Tex.—Bridges—Union Bridge & Construction Co., Kansas City, Mo., for the construction of the two bridges on the Lometa-Brady-San Saba extension of the Santa Fe, one across the San Saba River and the other across the Colorado River.

ROADS AND STREETS.

Mobile, Ala.—Sidewalks—Kooiman & Co., at $0.68, for the construction of sidewalks in this city.

Phoenix, Ariz.—Road—Johnson & Shea, Riverside, Cal., for the construction of the first section of the Prescott-Phoenix territorial road, from Prescott to the Mount Union summit.

Tucson, Ariz.—Paving—Concrete Construction Co., at $9,000, for the construction of a macadamized roadway on North Stone Ave.

Sacramento, Cal.—Road—George Williams, at $1,395, for the construction of a new wagon road on Saratoga hill in District No. 2.

Stockton, Cal.—Paving.—Cy Moreing & Son, city, for paving roads in San Joaquin County.

Mishawaka, Ind.—Paving.—Western Construction Co., Lafayette, Ind., at $9,419, for paving South Mill St., with bitulithic.

Peoria, Ill.—Paving—Jansen & Zoeller, Pekin, at $1.69 per yd., for paving Washington St., from Fourth St. to Court St. The work includes 15,000 sq. yds. of pavement, 6,000 ft. of cement curb and 600 ft. of protection curb. The work will cost about $27,000.

Webster City, Ia.—Paving—Sullivan & Zitterell, city, for the construction of pavement in this city at the following prices; Paving alley, $2.08 per sq. yd.; paving Second St., $2.02 per sq. yd.; First, Division and Des Moines Sts., $1.96½ per sq. yd.; curbing and guttering, $0.67½ per ft.

Centerville, Ia.—Brick Paving. — Bids were opened May 13 by this city, Hall & Addams, Engineers, for paving, the contract being let to McGuire & Stanton, Leavenworth, Kans., at $64,711. The itemized bids received on the work were as follows: (1) standing for 25,930 sq. yds. brick paving on 5-in. base, 1½-in. cushion, with cement filler, the bid including grading; (2) for 20,910 lin. ft. combined curb and gutter, 24-in. gutter, 1-in. wearing coat, and (3) for 4,000 cu. yds. extra grading:

	(1)	(2)	(3)
M. Ford, Cedar Rapids, Ia....	$2.075	$0.55	$0.35
Cedar Rapids (Ia.) Con. Ct..	2.095	.57	.36
North. Const. Co., Cdr. Rapids.	2.14	.68	.36
McGuire & Stanton, Leavenworth, Kans.	2.03	.52	.30

Bovey, Mich.—Road—A. A. Mitchell, at $3,500, for widening the road between this city and Grand Rapids, from 12 to 30 ft.

Marquette, Mich.—Road—County road commissioners awarded the following road contracts: James Oxnam, Ironwood, at $9,306, for constructing the first four miles of the Ironwood and Watersmeet road. This section is between Ironwood and Bessemer; John Hanousek, Ramsey, at $4,922, for the next two miles, Bessemer township; Henry Poykonen, at $1,700, for the next mile; Andrew Katane, at $1,600, for the last mile.

Albert Lea, Minn.—Curb & Drains.—Albert Lea Construction Co., at $4,620, for constructing 9,800 ft. of concrete curb and drains. Bids were opened May 18.

Sedalia, Mo.—Road—Hyatt & Johnson, at $15,000, for the construction of six stretches of rock and gravel roads, one-half mile extensions of road previously constructed, as follows: Georgetown, Ben Harned, Smithton, Abel, Beaman and Dresden.

St. Joseph, Mo.—Paving—Phoenix Brick & Construction Co., for paving Fourth, Albermarle to Isabelle, with brick, at the following prices: New curbing, $0.40; old curb reset, $0.16; old curb recut and reset, $0.20; artificial stone sidewalk, per sq. ft., $0.12½; new brick walk, $0.80; old brick walk relaid, $0.30; vitrified brick paving, $1.29¾ per sq. yd.

Havre, Mont.—Walks. — To Meracle Construction Co., Minneapolis, Minn., at $8,500, for constructing about 37,900 sq. ft. of cement walks.

Port Jervis, N. Y.—Paving.—A. Demarest, Seward, N. J., at $23,706, for grading and macadamizing a public road in Seward County.

Syracuse, N. Y. — Paving — Warner-Quinlan Asphalt Co., at $5,797, for paving Furman St. with asphalt; F. J. Baker, at $6,680, for the paving of Dewitt St. from James St. to Highland Ave., with stone curb; and at $6,151, for paving Oxford St. from Cortland Ave., to Onondaga circle.

Rochester, N. Y.—Paving & Water Mains—Following contracts have been awarded by the board of contracts: Ripton & Murphy, at $3,332, for trenching and laying water pipe in group 238; Whitmore, Rauber & Vicinus, at $2,934, for paving and sewering Tallinger alley; at $24,545, for paving Mt. Hope Ave. with asphalt and Medina block; at $9,679, for paving Oakland St. with brick; and at $18,567, for paving Federal St. with brick.

Cleveland, O.—Paving.—Enterprise Paving & Construction Co., 8444 Broadway St., Cleveland, O., for the construction of block stone pavement in this city. Bids were opened May 14.

Cleveland, O.—Paving.—Standard Paving Co., city, at $10,778, for paving on Cornell road at Nickel Plate Railroad crossing.

Steubenville, O.—Paving—J. O. Bates for the construction of cement walk and paving on Park St. and Grandview Ave., in Pleasant Heights.

Holdenville, Okla.—Paving—Shelby & Downard, Ardmore, at $1.87 per sq. yd., for the construction of the first 20 blocks of paving in this city. The pavement will be of rock asphalt and the work will commence within 60 days.

Scranton, Pa.—Grading & Sewers—P. F. McGowan, Avoca, at $21,000, for the grading of streets, laying of sewers and flag walks on the plat of the Naw Aug Park Land Co.

Connellsville, Pa.—Paving — James Nixon, Clairton, for paving with brick the road leading from the county home to Jenning's run in South Union township.

Ellensburg, Wash.—Paving—D. A. Williams, Tacoma, at $150,000, for the paving of the entire business district of the city, approximately 13 blocks, with asphalt pavement.

Olympia, Wash. — Roads — State Highway Board has awarded the following contracts for constructing roads: J. C. Charles, Keller, at $15,839, for state aid road No. 4, Lincoln county; Warren Shorts, Seattle, at $7,415, state aid road No. 15, Cowlitz county; W. F. Guernsey & Co., Seattle, at $87,033, state aid road No. 69, King county; P. E. McHugh, Tacoma, at $51,181, state aid road No. 70, Pierce county; Sloan Bros., Seattle, at $11,123, state road No. 7, King county.

Janesville, Wis.—Paving—George W. Graham of Gund-Graham Co., at $26,000, for the construction of brick paving in this city.

Winnipeg, Man.—Paving.—J. W. Astley, engineer of construction for the city, for the construction of asphalt pavement in this city.

SEWERS AND WATER SUPPLY.

Decatur, Ala.—Sewer—McPoland & O'Gara, for the construction of the laterals to the new addition to the sewer system in New Decatur.

Cedar Falls, Ia.—Sewers.—W. D. Yeager, Cedar Rapids, Ia., at $2,891, for the construction of storm sewers in this city; Schorle & Kenety, Dubuque, Ia., at $4,427, for the construction of sanitary sewers. Bids were opened May 23.

Springfield, Ill.—Sewers—Henry Nelch & Son, for the construction of sewers as follows: On 17th St., from Cook St. to Laurel St.; Edwards St., from 18th St. to Wheeler Ave.; Edwards St., from 11th St. to 14th St., at $1.25, $0.80 and $1.10 per lin. ft., respectively.

Brazil, Ind.—Water Mains.—U. S. Cast Iron Pipe & Foundry Co., 217 La Salle St., Chicago, at $25.95 per ton, for furnishing 3,000 ft. of 4-in. cast iron water mains. Bids were opened May 17.

Manahattan, Kan.—Sewer System—W. W. Cook & Son, Junction City, for the construction of a sewer system in this city.

Boston, Mass.—Remodeling Water System.—J. A. Costello, city, at $2,345, for remodeling water system at Fort Strong, Mass. Bids were opened Apr. 23.

Baltimore, Md.—Sewer.—United Engineering & Construction Co., city at $83,836, for the construction of sanitary sewer, Jones, Falls interceptor, contract No. 50, Section No. 2. Bids were opened May 4.

Baltimore, Md.—Sewer—United Engineering & Construction Co., city, at $83,836, for building the Jones' Falls sanitary interceptor for the sewerage commission.

Hutchinson, Minn.—Sewer & Water Main.—L. W. Schruth, Fargo, N. Dak., at $4,106, for

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CHAS. S. HILL
C. T. MURRAY
F. A. SMITH
} EDITORS

MYRON C. CLARK . . . . . PUBLISHER
F. P. BURT . . . . . MANAGER
CALVIN B. ROSS . . . . . ADVERTISING MANAGER

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CONTENTS.

EDITORIAL:

The Question of Contract or Day Labor as Seen by the "Pacific Outlook".....491
Contract or Day Labor.....492

CONCRETE SECTION:

Standard Specifications for Reinforcing Bars for Concrete.....492
Requirements of Successful Granolithic Floor Construction with Specifications for Mill Floors.....492

EARTH AND ROCK SECTION:

An Economical Substitute for a Timber Trestle in Making a High Embankment..494
A Modern Stone Crushing Plant of 600 Cu. Yds. Capacity per Hour, Some Costs of Drilling, of Maintenance of Plant and of Erecting Machinery.....495
Earthwork Shrinkage, Application and Amount.....498
Annual Meeting of the Society for the Promotion of Engineering Education.....499

ROADS AND STREETS SECTION:

English Methods and Experiences in Dust Prevention and Road Preservation and in the Construction of Tar Bound Roads...500
Bituminous Macadam in State Road Construction Work in New Jersey.....503

WATER-WORKS AND SEWER SECTION:

Some Published Costs of Tunnel Work on the Los Angeles Aqueduct.....504

GENERAL SECTION:

Pressure Resistance and Stability of Earth.507

The Question of Contract or Day Labor As Seen by the "Pacific Outlook."

Two weeks ago we quoted from the *Pacific Outlook*, a journal for good government published in Los Angeles, Cal., a defense of day labor work by the assistant chief engineer of the Los Angeles aqueduct. In this issue we publish costs compiled from various sources of portions of the aqueduct work and also reprint an editorial on the question between day labor work and contract work which we find in a later issue of the journal named. This editorial shows so very incomplete a conception of the question at issue and of the breadth of the study that has been given to it that it deserves comment. The question of the relative economy of day labor and contract work may, we think, claim interest aside from the "principles of democracy and good government" involved. The construction and maintenance of sewers, water-works, streets and buildings account for the great bulk of the money spent by every city in its public services to the people, and we doubt if it will be regarded by many as a "dull subject" or a "commonplace detail" to learn whether this money is expended in the most economical and efficient manner. We suspect that the apology of our contemporary for devoting the space that it has to the subject is rather gratuitous.

The editor of the *Pacific Outlook* mistakes the position of the "firm of Boston engineers" and of "engineering and contracting publications" in the study of the economics of day labor and contract construction. So far as the publications named go, the truth is that "most" of them have very persistently refrained from taking any "attitude" or have taken one in favor of day labor work. Indeed we know of no documents of similar importance on the economics of construction work which have received less space in "engineering and contracting publications" generally, than have the reports of Metcalf & Eddy on Boston's sewer and water-works construction finances. It should be noted carefully just what was the work done by these gentlemen who are the "firm of Boston engineers" to which our contemporary refers.

Messrs. Metcalf & Eddy were employed as engineers to investigate the financial management of the construction and maintenance work of the water-works and sewer departments of the city of Boston. Other experts were similarly employed to investigate the work of other city departments—this is an item that should not be overlooked. These engineers performed their tasks with notable thoroughness and reported the results in detail. It is these detailed reports of their findings with which students of the question between day labor and contract work have to deal, and not the opinions of the investigating engineers, as then or afterwards given personal expression. It matters much of course that these engineers voiced their opinions after finding the facts, but it matters much more that the facts were found. The position is not that a "firm of Boston engineers" is "throwing the weight of its influence in favor of contract work," but that the facts disclosed by them and by other engineers working independently are doing so. Let us keep to this point.

Our contemporary properly submits that "the experience of nine cities out of ten shows that work can be done more cheaply under contract than by direct day labor." We think this estimate is over liberal to day labor work but it may stand as put. Why is day labor not as cheap as contract work? The editor of the *Pacific Outlook* finds that the advocates of contract work "explain" it by the claim that "city officials and employes are largely incompetent or dishonest or both." We are at loss to know where our contemporary got this "explanation." None but a very superficial study of the reports of the engineers who investigated conditions in Boston would give it, and certainly the editorials which have been published in ENGINEERING-CONTRACTING have been more poorly put than we had realized if they have seemed to give it. Incompetency and dishonesty of city officials have had a part in the extravagant cost of day labor work in many instances, but were these the only causes the case against it would be far weaker even than our contemporary asserts. The fundamental reason for the high cost of day labor work goes deeper and spreads far wider; the conditions governing day labor work violate the fundamental law of economic production, which is that the reward shall increase with increased performance.

It is important that the arguments of those who advocate contract work should be clear to and be made clear by journals like our contemporary, and they will bear repeating. The contract system of doing public work is advantageous for the following reasons:

(1) The contractor is paid for his services by his profits. Let it be noted here, because it is important, that these profits are a recompense for skilled service and nothing else. It is a common error to assume that the contractor's profits are something for which the city gets nothing, a gift of a sort to the contractor. Dispense with the contractor and the city must substitute some one in his place to render the service of manager. This substitution can never be complete. The contractor is a manager appointed by no official, elected by no party or persons, selected by no civil service examination. He has become a manager by virtue of the law of the survival of the fittest in the competition and strife of business. He is a skilled manager because skill is the price that competition demands for allowing him to continue in the business of contracting. He is an efficient manager because his pay (profits) is determined by his efficiency; his salary does not go on regardless of cost, indeed unless he watches closely the cost he may get no salary.

(2) The contractor is a master. He is free to pay his superintendents according to his judgment of their worth and his workmen according to their output. The city's manager, appointed, elected or selected by examination, is not a master—at most he is only a proxy for a master. And who is this master? He is a thousand, a million, or perhaps, if a Panama canal is being built, four score million—never seen, never felt, never heard, never a living personality on the job. Granting such a manager all honesty, why should he sit up nights devising ways of increasing output and reducing costs? Why should he go about by day jumping on his lieutenants and workers to sting them into action? Will he get a share in the savings effected, a partnership in the business, an increase in salary? No, he will simply lose sleep and make enemies of his subordinates. We are not forgetful of the impulse to make a good record, we will even grant this impulse and not the hope of financial gain to be all important with the chief himself, but his hands are tied by the indifference to it of the vast majority of the men beneath him.

There are other reasons for the superior economy of contract work. A contractor is more free to try out and to invent labor saving devices; he is not restricted to working his plant in one locality nor on one class of work; he can usually buy machines and materials more cheaply, and he can do his work with less expense for overhead charges. But these are all minor items compared with the two first mentioned. It is not plant, it is not organization, it is not personal honesty that determines costs. They are factors in favor of low costs, but factors which count for little unless directed by a mind keenly bent on saving every penny and free to bring every resource to bear to make that saving possible.

The editor of the *Pacific Outlook* mentions with pride the cities of Galveston and Des Moines with their commission forms of city government. He looks with no more hopeful eye on this form of government than does ENGINEERING-CONTRACTING. Were it the fact, as our contemporary assumes, that the extravagant cost of day labor construction is "because city officials and employes are largely incompetent or dishonest or both," then commission government might give us a solution of our problem. But this is not the fundamental cause of high day labor costs, it is merely a factor which is often perhaps, but not always operative. An honest and efficient commission government will palliate in a measure the conditions that lead to extravagance in day labor work, but it will not strike to the root of the reason that makes contract work more economical. This is not a reflection on commission government or on the men who head these commissions. It is merely a recognition of a controlling influence in human nature. There are few men of higher honor or greater faithfulness to duty than the teachers of our engineering schools, but this is what one of the best of them and a man of wide practical experience has to say of the cause of inefficiency in engineering school training:

With reference to administration, the fun-

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damental limitation to efficiency seems to me to lie in a fact which has already been referred to, namely, that the administrators—that is to say, the trustees—have no financial interest at stake. This is the fundamental difference between the administration of a college and the administration of a business concern. Where men have no financial interest they cannot be expected to fully realize the responsibility, nor will they be apt to energetically take the necessary steps to insure efficiency.

For this reason, among others, I do not believe that education ever can be as efficient as business. I am not unmindful of the fact, of course, that there are many men who, if they accept positions on a board of college trustees, will take the same pains and feel the same responsibility as if they were trustees of a business corporation in which their own money as well as the funds of widows and orphans were invested; but this is somewhat contrary to human nature and must always be the exception. Money, or rather the love of it, may or may not be the root of all evil, but it certainly comes very near being the source of all efficiency.*

Instead of opening the door to the possibility of efficient day labor construction commission government of the kind which the *Pacific Outlook* mentions as existing at Galveston and Des Moines opens a certain way to developing the highest economies of contract construction. Practically the only well founded criticisms of doing city work by contract are (1) collusion between contractor and city official to defraud, (2) inefficiency and favoritism because of political influences. Eradicate these so that bids can be made on plain and fair specifications and with free and open knowledge of conditions and complete assurance of freedom from graft and contract costs will show an economy which can be reached in no other way.

In concluding we may mention that the closing paragraph of the *Pacific Monthly* editorial which we reprint is about as close an approach to tenuity of argument as a comet's tail is to tenuity of matter. How in heaven's name is a city "dodging responsibility" by having its sewers built or its streets paved by contract? Why is it a "confession" that "means paralysis of all effort toward improvement" to call upon expert constructors to build bridges and pumping engines? As well might we say to a merchant that it "means paralysis of all effort toward improvement" for him to contract with his shoe maker instead of setting up a cobbler's bench in his basement. If the call for socialism in city government has no better arguments than these it is in a mighty bad way.

Contract or Day Labor.

Pacific Outlook has given space lately to discussion of the comparative merits of contract and direct day labor as applied to city work. This may seem to some of our readers a dull subject, dealing with a commonplace detail of administration, but in reality it involves some important principles of democracy and good government, and for that reason is well worth space.

A firm of Boston engineers which has made a special study of economic municipal administration and whose reports on such topics have attracted national attention, is throwing the weight of its influence in favor of contract work and most of the technical engineering and contracting publications take the same attitude. These people have a simple and convincing argument—viz.: that the experience of nine cities out of ten shows that work can be done more cheaply under contract than by direct day labor. Case after case is cited of cities that try one method or the other, and almost invariably the figures prove that economy lies on the side of the contractor.

Yet these advocates of the contractor system give their whole case away when they

(Continued on page 506.)

*Extract from an address by Prof. Geo. F. Swain, M. Am. Soc. C. E., of Harvard University, at the opening of the new engineering building of Union University, Schenectady, N. Y.

Concrete and Reinforced Concrete Section

Note: This section is devoted to methods and cost of constructing concrete and reinforced concrete structures. It will cover the selection, testing and proportioning of concrete materials; laboratory tests of concrete; concrete mixing, transportation and placing; fabrication and placing of reinforcement, and form construction and erection. It will also contain articles on new and interesting developments in the design of reinforced concrete.

Standard Specifications for Reinforcing Bars for Concrete.

The specifications for structural steel of the Association of American Steel Manufacturers are well known to bridge and structural engineers as safe and reliable. When not otherwise specified all steel shapes for structural work are manufactured according to these specifications and that means of course that they control a great bulk of all structural steel. To supplement these structural steel standard specifications the association has just adopted by letter ballot a standard specification for reinforcing rods for concrete which we reprint as follows:

Manufacture.—1. Steel may be made by either the open hearth or Bessemer process. Bars shall be rolled from billets.

Chemical and Physical Properties.—2. The chemical and physical properties shall conform to the following limits:

Properties considered.	Structural steel grade. Plain bars.	Structural steel grade. Deformed bars.	High grade. Plain bars.	High grade. Deformed bars.	Cold-twisted bars.
Phosphorus, maximum.					
Bessemer	.10	.10	.10	.10	.10
Open-hearth	.06	.06	.06	.06	.06
Ultimate tensile strength, lbs. per sq. in.	55/70,000	55/70,000	80,000 min.	80,000 min.	R'c'd'd only
Yield point, minimum, lbs. per sq. in.	33,000	33,000	50,000	50,000	55,000
Elongation, per cent in 8 ins., minimum	1,400,000	1,250,000	1,200,000	1,000,000	5%
	T. S.	T. S.	T. S.	T. S.	
Cold bend without fracture:					
Bars under ¾-in. in diameter or thickness	180°d.= 1t.	180°d.= 1t.	180°d.= 3t.	180°d.= 4t.	180°d. 2t
Bars ¾-in. in diameter or thickness and over	180°d.= 1t	180°d.= 2t.	90°d.= 3t.	90°d.= 4t.	180°d.= 3t

The hard grade will be used only when specified.

Chemical Determinations.—3. In order to determine if the material conforms to the chemical limitations prescribed in paragraph 2 herein, analysis shall be made by the manufacturer from a test ingot taken at the time of the pouring of each melt or blow of steel, and a correct copy of such analysis shall be furnished to the engineer or his inspector.

Yield Point.—4. For the purposes of these specifications, the yield point shall be determined by careful observation of the drop of the beam of the testing machine, or by other equally accurate method.

Form of Specimens.—5. (a) Tensile and bending test specimens may be cut from the bars as rolled, but tensile and bending test specimens of deformed bars may be planed or turned for a length of at least 9 ins. if deemed necessary by the manufacturer in order to obtain uniform cross section.

(b) Tensile and bending test specimens of cold-twisted bars shall be cut from the bars after twisting, and shall be tested in full size without further treatment, unless otherwise specified as in (c), in which case the conditions therein stipulated shall govern.

(c) If it is desired that the testing and acceptance for cold-twisted bars be made upon the hot rolled bars before being twisted, the hot rolled bars shall meet the requirements of the structural steel grades for plain bars shown in this specification.

Number of Tests.—6. At least one tensile and one bending test shall be made from each melt of open heart steel rolled, and from each blow or lot of ten tons of Bessemer steel rolled. In case bars differing ⅝ in. and more in diameter or thickness are rolled from one melt or blow, a test shall be made from the thickest and thinnest material rolled. Should either of these test specimens develop flaws or should the tensile test specimen break outside of the middle third of its gaged length, it may be discarded and another test specimen substituted therefor. In case a tensile test specimen does not meet the specifications, an additional test may be made.

(d) The bending test may be made by pressure or by light blows.

Modifications in Elongation for Thin and Thick Material.—7. For bars less than 7/16 in. and more than ¾ in. nominal diameter or thickness, the following modifications shall be made in the requirements for elongation:

(e) For each increase of ⅛ in. in diameter or thickness above ¾ in. a deduction of 1 shall be made from the specified of elongation.

(f) For each decrease of 1/16 in. in diameter or thickness below 7/16 in. a deduction of 1 shall be made from the specified percentage of elongation.

(g) The above modifications in elongation shall not apply to cold-twisted bars.

Number of Twists.—8. Cold-twisted bars shall be twisted cold with one complete twist in a length equal to not more than 12 times the thickness of the bar.

Finish.—9. Material must be free from injurious seams, flaws or cracks, and have a workmanlike finish.

Variation in Weight.—10. Bars for reinforcement are subject to rejection if the actual weight of any lot varies more than 5 per cent over or under the theoretical weight of that lot.

Requirements of Successful Granolithic Floor Construction with Specifications for Mill Floors.*

The experience of this company in its own construction work has shown it that the highest degree of serviceableness in a granolithic surface can be obtained only by following very carefully certain principles of construction and certain methods of manipulation, and this company has believed, and in the light of recently accumulated evidence, still believes, that the properly constructed granolithic surface is cheaper in first cost and will give more wear for general factory and machine shop purposes than the wood top floor. In making this statement we have no intention of asserting or seeming to assert that every granolithic floor, however constructed, is necessarily better than any wood top floor. That would be absurd on the face of it.

There are certain situations where in spite of its higher first cost the wood top floor is propably better than any granolithic surface for the owner to put in, simply because his case may require certain qualities which the wood top can provide, which no masonry surface can give, and which he must have, even at a higher first cost. It must also be clear

*Extract from an article furnished by the Aberthaw Construction Co., Boston, Mass.

that a granolithic surface so faultily laid that it loads the work room with dust created by the movement of the workers' feet, that chips and cracks freely under blows from material moved about on it, or that peels off from the concrete floor slab underneath, is not a good investment for the owner, even though its first cost was less than that of wood top. The virtues of a wood floor are inherent in naturally formed material whose fitness is apparent at a glance. Saw up the tree, season the sawed and planed strips, let any carpenter make them into a floor, and you have a wearing surface of certain high recognized value. With the granolithic surface, in contrast, it is necessary to select cement and aggregate for certain qualities not evident in the appearance of these materials, to determine proportions, to put the materials on the right kind of surface at the right time, to manipulate them in just the right manner, and to protect the green surface for a certain number of days while it is setting. The mere statement of the procedure necessary with the granolithic finish is enough to show that the average granolithic floor will be more or less unsatisfactory because the average concrete worker is inclined to haste, and is often ill informed as to the procedure necessary for getting a good surface. In other words, the success or failure of the granolithic surface in point of durability comes down to the question of workmanship.

Cost.—Certain general principles which apply to the matter of choosing between the granolithic and wood surface may well be stated as a preface to a more detailed discussion. A 1-in. troweled surface of cement finish can be put in place for about the cost of good quality maple top flooring delivered on cars at the site of the work. The difference in cost between the top floor of cement and that of wood will be the cost of the under floor, the screeds, and cinder or other fill between the screeds, plus the cost of the extra strength in columns and girders required to carry the load of the combination wood floor, which is much heavier than the 1-in. granolithic finish. On the ground of first cost therefore the advantage is entirely with the cement floor.

The difference in cost is not merely a question of the comparative cost of laying an inch of granolithic surface and laying the maple top with its under floor and screeds. The granolithic finish ought when possible to be laid upon the floor slab while the latter is green. This is the only way, in the first place, to secure a perfect bonding between the surface finish and the slab. In the next place this uniting of the cement finish with the cement slab makes the finish so completely an integral part of the floor slab that it bears part of the compression strains in the floor structure, and by this fact permits of the use of a much lighter slab than is required for a wood top. The importance of this fact in self supported floors is obvious.

The wood floor, on the other hand, is absolutely dead load so far as the concrete floor slab underneath it is concerned. The weight of screeds, of cinder or concrete fill between the screeds and not forming structurally a part of the floor slab, and of the 2 or 3 ins. of plank in the under floor, plus the ⅞-in. maple overlay, reaches a much higher total figure than might be supposed by any one who has not gone into the engineering side of the matter. Wherever therefore a wood finish is used on top of a cement floor, a considerable increase in the strength of columns, girders, and floor slabs is needed for the dead load of the wood floor in excess of the strength that would be required for the granolithic finish. It should be clear therefore that the wood top floor in the concrete mill or factory means a higher cost per square foot or cubic foot for the whole structure.

Quickness of Construction.—If a wood top floor is used, supported by a concrete slab, time must be given to dry the slab out thoroughly before the kiln dried stock is put in place, else the floor will swell, curl, and make trouble. The whole building must be well dried out in order to get a satisfactory result, and even by forcing the building with heat and by carefully airing it oftentimes a wood floor comes out in disappointing shape. With the full knowledge of the danger, owners have frequently found it necessary to lay wood floors much before the under concrete has dried out, with the knowledge that they would always be disappointed in the appearance of the floor. If, when the slab is wet, water-proof paper is laid between the under flooring and the top flooring it is almost certain to cause dry rot in the under flooring and the screeds, and to make trouble later on.

Cement finish can be put on at the same time as the under concrete, or can be put on at any time during the construction of the building, but if the under concrete is wet a better surface will be obtained than if it has been thoroughly dried out. Accordingly, so far as speed goes, the advantage is with the cement top floor. These two features interest the builder of any structure at the time of erection fully as much as they interest the owner, and are strong enough to prejudice the man responsible for the erection of any building very much in their favor. The proof of the selection comes on another man who has often not been responsible for the selection of the material, and due weight must be given to his opinion.

Principles of Construction.—Aside from the desirability of laying the granolithic surface on the wet floor slab, which has already been mentioned, there is also required for the satisfactory cement surface proper choice of aggregate, proper proportioning, and proper manipulation. To give good service the aggregate must be a hard, tough stone. Many stones that are hard are so brittle that they crack under a slight blow, and will come out from the cement leaving a pocket, which becomes a center for further breaking down. Sand is objectionable because brittle. Proper manipulation of the cement, aggregate, and water, which go to make up the granolithic finish, is difficult to secure, and it has been one of the problems of the Aberthaw Company's own work to get its men trained to the efficient handling of this material. This company has found that the best result is obtained with a finishing mixture that is rather dry—wet enough to make a good bond with the green floor slab underneath, but dry enough so that prolonged troweling is required to secure a film of water on the surface. The trowel, in its contact with the aggregate, should arrange the pieces of stone so that they lie with flat faces uppermost, thus providing a good wearing surface. It is difficult to get the ordinary concrete workman to trowel a cement finish with the care that is necessary. Good wearing quality requires that the aggregate in the finish shall be worked into an absolutely perfect bond with the cement, and angular aggregates set in a thin layer of cement form a material that the average workman does not enjoy working over. When the granolithic finish is completed the aggregate should show on the surface in innumerable points or flat surfaces with the solid cement between. These points and surfaces of the aggregate, if they are of properly hard, tough material, will take the greater part of the heavy wear on the surface, protecting the mortar to a large degree from the effects of the truck wheels, which are the cause of most serious wear.

It should be evident to any one who looks at the matter broadly that no floor material is everlasting or combines all the qualities that manufacturers of greatly different requirements ask of a floor for their own particular purposes. It should be clear, further, that no floor made of an artificial material can possibly be equal in wear resisting qualities to a floor laid with slabs of syenite, for instance, which is a material for the making of which nature could command laboratory facilities far beyond any at the command of man.

It must be evident that the answer to the question, What is the best floor? must be determined very largely by the circumstances of the particular case. No one surface is equally good for all possible uses, and the conditions demanded for the proper construction of a given type of floor may sometimes make it impracticable to put in that type when it is really desired. Granolithic surface, wood top, and some of the other surfaces have each their excellences and defects, and a choice must be made by weighing all the conditions in each instance.

This discussion has necessarily been concerned mainly with granolithic and wood floors. We conclude it by giving specifications for the two types, representing the practice of the Aberthaw Construction Co. in concrete and that of Lockwood, Greene & Co. and F. W. Dean in wood floors.

SPECIFICATION FOR GRANOLITHIC FINISH ON CONCRETE BASE, ACCORDING TO THE PRACTICE OF THE ABERTHAW CONSTRUCTION COMPANY.

These specifications contemplate work in localities where tough stone is available; local conditions will govern the selection of other materials.

If the surface is to be laid upon an unset concrete base, the specifications should require that it be laid as soon after the base is in as may be, and if possible before the under concrete has set, so that the base and the finish shall bond together; otherwise the specification will apply.

Mixture of the top finish should be in the proportion of 1 part Portland cement; 1 part stone from 1-2 in. to the smallest size, excluding dust; and 1 part sharp sand. (No grains passing a 50 screen, the majority of sizes which will pass between a 20 and a 30 screen.) This shall be mixed to a stiff paste, just wet enough so that in troweling the water will barely work to the surface.

Base. If old concrete, the surface shall be roughened either by sand blast, acid treatment, or other equally satisfactory method of cleaning the stones so that the mortar shall adhere to them. The under concrete shall be thoroughly wet, and shall be kept wet long enough to absorb all the water it will take up readily, thus insuring a base so wet that it will not draw water from the finish when the latter is applied. Before scrubbing the base with grout, the excess of water shall be removed so that the finish shall not become too wet.

Finish. The surface of the base shall first be scrubbed with a thin grout of pure cement rubbed in with a broom. On top of this, before the thin coat has set, a thin coat of finish, mixed as above specified, shall be troweled hard, using as much pressure as possible, and rubbing the finish hard down on the roughened base so that it shall take firm bond. After this, the finish shall be applied to the desired thickness, screeded and floated to a true surface. Between the time of the initial and final set, it shall be finished by skilled workmen with steel trowels and worked to final surface. Under no condition shall dryer be used, nor shall water be added to make the material work easily.

It is to be understood that with the mixture specified, the surface will show slightly pebbled because of the small pieces of stone. It will not be possible to get so slick a job as can be obtained by using sand alone, and this is not expected.

If the finishing is done in hot weather, the finish shall be protected from sun and wind in order to prevent too rapid setting.

SPECIFICATIONS FOR COMPOSITE FLOORS WITH TAR CONCRETE BASE SHOWING PRACTICE OF LOCKWOOD, GREENE & CO., ARCHITECTS AND ENGINEERS, BOSTON.

Tar Concrete Base.—Lay a tar concrete base to support plank sub-floor. The surface of the ground to receive concrete to be well rolled to a true level before laying the concrete. Where filling is required, it must be tamped and puddled thoroughly. A layer 4½ ins. deep of concrete shall be put down, composed and laid as follows:

First—A layer 3 ins. thick of coarse screened gravel, thoroughly mixed with tar and rolled down to a hard, level surface.

Second—A layer of pea gravel screened and well mixed with coal tar, to fill up spaces between and to be again well rolled, making both layers 3½ ins. thick, with a hard surface.

On this bed spread top dressing, consisting of sand heated and thoroughly mixed with the coal tar and pitch (one part pitch and three parts tar). To be mixed together until the sand is completely covered, making a homogeneous mass. Spread the top dressing 1½ ins. thick

over the whole surface, using a 1½-in. plank as a gauge and leveling off even with top of same. This to be rolled to a level surface, 1 in. thick, ready for receiving floor plank, which is to be bedded on the top dressing before hardening.

Plank Sub-Floor.—The floor plank where supported on concrete, to be of sound hemlock, 3 ins. thick, planed on one side to an even thickness and edges jointed, so that each plank is the same width its entire length. To be laid level on concrete, following closely after top dressing of concrete is laid, before hardening that the plank may be bedded on it. To run across the building, butted and toe-nailed with 4-in. wire nails. This plank is not to exceed three different widths in the entire lot and not over 10 ins. wide.

Maple Top Flooring.—To be of maple, all of clear stock, 1 in. thick before planing, air-dried and kiln-dried and not over 4 ins. wide. All flooring planed on one side to an even thickness and edges jointed, making each board the same width for the whole length and the under side double channeled or plowed. All ends to be matched.

Laying.—Separate the several widths, laying each course lengthwise of the building, with one width of boards. Break joints at random for every course of boards and crowd together and hold by temporary nailing. To run at right angles with floor plank and each board neatly fitted at the ends.

Note: This flooring is not to be taken into the building or laid until the walls and plank are thoroughly dried out.

Nailing.—To be finally nailed with 10d. or 3-in. wire floor nails. Nailed in diagonal rows, 14 ins. apart across the boards, with two nailings in each row in every board. All nails set and all standing joints smoothed down to make a smooth, level floor.

SPECIFICATIONS FOR LOCKING A WOOD-TOP FLOOR TO A CONCRETE FLOOR ACCORDING TO PRACTICE OF F. W. DEAN, MILL ENGINEER AND ARCHITECT, BOSTON.

Two-inch by three-inch beveled edge planed sleepers shall be built into the concrete in the following manner:

The concrete floor shall be brought up to within two inches of its ultimate thickness. The sleepers will then be accurately placed in parallel lines 18 ins. apart and running at right angles to the girders. The concrete should then be poured between the sleepers, using them as screeds in leveling the top surface. Care must be taken to see that the sleepers are thoroughly imbedded in the concrete without any voids. On top of the sleepers and at right angles to them shall be spiked square edged plank surfaced on one side and both edges, 3 ins. thick and 7 to 10 ins. wide. This plank shall be tightly drawn up and nailed with two 4-in. nails at each bearing. The ends of the planks shall meet half way between the sleepers.

Finished flooring to be of clear stock maple, ⅞ in. finished thickness, thoroughly air and kiln-dried and not over four inches wide. The flooring to be planed to an even thickness, the edges and ends squared, and the underside double channeled or plowed. Finished floor to be laid at right angles to the under flooring and each board neatly fitted at the ends, breaking joints at random. Floor to be finally nailed with eight penny wire floor nails in diagonal rows 16 ins. apart across the boards with two nailings in each row in every board. The floor to be finished off perfectly smooth on completion.

Officials of the Chicago & Northwestern Ry. have under consideration the construction of a cutoff from Crofton to Niobrara, Neb. The present route on the Northwestern is southwest to Norfolk, Neb., from Sioux City, then northwest to Niobrara, and on west through Bonesteel. The proposed cutoff would establish almost a straight stretch of track from Sioux City west to Niobrara, barring a small V line from Sioux City southwest to the Crofton branch. Some of the petitioners are asking that the cutoff be built from Wynot, Neb., west to Niobrara, which route would be yet a few miles shorter than that by way of Crofton, but it is thought that if the line is established at all it will be through Crofton and not Wynot.

Earth and Rock Section

Note: This section is devoted to methods and costs of excavating earth and rock and building embankments. It will cover the grading of roads and railroads, diking and canal work, dredging, building reservoirs and earth dams, sewer and water pipe trenching, quarrying, etc.

An Economical Substitute for a Timber Trestle in Making a High Embankment.*

Usually two methods are employed in making embankments where locomotives and dump cars, either narrow or standard gage, are used. The first method is to lay the track on the ground, and, by dumping alternately to right and left, jack up the track until the required height is reached. This method is most economically employed where the ratio of length of embankment to height is 25, or more, to 1. The second method is to build a trestle and make the fill by dumping from it. Building trestles is more or less expensive, and, if the material to compose the embankment contains a considerable proportion of large rock or boulders, there is always the danger of carrying away a bent or otherwise seriously injuring the structure.

Several years ago, the writer was one of the engineers on a piece of heavy railroad work in the South where the embankments were high and were made by trestling. One of the embankments to be made contained about 115,000 cu. yds., reached a maximum height of 57 ft., and was slightly over 800 ft. long, from grade point to grade point. To build a trestle would have cost between $6,000 and $8,000, and, as the material to make the fill was mostly rock, the chances were very great that a part of the structure would be carried away before the completion of the work. To avoid the necessity of constructing a trestle, the following scheme was adopted:

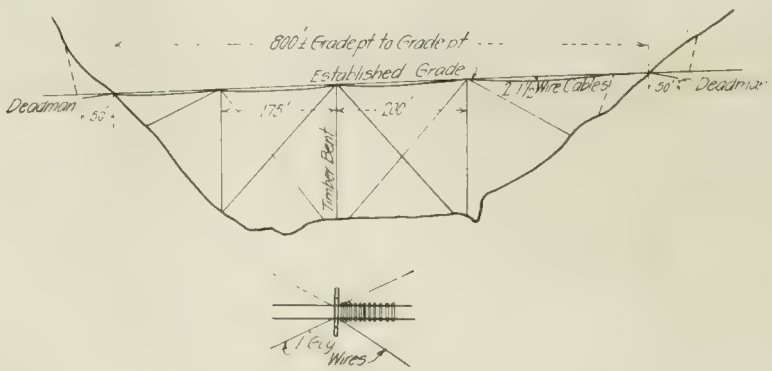


Fig. 1.—Diagram Elevation of Wire Rope Trestle for Making Large Fill.

The cuts at both ends of the embankment were opened up in the usual manner with carts for about 60 ft., as indicated by the dotted lines in Fig. 1. At points, approximately 50 ft. from each grade point, deadmen were sunk, and two 1½-in. wire cables, spaced 3 ft. 6 ins., were stretched from one to the other and hauled as taut as possible. At points about equally dividing the fill, three timber bents were erected, as shown in Fig. 1. These bents were made from timber cut on the right-of-way. Their construction is showni n Fig. 2. Caps were about 8x8 ins. x 6 ft. and sills about 10x10 ins. As this timber was cut on the ground, the dimensions varied slightly.

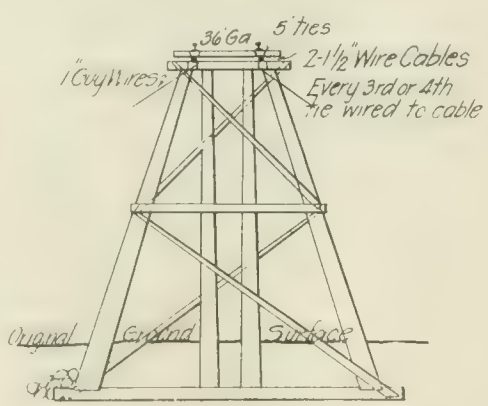


Fig. 2.—Details of Timber Bent for Wire Rope Trestle.

In erecting, the tops of the caps were brought to the established grade line, and the sills were sunk in a trench 3 or 4 ft. deep, which was backfilled with rock or earth. This steadied the bents and prevented their kicking out at the foot. From the caps, 1-in. guy wires were run out at angles of about 45°, in order to clear the dumping of material as far as possible, and fastened to deadmen. The main cables were then fastened to the caps by wire lashings and the ties placed on them, every third or fourth tie being lashed to the cables. The rail was then laid on the ties, brought to the established grade line, and the were laid far enough ahead to accommodate the length of train used.

The method of operation was as follows: A train of loaded cars was backed onto the approach fill, and, at the point where the cables left the fill, were dumped, the first car on one side, the second on the other side, alternate cars on alternate sides, until the entire train was unloaded. The train was then run back on the approach fill and the cars righted. Dumping the cars on alternate sides balanced the weight on the cables, prevented the overturning of the train and made the fill about equal on both sides of the track. All cars were dumped before their loaded weight came on the cables, only empty cars being supported thereon. Little or no shoveling of material was required, most of it sliding to the bottom of the fill, and what little remained was generally used in jacking up the track. As the bents were approached, more or less care was exercised to prevent their being injured, but no more so than on any other trestle.

The work was carried forward in this manner until the ravine had been spanned, after which it was widened out in the usual way.

In building the trestle it was assumed that the deflection of the cables at the center of a bay would be about 5 per cent of the span, but, by jacking up the track as the embankment was made, the deflection was reduced to about 3 per cent. When dumping at the center of a 200-ft. span this gave about a 6 per

*A paper by J. L. Ingle, Jr., presented to the American Society of Engineering Contractors.

cent grade for a dinkey engine to start an empty train on, and was not prohibitive.

The plan described left very little material in the dump, saved the main cables, guys, and caps, and was much more quickly and cheaply carried out than would have been the erection of an all timber trestle. The writer left for other work before the completion of this fill and so has no exact data as to cost. Figuring maintenance at the same rate as during his connection with the work, and barring accidents, the cost should have amounted to about 3 cts. per cu. yd. of embankment.

A Modern Stone Crushing Plant of 600 Cu. Yds. Capacity Per Hour—Some Costs of Drilling of Maintenance of Plant, and of Erecting Machinery.

With the ever increasing demand for crushed stone for various engineering constructions and for industrial uses, the production of this material has increased, in the last few years, to enormous proportions.

The increase in the demand in Chicago and vicinity in particular, is due to the great activity in all kinds of building and other construction, and also partly to the development of iron and steel manufacture in the Calumet region, where a large quantity of limestone is required for use as a flux in the blast furnaces.

Southwest of Chicago, along the line of the Chicago Main Drainage Channel are large deposits of limestone, which outcrop on the surface. Many crushing plants, large and small, are in operation in this district. Among these plants is the new plant of the Dolese & Shepard Co., of Chicago. This plant was built in a period of ten months, after the burning of a former plant on the site, and has now been in operation eight months. This plant is interesting as a whole, because of its capacity and its output, and is interesting in detail because of many features which are departures from standard methods and which in many details are of original design. Many of these features are due in a considerable degree to Mr. Geo. W. Patnoe, Master Mechanic and General Superintendent for the company, who has been in direct supervision of the design and construction of the plant. The whole plant is the outcome of 30 years of experience in the business of quarrying and crushing stone for the Chicago market.

Quarry.—The company owns about 300 acres of land of which 130 acres are available for quarrying purposes to a depth of 150 ft. as tested by core drills. It is estimated that it would take about 75 years to exhaust the rock within the limits examined. The quarry was opened a few years ago and, up to the time of the destruction of the plant by fire in the early part of 1908, was operated according to standard quarry methods. The quarry as now opened has an area of about 21 acres and a depth of 40 ft.

The new system of quarrying and handling the rock consists of drilling with well drilling machines and loading the rock with steam shovels into electrically operated dump cars. The well drilling machines have proven a decided economy over the smaller tripod drills. Records have been kept which show each day's work with length of time worked, depth of holes drilled, time not drilling and for what reason, quantity of repairs, name of drills and date. Table I shows a record of six well-drilling machines. This record is taken from the daily reports for 30 consecutive working days. The holes were 5⅝ ins. in diameter and 40 to 45 ft. in depth. According to records the power on the electrical blast hole drilling machines costs from $1.80 to $2.00 per 10-hour day, whereas the power on the tripod air drills costs $5 to $5.20 per 10-hour day. Only one-third as many of the larger holes are required for breaking up the rock as of the smaller holes.

When the new plant was started it was intended to use electrical equipment throughout, and a trial was made with an electric shovel. This, however, proved too slow for the work. The company furnishing the shovel put it out as an experiment and will replace it with a steam shovel. The swinging motion worked very satisfactorily, but the 200-h.p. motor could not accelerate fast enough for handling the dipper at the required speed. The capacity of the shovel did not exceed 1,200 cu. yds. in 10 hours. The steam shovels are expected to handle 1,800 to 2,000 cu. yds. in that time.

Fig. 1.—View of Quarry and Crushing Plant of the Dolese & Shepard Co., Near Chicago, Ill.

Another of the departures from the ordinary, was the adoption of an electric haulage system. This system uses a third rail placed in the center of the track and the cars are controlled by one man who is located in a tower which commands a view of the greater part of the track system. This system is the invention of F. E. Woodford, President of the Woodford Engineering Co., Chicago, and was installed under his direction. An installation of this system for canal work was described in our issue of May 18th, 1910.

Much discussion was caused in engineering circles when this system was installed for stone quarry use, and many predictions of its failure were made. It is true that the cars have cost the owners almost as much for repairs as they cost new. The experience was necessary, however, to perfect the mechanical features and make the cars strong enough to stand the jolts and wear from this class of work.

The quarry company considers that this experience has proven, in spite of the excess maintenance cost during the first few months, that the system is worth all the money put into it. A brief description of the new cars is as follows: The average weight is 26,300 lbs., and the capacity is 12 cu. yds. Each car is equipped with two 30 h.p. motors using a direct current at 220 volts, and has an automatic brake which controls this speed of the car on down grade and another arrangement which enables the tower man to set the brake. The tower man controls all movements of the cars from a centrally located tower house.

The chief annoyance was the constant breakage of the cast iron cores in the resistance coils placed upon the car for the automatic control of the brake. This caused several smash-ups and the remedy was found in substituting iron wire in place of the cast iron piece. The car was further strengthened by using steel box beams in place of the channels first used. The bottom of the car was changed from 4-in. to 5-in. planks and the steel plate lining was divided up into sections, held down with T-irons as shown by Fig. 3.

The maintenance of the first 25 cars put in service required the time of three men in the repair shop. With the cars now in use the maintenance will not, it is figured, exceed $5 per month per car. With this system the labor required for bringing stone from quarry to crusher is but one man. The power required for bringing 4,000 cu. yds. of rock to the crusher costs $22, according to the records.

Automatic Weighing.—Each car is weighed automatically as it passes over the scales and is not required to stop. The number of the shovel which loads the car is also taken at the same time by an automatic arrangement. These figures are stamped on a tape by the machine in the scale house, and the tape figures are sent to the main office each night. In this way an absolutely accurate record is kept of the number of cars loaded by each shovel, each day, of the weight of the material on each car, and of the total for all. By this method deficiencies can easily be located. The cars are dumped by an electrically operated pneumatic lift which is controlled by the tower man.

Electrical Equipment for General Plant.—There is no power house, but the electric current is furnished by a transmission line (carrying 33,000 volts) from the Economy, Light & Power Co.'s power plant at Joliet, Ill. Provision is also made for connection, in case of emergency, with one of the Commonwealth Edison Co.'s plants, in Chicago,

In the sub-station, the current is stepped down from 33,000 to 480 volts with three 750 k.w. transformers supplying three-phase current at 60 cycles to the motors throughout the plant. There is one 400 k.w. and two 200 k.w. Allis-Chalmers' motor-generator sets supplying 220-volt direct current for the electric haulage system. There is also a complete equipment of measuring and recording instruments for indicating the power required in different branches of the work. Each building contains a transformer to step down the 480-volt current to the 120-volt lighting circuit. The entire plant requires about 1,600 h.p.

by Figs. 1 and 2. The buildings are of structural steel covered with galvanized corrugated iron. They rest on concrete foundations. Two of them, the No. 9 crusher building and the main screenings house, are built directly over reinforced concrete bins. Each building contains an overhead traveling crane or trolley hoist for handling the machinery in erection or in repair work. The crane and hoist runways extend outside the building over a sidetrack.

The main crusher, a McCully gyratory No. 21, is stated to be the largest made. It has a two-arm spider and its ordinary capacity is about 6,000 cu. yds. of rock in 10 hours, but this can be exceeded by 50 per cent if required. The total weight of the machine is 225 tons. It is driven by a 250 h.p. motor with rope transmission.

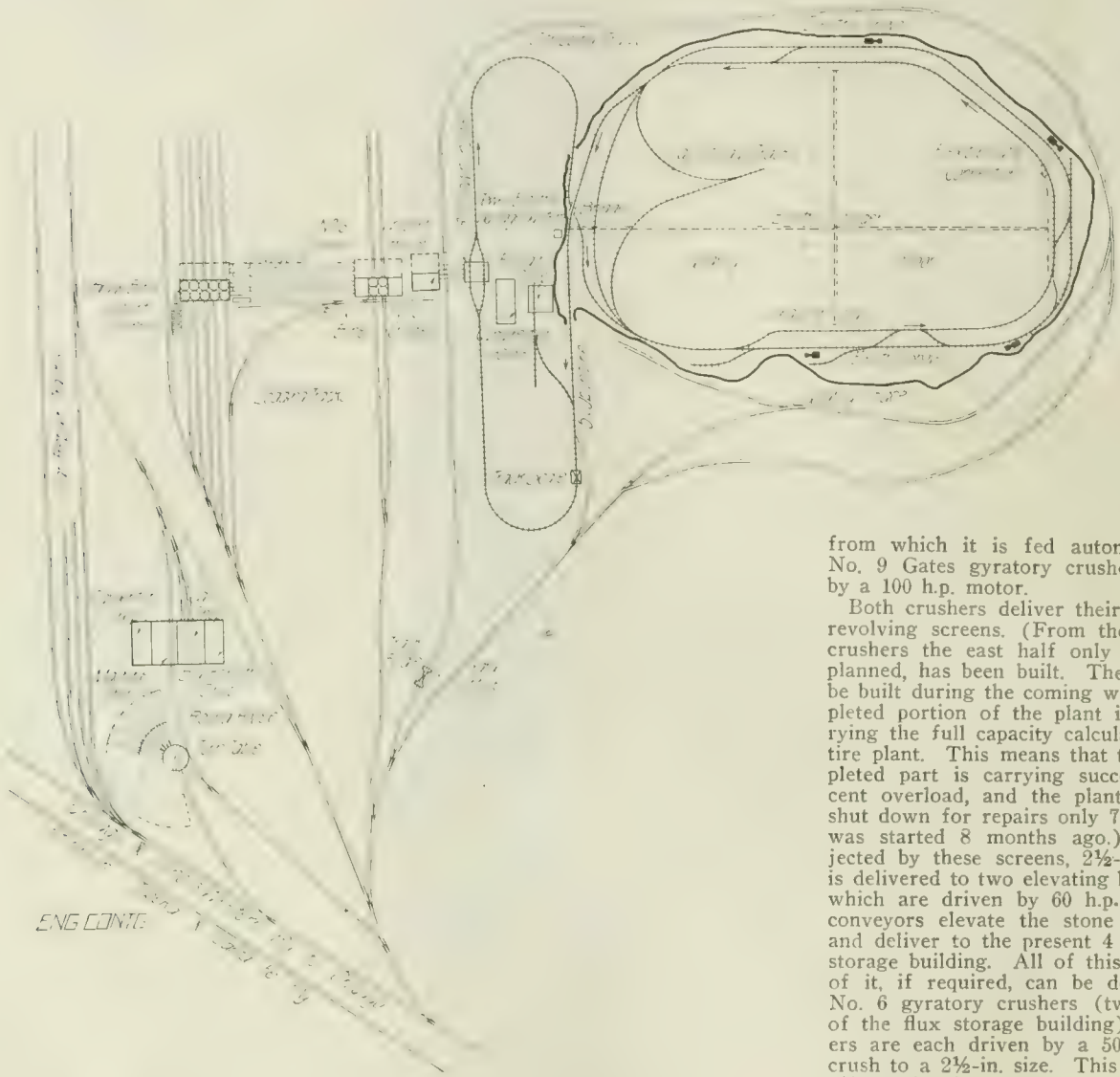


Fig. 2.—Lay-Out Plan of Quarry and Crushing Plant Shown by Fig. 1.

The main crusher discharges its product in 6-in. size onto two parallel bucket conveyors. The crusher discharges on both, or on either side as desired. These conveyors elevate the stone on a 45° incline to the top of the next building, and deliver it to a large steel bin from which it is fed automatically to two No. 9 Gates gyratory crushers, each driven by a 100 h.p. motor.

Both crushers deliver their product to two revolving screens. (From these No. 9 Gates crushers the east half only of the plant as planned, has been built. The other part will be built during the coming winter. The completed portion of the plant is, however, carrying the full capacity calculated for the entire plant. This means that the present completed part is carrying successfully 100 per cent overload, and the plant has had to be shut down for repairs only 7½ hours since it was started 8 months ago.) The stone rejected by these screens, 2½-in. to 4-in. size, is delivered to two elevating bucket conveyors which are driven by 60 h.p. motors. These conveyors elevate the stone on a 45° angle and deliver to the present 4 bins of the flux storage building. All of this stone or a part of it, if required, can be delivered to four No. 6 gyratory crushers (two on each side of the flux storage building). These crushers are each driven by a 50 h.p. motor and crush to a 2½-in. size. This product and the 2½-in. size from the No. 9 crushers are delivered to two 30-in. belt conveyors which are about 350 ft. long and are on an incline of 23°. Each is operated by a 60 h.p. motor. These belts deliver to the main screen house. This house now contains, four revolving screens 4 ft. in diameter and 28 ft. long, with 16-ft. jackets, four revolving screens 4 ft. in diameter and 24 ft. long, and four shaking screens, 3x12 ft. The two belt conveyors discharge into the 28-ft. revolving screens whose rejections are in turn discharged into the 24-ft. screens which have larger perforations. The stone that passes through the first revolving screens is delivered to the shaking screens, which separate

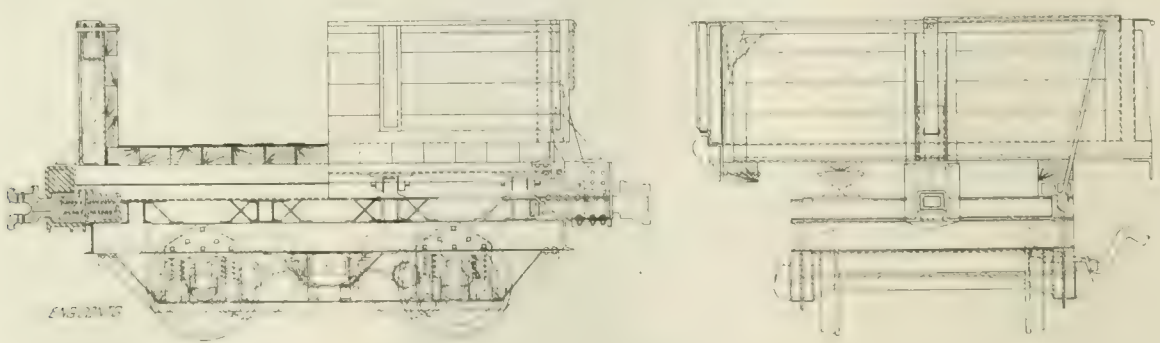


Fig. 3.—Details of Electric Quarry Car.

Crushing Plant.—The crushing and screening plant occupies five buildings which are connected with each other by belt and bucket conveyors. The general arrangement is shown

TABLE I.—RECORD OF A 30-DAYS' RUN OF WELL DRILLING MACHINES AT THE QUARRIES OF DOLESE & SHEPARD CO., CHICAGO, ILL.

Date,	A		B		C		D		E		F	
1910.	Ft.	Hrs.	Ft.	Hrs.	Ft.	Hrs.	Ft.	Hrs.	Ft.	Hrs.	Ft.	Hrs.
2-3	12	1	42	10½	34	10½	..	..	..	..	..	..
2-4	44	10	50	10½	33	10½	28	10½	..	..	..	..
2-5	50	10	35	10½	33	10½	24½	10½	..	..	..	..
2-7	51	10	30	10½	14	10½	30	10½	21	4½	29	6½
2-8	44½	10½	30	10½	33	10½	33	10½	45	10	43	10½
2-9	61	10	46½	11	30	11	36	11	49	11	44	11
2-10	54	10	46	11	45	11	41	11	34	11	30	11
2-11	66	10	42	11	36	11	33	11	45	11	52	11
2-12	56	10	37	11	35	11	30	11	43	11	50	11
2-14	70	11	41	11	33	11	31	11	42	11	19	11
2-15	54	11	6	11	28	11	27	11	40	11	45	11
2-16	71	11	29½	11	29	11	7	11	57	11	49	11
2-17	56	11	21	11	27	11	28	11	18	11	41	11
2-18	58	11	31	11	42	11	23	11	38	11	38	11
2-19	49	11	25	11	27	11	45	10	33	11	43	12
2-20	no work		no work		no work		no work		27	11	25	10
2-21	10	5	34	11	24	11	36	11	47	11	43	11
2-22	52	11	25	11	25	11	34	11	45	11	53	11
2-23	76	11	39	11	bit fast		6	3	no work		56	11
2-24	64	11	33	11	28½	11	40	11	43	11	49	11
2-25	61	11	30	11	39	11	39	11	35	11	35	11
2-26	2½	2	5	3	5	2	no work		no work		no work	
2-28	65	11	37	11	27	11	38½	11	28½	3	46	11
3-1	83	11	no record		..	..	..	..	..	..	..	..
3-2	82	11	45	11	30	11	45	11	63	11	59	11
3-3	68	8	50	11	32	11	51	11	59	11	53	11
3-4	40	6	30	11	34	11	10	6	52	11	40	11
3-5	60	10	no work		26	8	30	4	20	4½	26	6
3-7	80	11	41	11	36	11	no work		35	9½	35	9½
3-8	53	8	35	11	32	7	no work		28	6	38	9
	*1595		*916		*817½		*746		*947½		*1041	
	†274½		†286½		†278½		†241		†235½		†261½	
	§5.10		§3.2		§2.11		§3.1		§4		§3.11	

*Total number feet.
†Total number hours.
§Average number feet per hour.

Date, 1910.	Repairs and Delays.
	Drill A—Power, 10 h.p. motor.
2-15	1 hour turning rope.
3-4	1 hour rope.
3-5	1 hour rope.
3-8	3 hours new rope.
	Drill C—Steam power.
2-7	4 hours injector.
2-16	2 hours hot box.
2-17	2½ hours repairs.
2-20	6 hours repairs.
2-21	1 hour repairs.
2-22	2 hours boiler.
3-4	1 hour rope.
	Drill E—Steam power.
2-15	1 hour turning rope.
2-19	2 hours on rope.
3-7	2 hours on rope.

Date, 1910.	Repairs and Delays.
	Drill B—Steam power.
2-25	2 hours on boiler.
2-15	1 hour turning rope.
	Drill D—Steam power.
2-7	3 hours on engine.
2-16	5½ hours on boiler.
2-19	2 hours on rope.
2-22	5 hours on boiler.
3-4	3 hours on boiler.
	Drill F—Steam power.
2-14	8 hours broken sheave.
2-19	1 hour on rope.
2-20	4 hours on boiler.
2-25	3½ hours on boiler.

Note.—The renewal of rope is required on an average of once in 30 days. Two men are required to operate one machine, but where several machines work close together the number of helpers may be reduced.

it into smaller sizes and it then passes to the storage bins. The rejections from the revolving screens are delivered by horizontal conveyors to the recrushing rolls house. This house contains two sets of rolls 54 ins. in diameter and 24 ins. wide, having the surfaces fitted with chilled iron corrugated plates of the herring-bone pattern. There are also two sets of rolls, 36x16 ins. for crushing to ½-in. size or less. Two 100 h.p. motors operate the rolls by belt transmission. Each motor is belted to a shaft to which is belted one set of large rolls and one set of small rolls.

The horizontal conveyors mentioned, were designed especially for this plant. Each consists of a rubber belt to which steel strips 2 ins. wide are fastened crosswise to the belt, and bent up on the ends. These are placed side by side and form a rectangular trough. These belts are fitted with speed changing devices, so as to vary the amount of stone delivered to the rolls. The recrushed product is delivered on a return belt to the main belt, and by it again to the screening plant where it passes a second time through the screens.

The general arrangement of the plant is designed so as to make possible its operation in subdivisions, each subdivision being operated in connection with others or shut off as desired according to the required capacity of output. It is also arranged, so that, by use of a belt conveyor any of the bins of the larger sized stone may be emptied and carried to the recrushing plant.

All chutes are lined with vitrified brick and wherever possible at the junctions of chutes, where there is a constant dropping of stone, pockets are made which collect just enough stone to protect the chute from wearing.

The storage bins are at present 10 in number, each being a cylinder 20 ft. in diameter and 32 ft. deep and having a capacity of 400 cu. yds. They are of reinforced concrete with walls 8 ins. thick (12 ins. at points of contact with adjacent bins or the side walls of the building). The bottom of the bins is a 14-in. slab of reinforced concrete which covers the entire area of the building. The bins are supported on heavy square, reinforced concrete columns. Five loading tracks pass under these bins and have a clearance of 22 ft. above the rails. Under the bins for the storage of the 4-in. flux stone are two loading tracks.

Each bin is fitted with a gate for discharge into the cars. These gates are operated by compressed air. The pipes lead to a central point so that one man can operate four gates at a time. A 50-ton car can be loaded in this way in about one minute.

The scales for weighing the loads will eventually be transferred to below the bins. Here the weight of the empty car can be taken automatically and the scale beam set at the weight which equals the capacity of the car. An arrangement will be made to provide an electrical contact which will cause the pneumatic apparatus to close the discharge gates.

This plant can supply stone of any size from rip rap to a fine dust which will pass a 100-mesh sieve. It can also supply stone in mixtures of different sizes, being so mixed as to be made into concrete by simply adding the necessary cement.

Washing Plant.—For the purpose of providing a small, clean stone for reinforced concrete work, a washing plant is being constructed. This plant will be located southeast of the storage bins (see Fig. 2) and will be a timber frame structure covered with galvanized iron. Figure 4 shows a section of this building. Arrangement is made here for washing all sizes of stone from 1¼-in. down to the size of torpedo sand. The material is washed in running water and the product screened as shown in the drawing. The last stage of the washing process is as follows: The fine material and the water finally reach the automatic gravity dump box marked *A* in Fig. 4, and which is shown in detail by Fig. 5. The bottom of this box, as shown, slopes down from the receiving end to the dumping pipes, *A*. The fine material fills up the triangular section and the water flows out at the spout *B*. When sufficient pressure is exerted by the weight of the material, the diagonal bottom tips on the axle *X*. This lowers the outlet pipes away from the beam *C* (this beam acts as a stopper) and the material flows out through the pipes until enough weight is released to turn the balance in the opposite direction. Then the bottom swings back and the process is repeated.

Maintenance and Depreciation of Plant.—The general plant is, of course, built on modern principles and the design and selection of all machinery is the result of many years of experience. It was intended to build a plant which would be of the greatest efficiency possible with the best machinery obtainable. According to experience the company has estimated the life of the plant at 20 years. That is a 5 per cent annual depreciation on the plant. The maintenance and repairs for the machinery of the crushing plant varies for different machines. Crushers cost about 5 per cent of their value annually while for the screens and conveyors this cost amounts to 15 per cent. The larger sized stone wears the screens much faster than the smaller. An example of this is shown in the

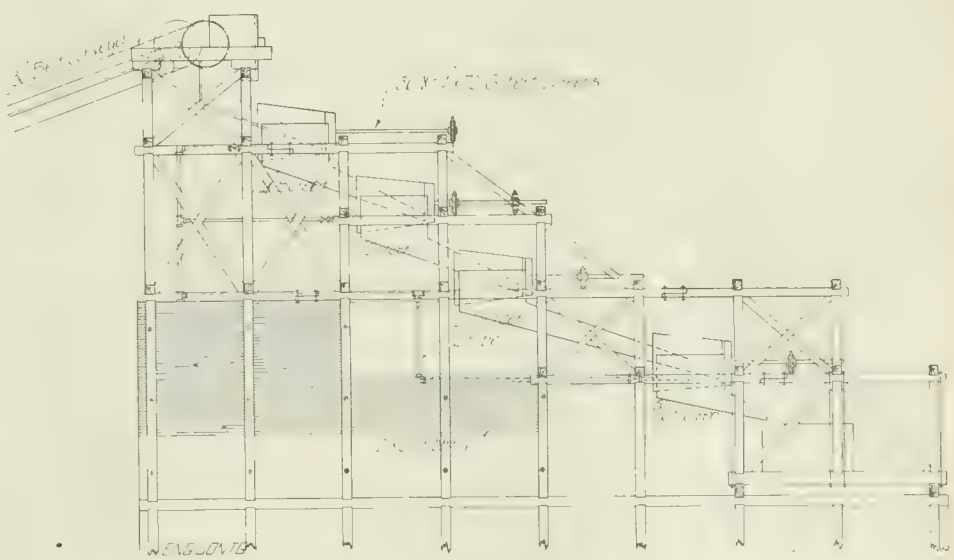


Fig. 4.—Section of Washing Plant.

fact that the screens which take the product from the No. 9 crushers, had to be renewed after 6 months' service. They were of ½-in. material with 3½-in. holes. The screens in the other part of the plant which handle nothing over 2½ ins., have now been in service 8 months, are of ⅜-in. material and show very little wear. All screens when renewed will be of manganese steel.

It is interesting to note in conclusion that there are approximately 960 tons of crushers, screens, and elevators in the plant. This machinery was erected by contract by Olson Bros. & Co., Engineers and Contractors, Chicago, Ill. The cost of erecting this machinery amounted to about $13,000. The contractor had the use of the cranes in each building and was able, with these, to handle all heavy machinery directly from the cars to the foundations. The cost of placing the heavy crushers ran as low as $8 per ton and the cost of erecting the lighter machinery, such as belts, etc., ran as high as $30 per ton.

For the use of the photograph we are indebted to Mr. R. H. Hall, Commercial and Engineering Photographer, Chicago, Ill. We wish also to acknowledge the courtesy of the officials of the Dolese & Shepherd Co., especially of Mr. Geo. W. Patnor, Master Mechanic and General Superintendent, and Mr. A. V. Konsberg, Purchasing Agent, for the information and drawings from which this article has been prepared.

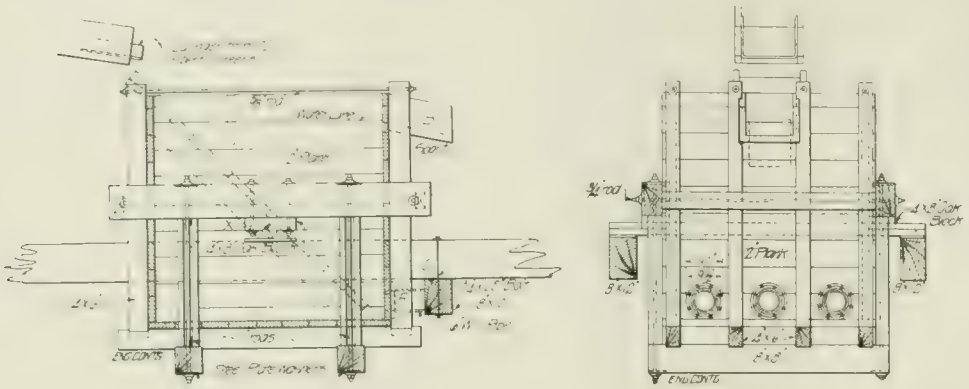


Fig. 5.—Automatic Gravity Dumping Bin for Washing Plant.

Earthwork Shrinkage, Application and Amount.

BY F. B. ESPENSHADE *

How much earthwork shrinks and the comparison of excavation and embankment quantities are very important subjects upon which the opinions of engineers are much at variance. They are also much mooted subjects between engineers and contractors. Shrinkage is usually applied in several ways:

(1) By raising the height of crown above the established subgrade by a percentage of embankment height.

(2) By adding additional width to the standard crown width.

(3) By combining methods one and two.

(4) By adding a shrinkage percentage to the height of embankment, computing a new slope distance for this corrected height, thus increasing the width between slope stakes.

While I have known engineers to use the last method, it seems unusual and defeats the purpose of shrinkage, as it adds width to the embankment where gravity and the action of the elements naturally provide it. In cases where sliding or sloughing is to be expected, it is better practice to increase the slope ratio.

The first method of applying shrinkage to the height of embankment fulfills all requirements, if the embankments are light or of considerable length. But in heavy country where the profile of the ground surface indicates short, heavy fills and short, heavy cuts following each other in rapid succession, it is preferable either to apply the shrinkage by adding to the height and width of crown or chiefly to the latter.

The amount of shrinkage added, under different conditions that arise, is quite variable. This is as it should be, as the methods of construction and materials vary within wide limits. It has been my experience that the allowance for shrinkage is usually less than the total settlement that the embankment undergoes while attaining its permanent set. This seems expedient in many cases where the track laying closely follows the roadbed construction.

Were the necessary shrinkage to obtain the established subgrade at final settlement added to the height in short, heavy fills, anomalous conditions would result. In such cases, if the greater part of the shrinkage is not provided for by increasing the crown width, it is much better not to apply any than to attempt to add a sufficient shrinkage above subgrade, if track laying follows before the embankments have settled appreciably. Considering the ease with which gravel and other good material can be placed in many instances, it may be wise to omit the shrinkage on short, heavy fills or at bridge approaches or the greater part of it.

In "Civil Engineer's Pocketbook," by John C. Trautwine, on page 799, under Shrinkage of Embankment we find the following paragraph:

> Although earth when first dug and loosely thrown out swells about 1-5 part, so that a cubic yard in place averages about 1 1-5 or 1.2 cubic yards when dug, or one cubic yard dug is equal to 5-6 or to 0.833 of a cubic yard in place, yet when made into embankment, it gradually subsides or settles or shrinks into a less bulk than it occupied before being dug. The following are approximate averages of the shrinkage; or, in other words, the earth measured in place in a cut, will, when made into embankment, occupy a bulk less than before by about the following proportions.
>
> Gravel or sand, about 8%; or 1 in 12½ less.
>
> Clay, about 10%; or 1 in 10 less.
>
> Loam, about 17%, or 1 in 8⅓ less.
>
> Loose vegetable surface soils, 15%, or 1 in 6⅔ less.
>
> Puddled clay, about 25%; or 1 in 4 less.

I have known most estimable engineers of wide experience to testify as expert witnesses in court that earth does not occupy less space in settled embankments than in the original position in cut. However, it is usually conceded by engineers that average material, such as gravel, clay and loam, does occupy less space in embankment finally than originally in cut.

It does seem that Mr. Trautwine's figures are very high. Following his assumption that loose dirt occupies about 20 per cent more space in embankment than in excavation and that 1 cu. yd. of this loose material afterwards settles to 0.83 of its original bulk in place, we get a total shrinkage equal to 30.8 per cent of the loose bulk. Embankments built by wheelbarrows approach "loosely thrown out" material, as the tramping and wheeling on the embankment are of little consequence.

In the wheelbarrow embankments that have come under the writer's experience he has used 15 per cent and while it has seemed too small it certainly did not lack more than 4 per cent in any case of providing correct subgrade at the end of two years. These embankments were made from clays and loams saturated with water, as the wheelbarrow is used today only on such work. As the material was extremely wet we would expect the shrinkage to approach puddled clay.

For puddled clay Mr. Trautwine would have about 60 per cent shrinkage, allowing that 1 cu. yd. in excavation makes 1.2 cu. yds. in embankment and settles afterwards so as to occupy 0.75 cu. yd. Johnson's "Surveying" mentions that clay and loam dumped loosely increases about one-twelfth at first and then settles to about one-sixth of this increased volume. These opinions differ widely. One claims one-fifth and the other one-twelfth swell for loosely thrown out material.

The writer has counted wagon loads taken from cuts, the wagons were measured and loaded fully to the measured volume or over, and has found that the increase is fully one-third. With wagons as usually loaded when a contractor is doing good work, if the swell be considered as 50 per cent or if two-thirds of the wagon load measurement be used, the estimate thus taken would approximate the excavation measurement.

This experience with wagons varies so widely from that with the wheelbarrows that it seems that the wide difference must be due to the variance in the nature of the material and the size of bulk considered.

For light fills, less than 4 ft., constructed by slips and wheelers, and containing clay and loam, I have used as high as 12 per cent shrinkage on embankments with good results. Or what is better for this kind of work is to have the contractor roughly build the embankments to grade, allowing the work to remain several months, during a period in which the embankment becomes thoroughly wet from rains, then add about 10 per cent shrinkage. Where the time and rain are sufficient this latter method gives good results. If the vegetable matter is small as in the case of deep borrow pits 10 per cent for newly built and 8 per cent for embankments of long standing do very well. The vegetable matter is very important to allow for, even when removed by burning as much as possible. This is especially true where grass roots and stubble occur in fills less than 2 ft. and if shrinkage is added up to 20 per cent for such fills no fear need be entertained that embankments will not settle to subgrade.

I have compared the excavation quantities quite frequently with embankment quantities. Where a shrinkage of from 8 to 12 per cent was used in prairie country, the excavation measurements usually exceeded the embankment quantities from 5 to 8 per cent. Where embankments were completed promptly, allowing 10 per cent shrinkage, the excess excavation quantities could be expected to be close to 6 per cent unless there was a loss or the material was unusual. This has followed in the writer's experience very often with clay and loam and the settled embankments usually approached the true subgrade quite closely.

With shrinkage applied in this manner varying from 8 to 12 per cent the embankments in every case seemed to settle to subgrade or below it by a very small percentage. Mr. Johnson claims that 100 cu. yds. of embankment will require 111 cu. yds. excavation. This is variously estimated by text book writers from 108 to 115 cu. yds. for the excavation equivalent of 100 cu. yds. of settled embankment. I consider that the initial swell of the material is much more than Mr. Trautwine or Mr. Johnson states for loose material and that 100 cu. yds. in embankment usually requires less than 111 cu. yds. excavation. This percentage of excess is very important from the contractor's point of view when the contractor is paid in embankment, as he sometimes is. The question arises, "What is the contractor to be paid for?" Certainly he should not be paid for embankment quantities without an additional allowance for the increased mate-

* 6235 Greenwood Ave., Chicago, Ill.

rial required for embankments in excess of the excavation quantities.

This additional allowance may be very misleading if applied to unusual conditions. The writer experienced very unusual conditions on a 16-mile section of railroad work on the Pacific coast extension of the Chicago, Milwaukee & St. Paul Ry. in Montana, where the excavation quantities exceeded the embankment quantities by 25 per cent and on some miles by as much as 30 per cent. The contractor was paid in excavation with overhaul for distances in excess of 500 ft. The center line of roadbed crossed and touched a river channel 33 times; the channel crossings were filled in and the stream was diverted on the outside of the railroad right of way on a special right of way for channel changes, which was usually parallel to the railroad right of way. The material excavated from the new river channel was used to make the embankment. The embankment at the river crossing was protected by a false berm 10 ft. wide and above high water mark on the side exposed to the new river channel and a lower and narrower berm on the old channel side. All embankment quantities were measured in the usual manner in the roadbed, and false berms were measured as constructed, which included the shrinkage. As this work extended over a period of 1½ years and the season when the channels were closed was notable for floods and extreme high water, the loss by washing, which in many cases was impossible to measure, was excessive. A dam of rock, hay or sand bags was used to stop the flow in the old channel, forcing the water into the new channel, which was taken out to a narrow section first and widened later to complete the new channel and finish the embankment.

The shrinkage used on this work was from 8 to 10 per cent, applied on top for the light fills and by increased width and top shrinkage at the old channel crossings. The work averaged 30,000 cu. yds. per mile. The contractor was paid in excavation. Many of the new channels required four or five separate cross sectioning and carefully platted sections in order to keep close record of the action of the water. Very large volumes of material were lost by erosion where the channels were open, while at other times the overflow water deposited equally as large volumes in unopened channels.

This instance of unusual difference between the excavation and embankment quantities is of little value for comparison of how much earthwork shrinks, but illustrates the necessity of the contract being specific on the method of measuring pay quantities. Frequently contracts read that the contractor is to be paid excavation measurement or embankment measurement "when in the opinion of the engineer" it is not deemed advisable to use embankment measurement. The engineer might deem it advisable to give embankment measurement even in an unusual case, as stated above. The "opinion of the engineer" is a very uncertain factor to overcome in bidding and may mean the entire profits of the work to the contractor. Where there is no excessive loss by water and the rate and manner of applying shrinkage have been determined beforehand, the "opinion of the engineer" may vary for embankment measurement from allowing no excess to at least 10 per cent, depending upon who the engineer is. No doubt some contracts are drawn that overcome this uncertainty, but the writer has never seen a contract on any work that has come under his supervision that recognizes the fact that excavation quantities exceed embankment quantities.

I have observed that the excess is about 6 per cent for clay and loam when 10 per cent shrinkage is used upon embankments. Is this percentage nearly correct? The writer would like to hear the experience of engineers on this subject. It is not likely that where the opinions of text book writers and engineers of experience differ widely these views will agree with my experience, but it is hoped that opinions expressed on this much mooted subject may be valuable in determining the amount of shrinkage to apply for railroad embankments and whether there is excess material required for embankments, above and beyond excavation quantities, and how much.

I wish to refer to the large personal error that frequently occurs in cross section work. It should be the endeavor of the engineer to find the cubic yards and it might be better to give less thought of the tenths of cubic yards, which is a fineness beyond the ability of most of us. I have known an old engineer in the employ of a contractor who even went so far as to think the use of tenths of cubic yards in a note book should be sufficient cause for dismissal. Railroad companies require the cross section notes computed to tenths of a cubic yard. It certainly is beyond the accuracy of engineers to cross section to the nearest cubic yard in many places.

Cross sectioning is often spoken of slightingly by engineers as an approximation at best; the engineer should make the work a study and endeavor to do good work. The personal error is frequently high and usually works a hardship upon the contractor unless the rodman has a cultivated faculty of holding the rod only so as to be advantageous to the contractor.

I consider 8 to 12 per cent for wheelers and slips, 10 to 15 per cent for wagon work and 15 to 20 per cent for trestle filled embankments from cars, varying according to material and local conditions, as being not wide of the mark. The manner of applying the shrinkage must be adapted to the case in hand. In heavy fills that are long very good results can be obtained by establishing a temporary grade line that fulfills the shrinkage requirement at the crucial points and not wide of the mark over the entire embankment. This latter method of applying shrinkage is quite easy and provides an embankment that *is* ready for the track.

Annual Meeting of the Society for the Promotion of Engineering Education.

As a part of the program for the meeting of the Society for Promotion of Engineering Education this summer, it is proposed to organize a symposium on efficiency in engineering education. This subject will be discussed under the following heads:

(1) Organizing and systematizing the work of the students; methods of arousing their interest and of encouraging them to make the best use of their time and opportunities.

(2) Organizing and systematizing the work of instructors so that each department of study shall have its due share of the student's time and energy, and no more.

(3) Conduct of recitations and examinations, control of outside reading, study, and problem work so as to secure the best results.

(4) Improvement of lecture instruction; use and abuse of lectures; utilization of syllabi, indices, bibliography and encouragement of outside reading; lecture illustration, experiments, use of blackboard, models, diagrams, lantern slides; economy of student's time and energy and methods of securing his attention in lecture period. Advantages and disadvantages of printed lecture notes.

(5) Relative advantages and disadvantages of lectures and recitations. Subjects suited to one or the other method of instruction. Limitations of each method.

(6) Improvement of laboratory instruction; in the preliminary preparation of students, in the supervision of laboratory work, in the character of the work required, in facilities for work, in reports of work done, and deductions therefrom.

(7) Improvements in shop work instruction. Relative importance of manual training and study of actual shop practice. Should manual training form any part of the curriculum?

(8) Organization of vacation work. Assignment of time to different subjects. Utilization of time to best advantage. Class work versus individual study. Should students be encouraged to seek remunerative employment by allowing academic credit for such work?

(9) Graduation theses. In what ways can these be made more useful?

(10) Original investigation. Is it desirable to have the graduation theses involve original investigation by the students?

The committee on mathematical instruction will report at the meeting of the society at Madison, June 23, 24 and 25. As a basis for the discussion of this report the following questions have been suggested:

(1) What proportion of the students in engineering schools, who have completed the required work in calculus, are able to apply that knowledge and solve simple, practical problems?

(2) What proportion of the graduates of engineering schools, who receive instruction in calculus and in its application to mechanics, thermo-dynamics and engineering are capable of using calculus as a tool, readily, with difficulty, or not at all?

In all cases where these two questions have been put the answer invariably has been that the percentage of students who can make use of the calculus is very small, ranging from two to ten per cent. This indicates that the instruction in calculus fails lamentably in securing the desired results, which suggests the following further questions:

(3) Is the proportion of students who can utilize their knowledge of calculus materially above the average in any institution in the country? If so, why?

(4) Is it possible to increase the efficiency of instruction in calculus in one or more of the following ways:

(a) By omitting certain portions of the calculus as now taught and concentrating the work on a more limited field, so as to secure better results.

(b) By abandoning the highly theoretical treatment of the subject and teaching it as arithmetic is taught in the elementary schools, with very limited emphasis on the theoretic side and major emphasis on its practical application. We do not instruct children in the theory of numbers, but give them practical rules for addition, subtraction, multiplication, division, etc. The result is that the large majority of those studying arithmetic are able to use these rules successfully in everyday life.

(5) Is it desirable or necessary to provide additional time for instruction in calculus, and should this instruction extend through two, three or four years of the engineering course? Should this additional instruction be entrusted to the department of mathematics, to the department of mechanics, or to the engineering departments, and in what proportion?

(6) Is it desirable or necessary to give instruction in other branches of higher mathematics to students in engineering schools, and if so, what adidtional subjects should be taught and how much time should be allotted to each respectively?

It is felt that no more important subject has come before the Society. If the failure to secure adequate results is due to insufficient time given to the subject, the time given should then be increased, even to the extent of eliminating some of the higher studies in engineering. Calculus is a subject that can not well be acquired by the student after he leaves the engineering school, while engineering studies can be pursued to any extent desired in after life.

The Netherlands is strongly urging the canalization by Belgium of the Meuse from Vise to Keesnich, a distance of 39⅛ miles, in order to facilitate inland navigation from the Liege industrial region to the port of Rotterdam, which has become a formidable competitor of Antwerp. The freight service from the basin of Liege to Antwerp is at a disadvantage as compared with that to the Dutch port. Freight rates are lower from Liege to Rotterdam than to Antwerp, notwithstanding the distance between Liege and Antwerp is shorter.

Roads and Streets Section

Note: This section is devoted to methods and costs of road and street construction. It will cover road building in all its details, the construction of pavements, sidewalks and gutters, the testing and use of paving materials and the machinery and tools used in road building and paving.

English Methods and Experiences in Dust Prevention and Road Preserva ion and in the Construction of Tar Bound Roads.

English road engineers were among the first to recognize the necessity of some treatment for macadam roads to prevent dust and also to preserve the road surface. As a result a large amount of experimental work has been done in England, both in the use of dust preventives and road preservatives and also in the construction of motor proof roads. The methods employed by the English road authorities in their work and the results attained are of no little interest, and we have accordingly abstracted and rearranged the notes that follow from the special roads issues of April 15 and 22 of the *Surveyor* and from the April 29 issue of the same paper. The notes in the main refer to the work done during 1909.

TAR PAINTING AND TAR SPRAYING.

Aylesbury.—The length of road tar painted was 3.81 miles, the area being 46,398 sq. yds. The cost per sq. yd. was 1.246 cts.; 8,196 gallons of tar, or .17 gallon per sq. yd., were used. Tar cost 3 cts. per gallon. About 23 tons of sand, or 1.1 lbs. per sq. yd., was used. The method of painting was as follows: The tar was heated in a 50-gal. boiler, sprayed by small sprayer attached to boiler and spread with brushes by hand labor only. Tar painting effected a saving of about $200 in street watering, reduced the dust nuisance and effected some economy in scavenging; the roads in general derived considerable benefit.

High Wycombe.—Ordinary gas tar applied by hand was used in tar painting. Treatment proved very beneficial so far as dust prevention is concerned and also proved a surface preservative. This was particularly noticeable on a section of Tarmac which was partially painted.

Barnstaple.—During the year 17,000 sq. yds. of road surface was tar painted by hand labor at a cost of 1.8 cts. per sq. yd. "It must be admitted," states the borough surveyor, "that the continuous wet weather during the autumn and winter in this district has to a very considerable extent spoilt the effects of the tar coating. So far as surface protection is concerned, and the present condition of much of the road surface tarred last summer, shows that the tar has entirely disappeared. My experience is that tar painting, to warrant the expenditure upon it, should be effective for practically a year. There is no saving in scavenging whatever where the traffic is at all heavy; in fact, the scavenging costs more, for I found it necessary to water frequently during dry, windy days. There is no doubt that tar painting (being comparatively cheap) is the most popular method of dealing with the dust nuisance, but where the treatment is subject to ordinary town traffic the effect is worn off in six months. On the country roads, however, given a normal winter, the treatment will last for about a year. I prefer hand labor to machine for this work, but of course the former method is too slow to allow of any considerable area being done in a short time."

Gloucester.—The city last summer purchased a new 320-gal. tar boiler and did a great deal of tar spraying, the hot tar being distributed by means of a flexible hose worked by hand, pumped direct from the boiler by a hand pump attached thereto. The cost of the tar painting work was as follows:

	Per sq. yd.
Materials	$1.16
Labor	.54
Total	$1.70

Regarding the work the city surveyor states: "The success of tar spraying depends entirely upon it being done in dry weather on a road with a good surface, and the longer the time the hot tar can remain on the road before being sanded, and before the traffic is allowed to go over it, the better. Undoubtedly tar painting, when done under satisfactory conditions, very much reduces the dust in summer; it also reduces the amount of mud in winter, but what mud is made is of a nasty black sticky nature. The tar painting requires to be repeated in the following summer, and is then much more effective than the first coat, provided always that the road has still a good surface. It is absolutely essential that tar painting should only be applied to a road which is in a thoroughly good condition, and although there are no wearing properties in the tar itself its effect is to waterproof the surface of the road and thereby to prevent mud and consequent dust being worked up from the subsoil below. If a road is very much worn indeed, requiring a heavy coat of stone, I should then prefer coating it with tar macadam in preference to making up as before with ordinary stone and then tar painting.

Exmouth.—Tar painting has been carried out in this place for the past five years, and so successful has it been that the quantity executed has been steadily increased each year. On the roads where there is heavy traffic the life of one coat of tar paint has been about five to seven months in the middle of the road, though on the quarters it has been much longer than this, say two years. On medium and light traffic roads the life is equal to two summers. The cost of road maintenance is reported to be reduced by tarring 10 to 15 per cent per annum. An area of 91,370 sq. yds. was tarred in 1909 at a cost of about $1,000. The grit used for spreading over the tar was obtained free on the beach.

Alton.—The surveyor reports tar painting has greatly reduced the dust, and has been found, by watering and sweeping with horse broom once weekly and daily scavenging of horse dung, to give good results. A tar spray machine is used. When rain appeared likely to spoil newly laid tar the surface was covered with hot sand with satisfactory results.

Basingstoke.—At this place experiments were carried out last year both by tarring under pressure and also by hand. Typical costs follow. Tarring main London to Winchester road using Tarroads machine with engine; total length tarred 543 yds., area 2,990 sq. yds.; 5 sq. yds. per gallon of tar estimated:

	Per sq. yd. Cents.
Manual and team labor preparing road and spreading grit, etc.	$0.40
5½ tons ¼-in. to dust granite, at $2.50	.41
Tarring, one coat	1.76
Total	$2.60

Tarring by hand labor street in center of town; ordinary gas works tar, boiled; length tarred 220 yds., area 2,283 sq. yds.; 5½ sq. yds. tarred per gallon of tar:

	Per sq. yd. Cents.
Manual and team labor, preparing, tarring and guttering road	$0.60
108 gals. tar at 3 cts.	.51
6½ tons granite dust at $2.50	.72
Coal and incidentals	.06
Total	$1.92

The council considered the various lengths tarred very satisfactory as regards dust abatement, quick drying after rain and reduced scavenging.

Tonbridge.—The rural district council engineer reports that the experience of the past winter has proved to him that there is an advantage in using a tar compound over ordinary tar; that unless the road previous to being treated is in good condition the effect soon disappears in wet weather; that tarring surfaces of any road from light up to medium traffic is an economical means of road maintenance, but with heavy traffic roads the tarring is only an expensive palliative for the dust question, and a better system of road making in the way of tarred macadam of some nature other than the water bound system must be adopted.

Market Harborough.—Tar painting of main roads in this district was commenced in 1906. The cost per sq. yd. for hand painting has been 1.60 cts., practically half of which is for labor, and the remainder for materials and carting. The engineer reports that the advantages of tar painting in this district are unquestionable in respect to the laying of the dust and the preservation of road surfaces. The only disadvantages that have been found are that at certain times of the year the surface gets a little greasy and granite chippings have to be thrown on. In tar painting the most serviceable result has been obtained when the tar is poured on a recently steam rolled road, of course waiting until the surface is dry. Half of the road is done at a time, as far as possible keping the traffic off, and gritting with ¼-in. granite chippings without dust—very sparsely spread—as it was found that the dust tended to make a film. It was found in this district that practically the tar painting does not withstand the winter, with the exception of that on the sides of a wide road.

Grimsby.—A few experimental lengths of tar painting were done in this district with varying results. Broadly speaking, it was found that where the streets get the benefit of the sun the experiment was a success. Where the streets are shaded from the sun during the warm hours of the day, the treatment has not been so successful. However, the process generally has been found to be successful and to diminish the quantity of both dust and mud until late in the autumn, when the disintegrating effects of the night frosts came into play, and the experience then was that the amount of mud in the case of those streets which had been thinly tarred was no greater and no worse than usual, but in the streets which had been thickly tarred the mud during the winter was exceedingly nasty. The method of applying the tar was as follows: The street was first well brushed and all dust removed; the tar was applied as hot as possible from a can with a rose similar to an ordinary watering can, and was at once brushed in by able-bodied workmen with ordinary brooms. A sand-drying apparatus was in attendance, and as soon as possible after the tar had been brushed into the road it was sprinkled with hot dry sand.

Woolwich.—Approximately six miles of roads were tar sprayed last season. The engineer states that from an experience and trial of several dust laying specialties he has come to the conclusion that up to the present tar spraying and painting is the least objectionable and most efficacious, when the work is undertaken on properly prepared roads in dry weather. He has found that such treatment leads to a substantial saving in the cost of scavenging, watering and maintenance.

Burnham.—The engineer reports that between four and five miles of roads were tar sprayed with highly satisfactory results. A considerable saving in the cost of scavening was effected, not a single load of mud having been created until well into November, and a large quantity of water was saved in street watering. Some cases of horses slipping occurred, all on limestone roads. On roads of granite no cases of slipping occurred.

Surrey.—The county surveyor reported that the past season was a particularly disappointing one for tar painting, as the weather except for very short periods was most unfavorable. He states that this resulted in a good deal of work being done under far from ideal conditions, and at a considerable increase of expense. The abnormally damp winter was singularly unfavorable to the life of the tar painting; and on roads subject to heavy

traffic, particularly in shaded and damp situations, the surface water-proofing was largely destroyed before the end of 1909, but there is no doubt the tar below the surface to a great extent prevented the water from passing through to the foundations, and was valuable in minimizing the damage due to the abnormally wet season. On exposed roads where the traffic was not heavy the waterproof coating has remained intact throughout the winter, particularly where the surface has been tarred in two consecutive years. While the results were undoubtedly less favorable than they would have been in a normal year, the engineer is of opinion that value was obtained for the expenditure incurred in the prevention of disintegration for several months, and in the measure of waterproofing afforded throughout the winter.

Godalming.—In this borough tar painting is done by hand, half the road being painted at one time, permitting the tar to sink into the road and avoiding as far as possible dressing the road with loose material.

Haywards Heath.—Last year five miles of roads were tar painted in this district with very satisfactory results, the continuous rain experienced during the summer having very little effect on the tarred surface, which remained hard and sound the whole of the summer and autumn. Ordinary crude tar from the local gas works is used, and the roads are painted by hand labor. For the above mileage three gangs of men are employed, each gang (six men) being supplied with a 50-gallon boiler. So far it has been found that the best local material with which to cover the tar is sea sand containing about 50 per cent of small pebbles. The tar is spread with an ordinary 3-gal. water can with a few large holes punched in the rose, and the boilers are fitted with draw-off cocks.

Horsham.—Several roads were tar painted last year in this district, and the results were found to be very satisfactory, as both the dust and also the mud nuisances were much abated, and the surfaces of the roadways much preserved from wear.

West Riding.—During the past three years many of the main roads in this district have been tar sprayed or tar painted. The county surveyor states that in his opinion tar, or a good tar compo, is by far the most effective and economical dust palliative on the market. He further states that the treatment of the surface of macadamized main roads in this district has produced very satisfactory results. The initial cost of the tar treatment in West Riding has been from about 2 to 3 cts. per sq. yd. when applied by machine, but when carried out by hand labor the cost has been at 1½ cts. per sq. yd. When the application has been successfully carried out the life of the macadam has been considerably increased, and the lengthened life the treatment gives to the macadam surface will be found to pay the cost of the application for each year of its life. The saving in the cost of scavenging and watering has also been found to be considerable.

Caversham.—The district county surveyor reports that "Tar painting in this district, although carried out under ideal conditions, and with the utmost care, has so far proved an absolute failure, and has simply resulted in sticky, black mud throughout the winter in streets where there has been average traffic. Perhaps this may be accounted for by the long spell of alternate frost and rain experienced during this year."

Abersychan.—Experience in tar painting in this district has been favorable, it being found that until the setting in of winter the surfaces remained in good condition and were fully preserved. After the break-up occurs the amount of mud removed from the tar painted surfaces has been found to be about 50 per cent less than that on unpainted surfaces.

Haverfordwest.—About 10,000 sq. yds. of road surface, mostly on the busiest street in the town, were tar painted last summer. The work was done by hand labor and cost about 2 cts. per sq. yd. on the average, including granite chippings. The best results were obtained by treating roads that were in a thoroughly good state of repair, all horse droppings and dust being swept off and removed, the tar applied direct from a tar-boiler boiling hot through a coarse rose of a large watering-pot and thoroughly worked into the surface with hand brooms. Immediately the painting was done it was evenly covered with a sprinkling of clean ½-in. granite chippings, and crushed into the surface with a 10-ton steam roller. The borough surveyor further states: "Although I have been tar painting in a small way for six years, last year was the first time I adopted this method. In previous years I always sprinkled the tar with sand or some fine binding material and left it to the traffic, but a very much harder and better surface was obtained with the granite chippings crushed in in the way I have described. It only needs to be run over about twice or three times to a place with the roller to make a perfectly satisfactory job. I have found tar painting to be highly satisfactory as a dust preventive and road preserver for the summer months, but I regret to say I have not yet been able to find any surface treatment that will prevent or minimize mud to any appreciable extent on a heavily-trafficked macadam road during the winter months. I treated a residential street in the way I have described last summer, and as a result it has been quite free from mud throughout the winter, and its surface is now in perfect condition, but this is not the case where heavy traffic prevails. Judging from my past experience of tar painting, I consider it is a most advantageous and economical treatment for roads that are in good condition, if it is done when they are thoroughly dry and clean, but I would not recommend it for roads in a bad state of repair, nor in any case under unfavorable climatic conditions."

Bolsover.—One section of road was tar painted last summer with crude tar from the city gas works. The work was done during the only dry week last summer; the roadway was thoroughly scoured of all dust for some time before hand, and the tar was spread from an old water cart and thoroughly swept in. Slag screenings were spread over this surface and traffic allowed on it the following day. The weather was continually wet ever since the treatment was applied and no good results have been had since Christmas.

Dumfries, Scotland.—The burgh inspector reports that tar painting has answered admirably for two seasons and even during the winter months. The amount of mud on such roads has been considerably less than on ordinary macadam. The cost of tar paint and chips has been found to stand almost a season's wear, and is a very economical method of maintenance. It has also been found that tar macadam or tar painted roads shaded by houses or trees have not turned out as well as roads in exposed situation.

Bridge of Allan, Scotland.—Tar painting has been carried out in this place for some years with varying success. Where the road does not carry any great weight of traffic and the weather is fairly good, tar painting has been found to be decidedly an advantage, in so far as that it minimizes the dust nuisance and saves watering. On the other hand, where the traffic is heavy and the weather wet it has been found that the tarred surface in places soon becomes worn off, and during the winter the road comes back to the old conditions.

Haddingtonshire, Scotland.—It has been for some years the practice in this district to tar paint all of the macadamized roads, and excellent results have been secured. In this district the work is begun in May, if the weather is suitable, and is all done by hand labor. It has been found that the tar painting remains good for a period of about six months on the streets with the heaviest traffic, but about November the surface begins to break up and works into black sticky mud, which has to be swept off, after which all traces of the tar soon disappear. On other roads, where the traffic is very light, it has been found that the tar painting remains good for two and sometimes three years, after which a much smaller quantity of tar is required to repaint the surface. The cost of tarring amounts to about 2 cts. per sq. yd. complete, the one coat being found sufficient. The tar is obtained from the local gas works, and is applied hot and only in dry weather. One-half of the width of the roadway is treated at a time, and this is immediately covered over with a good coating of dust, and the traffic is then allowed to pass over. In a day or two, when the tar has hardened, the dust is all swept off the road, which is then thoroughly watered. It is a mistake, states the county surveyor, to expect that a tarred road will require no watering during the whole season, as a certain amount of dust is bound to accumulate from horse droppings and dirt carried onto the road by the wheels of vehicles, and it is found advantageous to give an occasional washing, and to pay great attention to the thorough sweeping of the side channels, to which the dust naturally gravitates. The increased life of the road fully meets the cost of tarring.

Renfrewshire, Scotland.—The borough surveyor reports that in this district tar spraying is done by machine at a cost varying from 1½ cts. to 2 cts. per sq. yd., exclusive of cost of sweeping or sanding. He states that this is effective for one season only, on roads carrying heavy traffic, but where the traffic is light it may suffice for a longer period. He further states that it is essential that the roads be well constructed of good hard material with a homogeneous surface in order to obtain the best results. He believes that it is impossible to treat successfully a surface worn into holes or depressions.

Aylesburg.—During last year 4,185 sq. yds. of road surface were tarvia painted in this district. The surface was treated and sprinkled with granite chippings, at a cost of 4.28 cts. per sq. yd. The cost per sq. yd. without chippings was 2.9 cts.

Marple.—During the past two seasons about 11,000 sq. yds. of tar grout macadam have been laid in this district, some lengths of which have been a marked success and others not good. The method adopted in this district, after a number of experiments, is to prepare the road surface and to spread a fairly heavy coat of metal about 12 sq. yds. to the ton, taking care that any old metal that is used is screened, to remove the dirt and small material. The macadam is then slightly rolled with a 10-ton roller. The tar-cementing mixture is then applied hot by means of a hand spreader, the amount applied being about 2/3 gal. The macadam is then racked with ½-in. limestone chips, the chips being well brushed into the interstices and any surplus swept off. The macadam is then rolled again and a further dressing of tar mixture is applied, about one-third of a gallon being used per yard, and the macadam is again racked with ½-in. limestone chippings and rolled to a finished surface. The tar mixture consists of crude tar from the city gas works, with one-quarter of its weight of pitch added, well boiled until the water contained therein is evaporated. One gallon per sq. yd. is used. The stone used for macadam is a local stone, obtained from Macclesfield, and the chippings are Derbyshire limestone. Stone for macadam costs $1.86 per ton, delivered at wharf; ½-in. Derbyshire limestone, $1.56 per ton, delivered in the sheds; tar, $3.96 per ton at gas works; pitch, $6.72 per ton at station. The finished tar work costs about 26 cts. per sq. yd. It has been found that limestone makes a tougher cementing material than granite, and that the local macadam laid as tar grout macadam makes a better road than granite macadam laid water-bound; and that granite water-bound macadam and local stone tar grout macadam cost about the same amount.

TARVIA.

St. Germans.—During the past season the rural district council engineer has directed his attention chiefly to preparing a cheap form of bituminous concrete for the road coating, believing this to be far more economical than the constant application of tar to the surface of the road as a painting, as this, he believes, only suffices for the one season. The

method which has been adopted is first to do the necessary improvement to the cross-falls and correction of the surface to be coated; then to spread the road material and roll dry till firm. This is then sprayed or fluxed with liquid Tarvia. Directly upon this is spread the major binder, which is specially screened and dusted from the stone crushers and mixed with the Tarvia until in a "live" state. The whole is then thoroughly brushed in and rolled, and finally coated with dry screened chippings, to lick up an excess of Tarvia and to present a gritty asphaltic surface impermeable to moisture through the whole thickness of the coating. The surveyor states that the spraying and painting has not been particularly successful owing to its temporary nature. As soon as the severe weather of the winter approaches it is damaged and becomes useless; but the bituminous-bound coating, as above described, has stood the test through the severe winter weather, and is always clean and quickly dries after rain. The result is a much more permanent coating, a clean road surface during winter and a practically dustless condition during summer.

Kesteven.—The county surveyor reports that experimental lengths have been put down with Tarvia, Ferromac, Vianex, and with gravel for binding, and good results have been got with each, and that generally the use of binding has and is,being reduced to a minimum the surface, after rolling is completed, being afterwards covered with a thin layer of slag dust. This quickly fills up any interstices and makes a smooth skin, which appears to reduce the dust nuisance, prevents stones breaking loose, and forms an excellent surface for tar painting the whole surface of the main roads, which, owing to its slipperiness under certain conditions, is not generally acceptable in this county. Tracks about 2 ft. to 3 ft. wide, for each line of wheels of motor traffic on the trunk main roads, have been painted with Tarvia and covered with clean fine chippings. These tracks have proved very economical and very acceptable to the county; they effectually prevent the disintegration of the surface, reduce very considerably the dust, leave the other parts of the road untouched for horse traffic, and finally it costs very little to do. From experience on the Great North Road there seems to be no room for doubt that tar painting where there is any great amount of motor traffic is a decided economy as well as adding to the comforts of the road.

Sunbury-on-Thames.—During last summer 12,000 sq. yds. of road surface were tar painted in this district. Tarvia fluid and ⅜-in. granite chippings were used; the work was done by hand labor, and the cost, inclusive of light horse-rolling, was 3½ cts. per sq. yd. The district engineer reports that the improvement in the surface was very marked through the summer and autumn, and the road was in good order until after Christmas. The very bad weather and continual alternation of frost and thaw during January and February cut up the surface badly, and it had to be swept with a horse-broom set light several times. An advantage that was noticed is that the road very quickly comes to a good running surface again, two days' fine weather making it quite good going. The council intend to do a greater superficial area this season, and have reduced the contract number of street watering vans accordingly.

Horbury.—During the past two years 2,790 sq. yds. of road have been laid in this district on the Gladwell principle, bound with granite chippings and Tarvia. The results on the whole have been good, the least satisfactory being that portion between the rails on the tramway track. The cost of a Gladwell road in this district, using 2¼-in. Welsh granite at $2.78 per ton, special ¼-in. granite chippings at $2.40 per ton, and Tarvia at 9 cts. per gal., is about 44 cts. per sq. yd. (the figures given are the prices of materials at station). In August, 1908, a trial length of main road was tar-sprayed with Tarvia, at a cost of 3 cts. per sq. yd., the area being 3,132 sq. yds., and the hot Tarvia was sprayed on the road with a machine owned by the Taroads Syndicate, Ltd.; in July, 1909, 3,700 sq. yds. of main road were surface tarred by hand, at a cost of 2½ cts. per sq. yd., Tarmite being the preparation used. The district council engineer states that in his opinion the tar treatment of roads can only claim to be a dust preventative, and it cannot claim to reduce to any appreciable extent the amount of mud in wet weather. As a preservative he considers that the life of a road will be lengthened if it be tar painted.

TAR-MACADAM.

Dunfries, Scotland.—The burgh inspector reports that the experience during the past five years has convinced him that the most economical way to deal with suburban roads is to put down a coat of tar-macadam composed of 2½-in. whinstone metal finished with ¾-in. tarred chips, thoroughly rolled with steam roller, the total cost being 28 cts. per sq. yd. At Milldamhead, Annan-road, where there is heavy motor traffic, a stretch of roadway treated in 1906 is as perfect today as when newly finished, the peculiarity of this section being that only crude tar, without heating or any preparation, was used in its formation, and during the last four years no mud has ever appeared on its surface.

Perthshire.—The engineer of this district carried out three experiments last year with a prepared tar which is a composition of distilled tar and oil. The following are the treatments and the results: No. 1 System.—Running in hot tar between stones before being steam road rolled, allowing ¾ gal. of tar to 1 sq. yd. of bed of metal and binding with tarred chips. This system has shown most excellent results; there has been an entire absence of mud or dust during the past year, and it presents a smooth and dry surface in winter. It is thoroughly waterproof, concrete in construction and the treatment is simple and expeditiously worked. Estimate of cost 6 cts per sq. yd. more than the cost of water-bound system. No. 2 System.—Laying a coat of tarred ¼-in. chips over a macadamized surface 1 in. in thickness, and spreading a bed of 2½-in. metal 4 in. thick on top, then steam road rolling and binding with the same matrix as used for sub-binder or bottom cushion. This system has shown good wearing results. The metal bed resting on a soft cushion produces an elasticity on the surface when traffic passes over, thus minimizing the vibrating power and effecting a longer life to the metal. Scarcely any mud or dust has been produced during the past year, but as the sub-binder has a tendency to work up through the interstices of the stones it has the effect of causing larger voids between the metal, thus allowing surface water to percolate more readily down through the bed than is the case with system No. 1. Estimate of cost over water-bound system, 7 cts. per sq. yd. No. 3 System.—Blinding metal bed, after being thoroughly consolidated with steam road-roller, with ½-in. tarred chips. This makes a clean and dry surface and prevents mud and dust to large extent, and is much to be preferred before untarred chips, sand, gravel or ordinary road scrapings. Estimate of cost, 1 ct. per sq. yd. more than cost of water-bound system. The engineer states that from his observations and experience of different systems and treatments with tar, system No. 1 appeals to him as being the simplest, most endurable, least expensive and most expeditious remedy suitable for a large mileage. Although system No. 2 is almost equally as good as No. 1, still the details of preparations and the working operations are somewhat arduous and slow. No. 3 system might be largely adopted—where chips are easily available—as a good binding material. It is his intention to extend No. 1 system over longer lengths of road this season, particularly on main roads passing through burghs or villages.

Caversham.—The district council surveyor is to construct another section of "tar-bound" road upon the same principle as tried last spring with very great success. In this construction the old road was scarified and shaped, and the new road stone (Rowley Regis 2½-in. granite used) carefully spread to an even surface and well rolled in a perfectly dry state; a coating of ½-in. to ¼-in. clean granite chippings was then spread over the road and thoroughly broomed into all interstices and again lightly rolled. The surface was then treated with a mixture of hot tar and pitch, thoroughly broomed into it, and finished with a coating of ¼-in. chippings and again very lightly rolled. The section so treated last spring has so far stood admirably, and shows little or no signs of wear. The district council surveyor is also at the present time experimenting with a concrete road as follows: The surface of the road under treatment is shaped and a layer ¾ in. thick of hard local gravel mixed with sand and cement (small proportion of cement) is spread over the surface; the granite is then spread and thoroughly rolled down to a mosaic surface, chippings are then spread over and broomed in, and finally the whole is grouted up with granite chips, dust and cement, and lightly rolled. The traffic is kept off until dry.

SLAG-TAR-MACADAM.

Bolsover.—This district is in the center of an iron smelting area and uses much slag in the construction of its roads, the slag being delivered at an average cost of 96 cts. per ton. A considerable amount of tarred-slag-macadam is to be constructed this summer, the method of construction being as follows: The old surface of the street is taken off for a depth of 6 in., and is then rolled and leveled smooth with the steam roller; this bed is then tarred over with crude tar, and about 4½ in. of tarred-slag rejections is carefully spread and rolled in. Over this is laid about 3 in. of 2¼-in. tarred slag, and this is similarly rolled in with the steam roller, and above it is spread ¾-in. tarred slag for the finishing coat. This has been found to make a good non-slippery surface and costs less than 39 cts. per sq. yd. in this district.

Isle of Ely.—The county surveyor reports that a length of slag tar-macadam has been laid in this district on a heavy-traffic town road with most satisfactory results, as after three years' wear no repairs are, or have been, necessary except to make good a sewer trench opened by the urban authority soon after the road had been made. He states that but for the difficulty in providing and high initial cost this material would be used to a much larger extent, as it must prove an economy in the long run. Tarred binding has also been experimented with, but it has not proved very successful under heavy traffic.

TREATMENT WITH OIL-TAR.

Southall-Norwood.—The district council engineer reports as follows regarding treating the roads with oil-tar: "We shall also—as during the past three years—oil-tar our roads, as we find it to be the cheapest and most effective palliative for dust laying. In addition, it keeps the public health of the district at a high level. We do not use water carts at all, the whole of the roads being treated with oil-tar.

Bradford-on-Avon.—During the coming summer it is proposed to treat some five to six miles of roads in this district with oil-tar sprayed on. Last summer some of the roads received two coats, the majority only one. The result was excellent, and not much trouble was experience as regards foothold for horses. The cost was, in the opinion of the engineer, easily covered by the decreased wear and tear of the roads. Some of the roads treated were waterproof till after Christmas.

TARMAC.

Sunbury-on-Thames.—In the autumn, 2,504 sq. yds. of Tarmac was constructed, the existing granite being scarified and removed. The following are the details of actual cost:

179 tons 6 cwt. 2¼-in. Tarmac at $3.74 per ton	$ 669.92
128 tons 1 cwt. 1½-in. Tarmac at $3.74 per ton	481.14
10 tons slag dust at $2.34	23.64
Labor on scarifying and spreading	92.56
Cartage of Tarmac and scarifying granite	188.52

Six-ton steam roller at $5.86 per day....	71.88
Scarifying at $1.36 per yard.....	31.66
Total	$1,559.32
Credit for value of 263 yds. of scarified granite carted away...	259.82

The superficial area tar-macadamized was 2,504 yds., giving a cost of 62 cts. per yd. for all work. Taking credit for the scarified granite as above, the cost per sq. yd. was reduced to 52 cts. The Tarmac was laid in two coats, with a total thickness of 4 in.

COMPARISON OF THE COST AND ADVANTAGES OF SURFACE SPRAYING WITH TARVIA, TAR COMPO, TAR AND TAR MACADAM AND GLADWELL MACADAM.

The work was done last summer in Grangemouth under the direction of D. A. Donald, burgh surveyor. In July and September of last year Mr. Donald submitted the following reports: No. 1 Report.—Treatment of roads with Tarvia, tar compo, and tar. *Surface Spraying.*—(1) Bo'ness road, North Bridge street, Middle street, North Charlotte street, North Basin street.—These streets were treated in the following manner: Surfaces brushed with street rotary brush to remove all dust and surplus blinding, sprayed with Tarvia (a specially prepared bituminous compound) with "Aitken's patent pneumatic tar-sprayer," at the rate of 5 sq. yds. to the gallon, and at a pressure of 200 lbs. per sq. in., and blinded with Sussex pea gravel. The cost of the various operations in connection with this experiment are as follows:

	Per sq. yd. Cents
Sweeping and preparing road surface....	$0.10
Tarvia and application with Aitken's Sprayer	2.40
Sussex pea gravel blinding and labor spreading	1.40
Total	$3.90

If blinded with whinstone chips, .76 ct. per sq. yd.

(2) Grange street, South Charlotte street and Waterloo place.—These streets were treated in the following manner: Surfaces brushed with street rotary brush to remove all dust and surplus blinding, sprayed with tar compo (refined tar with 15 per cent of bitumen added), with Aitken's pneumatic tar-sprayer, at the rate of 5 sq. yds. to the gallon, and at a pressure of 200 lbs. per sq. in., and blinded with Sussex pea gravel. The costs of the various operations in connection with this experiment are as follows:

	Per sq. yd. Cents.
Sweeping and preparing road surface	.10
Tar compo and application with Aitken's sprayer	2.70
Sussex pea gravel blinding and labor spreading	1.40
Total cost	$4.20

If blinded with whinstone chips, .76 ct. per sq. yd.

(3) Abbots road, from Kerse road westwards 166 yds.—This portion of Abbots road was treated in the following manner: Surface brushed with street rotary brush to remove all dust and surplus blinding, sprayed with ordinary refined tar with Aitken's patent pneumatic tar-sprayer, at the rate of 6 1/3 sq. yds. to the gallon, and at a pressure of 200 lbs. per sq. in. and blinded with whinstone chips. The costs of the various operations in connection with this experiment are as follows:

	Per sq. yd. Cents.
Sweeping and preparing road surface	.06
Tar and application with Aitken's sprayer	1.20
Whin chips and blinding and labor spreading	.76
Total cost	2.02

Tar-Macadam.—(4) Abbots road, from Bowling Green gate to Kerse road.—This road was treated in the following manner: A coating 4 ins. thick of 2½-in. steel slag from Bowling Green gate to Talbot street and 2½ ins. hand-broken metal from Talbot street to Kerse road was applied to the old surface of the road, sprayed with tar, blinded with whinstone chips and rolled, and again sprayed with tar and blinded with whinstone chips and finally rolled. This is an expeditious method of forming tar-macadam, and requires very little rolling and blinding compared with an ordinary water-bound road. The cost of this form of tar-macadam works out at 4½ cts. per square yard over that of an ordinary water-bound road.

Gladwell Tar-Macadam.—(5) Abbotts road, from Bo'ness road to Bowling Green gate.—This road was treated in the following manner: A matrix composed of Tarvia and ¼-in. whinstone chips (in the proportion of 15 gal. of Tarvia to 1 cu. yd. of chips) both slightly heated before mixing, was applied to the surface of the road about 1½ ins. thick. A two-stone-deep coating of machine-broken whinstone metal was spread on the top of this matrix and rolled slowly, the matrix being worked up into the interstices of the metal and forming a binder. After the metal was thoroughly rolled and consolidated, liquid Tarvia, slightly heated, was poured over the surface of the road to fill up the interstices and blinded with ¼-in. whin chips. The cost of this system works out at 8.40 cts. per square yard over that of an ordinary water-bound road, but this cost could be considerably reduced if suitable appliances were procured for heating the chips and mixing the matrix.

Comparison of Costs.—The following is a comparison of the cost of the above work, including all labor:

	Per sq. yd. Cents.
Surface spraying with Tarvia, 3,361 sq. yds.	3.90
Surface spraying with tar compo, 1,765 sq. yds.	3.70
Surface spraying with tar, 940 sq. yds.	2.02
Extra cost of tar-macadam over that of water bound road, 1,060 sq. yds.	2.50
Extra cost of Gladwell-macadam over that of ordinary water-bound road, 453 sq. yds.	8.40

Hand Tar Spraying.—No. 2 Report.—Hand tar-spraying surface of Lumley street from Kerse road to Wallace street.—Lumley street was sprayed with ordinary refined tar. The operation consisted of: (1) Sweeping the surface with horse sweeper and hand brushes to remove all dust. (2) Spraying ordinary refined tar, heated in a tar boiler on the surface of the road with ordinary watering cans at the rate of 6½ sq. yds. to the gallon. (3) Blinding the tar with ¼-in. whin chips. The costs of the various operations are as follows:

	Per sq. yd. Cents.
(a) Sweeping and preparing road surface..	.10
(b) Tar and application with watering cans	1.20
(c) Chips, cartage and labor spreading....	.50
Total cost per sq. yd.	1.80

Regarding these experiences Mr. Donald states: "The portion of Bo'ness road opposite the town hall was tar-sprayed at a cost of about 2 cts. per square yard. The experiment was satisfactory, and a clean and almost dustless road was the result during the summer months, but in the winter months the tarred surface was broken and the road appeared in much the same condition as other roads which had no treatment with the tar. The cause of this is: (1) The fact of the road carrying a considerable amount of heavy traffic. (2) The road having no bottom. Notwithstanding the breaking up of the tarred surface in the winter time, I give it as my opinion that the tar-spraying has increased the life of the road, and this, I think, justifies the expense, which, after all, is very low."

"Lumley street, which was treated in the same manner, is a good road today. This road does not carry the same traffic as Bo'ness road, and it has a good bottom. The experiment has been satisfactory, both in summer and winter, and to preserve its good condition it might be necessary to prepare and re-tar-spray some portions of it this year. As to the saving on this road: Last winter it was scraped on an average once per week. The cost of scraping last winter I put at $92. The cost of tar-spraying was $43.75. Consideration must also be given to the preservation of the road and the comfort to pedestrians and dwellers in the streets.

"The other streets tar-sprayed were those in the old town. Those today are in good condition, and the scraper was never used on them during the winter.

"The experiments on Abbots road were of a different nature, and the road now forms what is called a tar-macadam *in situ* road. It has stood well during the winter months and is in good condition today. The road, of course, carries very little traffic. The cost of this experiment was 10 cts. per square yard from Bo'ness road to Bowling Green gate and 9½ cts. per yard from Bowling Green gate to Kerse road."

Bituminous Macadam in State Road Construction Work in New Jersey.

During 1909 a total of 70 miles of bituminous macadam roads were built in New Jersey under the direction of the state commissioner of public roads, and at the end of the year 31 additional miles were in course of construction. The standard state specifications for the construction of macadam roads with asphaltum binder contain the following requirements regarding the application of the binder: When the second course of broken stone has been spread and rolled, asphaltum binder shall be applied by means of a mechanical distributor designed to evenly distribute the asphaltum binder, to regulate

TABLE SHOWING THE CONTRACT PRICES IN 1909 FOR STATE ROADS IN NEW JERSEY CONSTRUCTED WITH BITUMINOUS BINDERS.

Road.	County.	Kind of Surfacing	Width surfacing, Ft.	Length, miles.	Depth of stone, ins.	Square yards.	Price per sq. yd.
Paterson Plank	Bergen	Macadam with asphaltum binder[1]	18	2.31	8	24,125	$0.90
River Road	Bergen	Macadam with tar binder[2]	22	2.44	7	29,087[3]	.75
Jamesburg	Middlesex	Macadam with asphaltum binder	14	1.32	8	11,103	.85
Hopewell	Mercer	Macadam with liquid asphalt		2.03	6	22,146	.57[4]
Trenton Turnpike	Middlesex	Macadam with asphaltum binder	16	2.50	8	23,584	.81
Helmetta	Middlesex	Macadam with asphaltum binder	14	2.70	8	22,248	.83
Plainsboro	Middlesex	Macadam with asphaltum binder	14	2.46	6	20,338	.90
Green Brook	Somerset	Macadam with asphaltum binder[5]	14	1.16	8	9,528	.70
Stoutsburg	Somerset	Macadam with asphaltum binder	14	2.05	8	16,870[6]	.90
Jefferson Ave	Middlesex	Macadam with amiesite[7]	16	2.04	7	3,900	.94
Terrill	Union	Macadam with amiesite	16	1.89	6	18,068	.91
Edgar	Union	Macadam with asphaltum binder	16	3.32	8	7,374	.90
Edgar	Union	Macadam with asphaltum binder	16	3.32	8	23,432	1.05
Edgar	Union	Macadam with asphaltum binder	16	3.32	8	533	.30
Edgar	Union	Macadam with asphaltum binder	16	3.32	8	667	.60
Washington Ave	Union	Macadam with asphaltum binder	16	1.16	8	5,296	.90
Washington Ave	Union	Macadam with asphaltum binder	16	1.16	8	6,133	1.00
Walnut Ave	Union	Macadam with amiesite[7]	16	1.19	8	9,797	1.10
Walnut Ave	Union	Macadam with amiesite[7]	16	1.19	8	1,636	1.20

[1]1.3 gal. of hot asphaltum oil applied to top coat. [2]Tarvia applied by penetration method on second course. [3]Also ¼ gal. tar additional application per sq. yd. to the 29,087 sq. yds., at 9 cts. per sq. yd., making the total cost 64 cts. per sq. yd. [4]This is a bid of 51 cts. per sq. yd. for plain macadam plus 6 cts. per sq. yd. for applying liquid asphalt. [5]1.3 gal. of asphaltum oil per sq. yd. [6]Telford. [7]Upper 3 ins. composed of amiesite. [8]1.3 gal. per sq. yd.

the width of distribution, to control the quantity distributed and to maintain the asphaltum binder at a uniform temperature.

The quantity of asphaltum binder required will be 1.2 gals. of residual bitumen per square yard of macadam surface, the temperature of which when applied shall be not less than 190° F. nor more than 200° F.

Before any binder is applied to the 1½ in. stone, the contractor must have on hand the required amount of ¾ in. stone and screenings necessary to finish the road so the same can be applied at once after the rolling has been finished, also the quantity of the 1½ in. stone coated at any one time shall not be so large but that there will be sufficient binder left in the car for the surface dressing.

After the application of the asphaltum binder the rolling shall continue until the stone ceases to sink or creep in front of the roller. The wheels of the roller are to be kept constantly wet so that they will not adhere to any of the coated stone during the rolling. The amount of rolling required to be done shall be subject to the approval of the engineer and supervisor.

Any depressions formed during the rolling, or from any other cause, are to be filled with 1½ in. stone or ¾ in. stone or both, together with asphaltum binder, as ordered by the engineer, and the roadway then rolled until brought to the proper grade and curvature as determined by him. Additional asphaltum binder must also be applied in such quantities and at such points as directed by the engineer, so that the entire surface of the second course of stone will show a uniform quantity of asphaltum binder upon its face before the spreading of the surface course of stone.

When the two courses of stone are rolled to the satisfaction of the engineer and supervisor, a coat of ¾ in. stone shall be spread of sufficient thickness to make a smooth and uniform surface to the road. This ¾ in. stone must not contain over 5 per cent of material small enough to pass a screen having ¼ in. openings and must be as free as possible from dust. A second application of the asphaltum binder shall then be made at the rate of .3 gal. of residual bitumen per square yard, and after this second application of binder has thoroughly penetrated the ¾ in. stone, stone dust shall be applied in sufficient quantity to just fill the voids and the road again rolled until it becomes thoroughly consolidated, hard and smooth.

Rolling must be done by contractor with a 10-ton standard steam macadam roller, so constructed as to give a compressing power of not less than 400 lbs. per lineal inch on drivers, approved by the engineer.

The accompanying table, compiled from the last annual report of Frederick Gilkyson, state commissioner of public roads, shows the contract price and details of construction of a number of bituminous macadam roads built last year.

During the month of April the total amount of material excavated in the canal division of the Panama Canal was 1,723,339 cu. yds., of which 556,787 cu. yds. were classified as earth and 1,166,552 cu. yds. as rock. Of this quantity, 1,685,030 cu. yds. were removed by steam shovels. The high record of the month was made by shovel No. 204, working 26 days in the Culebra district, which excavated 55,635 cu. yds. of rock. The second best record for the month was made by shovel No. 205, working 25 days in the Culebra district, which excavated 54,597 cu. yds. of rock. The best record for a shovel of the 70-ton class was made by shovel No. 127, working in the Tabernilla district, which excavated 35,164 cu. yds. of earth in 26 days. Shovel No. 217, in the Culebra district, made the high record for one day by excavating 2,945 cu. yds. of rock on April 28. Shovel No. 127, working in the Tabernilla district, excavated 1,624 cu. yds. of earth on April 2, being the high record for one day for a 70-ton shovel during the month.

Water-works and Sewer Section

Note: This section is devoted to methods and costs of constructing sewers and water-works. It will cover the construction work for all details of water supply and sewerage, including sewage purification and water filtration.

Some Published Costs of Tunnel Work in the Los Angeles Aqueduct.

In our issue of May 18, 1910, we gave some figures of cost of tunneling on the Los Angeles aqueduct, which were submitted by Mr. J. B. Lippincott, assistant chief engineer, to show the economy of day labor work. As presented these figures told very little regarding the real economy or otherwise of the work since no data were given as to cross-sections of tunnel, character of material penetrated or methods of work. In fact, very few figures of detailed costs in this work have been made public. Such of these as we have been able to find we have collected and rearranged for study by contractors in the following paragraphs:

The tunnels in the Los Angeles aqueduct are all of one type but vary in sections; the type is shown by Fig. 1. This is one of the largest of the sections on the power pressure pipe line, where a capacity of 1,000 sec. ft. is

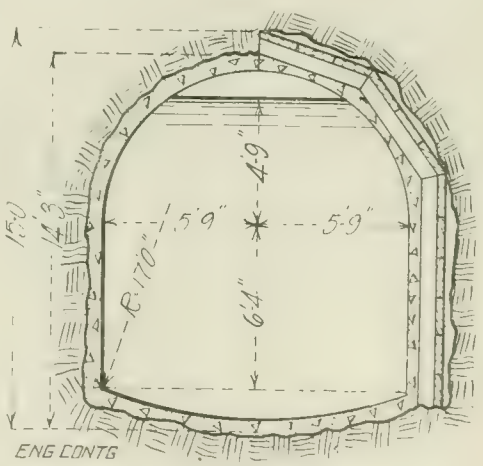


Fig. 1.—Cross Section of Power Pressure Line Tunnel, Los Angeles Aqueduct.

provided. In normal conduit lines a nominal capacity of 420 sec. ft. is provided. The computed capacities, quantities, etc., of the several standard tunnel sections adopted are as follows:

With these data the following general and specific costs may be studied somewhat understandingly.

	S=.002	S=.0013	S=.001	S=.0005	S=.00035
Capacity, sec. ft.	433	430	432	438	430
Velocity, ft. per sec.	8.48	7.2	6.5	4.991	4.64
Excavation, cu. yds.*					
Timbered	3.37	3.74	4.665	5.09	6.38
Untimbered	2.705	3.045	3.344	4.28	5.38
Concrete, cu. yds.*					
Timbered	0.907	0.975	1.002	1.125	1.38
Untimbered	0.684	0.716	0.752	0.88	1.05

*Per lineal foot of tunnel.

TUNNELS ON TAWIONE DIVISION.

The standard sections for tunnels on this division are shown by Figs. 2 and 3. The dimensions and quantities of these sections are:

	S=.0013	S=.001
Dimensions, ft.	8x9	8½x7½
Capacity, sec. ft.	430	432
Velocity, ft. per sec.	7.2	6.5
Excavation, cu. yds. per lin. ft.:		
Timbered	3.740	4.665
Untimbered	3.045	3.344
Lining, cu. yds. per lin. ft.:		
Timbered	0.975	1.002
Untimbered	0.716	0.752

Mr. J. B. Lippincott gives* the cost per lineal foot of tunnel work on this division for 61,515 lin. ft. of excavation and 33,805 lin. ft. of lining as follows:

Item.	Per lin. ft.
Excavation	$12.70
Lining	6.80
Maint. and operation	0.68
Equipment	2.20
Total	$22.38

Roughly, from the above figures, the cost of excavation will have been from $3.12 to $4.17 per cu. yd. and the cost of lining from $6.79 to $9.50 per cu. yd.

SOME COSTS OF THE LOS ANGELES AQUEDUCT TUNNEL WORK.*

The cross-sections of the various tunnels differ slightly. One, typical of the work on the Saugus division, is shown in the accompanying Fig. 1. For this cross-section the excavation amounts to 6.7 cu. yds. per lin. ft. where the ground must be timbered, and 5.93 where no timbering is necessary. The concrete used in lining is 1.314 and 1.029 cu. yds. for timbered and untimbered respectively. The capacity of this tunnel is 1,000 sec. ft. at a velocity of 7.81 ft. per sec. This section is used among other places at Tunnel 73. At the long Newhall tunnel, No. 104, a similar but smaller section is driven. For this the excavation is 5 cu. yds. timbered, and 4.12 untimbered; concrete 1.11 and 0.80 cu. yds.; capacity 420 sec. ft., and velocity 4.91. At Tunnel 82 a slightly different section of the same capacity is used.

In the main the tunnels are driven in soft rock, sandstone and cemented gravel being most common. On the Saugus division, the one nearest the city; the ground stands well whether wet or dry. The favorable character of the ground has been an important factor in reducing the costs. While there have been many difficulties, including gas and the inflow of oil, there has been relatively little of the ground which was faulted and moving as in mines and not a great deal of hard igneous rock, such as is abundant in mining districts. Much of the work has been done by hand. Frequently the holes could be drilled with augurs and after blasting up to the spring line, the rest was picked down. Some excellent records both as to cost and speed have been made on the Saugus division of which D. L. Raeburn is engineer.

At Tunnel 82, with J. T. Nolan in immediate charge, a typical month's record showed: North portal, 399 ft. progress, 399 ft. timbered, unit cost $8.58 per ft. for excavation, $1.32 for timbering; at the south portal the corresponding figures were 434, 424, $7.72, $1.16. For the total work the average cost of the tunnel unlined was $9.43. The ground here is a compact sand and clay. Three miners work at the breast boring with hand augurs and getting in two rounds per shift of 8 hours, the holes being 3 ft. deep and a round consisting of 6 to 9 holes. Two other miners trim down the sides and pick down the top, working on a false staging. Five men shovel, tram, and timber, and there is a foreman for each crew. The eleven men constitute a unit. Miners are paid $3 when working in dry ground and $3.50 when it is wet. The shovelers and trammers get $2.50

*Engineering-Contracting, May 18, 1910.

*"Mining and Scientific Press," May 14, 1910.

and $3. A minimum of 4 ft. is required where the ground does not need timbering and 3½ ft. where it must be supported. A bonus of 25 cts. per foot is paid for all above this, the money being divided among the men working in the drift. In practice it amounts to additional compensation to the amount of 75 cts. to $1 per day per man, but the system greatly increases the speed of the work and decreases the cost. Much the same organization is maintained at other points, though where the ground is harder hand-drills are necessary. (To arrive at the cost of excavation per cubic yard we assume the excavation to have been the same per lineal foot as in the Newhall tunnel, or 5 cu. yds. for timbered and 4.12 cu. yds. for untimbered. In the north portal 399 ft. of timbered section cost $8.58 per lin. ft. or $8.58 ÷ 5 cu. yds. = $1.716 per cu. yd. of excavation.—Editors.)

In the Newhall tunnel, driven in wet cemented gravel, four men work at the breast with hand-drills. At this tunnel one month's progress was as follows: North portal, 176 ft., unit cost $29.36, timber $5.92; south portal, 301 ft., $14.44, timber $6.35. The total progress at that date had amounted to 5,572 ft., at a unit cost of $17.65 for excavation and $5.30 for timbering. Concrete lining had been put in 1,017 ft. of sides and arch at a unit cost of $5.66 per ft., and in 1,075 ft. of bottom at a further cost of $1.91. (At $17.65 per lin. ft. for excavation the cost per cubic yard was $17.65 ÷ 5 cu. yds. = $3.53.—Editors.)

Tunnel 73, C. B. Worthen, constructing engineer, was driven by hand-drilling through wet shale at the north, and schist at the south. A typical month's work here was: North portal, 168 ft., $18.94; south portal, 126 ft., $26.29. For a total distance of 3,271 ft., the unit cost was $26.35. The unit cost of the tunnel complete except for bottom lining was $43.43 per foot. (At $26.29 per lineal foot the cost of excavation was $26.29 ÷ 6.7 cu. yds. = $3.923 per cu. yd. This figure assumes timbered sections throughout, which makes the cost less than it would be were untimbered sections allowed for.—Editors.)

In comparing these figures the cross-section as well as the character of the ground should be taken into account, and it is also proper to state that these are not picked out as representing the best records either as to cost or speed. With these reservations in mind, the following miscellaneous data regarding cost per foot in a number of the tunnels on the aqueduct may be read with interest:

COST OF TUNNELS DRIVEN WITH MACHINE DRILLS

Tunnel	Distance, feet	Average cost	Ground.
12 North	818	$19.34	Hard granite.
12 South	824	21.63	Hard granite.
13 North	...	22.93	Hard granite.
14 South	...	28.12	Hard granite.
15 South	...	22.73	Hard granite.
16 North	...	21.66	Hard granite.
16 North	...	16.98	Hard granite.
17	...	18.31	Hard granite.
3 South	774	12.92	Gas in rock.
3 South	1,124	14.09	
7 North	1,347	14.68	
1 B	1,251	9.37	Granite.
3	1,014	12.60	Granite.
2	1,021	10.57	Wet and blocky

The above are average costs for tunnels complete, timbered, and ready for lining. The unit figures in each case differ a little from those given but fall within the range indicated. The powder consumption ranges from 4.30 to 39.09 lbs. per lin. ft. of advance.

At the Elizabeth tunnel, November, 1909, using powder of 40 to 60 strength, 17.50 lbs. per lin. ft. of advance was used at the north portal and 38.09 at the south. This tunnel is driven in hard rock with machine drills. In the same month at Tunnel 73, 5.80 lbs. was used at the north portal and 8.20 at the south. The excavation here is in a soft sandstone and the holes are drilled by hand.

One of the most interesting phases of the work is that of lining the tunnels with concrete. The mixture is 1 to 7, natural gravel and sand being used with Portland cement. The latter is in part manufactured at a plant built and operated by the Aqueduct Bureau, and in part purchased on bids in lots of 2,000 bbls. or more. The cement costs approximately $1.15 per bbl. when so bought, or $1.45 delivered on the work. It is mixed outside the tunnels in Ransome or similar machines and carried to the work in tunnel cars. The process of lining involves (a) setting the forms; (b) dry-packing where the section has been over-broken; (c) placing the mixture for walls and arch; (d) tearing down the forms; (e) smoothing and plastering the surface; (f) lining the bottom. The forms consist of a series of wooden panels placed horizontally and fitting against steel ribs. The latter are in two pieces joined by a removable key at the crown of the arch and each extending down to a mud sill at the side. To prevent crowding in, the base of the rib and the sill are braced by sprags against the ends of the cross-ties under the tunnel track. The ribs are made of light T-steel, shaped to conform to the finished cross-section, and are easily placed and removed. Dry-packing with boulders and broken rock is necessary in order to economize the concrete. It is impossible to break a tunnel so as to conform absolutely to a cross-section and leave exactly the calculated space for timbers and concrete lining. One of the difficulties of the work was to train miners not to over-break the section. In dry-packing the boulders are placed by hand, as the panels in the forms are

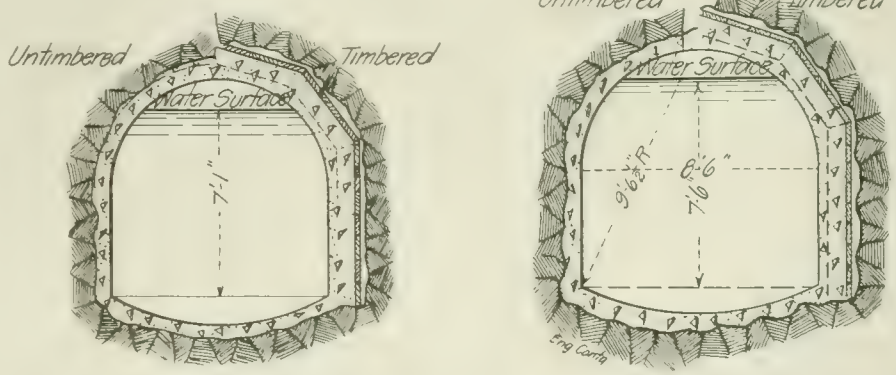


Fig. 2.—Standard Sections of Tunnels, Jawbone Division, Los Angeles Aqueduct.

shipped into place so as to leave as nearly as possible uniform space for concrete. The minimum thickness of the latter allowed 4 ins.

In lining the sides the concrete is shoveled from the car directly into place as the panels and dry-packing proceed. To cover the arch it is necessary to have a movable stage. This is shown as a "jumbo" and is a long platform stretching from side to side and supported by legs, which straddle the regular track and run on extra temporary rails laid near the foot of the wall. As the work progresses the whole structure moves forward. At the front is a hinged inclined track that can be lowered by means of a motor on the jumbo, and up which the cars loaded with concrete, rock and panels may be pulled by an electric hoist. The platform is long enough to permit a full gang of men to work.

After about 36 hours the forms are torn down and the rough places trimmed with small hammers. The surface is then coated, where it is necessary, with a thin wash of cement, which is practically a plaster. Later the regular track is torn up and the bottom lined, the work resembling sidewalk laying. Concrete workers are paid $2 to $2.50, according to the character of the work. Foremen get as much as $4 per day. The work here, as in all other departments, is on an 8-hour basis. Under these conditions the concrete costs $5.28 to $8.07 per cu. yd. in place, the amount varying with local conditions and depending somewhat on the relative amounts of arch and bottom work included in each piece of work. The cost for labor and mixing covering complete lining of 853 ft. of Tunnel 20 amounted to: Bottom, $2.39; sides, $1.87; arch, $2.85. The total costs on this particular piece of work were:

	Per foot of tunnel	Per cu. yd.
Lining bottom	$0.88	$6.72
Lining sides	1.81	6.29
Lining arch	2.79	8.07
Plastering walls	0.31	0.17*

*Per square foot of surface. (This figure is evidently in error.—Editors.)

The cost for bottom was a little low here, other figures being $1.16, $1.33, $1.91 per foot of advance. Total costs per foot of advance at other places ran $4.33, $4.54, $5.21, $7.89.

SOME DETAIL TUNNEL COSTS IN TUNNEL NO. 7 OF THE LOS ANGELES AQUEDUCT.*

The appended study covers unit costs of driving a timbered tunnel in the Little Lake division of the Los Angeles aqueduct (William Mulholland, chief engineer; J. B. Lippincott, assistant chief engineer; Edward Comerer, foreman in charge, and the writer engineer in charge of the division) during the 15-day period from Aug. 15 to Aug. 29, inclusive. The figures refer to the north heading only.

During this period 90 ft. were driven in 15 8-hour shifts. The tunnel is approximately 10x10 ft. in section and contains 3½ cu. yds. in place per lineal foot to pay line. The over-breakage was about 17 per cent, making a total of 6½ cu. yds. of broken material per foot of tunnel.

The heading is 800 ft. in from the portal. It is lighted by electricity in 110 volts, and ventilated by a No. 3 Champion blower through 12-in. pipe, the heading being cleared in fifteen minutes after shooting.

Drilling is done by one No. 7 Leyner drill, water being forced through the hollow steel. This drill used approximately 66 cu. ft. air per minute at 83 lbs. pressure, drilling holes to 10 ft. in depth.

Mucking is facilitated by steel sheets laid down before shooting. The muckers use No. 3 D-handle square-point shovels. Dirt is hauled away in 32 cu. ft. rocker dump cars pulled by a 3½-ton locomotive running on a single 24-in. gage track laid with 25-lb. steel.

The rock is a close-grained hard gray granite, with numerous seams, causing the drill to run from alinement, but it breaks well. The seams and water combined make it necessary to timber all this ground. The ground carries enough water to make disagreeable mucking, and to require pumping.

The timbering comprises sets of 6x8-in. Oregon pine, spaced 5 to 8 ft. apart, as ground permits, and 2x6 lagging. Each set consists of two vertical posts and a four-segment arch.

The crew consisted of one shift boss at $3.50 per day; four miners at $3; five muckers at $2.50, and one trammer at $2.50. The blacksmith doing the repair work was paid $4 per day.

The four miners worked on day shift, drilling the ground, timbering and shooting. The muckers followed on night shift. This arrangement resulted in a clean heading for the drill crews, and nothing interfered with the mucking crew.

The cost of work during the 15-day period is tabulated below in detail (Table I).

To explain the table further the following particulars are noted as to drilling and powder:

Drilling.—During the 15-day period 150 holes were drilled, aggregating 1,202.3 ft. in length. The average depth of hole therefore

*An article by C. H. Richards, Division Engineer Little Lake Division, Los Angeles Aqueduct, in "Engineering News," Nov. 18, 1909.

was 8 ft. The average speed of drilling was 21.74 ft. hole per hour of actual drilling time, or 15.84 ft. per hr. if lost time is included. This means that the average hole (8 ft.) was drilled in 22 mins. The fastest hole, however, was 9 ft. 6 ins., drilled in 10 mins., while the slowest was 8 ft. 6 ins., drilled in 78 mins. The average cost of drilling per foot of hole was 3.6 cts., as given in the table.

TABLE I.—SHOWING UNIT COSTS OF TUNNELING AND TIMBERING, NORTH HEADING OF TUNNEL NO. 7, LITTLE LAKE DIVISION OF LOS ANGELES AQUEDUCT.
For 15-day period, Aug. 15-Aug. 29, 1909; advance 90 ft.

Class of work.	Totals for 90 ft. length. Labor. Hours.	Cost.	Cost per lin. ft. tunnel.
Labor:			
Inside labor:			
Squaring heading	23.5	$ 9.03	$0.10
Setting up and tearing down machine (1)	36.	16.59	.184
Drilling, incl. time of shift boss (3.6 cts. per ft. of hole.)	55.33	43.21	.48
Blowing out holes	5.75	4.15	.046
Loading and shooting	58.25	22.31	.248
Mucking (412 cars)	835.	268.44	2.98
Trimming, stulling, caves, etc.	102	39.24	.436
Timbering ($11.32 per M)	107.25	40.82	.453
Lost time	40.75	15.66	.174
Bonus (30 cts. per man per ft. over 2.3 ft. per shift)	.....	112.08	1.24
Repairs to trolley, pump, etc.	3.25	1.20	.013
Totals, inside labor	1,265.08	$572.73	$6.354
Outside Labor:			
Sharpening steel (with Leyner No. 2 machine)	44.	$ 17.83	$0.198
Repairing drill	7.5	2.88	.032
Framing timbers at shop ($2.42 per M)	.....	8.75	.097
Light and power	90.	33.75	.375
Totals outside labor	141.5	$ 63.21	$0.702
Auxiliary Labor:			
Laying track, 90 ft	31.5	$ 12.75	$0.141
Drainage line, 90 ft	43.5	14.33	.16
Ventilation line, 72 ft	11.	3.44	.043
Trolley line, 95 ft	18.	6.35	.067
Air line, 80 ft	2.5	.80	.01
Water line, 80 ft	2.5	.79	.01
Lights line, 90 ft	8.	2.86	.032
Totals auxiliary labor	117.0	$ 41.32	$0.463
Local Administration and Engineering:			
Proportion of division engineer and assistant's time		$ 50.40	$0.56
Total labor cost		$727.66	$8.084
Material:			
Construction Material and Supplies:			
Drill repairs ($0.018 per ft. hole.)		$ 22.47	$0.25
Drill supplies, oil steel, coal ($0.008 per ft. hole.)		9.41	.104
Mucking supplies, oil, etc		.73	.008
Power and lighting current (4,207 KW. hrs., at 1.7 cts.)		71.52	.795
Explosives, powder, fuse, caps, etc. (11.66 lbs. powder per ft. tunnel.)		157.69	1.752
Timbers, wedges, dowels, nails, etc. (3,579 ft. B. M. = 40 ft. B. M. per ft. tunnel.)		122.16	1.36
Lighting candles $8.59, el. lt. globes $3.09		11.67	.13
Totals, constr. material		$395.65	$4.399
Auxiliary Material:			
Trackage, 25-lb. rail, ties, etc		$ 21.11	$0.235
Drainage, 2-in. pipe and el. wire		7.87	.087
Ventilation, 12-in. pipe (for 72 ft.)		29.21	.405
Trolley, wire, etc. (for 95 ft.)		9.73	.102
Air line, pipe, etc. (for 80 ft.)		7.25	.09
Water line, pipe, etc. (for 80 ft.)		7.25	.09
Lights line, wire, etc		2.22	.025
Totals, auxiliary material		$ 84.64	$1.034
Total material cost		$480.29	$5.433
Live Stock:			
Mule, 15 days at 90 cts		$ 13.50	$0.15
Total direct and auxiliary field charges		$1,221.45	$13.667

Explosives.—There were used 650 lbs. of 1⅛-in. 40 per cent gelantine; 250 lbs. 1-in. 40 per cent gelantine, and 150 lbs. 1-in. 60 per cent gelantine, a total of 1,050 lbs. This is 11.66 lbs. per lin. ft. of tunnel, or 3.3 lbs. per cu. yd. place measurement. The cost (delivered) was $140.87. Adding the cost of fuse (2,700 ft. $13.85), caps (306 = $2.49), and tamping stick ($0.48), makes the total cost $157.69, which is about $0.50 per cu. yd. place measurement and $0.27 per cu. yd. loose.

The following summarized the above cost, together with the field and office charges assessable to the work. Attention may be called to the fact that the figure $12.165 given as direct charge differs from the previous total of $13.667 by the amount ($1.502) charged for tracks, the latter being included in the previous detail tabulation. In the recapitulation the auxiliary charge is reduced by the estimated amount of salvage on the track material.

RECAPITULATION OF UNIT COSTS.

Class of charge.	Cost per foot of tunnel, dollars.
Direct Charges:	
Labor	$7.056
Material and supplies	4.399
Local administration and engrg.	0.56
Live stock service	0.15
	$12.165
Auxiliary Charges:	
Labor on tracks, etc	$0.468
Material for tracks, etc	1.034
	$1.502
Salvage on material about 66%	.69
	0.812
Roads and trails*	1.50
Buildings*	0.20
Water supply*	0.22
Machinery and tools	1.06
Total fixed charges	$15.957
Add 3% for executive office administration	0.475
Total cost of tunnel, timbered and ready for lining, per lin. ft.	$16.432

*The total cost of these works on the entire division, apportioned to the several parts of the permanent construction, gives as estimated charges per foot of this tunnel the figures noted.

(Deducting from the total of $13.667 of Table I the charges that obviously belong to timbering we get a cost of $11.75 per lin. ft. for excavation, which is equivalent to $3.36 per cu. yd.—Editors.)

SUMMARY OF COSTS FOR FIVE MONTHS ON THE ELIZABETH TUNNEL.*

The Elizabeth tunnel is the most important tunnel on the aqueduct. It is 26,800 ft. long and has a net sectional area after lining of 90 sq. ft. The amounts of excavation per lineal foot are: 5.02 cu. yds. for timbered section and 4.18 cu. yds. for untimbered section. The material penetrated is granite rock, ranging from very hard solid rock to rotten and blocky rock. The tunnel is being driven with a first-class plant of air compressors, water Leyner drills and electric haulage. Mr. Lippincott's cost figures for the five months October, 1909, to February, 1910, are as follows:

	Heading. North.	South.
October, 1909.		
Exc. per lin. ft. heading	$23.80	$30.20
Timb. per lin. ft. timbered	6.33	3.79
Admin. and housing per lin. ft. heading	1.53	3.55
Totals*	$31.66	$35.35
November, 1909.		
Exc. per lin. ft. heading	$24.65	$33.91
Timb. per lin. ft. timbered	5.86	5.25
Admin. and housing per lin. ft heading	1.91	4.62
Totals*	$32.42	$39.62
December, 1909.		
Exc. per lin. ft. heading	$23.11	$29.96
Timb. per lin. ft. timbered	6.99	7.72
Adm. and housing per lin ft. heading	1.56	3.62
Totals*	$31.66	$34.42
January, 1910.		
Exc. per lin. ft. heading	$24.64	$28.83
Timb. per lin. ft. timbered	7.04	6.33
Adm. and housing per lin. ft. heading	1.85	2.30
Totals*	$33.53	$32.45
February, 1910.		
Exc. per lin. ft. heading	$21.94	$25.73
Timb. per lin. ft. timbered	5.60	4.13
Adm. and housing per lin. ft. heading	2.25	1.67
Totals*	$29.79	$29.97

*Costs per lineal foot of timbering are reduced to costs per lineal foot of heading to get these totals.

General Note: These costs do not include percentage of charge for equipment, buildings or pipe lines.

To get at the unit costs of excavation some computation is necessary. Mr. Lippincott gives the following figures of progress from which we may compute the volume of excavation with reason accuracy:

	North Heading. Total lin. ft.	Timbered lin. ft.	South Heading. Total lin. ft.	Timbered lin. ft.
October, 1909	547	547	413	159
November, 1909	471	471	378	85
December, 1909	476	476	480	50
January, 1910	481	481	515	104
February, 1910	529	529	516	188

For timbered section the volume of excavation per lineal foot is 5.02 cu. yds., and for untimbered section it is 4.18 cu. yds. The entire advance of the north heading being timbered, the volume of excavation ran 5.02 cu. yds. per lin. ft. throughout. In the south heading a portion of the advance each month was timbered and a portion untimbered, so that the volume of excavation per lineal foot for each month varied and must be averaged for each month to get unit costs. Doing this we get the following costs per cubic yard for excavation in each heading for each month:

Month.	North Heading.	South Heading.
October, 1909	$4.74	$6.76
November, 1909	4.91	8.21
December, 1909	4.60	7.01
January, 1910	4.91	6.63
February, 1910	4.37	5.73

The greater cubic yard costs of the south heading are due to the more intractable rock, which is described as medium hard and hard granite. The difference in the nature of the rock in the two headings is indicated fairly well by the different amounts of powder used per lineal foot of heading, as given by Mr. Lippincott, and which we have reduced to pounds per cubic yard of excavation to enable more ready comparison:

Month.	Lbs. per cu. yd. North Heading.	South Heading.
October, 1909	4.054	6.040
November, 1909	3.486	9.225
December, 1909	2.549	8.407
January, 1910	2.808	7.747
February 1910	3.008	6.303

(Continued from page 492.)

explain why day labor is not as cheap as the contracted work; it is because city officials and employes are largely incompetent or dishonest or both. The contractor must have a profit to continue in business. As the element of chance enters to a considerable degree in his work, his profit ought to be a fair percentage. Theoretically this puts him at a great disadvantage as against the city doing its own work. Practically, however, this disadvantage is entirely overcome by the looseness, stupidity, and crookedness of those in whose hands the people of the city have placed their business affairs.

And why have the people chosen agents of that sort? Merely because they would rather play at the game of partisan politics than have the city properly managed.

Whenever we have an example of a properly managed city, like Des Moines or Galveston, or a properly managed department in a city, like our own water department, we have plenty of instances obtainable where the city has saved money by doing its own work. A thing that is true theoretically is always true practically when it is given a fair chance.

Fleeing to the contractor system simply tends to palliate a little the damage of bad government, and to that extent serves to perpetuate the evils. If the government is crooked and incompetent, money will be lost through contractors quite as much as through direct labor, although it may not show in the accounts. The loss usually takes the form of inferior work, which must, sooner or later, be replaced at great cost.

Occasionally there are forms of city work that are not adapted to direct labor, and it is always well on any great enterprise to let sections here and there by contract to get the test of a comparison, but for a city government to attempt to dodge responsibility by putting everything into the hands of contractors is to confess that government itself is a failure, and such a confession means paralysis of all effort toward improvement. A wise public sentiment will insist that the city does business for itself, and if the results are bad, will demand that the whole system be reformed.—Editorial in the *Pacific Outlook* for May 14, 1910.

*From data furnished by J. B. Lippincott, Assistant Chief Engineer Los Angeles Aqueduct, to "Engineering News," April 28, 1910.

Unclassified and General Articles

Note: This section is devoted to methods and cost articles on construction work not properly coming under any of the preceding classifications.

Pressure Resistance and Stability of Earth.*

In the writer's paper, "The Bracing of Trenches and Tunnels, With Practical Formulas for Earth Pressures,"† certain minor experiments were noted in connection with the arching properties of sand. In the present paper it is proposed to take up again the question of earth pressures, but in more detail, and to note some further experiments and deductions therefrom, and also to consider the resistance and stability of earth as applied to piling and foundations, and the pressure on and buoyancy of subaqueous structures in soft ground. In order to make this paper complete in itself, it will be necessary, in some instances, to include in substance some of the matter of the former paper.

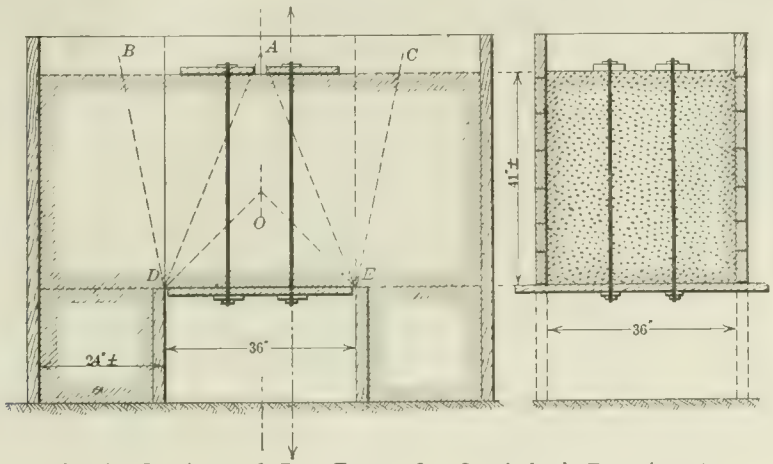


Fig. 1.—Sections of Box Frame for Sand Arch Experiments.

Experiment No. 1.—As shown in Fig. 1, wooden abutments, 3 ft. wide, 3 ft. apart, and about 1 ft. high, were built and filled solidly with sand. Wooden walls, 3 ft. apart and 4 ft. high, were then built crossing the abutments, and solidly cleated and braced frames were placed across their ends about 2 ft. back of each abutment. A false bottom, made to slide freely up and down between the abutments, and projecting slightly beyond the walls on each side, was then blocked up snugly to the bottom edges of the sides, thus obtaining a box 3x4x7 ft., the last dimension not being important. Bolts, 44 ins. long, with long threads, were run up through the false bottom and through 6x15x2in. pine washers to nuts on the top. The box was filled with ordinary coarse sand from the trench, the sand being compacted as thoroughly as possible. The ends were tightened down on the washers, which in turn bore on the compacted sand. The blocking was then knocked out from under the false bottom, and the following was noted:

As soon as the blocking was removed the bottom settled nearly 2 ins., due to the initial compacting of the sand under the arching stresses. A measurement was taken from the bottom of the washers to the top of the false bottom, and it was noted as 41 ins. (Fig. 1). After some three or four hours, as the arch had not been broken, it was decided to test it under greater loading, and four men were placed on it, four others standing on the haunches. Under this additional loading of about 600 lbs. the bottom settled 2 ins. more, or nearly 4 ins. in all, due to the further compression of the sand arch. About an hour after the superimposed load had been removed, the writer jostled the box with his foot sufficiently to dislodge some of the exposed sand, when the arch at once collapsed and the bottom fell to the ground.

Referring to Fig. 2, if, instead of being ordinary sand, the block comprised within the area, *A U J V X*, had been frozen sand, there can be no reason to suppose that it would not have sustained itself, forming a perfect arch, with all material removed below the line, *V E J*, in fact, the freezing process of tunneling in soft ground is based on this well-known principle.

If, then, instead of removing the mass, *J E V*, it is allowed to remain and is supported from the mass above, one must concede to this mass in its normal state the same arching properties it would have had if frozen, excepting, of course, that a greater thickness of key should be allowed, to offset a greater tendency to compression in moist and dry as against frozen sand, where both are measured in a confined area.

If, in Fig. 2, $E\,V\,J = \phi$ = the angle of repose, and it be assumed that *A J*, the line bisecting the angle between that of repose and the perpendicular, measures at its intersection with the middle vertical (*A*, Fig. 2) the height which is necessary to give a sufficient thickness of key, it may be concluded that this sand arch will be self-sustaining. That is, it is assumed that the arching effect is taken up virtually within the limits of the area, *A N₁ V E J N A*, thus relieving the structure below of the stresses due to the weight or thrust of any of the material above; and that the portion of the material below *V E J* is probably when sustained from below forms a natural "centering" for the natural arch above. It is also probably true that the material in the areas, *X N₁ A* and *A N U*, does not add to the arching strength, more especially in those materials where cohesion may not be counted on as a factor. This is borne out by the fact that, in the experiment noted, a well-defined crack developed on the surface of the sand at about the point U_1, and extended apparently a considerable depth, assumed to be at *N*, where the haunch line is intersected by the slope line from *A*.

In this experiment the sand was good and sharp, containing some gravel, and was taken directly from the adjoining excavation. When thrown loosely in a heap, it assumed an angle of repose of about 45°. It should be noted that this material when tested was not compacted as much, nor did it possess the same cohesion, as sand in its normal undisturbed condition in a bank, and for this reason it is believed that the depth of key given here is absolutely safe for all except extraordinary conditions, such as non-homogeneous material and others which may require special consideration.

Referring again to the area, *A N₁ V J N A*, Fig. 2, it is probable that, while self-sustaining, some at least of the lower portion must derive its initial support from the "centering" below, and the writer has made the arbitrary assumption that the lower half of it is carried by the structure while the upper half is entirely independent of it, and, in making this assumption, he believes he is adding a factor of safety thereto. The area, then, which is assumed to be carried by an underground structure the depth of which is sufficient to allow the lines, *V A* and *J A*, to intersect below the surface, is the lower half of *A N₁ V E J N A*, or its equivalent, *A V E J A*, plus the area, *V E J*, or *A V J A*, the angle, *A V J*, being $\alpha = \frac{1}{2}(90° - \phi) + \phi = 45° + \frac{\phi}{2}$.

It is not probable that these lines of thrust or pressure transmission, *A N*, *D K*, etc., will be straight, but, for purposes of calculation, they will be assumed to be so, also, that they will act along and parallel to the lines of repose of their natural slope, and that the thrust of the earth will therefore be measured by the relation between the radius and the tangent of this angle multiplied by the weight of material affected. The dead weight on a plane, *V J*, due to the material above, is, therefore, where

l = span or extreme width of opening = $V J$,

W = weight per cubic foot of material, and

W_1 = weight per linear foot.

$$W_1 = \frac{2 \times \frac{l}{2}\tan.\alpha \times W}{2} = \frac{1}{2} l \tan\left\{\frac{1}{2}(90° - \phi) + \phi\right\} W = \frac{l}{2}\tan.\left(45° + \frac{\phi}{2}\right) W.$$

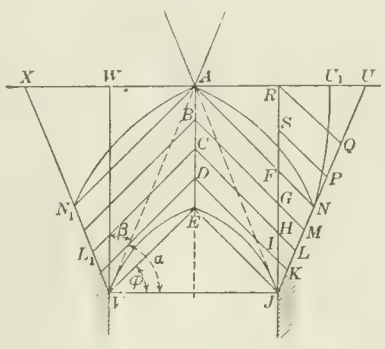


Fig. 2.

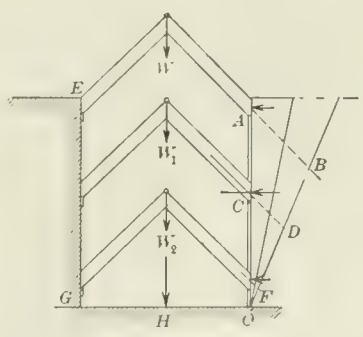


Fig. 3.

The application of the above to flat arched or circular tunnels is very simple, except that the question of side thrust should be considered also as a factor. The thrust against the side of a tunnel in dry sand having a flat angle of

*Paper by J. C. Meem, read before the American Society of Civil Engineers, May 18, 1910, and published in the Proceedings, Vol. XXXVI, p. 653.

†Transactions Am. Soc. C. E., Vol. LX, p. 1.

repose will necessarily be greater than in very moist sand or clay, which stands at a much steeper angle, and, for the same reason, the arch thrust is greater in dryer sand and therefore the load on a tunnel structure should not be as great, the material being compact and excluding cohesion as a factor. This can be illustrated by referring to Fig. 3 in which it is seen that the flatter the position of the "rakers" keying at W_1, W_2, and W, the greater will be the side thrust at A, C, and F. It can

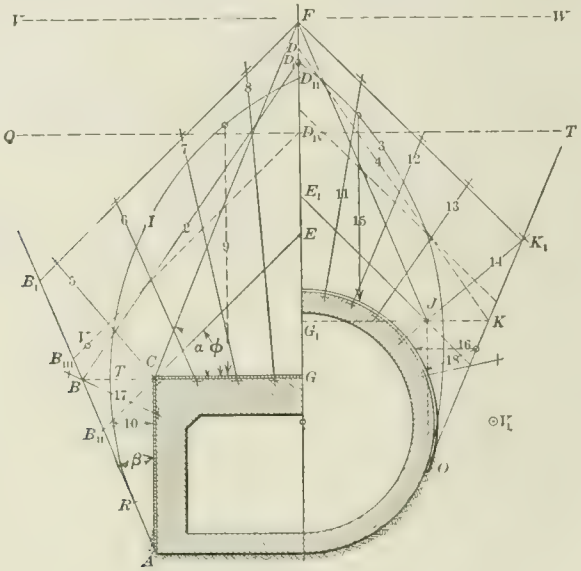


Fig. 4.

also be illustrated by assuming that the arching material is composed of cubes of polished marble set one vertically above the other in close columns. There would then be absolutely no side thrust, but, likewise, no arching properties would be developed, and an indefinite height would probably be reached above the tunnel roof before friction enough would be developed to cause it to relieve the structure of any part of its load. Conversely, if it be assumed that the superadjacent material is composed of large bowling balls, interlocking with some degree of regularity, it can be seen that those above will form themselves into an arch over the "centering" made up of those supported directly by the roof of the structure, thus relieving the structure of any load except that due to this "centering."

If, now, the line, $A\ B$, in Fig. 4, be drawn so as to form with $A\ C$ the angle, β, to be noted later, and it be assumed that it measures the area of pressure against $A\ C$, and if the line, $C\ F$, be drawn, forming with $C\ G$, the angle α, noted above, then $G\ F$ can be reduced in some measure by reason of the increase of $G\ C$ to $C\ B$, because the side thrust above the line, $B\ C$, has slightly diminished the loading above. The writer makes the arbitrary assumption that this decrease in $G\ F$ should equal 20 per cent of $B\ C = F\ D_1$. If, then, the line, $B\ D_1$ be drawn, it is conceded that all the material within the area, $A\ B\ D_1\ G\ C\ A$, causes direct pressure against or upon the structure, $G\ C\ A$, the vertical lines being the ordinates of pressure due to weight, and the horizontal lines (qualified by certain ratios) being the abscissas of pressure due to thrust. An extreme measurement of this area of pressure is doubtless approximately more nearly a curve than the straight lines given, and the curve, $A\ R\ T\ I\ D_2$, is therefore drawn in to give graphically and approximately the safe area of which any vertical ordinate, multiplied by the weight, gives the pressure on the roof at that point, and any horizontal line, or abscissa, divided by the tangent of the angle of repose and multiplied by the weight per foot, gives the pressure on the side at that point.

The practical conclusion of this whole assumption is that the material in the area, $F\ E\ C\ B\ B_1$, forms with the equivalent opposite area an arch reacting against the face, $C\ B\ B_1$, and that, as heretofore noted, the lower half (or its equivalent, $B\ D_1\ G\ B$) of the weight of this is assumed to be carried by the structure, the upper half being self-sustaining, as shown by the line, $B_{III}\ D_{IV}$ (or for absolute safety the curved line), and therefore, if rods could be run from sheeting inside the tunnel area to a point outside the line, $F\ B_1$, as indicated by the lines, 5, 6, 7, 8, 11, 12, 13, etc., that the internal bracing of this tunnel could be omitted, or that the tunnel itself would be relieved of all loading, whereas these rods would be carrying some large portion at least of the weight within the area circumscribed by the curve, $D_{II}\ I\ T\ G$, and further, that a tunnel structure of the approximate dimensions shown would carry its maximum load with the surface of the ground between D_{IV} and F, beyond which point the pressure would remain the same for all depths.

In calculating pressures on circular arches, the arched area should first be graphically resolved into a rectangular equivalent, as in the right half of Fig. 4, proceeding subsequently as noted.

The following instances are given as partial evidence that in ordinary ground, not submerged, the pressures do not exceed in any instance those found by the above methods, and it is very probable that similar instances or experiences have been met by every engineer engaged in soft-ground tunneling:

In building the Bay Ridge tunnel sewer, in 62d and 64th streets, Brooklyn, arch timber bracing was used for more than 4,000 ft., or for two-thirds of the whole 5,800 ft. called for in the contract. The external width of opening, measured at the wall-plate, averaged about 19 ft. for the 14½-ft. circular sewer and 19½ ft. for the 15-ft. sewer. The arch timber segments in the cross-section were 10x12-in. North Carolina pine of good grade, with 2 ins. off the butt for a bearing to take up the thrust. They were set 5 ft. apart on centers, and rested on 6x12-in. wall-plates of the same material as noted above.

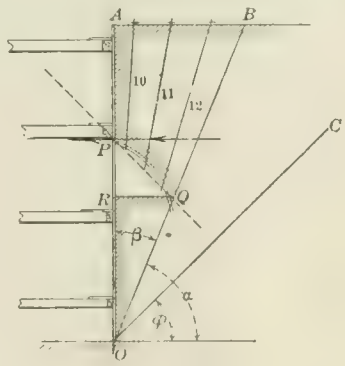


Fig. 5.

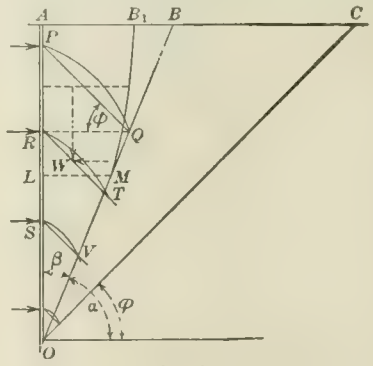


Fig. 6.

The ultimate strength of this material, across the grain, when dry and in good condition, as given by the United States Forestry Department tests is about 1,000 lbs. in compression. Some tests* made in 1907 by Mr. E. F. Sherman for the Charles River Dam in Boston, Mass., show that in yellow pine, which had been water-soaked for two years, checks began to open at from 388 to 581 lbs. per sq. in., and that yields of ¼ in. were noted at 600 to 1,000 lbs. As the tunnel wall-plates described in this paper were subject to occasional saturation, and always to a moist atmosphere, they could never have been considered as equal to dry material. Had the full loading shown by the foregoing come on these wall-plates, they would have been subjected to a stress of about 25 tons each, or nearly one-half of their ultimate strength. In only one or two instances, covering stretches of 100 ft. in one case and 200 ft. in another, where there were large areas of quicksand sufficient to cause semi-aqueous pressure, or pockets of the same material causing eccentric loading, did these wall-plates show any signs of heavy pressure, and in many instances they were in such good condition that they could be taken out and used a second and a third time. Two especially interesting instances came under the writer's observation: In one case, due to a collapse of the internal bracing, the load of an entire section, 25 ft. long and 19 ft. wide, was carried for several hours on ribs spaced 5 ft. apart. The minimum cross-section of these ribs was 73 sq. ins., and they were under a stress, as noted above, of 50,000 lbs. or nearly up to the actual limit of strength of the wall-plate where the rib bore on it. When these wall-plates were examined, after replacing the internal bracing, they did not appear to have been under any unusual stress.

In another instance, for a distance of more than 700 ft., the sub-grade of the sewer was 4 ft. below the level of the water in sharp sand. In excavating for "bottoms" the water had to be pumped at the rate of more than 300 gals. per min., and it was necessary to close-sheet a trench between the wall-plates in which to place a section of "bottom." In spite of the utmost care, some ground was necessarily lost, and this was shown by the slight subsidence of the wall-plates and a loosening up of the wedges in the supports bearing on the arch timbers. During this operation of "bottoming," two men on each side were constantly employed in tightening up wedges and shims above the arch timbers. It is impossible to explain the fact that these timbers slackened (without proportionate roof settlement) by any other theory than that the arching was so nearly perfect that it relieved the bracing of a large part of the load, the ordinary loose material being held in place by the arching or wedging together of the 2-in. x 3-ft. sheeting boards in the roof, arranged in the form of a segmental arch. The material above this roof was coarse, sharp sand, through which it had been difficult to tunnel without losing ground, and it had admitted water freely after each rain until the drainage of a neighboring pond had been completed, the men never being willing

*Engineering News, July 1, 1909.

to resume work until the influx of water had stopped.

The foregoing applies only to material ordinarily found under ground not subaqueous, or which cannot be classed as aqueous or semi-aqueous material. These conditions will be noted later.

The writer will take up next the question of pressures against the faces of sheeted trenches or retaining walls, in material of the same character as noted above. Referring

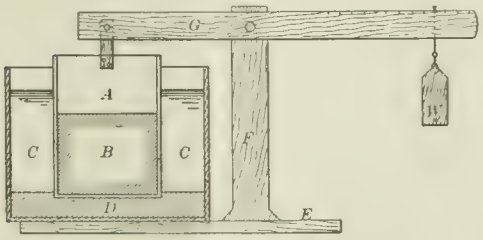


Fig. 7.

to Fig. 2, it is not reasonable to suppose that having passed the line, *R F J*, the character of the stresses due to the thrust of the material will change, if bracing should be substituted for the material in the area, *W V J R*, or if, as in Fig. 3, canvas is rolled down along the lines, *E G* and *A O*, and if, as this section is excavated between the canvas faces, temporary struts are erected, there is no reason to believe that with properly adjusted weights at *W or* W_2, an exact equilibrium of forces and conditions cannot be obtained. Or, again, if, as in Fig. 5, the face, *P Q*, is sheeted and rodded back to the surface, keying the rods taut, there is undoubtedly a stable condition and one which could not fail in theory or practice, nor can anyone, looking at Fig. 5, doubt that the top timbers are stressed more heavily than those at the bottom. The assumption is that the tendency of the material to slide toward the toe causes it to wedge itself between the face of the sheeting on the one hand and some plane between the sheeting and the plane of repose on the other, and that the resistance to this tendency will cause an arching thrust to be developed along or parallel to the lines, *A N*, *B M*, etc., Fig. 2, which are assumed to be the lines of repose, or curves approximating thereto. As the thrust is greatest in that material directly at the face, *A O*, Fig. 6, and is nothing at the plane of repose, *C O*, may be assumed arbitrarily that the line, *B O*, bisecting this angle divides this area into two, in one of which the weight resolves itself wholly into thrust, the other being an area of no thrust, or wholly of weight bearing on the plane of repose. Calling this line, *B O*, the haunch line, the thrust in the area, *A O B*, is measured by its weight divided by the tangent of the angle, *P Q R* = ϕ, which is the angle of repose: that is, the thrust at any given point, $R = R\ O \div \tan.\ \phi$.

The writer suggests that, in those materials which have steeper angles of repose than 45°, the area of pressure may be calculated as above, the thrust being computed, however, as for an angle of 45°.

In calculating the total pressure due to this thrust against the retaining wall or sheeted face, there is the weight of the mass multiplied by the distance of its center of gravity vertically above the toe, or approximately:

$$\text{Area, } A\ O\ B, \times \text{weight per unit} \times \frac{2}{3} \text{ height,}$$

where h = height,

W = weight per foot of material = 90 lbs.,

and $\beta = \frac{90° - \phi}{2}$

P = pressure per linear foot (vertically),

then $P = h \times \frac{h}{2} \text{ (tan. } \beta) \times W \times \frac{2}{3} h = \frac{1}{3} h^3 \text{ tan. } \beta.$

The next points to be considered are the more difficult problems concerning subaqueous or saturated earths. The writer has made some experiments which appear to be conclusive, showing that, except in pure quicksand or wholly aqueous material, as described later, the earth and water pressures act independently of each other.

For a better understanding of the scope and purpose of this paper, the writer divides supersaturated or subaqueous materials into three classes:

Class A.—Firm materials, such as coarse and fine gravels, gravel and sands mixed, coarse sands, and fine sands in which there is not a large proportion of fine material, such as loam, clay, or pure quicksand.

Class B.—Semi-aqueous materials, such as fine sands in which there is a large proportion of clay, etc., pure clays, silts, peats, etc.

Class C.—Aqueous materials, such as pure quicksands, in which the solid matter is so finely divided that it is amorphous and virtually held in suspension, oils, quicksilver, etc.

Here it may be stated that the term, "quicksand," is so illusive that a true definition of it is badly needed. Many engineers call quicksand any sand which flows under the influence of water in motion. The writer believes the term should be applied only to material so "soupy" that its properties are practically the same as water under static conditions, it being understood that any material may be unstable under the influence of water at sufficiently high velocities, and that it is with a static condition, or one approximately so, that this paper deals.

A clear understanding of the firm materials noted in Class A will lead to a better solution of problems dealing with those under Class B, as it is to this Class A that the experiments largely relate.

The experiments noted below were made with varying material, though the principle type used was a fine sand under the conditions in which it is ordinarily found in excavations, with less than 40 per cent voids and less than 10 per cent of very fine material.

Experiment No. 2.—The first of these experiments, which in this series will be called No. 2, was simple, and was made in order to show that this material does not flow readily under ordinary conditions, when not coupled with the discharge of water under high velocity. A bucket 12 ins. in diameter, containing another bucket 9 ins. in diameter, was used. A 6x6-in. hole was cut in the bottom of the inner bucket. About 3 ins. of sand was first placed in the bottom of the larger bucket and it was partly filled with water. The inside bucket was then given a false bottom and partly filled with wet sand, resting on the sand in the larger bucket. Both were filled with water and the weight, *W*, Fig. 7, on the arm was shifted until it balanced the weight of the inside bucket in the water, the distance of the weight, *W*, from the pivot being noted. The false bottom was then removed and the inside bucket, resting on the sand in the larger one, was partly filled with water, the conditions at the point of weighing being exactly the same, except that the false bottom was removed, leaving the sand in contact through the 6x6-in. opening. It is readily seen that, if the sand had possessed the aqueous properties sometimes attributed to sand under water, that in the inside bucket would have flowed out through the square hole in the bottom, allowing it to be lifted by any weight in excess of the actual weight of the bucket, less its buoyancy, as would be the case if it contained only water instead of sand and water. It was found, however, that the weight resting at a distance of more than nine-tenths of the original distance from the pivot, would not raise the inside bucket. On lifting this inside bucket bodily, however, the water at once forced the sand out through the bottom, leaving a hole almost exactly the shape and size of the bottom orifice. It should be stated that, in each case, the sand was put in in small handfuls and thoroughly mixed with water, but not packed, and allowed to stand for some time before the experiments were tried, to insure the compactness of ordinary conditions. The sand was stable enough to allow the bucket to be put on its side for the moment of being photographed, although it had been pulled out of the water a little less than 3 mins.

Experiment No. 3.—In order to show that the arching properties of sand are not destroyed under subaqueous conditions, a small sand-box, having a capacity of about 1 cu. ft., and similar to that described in Experiment No. 1, was made. The bottom was cut out, with the exception of a ¾-in. projection on two sides, and a false bottom was placed below and outside of the original bottom, with bolts running through it, keying to washers on top of the sand, with which the box was partially filled. One side of the box contained a glass front, in order that conditions of saturation could be observed. The box of sand was then filled with water and, after saturation had been completed and the nuts and washers had been tightened down, the box was lifted off the floor. There was found to be no tendency whatever for the bottom to fall away, showing conclusively that the arching properties had not been destroyed by the saturation of the sand.

The next three experiments were intended to show the relative pressure over any given area in contact with the water in the one case or sand and water in the other.

Experiment No. 4.—The apparatus for this experiment consisted of a 3-in. pipe about 4 ins. long and connected with a ¾-in. goose-neck pipe 17 ins. high above the top of the bowl shown in Fig. 8. A loose rubber valve was intended to be seated on the upper face of the machined edge of the bowl and weighted down sufficiently to balance it against a head of water corresponding to the 17-ins. head in the goose-neck. The bowl was then to be filled with sand and the difference, if any, noted between the weight required to hold the flap-valve down under the same head of water flowing through the sand. The results of this experiment were not conclusive, owing to the difficulty of making contact over the whole area of the sand and the rim of the bowl at the same time. At times, for instance, less than 1 lb. would hold back the water indefinitely, while, again, 2 or 3 lbs. would be required as opposed to the 4½ lbs. approximate pressure required to hold down the clear water. Again, at times the water would not flow through the neck at all, even after several hours, and after increasing the head by attaching a longer rubber tube thereto. In view of these conditions, this experiment would not be noted here, except that it unexpectedly developed one interesting fact. In order to insure against a stoppage of water, as above referred to, gravel was first put into the bottom of the bowl and the flap-valve was then rubbed down and

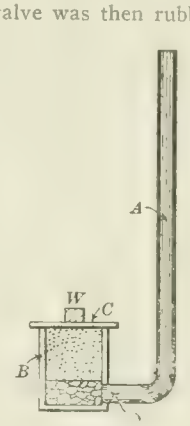


Fig. 8.

held tightly while the pipe was filled. On being released, the pressure of water invariably forced out the whole body of sand. Care was taken to see that the sand was saturated in each case, and the experiment was repeated numberless times, and invariably with the same result. The sand contained about 40 per cent of voids. The deduction from this experiment is that the pressure of water is against rather than through sand and that any excess of voids occurring adjacent to a face against which there is pressure of water will be filled with sand, excepting in so far, of course, as the normal existing voids allow the pressure of the water to be transmitted through them.

If, then, the covering of sand over a structure is sufficiently heavy to allow arching to be set up, the structure against which the pressure is applied must be relieved of much of the pressure of water against the area of sand not constituted as voids acting outside of the arching area. This is confirmed by the two following experiments:

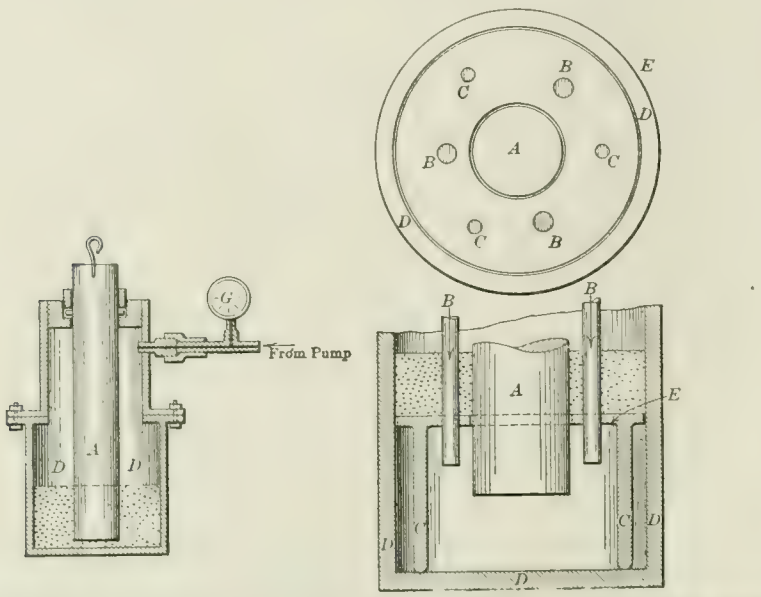


Fig. 9.—Apparatus for Measuring Loss of Water Pressure in Subaqueous Material.

Experiment No. 5.—The same apparatus was used here as in Experiment No. 2, Fig. 7, except that the inside bucket had a solid bottom. The inside and outside buckets were filled with water and the point was noted at which the weight would balance the inside bucket at a point some 3 ins. off the bottom of the outside bucket. This point was measured, and the bottom of the larger bucket was covered over with sand so that in setting solidly in the sand the inside bucket would occupy the same relative position as it did in the water. The same weight was then applied and would not begin to lift the inner bucket. For instance, in the first part of the experiment the weight stood at 12 ins. from the pivot, while in the next step the weight, standing at the end of the bar, had no effect, and considerable external pressure had to be exerted before the bucket could be lifted. Immediately after it was relieved, however, the weight at 12 ins. would hold it clear of the sand. No attempt was made to work the bucket into the sand; the sand was leveled up and the bucket was seated on it, turned once or twice to insure contact, and then allowed to stand for some time before making the experiment. No attempt was made to establish the relationship between sands of varying voids, the general fact only being established, by a sufficient number of experiments, that the weight required to lift the bucket was more than double in sand having 40 per cent of voids than that required to lift the bucket in water only.

Experiment No. 6.—The apparatus for this experiment consisted essentially of a hydraulic chamber about 8 ins. in diameter and 1 ft. high, the top being removable and containing a collar with suitable packing, through which a 2½-in. piston moved freely up and down, the whole being similar to the cylinder and piston of a large hydraulic jack. Just below the collar and above the chamber there was a ½-in. inlet leading to a copper pipe and thence to a high-pressure pump. Attached to this there was a gage to show the pressure obtained in the chamber, all as shown in Fig. 9. The purpose of the apparatus was to test the difference in pressure on any object submerged in clear water and on the same object buried in the sand under water. It is readily seen that, if pressure be applied to the water in this chamber, the amount of pressure (as measured by the gage) necessary to lift the piston will be that due to the weight of the piston, less its displacement, plus the friction of the piston in the collar.

Now, if for any reason the bottom area of the piston against which the water pressure acts be reduced, it will necessarily require a proportionate amount of increase in the pressure to lift this piston. If, therefore, it is found that 10 lbs., for illustration, be required to lift the piston when plunged in clear water, and 20 lbs. be required to lift it when buried in sand, it can be assumed at once that the area of the piston has been reduced 50 per cent by being buried in the sand, eliminating the question of the friction of the sand itself around the piston. In order to determine what this friction might be, the writer arranged a table standing on legs above the bottom of the chamber, allowing the piston to move freely through a hole in its center. Through this table pipes were entered (as shown in part of Fig. 9). The whole was then placed in the chamber with the piston in place, and the area above was filled with sand and water. It is thus seen that, the end of the piston being free and in clear water, the difference, if any, between the pressure required to lift the piston when in clear water alone and in the case thus noted, where it was surrounded by sand, would measure the friction of the sand on the piston. After several trials of this, however, it was clearly seen that the friction was too slight to be noted accurately by a gage registering single pounds, that is, with a piston in contact with 6 ins. of sand vertically, a friction of 25 lbs. per sq. ft. would only require an increase of 1.8 lbs. on the gage. It is therefore assumed that the friction on so small a piston in sand need not be considered as a material factor in the experiments made.

The piston was plunged into clear water, and it was found that the pressure required to lift it was about 4 lbs. The cap was then taken off, a depth of about 2 ins. of sand was placed in the bottom of the chamber, and then the piston was set in place and surrounded by sand to a depth of some 6 ins., water being added so that the sand was completely saturated. This was allowed to stand until it had regained the stability of ordinary sand in place, whereupon the cap with the collar bearing was set in place over the piston, the machine was coupled up, and the pump was started. A series of four experiments, extending over a period of two or three days, gave the following results.

Test 1.—The piston began to move at a pressure of 25 lbs. The pressure gradually dropped to 7½ lbs., at which point, apparently, it came out of the sand, and continued at 7½ lbs. during the remainder of the test.

Test 2.—The piston was plunged back into the sand, without removing the cap, and allowed to stand for about 2 hours. No attempt was made to pack the sand or to see its condition around the piston, it being presumed, however, that it had reasonable time to get a fair amount of set. At slightly above 20 lbs. the piston began to move, and as soon as a pocket of water accumulated behind the piston the pressure immediately dropped to 9 lbs. and continued at this point until it came out of the sand.

Test 3.—The piston was plunged into the sand and hammered down without waiting for the sand to come to a definite set. In this case the initial pressure shown by the gage was 17½ lbs., which immediately dropped to 8 lbs. as soon as the piston had moved sufficiently far to allow the water to accumulate below it.

Test 4.—The cap was again removed, the piston set up in place, the sand compacted around it in approximately the same condition it would have had if the sand had been in place underground; the cap was then set in place and, after an hour, the pump was started. The pressure registered was 25 lbs. and extend over a period of several seconds before there was any movement in the piston. The piston responded finally without any increase of pressure, and, after lifting an inch or two, the pressure gradually dropped to 10 lbs., where it remained until the piston came out of the sand.

The sum and average of these tests shows a relation of 22 lbs. for the piston in sand to about 8½ lbs. as soon as the volume of water had accumulated below it, which would correspond very closely to a sand containing 40 per cent of voids, which was the characteristic of the sand used in this experiment.

The conclusions from this experiment appear to be absolutely final in illustrating the pressure due to water on a tunnel buried in sand, either on the arch above or on the sides or bottom, as well as the buoyant effect upon the tunnel bottom under the same conditions.

While the apparatus would have to be designed and built on a much larger scale in order to measure accurately the pressure due to sands and earths of varying characteristics, it appears to be conclusive in showing the principle, and near enough to the theoretical value to be taken for practical purposes in designing structures against water pressures when buried in sand or earth.

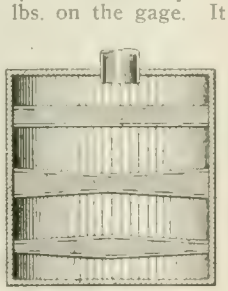


Fig. 10.

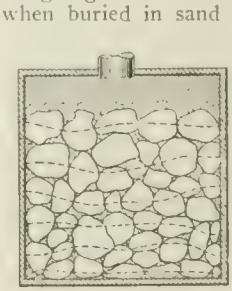


Fig. 11.

It should be carefully noted that the friction of the water through sand, which is always a large factor in subaqueous construction, is virtually eliminated here, as the water pressure has to be transmitted only some 6 or 8 ins. to actuate the base of the piston, whereas in a tunnel only half submerged this distance might be as many feet, and would be a considerable factor.

It should be noted also that although the area subject to pressure is diminished, the pressure on the area remaining corresponds to the full hydrostatic head, as would be

shown by the pressure on an air gage required to hold back the water, except, of course, as it may be diminished more or less by friction.

The writer understands that experiments of a similar nature and with similar apparatus have been tried on clays and peats with results considerably higher; that is, in one case, there was a pressure of 40 lbs. before the piston started to move.

The following is given, in part, as an analysis and explanation of the above experiments and notes:

It is well known that if lead be placed in a hydraulic press and subjected to a sufficient pressure it will exhibit properties somewhat similar to soft clay or quicksand under pressure. It will flow out of an orifice or more than one orifice at the same pressure. This is due to the fact that practically voids do not exist and that the pressure is so great, compared with the molecular cohesion, that the latter is virtually nullified. It is also theoretically true that solid stone under infinitely high pressure may be liquefied. If in the cylinder of a hydraulic press there be put a certain quantity of cobblestones, leaving a clearance between the top of the stone and the piston, and if this space, together with the voids, be filled with water and subjected to a great pressure, the sides or the walls of the cylinder are acted on by two pressures, one almost negligible, where they are in contact with the stone, restraining the tendency of the stone to roll or slide outward, and the other due to the pressure of the water over the area against which there is no contact of stone. That this area of contact should be deducted from the pressure area can be clearly shown by assuming another cylinder with cross-sticks jammed into it, as shown in Fig. 10. A glance at this figure will show that there is no aqueous pressure on the walls of the cylinder with which the ends of the sticks come in contact and the loss of the pressure against the walls due to this is equal to the least sectional area of the stick or tube either at the point of contact or intermediate thereto.

Following this reasoning, in Fig. 11 it is found that an equivalent area may be deducted covering the least area of continuous contact of the cobblestones, as shown along the dotted lines in the right half of the figure. Returning, if, when the pressure is applied, an orifice be made in the cylinder, the water will at once flow out under pressure, allowing the piston to come in contact with the cobblestones. If the flow of the water were controlled, so as to stop it at the point where the stone and water are both under direct pressure, it would be found that the pressures were totally independent of each other. The aqueous pressure, for instance, would be equal at every point, while the pressure on the stone would be through and along the lines of contact. If this contact was reasonably well made and covered 40 per cent of the area, one would except the stone, independently of the water, to stand 40 per cent of the pressure which a full area of solid stone would stand. If this pressure should be enormously increased after excluding the water, it would finally result in crushing the stone into a solid mass; and if the pressure should be increased indefinitely, some theoretical point would be reached, as above noted, where the stone would eventually be liquefied and would assume liquid properties.

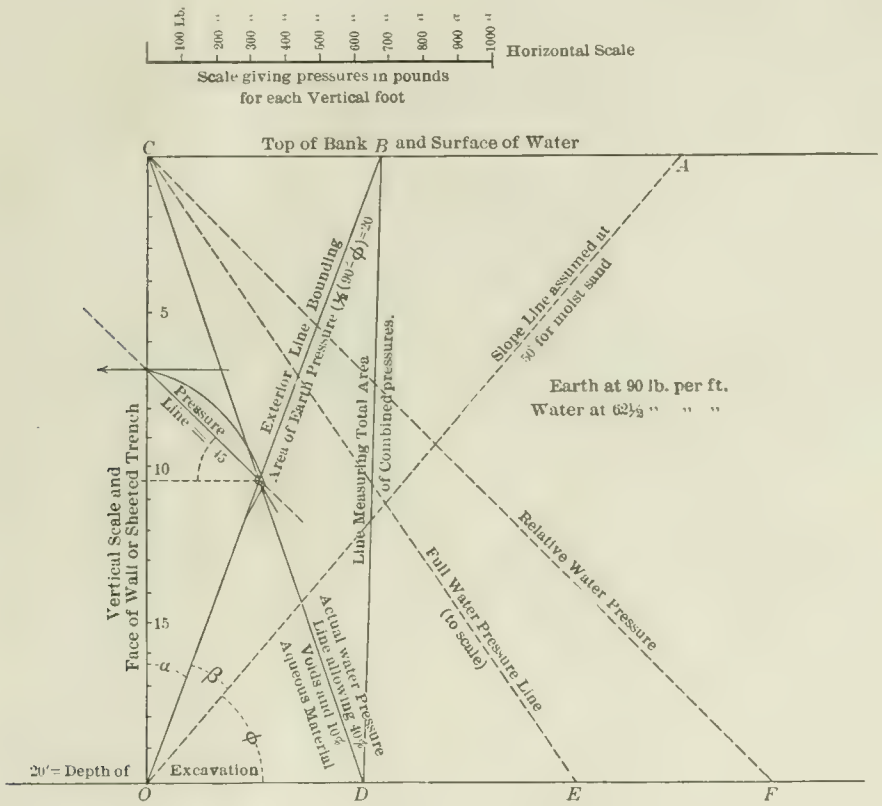


Fig. 12.—Combined Earth and Water Pressures.

It was the knowledge of this principle which enabled the contractors to jack up successfully the roof of a long section of the cast-iron lined tubes under Joralemon street in Brooklyn, in connection with the reconstruction of the Battery tubes at that point, the method of operation being to cut through a section of the roof, 4x10 ft. in area, through which holes were drilled and through which again the sand was "bled," heavy pressure being applied from below through the medium of hydraulic jacks. By a careful manipulation of both these operations, sections of the roof of the above dimensions were eventually raised the required height of 30 ins. and permanently braced there in a single shift.

If water in excess be put into a cylinder containing sand, and pressure be applied thereto, the water, if allowed to flow out of an orifice, will carry with it a certain quantity of sand, according to the velocity, and the observation of this might easily give rise to the erroneous impression that the sand, as well as the water, was flowing out under pressure, and, as heretofore stated, has caused many engineers and contractors to apply the term "quicksand" to any sand flowing through an orifice with water.

Sand in its natural bed always contains some fine material, and where this is largely less than the percentage of voids, it has no material effect on the pressure exerted by the sand with or without water, as above noted. If, however, this fine material be largely in excess of the voids, it allows greater initial compression to take place when dry, and allows to be set up a certain amount of hydraulic action when saturated. If the base of the material be sand and the fill be so-called quicksand in excess of the voids, pressure will cause the quicksand to set up hydraulic action, and the action of the piston will appear to be similar to that of a piston acting on purely aqueous material.

Just here the writer desires to protest against considering semi-aqueous masses, such as soupy sands, soft concrete, etc., as exerting hydrostatic pressure due to their weight in bulk instead of to the specific gravity of the basic liquid. For instance, restoring again to the illustration of cubes and spheres, it may be assumed that a cubical receptacle has been partly filled with small cubes of polished marble, piled vertically in columns. When this receptacle is filled with liquid around the piles of cubes there will be no pressure on the sides except that due to the hydrostatic pressure of the water at 62½ lbs. The bottom, however, will resist a combined pressure due to the water and the weight of the cubes. Again, assume that the receptacle is filled with small spheres, such as marbles, and that water is then poured in. The pressure due to the weight of the solids on the bottom is relieved by the loss in weight of the marbles due to the water, and also to the tendency of the marbles to arch over the bottom, and while the pressure on the sides is increased by this amount of thrust, the aqueous pressure is still that of a liquid at 62½ lbs., and it is inconceivable that some engineers, in calculating the thrust of aqueous masses, speak of it as a liquid weighing, say, 120 or 150 lbs. per cu. ft.; as well might they expect to anchor spherical copper floats in front of a bulkhead and expect the hydrostatic pressure against this bulkhead to be diminished because the actual volume and weight of the water directly in front of the bulkhead has been diminished. Those who have had experience in tying narrow deep forms for concrete with small wires or bolts and quickly filling them with liquid concrete, must realize that no such pressures are ever developed as would correspond to liquids of 150 lbs. per cu. ft. If the solid material in any liquid is agitated so that it is virtually in suspension, it cannot add to the pressure, and if allowed to subside it acts as a solid, independently of the water contained with it, although the water may change somewhat the properties of the material, by increasing or changing its cohesion, angle of repose, etc. That is, in substance, those particles which rest solidly on the bottom and are in contact to the top of the solid material, do not derive any buoyancy from the water, while those particles not in contact with the bottom directly or through other particles, lose just so much weight through buoyancy. If, then, the vertical depth of the earthy particles or sand above the bottom is so small that the arching effect against the sides is negligible,

the full weight of the particles in contact, directly or vicariously, with the bottom acts as pressure on the bottom, while the full pressure of the water acts through the voids or on them, or is transmitted through material in contact with the bottom.

Referring now to materials such as clays, peats, and other soft or plastic materials, it is idle to assume that these do not possess pressure-resisting and arching properties. For instance, a soft clay arch of larger dimensions, under the condition described early in this paper, would undoubtedly stand if the rods supporting the intrados of the arch were keyed back to washers covering a sufficiently large area.

The fact that compressed air can be used at all in tunnel work is evidence that semi-aqueous materials have arching properties, and the fact that "blows" usually occur in light cover is further evidence of it.

When air pressure is used to hold back the water in faces of large area, bracing has to be resorted to. This again shows that while full hydrostatic pressure is required to hold back the water, the pressure of the earth is in a measure independent of it.

In a peaty or boggy material there is a condition somewhat different, but sufficiently allied to the soft clayey or soupy sands to place it under the same head in ordinary practice. It is undoubtedly true that piles can be driven to an indefinite depth in this material, and it is also true that the action of the pile is to displace rather than compress, as shown by the fact of driving portions of the tunnels under the North River for long distances without opening the doors of the shield or removing any of the material. The case of filling in bogs or marshes, causing them to sink at the point of filling and rise elsewhere, is readily explained by the fact that the water is confined in the interstices of the material, admitting of displacement but no compression.

The application of the above to pressures over tunnels in materials of Class A is that sand or solid matter is virtually assumed to be a series of columns with their bases in such intimate contact with the tunnel roof that water cannot exert pressure on the tunnel or buoyancy on the sand at the point of contact, and that if these columns are sufficiently deep to have their upper portions wholly or partially carried by the arching or wedging action, the pressure of any water on their surfaces is not transferred to the tunnel, and the only aqueous pressure is that which acts on the tunnel between the assumed columns or through the voids.

Let l = exterior width of tunnel,
δ = depth of cover, as:
D_w = depth, water to roof,
D_e = " earth to roof,
D_x = " of cover of earth necessary to arching stability, that is:

$$D_x = \frac{l}{2}\left(\tan.\left(\frac{90^\circ - \phi}{2}\right) + \phi\right) = \frac{l}{2}\tan.\left(45^\circ + \frac{\phi}{2}\right),$$

where ϕ = angle of repose,
and $D_w + D_e = D_x$.

Then the pressure on any square foot of roof, as V_p, as at the base of any vertical ordinate, as G in Fig. 2, $= V_p$.

W_e = weight per cubic foot of earth (90 lbs.),
W_w = weight per cubic foot of water (62½ lbs.),

we have

$$V_p = V_e \times W_e + D_w \times W_w \times 0.40 = V_e \times 90 + D_w \times 62\tfrac{1}{2} \times 0.4 = V_e 90 + D_w \times 25$$

And for horizontal pressure:

P_h = the horizontal pressure at any abscissa (10), Fig. 2, $= A_{10}$ at depth of water D_{w_1} is

$$P_h = \frac{A_{10} \times 90}{\tan.\phi} + D_{w_1} \times 62\tfrac{1}{2} \times 0.4 = \frac{A_{10} \times 90}{\tan.\phi} + D_{w_1} \times 25.$$

The only question of serious doubt is at just what depth the sand is incapable of arching itself, but for purposes of safety the writer has put this at the point F, as noted above, $= D_x$, although he believes that experiments on a large scale would show it to be nearer 0.67 D_x, above which the placing of additional back-fill will lighten the load on the structure.

We have, then, for $D_e < D_x$, the weight of the total prism of the earth plus the water in the voids, plus the added pressure of the water above the earth prism; that is:

The pressure per square foot at the base of any vertical ordinate $= V_p$.

$V_p = D_e \times 90 + D_e \times 62\tfrac{1}{2} \times 0.40 + (D_w - D_e \times 62\tfrac{1}{2}$.

To those who may contend that water acting through so shallow a prism of earth would exert full pressure over the full area of the tunnel, it may be stated that the water cannot maintain pressure over the whole area without likewise giving buoyancy to the sand previously assumed to be in columns, in which case there is the total weight of the water plus the weight of the prism of earth, less its buoyancy in water; that is:

$V_p = D \times 62\tfrac{1}{2} + D \times (90 - 62\tfrac{1}{2})$,

which, by comparison with the former method, would appear to be less safe in its reasoning.

Next is the question of pressure against a wall or braced trench for materials under Class A. The pressure of sand is first calculated independent, as shown in Fig. 6. Reducing this to a basis of 100 lbs. for each division of the scale measured horizontally, as shown, gives the line, B O, Fig. 12, measuring the outside limit of pressure due to the earth, the horizontal distance at any point between this line and the vertical face equaling the pressure against that face divided by the tangent of the angle of repose, which in this case is assumed to be 45°, equaling unity. If the water pressure line, C F, is drawn, it shows the relative pressure of the water. In order to reduce this to the scale of 100 lbs. horizontal measurement, the line, C E, is drawn, representing the water pressure to scale—that is, so that each horizontal measurement of the scale gives the pressure on the face of that point—and, allowing 50 per cent for voids, halving this area gives the line, C D, between which and the vertical face any horizontal line measures the water pressure. Extending these pressure areas where they overlap gives the line, B D, which represents the total pressure against the face, measured horizontally.

Next, as to the question of buoyancy in Class A materials. If a submerged structure rests firmly on a bottom of more or less firm sand, its buoyancy, as indicated by the experiments, will only be a percentage of its buoyancy in pure water, corresponding to the voids in the sand. In practice, however, an attempt to show this condition will fail, owing to the fact that in such a structure the water will almost immediately work under the edge and bottom, and cause the structure to rise, and the test can only be made by measuring the difference in uplift in a heavier than water structure, as shown in Experiment No. 5. For if a structure lighter than the displaced water be buried in sand sufficiently deep to insure it against the influx of large volumes of water below, it will not rise. That this is not due entirely to the friction of the solid material on the sides has been demonstrated by the observation of subaqueous structures, which always tend to subside rather than to lift during or following disturbance of the surrounding earth.

The following is quoted from the paper by Charles M. Jacobs, M. Am. Soc. C. E., on the North River division of the Pennsylvania Railroad tunnels:*

> There was considerable subsidence in the tunnels during construction and lining, amounting to an average of 0.34 ft. between the bulkhead lines. This settlement has been constantly decreasing since construction, and appears to have been due almost entirely to the disturbances of the surrounding materials during construction. The silt weighs about 100 lbs. per cu. ft. * * * and contains about 38 per cent of water. It was found that whenever this material was disturbed outside the tunnels a displacement of the tunnels followed.

*Proceedings, Am. Soc. C. E., for January, 1910.

Thus in substance confirms observations made in the Battery tubes that subsidence of the structure followed disturbance of the outside material, although theoretically the tubes were buoyant in the aqueous material.

The writer would urge, however, that in all cases of submerged structures only partially buried in solid material, excess weighting be used to cover the contingencies of vibration, oscillation, etc., to which such structures may be subjected and which may ultimately allow leads of water to work their way underneath.

On the other hand, he urges that in cases of floor areas of deeply submerged structures, such as tunnels or cellars, the pressure to be resisted should be assumed to be only slightly in excess of that corresponding to the pressure due to the water through the voids.

The question of pressure, etc., in Class B or semi-aqueous materials will be considered next. Of these materials, as already shown, there are two types: (*a*) sand in which the so called quicksand is largely in excess of any normal voids, and (*b*) plastic and viscous materials. The writer believes that these materials should be treated as mixtures of solid and watery particles, in the first of which is quicksand, or aqueous portion, being virtually in suspension, may be treated as water, and it must be concluded that the action here will be similar to that of sand and pure water, giving a larger value to the properties of water than actually exists. If, for instance, it should be found that such a mixture contained 40 per cent of pure water, the writer would estimate its pressure on or against a structure as (*a*) that of a moist sand standing at a steep angle of repose, and (*b*) that of clear water, an allowance of 60 per cent of the total volume being assumed, and the sum of these two results giving the total pressure. Until more definite data can be obtained by experiments on a larger scale, this assumed value of 60 per cent of the total volume for the aqueous portion may be taken for all conditions of semi-aqueous materials, except of course where the solid and aqueous particles may be clearly defined, the pressures being computed as described in the preceding pages.

As to the question of pure quicksand (if such there be) and other aqueous materials of Class C, such as water, oil, mercury, etc., it has already been shown that they are to be considered as liquids of their normal specific gravity; that is, in calculating the air pressure necessary to displace them, one should consider their specific gravity only as a factor and not the total weight per volume including any impurities which they might contain undissolved.

In order to have a clearer conception of aqueous and semi-aqueous materials and their action, they must be viewed under conditions not ordinarily apparent. For instance, ideas of so called quicksand are largely drawn from seeing structures sinking into it or from observing it flowing through voids in the sheeting or casing. The action of sand and water under pressure is viewed during or after a slump, when the damage is being done or has been done, whereas the correct viewpoint is under static conditions, before the slump takes place.

The following is quoted from the report of Mr. C. M. Jacobs, chief engineer of the East River gas tunnel, built in 1902-03:

> We found that the material which had heretofore been firm or stiff had, under erosion, obtained a soup-like consistency, and that a huge cavity some 3 ft. wide and 26 ft. deep had been washed up toward the river bed.

This would probably be a fair description of much of the material of this class met with in such work, if compressed air had not been used. The writer believes that in soft material surrounding submerged structures the water actually contained in the voids is not infrequently, after a prolonged period of rest, cut off absolutely from its sources of pressure and that contact with these sources of pressure will not again be resumed until a leak takes place through the structure, and even when there is a small flow or trickling of water through such material it confines itself

to certain paths or channels and is largely excluded from the general mass.

The broad principle of the bearing power of soil has been made the subject of too many experiments and too much controversy to be considered in a paper which is intended to be a description of experiments and observed data and notes therefrom. The writer is of the opinion, however, that entirely too little attention has been given to this bearing power of the soil; that while progress has been made in our knowledge of all classes of materials for structures, very little has been done which leads to any real knowledge of the material on which the foundation rests. For instance, it is inconceivable that 1 or 2 tons may sometimes be allowed on a square foot of soft clay while the load on firm gravel is limited to from 4 to 6 tons. The writer's practical observations have convinced him that it is frequently much safer to put four times 6 tons on a square foot of gravel than it is to put one-fourth of 2 tons on a square foot of soft clay.

In connection with the bearing power of soil, the writer also believes that too little study has been given to the questions of the lateral pressure of earth, and he desires to quote here from some experiments described in a book* published in England in 1876, to which his attention has recently been called. This book appears to have been intended for young people, but it is of interest to note the following questions from a chapter entitled "Sand." This chapter begins by stating that—

During the course of a lecture on the Suez Canal by Mr. John H. Pepper, which was delivered nightly by him at the Polytechnic Institute in London, he illustrated his lecture by some experiments designed to exhibit certain properties of sand, which had reference to the construction of the Suez Canal, and it is stated that though the properties in question were by no means to be classed among recent discoveries, the experiments were novel in form and served to interest the public audience.

Further quotation follows:

When the Suez Canal was projected, many prophesied evil to the undertaking, from the sand in the desert being drifted by the wind into the canal, and others were apprehensive that where the canal was cut through the sand the bottom would be pushed up by the pressure on the banks * * *.

The principle of lateral pressure may now be strikingly illustrated by taking an American wooden pail and, having previously cut a large circular hole in the bottom, this is now covered with fine tissue paper, which should be carefully pasted on to prevent the particles of sand from flowing through the small openings between the paper and the wood * * * and being placed upright and rapidly filled with sand, it may be carried about by the handle without the slightest fear of the weight of the sand breaking through the thin medium. * * *

Probably one of the most convincing experiments is that which may be formed with a cylindrical tube 18 ins. long and 2 ins. in diameter, open at both ends. A piece of tissue paper is carefully pasted on one end, so that when dry no cracks or interstices are left. The tube is filled with dry sand to a height of say 12 ins. In the upper part is inserted a solid plug of wood 12 ins. long and of the same or very nearly the same diameter as the inside of the tube, so that it will move freely up and down like the piston of an air pump. The tube, sand, and piston being arranged as described, may now be held by an assistant and the demonstrator, taking a sledge hammer, may proceed to strike steadily on the end of the piston and, although the paper will bulge out a little, the force of the blow will not break it.

If the assistant holding the tube allows it to jerk or rebound after each blow of the hammer, the paper may break, because air and sand are driven down by the succeeding blow, and therefore it must be held steadily so that the piston bears fairly on the sand each time.

A still more conclusive striking experiment may be shown with a framework of metal constructed to represent a pail, the sides of which are closed up by pasting sheets of tissue paper inside and over the lower part. As before demonstrated, when a quantity of sand is poured into the pail the tissue paper casing at the bottom does not break, but if a sufficient quantity is used the sides formed of tissue paper bulge out and usually give way in consequence of the lateral pressure by the particles of sand.

The writer has made the second experiment noted, with special apparatus, and finds that with tissue paper over the bottom of a 2-in. pipe, 15 ins. long, it will stand the blow of a heavy sledge hammer, transmitted through a wooden piston, at least once and sometimes two or three times, while heavy blows given with a lighter hammer have no effect at all. That this is not due in any large measure to inertia can be shown by the fact that more than 200 lbs. can safely be put on top of the wooden piston. It cannot be accounted for entirely by the friction, as the removal of the paper allows the sand to drop in a mass. The explanation is that the pressure is transmitted laterally to the sides, and as the friction is directly proportional to the pressure, the load or effect of the blow is carried by the proportional increase in the friction, and any diaphragm which will carry the direct bottom load will not have its stresses largely increased by any greater loading on top.

The writer believes that experiments will show that in a sand jack the tendency will be for the sides to burst rather than the bottom, and that the outflow from an orifice at or near the bottom is not either greatly retarded or accelerated by ordinary pressure on top. The occurrence of abnormal voids, however, causes the sand to be displaced into them.

The important consideration of this paper is that all the experiments and observations noted point conclusively to the fact that pressure is transmitted laterally through ground, most probably along or nearly parallel to the angles of repose, or in cases of rock or stiff material, along a line which, until more conclusive experiments are made, may be taken as a mean between the horizontal and vertical, or approximately 45°. There is no reason to believe that this is not the case throughout the entire mass of the earth, that each cubic foot, or yard, or mile is supported or in turn supports its neighboring equivalent along such lines. The theory is not a new one and its field is too large to encompass within the limits of a single paper, but for practical purposes and within the limited areas to which we must necessarily be confined, the writer believes it can be established beyond controversy as true. Certain it is that no one has yet found in ground free from water pressure or abnormal conditions any evidence of greater pressure at the bottom of a deep shaft or tunnel than that near the surface. Pressures due to the widening of mines beyond the limits of safety must not be taken as a controversion of this statement, as all arches have limits of safety, more especially if the useless material below the theoretical intrados is only partly supported, or is allowed to be suspended from the natural arch.

The writer believes also that the question of confined foundations, in contradistinction to that of the spreading of foundations, may be worthy of full discussion, as it applies to safe and economical construction, and he offers, without special comment the following observations:

He has found that in soft ground results are often obtained with small open caissons sunk to a depth of a few feet and cleaned out and filled with concrete, which offer much better resistance than spreading the foundation over four or five times the equivalent area.

He has found that small steel piles and coffer dams, from 1-ft. cylinders to coffer dams 4 or 5 ft. square, sunk to a depth of only 1 or 2 ft. below adjacent excavations in ordinary sand, have safely resisted loads four or five times as great as those usually allowed.

He believes that short cylinders, cleaned out and filled with concrete, or coffer dams of short steel piling with the surface cleaned out to a reasonable depth and filled with concrete horizontally reinforced, will in many instances give as good results as, and in most cases very much better than, placing the foundation on an equivalent number of small long piles or a proportionately greater spread of foundation area, the idea being that the transmission of pressure to the sides of the coffer dam will not only confine the side thrust but will also transfer the loading in mass to a greater depth where the resistance to lateral pressure in the ground will be more stable; that is, the greater depth of foundation is gained without the increased excessive loading or necessity for deep excavation.

As to the question of the bearing value and friction on piles, the writer believes that, while the literature on engineering is full of experimental data relating to friction on caissons, there is little to show the real value of friction on piles. The assumption generally made of an assumed bearing value and the deduction therefrom of a value for the skin friction is fallacious. Distinction also is not made, but should be clearly drawn between skin friction pure and simple on smooth surfaces and the friction due to pressure. Too often the bearing value on irregular surfaces as well as the bearing due to taper in piles, and lastly the resistance offered by binding, enter into the determination of so called skin friction formulas. The essential condition of sinking a caisson is keeping it plumb; and binding, which is another way of writing increased bearing value, will oftentimes be fatal to success.

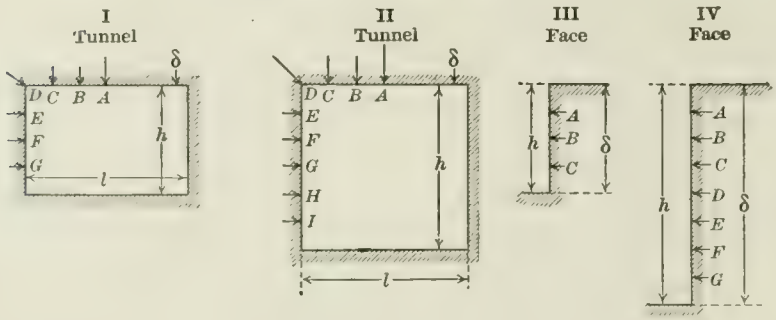
The writer believes that a series of observations on caissons sunk plumb under homogeneous conditions of ground and superficial smoothness will show a proportional increase of skin friction per square foot average for each increase in the size of caissons, as well as for increase of depth in the sinking up to certain points, where it may finally become constant, as will be shown later. The determination of the actual friction or coefficient of friction between the surface of the pile and the material it encountered is not difficult to determine. In sand it is approximately 40 per cent of the pressure for reasonably smooth iron or steel, and 45 per cent of the pressure for ordinary wood surfaces. If, for instance, a long shaft be withdrawn vertically from molding sand, the hole may remain indefinitely as long as water does not get into it or it does not dry out. This is due to the tendency of the sand to arch itself horizontally over small areas. The same operation cannot be performed on dry sand, as the arching properties, while protecting the pile from excessive pressure due to excessive length, will not prevent the loose sand immediately surrounding the pile from exerting a constant pressure against the pile, and it is of this pressure that 45 per cent may be taken as the real value of skin friction on piles in dry sand.

In soft clays or peats which are displaced by driving, the tendency of this material to flow back into the original space causes pressure, of which the friction will be a measured percentage. In this case, however, the friction itself between the material and the clays or peat is usually very much less than 40 per cent and it is for this reason that piles of almost indefinite length may be driven in materials of this character without offering sufficient resistance to be depended on, as long as no good bearing ground is found at the point.

If this material is under water and is so soft as to be considered semi-aqueous, the pressure per square foot will increase in diminishing proportion to the depth, and the pressure per area will soon approach and become a constant, due to the resistance offered by the lateral arching of the solid material, whereas in large circular caissons or caisson shafts where the horizontal arching effect is virtually destroyed or at least rendered noneffective until a great depth is reached, the pressure must necessarily vary under these conditions proportionately to the depth and size of the caisson in semi-aqueous material. On the other hand, in large caisson shafts, especially those which are square, the pressure at the top due to the solid material will also increase proportionately to the depth, as already explained in connection with the pres-

*"Discoveries and Inventions of the Nineteenth Century," by Robert Routledge, Assistant Examiner in Chemistry and in Natural Philosophy to the University of London.

TABLE 1.—Pressures on Typical Structures Under Varying Assumed Conditions.



Key to Table of Pressures, etc.

h = exterior height, l = exterior width,

δ = depth of cover, that is, D_E = earth, and D_W = water depth,

ϕ = angle of repose, and, for tunnels $D_W > D_E >$ a depth

$$= \frac{l}{2}\left(45° + \frac{\phi}{2}\right)$$

W_E = weight of 1 cu. ft. of earth = 90 lb.; W_W = weight of 1 cu. ft. of water = 62½ lb.

Conditions: 1 = normal sand, 2 = dry sand, 3 = supersaturated firm sand with no voids, 4 = supersaturated semi-aqueous material, 60% aqueous, that is, 60% water and aqueous material.

Combined assumed conditions.	h	l	ϕ	D_E	Combined assumed conditions.	h	l	ϕ	D_E	D_W
I_1	20	30	45°	40	I_3	20	30	50°	40	60
I_2	20	30	30°	40	I_4	20	30	40°	40	60
II_1	15	15	45°	40	II_3	15	15	50°	40	60
II_2	15	15	30°	40	II_4	15	15	40°	40	60
III_1	15	....	45°	15	III_3	15	....	50°	15	15
III_2	15	....	30°	15	III_4	15	....	40°	15	15
IV_1	30	....	45°	30	IV_3	30	....	50°	30	30
IV_2	30	....	30°	30	IV_4	30	....	40°	30	30

Approximate Pressures on Tunnel, per Square Foot.

Pressure, per square foot, at	I_1 Earth.	I_2 Earth.	I_2 Water.	I_3 Combined.	I_2 Earth.	I_4 Earth.	I_4 Water.	I_4 Combined.	II_1 Earth.	II_3 Earth.	II_3 Water.	II_3 Combined.	II_2 Earth.	II_4 Earth.	II_4 Water.	II_4 Combined.
A	3 240	3 690	1 500	5 190	2 325	2 880	2 250	5 130	1 485	1 755	1 500	3 255	1 035	1 305	2 250	3 555
B	2 745	3 105	1 500	4 605	1 845	2 385	2 250	4 635	1 305	1 485	1 500	2 985	945	1 170	2 250	3 420
C	2 160	2 475	1 500	3 975	1 350	1 800	2 250	4 050	1 125	1 215	1 500	2 715	810	990	2 250	3 240
D	450	540	1 500	2 040	450	450	2 250	2 700	405	405	1 500	1 905	540	450	2 250	2 700
E	360	360	1 625	1 985	450	450	2 438	2 888	405	405	1 625	2 030	540	450	2 438	2 888
F	270	270	1 750	2 025	450	360	2 626	2 986	360	360	1 750	2 110	540	450	2 626	3 076
G	235	225	1 875	2 100	360	270	2 814	3 084	315	315	1 875	2 190	360	360	2 814	3 174
H	....	....	....	....	....	....	....	....	180	225	2 000	2 225	180	180	3 000	3 180
I	....	....	....	....	....	....	....	....	90	110	2 175	2 285	135	135	3 188	3 323

Approximate Pressures on Sheeted Trench Faces or Walls.

Pressure per square foot at	III_1 Earth.	III_3 Earth.	III_3 Water.	III_3 Total earth and water.	III_2 Earth.	III_4 Earth.	III_4 Water.	III_4 Total earth and water.	IV_1 Earth.	IV_3 Earth.	IV_3 Water.	IV_3 Total earth and water.	IV_2 Earth.	IV_4 Earth.	IV_4 Water.	IV_4 Total earth and water.
A	575	510	100	610	1 350	810	140	950	1 370	1 210	100	1 310	3 175	1 910	150	2 060
B	400	350	190	540	900	540	260	800	1 170	1 030	200	1 230	2 700	1 610	290	1 900
C	200	175	280	455	450	270	380	650	970	855	290	1 145	2 250	1 355	430	1 785
D	....	....	....	....	....	....	....	....	775	680	370	1 050	1 800	1 100	570	1 670
E	....	....	....	....	....	....	....	....	590	515	460	975	1 350	820	710	1 530
F	....	....	....	....	....	....	....	....	400	350	560	910	900	540	860	1 400
G	....	....	....	....	....	....	....	....	190	170	650	820	450	275	1 000	1 275

sure of earth against sheeting and retaining walls.

The writer believes that the pressure on these surfaces may be determined with reasonable accuracy by the formulas already given in this paper, and with these pressures, multiplied by the coefficient of friction determined by the simplest experiment on the ground, results may be obtained which will closely approximate the actual friction on caissons at given depths. The friction on caissons, which is usually given at from 200 to 600 lbs. per sq. ft., is frequently assumed to be the same on piles 12 ins. or less in diameter, whereas the pressures on these surfaces, as shown, are in no way comparable.

The following notes and observations are given in connection with the skin friction and the bearing value of piles:

The writer has in his possession a copy of an official print which was recently furnished to bidders in connection with the foundation for a large public building in New York city. The experiments were made on good sand at a depth of approximately 43 ft. below water and 47 ft. below an adjacent excavation. In this instance a 16-in. pipe was sunk to the depth stated, cleaned out, and a 14-in. piston connected to a 10-in. pipe was inserted and the ground at the bottom of the 16-in. pipe subjected to a loading approximating 28 tons per sq. ft. After an initial settlement of nearly 3 ins. there was no further settlement over an extended period, although the load of 28 tons per sq. ft. was continued.

In connection with some recent underpinning work, 14-in. hollow cylindrical piles 6 ft. long were sunk to a depth of 6 ft. with an ordinary hand hammer, being excavated as driven. These piles were then filled with concrete and subjected to a loading in some cases approximating 60 tons. After a settlement ranging from 9 to 13 ins. no further settlement took place, although the loading was maintained for a considerable period.

In connection with some other pile work, the writer has seen a 10-in. pipe, ⅜ in. thick, 4 ft. below the bottom of an open cylinder, at a depth of about 20 ft., sustain in gravel and sand a load approximating 50 tons when cleaned out to within 2 ft. of the bottom.

He has seen other cylindrical piles with a bearing ring of not more than ¾ in. resting on gravel at a depth of from 20 to 30 ft., cleaned out practically to the bottom, sustain a measured load of 60 tons without settlement.

As to skin friction in sand, a case came under his observation wherein a 14-in. hollow cylindrical pile which had stood for 28 days at a depth of about 30 ft. in the sand, was cleaned out to its bottom and subjected to hydraulic pressure, measured by a gage, and sunk 2 ft. into the sand without any pressure being registered on the gage. It should be explained, however, that the gage could be subjected to a pressure of 250 lbs., equal to a total pressure of 7,000 lbs. on the piston of the jack without registering, which corresponded, assuming it all as skin friction, to a maximum of not more than 78 lbs. sq. ft., but it should be noted that this included bearing value as well, and that the pressure was very far from 7,000 lbs. in all probability at the beginning of the test.

In the case of the California stove pipe wells driven by the Board of Water Supply on Long Island, the writer is informed that one of these tubes, 12 ins. in diameter, was sunk to a depth of 850 ft. In doing this work the pile was excavated below the footing with a sand pump and was then sunk by hydraulic pressure. Assuming the maximum capacity of the jacks at 100 tons, which is not probable, the skin friction could not have amounted to more than 75 lbs. per sq. ft. It cannot be assumed in this case that the excavation of the material below the pile relieved the skin itself of some of its friction, as the operation consumed more than 6 weeks, and even if excess material was removed it is certain that a large percentage of it would have had time to adjust itself before the operation was completed.

In connection with this, the writer may call attention to the fact that piles driven in silt along the North River and in soft material at other places are sometimes 90 ft. in length, and even then do not offer sufficient resistance to be depended on for loading. This is due to the fact that the end of the pile does not bear in good material.

The writer believes that the foregoing notes will show conclusively that the factor to be sought in pile work is bearing value rather than depth or skin friction, and however valuable skin friction may be in the larger caissons, it cannot be depended on in the case of small piles, except in values ranging from 25 to 100 lbs. per sq. ft.

Table I gives approximate calculations of pressures on two types of tunnels and on two heights of sheeted faces or walls, due to four widely varying classes of materials.

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Containing Items of Interest to Railroad, Public Works and Other Contractors.

The Doings of the Week.

The principal feature of railroad construction work of the week appears to be the announcement that the Canadian Northern interests were taking bids for the construction of the Duluth, Winnipeg & Pacific Ry., a 75-mile line to extend from Virginia, Minn., to Duluth, Minn. Another railroad construction contract which it appears likely will be let soon is for the construction of the steam line of the New York, Westchester & Northern R. R. to connect New York city and Danbury, Conn.—Official announcement has been made that the Canadian Northern Ry. has obtained $50,000,000 in the British money markets for development purposes.—Among the railroad construction contracts let recently were the following: John H. Dobbing, York, Pa., for grading for the extension of the Hanover & McSherrytown Street Ry. from McSherrytown, Pa., to Conewago Chapel; McCann Bros., Murphysboro, Ill., for constructing the 12-mile line of the Oil Belt Traction Co. between Bridgeport and Oblong, Ill.; Thompson & Scott, St. Louis, Mo., for the grading work for the 32-mile extension of the Stephensville North & South Ry. (Cotton Belt) from Hamilton to Gatesville; Warren Construction Co., Chicago, Ill., for the construction of car shops at Beech Grove, Ind., for the Big Four Ry.; Dan Sweeney & Co., Oklahoma City, Okla., for the grading work for the first 13 miles of line for the Oklahoma Public Service & Interurban Lines of Stillwater, Okla., and the M. B. Ryan Bridge Co., Shawnee, Okla., for the bridges and culverts; Somerset Construction Co., Somerset, Pa., subcontract from the Carter Construction Co. for about 6,000 cu. yds. of concrete work at Meyersdale, Pa., and H. E. Nay, Roanoke, Va., for 5,000 cu. yds. of concrete work near Confluence, Pa., both on the Western Maryland R. R. extension; A. B. Corey Construction Co., Ogden, Utah, for constructing of sidings and double track extensions on the Southern Pacific; Morrison & Clark, Summerside, Prince Edward's Island, Canada, $200,000 contract for revision work on the Intercolonial Ry. near Chatham, N. B.; Thrasher & Gunter, Chatanooga, Tenn., for constructing nine miles of line for the Nashville, Chattanooga & St. Louis Ry. between Wauhatchie and Whiteside, Tenn.; Herman W. Tapp Construction Co., Fort Wayne, Ind., for the track elevation work of the Pennsylvania R. R. in Fort Wayne.—Bids for two large barge canal contracts were opened May 24 by the state superintendent of public works at Albany, N. Y., H. S. Kerbaugh, Inc., Philadelphia, Pa., at $1,990,000 being the lowest bidder for contract No. 63, which calls for work between the Wayne-Monroe county line and Kings Bend west of Pittsfield. E. M. Graves, Cleveland, O., at $767,467, was the low bidder for contract No. 73, which calls for dredging the Hudson River from Stillwater to Northumberland, N. Y.

The History of the Term "Engineer."

It will be interesting doubtless to many followers of the engineering profession to know how the term "engineer" originated. In the appendix to the presidential address of Jas. C. Inglis, president of the Institution of Civil Engineers of Great Britain, considerable light is thrown on the subject. According to this the word engineer originated from an ancient French verb *s'ingenier*, and an engineer, according to the strict derivation of the term, is not necessarily a person "who has to do with engines, but any one who seeks in his mind; who sets his mental power in action, in order to discover or devise some means of succeeding in a difficult task he may have to perform." In the early use of the term, an engineer was, according to the most common acceptance of the term, a person in military service, whose business it was not only to direct warlike engines or weapons (a duty transferred at a later period to the artillery officer), but to undertake the design and construction of fortifications, siege works, roads, bridges, buildings, machinery, and all other works for military service which required knowledge, experience, and skill in the arts of construction. Down to a recent period the title "Engineer" was never applied to the constructors of similar works in civil life, yet the construction of such works generally has existed from time immemorial. Perhaps the earliest example of a definite class of persons expressly devoting themselves to civil works of an engineering character was the association known as the "Freres Pontiers" (Brethren of the Bridge), which was organized in France about the twelfth century for the purpose of building bridges wherever rivers were dangerous or difficult to ford. Branches of this association extended over all parts of northern Europe and great numbers of important works were executed, some of which still exist. In the twelfth century also the Italian republic began to improve its rivers, and the work was continued for many years. But about the commencement of the seventeenth century the great rivers in the north of Italy appear to have relapsed into a very bad condition and disastrous inundations resulted. The most learned scientific men of the day were consulted as to how the evils might be remedied. As a result valuable theoretical and experimental studies, which lasted for a century and a half, and ultimately formed a thorough basis for hydraulic science and practice, were conducted. The knowledge thus acquired spread rapidly throughout Europe and gave a great impulse to hydraulic operations. A new class of practitioners, apart from the architects, were called for, who should devote their attention to hydraulic constructions, with all their necessary mechanical arrangements; and with these soon became associated constructive works which did not embody the artistic element, and might therefore be fairly dissociated from the profession of the architect. Thus the new class of men undertook to design not only river and hydraulic works, but roads, bridges, docks, harbors, mills, and machinery, and massive buildings generally. Such a class required a new name, and this was easily found. It could not fail to be noticed that the kind of work undertaken by these practitioners was exactly analogous to that allotted to the "engineers" of the military service, and the new profession therefore adopted the same title, prefixing, however, the word "civil," to indicate that they were civilians and so to distinguish them from their military brethren. Hence the origin of the term civil engineer, its true meaning being a person who devotes himself to occupations of the kind originally practiced by military engineers, but who belongs to the civil and not to the military community. It is probable that Smeaton was the first civil practitioner (if not absolutely, at least in England), who formally denominated himself an "engineer." A report he made, dated July 11, 1761, on a canal in Staffordshire, is entitled: "Report by John Smeaton, engineer, concerning the practicability, etc., of a navigable canal . . . as projected by Mr. James Brindley, engineer."

The Chinese Canalization Systems.

The Chinese, the oldest farmers in the world, have their systems for irrigating their rice fields so well developed and scientifically arranged that it is a pretty nimble raindrop that gets away from them. Some idea of the magnitude and complexity of the systems of canalization which have been constructed in China is given by Prof. F. H. King of the agricultural department of the University of Wisconsin in a recent study of the soil and crops and people of the far eastern countries.

While passing by houseboat through the Chekiang province from Shanghai to Hangchow he made a careful record of the number and width of laterals leading into the Grand Canal on one side and out from it on the other, and found in 57 miles of the 117 miles no less than 134 having an average water surface width of 22 ft. on one side and 190 with an average width of 19 ft. on the other. This is a mean of nearly three canals to every mile traveled, cutting the field on either side. The canals were from 6 to 10 ft. or more in depth, and the soil removed has been leveled back over the fields, leaving no sign of excavated earth.

Blackwell vs. Hill.

A. F. Blackwell, builder and president of the Idaho & Washington Northern R. R., is noted for being somewhat "sot" in his ways: when he makes up his mind to do a thing he usually goes ahead and does it. Blackwell began by making money in timber lands and he made so much of it that he decided that he could afford to build some railroads. So he started in, as Spokane people think, merely to show how well a railroad could be built. He built the first interurban line from Spokane, sold it to the Hill interests, and then built the Idaho & Washington Northern Ry. Last summer James J. Hill was in Spokane and met Blackwell. "I understand you intend building a railroad down the Pend Oreille River," was his greeting. "I do," replied Blackwell. "But I plan to build a branch of the Great Northern down there," said Hill. "Then there'll be two roads," was the reply. And Blackwell built his road.

The Franklin & Lewisburg R. R., of Williamson County, Tenn., has been incorporated with a capital stock of $10,000 and proposes the construction and operation of a line. The incorporators are: J. J. Covington, E. E. Green, S. D. Beel, R. A. Bailey, Jr., B. H. Paschall, J. E. Short, Jolen H. Truett, O. E. Cox and J. A. Pierce.

Commercial Club of Harlan, Ky., have succeeded in raising the bonus necessary to insure the construction of the Wasioto & Black Mountain R. R., from Poor Fork to that city.

Confirmed Reports by Engineers and Contractors

RAILROADS, POWER DEVELOPMENTS, LEVEES, DRAINAGE AND IRRIGATION WORKS.

Railroads—Steam and Electric.

ARKANSAS.

The Pine Bluff & Northern R. R. has been incorporated and will build a line from Pine Bluff, Ark., to Searcy, Ark., a distance of 80 miles. Walter J. Miller, Lamar, Mo., is president.

The city council of Hope, Ark., has not as yet granted a franchise for a street railway for the city. J. H. Black, Jr., Texarkana, Ark., is the applicant. Work on the road will not be started before six months after the franchise is granted.

The Walsh Construction Co., Davenport, Ia., has sub-let part of the work of double-tracking the Missouri Pacific Ry. between McAlmont and Bald Knob, Ark., to Ball & Peters. The double-tracking contract involves 2,000,000 cu. yds. of earth and rock excavation.

Ball & Peters, Southern Trust Bldg., Little Rock, Ark., have contracts for second track work on the St. Louis, Iron Mountain & Southern Ry. at White River and Diaz, Ark., Poplar Bluff and Harviell, Mo., and team work Little Rock to Bald Knob, Ark. The contract involves 300,000 cu. yds. of earth excavation. About one-half of the work is steam shovel, which is covered by Ball & Peters' outfit. The balance is team work and will be sublet. Part of the latter is already covered.

IDAHO.

Regarding the projected new line of the Oregon Short Line R. R. from Saline to Burley, Idaho, we are advised that preliminary surveys have been made and a company incorporated; no work has yet been authorized on the line.

IOWA.

The Waterloo, Cedar Falls & Northern R. R. has indefinitely postponed the work of double tracking its line at Waterloo from Broadway to Electric Park.

MICHIGAN.

The Boyne City, Gaylord & Alpine R. R., W. H. White, president, Boyne, Mich., has surveys under way east of Gaylord for new construction work, but does not expect to let any contracts.

MONTANA.

The construction of an electric railway from Butte to Anaconda, passing through Geyser Springs, is proposed. The projected length of the line is 28 miles. Surveys have not been made as yet, and the date for awarding construction contracts is indefinite, as not all of the construction capital has been secured. Samuel Barker, Jr., Butte, Mont., is chief engineer. I. A. Heilbronner, Butte, Mont., is interested.

The Eastern Montana Electric Ry. Co. has made application to the city council of Billings, Mont., for a 50-year franchise and the same has been acted upon favorably by the city council and referred to the tax payers, to be voted on at a special election in the near future. The company has already received and accepted long time franchises from the cities of Red Lodge, Bridger, and Laurel, Montana. One-third of the location work has already been completed and right of way men are now in the field taking up the rights of way. The tonnage and traffic reports thus taken from the data received from the men in the field, who have as yet covered but one-half of the territory contiguous to this line, show earnings double the amount estimated for the entire line at the time of its preliminary presentation. F. A. Kesselhuth, Billings, Mont., is chief engineer.

NEBRASKA.

The Commercial Club of Norfolk, Neb., has taken up the matter of promoting an interurban line from Norfolk to Newmans Grove, Neb., and is meeting with much encouragement. An engineer has been over the proposed route and pronounces it excellent. L. P. Pasewalk is secretary of the Commercial Club.

NEW MEXICO.

We are advised that the Mountain, Valley & Plains R. R. Co. has no plans for extension of its line beyond Cimarron, N. M., but is bending all of its energies in the direction of completing the construction of the road from Guthrie, Okla., to Cimarron, N. M. H. S. Wannamaker, Amistad, N. M., is general manager.

OKLAHOMA.

The Oklahoma Public Service & Interurban Lines, of Stillwater, Okla., has awarded the contracts for the construction of the first section of 13 miles to Dan Sweeney & Co., Oklahoma City, for the grading work, and to M. B. Ryan Bridge Co., Shawnee, Okla., for the bridges and culverts. Surveys are under way for 85 additional miles of line and the company will be ready for bids in 60 or 90 days. The company will also be in the market in about 60 days for supplies, equipment, etc. R. G. Sturgeon, Stillwater, Okla., is chief engineer.

PENNSYLVANIA.

The Norristown Transit Co. has applied to the council of Norristown for a franchise to build a trolley line through the city. If this franchise is granted the road will be built to connect with the Philadelphia & Western near Bryn Mawr in one direction and to connect with the Lehigh Valley Transit Co. in the other direction. If the franchise is not granted in Noristown the line will be built around the city and connected to the Lehigh Valley line. The ordinance has passed two readings in the council and will come up for a third reading about June 15.

TENNESSEE.

We are advised that there is no definite assurance that the Greenville & Knoxville Ry. Co. will extend its line to Knoxville, Tenn. However, the outlook for the extension is decidedly encouraging, but some two or three months will be required to reach a definite conclusion. The towns and counties along the proposed line—through North Carolina particularly—are very anxious for the extension and have been sending delegations to the company promising to make liberal town and county subscriptions, provided the line is extended, and these matters are now under consideration, but have not reached a conclusive point. If the aid promised should be extended in a definite way and of satisfactory amount, the extension will be made.

TEXAS.

The Gainesville, Oklahoma & Western Ry. is now ready to let contracts for 20 miles of its line. Location surveys for 12 miles of this have been completed and the rest will be finished by the time the contractors are ready to move onto the work. This work will require about 13,000 cu. yds. of earth excavation and embankment per mile. There will also be required about eight pile trestles varying in length from 56 ft. to 280 ft. F. B. Truax, Gainesville, Tex., is chief engineer.

WASHINGTON

The Mount Adams Ry. Co. has completed surveys for the first 20 miles of its projected line and has secured $100,000 for construction purposes. Construction contracts will be let about July 1. The projected length of this line is 40 miles and the route is from White-Salmon Station on the North Bank R. R. to Glenwood, Wash. Rudolph Lauterbach, White Salmon, Wash., is president.

Power Developments, Levees, Drainage and Irrigation Works.

CALIFORNIA.

The Sacramento Valley Irrigation Co., Willows, Cal., has let the contract for a part of the reconstruction of its Central Canal to J. M. Kearth of Colusa, Cal., the contract calling for 370,000 yds. of reconstruction, at 17 cts., and to John Laugenour of College City, Cal., 235 cu. yds. of new construction, at 14¾ cts. per cu. yd., with a bonus for completion on time; 200,000 yds. have also been let to three other parties in small lots. In about two months the company will be prepared to let the several contracts for lateral and drain construction on the "Delevan Unit," which will amount to about 1,200,000 yds.

INDIANA.

As noted in our last issue, bids ore being asked until 10 a. m., June 20, by Maj. Thos. H. Rees, U. S. engineer, 508 Federal Bldg., Chicago, Ill., for constructing concrete superstructure, pile clumps and interlocking steel sheeting in Michigan City, Ind. The work to be done consists of driving a line of interlocking steel sheeting about 240 ft. in length (or longer, if available funds permit), parallel to and outside of the breakwater and around the northeasterly end, as directed. Placing two clumps of piles at the northeasterly end of the breakwater and placing riprap around them. Removing the decking, the top course of the side timbers and cross-ties of the new (northeasterly) crib (100 ft. long by 30 ft. wide) of the breakwater and constructing, on a foundation prepared therefor, a concrete superstructure. The following are the approximate quantities: 250 lin. ft. interlocking steel sheeting, 26 white oak or pine piles, 50 ft. long, 360 lin. ft. 1-in. wire rope, 150 galvanized staples, 4 in. long, 60 cords riprap, 128 cu. ft. each, 660 cu. yds. concrete, 150 cu. yds. spall or gravel for foundation, 3,300 lbs. steel rods, 350 lbs. steel drift bolts, 280 lbs. steel screw bolts, 70 lbs. eye bolts with mooring rings, 3,300 ft. B. M. pine timber, 700 ft. B. M. oak plank, 500 lbs. 8-in. wrought iron spikes, 100 lin. ft. foundation to be prepared, 20 hours use of dredge, if required.

IOWA.

N. C. McGinnis, Bement, Ill., has been awarded the contract for constructing joint Drain No. 70, Webster county, Ia., and Drain No. 95 in Calhoun county, Ia., bids for which were opened May 23, at Rockwell City, Ia. The contract prices were as follows: 6.11 cts. per cu. yd. for the main line; 7 cts. per cu. yd. for Sec. 2, Branch No. 4, and 7 cts. per cu. yd. for Sec. 9, Branch No. 1. The work includes the following: Sec. 1, main line—46,400 cu. yds., 26-ft. bottom; 36,300 cu. yds., 20-ft. bottom; 38,400 cu. yds., 18-ft. bottom; 236,500 cu. yds., 12-ft. bottom; 50,900 cu. yds., 8-ft. bottom; 30,925 cu. yds., 6-ft. bottom; 58,450 cu. yds., 5-ft. bottom. Sec. 2, Branch No. 4—102,204 cu. yds., 5-ft. bottom. Sec. 9, Branch No. 1—23,000 cu. yds., 5-ft. bottom.

LOUISIANA

Contracts for levee work in the Fifth Louisiana Levee District, bids for which were opened May 25 at New Orleans, La., have been let as follows: Wilson Point levee, 50,000 cu. yds., T. S. Shields, Greenville, Miss.; Elton levee, 100,000 cu. yds., and Wyley to Hollybrook levee, 190,000 cu. yds., Hercules

Items Concerning Contractors and Their Work

RAILROADS, POWER DEVELOPMENTS, LEVEES, DRAINAGE AND IRRIGATION WORKS.

(Confirmed Reports, Continued.)

Co., Ltd., 407 Cotton Exchange Bldg., New Orleans, La.; Wilton levee, 100,000 cu. yds., Helgason Bros., Vicksburg, Miss.

WASHINGTON.

George Cooke & Son, 414 Columbia Bldg., Spokane, Wash., have the contract for constructing the main laterals distributing system for the Cowishe branch (Tieton unit, Yakima project). The contract includes 350,000 cu. yds. earth excavation and 35,000 cu. yds. rock excavation. The subcontractors on the work are as follows: Minney & Maxwell, George & Cady, Jas. Lineham, W. L. Carpenter, P. A. Jennings and A. Henderson & Co.

WISCONSIN.

The Great Lakes Dredge & Dock Co., Chicago, Ill., at the following bid per short ton delivered in place in the breakwater, was the only bidder, May 25, for building rubble mound breakwater at Superior Entry, Wis., for the U. S. government: Quarry run, $1.60 per ton; 10-ton and greater $1.60 per ton. The bid was recommended for acceptance.

Arkansas Notes.

FROM CORRESPONDENTS AND OTHER SOURCES.

McCrory & Beedeville Southern Ry. Co., recently chartered with a capital stock of $100,000, proposes to build a railroad from McCrory, Woodruff county, to Beedeville, Jackson county, a total distance of 14 miles. The incorporators are as follows: Clayton Hailey, E. L. Hamilton, W. B. Fakes, G. G. McCrory, Sam Turpin, I. H. Beidleman and R. B. Keating. The company has a 50-year franchise.

J. C. Knox, Monticello, Ark., general attorney for the Arkansas, Louisiana & Gulf R. R., has filed an application with the Secretary of State for the renewal charter for the extension of the line from Pine Bluff, Ark., to Hazen. The company of which J. M. Parker is president has about 66 miles of track in operation.

Stockholders of the Memphis, Paris & Gulf Ry. are considering a proposition to increase the capital stock from $640,000 to $6,260,000 and issue bonds for the extension of the present trackage from Murfreesboro, Ark., to Memphis and Ashdown, Ark., and Texas. It is also believed that the name of the company will be changed to the Memphis, Dallas & Gulf.

Work has been commenced by Ball & Peters, Little Rock, Ark., contractors, who have a construction contract for double track on the Iron Mountain between White River bridge and Diaz. About 150 men are employed on the job.

California Notes.

FROM CORRESPONDENTS AND OTHER SOURCES.

In response to the demand of residents of the Sunset District the Board of Supervisors of San Francisco have adopted a resolution granting a street railway franchise commencing at Third and Parnassus avenues, along Third avenue to Judah street, thence to Ninth avenue to Pacheco street. It is understood that the residents of the Sunset District have raised $20,000 to induce the United Railroads to build the desired extension.

Advices from Wengler state that the Mount Shasta Power Co. has put in air compressors for drilling its seven-mile tunnel, which is to convey 250,000 ins. of water from Pitt River across the "Big Bend" and deliver it at an elevation where it will generate 100,000 hp. of electric energy. Work on the tunnel has been under way for some time.

The Highland Pacific R. R. Co. is reported to have been financed by San Francisco capitalists. The company is to build a standard-gage railroad from Santa Rosa via Alexander Valley, Highland Springs and Lakeport to Upper Lake. Dr. A. E. Dickinson of San Jose is president.

The Southern Pacific Ry. is planning to shortly rebuild its wharf at Newport Beach. About 100 ft. will be taken off the end of the wharf.

Construction work on the electric line of the Central California Traction Co. of San Francisco, between Sacramento and Stockton, is going forward rapidly. Three miles of piling and bridge work across the Cosumnes River and lowlands has been completed. The track bed has been ballasted in the neighborhood of Oak Park, and the track on 8th St., Sacramento, between J and L, has been completed.

Farmers in the vicinity of Greenview have appointed a committee consisting of Fred Smith, Mike Marlahan and Frank Jenner to arrange plans for straightening Scott River, starting at a point almost east of Etna, and running to the bridge near Fort Jones, a distance of some six miles. They propose to purchase a dredger and cut, as nearly as possible, a straight line down the center of the valley, purposing to protect the rich valley lands from the yearly floods. The promoters propose to bond the district for $30,000 or more to erect a dredger and carry on the reclamation work.

Advices from Sacramento, Cal., state that H. A. McClelland of the Mercantile Trust Co. of that city has filed a deed with the County Recorder for a broad right of way sufficient for the accommodation of a double track over certain streets in Elmhurst.

Reports from Nevada county, California, are to the effect that work will soon be commenced on the line of the California Midland Road and that the line will run from Grass Valley to Auburn by way of Marysville, Cal. Bonds are said to have been disposed of in foreign markets to provide funds for the project.

Colorado Notes.

FROM CORRESPONDENTS AND OTHER SOURCES.

The San Luis Power & Water Co., with a capitalization of $1,000,000, has filed articles of incorporation in New Mexico, the incorporators being H. Alexander Smith, Geo. Bierbrauer and Michael B. Hurley of Colorado Springs, Colo. The New Mexico offices are at Costilla, Taos county, and the directors are Franklin E. Brooks, Gerald Hughes, Fred Hughes Fred. C. Moffat, Horace G. Lunt and H. Alexander Smith. The company will operate in El Paso and Costilla counties, Colorado, and Taos county, N. M.

The Denver, Greeley & Northwestern R. R. Co. has been incorporated with a capital stock of $2,700,000. The new company, which is a merger of the holdings of the Denver, Greeley & Fort Collins and the Northern Colorado Railway & Utility Companies, plans the construction of a railroad from Denver, Colo., to Greeley, with telephone, telegraph, electric light and electric power transmission lines. The incorporators are A. W. Trenholm, a prominent railroad man of Minnesota; Otto Bremer, former treasurer of St. Paul, Minn.; C. McC. Reeve, a wealthy resident of Minneapolis; J. R. Hutchison, formerly auditor of the Denver, Laramie & Northwestern and now connected with the University of Wyoming; Ralph Hartzell, formerly assistant United States district attorney; Edward W. Genter and George L. Nye, wealthy residents of Denver; George J. Spear, C. H. Ramsey and H. E. Churchill of Greeley.

Contracts will be let soon for the construction of 51 miles of double track between Pueblo and Walsenburg, Colo., to be built jointly by the Denver & Rio Grande and Colorado & Southern Railroads at a cost of $5,400,000. Plans for the work have been approved by the companies interested. W. A. Balcom is division engineer of the Denver & Rio Grande at Pueblo, Colo.

The State Land Board at Denver has been petitioned for the immediate segregation of 280,000 acres of land in Rio Blanco county, which were to have been irrigated by the White River irrigation project which was abandoned by the U. S. government. Four large irrigation companies are now contesting for the privilege of taking up and carrying to completion the project. At the recent hearing the claimants appearing before the State Board were the Maggenheimer syndicate, represented by Attorneys C. D. Hayt and C. S. Thomas; the White River & Trappers' Lake Reservoir Co., represented by Dorsey & Hodges; the Northwestern Canal & Reservoir Co., represented by H. H. Clark, and a fourth company represented by E. G. Kindred. The first three claimants have parallel systems, each one of their filings appropriating the full measure of water from White River needed for the irrigation of 288,000 acres. The fourth company has a different water shed, and its plans do not conflict materially with the plans of the other three.

The Southern Colorado Reservoir & Irrigation Co. has been incorporated with a capital stock of $1,000,000, David W. Brunton, Zeph C. Felt, Arthur Ponsford and Edward S. Worrell, Jr., being the incorporators. The company plans to irrigate thousands of acres of arid land in the San Luis Valley. Work will be started within the next two months. The headquarters will be in Denver and offices will soon be opened.

Advices from Holly state that the organization of the Monmouth Irrigation District has been unanimously authorized by residents of northern Prowers and southern Kiowa counties. The project will cost $4,000,000 and when completed will add 120,000 acres to the productive irrigated land of the Arkansas valley. The land to be reclaimed lies north of Hartman and Bristol. It will be watered from the Monmouth reservoir and by the use of unappropriated water from the Purgatoire and Arkansas Rivers. Among the men behind the enterprise is A. E. Bent, former state treasurer.

The signing of joint track operation contracts by the Denver & Rio Grande, the Colorado & Southern and the Santa Fe for the operation of tracks between Denver and Pueblo and Pueblo and Walsenburg, assures the expenditure of $1,000,000 for construction work. Signing of these agreements also practically assures that a double track will soon be maintained due south from Denver a distance of 170 miles. The Denver & Rio Grande, the Colorado & Southern and the Santa Fe have entered into an agreement to jointly operate the tracks from Denver to Pueblo while the Denver & Rio Grande and the Colorado Southern have contracted for the joint construction of a track from Pueblo to Walsenburg.

Engineers of the Union Pacific R. R. have been laying out the new yards for the road at Fort Collins, which will require the construction of more than 12,000 ft. of trackage within the city limits.

Idaho Notes.

FROM CORRESPONDENTS AND OTHER SOURCES.

William Ashton, Salt Lake City, Utah, chief engineer Minidoka & Southwestern R. R. (Oregon Short Line), has filed plats, officially adopted May 13, by the directors of the company in the United States Land Office, showing the definite location of the Buhl-Nyssa extension across Southern Idaho. The general route of the new line will be from Buhl, Idaho, northwesterly along the Snake River through Bruneau-Twinn Falls tract,

Bruneau and Grand View, thence west along the south bank of the Snake River to Nyssa.

The Pittsburg & Gilmore R. R., now under construction from Armsted, Mont., into Lemhi county of Idaho, is, it is thought, planned by James J. Hill to form a link of the new transcontinental route from St. Paul to San Francisco, Cal. Board of directors of the company have filed resolutions of intention to construct from Armstead to Dillon, and from Dillon, Mont., into Butte and from Dillon into Whitehall. The estimated cost of this work is $1,500,000.

Illinois Notes.

FROM CORRESPONDENTS AND OTHER SOURCES.

The Evansville, Mount Carmel & Olney Interurban Co. has been incorporated with a capital stock of $30,000 and principal offices at Mount Carmel. The company proposes to construct a line from the Wabash River in Mount Carmel, Ill., to Olney, Ill., through counties of Wabash, Lawrence and Richland. The incorporators and first board of directors are as follows: E. Q. Lockyear, Evansville, Ind.; C. J. Seibert, Evansville, Ind.; S. J. Laubscher, Evansville, Ind.; Thomas Marvel, Cynthiana, Ind.; E. B. Bixler, Cynthiana, Ind.; Aden Knoph, Olney, Ill.; J. F. Hyatt, Olney, Ill.; James F. Seibert, Lancaster, Ill.; J. O. Smith, Lancaster, Ill.; Lewis Seitz, Mount Carmel, Ill.; Robert Parkinson, Mount Carmel, Ill.

Wallace Treichler, C. E., Rock Island, Ill., has completed the survey of the two new proposed routes for the Tri-Cities & Northeastern interurban. These routes are the Silvis-Hampton and the Silvis-Riverdale farm routes, one of which is to be substituted for the Watertown-Hampton route which was first proposed.

The Peoria, Galesburg Ry. Co., which proposes to build an interurban line between the two cities named, has again applied to the city council of Peoria for a franchise for a line on Antoinette street in that city.

The park commissioners of Decatur have asked the Decatur Railway & Light Co. to extend a street car line southwest to Lincoln park.

The Galesburg, Rock Island Traction Co. has secured about 80 per cent of the right of way for its proposed electric railway, and it is hoped to have actual construction work started by July 15. R. V. Field, Galesburg, Ill., is treasurer.

The Wabash R. R. is shortly to begin the erection of a 300-ton coaling station at Mt. Olive.

The Keithsburg Drainage District Board of Commissioners of Keithsburg have awarded the contract for levee work to Grant Smith & Co. & Locker, who have been doing the work in Boston Bay. The dredge work was let to McWilliams & McWilliams.

Pryce & Sievers, coal mine operators of Moline, owning coal property on the road between Coal Valley and Sherrard, one-half mile northwest of the county farm, are considering building an electric road from their mine to Coal Valley, a distance of 1¼ miles over the hills. The line would be used for hauling coal.

The Illinois Traction system has awarded the contract for the steel overhead bridge over the Chicago & Alton tracks out of Springfield to the McClintic-Marshall Construction Co. of St. Louis, at about $65,000. This is the bridge over the Alton tracks in connection with the building of the belt line about the city of Springfield. Piers on the bridge will cost about $8,000. The bridge, including approaches will be 2,400 ft. long.

The Burton Construction Co. of Chicago, Ill., has been incorporated with a capital stock of $10,000 and proposes to engage in general construction and contracting business and deal in construction materials. J. C. Kistler and Eber C. Chase are the incorporators.

The Chicago, Burlington & Quincy R. R. Co. has started work at Savanna, Ill., on the proposed double track between Minneapolis, Minn., and Chicago, Ill. Steam shovels are widening the roadbed between cuts, and it is expected that it will be possible to lay about 100 miles of track this summer. W. L. Breckinridge, Chicago, Ill., is engineer maintenance of way.

The Cleveland, Cincinnati, Chicago & St. Louis Ry. Co. has awarded the contract to Warren Construction Co., Chicago, Ill., for the construction of the car shops at Beech Grove, Indianapolis, Ind. The contract provides that work shall be completed by Feb. 15, 1911. The work is estimated to cost $1,000,000.

The Barous Construction Co. of Chicago has been incorporated with a capital stock of $10,000 and will engage in a general grading and excavating business. The incorporators are George H. Miller, Isadore Goldstein and Thomas W. Reilly.

Indiana Notes.

FROM CORRESPONDENTS AND OTHER SOURCES.

The Commissioners of Pike, Dubois and Gibson counties, are said to be considering plans for straightening Patoka River. The largest place to straighten is where the river leaves Marion Township to a point near Winslow, almost five miles in length and paralelling the Southern railroad track. The channel will be cut about 60 ft. at the top, 50 ft. at the bottom and 12 ft. deep, and it is claimed by the promoters that it will prevent the overflowing of about 20,000 acres of fertile land.

Reed & Tripp, South Bend, Ind., have secured a grading contract on the Santa Fe, 80 miles southeast of Kansas City, and have shipped their outfit to that place. The work will probably last until November.

The Pennsylvania R. R. has awarded the contract for its track elevation work in Fort Wayne to the Herman W. Tapp Construction Co. of Fort Wayne. The grade crossings will be eliminated by the elevation of the tracks for a distance of something more than one mile. The Wabash, which is also compelled to elevate its tracks in Fort Wayne, will do the work with its own force under the direction of W. S. Danes, engineer of maintenance of way.

The Lafayette Engineering Co., Lafayette, has been awarded the contract for the erection of a $25,000 addition to the Monon R. R. shops at Lafayette. The new shops will be equipped with six engine pits, one drop pit and five repair pits.

Harold Keith, county surveyor, Goshen, Ind., has estimated the cost of the proposed widening, deepening and straightening of Rock Run in Elkhart County at $36,669.

Iowa Notes.

FROM CORRESPONDENTS AND OTHER SOURCES.

Rheins & Chamberlain, Des Moines, representing eastern capitalists, are promoting a project for building an interurban line from Iowa City to Des Moines by way of Williamsburg and Montezuma.

The stockholders of the Sioux City & Spirit Lake Interurban Ry. Co. have voted to complete the road at once. Frank Patch, Hartley, Ia., is president.

A project is under consideration for the construction of a 7,000 hp. electric plant on the Niobrae River, near Valentine, Neb. The project includes the construction of an interurban line from Valentine toward Sioux City, with an ultimate terminus at the latter place. The distance between the two cities is 250 miles. The W. K. Palmer Co., Kansas City, Mo., are the engineers. C. H. Cornell, president of the First National Bank of Valentine, Neb., is promoting the project.

Citizens of Ottumwa, Ia., have subscribed 12 miles of right of way and a bonus of $75,000 toward the construction of the proposed line of the Iowa City Interurban Co.

The Muscatine North & South Ry., Chas. Howard, general manager, Muscatine, has secured all right of way and all plans have been made preparatory to extending the Muscatine north and south line the 25 miles from Elrick Junction to Burlington. The road at present runs only the 30 miles between Muscatine and Elrick.

The Joint Board of Supervisors of Woodbury and Monona counties, have been over the route of the West Fork drainage ditch with a view to making a final settlement preparatory to advertising the work.

The Chicago Great Western Ry. is about to start work, it is said, on the improvement of its western division from Oelwein to Council Bluffs, from Hayfield to Clarion and the Lehigh branch. The work includes the improvement of the roadbed and the laying of new 75-lb. rails. Elzy Construction Co., Marshalltown, Ia., it is believed, will do the work. L. C. Fritch, Chicago, Ill., is chief engineer.

The Keokuk & Hamilton Water Power Co. is taking steps toward the construction of a railroad from Hamilton, Ill., to the dam site at Keokuk.

Engineers are reported to have surveys well under way for the construction of the proposed railroad from Red Oak through Greenfield and Winterset to Des Moines, Ia., a distance of 108 miles. It is said that $400,000 of stock has already been subscribed.

William McKinley, Illinois congressman, and L. E. Myers, Chicago, Ill., are reported to have opened negotiations for the purchase of the street railway in Des Moines, Ia.

Kansas Notes.

FROM CORRESPONDENTS AND OTHER SOURCES.

The Commercial Club of Conway Springs, Kan., of which J. J. Booth is president, is advocating the construction of an interurban line from Hutchinson to Arkansas Springs, passing through Conway, Wellington and Gueda Springs.

The Metropolitan Street Ry. Co. of Kansas City, Mo., is considering constructing two car line extensions in Kansas City, Kan. The Quindaro boulevard line is to be extended west to the new city limits. A cross-town line is to be built on 18th St. from Minnesota Ave. to Central Ave. The Grandview cars now run to the city park and the park board has been asked for permission to build a loop around the park. John M. Egan, president of the company, has asked the directors for an appropriation for the work.

Burns & McDonnell, consulting engineers, Kansas City, Mo., have completed plans for the new concrete dam to be built by the city of Wichita across Little Arkansas River, near Central Ave., and the city clerk is now calling for bids. The dam will cost about $22,000.

The Missouri Pacific Ry. has been making surveys with a view to cutting down Kickapoo Hill, near Leavenworth.

The laying of 90-lb. rails on the Atchison, Topeka & Santa Fe R. R., from Ottawa, Kan., through Chanute to Cherryvale, has been completed as far as Welda.

Eugene Tilleux, Hutchinson, Kan., is promoting the construction of a railroad from Wakita, on the Nashville, joining two branch lines of the Atchison, Topeka & Santa Fe Ry. The cost of the work is estimated at $150,000.

The rights of the proposed Topeka & Southwestern R. R. have been taken over by the Winnipeg, Salina & Gulf R. R., and headquarters will be opened by H. Leon Miller, president of the latter company at 627 Kansas Ave., Topeka. A direct line from Council Grove and Topeka with entrance rights to Kansas City have in that way been arranged.

Louisiana Notes.

FROM CORRESPONDENTS AND OTHER SOURCES.

Property owners from the Mounds and Delta Districts met recently at Tallulah, La., and completed the preliminary details in the organization of Mounds District No. 1, which covers about 60,000 to 80,000 acres lying between the canal bayou district and the Mississippi River.

Officials of the Louisville & Nashville R. R. have been in conference with the engineers of the various railroads entering New Orleans with a view to reaching an amicable arrangement for the rearrangement of tracks on the river front between Canal and Poydras Sts. The Southern Pacific has recently bought an entire square of ground on which it is proposed to erect a big warehouse and the Louis-

ville & Nashville tracks are the nearest to the property.

The Lake Arthur Reclamation Co. has filed its charter at Lake Charles. The company is capitalized at $50,000. The officials are as follows: Edward S. Streator, president; Val A. Miller, vice-president; Winfield S. Streator, secretary, and John B. Ferguson, treasurer. The company will do a general reclamation and land business.

The town of Cottonport has voted a tax to assure the construction of the Gulf Belt Northwestern Ry. line through that place.

Citizens of Newton have subscribed about $25,000 for stock of the Newton Northwestern R. R. Co., which proposes to construct a railroad from Newton, Miss., through Carthage, Conehotta, Walnut Grove and other points in Leake county, Mississippi. The company has already been chartered. H. J. Majure, Newton, Miss., is interested.

The Yazoo & Mississippi Valley R. R., W. S. King, general superintendent, Memphis, Tenn., is to begin at an early date bettering the roadbed of the Baton Rouge & Hammond line. The bridges will be filled in and other work done.

Bids were opened May 25 at the office of the State Board of Engineers in New Orleans, for approximately 350,000 cu. yds. of levee work in East Carrollton Parish, contracts being let as follows: Elton Levee, 100,000 cu. yds, awarded to Hercules Co., Ltd., New Orleans, at 23 cts. per cu. yd. Levee from Wyly to Hollybrook, 100,000 cu. yds., awarded to Hercules Co., Ltd., at 22.3 cts. per cu. yd. Wilson Point Levee, 100,000 cu. yds., awarded to Helgason Bros., at 17.9 cts. per cu. yd. Those bidding on the several pieces of work were M. L. Linnan, Hercules Co., Ltd., Helgason Bros., Donovan & Daley, R. T. Clerk & Co., W. C. Mullen, J. M. Sullivan, H. F. Garbish, O. A. Gibson, J. G. Sessions, N. C. Williamson and T. S. Shields.

Michigan Notes.

FROM CORRESPONDENTS AND OTHER SOURCES.

Business men of New Lothrop village and farmers in the vicinity of that place have raised $12,000 of the required $15,000 for the continuation of the spur railroad line from New Haven to New Lothrop, 9 miles. The spur is on the Ann Arbor R. R., 6 of the 15 miles having been completed last year. G. K. Lowell, Detroit, Mich., is general manager of the Ann Arbor R. R.

Tench & Co., contractors, who are constructing the Lansing & Flint electric line, have moved their entire outfit from Morrice to Haslett and work has been started on the last section of the grading.

The Michigan Central, according to reports, will issue bonds amounting to $1,500,000 to provide funds for the construction of double track on the Grand River Valley R. R., between Jackson, Mich., and Grand Rapids, a distance of 84 miles. R. D. Starbuck, Detroit, Mich., is assistant chief engineer of the Michigan Central.

City council of Detroit, Mich., has passed an ordinance granting the Detroit United Ry. Co. permission to construct an extension of the Third Ave. line to the city limits on Hamilton Blvd.

Active steps are being taken toward the construction of the proposed line of the Flint, Fenton & Ann Arbor R. R. As projected the route will be through Brighton and Hartland, Mich.

Surveys have been completed by the engineers of the Grand Trunk Ry. for the construction of the proposed line from Saginaw, Mich., to Ashley on the Ann Arbor, a distance of 28 miles. T. T. Irving, Detroit, Mich., is resident engineer of the company.

Representative of the Wabash Ry. is reported to be securing right of way for the construction of a double track from Detroit to Adrian, Mich.

The city of East Lansing held an election May 31 to vote on the question of the confirmation of the granting of a franchise by the common council of the city of East Lansing to the Detroit, Lansing & Grand Rapids Ry. This is one of the last franchises that the railway will have to secure for its projected electric line.

Minnesota Notes.

FROM CORRESPONDENTS AND OTHER SOURCES.

The Chicago, Milwaukee & St. Paul Ry. is said to have surveys under way for a cut-off line in Minnesota which would cut down the running time on its Pacific Coast line. The surveyors have started at Hutchinson, present terminus of a 14-mile branch from the H. & D. line at Glencoe, 51 miles west of Minneapolis. Their destination is said to be Appleton, 144 miles west of Minneapolis by the present line.

According to advices from Hutchinson, Minn., engineers are busily engaged in running lines for an electric railway from Minneapolis, through Watertown, Winsted and Northern McLeod counties.

The Mackenzie & Mann syndicate has called for bids for the construction of the Duluth, Winnipeg & Pacific Ry. from Virginia, Minn., to Duluth, Minn., about 75 miles. The construction of this line will give the Canadian Northern R. R. close connection with the Chicago & Northwestern Ry. at Chicago. It is understood the necessary arrangements have been made between the companies. It will also give the C. N. R. a through line from Duluth to Winnipeg and the west. As stated in our last issue, $4,700,000 has been secured by Mackenzie & Mann for the financing of this piece of construction. H. T. Hazen, 619 Lyceum Bldg., Duluth, Minn., is chief engineer.

Duluth and the Ranges.

BY PETER E. MEAGHER.

Melvin Pattison and Frank Beale of the Brown Hoisting Machinery Co., Cleveland, O., were callers at this office a few days ago. They have already started on their contract of erecting the new coal dock for the Pittsburg Coal Company at Duluth, Minn. They have a great many men already engaged on this work and will rush this dock to completion as fast as possible.

Andrew Perian of Carl Hall & Co., contractors, was a caller the other day. He reported that his firm had just secured another small contract from the Duluth & Iron Range Ry. Co., and they will start on the same immediately.

Arthur Mitchell, general superintendent for this territory for the MacArthur Bros. Co., returned from a trip to Chicago this week. He said that they had two large contracts on the Mesabe Range, and that they were working night and day crews on the same.

C. F. Haire, chief engineer of the Duluth & Northern Minnesota Ry. Co., was a caller last week. At the present time they have ten or twelve miles of work under construction.

Will Phillips, representing Taylor Iron & Steel Co., manufacturers of Tisco dipper teeth, came in to see us recently, and judging from the amount of orders that he had for teeth would say that business is very fine with him.

C. J. A. Morris of Morris & Shepard was a caller last week. He was up here looking over his three large dock contracts at this point, and left from here for his railroad work in North Dakota, and incidentally while here he purchased a 35-ton new Vulcan traction steam shovel from the writer. This shovel is to be used on his railroad work in Dakota.

J. D. O'Connell, Duluth contractor, was awarded a street contract for paving by the city of Two Harbors, which amounts to about $68,000. He will start on this work immediately.

C. E. Jameison, railroad contractor, was a visitor, and reported that he was just finishing up his contract on the Soo Line that he had taken from Foley, Welch & Stewart, St. Paul, Minn.

John Bergman, railroad contractor, who has some work on the Duluth & Northern Minnesota Ry. near Duluth, was a caller a few days ago and purchased 18 dump cars from the writer, to be used on his present contract.

A. Guthrie, the railroad contractor from St. Paul, was a visitor in Duluth a few days ago. He was up here, we understand, on business connected with his mining interests.

Dale & Bumgardner, railroad contractors, St. Paul, Minn., were awarded a very nice steam shovel contract by the Northern Pacific Ry. Co. at Staples, Minn., and have already started on the same.

Winston-Dear Co. of Hibbing, Minn., are making good progress on their 6,000,000 yd. contract that they have for stripping the Buffalo & Susquehanna Mine at Hibbing. Have already completed their big trestle and are using temporarily a large narrow gage plant until their new standard-gage plant is in operation. They will continue to run a day and night shift for a long time to come.

Pastoret-Lawrence Co., general contractors, Duluth, Minn., were callers at this office recently and purchased some equipment for their large sewer work at Rice Lake, Wis. They have already started on this contract.

H. L. Bartlett of the H. L. Bartlett Co., general contractors, was a caller and said that they were very busy at the present time.

O. A. Lewellan, general agent for the northwest for the J. I. Case Co., spent a couple of days with us here recently, looking up prospects for business in his line.

W. F. King, contractor, was a caller this week and said that he was very busy at the present time and that he was awarded another concrete contract by the Duluth & Northern Minnesota Ry. Co.

Any sub-contractors who are looking for work, or any contractors that have teams that they would like to put to work, by addressing this office will find something of interest to them. We have quite a bit of work to sub-let and will be glad to hear from any one interested.

The labor situation in Duluth at the present time is excellent. There is quite a demand for laborers, but there seems to be about enough to fill all orders. The wages have not gone up any, and I do not think they will for some little time.

Contractors and others when in this section are cordially invited to make the office of Peter E. Meagher, 409 West Michigan St., Duluth, Minn., their headquarters while here. If there is anything worth knowing, we know it and will always be glad to give all the information we can regarding this section of the country.

Missouri Notes.

FROM CORRESPONDENTS AND OTHER SOURCES.

The St. Louis & Iron Mountain Ry. is reported to be considering moving its division headquarters from Cotter, Ark., to Crane, Mo.

The town of Philadelphia, Mo., about 12 miles northwest of Palmyra, has completed the raising of $6,000 as a bonus for the construction of the proposed Palmyra & LaPlata interurban line through the town.

The Deering Southwestern Ry., F. B. Montgomery, president, Harvester Bldg., Chicago, Ill., is to be extended into Caruthersville. The city agrees to give right of way and 20 acres for terminal purposes. The road at present is 9 miles long.

The Cotton Belt R. R. Co. is stated to have purchased three blocks of railroad property for freight depots and terminals in North St. Louis. The property is between Main and Lewis, Florida and Dickson Sts., and has a frontage of 1,000 ft. The amount paid is reported to be $1,250,000 and it is said that $2,000,000 will be spent on the improvements.

St. Louis Items.

BY A. B. KOENIG.

McCann Bros. of Murphysboro, Ill., secured the contract to building the Oil Belt Traction Co. line 12 miles between Bridgeport and Oblong, Ill. They have some nice paved way both ways on this line to let.

Costello Bros. are getting along nicely with all of their Big Four R. R. work in Indiana.

The Interstate Contracting Co. of Chicago secured a nice steam shovel contract from the Sligo Iron Co., near Sligo, Mo. It is also doing some work in Minnesota. H. Hender-

son, general manager of this company, spent a couple of days in town with us last week.

James Ward has his outfit at work at Madisonville, Ky., on the L. & N. R. R.

A. B. Koenig returned to St. Louis after a ten day trip through the west, looking over the various labor markets. Koenig visited every important city in the west during this time.

Burke Bros. are still busy with their street paving contracts in Fort Smith, Ark.

The L. J. Smith Construction Co. had to lay up one of its steam shovels, which was getting out gravel at Fort Gibson, Okla., for its ballasting contracting on the Missouri Pacific R. R., on account of the high water of the Grand River. The company expects to resume work as soon as the water in the river recedes enough to permit the shovel to get out the gravel.

The Gould system contemplates a cut-off between the main line from Riverton, Utah, and the Bingham-Garfield branch at Wellby and the Western Pacific line.

At a meeting held in Caruthersville, Mo., on May 25 between the president of the Deering & Southwestern R. R. Co. and the Commercial Club resulted in an agreement to extend the road to Caruthersville. This will greatly reduce freight rates, giving western connection with the Cotton Belt. The city agreed to secure the right of way and donate 20 acres for terminal purposes.

Within six months the Chicago, Burlington & Quincy R. R. Co. will begin work on a double track structure across the river at a point within a few hundred feet of the bridge now owned by the Chicago, Burlington & Quincy—the old Hannibal. C. R. Fickes of Chicago, engineer for the railroad company, who has been in charge of a force of men for the last two months has been taking soundings in the Missouri in the vicinity of the old bridge and making preliminary plans for the new. It is probable that the old structure will be abandoned as soon as the new bridge is ready for use. The Hannibal bridge has been in use since 1869 and no longer is considered safe for heavy railway traffic. It is now used by the Chicago, Burlington & Quincy, the Chicago, Rock Island & Pacific, the Great Western and the Wabash railways.

Davis & Blair of Joplin, who were recently awarded the contract for grading the new railroad to be built from Phillipsburg on the Frisco, 194 miles southwest of St. Louis, to Buffalo, Dallas county, have begun work with a large force of men and teams, and the task will be pushed to early completion. The new road, which will open up one of the richest sections in the state, is known as the Laclede, Dallas & Western, and is being pushed by Kansas City capital.

The state board of railroad incorporators of Arkansas on May 26 granted the Pine Bluff & Northern R. R. Co. a charter to build a road from Pine Bluff to Searcy, 80 miles. The capital stock of the company is $1,600,000. The road will connect at Searcy with the Missouri & North Arkansas at Gaynor with the Iron Mountain at McCreanor with the Rock Island and at Tucker with the Cotton Belt. The incorporators are W. J. Miller, Lamar, Mo., president; Wm. M. Kavanaugh, Little Rock, vice president; C. P. Hornwell, Little Rock, secretary and attorney; D. V. Nixon, Tucker; J. M. Gates, Lonoke; E. A. Robbins, Searcy; S. S. Jett, Carlisle; T. M. Fletcher and S. M. Savage, Lonoke; F. C. Kylo, McCreanor; C. C. Kavanaugh, Little Rock. W. J. Miller is the largest stockholder.

Senator Warner introduced a bill in the U. S. Senate on May 26 to authorize the St. Louis & Kansas City Electric Railway Co. to build a bridge across the Missouri River at or near Arrow rock. It must be located so as not to interefere with navigation.

An additional appropriation of $25,000 was asked last week by the board of public improvements for the first section of the Baden public sewer. The estimate was $256,000, but the lowest bid received was $280,157.15, from the Hoffmann-Hogan Construction Co. All other bids were rejected and the lowest bid will be held pending the appropriation; new bids will be asked. The highest bid was $355,000, just $99,000 above the estimates. The sewer is to be 18½ by 38 ft., or 475 ft., 17 by 23 for another half mile and 13 by 18 for 1,634.41 ft. The big end of the sewer is to be as wide as the roadway in the average residence street.

Montana Notes.

FROM CORRESPONDENTS AND OTHER SOURCES.

Advices from Missoula state that John R. Toole, president of the Blackfoot Ry., is about to award a contract for the extension of the Blackfoot line from the landing, 25 miles north, to a junction with the Blackfoot River, northeast of Clearwater postoffice. It is reported in some quarters that this contract has already been let to T. J. White of Hamilton, Mont.

Right-of-way agent of the Northern Pacific is closing up the deeds to the land which has been recently purchased for the double track between Bozeman and Logan, a distance of 25 miles. Engineers are also busy completing the final surveys and construction work, it is said, will be started as early as possible.

Advices from Libby, Mont., state that work is well underway on the extension of the railroad of the Dawson Lumber Co. Upon the completion of the new work, about 14 miles of road will be in operation.

According to a statement of John F. Stevens of Portland, Ore., president of the Oregon Trunk Line, the Pacific & Eastern, now controlled by Hill interests, will not be built immediately beyond Butte Falls. It may go to the coast in the future.

Surveys are being made by George R. Metlen, C. E., Dillon, Mont., for the irrigation reservoir to be constructed across the upper end of the lower Ruby canyon, about five miles above Alder, for the Homestead Land & Irrigation Co., which was incorporated recently for the purpose of reclaiming, under the provisions of the Carey act, a large acreage on the bench between the Beaverhead and Ruby rivers. The incorporators are Lee Mantle, A. J. Davis, Eugene Carroll and R. A. Carnochan of Butte and W. A. Clark of Virginia City. The dam, which will be constructed across the Ruby river about 12 miles southwest from Virginia City, will be 150 ft. in height and will back up the water of the river a distance of about three miles.

The Northern Pacific Ry., W. L. Darling, chief engineer, St. Paul, Minn., is reported to have received bids for the grading work for the extension of the Western Dakota R. R. from Mott, N. D., to Terry, Mont. It is stated that this work will be commenced some time this summer. The new extension will be about 225 miles long, which, together with the Mott branch of the Western Dakota R. R., will make about 350 miles of new track for the N. P. The total cost of building the lines north to Stanton, south to Fort Yates and from Cannon Ball west to Mott is estimated at about $12,500,000. It is said that the extension from Mott to Terry will cost as much or more, as part of the right of way runs through the Bad Lands.

Donald McIntosh, Milwaukee, Wis., contractor for the Chicago, Milwaukee & St. Paul branch line, has established his first grading camp on the line of the Milwaukee on the Woodman ranch, three miles from Lewistown, to grade towards Great Falls. Other camps are being established in extending the line from the Musselshell country to near Great Falls.

The Chicago, Burlington & Quincy R. R. is reported to be about to let contracts involving the expenditure of approximately $1,000,000 for building a new line from Scribner to Fromberg and tearing up the present line between Scribner and Toluca.

New York Notes.

FROM CORRESPONDENTS AND OTHER SOURCES.

The New York Central & Hudson River R. R. is reported to be about to award a contract for the double-tracking of all that portion of the Falls road between Lockport and Albion which is not double-tracked. It is planned if possible to have all this work completed by fall. There is about 21 miles of the road not double-tracked in the stretch mentioned.

The Rochester & Southern Construction Co., which proposes the construction of an electric railway between Rochester, Corning and Elmira, is reported to have secured the necessary capital for carrying out the project. George E. Engert, Rochester, is interested.

John F. Turk, promoter of the proposed electric railroad from Hornell to Bath, passing through Howard, has announced at the latter place that if $75,000 can be raised locally by the sale of stock, the success of the road will be assured, as New York parties will undertake the financing of the road from that point.

The city of Dunkirk has voted to issue $100,000 of bonds for the erection of a public dock.

The Hudson Valley Ry. Co. of Glens Falls has petitioned the village of Saratoga Springs for a franchise to lay a trolley track through East Ave. in the village. The petition is made for the purpose of uniting the Glens Falls line with the Troy-Saratoga road, and thus to form a direct trolley route from Troy to Warrensburg without change of cars.

Surveys have been completed and most of the preliminaries adjusted for the construction of the steam railroad which the New York, Westchester & Northern R. R. Co., backed by the New York, New Haven & Hartford R. R. Co., is to build, connecting New York and Danbury. Contractors have been over the route and according to a statement of President Leverett S. Miller of New York City, construction operations will begin in a few weeks, after the New York Public Service Commission has given its formal approval of the plans for the part of the road lying within the state of New York.

The New York Dock Co. Ry. has been incorporated with a capital stock of $500,000, and proposes the construction of the road in three sections, as follows: First from Fulton St., along the East River to Wall St. Ferry; the second, from Columbia St., down to Buttermilk Channel; the third, from Summit to Walcott St., around the Atlantic Basin. The directors are as follows: G. E. Spencer, Charles E. Hotchkiss, Henry M. Haviland, Walter Haviland, Arthur N. Taylor, Charles A. Lewis and Charles Jackson of Brooklyn, N. Y., and M. W. Lord and J. B. Summerfield of New York city.

Bids were opened May 24 at Albany by the State Superintendent of Public Works for two barge canal contracts. H. S. Kerbaugh, Inc., of Philadelphia, was lowest, at $1,990,043, for contract No. 63, for work between the Wayne-Monroe county line and Kings bend, west of Pittsfield, and E. M. Graves of Cleveland, O., was the lowest, at $767,467, for contract No. 73, for dredging the Hudson River from Stillwater to Northumberland. The engineer's estimate for this latter work was $778,960.

The New York Central & Hudson River R. R. has filed plans with the Bureau of Buildings of Buffalo for an addition to the car shops of the company at East Buffalo. The new building will increase the capacity of the plant 150 per cent. The new structure will be located on William St. near the Erie tracks and will cost about $90,000. Other equipment will cost about $50,000 more.

Ohio Notes.

FROM CORRESPONDENTS AND OTHER SOURCES.

City council of Fremont has granted a 25-year franchise to the Fremont Street Ry. Co., which will turn over its franchise and local property to the new Fremont-Fostoria line, which is to be built this summer. R. W. Lysle of Chicago, former city engineer of Fostoria, has the contract to furnish the material and construct the road and has his material orders placed with assurances of prompt delivery.

The A. & A. Short Line Ry. Co. of Alliance has been incorporated with a capital stock of $10,000. W. P. Keith is an incorporator.

The Fath Construction Co. of Cleveland has been incorporated with a capital stock of $30,-

000, the incorporators being Charles Fath, Commodore P. Ruple, E. C. Cooke, H. A. Hauxthurs and A. B. McGraw.

The Lake Shore & Michigan Southern R. R. has purchased the property now occupied by the Wilson hotel at the Himrod Ave. Youngstown crossing, with a view to moving the buildings so that the curve in its tracks at this point may be eliminated.

It is stated that the report of the various railroads interested in the proposed elimination of grade crossings in Youngstown and the erection of a union station will be ready about July 1. The plans outlined include the formation of a terminal company to secure right of way and make improvements which will be necessary before the dangerous grade crossings will be abandoned. It is said the improvements, as outlined, call for an expenditure of over $5,000,000 for new tracks and the union passenger station.

According to reports the Marietta, Columbus & Cleveland R. R. Co. has had surveys made for the construction of an extension of the line from Palos Junction, the present terminus of the road, to Athens, where connections will be made with the Hocking Valley. It is said that all financial arrangements have been completed for the work and that actual construction will be started shortly. The headquarters of the company are at Marietta, Ohio.

The Cincinnati, Hamilton & Dayton R. R. is to shortly award a contract for the construction of new shops and a roundhouse in Toledo to cost $100,000.

Plans are reported under consideration for extending the Cincinnati, Georgetown & Portsmouth R. R., E. W. White, general manager, Cincinnati, O., from Portsmouth to West Union.

Oklahoma Notes.

FROM CORRESPONDENTS AND OTHER SOURCES.

The Osage Western Ry. Co. has submitted a proposition to the citizens of Ponca for the construction of the road into and through Ponca city to Tonkawa. It was the original intention of the company to build the road on the most direct line from Pawhuska to Enid, going 12 miles south of Ponca city.

Advices from Erick, Okla., state that promoters of the proposed Erick-Englewood R. R. are about to let contracts for the construction of the line. Commercial Club of Erick is interested.

At the last annual meeting of the Choctaw, Newcastle & Western Ry. Co., held at McAlester, Okla., the following directors elected: G. W. Stone, Oklahoma City, president; W. L. H. Clayton, Jr., McAlester, vice-president; Henry Leboquest, secretary-treasurer; A. H. Price and W. E. Wilson, Oklahoma City, Okla. It was also announced that 11 miles of line will be built at once to connect between Alderson and the Rock Island & Savanna, on the Missouri, Kansas & Texas.

Oregon Notes.

FROM CORRESPONDENTS AND OTHER SOURCES.

Preliminary steps have been taken to organize an irrigation district in the vicinity of Grants Pass. It is proposed to build a storage reservoir at the head of the Applegate River to irrigate the valley in the vicinity of Grants Pass by a gravity system. F. J. Blakeley, Roseburg, Ore., is interested.

The Puget Sound Bridge & Dredging Co., Seattle, Wash., has been awarded the contract for construction of a masonry dam across the Clackamas River, 30 miles south of Portland to cost $325,000. The work will require a year and the power to be developed will be used by the Portland Railway, Light & Power Co. The dam, which will be of Ambursen type, will be 885 ft. long, 100 ft. high, 140 ft. thick at the base and 12 ft. wide at the top. Hydro-electric power to the extent of 25,000 hp. will be developed.

The Carlton & Coast R. R. Co. which is controlled by the Carlton Consolidated Lumber Co., W. B. Dennis, general manager, Carlton, Ore., is stated to have asked bids for building the first section of its line. This road will be a connection between Carlton on the Southern Pacific & Fairdale, in the heart of a thickly-timbered county. The line is to be completed within 90 days after the award of the contracts. Rails have already been received.

George Alexander, consulting engineer, Boston, Mass., has completed preliminary surveys for the construction of the proposed line of the Central Railway of Oregon, from Union, Ore., over Blue Mountains to Walla Walla, Wash. The matter of proceeding with the work will now be taken up by the stockholders.

Advices from Fairview, Ore., state that a considerable force has been put to work on the construction of the right of way for the Troutdale cutoff of the Oregon Railroad & Navigation Co. All right of way has been secured to the junction and work will progress steadily.

It is understood that construction work will be started shortly on the proposed line from Salem, Ore., to Silverton. According to the present plans of the company the line will extend through Silverton up into Clackamas county, and by way of Oregon City to Portland, Ore. A. Welch, Portland, Ore., is president of the company.

It is believed that Stephen Carver, Corvallis, Ore., is backing a project to construct a railroad from Eugene, Ore., 20 miles, to connect with an extension of his Corvallis & Alsea River R. R. City council of Eugene is now considering the granting of a franchise over certain streets for the new railroad. The ultimate object of the project is believed to be a line to tidewater on the Siuslaw River.

The section of the Woodburn-Springfield Branch of the Southern Pacific between Crabtree and Lebanon, Ore., put out of commission some time ago by a change in the course of the Santiam River, is nearly rebuilt, and it is expected that operation of it will be started about the middle of June.

Committee recently appointed by the Jacksonville, Ore., Commercial Club has succeeded in obtaining all right of way for a proposed railroad to Blue Ledge Mining district and will tender deeds for same to John R. Allen, president of the Pacific & Eastern, trusting to interest him in the project.

The Oregon Trunk Ry. Co., John F. Stevens, president, Portland, Ore., has filed supplemental articles of incorporation declaring its intention to build up the valley of the Deschutes River and its tributaries, and in a general southerly direction to a point at or near Klamath Falls, in the state of Oregon, and also from a point on the main line of the railway of the said corporation in township 35 south, range 7 east, of the Willamette meridian, in Klamath County, Oregon, to a point in the city of Medford, Jackson County, Oregon, a distance of about 70 miles, with such branches and extensions as the corporation may hereafter decide upon.

Pennsylvania Notes.

FROM CORRESPONDENTS AND OTHER SOURCES.

The Philadelphia & Suburban R. R., a new company, which proposes the construction of a line at Philadelphia and vicinity, will shortly have an ordinance before the city council to permit it to construct a subway on Broad St.

The city council of Doylestown has passed an ordinance giving a right of way on Union St. to the Philadelphia & Easton and Rapid Transit Railway Co. to lay tracks on that street and build a union depot.

John H. Dobbing, York, Pa., has been awarded the contract to grade for the extension of the Hanover & McSherrystown Street Ry. Co.'s line from McSherrystown to Conewago chapel. The work has been started. From Conewago chapel the proposed new road will branch, one line going to Gettysburg the other to New Oxford.

The Carter Construction Co. of Chicago, Ill., which has the general contract for constructing the Western Maryland R. R. extension from Cumberland, Md., to Connellsville, Pa., has awarded the sub-contracts for concrete work in the vicinity of Meyersdale and Confluence. The Somerset Construction Co. of Somerset got the contract for work about Meyersdale, where there will be 6,000 cu. yds. of concrete work on the big viaduct that is to cross the Baltimore & Ohio tracks. In the vicinity of Confluence H. E. Nay of Roanoke, Va., was the successful bidder for about 5,000 cu. yds. of concrete work.

The Pittsburg & Shawmut R. R. Co., organized to construct the Pittsburg extension of the Pittsburg, Shawmut & Northern Ry. into the Pittsburg district, has elected the following directors: Harry Bronner, H. E. Huntington, Edwin Hawley, Frank Trumbull, Theodore P. Shonts and W. H. Taylor.

It is rumored that the Wabash R. R. is planning the construction of its lines through Butler county, Pa., to the extensive coal fields in Armstrong and Jefferson counties. Right of way men, it is said, are already closing contracts. As reported the Wabash will use the Baltimore & Ohio from Butler to Pittsburg, under a trackage agreement.

The Chambersburg, Greencastle & Waynesboro Street Ry. Co., Chambersburg, Pa., according to reports, is shortly to extend its line from Pen Mar Park to Blue Ridge Summit.

The Montgomery & Chester Electric Ry. Co. and the Phœnixville, Valley Forge & Stafford Ry. Co. are both trying to obtain a franchise for a right of way through the streets of Phœnixville. The latter company is to be the connecting link between the Philadelphia & Western and the Lehigh Valley Transit Co.

The West Shore Ry. Co. has been organized at Wilkesbarre and proposes the construction of a third rail railroad from that city to Pittston. Surveys have been made and a charter has been secured. The road will be about 8 miles long and will extend through Forty Fort, Wyoming, Exeter and West Pittston. The terminal of the road in West Pittston will be near the Valley station.

Texas Notes.

FROM CORRESPONDENTS AND OTHER SOURCES.

The Houston Electric Co., David Daly, general manager, Houston, is considering making certain street car line extensions in the east Third ward at Houston.

The East Texas Traction Co. is to decide on June 2 on the selection of the route of its proposed interurban line from Dallas to Terrell. Surveys for two routes have been made. Schuyler Marshall, Dallas, is interested.

Good progress has been made with the grading work for the Brownwood North & South R. R. from Brownwood. Practically half of the grading will be done by June 1, and by Aug. 1 the entire distance will be covered. The Texas Construction Co. has the general contract for the work.

The Houston Belt & Terminal Ry., F. T. La Pierre, resident engineer, Houston, is contemplating a number of improvements at Houston. There is contemplated a nine-mile belt railroad, to afford trackage for all roads desiring to enter Houston over the tracks; a $200,000 steel draw bridge over the ship channel about a mile above the turning basin, as well as many improvements in wharfage facilities.

Thompson & Scott, St. Louis, Mo., who have the general contract for the grading work for the extensions of the Stephensville North & South Ry. (Cotton Belt), from Hamilton to Gatesville, 32 miles, have sublet the first 18 miles of work out of Hamilton to W. P. McCoy, J. H. Kilbeck and G. J. Gammett.

The Bowers Southern Dredging Co. has its dredge No. 6 at work at Texas City, dredging a new channel and slip for the Texas City Transportation Co. The contract calls for the removal of about 400,000 cu. yds. of earth. The work will be completed July 1.

The Ball Construction Co., Dallas, at $107,000, and J. G. White Co., New York, at $85,000, were the only bidders for the completion of Lock and Dam No. 6 on the Trinity River for the U. S. government. The original bid, upon which the contract was let to the Hub-

bard Building & Realty Co. of Dallas on July 28, 1906, to begin work Oct. 10, 1906, and to finish Sept. 1, 1908, was for $144,113. The work was sublet to the Ball-Carden Co. of Dallas, and it is estimated by the engineer that about half of the work was done. All of the piling for the lock was driven, the land and the river walls of the lock were finished and the cofferdams constructed. It remains to have the floor of the lock laid and the dam built.

Topographic survey work along Little River in the vicinity of Cameron has been completed and the land owners are ready to begin the construction of levees as soon as decision is made as to the best type of levee. Arthur A. Stiles, Austin, is state levee and drainage commissioner.

The commissioners' court, at Angleton, has ordered an election for June 21 to vote on issuing $124,740 in bonds to complete the Pearland Drainage Project.

O. E. Gammill, who has just completed the Bryan college trolley line, has taken a subcontract for part of the work on the big levee being built along the Brazos River near Bryan and has moved his grading outfit to the bottom. His contract calls for the removal of 50,000 yds. of dirt.

The city council of Brownsville has granted a street railway franchise to B. G. Stegman and others for a railroad to be operated by electricity or gasoline motor power, construction to be commenced within four months, and three miles to be finished within one year. The whole line must be completed within two years.

Committees representing the Commercial Clubs of Palestine and Dallas have been appointed to arrange preliminaries for the construction of an air line railway between the two places. The proposed line will be about 100 miles long and will traverse a populous agricultural region. It will run several miles from any existing line. The two terminal cities and the towns along the route will raise bonuses in aid of the project, it is stated, and it is thought no difficulty will be experienced in bringing about the early construction of the line.

The Eastern Texas Traction Co. has completed preliminary surveys for four routes for the projected interurban line from Greenville to Wolfe City. These routes are as follows: Route A—Via Tidwell, Tyler's Gin, to Wolfe City. Route B—From Wolfe City via Tyler's Gin, White Rock and Tidwell to Greenville. Route C—From Greenville via Robert Gardner's; Green's Crossing and Aberfoyle to Wolfe City. Route D— From Greenville via Haney's Ridge, McWhirter residence, Spurlock Crossing, South Sulphur neighborhood and Aberfoyle to Wolfe City. A permanent line will be selected at once from the four routes surveyed.

The new river route survey for the Kansas City, Mexico & Orient Ry. has been completed. This survey was made following the initial selection of the divide route between El Dorado and Del Rio, missing Sonora, and over the protest of the latter town. After it was shown that the river route was shorter by more than 10 miles that the originally selected course, the survey was ordered and the estimate was found to be correct.

Grading work is under way for the new railroad between Anson and Hamlin. The two towns recently closed a contract with Col. Morgan Jones of Abilene for the construction of a new line of road from Abilene to Hamlin via Anson, and the work will be concentrated on the Anson-Hamlin end until same shall have been completed.

R. H. Baker, former president of the Trinity & Brazos R. R., has purchased the Texas Central R. R. He will organize a syndicate of Texas men to take over and operate the property as an independent enterprise. It will be extended from Waco to a connection with the Beaumont & Great Northern, which is to become a part of the Texas Central. The plans call for the building of the line to Beaumont on the southeast and to Rosewell, N. M., on the northwest.

Work is to be started at once by the Missouri Kansas & Texas R. R. on the laying of 15 miles of 85-lb. steel on the Fort Worth Division from Fort Worth to Eagan, Tex. After the completion of this stretch the remainder of the line from Eagan to Hillsboro will be laid with the heavy steel.

The construction work on the Gulf, Texas & Western has been completed into Seymour, Texas, and operation of that section will begin at once.

According to reports from the Southwest the Chicago, Rock Island & Pacific R. R. has under consideration the construction of a line west either from El Paso, Texas, or Albuquerque, N. Mex., to an outlet on the Pacific Coast.

Engineers of the American Central R. R. are now at work on the proposed line, and it is expected that construction work on the first block of the line between Miami, Texas and Vernon will be started soon. As projected this portion of the line will pass through Mobeetie and Wheeler, Texas, and Texola, Mangum and Olustee in Oklahoma. The company was originally incorporated to build from Canada to the Gulf through Western Dakotas, Nebraska, Kansas, Oklahoma and the Panhandle of Texas a direct feeder for the middle west to the Panama Canal.

Good progress is being made with the construction of the San Antonio, Rio Grande & Tampico Ry., and it is expected that 40 miles of the line extending from San Antonio to Jourdantown in Atascora county will be ready for operation by September.

I. H. Kempner and associates from Galveston have purchased the water works and irrigation rights at Alamogordo, N. Mex., for $180,000. It is claimed that with a further development of the water power that section of New Mexico can be made a very rich country.

Citizens of Goliad held a mass meeting May 24 to discuss further plans toward raising the railroad bonus required to get the Aransas Harbor railroad through the country.

The Nueces Valley R. R. Co. filed its charter at Austin on May 25. The company proposes construction of a railroad from Beeville, Tex., to Eagle Pass, 175 miles. Lee Frisby of Austin, R. M. Buck of Fort Worth, Ark.; W. A. Frisby of Beeville, and others, are the incorporators. It is stated that the road has been financed in Philadelphia, and that the construction contract will soon be let.

Promotors of the Dallas-Terrill interurban line are to meet on June 2 to definitely determine on the proposed route for the road.

Utah Notes.

FROM CORRESPONDENTS AND OTHER SOURCES.

The Beaver Land, Power & Irrigation Co. is to have work started shortly on an irrigation project near Milford. The project will include the building of two dams and the construction of about 100 miles of ditches, of which 30 miles will be main canals. Water enough will be impounded to irrigate 70,600 acres. The water to be used for irrigating purposes will be taken from the Beaver River. The work will be done under the direction of George L. Swendsen, Salt Lake City, engineer for Slick Bros. Co.

A progress of about 14 ft. per day is being made in the tunnel of the Strawberry Irrigation project of the U. S. Reclamation Service. The tunnel is now in over 1½ miles, about half way through the mountain. John Peters and Thomas J. Farrer, Provo, have been awarded the contract for hauling 2,000 tons of material from the railroad at Diamond switch, Spanish Fork canyon, to the mouth of the Strawberry Irrigation project tunnel, situated about 25 miles to the northeast and up toward the top of the mountains. L. J. Lytel, Provo, Utah, is Project Engineer.

The A. B. Corey Construction Co., Ogden, Utah, have a contract for the construction of sidings and double track extensions which is said to portend the ultimate double tracking of the Southern Pacific from Ogden to the Pacific Coast.

The Ogden Rapid Transit Co. is making good progress with the extension of its line from Utah Hot Springs to Brigham City. From Brigham City it is believed to be the intention of the company to carry its line up through Cache valley some time next year, using the old narrow gage line of the Utah & Northern Railroad Co. to reach the valley.

Virginia Notes.

FROM CORRESPONDENTS AND OTHER SOURCES.

A license to engage in a constructing and engineering busines in Virginia has been issued to the John Ferguson Co., a corporation organized and existing under the laws of the state of New Jersey. Preston Cooke of Richmond, is statutory agent. Maximum capital authorized by charter is $100,000.

Construction work is under way on a further extension of the Indian Creek & Pound River R. R., of which W. M. Currier, Glamorgan, Wise County, Va., is president, from a point near Pound Gap, on the Kentucky-Virginia border, running up the left fork of Pound River, contiguous to the Kentucky line, penetrating a rich timber field, yet almost untouched.

Washington Notes.

FROM CORRESPONDENTS AND OTHER SOURCES.

A project is under consideration for the construction of a new street car line for the north end of Seattle. The route for the proposed line has been chosen as far as Woodland Park. The line will go north on Fourth Ave. to Queen Anne Hill and through a tunnel to Evanston Ave., crossing the canal at Etruria St., and thence to the park. At the park two branches, one on each side of Green Lake, are planned. C. H. Shields of the Spokane Grain & Fuel Co., Spokane, is interested.

The main construction camp of the Grays Harbor Construction Co., which has the contract for the construction of the Milwaukee road in the neighborhood of Cosmopolis, has been established about five miles from the city.

The Bellingham Bay & British Columbia R. R., Mott Sawyer superintendent, Bellingham, is to expend $50,000 or more during the coming summer in reballasting its road-bed and in doing other repair work to put its line in better shape and cut down running time.

Advices from Sumas, Wash., state that the Great Northern Ry. Co., is rushing work on the main line east of Abbottsford with all possible speed.

Attorney of the Northern Pacific and City Council of Steilacoom, Wash., have come to an agreement providing for the franchise through the city. The company, according to the contract must construct a depot and all viaducts over street crossings.

The U. S. House of Representatives has passed a bill granting an extension of one year to the Alaska Short Line R. R. to begin building its 300 miles of road across southwest Alaska from Cook's Inlet to Anvik by this bill the company has until June 1, 1911, to begin work.

The Tacoma Railway & Power Co., L. H. Bean, manager, Tacoma, will shortly start work on the extension of its 6th Ave. line at Tacoma.

Preliminary surveys for the projected interurban line of the Bellingham-Skagit Ry. Co. have been about completed, and actual construction work will probably be started soon. The line is to extend from Bellingham to the Skagit County towns and is to be built by the Stone & Webster Engineering Corporation, of which R. T. Laffin, White Bldg., Seattle, Wash., is district engineer.

The city council of Olympia has directed the city engineer to prepare estimates of the cost of filling in the tideland area between Percival's dock and Springer's mill and extending in places from Third St. out to C St, the latter being three blocks beyond First St. Eventually the Olympia Factory Site Co., of which Dr. P. H. Carlyon is the head, and which controls the tidelands out to deep water, proposes to fill the lands out to deep water, a distance of almost a mile.

Wisconsin Notes.

FROM CORRESPONDENTS AND OTHER SOURCES.

The Chippewa Valley Ry., Light & Power Co., Eau Claire, is to extend its street car line at Menominee, a distance of 1⅓ miles,

to the John Henes Park. The work is to be completed by July 15.

The Council Railroad Committee of Milwaukee has been considering an ordinance granting franchises to the Milwaukee Electric Railway & Light Co., so it can operate three north and south lines, using the 6th, 16th and 27th St. viaducts.

Final surveys have been made for determining the route for an extension of the Fairchild & North Eastern Ry. N. C. Foster, Fairchild, Wis., is president and general manager.

Grading has been started on the proposed Badger Short Line Ry., and camp has been established at Emerald, Wis. The heaviest piece of work to be encountered will be between Emerald and Camp 9, a distance of 4 miles. John Rassbach and G. E. Scott, Prairie Farm, are directors of the company.

Advices from Manitowoc, Wis., are to the effect that the Chicago & Northwestern Ry., has made surveys for an extension of a branch from New Denmark on the Manitowoc Green Bay extension to Kewaunee and Algoma. Construction work, it is said, will be started this year.

The Commercial Club of Madison, Wis., has appointed a committee to investigate the proposition of an electric, gasoline and steam railway extending westward from that city. C. S. Smith is one of the Committee.

Canadian Notes.

FROM CORRESPONDENTS AND OTHER SOURCES.

The city of Regina, Sask., has voted to construct a municipally owned street railway.

A company is said to be about to ask the municipal authorities of Toronto, Ont., for a franchise to operate railways beneath the city streets and to provide terminal facilities for steam and electric railways. If the company obtains the privileges it desires, it will apply for a Federal charter and will erect a large office building and terminal station at a point yet to be selected, probably in the southern business section of the city. Into this it purposes to run double-deck tunnels, the floors of which will be about 40 ft. below the surface of the ground. Upon the bottom of the tunnels the trains of railway cars will be hauled upon four tracks, two local and two express, by electric locomotives, to passenger and freight stations. Above that upon a steel structure, similar to that employed for elevated railways, electric cars will run. The third-rail system will be used in the tunnels. The promoters of the enterprise are R. L. Cowan and L. C. Reynolds of Toronto; M. J. Stewart and R. W. Foster of Stewart, B. C., and A. P. Gillies of Tacoma, Wash., and New York city.

The Canadian Pacific R. R. is reported to have received bids for grading work for a portion of the Kootenay Central Ry. It is planned to let contracts for about 30 miles of work starting from the south end of the line. The Kootenay Central, following the valleys of the upper Columbia and Kootenay Rivers, will link the main line of the C. P. Ry. with the Crow's Nest branch, traversing valleys reputed to be rich in mineral and agricultural resources. At its southern end the railway will join the Crow's Nest Pass branch at a point some miles to the east of Cranbrook, near Galloway. From Galloway the road will run to Fort Steele, thence along the valley of the Kootenay to Canal flat, past Upper Columbia Lake and the Upper Columbia River to Golden.

The Canadian Pacific R. R., C. E. Cartwright, division engineer, Vancouver, B. C., is to extend its docking facilities at Victoria, B. C. It is proposed to widen the Belleville St. wharf, adding an additional 30 ft. to the entire length, and extending it westerly as far as the property extends.

The Hyland Navigation & Trading Co., operating a fleet of river steamers, has bought five acres on the Red River at the foot of Lusted St., in the north end of Winnipeg, as a site for extensive docks. It is preparing to build a big equipment of scows and tugs for the freight business from Lake Winnipeg, made possible by the opening of St. Andrew's locks. The company paid $120,000 for the dock site and expects to invest as much more in equipment for this year's business.

Work is to be started at once on the Portland Canal Short Line Ry., according to a statement of W. H Grant, Victoria, B. C., superintendent of construction for the Mackenzie & Mann interests. The contract for a 60-ft. wide, 160-ft. long dock at Stewart, B. C., for the railroad, has been let to James McDonald, Victoria.

The Minister of Public Works has notified the city council of Quebec, Que., that the government will at an early date consider the question of dredging the river St. Charles.

Morrison & Clark, Summerside, P. E. I., have been awarded the contract for the diversion of the Intercolonial Railway, near Chatham, N. B., with a view to eliminating the present heavy grade between Loggieville and Nelson, and giving better railway facilities at Chatham. The whole work involves an expenditure of about $500,000, and the construction of about 8½ miles of railway. It is understood that the contract awarded to Morrison & Clark amounts to about $200,000.

It is reported here in Montreal that Sir Wm. C. Van Horne, of the Canadian Pacific Ry., will shortly leave on a trip to Australia to advise the Commonwealth with regard to the construction of a railway across the continent with the object of settling the interior, which is practically without inhabitants.

An agreement has been reached whereby the Grand Trunk Pacific Ry. will build a line from Weyburn, Sask., to connect with the Hill system at a point near Scobel, southwest of Weyburn.

The promoters of the Hudson Bay & Pacific Ry. will probably hold a meeting for organization purposes some time this month. The company proposes to construct a line of railway from Prince Albert to Fort Churchill on Hudson Bay, and the promoters are said to be ready to at once subscribe for $2,000,000 of stock.

Efforts are being made by the residents in the vicinity of Beulah, Man., to induce the Canadian Northern R. R., to lay track on the embankment constructed some time ago between that city and Isabell.

The Lachine, Jacques Cartier & Maisonneuve Ry Co., a subsidiary company of the Grand Trunk, is planning the construction of a line from the harbor front at Maisonneuve, Que., round the mountain to Lachine. The line will be completed to St. Laurent during the coming summer, it is expected. C. M. Hays, Montreal, Que., is president of the new company. Terminals and station will be established on St. Catherine St., between Frontenac and Harbor Sts.

The Long Sault & Abitibi Ry. Co. has filed articles of incorporation with a capital stock of $2,000,000 and principal offices at Hull, Que. The company asks wide powers, including the operation of railway and steamship, telephone and telegraph lines, operation of mineral and timber industries, mills and factories, and the running of hotels and boarding houses. The company proposes to build a line from a point on James Bay, between the interprovincial boundaries and the East Maine River in Quebec, and connect with the C. P. R. at a point between the Long Sault at the foot of Lake Temiskaming, and the Des Moines River. The promoters of the railway are Messrs. Thos. G. O'Brigham, Edward Mulligan and David Mulligan, all of Ottawa.

Sabin & Stevens, according to advices from Victoria, B. C., have been awarded the contract for clearing the right of way for the construction of the Comox Extension & Northern Ry. The contract calls for the completion of the work within five months after it is started, and covers the line from Union Bay north to Black Creek.

Edward Box, representing a syndicate of English capitalists, has signed an agreement with the town of Owen Sound, whereby the syndicate will construct a million dollar ship building and repair plant and two dry docks at Owen Sound. The plant will be built on the C. P. R. water front and that company is taking a block of stock in the concern. The company proposes to build in Owen Sound two dry docks, a graving dock 650 ft. long and a floating dry dock capable of handling steamers up to 300 ft. in length, and in addition to put in a ship building and repairing plant. The yard plans will include building berths for three vessels, so that three boats may be under construction at the same time. Complete machine shops, boiler shops, etc., will be built, and a large modern plant for the handling of large ship building contracts erected.

The Canadian Northern Railway Co. has filed with the railway commissioners for approval detailed plans for the entrance into Ottawa of the company's new line from Toronto to Montreal. The plans provide for an approach to the city from the junction with the company's present line from Quebec, east of the Rideau River. This action of the company seems to indicate that the road will pass through Ottawa instead of following the St. Lawrence frontier, as has been suggested.

Mackenzie, Mann & Co., Toronto, Ont., owners of the Canadian Northern Ry., are calling for tenders for the building of the first 60 miles of their road in British Columbia. This construction will be from the coast eastward.

The Canadian government is to have surveys started immediately under the direction of L. R. Boligny, to ascertain the possibility of making a navigable route between Edmonton and Winnipeg by way of the North Saskatchewan River and Lake Winnipeg. Explorers have reported that a 6 or 8 ft. waterway can be established on this route at a comparatively low cost, with few lockages, as the river has a deep and broad channel for nearly the whole distance. A vote of $10,000 was made in parliament last session to defray the cost of the survey.

Mexican Notes.

FROM CORRESPONDENTS AND OTHER SOURCES.

Southern Pacific engineers have completed the surveys for the Southern Pacific extensions in the barrancas of the Sierra Madre, near the Jalisco-Tepic boundary, and during the next few months will be engaged in the location of the extensions between the barrancas and the Tepic capital. Two lines have been located through the barrancas, one with a maximum grade of five-tenths of 1 per cent and the other with a maximum of 1 per cent. The cost of the 20 miles of mountain road is estimated at from $8,000,000 to $10,000,000. The line will be a succession of tunnels and viaducts. C. R. Breck, Jr., San Francisco, Cal., is the locating engineer.

Engineer Azam, of Pachuca, has gone to Ixmiquilpan to make a complete survey for the installation of the 5,000 H. P. hydroelectric plant for which his firm holds the concession. The plant will be situated some twenty kilometers east of the town of Ixmiquilpan on the Tonantongo River and is intended to supply power and light to the district of Zimapan Ixmiquilpan and Actopan.

Residents of the Mill and Dickinson streets sections of Springfield, Mass., have petitioned the city for the granting of a franchise to the Springfield Street Railway Co. to build a car line through Mill and Dickinson Sts. to the east entrance of Forest park.

The committee on railroads of the State Legislature of Massachusetts has recommended that the legislature pass the Berkshire trolley act, which provides that the New York, New Haven & Hartford R. R. Co. may purchase the capital stock of the Berkshire Street Railway Co. of Pittsfield, Mass. It is said that the New Haven company is to spend $2,000,000 in improving the street railway systems in the western part of the state.

The Maryland Dredging Co. of Baltimore, Md., is making good progress with its contract for excavating the Cape Cod ship canal in Massachusetts, the monthly excavation amounting to 750,000 cu. yds. New machinery has just been put on the work, and now on the 8 miles of construction there are eight dredging machines at work. These are in three groups, one at each end and the others in the middle. The middle section is being

excavated by land dredges of the type which were first used on the Chicago drainage canal. The Cape Cod canal will connect Cape Cod and Buzzard's Bay, and will be 25 ft. deep at mean low water and 100 ft. wide at the bottom. It will be without locks, as the land in that section is low and level and engineers believe that the tidal flow of the water will not prove troublesome. On the Cape Cod bay end a breakwater 5,000 ft. long is to be constructed, and work on this is progressing satisfactory. The southern end of the canal comes out in Buzzard's Bay. Under the terms of the contract the canal is to be completed by the fall of 1912.

The Carolina, Chinchfield & Ohio R. R., M. J. Caples, chief engineer, Johnson City, Tenn., is preparing to erect coal chutes and terminals on the upper water front at Charleston, S. C.

The Northern Pacific R. R. is securing right of way in the vicinity of Ryder, N. Dak., for the purpose, it is said, of extending the Turtle Lake line to a point south of Ryder, across the Missouri and into McKenzie county.

Preliminary work has been started near Oscuro, N. Mex., by Capt. D. W. Roberts, for a large irrigation project, which is being promoted by Patten Bros., Denver, Colo. The project proposes the construction of a large concrete dam.

R. H. Phillips, manager of the Washington, Spa Springs & Gretta Railway Co., which is preparing to build an electric line from the District of Columbia line to Bladensburg, has submitted the plans of the company to the Maryland State Roads Commission and asked for its approval. The line is being built toward Kensington, Md., and Sandy Springs and will eventually be extended to Ellicott City. Among those who are interested in the new road are Allan Farquahar, Charles Brooke, Gist Blair, Harold Harding and Bernard M. Carter of Baltimore, Md.

W. W. Finley, president of the Southern Ry., has announced that the Southern Ry. will shortly take up the matter of constructing extensive freight terminals at Atlanta, Ga.

The Pennsylvania R. R. has applied to the city authorities of Newark, N. J., for an ordinance to enable the railroad "to improve its passenger service between Newark and New York." The plans provide for the changing of the elevated structure at the Market St. station, Newark, so that four tracks can be operated instead of two, as at present. They also call for the replacing of the present station with a new one, to cost about $500,000.

The Nebraska Transportation Co., Omaha, Neb., is stated to have secured all right of way for the projected interurban line from Omaha to Fremont, Neb., and is said to be only waiting for satisfactory franchise in the latter place before beginning work. The line will be 30 miles long and will pass through Elmwood Park, Bennington, and Elk City.

The U. S. House of Representatives has passed a bill ratifying an act of the Hawaiian Legislature authorizing W. A. Hall, of Honolulu, and his associates to construct and operate a railroad on the island of Hawaii.

The Elizabeth & Trenton Street R. R. Co. has been incorporated with an authorized capital stock of $1,200,000. The company is to take over and operate the trolley road of the Trenton & New Brunswick Co., which was sold on May 1 under mortgage foreclosure proceedings. The new company will also take over the road and franchise of the New Jersey Short Line R. R. Co., which is an extension of the main line. The incorporators are Claude L. Rihl and Irvin Shupp, Jr., of Philadelphia; Charles Sinnickson, Rosemont, Pa.; Chester A. Entrekin, Ardmore, Pa.; H. Hayes. Aitkens, John W. Kelly, W. A. Garwood, Llanerch, Pa.; John R. Turner, Basking Ridge, N. J., and H. O. Coughlan, Brooklyn. The first directors chosen were Messrs. Shupp, Rihl, Aitkens, Entrekin, Kelly, Turner and Garwood.

It is reported that bids will be asked soon for the construction of the proposed car shop and mill plant at Omaha by the Union Pacific Ry. The work is estimated to cost about $400,000.

As a result of an inspection of the Salt Lake Division of the Southern Pacific Ry., by J. Davis and E. C. Manson, Superintendents, it has been announced that construction work on the new extension from Navajo, Ariz., to Owynio is progressing successfully and contractors expect to have the line completed for operation by August 1.

Construction work is progressing rapidly on the new classification yards of the Western Maryland R. R. near Cumberland, Md., on the West Virginia Division of the road. The improvements, it is estimated, will cost about $250,000.

The Southern New Hampshire Traction Co. has work well under on the reconstruction of the Merrimac Division. The work includes the cutting down of the Saunders Hill, between Haverhill and Merrimac, Mass.

According to reports the Great Northern Ry. Co., has a plan under consideration to construct a line from Towner, N. Dak., to Esmond crossing the new Avr-Surrey line. The present Towner-Maxbass line would then be extended to Regina, Sask., thus making a continuous line into that district.

It is reported that Thrasher & Gunter, Railroad Contractors, Chattanooga, Tenn., have been awarded the contract for the construction of 9 miles of track for the Nashville, Chattanooga & St. Louis Ry., between Wauhatchie and Whiteside, Tenn. Surveys for the work have already been made and the track will parallel the present main line of the Nashville road, however, at Etna the tunnel and heavy hill near that station will be eliminated.

The Cumberland & Pennsylvania R. R., H. W. Rittenhouse, engineer maintenance of way, Cumberland, Md., according to reports is to be extended from Mechanicsville, Md., its present terminus south toward Point Lookout.

The Franklin & Lewisburg R. R. Co. of Williamson County, Tenn., has been incorporated with a capital stock of $10,000. The incroporators are J. J. Covington, E. E. Green, S. D. Beel, R. A. Bailey, Jr.; B. H. Paschall, J. E. Short, Jolen H. Truett, O. E. Fox, J. A. Pierce.

The Creighton Electric Light & Power Co. of Creighton, Neb., is contemplating the rebuilding of its water dam at the Lower Mills, and furnishing Creighton with day and night service.

Russell Gaines, county surveyor, Louisville, Ky., is making a topographical survey and map of the overflowing districts in the third and fourth magisterial districts, south of the city of Louisville. The county already has $40,000 in the treasury for the purpose of constructing the canal. The ditch will be about ten miles long and will drain and reclaim some of the best lands in Jefferson county.

The W. O. Burton Co., Richmond, Va., is making good progress with its contract for constructing the Washington, Spa Spring & Gretta R. R. Co.'s line of street railway from 15th and H Sts. northeast, Washington, D. C., out the Bladensburg road to the line of the District of Columbia. It is expected that the line will be in operation by July 1.

The city council of Mobile, Ala., has adopted an ordinance authorizing the New Orleans, Mobile & Chicago R. R., W. F. Owen, general manager, Mobile, to build, maintain and operate railroad tracks in the city of Mobile in and near Choctow Point. The ordinance included right-of-way through Royal street to Augusta, where the company is to construct a passenger station and other improvements aggregating a cost of $250,000. The company is also granted the right to erect a spur track from the main line to the municipal water plant.

BIDS ASKED

Bridges.

Bids are asked on following work, the notes being arranged alphabetically by states:

Fort Smith, Ark.—Until 2 p. m., June 13, by Roy M. Johnston, Secy., Fort Smith and Van Buren District, for the substructure; the substructure and erection of the superstructure and the superstructure delivered and erected of a bridge over the Arkansas River, between Fort Smith and Van Buren, Ark. The bridge consists of nine 196 ft. spans carrying double track electric railway and a single track railway on a paved roadway between trusses, two paved roadways, and two sidewalks on cantilevers outside trusses. Piers and abutments will be sunk by the pneumatic process. Steel, about 4,000 tons. Masonry, about 10,000 cu. yds.

Cedartown, Ga.—Until June 20, by Board of County Commissioners, for the construction of three concrete arch bridges. J. L. Moore is Chairman of the Board.

Springfield, Ill.—Until 3 p. m., June 8, by Board of Administration, for repairing and completing six pier footings at the Watertown State Hospital, Watertown, Ill. Official advertisement will be found elsewhere in this issue.

Brookville, Ind.—Until 1 p. m., June 6, by County Commissioners, for the construction of concrete arches and fills. Charles A. Miller is Auditor of Franklin County.

Greencastle, Ind.—Until 2 p. m., June 6, by County Commissioners, for the construction of four bridges and approaches. D. V. Moffett is Auditor of the county.

Hammond, Ind.—Until noon, June 7, by County Commissioners, for the construction of six iron bridges and one concrete arch. Charles A. Johnson is Auditor of Lake County.

New Castle, Ind.—Until 10 a. m., June 16, by County Commissioners, for the construction of arches, culverts and bridges. W. L. Risk is Auditor of Henry County.

Scottsburg, Ind.—Until 11 a. m., June 13, by County Commissioners, for the construction of a 50-ft. bridge over White Oak Creek. Frank Gardner is Auditor of Scott County.

St. Louis, Mo.—Until June 21 by Board of Public Improvements, Mazime Reber, President, for the removal of the old wooden bridge on Kingshighway and the construction of the foundations and concrete work of a concrete viaduct with all necessary approaches on Kingshighway from Manchester Ave. to McRee Ave.

Lincoln, Neb.—Until 2 p. m., June 2, by Board of County Commissioners, for furnishing labor and material for the construction and completion of all bridges ordered to be constructed during the year. It is estimated that about 40 wooden bridges will be constructed and 10 iron ones.

Albuquerque, N. Mex.—Until 10 a. m., June 6, by Board of County Commissioners, A. E. Walker, Clerk, for the construction of the approach to the new iron bridge across the Rio Grande near Alameda.

Cleveland, O.—Until 11 a. m., June 25, by Board of County Commissioners, for the construction of bridges as follows: Report No. 2638, concrete bridge, Harvard Rd., Warrensville Twp.; report No. 2639, concrete bridge, Lander Rd., Orange Twp.; report No. 2644, Concrete Culvert, Chagrin River Rd., Orange Twp.; report No. 2650, bridge extension, Harrington and Brook Park Rds., Rockport and Middleburg Twps. Frank R. Lander is County Surveyor.

Warren, O.—Until June 27 (readvertisement of bids asked May 23), by County Commissioners, for the construction of a bridge over Yankee Run on East Liberty St., in Hubbard. W. R. Carrington is Clerk of the Commissioners.

Buildings.

Bids are asked on following work, the notes being arranged alphabetically by states:

Fort Smith, Ark.—Until June 2, by County Commissioners of this district, for the erection of a jail building for the district. J. T. W. Jennings, Commissioner.

Bloomington, Ind.—Until 10 a. m., June 20, by Trustees of Penn Township, for the construction of a one-story brick addition to the school building. Isa Newlin is Trustee of the township.

Indianapolis, Ind.—Until 4 p. m., June 10, by Henry Dupont, Architect, 624 State Life Bldg., Indianapolis, Ind., for the erection of a new St. Paul Methodist Church which is estimated to cost $25,000.

Jeffersonville, Ind.—Until 3 p. m., July 1, by James Knox Taylor, Supervising Architect, Treasury Department, Washington, D. C., for the construction complete, including plumbing, gas piping, heating apparatus, electric conduits

and wiring and lift of the United States Post Office at Jeffersonville, Ind.

Princeton, Ind.—Until June 20, by Elmer E. Reeves, Secy. Board of Education, for installing a heating and ventilating plant.

Rockville, Ind.—Until 2 p. m., June 16, by Adams Township Trustee for the construction of a one-story frame school house. L. B. Humphries is Township Trustee.

Somerville, Ind.—Until 2 p. m., June 7, by Advisory Board of Barton and Gibson County for the construction of a two-room addition to school house.

New Orleans, La.—Until 7:30 p. m., June 14, by Board of Commissioners of Port of New Orleans, for the entire erection and completion of a stable and toolhouse on the river front at the head of Poydras St.

Stanton, Mich. Until 1 p. m., June 22, by Board of Supervisors, for necessary labor and material for the construction and completion of county court house and jail, including sheriff's residence at Stanton.

St. Louis, Mo.—Until 3 p. m., June 7, by James Knox Taylor, Supervising Architect, Treasury Department, Washington, D. C., for the installation of a conduit and electric wiring and gas piping system in the U. S. Post Office at St. Louis, Mo.

Columbus, Neb.—Until 3 p. m., July 11, by James Knox Taylor, Supervising Architect, Treasury Department, Washington, D. C., for the construction complete, including plumbing, gas piping, heating apparatus, electric conduits and wiring of the United States Post Office at Columbus, Neb.

Omaha, Neb.—Until 11 a. m., June 13, by Capt. F. C. Bolles, Quartermaster, for the installation of a steam heating plant in Commissary Store House at Omaha Depot.

Madison Barracks, Sacket Harbor, N. Y.—Until 2 p. m., June 13, by Constructing Quartermaster, for the construction of heating, wiring and furnishing electric fixtures, making necessary water and sewer connections of a new bakery and construction of necessary roads and walks in connection therewith.

Madison Barracks, Sacket Harbor, N. Y.—Until 2 p. m., June 11, by Constructing Quartermaster, for the construction of plumbing, electric wiring and fixtures, for new station stables to replace the old ones.

Fort Constitution, N. H.—Until 2 p. m., June 7, by Constructing Quartermaster, for the construction of an ordinance shop at Fort Stark, N. H.

Howe, Okla.—Until June 6, by Howard Wellborn, Clerk of the School District No. 67, Leflore County, for the erection of two story brick school building.

Fort Moultrie, S. C.—Heating Plant.—Until 11 a. m., June 10, by Constructing Quartermaster, for the installation of hot water heating apparatus in the commanding officer's quarters.

Plankinton, S. Dak.—Until 8 p. m., June 1, by Plankinton Opera House Co., Plankinton, S. Dak., for the construction of a brick opera house building 50x120 ft.

Port Lavaca, Tex.—Until 5 p. m., June 15, by J. D. Crain, Secy. School Board, for the construction of a brick, stone trimmed, school building at Port Lavaca, Tex. A. O. Watson, First National Bank Bldg., is Architect.

Martinsville, Va.—Until noon, June 13, by J. H. Matthews, Clerk Board of County Supervisors, for the construction of a brick and reinforced concrete jail at Martinsville, Va.

Roads and Streets.

Bids are asked on following work, the notes being arranged alphabetically by states:

Whipple Barracks, Ariz.—Until 3 p. m., June 4, by Lieut. G. G. Bartlett, Constructing Quartermaster, for furnishing necessary labor and material for the construction of roads, concrete curbing, gutters and walks at Whipple Barracks.

Washington, D. C.—Until 2 p. m., June 4, by District of Columbia Commissioners, for laying cement sidewalks in the District. John A. Johnston is one of the commissioners.

Albia, Ia.—Until 2 p. m., June 1, by City Clerk, for the construction of 4,060 yds. of brick pavement and 4,025 ft. of combined curb and gutter at this place. Hall & Adams, Centerville, Ia., are the Engineers.

Aurora, Ill.—Until 2 p. m., June 6, by Board of Local Improvements, for the construction of a roadway on North Avenue, between the Easterly line of Broadway and Jackson St.

Downers Grove, Ill.—Until 8 p. m., June 8, by Board of Local Improvements, for necessary labor and material for grading, draining, curbing and paving with brick, Grove St., from Main to Carpenter St. The work includes the following approximate quantities: 1,650 cu. yds. of earth excavation for roadways, curb and gutter; 150 cu. yds. of earth excavation for parkways; 2,075 lin. ft. of combined concrete curb and gutter; 2,950 sq. yds. of vitrified paving brick pavement; 6 sewer manhole covers adjusted to the grade of finished street; 4 stormwater inlets set to grade and line of curb.

Downers Grove, Ill.—Until 8 p. m., June 8, by Board of Local Improvements, for necessary labor and material for grading, draining, paving with brick, Gilbert Ave., from Forest Ave. to a point 1,225 ft. west. The work includes approximately: 2,400 cu. yds. of earth excavation for roadways and curb; 200 cu. yds. of earth excavation for parkways; 2,475 lin. ft. of combined concrete curb and gutter curb; 3,350 sq. yds. of vitrified paving brick pavement; 50 lin. ft. of 10-in. vitrified tile drain; 1 stormwater inlet set to grade and line of curb; 1 stormwater inlet adjusted to line and grade of curb; 5 sewer manhole covers adjusted to the grade of finished street.

Naperville, Ill.—Until 3 p. m., June 7, by Board of Local Improvements, for labor and material for cleaning and resurfacing with a bituminous cement binder 88,133 sq. yds. of roadbed.

Brazil, Ind.—Until 7:30 p. m., June 7, by City Clerk, for the construction of the cement sidewalks on National Ave. Jacob Prevett is City Clerk.

Decatur, Ind.—Until 10 a. m., June 6, by Board of County Commissioners, for the construction of four macadam roads in the county. H. S. Michand is Auditor of Adams County.

Greencastle, Ind.—Until 2 p. m., June 6, by Board of County Commissioners, for the construction of a macadam road in Millcreek Township. D. V. Moffett is Auditor of Putnam County.

Kentland, Ind.—Until 1 p. m., June 6, by Board of County Commissioners, for the construction of a macadam road in Jefferson Township. Elmer R. Bingham is Auditor of Newton County.

Logansport, Ind.—Until 1 p. m., June 9, by Commissioners of Cass and Carroll Counties, for the construction of a gravel road. George W. Cann and M. S. Haun are Auditors of the counties.

Shelbyville, Ind.—Until 7:30 p. m., June 7, by Common Council, for grading and graveling a number of streets and alleys and for the construction of cement sidewalks and curbs on several streets. L. E. Webb is City Clerk.

Washington, Ind.—Until 10 a. m., June 7, by County Commissioners, for the construction of a gravel road. Thomas Nugent is Auditor of Davies County.

Hutchinson, Kan.—Until June 3, by Board of County Commissioners, for the construction of 12 miles of road in Reno County.

Lawrence, Kan.—Until 5 p. m., June 6, by F. D. Brooks, City Clerk, for grading, paving and curbing Alabama St., from Henry to Pinckney Sts.

Augusta, Ky.—Until June 1, by J. T. McCracken, for the construction of 7,800 ft. of turnpike, known as the Ohio Valley Turnpike. The work includes grading and surfacing with metal.

Natchitoches, La.—Until 5 p. m., June 8, by A. L'Herisson, Mayor, for the laying of 34,953 lin. ft. of concrete sidewalk and curbing.

Baltimore, Md.—Until 11 a. m., June 1, by Board of Awards, for grading, guttering and paving with improved pavement, Bentalou St., from Baltimore St. to Fayette St.

Frostburg, Md.—Until June 4, by City Clerk, for grading and paving 1,325 ft. on Union St. William Harvey is City Engineer.

Freehold, N. J.—Until 11 a. m., June 15, by Board of Chosen Freeholders, for stoning roadbed and wings, paving gutters and curbing Main St. and South St. in Freehold. Each bid must be accompanied with a certified check for $1,000. George W. Patterson, Jr., is Clerk of the Board and G. K. Allen, Jr., is Engineer.

Brooklyn, N. Y.—Until 11 a. m., June 8, by Alfred E. Steers, Borough President, for the 13 street improvement contracts, the largest being as follows: For regulating, grading and curbing, and laying sidewalks on Hegeman Ave., from Hopkinson Ave. to New Jersey Ave., excluding the land occupied by and intervening between the tracks of railroad companies together with all work incidental thereto. The work includes: 9,780 lin. ft. of new curbstone set in concrete; 14,170 cu. yds. of earth excavation; 20,240 cu. yds. of earth filling (to be furnished); 530 cu. yds. of concrete (not to be bid for); 45,370 sq. ft. of cement sidewalk.

Watertown, N. Y.—Until 8 p. m., June 3, by Board of Public Works, for furnishing necessary labor and material for paving viaduct over the railroad tracks on Arsenal St. Work includes 1,200 sq. yds.; also for furnishing 55,000 ft. B. M. timber, and plank treated with creosote; for painting all the iron and steel work on the bridge. E. W. Sayles is City Engineer.

Wadesboro, N. C.—Until 3 p. m., June 3, by Mayor and Commissioners, for the improvement of streets. The work includes: 18,000 sq. yds. of 8-in. macadam, using tar or asphalt as a binder; 2,500 lin. ft. of combined concrete curb and gutter; 6,000 sq. yds. cement sidewalks; 4,000 cu. yds. excavation. White & Piatt, Durham, N. C., are the Engineers.

Concord, N. H.—Until 1 p. m., June 3, by H. C. Hill, State Highway Engineer, for the construction of 4,000 lin. ft. of native stone highway in Hinsdale, N. H.

Canton, O.—Until 10 a. m., June 20, by Commissioners of Stark County, for draining, grading and paving with brick, 3.06 miles of road in Canton and Osnaburg Townships. J. H. McConnell is County Auditor.

Cincinnati, O.—Until noon, June 3, by County Commissioners, for the resurfacing under Specification No. 50, Montgomery Pike, from Cypress Ave. to the north line of Kennedy in Columbia and Sycamore Townships. Fred Dreihs is Clerk.

Delaware, O.—Until 1 p. m., June 11, by W. F. Whittier, County Surveyor, for the construction of the C. C. Wright Road in Scioto and Thompson Townships and extends from the bridge at Bokes Creek to the Mink St. road, about 1 mile in length. The work includes grading, draining and graveling.

Delaware, O.—Until 3 p. m., June 11, by W. F. Whittier, County Surveyor, for the construction of Moss Road in Genoa Township, from Galena and Westerville Road west to the Africa and Westerville Road. The work includes grading, draining and macadamizing.

Maumee, O.—Until noon, June 13, by George V. Raab, Village Clerk, for furnishing necessary labor and material for paving with vitrified brick or block, asphalt block, sheet asphalt, bitulithic, Westrumite, carbovia or bituminous macadam and otherwise improving Wayne St. from Waite Ave. to Kingsbury St. The work includes approximately 13,633 sq. yds. of paving and filler; 7,520 lin. ft. of curb, both straight and circles; 12,226 cu. yds. of excavation, price for which is included in the paving; 372 lin. ft. 8-in. sewer pipe, laid; 220 lin. ft. of 10-in. sewer pipe, laid; 1,600 lin. ft. 12-in. sewer pipe, laid; 7 manholes, complete, with covers and steps; 5 catch basins, complete, with cover and iron trap; 15 inlets, set on necessary brick or concrete foundation; 360 lin. ft. of retaining curb (headers).

Emsworth, Pa.—Until 4 p. m., June 2, by M'Bride Sur. & Eng. Co., Ltd., 708 Fitzsimmons Bldg., 331 Fourth Ave., Pittsburg, Pa., for grading, subgrading and paving Center Ave., from the easterly line of Emsworth Borough to Hazlewood Ave. The work includes approximately 4,000 cu. yds. of grading, 9,800 cu. yds. grading and 775 ft. of rough curb.

Superior, Wis.—Until June 14, by County Board, for the construction of a road to the steel plant.

Winnipeg, Man.—Until 11 a. m., June 1, by Board of Control, Winnipeg, Man., for constructing granolithic walks on portions of 20 streets. M. Peterson is Secy. of the Board.

Sewers.

Bids are asked on following work, the notes being arranged alphabetically by states:

Knoxville, Ia.—Until June 6, by City Clerk, for the construction of 4,925 ft. of 8-in. pipe with 4-in. drain tile, 13 manholes, 2 combined manholes and flushtanks and 1 flushtank. Hall & Adams, Centerville, Ia., are Engineers.

New Hampton, Ia.—Until 7:30 p. m., June 1, by E. B. Strike, City Clerk, for the furnishing and laying in open sewer ditch, 3,000 ft. 4-in. cast iron water pipe and the furnishing and setting of three 4-in. gate valves, crane, three 4-in. by 6-in. Mathew's double hydrant with frost case.

Louisville, Ky.—Until noon, June 10, by Commissioners of Sewerage, for the construction of Section "C," Northeastern Sanitary Trunk Sewer, Contract No. 69. The work consists of the construction of 1,830 ft. of 24-in. plain concrete sewer, 540 ft. of 20-in. vitrified pipe, 909 ft. of 18-in. vitrified pipe, including 3,299 ft. of earth excavation, from 2.1 to 15.8 ft. deep, about 270 cu. yds. of concrete and 1,200 cu. yds. rock excavation. J. B. F. Breed is Chief Engineer.

Louisville, Ky.—Until noon, June 10, by Commissioners of Sewerage, Equitable Bldg., Louisville, Ky., for the construction of a sewer known as Section "D," Northeastern Sanitary Trunk Sewer, Contract No. 70, of the Comprehensive System of Sewerage, Louisville. The work includes building a sewer 15 in. to 22 in. in diameter, total length about 3,369 ft. and from 5.6 to 12.4 ft. deep, and including 20 cu. yds. of concrete, 3,369 ft. of vitrified pipe from 15 in. to 22 in. diameter, and 700 cu. yds. of rock excavation. P. L. Atherton is Chairman and J. B. F. Breed is Engineer.

Hubbell, Mich.—Until 8 p. m., June 1, by Richard Cuddihy, Village Clerk, for the furnishing of 300 ft. of 30-in. sewer tile; 100 ft. of 8-in. sewer tile; 1 "Y" 30x30 ins.; 1 "Y" 30x30x20 ins. and one reducer 30x18 ins.

Owosso, Mich.—Until June 3, by City Clerk, for the construction of about 10,000 ft. of 8-in. and 10-in. sanitary sewer. Official advertisement of the work will be found elsewhere in this issue.

Crete, Nebr.—Until 2 p. m., June 20, by F. A. Novak, City Clerk, for the necessary labor and material for the installation of a sewer system in this city. The said sewer system shall consist of: 19,071, more or less, linear feet 8-in. pipe sewer; 10,376, more or less, linear feet 10-in. pipe sewer; 5,776, more or less, linear feet 12-in. pipe sewer; 4,983, more or less, linear feet 30-in. pipe sewer. P. A. Edquist, 832 New York Life bldg., Omaha, Nebr., is Special Engineer. Official advertisement of the work will be found elsewhere in this issue.

O'Neil, Nebr.—Until 8 p. m., June 14, by H. J. Hammond, City Clerk, for necessary material and labor for the construction complete of a sanitary sewer system. The Consolidated Engineering Co., 640 Bee Bldg., Omaha, Nebr., are the Engineers. Official advertisement of the work will be found elsewhere in this issue.

Freehold, N. J.—Until 11 a. m., June 22, by Charles H. Butcher, Town Clerk, for the extension of sewerage system and the construction of pumping stations. The work includes approximately 81,000 ft. of 8-in. sewers; 3,400 ft. of 4-in. iron pipe force mains; 3 pumping stations, not including houses and machinery; manholes, lampholes, flush tanks. Alex L. Moreau is Commissioner.

Binghamton, N. Y.—Until 4 p. m., June 1, by Board of Contract and Supply, for the construc-

tion of vitrified pipe sewer with necessary manholes, catch basins and lot connections to the curb line in Charles St.; laying both a sanitary and surface water vitrified pipe sewer with the necessary manholes, catchbasins and lot connections to the curb line in Oak St. and Gaines St.; laying a vitrified pipe sewer with the necessary manholes, catchbasins and lot connections to the curb line in Maiden Lane.

Brooklyn, N. Y.—Until 11 a. m., June 8, by Borough President, room 2, Borough Hall, Brooklyn, N. Y., for 13 sewer contracts, the largest being for the construction of sewer in 49th St., between 15th and 17th Aves., and an outlet sewer in 17th Ave., between 49th and 50th Aves. The contract including: 260 lin. ft. of brick sewer; 1,635 lin. ft. of 18-in. pipe sewer; 1,535 lin. ft. of 6-in. house connection drain; 18 manholes; 5 sewer basins; 1,000 ft. B. M., sheeting and bracing; 1,450 ft. B. M., foundation planking. Alfred E. Steers is Borough President.

Brooklyn, N. Y.—Until 11 a. m., June 8, by Alfred E. Steers, Borough President, for furnishing all the necessary labor and materials for the construction of a sewer in West 17th St., between Neptune and Canal Aves. The work includes the following approximate quantities: 692 lin. ft. of 8-in. pipe sewer; 954 lin. ft. of 6-in. house connections; 4 manholes complete; 2,400 ft. B. M., planking.

Cleveland Heights, O.—Until noon, June 14, by H. H. Canfield, Clerk of Village, for furnishing necessary labor and material for the construction of sewers in Maple Road, from Mayfield Road to Wood Road.

Cleveland, O.—Until noon, June 9, by Ira O. Hoffman, Secretary, Board of Public Service, for the construction of sewers in streets as follows: West 89th St., from Madison Ave. N. W. to 700 ft. Southerly; Lakeview Road, N. E. from Primrose Ave. N. E. to 450 ft. South of Osceola Ave., N. E. with temporary outlet into Parkwood Drive, N. E. That part of Eddy Road N. E. from Lake Shore & Michigan Southern Railroad to St. Clair Ave. N. E., which lies between Lake Shore & Michigan Southern Railroad and Sellars Ave., N. E. (so-called). McElhatten Ave. N. E. (formerly Florence St.), from East 136th St. to East 140th St.

Jefferson, O.—Until noon, June 1, by Village Council, for the necessary labor and materials for the construction of a sewage disposal plant. T. B. Miller is Clerk.

Lorain, O.—Until noon, June 7, by Director of Public Service, for the necessary labor and material for the construction of sewers in streets as follows: Elyria Ave. sanitary sewer from E. 28th st., southerly to E. 32d St.; Pearl Ave. sanitary sewer from the present end of the National Tube Company's sewer, thence southerly to a point about 175 ft. north of the center line of E. 28th St., thence along Pearl Ave. to the alley south of E. 32d St. L. B. Johnston is Clerk.

Marcus Hook, Pa.—Until 8 p. m., June 6, by Borough, for the construction of terra cotta pipe sewers, the erection of a pumping station and the grading and straightening of Market St. A. F. Damon, Jr., Post Office Bldg., Darby, Pa., is Engineer. W. E. Mallon, Marcus Hook, Pa., is Chairman of the sewer committee.

York, Pa.—Until 4 p. m., June 6, by Board of Public Works, for the construction of the following sewers: Carlisle Ave., 610 ft. of 8 in. terra cotta pipe; 440 ft. of 5 in. terra cotta pipe laterals; 23 ⅛ bends; 23 double Y's; 1 manhole; 1 flush tank; 40 ft. of 8 in. terra cotta pipe; 66 ft. of 5 in. terra cotta laterals; 4 ⅛ bends; 4 double Y's. South Queen St., 250 ft. of 8 in. terra cotta pipe; 1 flush tank; 892 ft. of 5 in. terra cotta pipe laterals; 44 ⅛ bends; 44 double Y's. Madison Ave., 1,532 ft. of 8 in. terra cotta pipe; 1,566 ft. of 5 in. terra cotta laterals; 3 manholes; 1 flush tank; 75 ⅛ bends; 75 double Y's. Manchester St., 450 ft. 8 in. main; 108 ft. 5 in. laterals; 9 ⅛ bends; 9 double Y's; flush tank; manhole. Harry Wasbers is Chairman of the Board.

Columbia, Tenn.—Until noon, June 15, by E. E. Erwin, Recorder, for the construction of a sewer system for the city, including 1,450 ft. of 10-in. and 4,250 ft. of 12-in. vitrified pipe, 68 "Y's" and 2,390 cu. yds. of excavation.

Princeton, W. Va.—Until noon, June 8, by city, for the construction of sanitary sewers with small amount of 24-in. cast iron pipe and of vitrified pipe of sizes 10, 12, 15, 18, 20, 22, 24, 27 and 30-in. with necessary manholes and lampholes. F. R. Van Antwerp, Princeton, W. Va., is Chief Engineer.

Milwaukee, Wis.—Until 10:30 a. m., June 3, by Board of Public Works, for the construction of sewers in the West Sewerage District as follows: Pipe sewer in Elm St., from a point 12½ ft. west of 46th St. to a point 12½ ft. east of 47th St., and in 47th St., from a point 12½ ft. south of Elm St. to Elm St., and in Elm St., from 47th St. to a point 12½ ft. east of 48th St.

Winnipeg, Man.—Until 11 a. m., June 1, by Board of Control, M. Peterson, Winnipeg, Man., Secretary, for the construction of sewers in portions of 20 streets.

Water Supply.

Bids are asked on following work, the notes being arranged alphabetically by states:

Animas City, Colo.—Until 6 p. m., June 14, by Pearl Roberts, Town Clerk, for the necessary labor and material for the construction of a system of water supply for the town.

North Chicago, Ill.—Until 10 a. m., June 14, by Bureau of Supplies and Accounts, Navy Department, Washington, D. C., for the construction of extensions to water mains, sewers, drains, heating and electrical distributing mains and concrete conduit at this station.

Lawrence, Kan.—Until 5 p. m., June 6, by F. D. Brooks, City Clerk, for the construction and extension of sewers throughout the city.

Hazlehurst, Miss.—Until June 7, by E. M. Cook, Mayor, and Board of Aldermen, for the construction of a reinforced concrete reservoir 40 to 50 ft. in diameter with a capacity of not less than 250,000 gals. of water.

Harrison, N. Y.—Until 4 p. m., June 14, by Board of Water Commissioners, for constructing water supply system, including 1 well, 1 pump, 2 triplex pumps, 2 induction motors, 1 elevated tank and approximately 21,000 lin. ft. of water mains with gate valves and hydrants. John M. Farley is Engineer.

Olean, N. Y.—Until 8 p. m., June 8, by Board of Water Commissioners for the trenching, laying and backfilling for the construction of approximately 3,100 ft. of 18-in. water line and 580 ft. of 6-in. line. Charles Keeman is Secretary.

Tyrone, Pa.—Until 2 p. m., June 10, by Tyrone Gas & Water Co., for the construction of a storage reservoir; also for an addition to its present reservoir known as No. 1. The work includes about 100,000 cu. yds. of earth work and about 2,000 cu. yds. of paving, masonry, etc.; also about 7,000 cu. yds. of puddle work.

Milwaukee, Wis.—Artesian Well.—Until 10:30 a. m., by Board of Public Works, for the construction of an artesian well on the grounds of the Municipal Tubercular Hospital in the Town of Wauwatosa, Wis.

Cheyenne, Wyo.—Until 2 p. m., June 21, by Water and Sewerage Committee, for the construction of a reinforced concrete lined reservoir, requiring approximately 2,800 cu. yds. of concrete and 55 tons of reinforcement. Official advertisement will be found elsewhere in this issue.

Winnipeg, Man.—Until 11 a. m., June 1, by Board of Control, M. Peterson, Winnipeg, Man., Secretary, for the construction of water mains in portions of 16 streets.

Miscellaneous.

Bids are asked on following work, the notes being arranged alphabetically by states:

Washington, D. C.—Inspection Car.—Until June 3, by Capt. F. C. Boggs, General Purchasing Officer, Isthmian Canal Commission, Washington, D. C., for furnishing one gasoline inspection car.

Washington, D. C.—Storage Balconies.—Until noon, June 8, by Bureau of Navigation, Navy Department, Washington, D. C., for the construction of storage balconies in boat house at the naval training station, Great Lakes, North Chicago, Ill.

Idaho Falls, Ida.—Hydro Electric Plant.—Until 3 p. m., June 17, by T. H. Hines, City Clerk, for the necessary labor and material for the construction of a hydro electric plant and pumping station. Louis C. Kelsey is Engineer.

Ottawa, Ill.—Retaining Walls.—Until 5 p. m., June 7, by City Council, Benjamin F. Krouse, Clerk, for the construction of four concrete retaining walls, containing approximately 1,775 cu. yds., four cement block balustrade walls, total length 1,120 ft.; for certain light poles, wiring, lamps, etc.; two concrete sidewalks, total length 585 ft.; 4,210 cu. yds. of earth embankment inside of retaining walls; 3,000 cu. yds. of earth embankment outside of retaining walls.

Wichita, Kan.—Concrete Dam.—Until noon, June 13, by William Sence, City Clerk, for the construction and material of a concrete dam across the Little Arkansas River, Riverside Park. Bert C. Wells is City Engineer. Official advertisement of the work will be found elsewhere in this issue.

New Orleans, La.—Wharf.—Until 7:30 p. m., June 14, by Board of Commissioners of the Port of New Orleans, 601 Hibernia Bank and Trust Co. Bldg., for the construction of the William A. Kernaghan Wharf, the lumber and piling to be furnished by the Board.

New Orleans, La.—Towboat.—Until 11 a. m., June 24, by Maj. H. Burgess, U. S. Engineers, for the construction and delivering of a steel hull sternwheel towboat Teche.

New York, N. Y.—Pier and Bulkhead.—Until noon, June 6, by Commissioner of Docks, Department of Docks and Ferries, for furnishing all labor and material for the construction of a new pier at the foot of Oliver St.; also for preparing for and building a new bulkhead platform westerly from said pier between Jame Slip and Oliver St., East River Borough of Manhattan.

Boston, Mass.—Wall.—Until 11 a. m., June 25, by R. C. Hollyday, Chief of Bureau of Yards & Docks, Navy Department, Washington, D. C., for repairs to north foundation wall, building No. 114 at the United States Navy Yard, Boston, Mass.

Boston, Mass.—Crematory.—Until 11 a. m., June 18, by R. C. Hollyday, Chief Bureau of Yards and Docks, Navy Department, Washington, D. C., for the construction of a refuse kiln at the Navy Yard, Boston, Mass.

Newburgh, N. Y.—Dam.—Until 7 p. m., June 6, by Board of Water Commissioners, for the raising of an earth dam and roadway, building concrete, masonry, stone, riprap, walls and slope paving and other work incidental thereto, including approximately: 4,000 cu. yds. earth excavation; 37,000 cu. yds. earth embankment; 3,450 cu. yds. puddle wall; 4,250 cu. yds. broken stone lining; 11,000 sq. yds. slope paving; 550 cu. yds. riprap walls; 500 cu. yds. concrete masonry and other work.

Newport, R. I.—Sea Wall.—Until 11 a. m., June 18, by R. C. Hollyday, Chief Bureau of Yards and Docks, Navy Department, Washington, D. C., for the construction of a rubble sea wall at the United States Naval Hospital, Newport, R. I.

Newport, R. I.—Break Water.—Until 11 a. m., June 23, by Lieut. Col. J. C. Sanford, U. S. Engineer, Newport, R. I., for the repairing of the breakwater at Sakonnet Harbor, R. I.

Wheeling, W. Va.—Boat.—Until 11 a. m., June 22, by Capt. F. W. Altstaetter, U. S. Engineers, for building quarter boat No. 28 and a hull for snag boat Capt. in Turtle for the Kanawha River improvement.

Ottawa, Ont.—Wharf Improvement.—Until 5 p. m., June 20, by Napoleon Tessier, Secy. Department of Public Works, Ottawa, Ont., for the extension of the Sault Ste. Marie Wharf.

Ottawa, Ont.—Port Improvement.—Until 4 p. m., June 3, by L. K. Jones, Secy. Department of Railways and Canals, Ottawa, Ont., for the improvement of the entrance to Port Colborne on the Welland Canal.

Excavation, Earth and Rock.

Bids are asked on following work, the notes being arranged alphabetically by states:

Wheaton, Ill.—Until 8 p. m., June 20, by A. L. Webster, City Engineer, for the deepening and widening of the South Side Drainage Ditch for a distance of 6,000 feet below the Septic Tank, ditch to be 6 ft. wide on bottom and 1 ft. to 1 ft. slope. Official advertisement will be found elsewhere in this issue.

New York, N. Y.—Dredging.—Until noon, June 27, by Col. W. M. Black, U. S. Engineer, 710 Army Bldg., New York, N. Y., for dredging in Newtown Creek, N. Y., and Wallabout Channel, N. Y.

Memphis, Tenn.—Levee Work.—Until noon, June 18, by Mississippi River Commission, First and Second Districts, U. S. Engineer Office, Custom House, Memphis, Tenn., for the levee work in Reelfoot and White River districts. Maj. M. L. Walker is the United States Engineer.

Milwaukee, Wis.—Dredging.—Until 10:30 a. m., June 6, by Board of Public Works, for the dredging of several rivers and canals in the City of Milwaukee. Charles J. Poetsch is Chairman of the Board.

Materials, Machines, Supplies, Etc.

Bids are asked on following work, the notes being arranged alphabetically by states:

Washington, D. C.—Wire.—Until 2 p. m., June 3, by James Wilson, Secy., United States Department of Agriculture, for furnishing and delivering platinum wire.

Washington, D. C.—Sheet Tin.—Until June 2, by Capt. F. C. Boggs, General Purchasing Officer Isthmian Canal Commission, Washington, D. C., for the furnishing and delivering of 200 sheets of bright tin, 20x28.

Washington, D. C.—Bolts, Pipe, Saws, Etc.—Until June 14, by Capt. F. C. Boggs, General Purchasing Officer Isthmian Canal Commission, Washington, D. C., for furnishing under Canal Circular 586, bolts, pipe, saws, valves, dishes, bowls, pitchers, spoons, kitchen utensils, water coolers, milk cans, clothes hampers, oil cloth, towels and aprons.

Washington, D. C.—Steam Shovel Repairs.—Until 10:30 a. m., June 23, by Capt. F. C. Boggs, General Purchasing Officer, Isthmian Canal Commission, Washington, D. C., for steel castings, repair parts for steam shovels.

Bluffton, Ind.—Steel Case.—Until 10 a. m., June 9, by County Commissioners, for the furnishing of steel case containing roller shelves and document files. O. D. Garrett is County Auditor.

Fort Leavenworth, Kan.—Road Roller.—Until 11 a. m., June 7, by Capt. William D. Davis, Quartermaster, for furnishing and delivering, f. o. b. cars, at Fort Leavenworth, Kan., one 5-ton tanden style road roller.

Vicksburg, Miss.—Wire and Manila Rope.—Until noon, June 20, by Capt. Clarke S. Smith, Mississippi River Commission, Third District, Vicksburg, Miss., for the furnishing of wire and manila rope, silicon bronze wire, wire strand, spikes, cable clips and wire staples.

Brooklyn, N. Y.—Pump Repairs.—Until 11 a. m., June 8, by Alfred E. Steers, President of the Borough of Brooklyn, N. Y., for furnishing all labor and material necessary for the repair and placing in first class condition two 10,000,000-gal. Worthington sewage pumps, Nos. 1135 and 1136.

Buffalo, N. Y.—Gates, Valves.—Until 11 a. m., June 27, by Col. W. L. Fisk, U. S. Engineers, Buffalo, N. Y., for the erection of steel lock gates, valves and operating machinery for ship lock in Black Rock Harbor at Buffalo, N. Y.

New York, N. Y.—Broken Stone.—Until noon, June 7, by George Cromwell, President Borough

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CHAS. S. HILL
C. T. MURRAY
F. A. SMITH
} EDITORS

MYRON C. CLARK . . . . . PUBLISHER
F. P. BURT . . . . . MANAGER
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CONTENTS.

EDITORIAL:

A Periodic Rate Fixing System for Controlling Public Service Corporations. 515

CONCRETE SECTION:

Concrete Work at Panama. 516
Results of Tests Made by the Louisville Sewer Commission to Determine Impermeable Mixtures for Concrete. 516
Concrete as a Fireproof Building Material. . 517

EARTH AND ROCK SECTION:

Some Notes on the History of the Rock Drill 518
Some Progress Data and Cost of Driving the South Portal Heading of the Elizabeth Tunnel, Los Angeles Aqueduct. 518
Remedies for Landslides and Slips on the Kanawha & Michigan Ry. 520
Annual Convention of the American Society of Civil Engineers 521

ROADS AND STREETS SECTION:

The Steam Rolling on Roads, and the Management and Care of Steam Road Rollers. 522

WATER-WORKS AND SEWER SECTION:

Method of Constructing Submerged Pipe Line Under the Kaministiqua River, Fort William, Ontario, Water Supply. 525
The New Sewerage System of Louisville, Ky.—General Description of the System. . 527

GENERAL SECTION:

Methods and Appliances Employed in Erecting the Chicago, Milwaukee & St. Paul Railway, Missouri River Bridge, at Mobridge, South Dakota. 530
The Average Car-Mile Cost of Operating Seventy-Five Electric Railways in New York State, Second District. 534
Method of Constructing Two Public Comfort Stations in Small Cities with Some Costs of Construction and Operation. . . . 535

DIRECTORY OF CIVIL ENGINEERING SOCIETIES 538
PERSONALS 538
CATALOGS WORTH HAVING. 538

A Periodic Rate Fixing System for Controlling Public Service Corporations.

Men instinctively dislike the corporation that draws royalties forever upon the inventiveness of its founder. This growing revulsion against conditions that permit the indefinite capitalization of brains has culminated in the present movement to regulate the rates of public service corporations. The danger now is that brains will be deprived of nearly all royalties that should come from the exercise of genius in building and operating public service plants.

In our issue of May 25 we showed that the present method of regulating public service corporation rates is to permit only a limited—say 7 per cent—return on the capital invested, thus fostering the policy of expending a greater amount of capital in construction than is really needed, and, at the same time, discouraging all efforts to reduce operating expenses. Clearly, if 7 per cent on invested capital is the limit of returns that brains can secure, it can serve no good purpose to reduced operating expenses, for such a reduction would be followed by a corresponding lowering of the rates.

We also showed that the correct theory of profits is to regard profits as a reward for managerial ability, and not as a return on invested capital. According to this theory, the 4 to 5 per cent interest on invested capital is regarded as a part of the cost of production. The balance remaining after deducting this interest and the operating expenses from the gross income is the *true profit*, which should be expressed as a percentage of the gross income.

We indicated the necessity of limiting this profits by fixing of public service corporation rates of charge at intervals of, say, ten years. So important is this feature of *periodic rate fixing* that we purpose discussing it at greater length.

If rates were automatically reduced so that profits could never exceed a given percentage—say, 10 per cent of gross income—obviously all incentive to reduce operating expenses would be removed. Such a condition would be fatal to any marked advancement in the science of transportation by rail, and American railway management would certainly deteriorate, for the great minds now working in that field would seek other occupation.

To the inventor the Government wisely gives a patent, which protects him for 17 years in the exploitation of the product of his brains. This plan for stimulating efforts in designing machines for economizing labor has proved amazingly effective. But in the use of machines there also comes a chance to exercise originality of a high order. The manager who conceived the plan of paying operators of machines a bonus for increased output was himself an inventor of as great merit as any that ever lived. Yet he made nothing upon which letters patent could be taken out. His only protection was to apply his scheme secretly in some line of business, or to secure control of some corporation having a natural monopoly. The latter, in fact, would be far better than an ordinary patent, for its life would be many times 17 years, aside from the fact that it would not be much subject to the competition of improved machines of the same general type.

We have drawn this parallel between the inventor of patentable machines and the inventor of unpatentable managerial methods to illustrate the essential similarity of the processes of mind involved, and to show that society should provide similar protection and rewards for both classes of inventors. For Edison and Harriman there should be similar inducements, similar protection, and similar rewards. Yet, the one the Government gives a 17-year protection—a protection that is by no means free from possible competition, while to the other is given a perpetual franchise. The franchise, moreover, usually involves entire freedom from competition as regards, at least, a part of the business. In brief, the inventor receives a patent of limited duration, while the managerial genius may secure a perpetual patent. Harriman can capitalize his brains, that is, he can effect economies of operation which, so long as railway rates are not lowered, may become operative perpetually, and thus enable him to sell these annual economies at a price found by dividing them by the prevailing rate of interest. In other words, he can "water the stock." This iniquitous bondage to managerial brains is so grossly unjust that it is certain not to last much longer. But in the revolt now in progress, there are the gravest dangers of governmental action that will destroy managerial incentive at the same time that it destroys the ills in question. The object should be to preserve the incentive that made Harriman a great power for good in the railway world, without giving his brains perpetual royalties. How can this be done?

We have already shown how it can not be done, for the existing public service commission method of limiting profits to 7 per cent on invested capital must prove fatal to managerial ambition. In seeking a method of preserving incentive, we have not far to look, for a consideration of the parallel between Edison and Harriman leads us to a logical solution of the problem.

The rates charged by all public service corporations should be periodically fixed so as to yield only a small true profit at the date of regulation, the time between such periods of rate fixing being, in essence, the term of the patent granted to managerial brains.

Whether the term of this "patent" shall be 10 years or whether it shall be longer, is a matter for further careful consideration. We are concerned now with indicating a rational method of solving this very difficult problem in political economy.

It will be noted that no change in existing laws is needed to put this method of governmental control into operation, for it is universally conceded that public service corporations are inherently subject to governmental regulation of their rates. Our proposed method leaves the ownership of public service plants—railways, lighting plants, etc.—in private hands, and thus insures that careful scrutiny of expenditures in construction and equipment which is so rarely secured when a government owns its own plant. If the government had built our railways, we should have some magnificent specimens of railway architecture, without a doubt—built to last like the Pyramids, and just about as profitable.

It is our belief that rarely should a government of any kind build and equip its public service plants, and never should operate them. Where plants, like waterworks, are now owned by cities, leases should be given to operating companies.

The term of a lease—the "patent"—should be comparatively short, and the water rates should be fixed in advance for the term. All records of operating cost should be under the constant scrutiny of city auditors and should be published annually. At intervals of, say ten years, new rates should be fixed and the operation for the ensuing ten years should be given to the operating company bidding the highest rate of rental for the use of the plant. Who that is familiar with city administration of waterworks can doubt the efficacy of this plan?

We may go much farther in the logical extension of this periodic rate system of government control, and apply it to many classes of government operation now regarded as inseparable from immediate governmental supervision. Our whole post office system, for example, is susceptible of great improvement as to quality of service and particularly as to economy. Both can be accomplished under the plan that we have outlined, and with the greatest ease. What president of a large railway could not make a dozen fortunes for himself in ten years if he were to take over the operation of the post office system, with a hand free to introduce all possible economies? As it now stands, there is a large annual post office deficit, which could unquestionably be wiped out by any capable business manager free to act, and yet driven to act under the powerful stimulant that prospective profits would engender. Nor would service be impaired under such management. In every human probability, the service would be vastly improved.

No system of managerial control of public service corporations is, or can be, free from defects. Occasionally defects of the present system become so great as to merit being called a public scandal. An

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excellent illustration of this condition occurred a few years ago in the management of the street railways of New York City, and the public is still suffering the consequences. A study of the underlying cause, however, serves to give added reason for the method of governmental control, which we have just outlined. The stock of these New York City railways was "watered" to a degree rarely attempted even by the most grasping of owners, and the company that undertook to operate most of the consolidated lines in Manhattan, had to pay rentals based on this "watered stock." The income proved insufficient to pay the normal operating expenses plus the rentals on the plant. Hence, the managers adopted the desperate expedient of cutting operating expenses by not making proper repairs to track and rolling stock. The inevitable result was a receivership, and we believe it was this particular receiver who remarked that he had expected to find a "going concern," but when he got it he found it was "almost gone."

The fault in such cases lies not with the system of private management but with a system that permits the immediate capitalization of profits in the form of watered stock. When this is done there is always a possibility that, either by a subsequent decrease in income or by an increase in operating expense, the true profits may be partly, if not wholly, wiped out. If all the true profits at one period have been capitalized, a later period of decreased true profits results disastrously where an operating company is paying rental based on capitalized profits of the earlier period. Our plan of periodic rate regulation, coupled with its concomitant full publicity both of operating cost and of first cost, would completely eliminate all such financial disasters. We do not claim perfection for the plan, but we do claim that it presents a nearer approach to ideal conditions than is secured under the existing system or under any system hitherto proposed. Thus, the benefits of individualism can be had in the operation of public service enterprises without a perpetuation of the bondage that brains now enforce upon the public. No longer will managerial promoters be able to capitalize the annual economies effected by their wits as well as the annual profits arising from the growth of traffic that a growing community yields. By the limited term of fixed rates, however, managerial genius will be placed precisely on a parity with mechanical genius. Our Harrimans will be given patents of no great duration than our Edisons, and both classes will be equally encouraged to exercise all the wit with which nature has endowed them.

Concrete Work at Panama.—Nearly one-eighth of the total amount of concrete to be laid in the Panama Canal locks had been placed at the close of work on May 21, when the total was 531,607 cu. yds—401,112 at Gatun Locks and 130,495 in the locks at Pedro Miguel. The concrete work is advancing at the rate of 4,000 cu. yds. a day and by July 1, when the entire plant at Pedro Miguel will be in operation, the daily rate will be 5,500 cu. yds. At Gatun Locks during the two weeks ending May 21, there were placed 35,022 cu. yds., a daily average of 2,918 cu. yds., the main plant of 8 mixers being in operation about 10 hours a day, and the auxiliary plant of two mixers 8 hours a day. The operation of these two plants for the week of May 16 to 21 was as follows:

	Construction Plant.			Auxiliary Plant.		
Date.	Concrete laid—Cu. yds.	Hours worked.	No. mixers used	Concrete laid—Cu. yds.	Hours worked.	No. mixers used
May 16..	2,040	50:00	6	928	8:15	2
May 17..	2,210	50:10	4	894	8:15	2
May 18..	1,852	64:30	6	832	8:15	2
May 19..	2,004	59:30	8	596	6:15	2
May 20..	2,292	76:02	6	561	8:15	2
May 21..	1,910	58:00	6	684	8:15	2
Total	12,308	....	.	4,495	....	.

Concrete and Reinforced Concrete Section

Note: This section is devoted to methods and cost of constructing concrete and reinforced concrete structures. It will cover the selection, testing and proportioning of concrete materials; laboratory tests of concrete; concrete mixing, transportation and placing; fabrication and placing of reinforcement, and form construction and erection. It will also contain articles on new and interesting developments in the design of reinforced concrete.

Results of Tests Made by the Louisville Sewer Commission to Determine Impermeable Mixtures for Concrete.

In connection with the extensive new sewer system being constructed at Louisville, Ky., as described in another column of this issue, tests were made to determine the efficiency of various methods of producing impermeable concrete mixtures. The results of these tests as reported by the commission's engineers were as follows:

TABLE I.—RESULTS OF TESTS OF METHODS OF WATERPROOFING CONCRETE; PRESSURE, 15 LBS. PER SQ. IN.

Specimen.	Seepage (Duration of test, 7 hours.) Cubic inches per sq. in.	Cubic centimeters per sq. centimeter.	Gallons per sq. foot	Total seepage in cu. centimeters.
Perfect Mixture.....	1.53	3.99	3.22	721
Concrete (1-2-4).....	6.30	16.6	13.85	3,000
Concrete with				
Clay, 5%.....	0.85	2.20	1.78	398
Clay, 10%.....	0.12	0.31	0.25	56
Concrete with				
Fine sand, 5%.....	4.86	12.65	10.21	2,290
Fine sand, 10%.....	1.20	3.12	2.51	565
Concrete with				
Hydrated lime, 4%.	0.71	1.83	1.48	332
Hydrated lime, 6%.	0.24	0.62	0.50	112
Hydrated lime, 8%.	0.10	0.27	0.22	49
Concrete with				
Medusa, 2%.....	0.92	2.49	2.01	450
Medusa, 4%.....	0.	0.	0.	0.
Concrete with				
Maumee, 4%.....	0.23	0.61	0.49	110
Concrete with				
McCormick	0.17	0.44	0.36	80
Concrete with				
Ceresit	1.98	5.03	4.22	928
Concrete with				
Toxement, 4%.....	0.	0.	0.	0.

The method used for determining the permeability of different concretes was similar to that employed in the Government laboratory for testing structural materials, located at St. Louis. Specimens of concrete were made 10 ins. in diameter and 4 ins. thick. These blocks were placed between iron castings, bolted firmly together in such a way as to allow the application of water under different pressures to a surface 6 ins. in diameter. In order to provide water at definite pressure, an air-tight iron tank containing filtered water was connected with another tank containing compressed air. The pressure was communicated from the air tank to the surface of the water in the other tank from which pipes properly controlled by valves conducted the water to the specimen.

In Table I are given the amount of seepage through the different specimens examined. These tests were made upon concrete, the constituent parts of which were so proportioned as to form a theoretically perfectly graded mixture; concrete—1 part cement, 2 parts Ohio river sand, and 4 parts Ohio river gravel; to which various commercial waterproofing compounds were added; and concrete in which a portion of the Ohio river sand was replaced by an equal portion of very fine sand and clay. Where hydrated lime, Medusa, Maumee and Toxement were used the amount added was a definite proportion of the quantity of cement used, but the quantity of cement was not reduced. The McCormick compound was furnished already mixed with cement and was said to have been mixed at the time of grinding. The Ceresit was substituted for a portion of the water and in the proportion of 1 to 20.

The dry waterproofing compounds and the hydrated lime were added to and thoroughly mixed with the cement before wetting. The tests covered by Table I were all carried out with a pressure of water of slightly over 15 lbs. per sq. in. and for a period of seven hours. Care was taken to avoid error due to evaporation.

Further tests showed that the quantity of seepage was approximately proportional to the pressure applied and that there was no material cessation after an application of pressure for eighteen hours.

Tests were made to ascertain if the addition of the several waterproofing materials in varying amounts reduced the tensile strength of neat and 1:3 mortar briquettes. The results of this study are given in Table II.

As a result of these investigations, concrete to be used in wet localities has been made by the substitution of 10 per cent of the regular (Ohio river) sand by a like amount of fine molding sand containing some clay. The first test of this mixture was in the reconstruction of a fire cistern in private property. This cistern was filled with water soon after its completion and the leakage was so slight, if there was any at all, that after a period of 48 hours, there was no perceptible reduction in

TABLE II.—RESULTS OF TESTS TO DETERMINE EFFECT OF WATERPROOFING MATERIALS UPON THE TENSILE STRENGTH OF NEAT AND MORTAR (1:3) BRIQUETTES.

Waterproofing materials added.	How added.	Per cent added.	Tensile Strength. ——Neat—— 7days.	28days.	—Mortar 1-3— 7days.	28days.
McCormick "A" from St. Louis.	Combined with cement at mill..	...	797	740	205	307
McCormick "B" Local.....	Combined with cement at mill..	...	513	577	199	220
Ceresit	In place of water.....	5	642	669	311	375
Moulding sand.....	In place of sand*.....	5	698	743	176	368
Moulding sand.....	In place of sand.....	10	636	642	177	510
Hydrated lime.....	Added directly.....	5	749	651	387	511
Hydrated lime.....	To dry cement.....	10	608	635	371	505
Clay	In place of sand*.....	2.5	753	737	235	344
Clay	In place of sand.....	5.0	718	912	221	401
Clay	In place of sand.....	7.5	644	802	344	327

*In the case of the neat briquettes the amount of sand and clay added were percentages of the dry cement.

TABLE III.—RESULTS OF PARTIAL ANALYSIS OF WATERPROOFING COMPOUNDS.

Waterproofing Compound.	Character of Compound.	Chemical Analyses (per cent). Volatile combustible matter.	Water.	Remainder.
McCormick	Dry	2.02	.....	97.98
Ceresit	Liquid	38.00	43.60	18.40
Maumee	Dry	17.60	.....	82.40
Toxement	Dry	17.50	.....	82.50
Medusa	Dry	34.03	.....	65.97

the height of water in the neck of the cistern, 21 ins. in diameter. The cistern was 10 ft. in diameter and contained a depth of 13 ft. of water. Since this test several sewers have been built of concrete made in this way with uniformly satisfactory results, so far as it has as yet been possible to test the structures.

Partial analyses of several waterproofing compounds were made to determine the proportion of volatile and combustible matter and water contained in them. The results of these analyses are given in Table III.

Concrete as a Fireproof Building Material.*

It has long been realized that, with the wood supply of the world constantly diminishing, wood was bound to become too expensive to use as a building material. But it is not so widely realized that the day when wood is as costly as non-combustible building materials is here. Today, concrete structures, and in some localities other non-combustible structures, can be erected at no greater first cost than wooden ones; with an added element of safety to those who use the building which cannot easily be overestimated.

In order to hold the place it claims—that of the cheapest and best fireproof construction material—concrete must be able to show itself cheapest in first cost, as well as cheapest in the long run.

Concrete materials are obtainable everywhere: Stone, ledges, gravel, sand, burnt ballast, slag, brick refuse, terra cotta chips, stone cutters' refuse and cinders, are all good aggregates for concrete.

As far as the cost of the labor of putting the material in place is concerned, much has been done toward reducing that to a minimum. With metal forms and certified concrete, concrete construction is cheaper today than that with brick, hollow terra cotta tile or any other material.

Charles T. Main, a member of the Society, has recently published the most valuable contribution regarding cost data of brick and wood mill construction (Eng.-Contg. Feb. 23, 1910). Mr. Main is a leading authority on this subject, and his data are conceded to be correct. Mills have been built entirely of concrete, in all parts of the country, in less time than it is possible to build them of brick and wood and for less money than the square foot and cubic foot prices collected by Mr. Main. A few years ago this statement would not have been true. Today, with the aid of new designs, new methods, new forms, scientific grading and proportioning, it is a fact that cannot be disputed, but one, nevertheless, not generally known.

The development of the entire concrete building and of the parts of the concrete building have been slow, because it has taken a long time to learn to think in concrete. Each student brought his stock of experiences from another field to bear on the problem, but the problem was so new that few could understand it in all its aspects. The engineer, who knew how to design the strength, knew little about artistic features. The architect, who alone could give beauty to the building, was not an expert in the methods that make low costs. Progress was made more difficult by the fact that so few of the structural features and construction methods were standardized.

The contractor, having analyzed his costs, saw that the forms were the largest single item in the cost of the concrete. This fact had its effect on the design of the concrete building, in the trend toward straightway repetition form work and flat-slab ceilings, with as little beam and girder work as possible. A further benefit was in the fewer corners for fire to attack or for interruption of the action of sprinklers, saving also in the cost of the sprinkler system.

After the flat-slab ribless type of ceiling, with its low cost of forms, came standardization of the units of forms for walls and columns. With the use of these metal form-units a new problem faced us, namely, slight modification of design to agree with the cheapest labor requirements of the metal forms. The influence was also felt, of the fire protection design thoroughly worked out and standardized by Charles L. Norton, professor of heat measurements at the Massachusetts Institute of Technology and engineer in charge of the engineering experimental station of the Factory Mutual Fire Insurance Companies. Mr. Norton's recommended practice, which is now universally accepted, is so simple and apparently so obvious that we sometimes forget to give him the credit for his work.

The importance of the forms, from the standpoint of economy, in being able to build fireproof buildings for the price of brick and wooden mill construction, is clearly shown by the fact that Charles D. Watson, of Syracuse, N. Y., on account of the reduction in the number and expense of forms, has been able to build a number of buildings from separately cast members and reduce the costs below anything ever cast in situ in wooden forms.

We come now to the latest developments, the metal form-units that have been perfected, densifiers for compacting the concrete, mechanical conveyors for displacing the wheelbarrow and hand tamping, and the concrete-producing factory, centrally located. These things have all arrived. Metal molds have reduced the price of concrete to that of wooden construction.

For the greatest saving in the cost per cubic foot of the completed building, the methods of construction, as well as the designs, must be standardized. This is rapidly being done. For example, the metal forms are set up and concrete is hauled in large quantities from a centrally located factory and poured at once for the entire story of a building. This does away with the joints between the work of two different days, and permits of figuring the tensile strength of the concrete in design calculation, with a great consequent saving of reinforcement. Such calculations cannot be safely figured unless the whole story is poured at once.

Figuring the cost of furring, lathing, plastering, interest, fixed charges, heating, and repairs, concrete is certainly cheaper than wood. If you also figure health, concrete is very much cheaper. A concrete building is cooler in summer and warmer in winter than any other kind. It can be cleaned out with a hose. It can be easily, quickly and thoroughly fumigated, room by room, or all at once. It is drier than any other, provided it is built with self-ventilating air spaces in all of the exterior walls. A concrete building is vermin-proof, and should germs or vermin get in the building, it may be easily rid of them.

It may seem that we have wandered from our subject of fires and their permanent elimination, but it was necessary to show that concrete is thus, from every standpoint, cheaper than wood, its only rival for low cost. Concrete construction is the best form for the elimination of fires, because it affords: (a) Least cause for fires; (b) least amount of damage to structural parts by fire; (c) least amount of damage to structural parts by water; (d) least amount of damage to contents of building by water; (e) least quantity of combustible structural materials in a room; (f) least speed of combustion of the contents of a room; (g) no concealed fires; all fires are in plain sight; (h) least spread of fire to adjoining parts of the same story; (i) least spread of fire to stories above; (j) least spread of fire to next buildings.

The causes of fires this paper will not discuss. The amount of damage done by a fire in a concrete building depends upon circumstances perfectly within our control and predeterminable. With concrete made of properly selected fire-resisting materials, practically no damage is done, except by prolonged high temperature. The results of recent tests by Prof. Ira H. Woolson, a member of the Society, and his assistant, J. S. Macgregor, prove conclusively that a concrete building properly designed, with as few projecting corners as possible, will withstand long periods of the hottest hardwood fires, with no resulting damage that cannot be thoroughly repaired with mortar and a plasterer's trowel. These tests were on full-sized rooms with walls of concrete made of different kinds of material.

Concrete for walls can be poured in metal molds with sufficient accuracy to permit of painting or wall-papering without further plastering or smoothing. This means that the best of this fire-resisting material is brought to the very surface of the wall where the flames strike. With metal molds all corners can be made rounded as cheaply as square, or metal corner beads may, if desired, be inserted and retained in the molds. Now, if a fire does occur in a building made of concrete cast in smooth metal forms, the damage is less than in any other type of building and the danger of spreading is less.

A concrete building can be damaged by water less than any other form of construction. To begin with, water does not injure concrete; in fact it improves its quality. There is no wood to swell, and afterwards to shrink and crack the plastering. Even the paint best suited to be used on concrete lends itself particularly well to washing down with water. There are no hollow spaces that the water can flow through, damaging the contents below. A concrete building is water-tight from floor to ceiling, and small quantities of water can be easily handled through small scuppers, either into the air space of the vaulted wall, or through the wall to the outside. The fire is never hidden by the construction; consequently no unnecessary streams of water are flooded into the building.

In a concrete structure there need be little or no combustible material. Let us take for example the dwelling house, for it is the most difficult to make both cheap and fireproof. In a concrete residence there is little trim that cannot be made better and cheaper of Portland cement than of wood. The chair rails and picture molding can be made of concrete. The trim around the windows and doors can be molded in metal molds as cheaply as straight members. Even the wire moldings can be done away with, and the conduits buried in the concrete partitions, walls, ceilings and floors. Baseboards should be made of concrete or else omitted entirely—as they serve no useful purpose in a concrete building, except in following wooden precedents. Windows may have cement sashes, with wired glass, and self-closing shutters, or self-dropping shutters of rolled-up metal or asbestos. Metal furniture may be used. The paint and varnish used on buildings and furniture should be selected carefully, as these are great factors in determining the temperature at which a fire will start and the speed with which it will spread. There is also a great difference in the paints and varnish used for painting concrete.

The flooring need not be of wood. There are many first-class non-combustible materials beside Portland cement that will fill every good requirement of wood and still be fireproof. There are also parquetry floorings, made of slow-burning wood, and much thinner than the old-fashioned hardwood floor, which make the best flooring in case wooden floors are desired. In a concrete residence there is no excuse for wooden underflooring nor for wooden screeds.

The best form of construction for the elimination of fires is one that keeps the fire in plain sight, once it is started. One of the greatest obstacles in fighting fire in wood construction is the difficulty of locating a fire after it is known to exist. Every second of time lost gives it accelerated fury. Holes cut through the walls, floors and ceilings to locate a fire oftentimes only furnish more drafts to feed the flames.

With hollow concrete blocks, or monolithic cast-in-place walls and partitions there are no chances for the fire to be concealed. There is no cause for cutting into the partitions, floors or ceilings. There is no damage to the structure from cutting, no injury from water. With such a building, if a fire does start, it starts in plain sight, remains in plain sight at all times and can be attacked instantly before it has spread; and the water damage will be practically nothing. Fires in plain sight are usually extinguished before the arrival of the fire department.

*A paper by Frank B. Gilbreth, General Contractor, New York City, read before the American Society of Mechanical Engineers.

Earth and Rock Section

Note: This section is devoted to methods and costs of excavating earth and rock and building embankments. It will cover the grading of roads and railroads, diking and canal work, dredging, building reservoirs and earth dams, sewer and water pipe trenching, quarrying, etc.

Some Notes on the History of the Rock Drill.

BY W. L. SAUNDERS.*

The rock drill is an American invention, conceived and developed in the United States. J. J. Couch of Philadelphia took out the first practical patents in 1849. In his experiments he was assisted by Jos. W. Fowle. The Couch drill was a crank-and-fly-wheel machine. Couch and Fowle separated in 1848, the latter filing a caveat in 1849 covering a drill of his own invention and describing the successful power rock drill substantially as it is today. The most important feature of Fowle's drill is that the cutting tool was attached directly to the piston. In other words, the steel leading into the hole was an extension of the drill piston rod. Fowle described this invention in his testimony before the Massachusetts Legislative Committee in his contest with Burleigh in 1874, as follows:

My first idea of ever driving a rock drill by direct action came about in this way: I was sitting in my office one day after my business had failed, and happening to take up an old steam cylinder, I unconsciously put it in my mouth and blew the rod in and out, using it to drive in some tacks with which a few circulars were fastened to the walls.

Abroad, the nearest approach to rock drill invention was the work of the German, Schumann, carried on in 1854. Fowle being without means to develop his ideas they remained in obscurity until Charles Burleigh purchased his patents and produced the Burleigh drill, about 1866. This drill was used in driving the Hoosac Tunnel in Massachusetts, in 1867.

Following Couch, Fowle and Burleigh, came Haupt, Wood, Ingersoll, Sergeant, Waring and Githens. Githens was the inventor of the Rand Drill.

The Ingersoll Drill was invented in 1871. Simon Ingersoll, a modest, ingenious and honest mechanic, came to New York from Connecticut, bringing with him the models of several inventions. He was riding in a New York horse car one day and was describing one of his inventions to a fellow passenger. Another passenger in the car was John D. Miner who overheard Ingersoll's conversation. Miner was a contractor, engaged with a gang of men on some rock excavation in New York City.

Miner broke into the conversation to ask Ingersoll why he didn't invent a rock drill, telling him that he had a gang of men at work striking a steel with a hammer to make a hole for blasting; that they could put in only about 10 ft. of hole per day; and that he did not see why a machine could not be built that would do the work.

Ingersoll said he could make such a machine and would go at it at once if he had the money. Miner gave him $50 and his card, saying that though he had never seen Ingersoll before, he had an honest face and he would trust him to spend that $50 in building a rock drill. "When you want any more," said Miner, "come to me and I'll give you another fifty."

Ingersoll's first rock drill was built in a shop at Second Ave. and 22d St., New York City, owned by J. F. de Navarro, and was managed by Sergeant and Cullingworth.

One day Henry C. Sergeant saw the patterns for Ingersoll's drill. He noticed that the front head was attached to, and was a part of the cylinder. He told the workmen that they should be in two pieces, and proceeded to saw off the pattern. At first point Ingersoll came into the shop. "What are you doing?" he asked. "I'm making this thing practical," said Sergeant, as he finished cutting off the pattern before Ingersoll could stop him. The result was the first row between Ingersoll and Sergeant and it led later to Mr. Navarro purchasing, on Sergeant's advice, all rights and patents held by Ingersoll. The Ingersoll drill was made with the separate front head as used today.

Mr. Navarro organized the Ingersoll Rock Drill Co., investing $10,000 in the concern. Litigation arose with Burleigh, of Massachusetts, who owned the rights of Fowle and others. However, Mr. Navarro's plentiful supply of funds and his liberal nature, brought about a settlement of the suits, and all the patents became the property of the Ingersoll Rock Drill Co.

The business quickly paid back to Mr. Navarro the $10,000 he had put into it, and in later years he sold his interests to Mr. W. R. Chapin for $525,000. Sergeant sold out because of friction with the management, went West, engaged in mining, returned to New York about 1885, and organized the Sergeant Drill Co.

Early in rock drill developments the Rand brothers, Addison C. and Jasper R., had become interested through their connection with the Laflin & Rand Powder Co. Addison C. Rand formed the Rand & Waring Drill & Compressor Co., later controlled exclusively by Rand and merged with the Rand Drill Co., established in 1871 and incorporated in 1879.

J. C. Githens, superintendent of the Rand Drill Co., invented the "Little Giant" rock drill. He was the originator also of many improvements, notably the double-screw column with column arm, which made practical the application of rock drill to mining and tunneling.

The Sergeant & Cullingworth Co., manufacturing the Ingersoll Drill, the Sergeant Drill Co., and the Ingersoll Rock Drill Co., were merged into the Ingersoll-Sergeant Drill Co. Later on, the Rand Drill Co. and the Ingersoll-Sergeant Drill Co. were consolidated in the Ingersoll-Rand Co., today carrying on the business of all these pioneer concerns. The Rand drill from the beginning had been the most formidable competitor of the Ingersoll and Sergeant types. The conjunction of the Ingersoll-Sergeant and Rand companies, therefore, was a combination of valuable patents in rock drills, compressors and general machinery for mining, tunneling and quarrying.

*President Ingersoll-Rand Co., New York, N. Y.

Some Progress Data and Cost of Driving the South Portal Heading of the Elizabeth Tunnel, Los Angeles Aqueduct.

Last week we gave figures of progress and cost for the Elizabeth Tunnel work on the Los Angeles Aqueduct for the five months, October, 1909, to February, 1910, inclusive. Since then we have received from Mr. J. B. Lippincott, Assistant Chief Engineer, complete figures of progress and cost for the South Portal heading of this tunnel for the month of April, 1910. These figures are notable among other reasons for showing a progress of 604 ft. for one month, which is the American record for hard rock tunneling. This tunnel has now set the record three times for America as follows:

October, 1908..... 466 ft.
March, 1909..... 476 ft.
April, 1910..... 604 ft.

The best records on other work are:

Gunnison Tunnel, January, 1908..... 449 ft.
Chicago Water-works, April, 1909..... 468 ft.

The cross-section excavated at the Elizabeth Tunnel is 12 ft. 4 ins. x 12 ft. 9 ins.; at the Gunnison Tunnel the record was made on a heading section of 8x12 ft. Both tunnels were in granite. The Chicago water-works tunnel was in limestone rock and had a circular excavation section 16 ft. in diameter.

The Elizabeth Tunnel is being driven full section by the lower heading method. Work at the South Portal was begun Sept. 20, 1907, with temporary equipment. New equipment was installed in April, 1908, as follows:

1—150 H. P. Fairbanks-Morse Motor Generator Set to furnish current for the lights and locomotive.

3—Westinghouse 33,000-400 V. 125-K. W. Transformers, together with the necessary intermediate transformers, auto starters, switchboards and meters, for handling both the underground and surface work.

1—No. 5½ Root rotary pressure blower of 4,000 cu. ft. capacity, for ventilation, belt driven by

1—30 H. P. Fairbanks-Morse D. C. Motor.

In August a small machine shop equipment

Form 1-10
CITY OF LOS ANGELES
DEPARTMENT OF PUBLIC WORKS

LOS ANGELES AQUEDUCT

PROGRESS REPORT

SOUTH PORTAL ELIZABETH TUNNEL
Description

Period APRIL, 20th to 30th, 191 0

W. C. Aston

Division No. 10-S

EWO No.	Tunnel No.	Stations Portal	From	To	Progress Ten-Day	Total	Month	Total	Hand or Machine	Character of Ground	No. of Shifts	Remarks
Already Reported Through												
353	12	SOUTH	173+51	171+22	229'		604'	9748'	Mch	Medium hard granite	30	
Totals												

This blank to be used for reporting "Tunnel Excavation," "Tunnel Timbering" "Conduit Excavation—Hand" and "Conduit Excavation—Shovel." Separate reports should be made for each of these classifications and compiled each ten days and monthly.

was placed in one side of the power house, consisting of 1 small lathe, 1 drill press, 1 circular saw, 1 emery wheel and 1 power hack-saw. These handle all the necessary shop work around the plant.

The tunnel was supplied with the following:

1—2400-pound Draw-bar pull Baldwin-Westinghouse Mine Locomotive.
15—40-foot Koppel side dump mine cars.
4—Model 6 Leyner Air Drills, together with all necessary receivers, water tanks, manifolds, hose, etc., to carry on the work.

The folowing buildings were erected on the ground:

1 power house, galvanized iron, 40x80 ft.
1 blacksmith shop, galvanized iron, 40x40 ft.
1 warehouse and office, galvanized iron, 20x60 ft.
1 barn and feed room, 38x64 ft.
1 blower room, 8x18 ft.
1 mess house, 40x64 ft.
3 bunk houses, 20x68 ft.
1 cottage, 4 rooms.
1 cottage, 3 rooms.
1 hospital, 5 rooms, 30x35 ft.
1 oil tank rack, 4x24 ft.
1 powder thawer, 3x4 ft.
1 powder magazine (tunnel).
1 root cellar (half tunnel), 8x12 ft.

The buildings are comfortable and in good condition, the mess-house and three bunk-houses being painted. The camp is supplied with water from a 45-ft. well, lifted 67 ft. by a No. 2 Gould centrifugal pump driven by a 7½-h. p. Fairbanks-Morse D. C. motor to an 8x16-ft. circular concrete tank reservoir, from which place it is distributed through 1,062 ft. of 2-in. main and smaller laterals to all the buildings. A 1-in. centrifugal pump driven by a 5 h. p. D. C. motor forces the water into a cooling tank, from which place it passes into the circulating system of the transformers and compressors. Fire protection is given by four 2-in. plugs fitted with 400 ft. of woven cotton hose.

This original equipment doubtless stands about the same at the present time. Power is supplied from the Castine substation of the Edison Co.'s Kern River transmission line and is carried to the tunnel over a single pole bare wire lines under a pressure of 30,000 volts.

As is quite generally known, the work is being done by day labor and a bonus system of payment is practiced. The base rate in this bonus system is 8 lin. ft. of tunnel per day, or 248 ft. for a 31-day month. For each lineal foot driven in excess of this amount, each man working continuously in the tunnel during the month is paid 40 cts.

Turning now to the records of the work for April, 1910, the formation was a fairly stiff granite on April 1, increasing gradually in hardness until April 20, when a marked change occurred toward softer material in which feldspar predominated. This made it possible to cut down the number of holes drilled, increase their length and decrease the powder charge. Very little over breakage resulted and no timbering was required. The records of progress during the month were as follows:

Date.	Feet.	Material.
1st to 10th	181	Medium hard granite.
10th to 20th	194	Very hard 8 days; soft 2 days
20th to 30th	229	Medium hard granite.

As will be noted, progress is reported in 10-day periods. This practice is uniform for all the aqueduct work, a uniform blank, Fig. 1, being used. The method of reporting total costs for the month is shown by Fig. 2. From this record for April, 1910, we get the following unit costs for excavation:

Item.	Per cu. yd.
Excavation	$2.84
Mucking	2.08
Drainage	0.02
Ventilation	0.03
Light and power	0.83
Engineering	0.06
General administration	0.29
Equipment and buildings (estimated)	1.57
Total	$7.83

The wage schedule for the tunnel work is as follows, an 8-hour day being worked:

Superintendent, per month	$300.00
Foreman, per month	135.00
Shift bosses, per day	4.00
Miners, per day	3.00
Muckers, per day	2.50
Blacksmith, per day	4.00
Carpenters, per day	$3.00 and 3.50
Mechanics, per day	$2.75, 3.00 and 3.50
Electrician, per month	110.00
Laborers, per day	$2.00 and 2.50
Construction clerk, per month	100.00
Storekeeper, per month	85.00

The following miscellaneous data are sent by Mr. Lippincott for the month covered by the above costs:

Total footage to March 31st	9,134 ft.
Footage during April	604 ft.
Total footage to date	9,738 ft.
Required progress for April	240 ft.
Increase over estimate (bonus)	364 ft.
Average daily footage	20.13 ft.
Required daily footage	8.0 ft.
Bonus daily footage	12.13 ft.
Average progress per shift	6.71 ft.
Required progress per shift	2.666 ft.
Bonus progress per shift	4.044 ft.
Bonus rate per shift, per foot, per man.	$0.40
Maximum bonus earned, per man	$48.52
Cost of bonus per foot of tunnel	$3.93
Number of shifts worked (3 shifts daily)	90
Number of men on bonus crew*	16
Shift boss	1
Miners	6
Muckers	9

*One foreman, who is in charge of all three crews, is also included in the bonus list.

Electrical energy used, K. W. H.	78,379
Energy cost at $0.0185 per K. W. H.	$1,450.02
Number of mules (used at heading to switch cars for electric locomotives)	3
Number of holes drilled	1,924
Total footage of holes drilled	16,079
Feet drilled per foot of progress	26.62
Total time drilling heading, hours	324
Average time drilling heading per foot.	

Form 1-17
CITY OF LOS ANGELES
DEPARTMENT OF PUBLIC WORKS
LOS ANGELES AQUEDUCT
ENGINEERING DEPT.

MONTHLY COST AND PROGRESS REPORT

E. W. O. ....

Description *South Portal — Elizabeth Tunnel* April 1910 Division 10 Sec. *South*

Work Started *September 13, 1907* Date Completed .... In immediate charge *W. C. Aston*

MONTH COST AND PROGRESS

CLASSIFICATION	No. Days Labor		STATIONS		QUANTITY		COSTS FOR MONTH						UNIT COSTS	
	Men	Live St'k	From	To	Lineal Feet	Cu. Yds.	Labor	Live St'k	Material and Sup.	Energy	Frt. and Hauling	Total	Lineal Feet	Cubic Yds.
							Theoretical							
Excavation	*Pay Roll*		*177+26*	*171+22*	*604*	*2525*	*(2732.69*							
	Bonus				"		*(996.99*		*2861.35*		*572.27*	*7163.30*	*11.86*	*2.84*
Mucking	*Pay Roll*				"		*(3756.00*							
	Bonus				"		*1380.49*	*81.00*	*48.58*		*9.71*	*5275.78*	*8.73*	*2.08*
Drainage					"		*44.49*					*44.49*	*.07*	*.02*
Ventilation					"		*85.10*					*85.10*	*.14*	*.03*
Light and Power					"		*452.04*		*172.91*	*1450.02*	*34.58*	*2109.55*	*3.49*	*.83*
Engineering					"		*159.50*		*2.83*		*.56*	*162.89*	*.27*	*.06*
Timbering					*None*		*0*							
TOTALS							*9607.30*	*81.00*	*3085.67*	*1450.02*	*617.12*	*14841.11*	*24.56*	*5.86*

TOTAL COST AND PROGRESS

	Office Administration, including Superintendent, Clerks and Supplies.	*280.25*	
General Division Administration for April	*Housing and sanitation, including Labor and Supplies, Lights and Fuel.*	*165.01*	
	Material handling, including labor and supplies,	*145.60*	*=1.22*
	Equipment and buildings are not included in above, but are estimated at approximately, per foot.		*7.00*
TOTALS	*Total cost of tunnel per foot, during April.*		*32.78*

Correct *P. J. Kurten* Construction Clerk Approved *W. C. Aston* Engineer in Charge Units to be Accomplished *18430* Total Estimate ... *580,570.00* *Includes Lining*

Remarks ....

minutes	32.38
Average time drilling one hole, 1 ft., minutes	1.209
Pounds of powder per foot (60%)	8.96
Pounds of powder per foot (40%)	11.09
Total	19.15
Number of cars mucked (32 C. F.)	3,216
Drill repairs (3 No. 9 Leyner), per foot	$0.111
Drill sharpener repairs (Leyner, No. 2), per foot	$0.102
Drill steel sharpened, pieces	6,865
Drill steel welded, pieces	445
Cars repaired	38
Car repairs per foot	$0.08

Remedies for Landslides and Slips on the Kanawha & Michigan Ry.*

The southern portion of the Kanawha and Michigan Railway, for 93 miles (from Point Pleasant to Gauley Bridge, W. Va.), is located on the east side of the Great Kanawha River. For about one-third of this distance the road is close to the banks of the river, on a hillside location, where there is practically no valley, the mountains rising directly from the stream. Owing to the character of the soil, there is considerable trouble, due to landslides and slips, the term slips being used where the fill, or embankment under the tracks, settles or slips toward the river.

Excessive rains occur during the winter, and small landslides are numerous, but do little damage; in most cases the water rushing from the mountains brings with it one or two uprooted trees and a few yards of earth. There is much more trouble with the larger landslides, that is, where the whole hillside gradually slips down toward the river, pushing the track ahead of it, and giving bad line and surface. At some places the track is not only pushed out of line but raised.

Landslides occur in almost every case where the hill or mountain side has been cleared of all forest. The top soil, or earth above the rock, which varies in depth from 8 to 20 ft., is mucky clay, which holds water in every low place, apparently being impervious. This clay soil soon becomes saturated, soft, and mucky, and, not having any roots or vegetation to hold it in place, and being on a slope, starts a downward movement, slipping on the rock, covering the ditches and ballast of the track, and pushing it out of line. These so-called landslides do not come down at once, but move slowly, thereby causing no immediate danger. In several places reverse curves have to be given to the alinement, in order to keep the track in surface.

At Point Pleasant, where there was a small landslide, the earth, as it came in, was removed by a steam shovel at the toe of the slope. The soil at this point was slipping on an inclined stratum of rock, the top of which was smooth and had the appearance of soapstone.

In cases where it was impracticable to remove the slide, the top-soil drainage system on the hillside above was at first tried, but did not work successfully, as the ditches, due to the slippery soil, soon filled up. It appeared that the small amount of surface water collecting in the low places caused by the roughened surface was sufficient to cause the slipping.

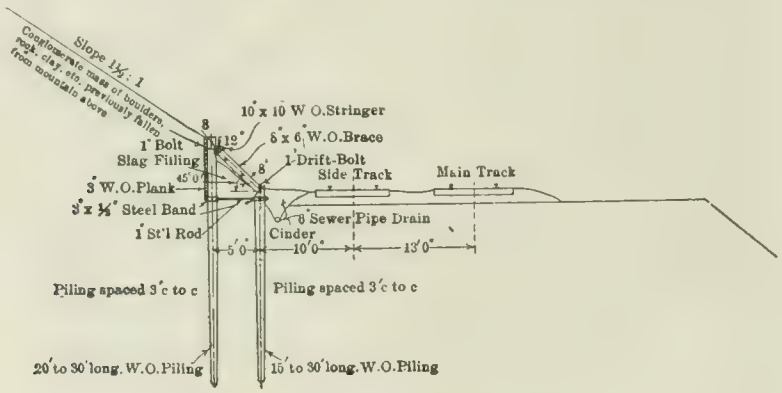


Fig. 1—Pile Brace Against Landslide.

At Leon, where considerable expense was incurred in maintaining the track around a slide, the hillside was removed, and the track, for 2,000 ft., was relocated on the rock bottom, obtained by cutting back to a side-hill location. By this method the entire landslide was removed and the track put on rock bed, thereby doing away with the trouble, at a cost of $20,000.

At Cannelton, where the largest slow-moving landslide occurred, the main track had been pushed out of line. Reverse curves were made, in order to get back to the alinement on either side, but, on account of the continual lining out of the track, the curves became too sharp for operation, and the side track between the hillside and the main track became completely covered. As this slide was of such extent and depth, it was out of the question to remove it in order to get back far enough for a rock sub-grade, as at Leon. The change of line not being feasible, it was proposed to remove part of the landslide, permitting the relocation of the tracks on their original alinement and, after completing this, to protect them from further slides.

A steam shovel was cut in at one end, and removed enough of the landslide to allow the two tracks to be changed to their original location. After the shovel had worked about three days a slide occurred one night, half burying the shovel. Steps were then taken to hold back the hillside before further slides could develop. This was done successfully by driving two parallel rows of piling, 5 ft. apart, about 3 ft. from center to center, as shown in Fig. 1. The upper rows, against the hill, were backed with 3-in. plank, the front rows being driven against this brace in order to aid in supporting the upper row. A 10x10-in. stringer was placed against the upper row, and from this 8x8-in. braces were carried diagonally, at an angle of 45°, to the lower row of piles, and these were sawed off at the ground level. Steel bands, with 1-in. rods to hold the two sets of piling together, were put on about 8 ins. below the top of the brace pile. The depth of penetration of the piling varied from 15 to 30 ft. The piling was selected large white oak, and oak timber was used for the stringers and braces. Moving the shovel ahead about 30 ft., then cutting it back, and driving the piling as shown, constituted a day's operation. The work was completed successfully without further serious landslides. In four weeks about 12,000 cu. yds. of earth were removed, the track was thrown back to its original alinement, and the landslide was stopped. This work cost $16,000.

The upper limit of the slide is about 135 ft. above the track. The slide consists of about 200,000 cu. yds. of moving earth. This work was done in the spring of 1907, and has been successful. At several places, due to excessive pressure, the braces have been embedded in the stringers. The earth from the top of the piling was given a slope of 1½ to 1; at several other points smaller slides have been stopped with one row of piling. The piles were driven 3 ft. c. to c. and cut off 3 ft. above the top of the rail, the ground above being given a slope of 1½ to 1. At one or two places, where one row was not sufficient, the trouble was stopped with brace piling. At points where the single row of piling showed signs of leaning, due to the pressure against that part of the piling above ground, this overturning, apparently due to too much length above ground, was stopped by cutting off the piling 3 ft. above the ground and giving the earth above it a slope of 1½ to 1.

In contending with landslides of this character in West Virginia, all that seems to be necessary is to obtain a good toe hold, which stops the movement of the earth above. The so-called slow-moving landslides on the Kanawha & Michigan Ry. have been stopped successfully by one of these methods.

The term, "slips," as the conventional name indicates, is applied to places where the soil slides into the river. These slips occur when the roadbed is constructed on a fill, ranging in depth from 5 to 10 ft., across narrow flats, between the hill and the river. Due to the constant movement of the earth, no trees grow on the land between the river and the railroad. The ground slips gradually into the river where, from time to time, its toe is cut away by the current.

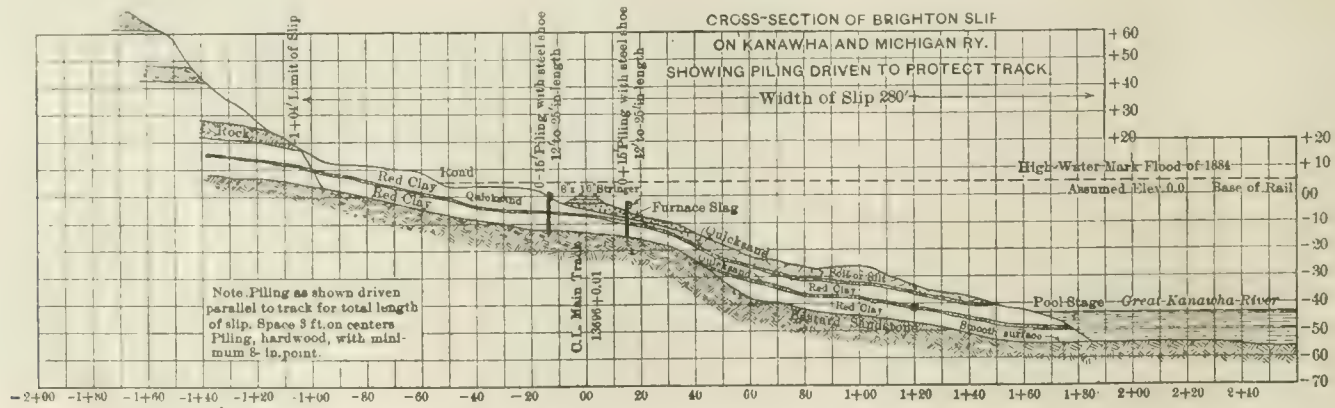


Fig. 2—Cross Section of Brighton Slip Showing Piling Driven to Protect Track.

*A paper by R. P. Black, presented Sept. 7, 1910, to the American Society of Civil Engineers, and published in the "Proceedings," Vol. XXXVI, p. 877.

The peculiarity of these slips is the fact that they may continue for one or more seasons without giving any trouble. Slips are due to high water and not to surface water. A quick rise and fall of the river will not cause the soil to move, but continued high water, or several successive floods, will start the slipping action.

In the spring of 1908, the length of track affected by the slips was 7,600 ft., necessitating, at several different points, the maintenance of speeds ranging from 6 to 20 miles per hour for five months, until the dry season, when this slipping action stopped. In Fig 2 is shown a cross section of the Brighton slip, which gave the greatest trouble. The section is taken at right angles to the track, the information for which was obtained by levels and test rods driven to rock. A stratum of rock, below the earth, slopes toward the river, ranging from 1:0.2 to 1:1. This rock is covered by successive layers of red clay, varying from 3 to 6 ft. in thickness. Immediately above the rock, and in thin seams, from 4 to 8 ins. thick, between the layers of clay, is found a quicksand mixed with fine clay. When the quicksand and fine clay become thoroughly saturated with water, the mixture affords a smooth surface over which the top soil or successive layers of clay slide toward the river. After high water these seams of quicksand can be traced readily by the water seepage. The quicksand is very slimy, and contains no grit. The water must remain over the ground long enough to force its way back into this quicksand and saturate well before the slipping action can take place.

In 1908, in order to keep the track safe, the gangs on four sections were increased from three—the normal force—to ten men each, and these increased forces were maintained for four months. The tracks had to be resurfaced and lined continually. At three different times, it was necessary to put on filling material and ballast in order to keep the track up to grade. This entailed a cost of $4,400 more than the normal expenses for the year. The track over the slips was not only costly to maintain, but dangerous, due to wrecks resulting from derailments on account of rapid settlement of the roadbed.

At Poca, where a trestle was maintained over a slip for about 800 ft., due to the heavy cost of changing the alinement, the trestlework was filled with heavy quarried rip-rap, and the fill was widened so that the stone reached the river's edge. The weight of this stone fill caused settlement, but, after adding stone from time to time for five years, the roadbed became solid. It is thought that the stone fill settled to the rock stratum below the slip, thereby stopping the movement.

For slips at other points where small fills were maintained, several remedies were suggested, one being to construct, at the river's edge, a wall which would act as a toe to hold back the moving soil. Owing to the necessary height of the wall, however, this was deemed too costly. At Brighton and Leon slips, where the alinement could not be changed, the remedy shown by Fig. 2 was proposed, the scheme being to drive two rows of piling, one on each side of the track, with a track-driver, the piling to be equipped with steel shoes for penetrating the rock strata. It was supposed that, with the toe hold in the rock, and the pinning together of the successive moving clay strata, this slipping action in the vicinity of the track would be stopped.

In the spring of 1909, test piling was driven for a distance of 50 ft. in the center of the Brighton slip. Transit observations taken from a base line, showed that the piling did not move any appreciable distance. The track held up well within the limits of the piling where, as on either side, it had been necessary to resurface continually.

The test being successful, two rows of piling were driven during December, 1909, on either side of the track at the Brighton slip, and between its limits, for a distance of 740 ft. The piles were equipped with steel shoes and were driven 3 ft. apart, center to center, on the down-hill side. Continuous 8x16-in. timber bracing was bolted to the piling. The work was done with a self-propelling track-driver. A temporary spur track was constructed at one end of the slip, thus dispensing with the services of a work train. The cost of this work was as follows:

Hardwood piling, 8,075 ft. at 13 cts.	$1,049.75
Steel shoes, 12,690 lbs. at 3 cts.	380.70
Labor	856.35
Fuel, etc.	120.00
Total	$2,406.80

Up to the present time, this remedy has been successful.

At another point, where the rock strata are not at great depth, it is proposed to go down the hillside about 20 ft. from the track, put down holes about every 20 ft., and blast the smooth surface of the rock. Thus, by roughening the surface and destroying the stratification, the sliding of the clay may be stopped.

Annual Convention of the American Society of Civil Engineers.

The following is the program of the annual convention to be held at Chicago, Ill., June 21 to 24, 1910.

Monday, June 20.—An Informal Reception will be held during the evening at the Congress Hotel, in order to enable those who arrive early enough to become acquainted with our Chicago Membership and with each other.

Tuesday, June 21.—10 A. M. First Meeting of the Convention.—John A. Bensel, President, will deliver the Annual Address, at the close of which the Business Meeting will be held. The business to be considered will be as follows: (1) The Time and Place for holding the next Annual Convention. (2) Report of a Special Committee appointed to formulate the general lines which should be followed in legislation affecting the practice of engineers. (3) Report of the Board of Direction in the matter of a proposed Special Committee to report upon the Preservation of Wood.

2. P. M.—Automobile drive through part of the Park System of the City of Chicago, the entire party being guests of the local membership.

8:30 P. M.—Second Meeting of the Convention.—This meeting will be held either in the Florentine Room of the Congress Hotel, or in Fullerton Hall of the Art Institute. Alfred Noble, Past-President, Am. Soc. C. E., will describe the New York Tunnel Extension of the Pennsylvania Railroad, illustrating his description with lantern slides.

Wednesday, June 22.—The day will be devoted to a visit to the new steel plant of the United States Steel Corporation at Gary, Ind., the party leaving Chicago at about 9:30 A. M., either by special train or by steamer. Luncheon will be served during the trip. The steel plant will be inspected, and those who are specially interested will be given an opportunity to inspect the water-works, sewerage and other municipal improvements of this new city. The return to Chicago will be about 4 P. M.

8:30 P. M.—Third Meeting of the Convention.—J. Waldo Smith, M. Am. Soc. C. E., will address the society on the subject of the New Water Supply for the City of New York. The address will be illustrated by lantern slides.

Thursday, June 23.—For this day a number of short excursions to local points of interest will be arranged. Parties will be made up according to individual preference, and will be personally conducted.

The following trips will be arranged for: 1. Excursion to Lockport, to inspect the Regulation Works and Power Plant of the Sanitary Canal. 2. Visit to the Chicago & Northwestern Ry. Passenger Terminal now under construction. 3. Inspection of the plant of the Commonwealth Edison Co. 4. Visit to the new Mail-Order Plant of the Sears-Roebuck Co. This is one of the largest mail-order houses in the world, there being about 8,000 employes. The sanitary arrangements in connection with this plant are especially interesting, as also are the arrangements for filling and shipping orders, which often aggregate 250,000 per day. 5. Visit to the new plant of the Western Electric Co.

8:30 P. M.—Fourth Meeting of the Convention.—An illustrated lecture will be delivered descriptive of the plans recently perfected for beautifying the City of Chicago. After adjournment of this meeting members are invited to a Smoker at the Chicago Engineers' Club.

Friday, 10 A. M., June 24.—This day will be devoted to an excursion. The party will first visit the Army Post at Fort Sheridan, and will then inspect the new Naval Training School at Lake Bluff. Luncheon will be served during the trip, and Ravinia Park will be reached early in the evening. Here dinner will be served and there will be a concert, and probably informal dancing.

Co-Operative Plan of Engineering Instruction Adopted by the University of Pittsburgh.

The trustees of the University of Pittsburgh have adopted a plan of co-operation recommended by the Committee on School of Engineering which is unique and appears to blend most satisfactorily with the engineering environment of this institution. This plan will be put into operation October 1, 1910.

The following is an abstract from the report of the Committee on School of Engineering to the board of trustees:

It has been a matter of common observation in connection with the educating of young men who enter the engineering activities that those who spent their vacations while at school in engineering offices and industrial establishments have been better prepared for entrance upon their life's work than their fellow students of otherwise equal abilities who devoted their time exclusively to school work. The contact with the engineering activities, even in this subordinate way, gives the student of engineering an insight into practical affairs which not only makes him of more immediate use to his employer upon graduation from school, but also fits him to pursue his studies to better advantage while in school.

If the student of engineering is thus benefited by such chance work as he may be able to get during vacation periods, then it is evident that he will be benefited still more by pursuing a systematic course in which the instruction in school is interspersed with suitable outside practical work.

The technical graduate who has taken school work only has no adequate knowledge of the organization which makes it possible for many men of diverse employment to work together as a single unit in the accomplishment of a desired result, or the system that is necessary for tying together inter-related departments for the attainment of economic production; nor does he even know as a beginner how to apply the knowledge at school in a manner altogether satisfactory to his employer.

Because of this unpreparedness of the average technical graduate, a number of large corporations have established student apprenticeship courses for the benefit of such graduates as seek employment with them.

The engineering schools and the companies who employ their graduates are thus working independently in their efforts to prepare young men for entrance upon their life's work. Since both school and future employer have the common aim to fit the young man for efficient service at the minimum of cost in time and money, it is evident that the best results cannot be had by independent action but by co-operation.

The University of Pittsburg, because of its splendid industrial environment, is most favorably situated to apply this co-operative principle to the education of young men who are preparing to enter the engineering industries. Instead of keeping the young man away from the actualities of his life's work for a period of four or more years prior to graduation, as is the general custom of engineering schools, the Committee on the School of Engineering have matured a co-operative plan whereby the student, while spending in school the amount of time usually devoted to instruction in our best engineering institutions will work four terms of three months each in the engineering industries of the Pittsburg district. By this plan the student gets

(Continued on page 529.)

Roads and Streets Section

Note: This section is devoted to methods and costs of road and street construction. It will cover road building in all its details, the construction of pavements, sidewalks and gutters, the testing and use of paving materials and the machinery and tools used in road building and paving.

The Steam Rolling on Roads, and the Management and Care of Steam Road Rollers.

In Great Britain steam road rollers have been used for many years not only in the construction of new roads, but also in the maintenance of old ones. In Ireland, in particular, much attention is paid to the steam rolling of roads, and practically all of the counties maintain several steam rollers for this purpose. As a result these Irish road engineers have acquired much information regarding the best methods of working road rollers. At the recent Irish Road Congress held at Dublin, Ireland, April 20-22, 1910, the three following papers were read on this subject. In passing it may be noted that in our issue of Sept. 2, 1908, we printed a valuable article on steam road rolling in Ireland, the author of the article being the Mr. Hackett whose paper follows. In our issue of Feb. 16, 1910, we also printed an article giving directions for working steam road rollers and steam traction engines. It should be noted that the costs given in this article have all been transposed from English to American monetary units.

The Steam Rolling of Roads.*

There are very many desirable methods of improving Irish roads, most of which will be discussed at the Congress. Of all these steam rolling is the most effective, and not merely so, but far and away outstrips in importance every other proposed improvement. It is immediate in effect, in many cases gives immediate relief to the rates, and is universally appreciated. It greatly increases the comfort and ease of traveling, enables 25 per cent more loading to be carried, and to greater distances, saves wear and tear on horses and equipment, prevents sore feet in cattle, and is a blessing to farmers, cyclists, and motorists. Besides this it brings other improvements in its train. It searches out weak and badly drained parts of a road, diminishes dust, shows up the evils of sharp corners and of shaded parts of a road, and generally raises the standard of road maintenance. There is now ample proof that steam rolling with the use of proper materials, intelligently and carefully applied, excellent and economical results are obtained. Although steam rolling, properly carried out, will on any road and with any class of materials which has heretofore been used, give better results both from the view of the ratepayer and the traveler than those obtained on the patching system, yet the best results can be obtained only when the other conditions are appropriate.

Slight reflection will enable one to realize the superiority of consolidating stones by a roller over the ordinary patching system. By ordinary patching repairs a smooth surface close in texture cannot be obtained, the result being that water lodges in depressions, eventually soaking into and softening the road and its foundations. With the smooth and nearly impervious surface secured by rolling in the stones the water runs off the road like off the slope of a roof. The greatest practical difficulty met with—before the introduction of rollers—in maintaining roads in good condition, although few people except road surveyors realized it, was not, as is generally supposed, the amount of traffic. This is seen by the fact that on a hill slope or at a cross roads where the traffic is doubled the surface is smooth and sound. The great difficulty was—the tendency of roads to become tracked by wheels. This evil is aggravated by every additional inch in height of the center of the road made for the purpose of throwing off the water; consequently roads made by patching had to be kept comparatively low in the center—too low for effective surface drainage. The cause of tracking is the tendency which horses and vehicles have of following in the track marked by a previous vehicle on a soft and dirty road. With a steam-rolled road the surface is so smooth, hard, and clean, that vehicles leave no tracks on it, and the traffic distributes itself naturally all over the roads, thus doing away with the road-maker's chief difficulty. In addition, it is found that without any danger of tracking the center of the road may safely be raised, thus assisting in the disposal of the water.

A rolled road under any favorable circumstances dries up in half an hour after rain ceases.

Again, it will be found that with stones consolidated by wheel traffic, a large proportion, probably one-third, will be found to have been broken into dust and rendered useless, the surface loose in texture, pervious to water, and composed, when opened up, of a large proportion of mud and small debris of stone.

On the other hand, a rolled surface will be found composed of stones compacted together like a tesselated pavement, presenting a smooth, hard, semi-impervious surface to the traffic and rain.

An observant person will not fail to notice in every county water-channels which have long since ceased to fulfil their original purpose, being now higher than the road which they were made to drain This state of affairs has come not as a sole result, as might at first sight be supposed, of the stones in the road wearing away, but from several other causes.

The inferior original surface permitted the foundations to ooze up and be scraped away in mud. At the same time the traffic on the weak surface caused a grinding action to take place internally in the road, so that there was a wear and attrition of stone going on not only at the surface, but internally. As this latter kind of wear is a novel one to put before a popular audience, it may be stated that it was an unrecognized factor even among engineers until late years. We know practically that a solid foundation was necessary, but till late did not realize why. This wear of stones is of great importance, and accounts, I have no hesitation in saying, in many cases to one-third of the surface wear. With the thick impervious coat of stones put on in rolling, the road becomes so strong and so watertight as to almost entirely prevent the destruction of the stones from percolation of water and internal attrition.

One of the greatest savings effected by rolling is the diminished amount of scraping and sweeping. In practice, under the patching system, it is found that out of every 24 cts. spent on maintenance, 8 cts. to 12 cts. goes in cleaning the road. Such expenditure puts nothing into the road, and is so far waste. With a steam-rolled road this expense is reduced by from 70 to 90 per cent. The importance of steam-rolling in urban districts from this, as well as from a sanitary point of view, is obvious.

From the foregoing comparison of the effects of the two systems one could infer, without experience, that the result of steam-rolling would be superior from every point of view, but it is now desirable to get to actual figures, to see how rolling works out from a ratepayer's point of view. I should, however, interpolate here the necessary explanation that the foregoing remarks and the following figures apply to coating and rolling in a layer of stones about 3 ins. thick all over the road. The system of rolling in patches one stone thick, as represented by the annual supply allotted to the road under the patching system, is one I have tried and do not approve of. It is wasteful under any conditions, as the roller is working three-fourths its time on parts of the road where there are no stones. In winter, with the road soft, it undoubtedly gives a better result than allowing the stones to be beaten in by the traffic, but that condition of the roads does not exist but for short periods even in winter, and when it does not exist the stones are ground to powder.

I now give (Table I) examples of four actual cases of roads steam-rolled in County Tipperary, South Riding, showing how the cost of steam-rolling actually worked out, treating expenditure for that purpose as a financial proposition, and comparing the original price of the road under the patching system with the cost of steam-rolling, and making the assumption that the initial cost of the rolling was borrowed and the money repaid at 3½ per cent, which is the actual state of affairs in my county; the term of repayment corresponding to the life of the road.

The condition of the roads is as follows:

TABLE I.

1. Name of Road.	Ballinlard.	Rathronan.	Racecourse.	Newton Anner.
2. Date when rolled.....	1901.	1901.	1903.	1909
3. Cost per perch under patching system per annum	$0.72	$1.32	$0.30	$1.08
4. Expenditure for rolling per perch	2.80	3.28	2.90	2.76
5. Annual repayment of interest and principal for life of road..	.37	.43	.28	.33
6. Average maintenance subsequent to rolling	.18	.24	.08	.20
7. Totals of Nos. 5 and 6	.55	.67	.36	.53
8. Saving per perch per annum	.17	.65	.00	.55
9. Life in years.....	9	9	13	10

Ballinilard, Rathronan, and Newtown Anner roads are now becoming defective on surface, and throwing up mud. They are, however, much sounder and better than before they were rolled. They should be rerolled within the next year or two, but less materials would now make a good job of them than when they were first rolled.

The Racecourse road is in perfect condition, showing no trace of wear, and perfectly clean. I would not be surprised if its life were 15 to 20 years. On the Motor Reliability Trials last summer the motors passed over this road between Cahir and Cashel; many drivers and passengers will remember its good condition.

It will be noticed, before I pass from this part of the subject, that there is shown by the actual figures a large saving on expensive roads, and that roads costing as low a price as 36 cts per perch can be rolled without money loss. The results far exceed the anticipations which were put before the County Council when this class of work was started.

I now add a few practical remarks derived from my experience: The main streets of urban districts, with a population of 5,000 to 10,000, will have to be rolled every three years, unless a better material than limestone is used, but less materials will be required for the second and subsequent rollings.

Repair, subsequent to rolling, by filling all depressions seen holding water with very small quantities of fine stone, ¾-in. gage or thereabouts—barely enough to fill depressions, and preferably broken stone. For light country roads limestone will give the most satisfactory road, and wears perfectly smooth. For heavier roads use the hardest stone procurable. Subsequent to rolling use sweeping-brushes; a man can cover twice the amount of road and produce cleaner work than he would with scrapers. Sweep, particularly in dry weather, as dust is easier swept than mud. Machine-sweepers are best, as the suitable times for sweeping, viz., very wet, or very dry, are usually limited, and the work cannot be overtaken with hand-brushes.

If gravel be used for steam-rolling, it must contain a fair proportion of broken stone, the

*By E. A. Hackett, County Surveyor, County Tipperary, S. R., Ireland.

more the better. The vibration of the traffic starts round gravel stones, and, following the easiest course, they come to the surface and make it like a cobble pavement. Use as little binding material as possible, and not until the stone is fairly well consolidated. Sand or fine gravel make the best binding, as it will not fly about in the wind and turn into mud, but old road scrapings may be used, and on country roads will do fairly well, but of course they produce mud or dust. Stones to pass through a 2½-in. ring is the happy medium as respects size.

The heavier rollers are the most economical to work, but for narrow streets you must have a roller which has a narrower roller path, 6 to 10 tons, say. Summer work is always the best. Roll until the stones present a smooth surface, but not until the divisions between them are obliterated, as if that be done the stone gets crushed. If necessary scarify road into proper shape before spreading stones, and coat with a layer that when complete gives 3 ins. in thickness. If necessary to put more than 3 ins. roll in two layers. Scarify road lightly in dry weather, or where rolled before. The supply and spreading of stones may be done by contract, but it is more successfully done by direct labor.

After all is said and done, success depends more than anything else on the personality of the county surveyor—his knowledge of the work and his capacity for administration, particularly his capacity for selecting subordinates. If a council is wise it will interfere as little as possible. I am glad to say I am in that happy position myself.

Steam Rolling in County Antrim.*

The method of applying and consolidating broken stones on the roads by steam rolling had been in operation on a small scale in County Antrim for several years previous to 1903, when, after seeing the results, the ratepayers generally began to recognize the benefits which they might expect to reap if a more extended system of steam rolling were adopted.

In the last quarter of the financial year 1903-4, proposals to raise sums varying from $243 to $2,430 in the following year for steam rolling were brought forward and approved of by all the Rural District Councils. A total of $14,700 was then allocated for steam rolling work.

As the number of rollers available on the hire system was limited and the tendered rates for rolling somewhat high, the County Council decided to purchase five steam rollers, so that they might be in a position to ascertain for themselves, on undisputable evidence, the relative merits of the "hire" and "purchase" systems.

A loan of $15,000 for the purchase of rollers was applied for and sanctioned by the Local Government Board, repayable within 10 years.

If the $15,000 to be raised by loan were made a county-at-large charge, the County Council considered it would not be right that the rural and urban districts should contribute in proportion to their respective valuations to the repayment of the loan, because (1) the rural districts would probably not use the rollers equally, and this method would make the expense bear hardest on those using them least; (2) it would probably be necessary to hire additional steam rollers, and the districts so hiring would have to pay the full price of the hired rollers, and also their proportion of the cost of the purchased rollers, which would manifestly be unfair; (3) the urban councils, who would receive no benefit under the scheme, might be obliged to contribute their proportion, and would thus have a serious grievance. For these reasons it was decided to fix a price per day for the use of the rollers, based not only on the actual working expenses, including repairs, etc., but on the annual payments in redemption of the loan, and to debit this price against each Rural Council for the actual number of hours the rollers might be used by it, the price was fixed at $1.08 per hour for roller and full gang based on the following rates:

	Per hour
Hire of roller plant, including fuel, stores, etc.	$0.54
Wages of driver	.12
Wages of flagman	.08
Wages of two sweepers	.12
Wages of carter and horse for water cart	.14
Wages of overseer	.10
Total	$1.08

A steam roller account was opened in the county books crediting it at above rates with the total number of hours actually worked by the rollers and debiting it with the working expenses, including repairs, insurance charges, and repayment of loan.

Two rollers, with outfits complete, including scarifiers, watering carts, and sleeping vans, were purchased in March, 1904, one roller 10 tons, and the other 12½ tons in weight. Two more rollers, with accessories, were purchased in March, 1905, one 12½ tons, and the other 15 tons. A fifth roller, 15 tons in weight, with outfit complete, was purchased in March, 1908.

A special assistant to the County Surveyor was appointed in 1904 by the County Council to supervise steam rolling work, etc.

The five rollers have been kept constantly at work since their arrival, except during frosty weather and when being overhauled or undergoing repairs; the actual tonnage of broken stones rolled in has averaged annually for the 10-ton roller, 9,000 tons; for the 12½-ton rollers, 10,500 tons, and for the 15-ton rollers, 12,000 tons, the stones being rolled in at the rate of about 3½ tons per hour with the 10-ton roller, 4½ tons per hour with 12½-ton rollers, and 5½ tons per hour with 15-ton rollers. The cost of rolling per ton, therefore, to the various districts using the rollers works out at 31 cts., 24 cts., and 20 cts. for the 10, 12½, and 15-ton rollers respectively, based on the chargeability of $1.08 per hour for the time worked by each roller; the actual cost per ton for rolling done up to date has been considerably less than the above—taking the first two rollers, which have now completed six years' work, the roller account stands as follows:

The total chargeability or earnings at $1.08 per hour for time worked by the two rollers in the various rural districts for the 6 years ended the 31st of March, was $31,200.

The actual cost of working the two rollers during this period, including wages, fuel and all stores, repairs and renewals, insurance charges and repayment of principal and interest on loan, was as follows:

Working expenses, including wages of men, coal, tools and minor repairs	$21,728.64
Insurance of workmen, third parties and boilers	267.14
General repairs and renewals	1,127.52
Repayment of principal and interest on loan	4,519.80
Total working expenses for 6 years	$27,643.38

which leaves a credit balance on the first six years' working of two rollers at the rate of about $292 per annum per roller.

The rollers at the end of five years were each overhauled thoroughly, one driving wheel on a 12½-ton roller had worn so thin that it required steel plating, the working parts of both rollers which required tightening up or repairing were forwarded to the makers, and at the same time a boilersmith was engaged, taking out boiler tubes, cleaning same, and replacing defective ones, while a fitter was engaged facing up slide valves and other repairs which could be carried out on the ground. The total cost of this overhauling of the two rollers was $1,001.52, including $92 for steel plating one driving wheel. The only other items of important expenditure were the renewal of main driving axle, which fractured on two occasions, and the renewal once of a crank shaft. In the former case the makers supplied the replace axles free of charge.

The rollers at the present time, after six years' wear, are in fair working order, but no doubt new driving wheels and other renewals will become necessary during the remaining four years of their assumed life. However, I venture to say that the market value of the rollers, at the end of this time, might balance the cost of their upkeep in the meantime.

The cost of steam rolling by contract previous to 1904 was $1.24 per hour for the hire of roller and accessories, with the full working gang previously referred to, or about 30 cts. per ton, but since the purchase of county plant, the contractors have reduced their tendered rates to 90 cts. per hour, or 24 cts. per ton, and during the last few years from ten to fifteen hired rollers have been engaged in addition to the five county rollers, as provision is now made by the District Councils for steam rolling 180,000 tons annually, or about 75 per cent of the total stone supplies.

As the chief object in steam rolling when surfacing roads with broken stones, is to obtain a solid, durable and smooth surface, it follows that the best materials available must be used, combined with the best workmanship, to insure the best results. The broken stone selected should be hard and tough, and at the same time durable under wear and tear and the other agencies to which it will be exposed. On roads subject to heavy traffic excellent results may be obtained if broken approximately cubical to a uniform gage of from 2¼ to 2½ ins. On roads subject to light traffic, stones broken to a smaller gage of from 1½ to 2 ins. gave a smoother wearing surface. In both cases, if uniformity of size is adhered to, the surface will wear uniformly, provided the road foundation be strong enough to resist the pressure applied by the traffic without crushing or permanent set. The stone used in County Antrim is principally basalt, varying in structure from columnar to amorphous, and the best selected qualities fulfill approximately the requirements mentioned. The next item of importance is the binding material used in rolling. The ideal binding material is one which will hold the stones firmly in position, and eliminate internal friction, so that the stone will wear on the exposed surface only until it becomes as thin as a coin. With ideal binding material it should also be possible to make the road surface practically impervious to water. The application of tar or a tar compound as a binding material, when used properly, seems to give the nearest approximation to these requirements, but the cost on a large scale is prohibitive. The material used for binding in County Antrim is old road detritus, freed from impurities, by a lengthened exposure to rain, frost and sunlight. This may be well effected by heaping the road scrapings when consolidated, against the face of road fence at intervals along roads which are to be rolled. This can be done so as not to look unsightly by building up the material about 6 ins. wide and as high if necessary as the bank of fence will admit. In the opinion of many road experts, with this class of binding material it is possible to obtain a better bond and more durable surface than with either fine stone screenings or loamy sand. Any binding material should be very sparingly used.

The practice of steam rolling as carried out in County Antrim under the supervision of the writer during the period under review, has been as follows: When a length of road has been selected for rolling, before materials are laid down, the road is thoroughly cleaned by scraping, etc., the margins trimmed to give if possible a uniform width for the working surface, which is to be steam rolled, including in most cases the two side channels. When ready for rolling operations, the surface is scarified if worn unevenly, provided the crust is considered strong enough. The stone coatings usually applied vary in depth from 2½ to 6 ins., according to the strength of existing crust and the class of traffic to which it is subject. The greater part of the stones are run out from the recesses or sidings adjacent on wheelbarrows, but occasionally the supply for spreading has to be supplemented by horse work where the distance of recesses from point of spreading exceeds a barrow run. Two of the most skillful men are selected for spreading, as in the art of good spreading the result of the rolling in a great measure depends, especially in the case of unscreened hand broken stones, which contain a considerable amount of fine material. When filled into barrows or carts, the fine material

*By J. F. Beatty, A. M. Inst. C. E., Assistant Surveyor, County Antrim, Ireland

shakes to the bottom, and when the load is tipped up on the road, the fine material remains separate from the coars. A good spreader applies the stones so that the fine material is scattered over the coarse, while a careless spreader may cover one square foot with coarse stones and the next with fine ones, or perhaps leave all the fine ones where they were dumped, and simply level them by pushing over the top stones with the back of the shovel point. A skillful spreader draws back the shovel deftly from under the stones, causing them to spread and drop in the required position. An unskillful spreader tilts the shovel over and allows them to slide off without spreading them, and to this practice may be attributed in many cases the uneven wear of a steam rolled coating.

After stones are spread to the desired cross section on a short length and to as great a width as possible, after allowing a clear space for the passing traffic, the roller can proceed to follow up the spreaders, commencing at side of road with one driving wheel and gradually working up to the center of road, shifting only a few inches each time the roller returns. The number of times that the roller has to be passed over depends on the weight of the roller, the nature of the foundation and materials, and also on the thickness of the coat to be rolled. If the road on which the stones are spread is dry and hard, watering has to be resorted to at the commencement. With machine broken stones screened to a uniform gage, after the first rolling, sufficient half inch tone chippings are applied to fill up the interstices, and the cross sweeping, watering, and rolling is then proceeded with until the road presents a mosaic like surface, with the stones well wedged together and the flat sides up. When loose stones are crushed by the roller instead of being forced into the road, binding material well mixed to the consistency of thick cream is applied in small quantities sufficient to fill the voids, and the necessary consolidation will be attained when the creeping motion of the stones ceases, as they will then have been forced into contact and interlocked. Any surplus binding is then swept off the surface and the rolling is completed.

Last season several experimental lengths of rolling were done, using tar as binding material, and the best results were obtained in dry weather by first cleaning the road thoroughly, and tar spraying the surface before applying the ¾-in. in stones was then applied on the top of this layer, and after depth of tarred stone chippings, the coating of 2½-in. broken being thoroughly sprayed, almost at once settled into position without creeping appreciably under the weight of the 15-ton roller used. Stone chips were then applied and worked into the interstices by cross sweeping and rolling. After this the surface was again sprayed and covered with very fine stone screenings free from dust, and the traffic turned on.

The Management and Care of Steam Road Rollers.*

Owners of steam road rollers cannot give, in the writer's opinion, too much attention to the management and care of their road rollers, and the author therefore thinks it advisable to give a few suggestions on this subject.

First of all, a steady and reliable man should be secured to take charge, as a good driver will add years to the "life" of a steam road roller and save the owner considerable expense in repairs.

The boiler should be insured with a good company, as they will have it inspected periodically by their own inspector. These inspections will cause little inconvenience. They can be made when the boiler is being washed out, which should be done every 14 days, or even more frequently, if dirty feed water has been used.

The Boiler.—Insist upon having clean water used to feed the boiler. Unclean water is liable to injure the boiler plates, cylinder, slide valve, starting valve, and any other surface over which the steam from dirty water passes.

If a leak is noticed from the boiler have it stopped immediately; this is very important.

Special attention should be given to washing out the boiler, which should be done when the boiler is cold.

If a pressure of water cannot be obtained for this purpose use a force pump to remove all sediment which will accumulate in the boiler. All mud-hole covers, or plugs, and the man-hole cover should be removed before washing out is commenced, and the inside of the boiler carefully inspected before they are replaced.

Scale should not be allowed in the boiler. As a preventive, pure caustic soda used judiciously has been found to be most effective. The proper amount is, for very hard water, 1 oz. to every 5 gals. of water, and for water of medium hardness, 1 oz. for every 10 gals., and for fairly good water, 1 oz. for every 15 gals. In using caustic soda the blow off cock should be opened every night after work, when pressure is in the boiler, until the water in the gage glass has been reduced by about ½ an inch.

The tubes should be drawn and cleaned every three years and carefully examined. If there are any tubes badly grooved or pitted they should be replaced with new ones.

Leaking tubes should be tightened with a suitable expander, the rollers of which should not be allowed to go beyond the tube plate.

The rollers should be driven on rising ground so as to keep the crown of the fire-box well covered with water. In case the boiler through accident or neglect becomes short of water, the fire should be drawn, until the proper amount of water has been put in the boiler.

If at any time the fire has to be drawn, a cover should be placed on the top of the funnel to prevent cold air passing through the tubes. The ashpan lid should also be closed. If cold air is allowed to pass through the tubes they may leak, owing to the sudden contraction. It is also injurious to the fire-box.

The inside of the fire-box should be frequently scraped and brushed with a wire brush, especially the seams and screwed stay heads, also the smoke-box tube plate and smoke-box.

If the roller is to be laid aside for any length of time, it is advisable to grease the plates of the fire-box and smoke-box after cleaning.

Grease or oil should not be allowed inside the boiler.

The fusible plug should be examined frequently and kept free from dirt, and the fusible metal renewed at least every six months, or whenever it shows signs of leakage.

The lagging on the barrel of the boiler should be removed every three years, the plates well cleaned and painted with red-lead paint, composed of 88 per cent of red lead and 12 per cent of raw linseed oil. This is the most efficient of all paints in protecting iron from rust.

It is necessary to examine the water gage fittings every day and to keep the passages free from sediment. The feed water fittings on the boiler should be examined and cleaned when the boiler is washed out.

The Tender.—The water tank of the tender requires cleaning out frequently, as dirt will accumulate in it from various causes, which if not removed will pass into the boiler. It is important to keep the bolts which hold the axle boxes, tender, and horn-plates together, perfectly tight.

Feed Pump.—If the feed pump refuses to act, this is usually due to bad vacuum, caused by an imperfectly packed gland, or a badly-made joint of the suction pipe, or perhaps leaking check valves from the boiler. These points should therefore be carefully examined. A pet cock is usually fitted, which if used properly will in most cases allow any air or steam in the barrel of the pump to escape. The passage into the boiler must be kept free from any obstruction.

The Injector.—If the injector fails to act, it may be due to hot water, or dirt in the tank. Small pieces of wood or waste will often give considerable trouble if allowed inside the body of an injector. It is therefore well to take the injector to pieces if trouble is experienced.

Steam Pressure Gage.—It is very important to have the steam gage in thorough working order. It is wise to have it tested from time to time. A steam roller should not be worked without one in perfect order.

Getting Up Steam.—The fire must not be lighted until the specified amount of water is clearly shown in the water gage glass. The necessary pressure of steam should be obtained gradually; it is injurious to the boiler to raise steam too quickly.

Safety Valves, which are usually fitted on the top of the cylinder casting, must be kept in thorough working order and allowed to blow off at least twice a day when at work.

Cylinder.—The joint between the cylinder foot and the boiler should be kept perfectly tight; if an escape of steam is noticed, it is always better to re-make the joint.

The piston should be drawn from time to time, the rings examined and tried in the cylinder to ascertain if they are a perfect fit, which is essential to make the piston when at work steam tight.

The slide valve should be kept steam tight, and accurately adjusted to insure the engine working economically.

The starting valve, which allows steam to enter the steam chest from the boiler, should be absolutely steam tight, and properly adjusted; this is most important; if any steam passes this valve, when it is assumed the steam is shut off, the engine is liable to start and might cause some serious accident.

It is necessary to keep the exhaust passage and pipe free from obstruction. They should be examined at least once every three months. Oil and dirt frequently accumulate here, causing considerable back pressure and loss of power.

Glands.—Special care is required, when packing a gland, to make it steam tight and to give the least possible resistance.

Packing should be obtained of the correct size for each stuffing-box. The piece of packing nearest the steam pressure should be renewed frequently. This piece will collect a considerable amount of grit, which will damage the rod if allowed to remain too long in the stuffing-box. When screwing up the gland the stud nuts should be given the same pressure so as to keep the gland parallel with the rod.

Link Motion and reversing gear must be kept in thorough working order to obtain good results and economical working of the engine. If play is allowed in any of the joints the power of the engine will be greatly reduced, and any defect should therefore be repaired at once.

Bearings should be properly adjusted from time to time; knocking should not be allowed in any bearing. Studs which hold caps of bearings should be frequently examined to ascertain if they are properly secured in the brackets; the threads of the studs and nuts also require careful inspection. Threads of studs are often fractured when a bad knock is allowed in a bearing.

Lubrication.—It is advisable to use the best quality of oil for lubricating the moving parts of a steam roller; and although the cost of such lubricants may be high, they will be found the cheapest in the end.

Syphons made of fine brass wire and worsted should be fitted in all oil cups; the worsted should rest on the bottom of the oil cup and pass down the pipe with the wire, to below the bottom of the oil cup. The oil cup of the connecting rod big end should have the worsted projecting only half an inch out of the oil pipe, as the oil will be thrown over the pipe every revolution of the crank shaft. Have the worsted renewed frequently.

Traveling.—When traveling from one part of a country to another, a steam roller should not be driven at a greater speed than at the rate of three miles per hour. If the driving rollers slip on a frosty road, stone sets, or a steep hill, a little sand, ashes or small pieces of wood will generally, if thrown under the driving wheels, get over the trouble.

If the ground is soft and the roller sinks, it

*By Wynnd Eddison.

is far better to have it lifted up with a screw-jack, and timber placed under the wheels, than to allow it to force itself out.

When passing through towns and villages the roller should be driven slowly and no steam allowed to escape. The ashpan lid should be closed when passing thatched buildings, stacks, or other combustible material.

When the roller is stopped to take in water, or for other reasons, the driver should examine all bearings and see that all nuts and set screws are perfectly tight, and that no split keys are missing.

Laying Up.—If it is necessary to lay up a roller for any length of time, the back cover of the cylinder should be removed, and the inside of the cylinder well greased; the steam-chest cover and the stop-valve cover should also be removed, and the faces well greased to prevent corrosion. At all times the roller is better in a dry shed. In the summer months the water may be left in the boiler, if the boiler is filled up to the filling hole, but the water should be renewed every two months. In the winter months it is better to drain all the water out of the boiler and pipes.

The following is a summary of Acts of Parliament which relate to road rollers:

First: When traveling the flagman shall precede the roller on foot by not less than 60 yds., and shall carry a red flag constantly displayed, and shall warn the riders and drivers of horses of the approach of such locomotive, and shall signal the driver thereof when it shall be necessary to stop, and shall assist horses and carriages drawn by horses passing the same.

Second: The driver of a road roller shall give as much space as possible for the passing of other traffic.

Third: The whistle of a roller shall not be sounded for any purpose whatever, nor shall the cylinder taps be opened within sight of any person riding, driving, leading or in charge of a horse upon a road; nor shall the steam be allowed to attain a pressure such as to exceed the limit fixed by the safety valves, so that no steam shall blow off when the locomotive is upon a road.

Fourth: The roller shall be instantly stopped on the person preceding the same, or any other person with a horse, or with a carriage drawn by a horse, putting up his hand as a signal to require such locomotive to be stopped.

Fifth: A road roller must carry two efficient lights to be fixed conspicuously—one at each side on the front of same—between the hours of one hour after sunset and one hour before sunrise.

A long span masonry arch has recently been completed on the Bellegarde-Chizery Ry. in France. The main arch is 262 ft. 9½ ins. long and springs from one side to the other of a rocky gorge 215 ft. deep at the elevation of the structure. The arch is 4 ft. 11 ins. thick at the crown and 8 ft. 2 ins. at the springing lines. The main arch carries eleven spandrel arches supporting the roadway. In order to construct this arch three timber towers 133 ft. high were first erected and then a system of braced centering was built out from them, the whole calling for nearly 264,000 ft. B. M. of timber and about 30 tons of steel. The total cost of this structure is given as only about $90,000.

The Nevada Copper Belt R. R. Co. has moved its headquarters to Mason, Nev. Work on the extension at Wabuska to the smelter site of the Mason Valley Co. is well along.

Water-works and Sewer Section

Note: This section is devoted to methods and costs of constructing sewers and water-works. It will cover the construction work for all details of water supply and sewerage, including sewage purification and water filtration.

Method of Constructing Submerged Pipe Line Under the Kaministiqua River, Fort William Ontario Water Supply.*

The river at the point of crossing is 330 ft. in width and only one sounding revealed a greater depth than 25 ft. At this time the draft of boats operating beyond the proposed crossing to the coal docks of the Canadian Northern Ry. did not exceed 17 ft., but before the work was completed the erection of a grain elevator and the establishment of a rail dock by the Grand Trunk Pacific Ry. developed a large traffic by ships drawing as much as 21 ft. of water. This traffic was still further increased by tugs hauling scows to the dumping ground in the lake from the dredges working on the upper reaches of the river. The river has frequently a considerable current, and usually carries a quantity of alluvial matter in suspension. The water is naturally of a dark brown color, owing to its passage through the muskegs and swamps that abound at the head waters of the river. As a result fifty candle power lights can only be seen through it as a beacon at a short distance, and are of no value as an illuminant.

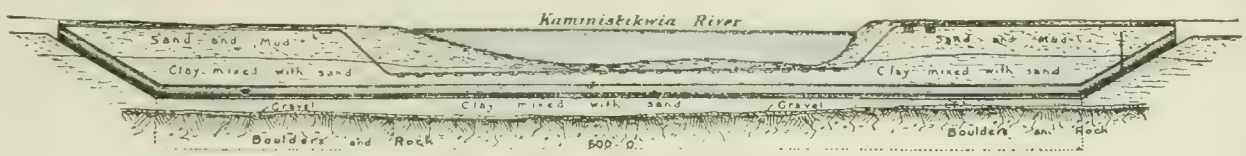


Fig. 1—Submerged Pipe Line and Proposed Tunnel.

The bed of the river is covered by several feet of alluvial deposit and sand, overlying a bed of blue-gray clay, itself containing a small percentage of fine sand. Solid rock of uncertain character is found at a depth of from 55 ft. to 58 ft. below water level. Overlying the rock is a bed of from 2 to 5 ft. in thickness of gravel and small boulders, bearing water under a head that rises in the boring tubes some 4 or 5 ft. above the surface of the river.

The question of a tunnel through the clay bed under the river was seriously considered, but it was decided that pipe lines would be sufficient for many years, and that this expenditure could be deferred until the growth of the city enabled it to bear the cost with less difficulty. Owing largely to an incomplete knowledge of the nature of the material to be encountered, this cost was originally thought to be much greater than will actually be necessary. It was also anticipated that pipe lines could be laid in a much shorter time, and the much needed temporary water supply more quickly obtained.

It was the writer's original intention, when the pipe line had been decided on, to dredge two channels and lay a duplicate main of hub and spigot pipe, with a flexible joint at every fourth joint, as sufficient until such time as a tunnel became necessary. The majority of the board of commissioners objected to the flexible joints and also to the ordinary lead joint for use under water. They wanted every joint under water to be a flanged joint, and were quite willing to bear any additional expense incurred by this method of construction.

The material for this work was ordered by the city from the D. Y. Stewart Co. of Glasgow some weeks prior to the award of the contract.

A special Y-connection was made with the pressure main on the south bank of the river, and two lines of hub and spigot pipe carried at a diverging angle of 45° with the center line until the ends were 100 ft. apart; 45° bends then carried the two pipe lines parallel 100 ft. c. to c. to the bank of the river, where they dipped by a one-eighth bend at an angle of 45° to a grade line 28 ft. below the normal water level of the river. This grade was matained for 300 ft. on both lines, at which point 45° bends were used to bring them to the surface, where a duplication of the arrangement on the south bank connected them at a second Y with the 18-in. main leading to the city. Every joint under water was a flanged joint. The flanged pipes were 12 ft. long, of standard specifications, ⅞ in. thick, and weighing not less than 2,000 lbs. per length. The flanges were ⅞x3 ins., supported by ribs, and provided with 12 ¾-in. bolts on a bolt circle of 22¾ ins. diameter. Corrugated copper gaskets were used for all flanged joints, after the turned faces had been thoroughly cleaned and lightly smeared with "manganesite" paste. Concrete cut-off walls were built around the pipes lying on both sides of every bend, as a support for the vertical bends and to resist the thrust tending to move the horizontal bends. Two 18-in. valves with spur gearing were placed close to the south Y and two laid flat with bevel gearing close to the north Y.

For the purpose of protecting the pipe at the water line from frost and from the danger of contact with boats two 50-ft. piles were driven 6 ft. c. to c., 18 ft. from the points where the pipes emerged from the river, 6 ft. nearer the shore, and 12 ft. c. to c., two more piles were driven, and two additional piles, 18 ft. c. to c., were driven close to the shore line. All these piles were securely tied together and into the bank with 8x12-in. walings and 12x12-in. internal cross bracing. Any tendency to slide into the river was overcome by attaching the whole structure to four ¾-in. wire ropes anchored to dead men 50 ft. from the river bank. A second line of waling was sunk on the inside of the piles at a depth of 6 ft.; 3x10-in. sheet piling was then driven on the inside of the walings around the frame thus formed, and the inclosed space backfilled to an elevation 3 ft. above the top of the pipe.

The specifications allowed the contractor considerable latitude as to the method to be adopted in laying this pipe. The essentials were that it be laid to grade on a solid bed: that it should bear a test pressure of 200 lbs. per sq. in.; that the contractor should bear all loss from breakage or damage, until the final acceptance of the work, and the method of laying adopted was to be entirely at his own risk. He was also to provide all necessary appliances for laying the pipe, drive all necessary piling and furnish a satisfactory and permanent support for the pipe.

This somewhat indefinite clause was almost forced on the writer by the very short time available for the production of the specifications and lack of time and opportunity to test some of the unknown factors in the problem.

Deferred delivery of the pipe delayed the commencement of this section until late in

*Extract from a paper by H. Sydney Hancock, Jr., presented to the Canadian Society of Civil Engineers

the summer. A sub-contract was let to the Great Lakes Dredging Co. of Port Arthur, the only company in the district at that time possessing the necessary dredges, scows, and diving outfit, and it placed an experienced diver foreman in charge of the work. The original soundings indicated that the solid clay foundation would be secured at the required depth. Two trenches 15 ft. in width were dredged across the river to a depth of 28 ft. below water level. The bottom of the trench was carefully prepared by a diver, assisted by careful measurements, and a firm level clay bed reported. Four lengths of pipe were then bolted together on the bank and lowered into a position by a hoist operating over the leads of a scow pile driver. Thus every fourth joint was made by a diver under water. Before the first pipe line was completed the writer contracted typhoid fever and tests were deferred until his recovery. Some of the bends had failed to arrive before winter set in, for which the contractor was not responsible, and it was necessary to extend the time of completion to the spring. The west pipe line had, however, been laid across and the most elementary tests proved it to be defective. The sub-contractors objected to doing any work during the winter, claiming, with justice, that the city had failed to supply pipe within the time contemplated by the contract. They finally, however, got their diver working, and just before the ice broke up, got east pipe line, three lengths at a time, care being taken that the joints that had been made under water should not be disturbed until they had been examined on the bank. This bank inspection revealed the fact that the previous diver, in his efforts to stop the leaks, had driven wood wedges between the flanges, forcing the copper gasket into the center of the pipe.

There being no effective hydraulic dredge on Thunder Bay and the dipper dredges in service only working to a depth of 29 ft., it was impracticable to lower the grade line for the purpose of securing a firm bed, and it was decided to support the pipe throughout its length. The obvious solution was to drive a double row of piles and support the pipe on the caps joining the two rows. Suitable materials and equipment for this form of construction were, however, not available, and the following was adopted in lieu of it:

Concrete blocks, 1x3x5 ft., were cast on the bank, reinforced with four bars of ½-in. round steel each way. Two ¾-in. inverted U-pieces of iron, with the points of the U hooked around the reinforcement, were placed in each block, so that when set two loops were exposed at either end of the block for the reception of the hooks of the hoisting chain. These blocks were laid at 12-ft. centers, supporting the center of each pipe. Often large quantities of silt had to be removed from the trench in order to reach clay. An 8-in. centrifugal pump was first used, with little success. Finally, two No. 4 Edson diaphragm pumps, attached to two lengths of hose, were found to work admirably.

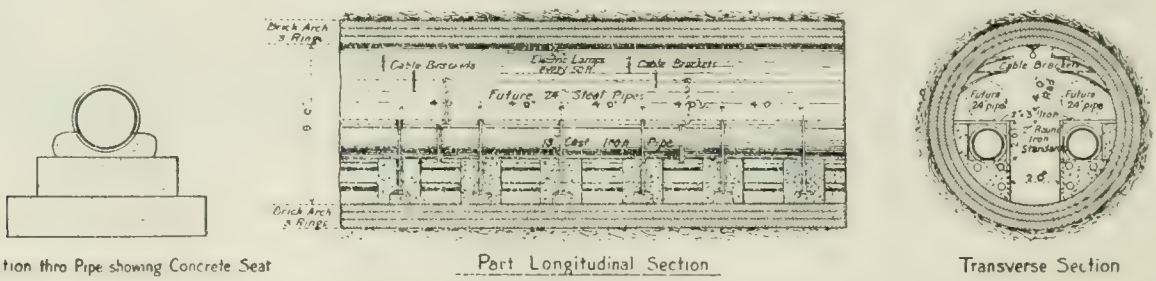
Further assistance was furnished by a 2-in. hose with ¾-in. nozzle, supplied with water from the reservoir at 125 lbs. pressure. The diver directed the ends of the hoses and nozzle. When solid clay was reached and a bed leveled by excavation, a block was lowered and leveled by means of a 20-lb. plumb bob. If the final elevation of the block was more than 1 ft. below grade, a second block, 4 ft. in length, was laid on the first, leaving a 6-in. step. In three cases, three blocks were necessary to raise from solid clay to within 12 ins. of the grade line. The elevation of the top block was then carefully measured, and a piece of flat, slaty rock of the necessary thickness was laid on the block to act as a temporary support for the pipe. A single pipe was then sent down and bolted up. A rich concrete of fine gravel was lowered in long sacks and worked between the pipe and the top of the block. The ends of the sack were padded up, so that when the concrete had set the pipe was supported by a cradle formed to the shape of the pipe. A blind gasket of ⅜-in. boiler plate was bolted to the open end of the pipe, and the whole line up to that point tested. A small hand force pump was the only pump available, and it refused to do better than 120 lbs. per sq. in. Ninety pounds was, however, easily secured after the pipe became full, the pump leaking badly above that pressure. If there was any fluctuation in the time required to raise the pressure, the last joint laid was carefully gone over until the best test was secured within the capacity of the pump, this capacity being checked on four lengths bolted together on the bank. Every joint was in this way tested under water. When the line was completed, a ¼-in. pipe from the pressure main was led through a blind gasket at the shore end of the river pipe. With the cock slightly turned, the river pipe held the same pressure, during a 24-hour test, as the pressure main on the shore side of the gate valve at the same elevation, or approximately a pressure of 125 lbs.

As concrete blocks were not considered in the original contract, an extra was allowed the contractor for this portion of the work. The personnel of the gang was as follows:

Foreman, at $8.00 per day	$ 8.00
Diver, at $10.00 per day	10.00
2 Helpers, at $3.50 per day	7.00
Hoistman, at $4.00 per day	4.00
6 Laborers, at $2.50 per day	15.00
1 Diving Suit, at $10.00 per day	10.00
1 Scow and Hoist, at $15.00 per day	15.00
Total per day of 10 hours	$69.00

A record was kept of the time spent in excavating for and placing the blocks, and resulted in the city paying the contractors $747 in addition to supplying the blocks. Thirty-five blocks were laid on this line under the horizontal 300 ft. of pipe on the river bottom, and as each block cost $4, the charges for material and labor amounted to $887, or $2.95 per foot.

The large river traffic greatly increased the cost of the work. The pipe lines were located at a bend in the river where light boats in a wind were swung over a wide range, and during the work in the middle of the river the passage of every boat meant a cessation of operation and the hauling of the scow well toward the shore line. This feature alone probably doubled the time spent on the work.



Section thro Pipe showing Concrete Seat — Part Longitudinal Section — Transverse Section

Fig. 2—Details of Submerged Pipe Line and Tunnel.

the line in such shape that the loss could be approximately measured as not less than 2,000 gals. per minute at a pressure of 125 lbs. Immediately after the ice had left the river they made further attempts to improve the line by tightening the joints. The failure of their force pump and the impossibility of procuring another, led, pending its repair, to the use of the pressure from the reservoir for temporary testing. One of the joints on the banks invariably blew out under this treatment, and some weeks were consumed in fitting a sleeve on this joint. When this had been fixed, gages on opposite sides of the river showed a pressure loss in the crossing of 3 lbs. and it was quite obvious that the joints under water were so badly made that the whole pipe line must be moved to effect a closure. The contractors were therefore notified that the pipe line must be taken up and relaid. They then took the position that the material supplied by the city was defective and that a tight joint could not be made with copper gaskets. This latter statement was easily refuted by an object lesson on the bank. The sub-contractors were in a rather strong position, as they owned the only available equipment within a large radius. However, after several weeks of acrimonious negotiation it was arranged that the chief contractors were to take over the work from the sub-contractors and that the latter would supply the necessary equipment at an agreed price per day. The chief contractors then arranged for the writer to directly handle the work, they to pay all costs.

Examination by an independent diver revealed the fact that, contrary to the report of the sub-contractors' diver, a clay bed had not been secured, and that there were holes filled with unsatisfactory material in the trench, varying from 1 to 3 ft. below grade, and in some cases extending over three or four pipe lengths. There was a slight deflection either up or down at each joint made under water, and some bolts were missing and others very loose. Work was commenced by raising the

The summer was drawing to a close when the first line was completed and put in operation. It was therefore deemed advisable to defer the relaying of the second line until the river was frozen over. Work could then be conducted from the ice and the delays due to navigation avoided, these advantages promising to more than offset the difficulty of working in very cold weather.

Prior to recommencing the remaining portion, however, a settlement was effected between the contractors and the city, by which the latter took over the work for an allowance of $2,500, its estimated cost, exclusive of blocks. When about half completed in January, 1908, the Dominion government announced its intention of dredging the river to a depth of 25 ft. and a width of 500 ft., in the course of a five-year programme. In view of this, the advisability of abandoning the pipe line and driving a tunnel was seriously considered. However, the low position of municipal bonds in the market at that time indicated that it would be sound finance to complete the pipe line and drive the tunnel at some future time within the five-year limit set for government operations, when the financial conditions would probably be more favorable. The second line was then completed at a total cost, including blocks, of $3,180. A slide at the north bank and an unexpected accumulation of sunken logs caused much trouble, but the cost only slightly exceeded expectations.

It is probable that a tunnel will be driven next year. While the main reason for this step is the contemplated widening of the harbor, it has become more necessary because of the rapid approach to a population of 30,000, foreshadowing the necessity of additional pipes, and to the fact that all large boats, in making this bend in the river, drag anchors if there is any wind, thus placing the pipes and cables (light and telephone) in constant danger.

Injury to the power cable seriously crippled

the work on the Loch Lomond tunnel, and in November last a boat dragging a large fluke anchor picked two lengths of pipe from one of the lines and carried them up the river. Both pipes were broken close to a flange, the remainder of the line remaining intact. The pipes carried away were Nos. 5 and 6 from the south bank. The flanges between pipes 4 and 5 were left, but the flanges between pipes 6 and 7 were carried away. Pipe 5 was replaced by an ordinary flanged pipe, and pipe 6 by one with a flange at its junction with No. 5 and spigot end to join 7. The joint between 6 and 7 was then made by a special sleeve, 24 ins. long, grooved and leaded and caulked under water with shredded lead. The pipe line is apparently as good as ever, having been in continuous operation since its repair.

The tunnel is to be 8 ft. internal diameter, lined with three rows of brick. Three concrete benches, 2 ft. wide, will support each 12-ft. length of the first double line, either 18 or 24 in. pipe. A second double line can be laid above the first when necessary on a steel staging. Conduits for cables will be placed in the benches, and additional racks provided above the pipe. The Kaministiquia Power Co. expects to carry its cables in the same tunnel in order to furnish power to the Grand Trunk Pacific Ry. terminals and elevators.

As a protection against accident, large notice boards were erected on both sides of the river warning navigators not to drag chains or anchors. Similar boards warning navigators of the presence of the pipe were placed 400 yds. up and down stream from the crossing. All boards are illuminated at night by red and white lights.

The cost to the city of the river crossing was as follows:

City Expenditure on River Crossing:

On pipe for river crossing	$ 5,317.00
Valves for river crossing	628.00
Gaskets for river crossing	134.00
Labor on second line pipe	2,676.00
Labor on second line—blocks	892.00
Cost of blocks, extra pipe, etc.	584.00
Pile driving and bank protection	415.43
Total	$10,640.43

The New Sewerage System of Louisville, Ky.—General Description of the System.

The city of Louisville, Ky., is constructing a $4,000,000 sewer system. This work, begun two years ago, will be finished two years hence, and will, when completed, provide one of the most complete sewer systems in the country, and from a standpoint of workmanship, one of the very best.

History.—Before outlining the sewer system itself, it will be necessary to take up a little of the history of Louisville which leads to the present work. Early sewer constructions in this city consisted in building storm drains, in what is now the business section. The primary object of these was the relief of the streets and adjacent property during heavy rains. As the city grew and a water system was introduced, these drains began to be used by the people as sewers. They were extended from time to time until 1870, when Gen. I. M. St. John, then City Engineer, made a careful study of the immediate and future needs of the city and recommended the building of a number of large trunk sewers. Several of these were begun by General St. John, and his successors in office have recommended and built others, both large and small, as the necessary funds were available.

The insufficiency of this sewer system, to serve the various parts of the city as well as the inadequacy of certain sewers to drain the districts for which they were built, was early recognized, but funds were not provided in sufficient amounts to keep up with the growth of the city, to say nothing of supplementing the system where found too small. Since 1890, very little sewer work had been done at all and in 1906 the old system consisted of about 113 miles of sewers. In many districts the system was outgrown; rains caused the flooding of many localities and sewage running in the gutters was a common sight.

After several propositions for issuing bonds were defeated in the elections of 1902 and 1904, the legislature of Kentucky, early in 1906, passed an enabling act, creating the Commissioners of Sewerage and authorizing, subject to ratification by popular vote, the issuing of bonds amounting to $4,000,000. This commission was immediately appointed and began work at once by appointing a Board of Engineers. This board prepared a report which was submitted to the General Council and which outlined several schemes, one of which was approved by the council and was ratified by popular vote in November, 1906.

The first topographical map of the city for the study of the Board of Engineers was prepared under the supervision of the Geographer of the United States Geological Survey, and through an arrangement by which the topographers were furloughed from this organization and employed by the Commissioners of Sewerage. About this time Mr. Samuel M. Gray, of Providence, R. I., and Mr. Harrison P. Eddy, of Worcester, Mass., were selected as consulting engineers. These men, with the Chief Engineer, Mr. J. B. F. Breed, constituted the Board of Engineers and the new sewer system for Louisville has been designed and is being constructed entirely under the supervision of this Board. The engineering force has been gradually increased from the beginning and the complete organization is shown by the accompanying diagram, Fig. 1.

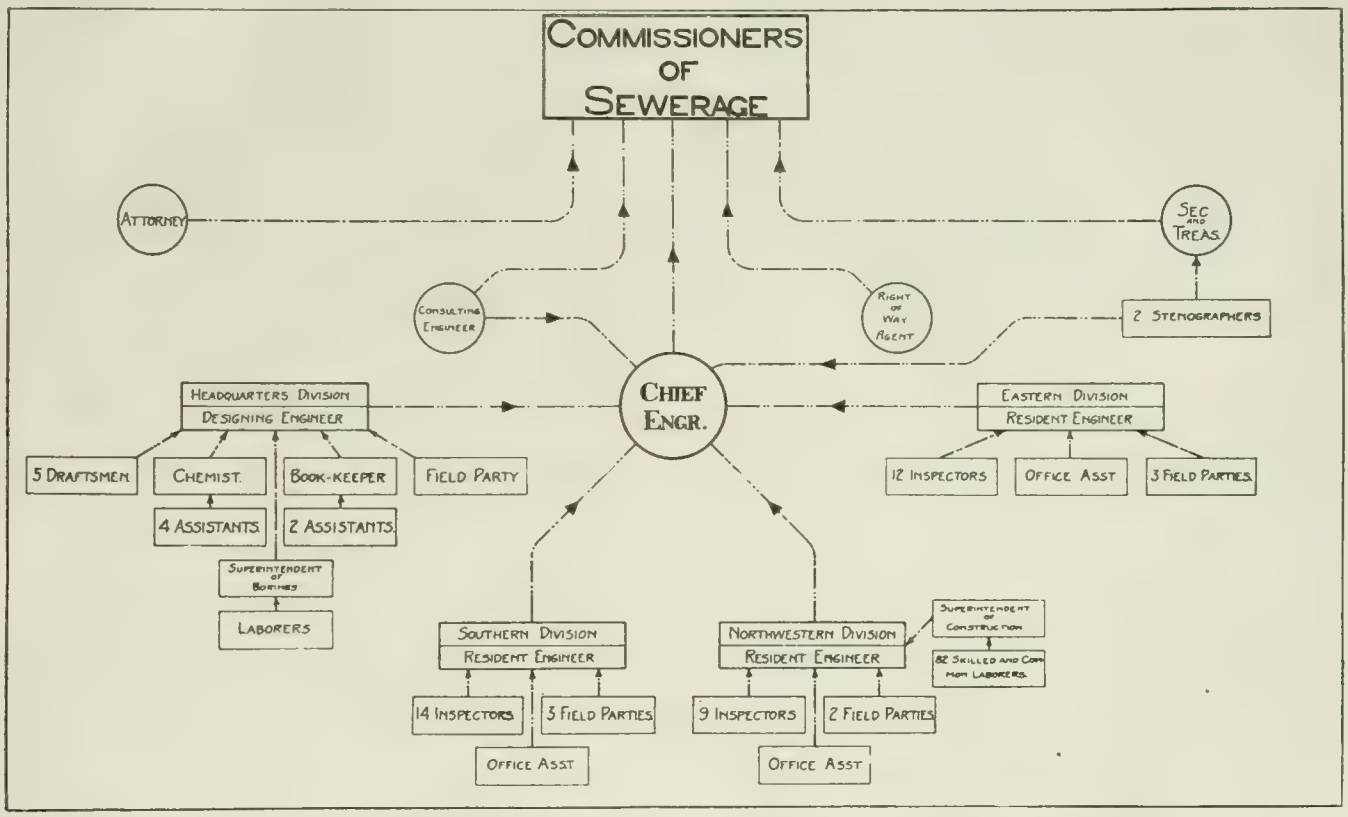


Fig. 1—Diagram Showing Organization of Engineering Department, Louisville Sewer Commission.

Topography.—The Ohio River flows past the city forming its north and west boundary lines. The river runs over a ledge of rock at Louisville, upon which it forms a series of rapids or low falls, the total fall of 28 ft., taking place in a distance of about 5 miles. When the river is high, however, this fall is not 28 ft., but is sometimes less than 1 ft. Thus below the falls the fluctuation is much greater than above them. A movable dam, built by the Government at the head of the falls, keeps the river at a depth of 9 ft. above that point. A large portion of the city is built upon a very level plateau which extends from Beargrass Creek west to the river. This plain is covered by a shallow layer of soft alluvial clay, below which is found a coarse sand, and in some places, considerable gravel. This gravel deposit is a reservoir for water which has been drawn upon for domestic and industrial supplies since the earliest days. Throughout the city are many wells on street corners, which were formerly the only means of supplying water for the city. The natural

outlet for this ground water is through the high banks of the river below the falls. Here are found large springs which run at all times during the season of low water in the river, but which are submerged when the river is high. Thus the ground water level rises while the river is in flood and falls during the low water season. This is especially true near the river bank. A peculiarity in the city topography is shown in the way in which most of the creeks find their way to the river. They all parallel the river for a considerable distance before finding a way to join it. This peculiarity was originally true in all cases, but has been changed in the case of Beargrass Creek which is now diverted by an artificial embankment and flows straight-away to the Ohio.

That part of the city east of Beargrass Creek differs widely in topography from the western portion of the city. From Beargrass Creek the land rises rapidly and is cut by several valleys having steep slopes. The soil is mostly clay, beneath which is a very irregular limestone ledge.

Improvement of Beargrass Creek.—A question in connection with the work of building sewers in Louisville, which has also been taken up and reported upon by the Commissioners, deals with the improvement of Beargrass Creek: This stream, which has three branches, drains an area of about 65 square miles and has for years been used as an open sewer. It is crossed by many bridges which obstruct the flow in times of high water. The districts near its banks have been inundated from time to time and enormous damage has been done. At times families were compelled to vacate their homes, and have even been taken from them at night by the Fire Department on account of a rapid rise in the stream.

The main line of the Louisville & Nashville Railroad which parallels the creek for about a mile, has been submerged so that trains were required to move very slowly, and at times, traffic has been entirely suspended. Manufacturers along the creek have suffered inconvenience and loss at intervals of increasing frequency. The bed of the South Fork of the creek is in places so high that several of the existing sewers do not have a free outlet even at times of low water, and at times of small freshets they are entirely submerged. This is a condition which is remedied by the Beargrass Intercepter, described later.

Since the time the city first built sewers discharging into the creek, the sewage has increased to such proportions that the stream has become a source of filth and very offensive and dangerous to the health of people living near it. The South Fork has been more troublesome by far, than either of the others because of its overflow, because it receives more sewage than the others, and because it has been the most subjected to encroachment by the erection of embankment and buildings, by the construction of a concrete channel 300 ft. long. The general scheme for the improvement will provide adequately for all flood waters in the creek. The Ohio River floods, however, will probably continue to cause overflows for short periods, but this is a condition which cannot be provided for at a reasonable expense.

Plan of Sewers.—The sewers outlined in the present plans, Fig. 1, constitute a comprehensive system. The old sewers will be intercepted, except in one or two minor cases, and provision made for taking care of the entire city and the outlying districts. It is intended to complete the main sewers first and devote the balance of the $4,000,000 to building the lateral sewers. This plan has been followed quite closely and at the present time most of the trunk sewers are completed or are nearing completion and many laterals are under construction. The main trunk sewers in the western part of the city are the Southern Outfall, the Northwestern Intercepter, and the Western Intercepter.

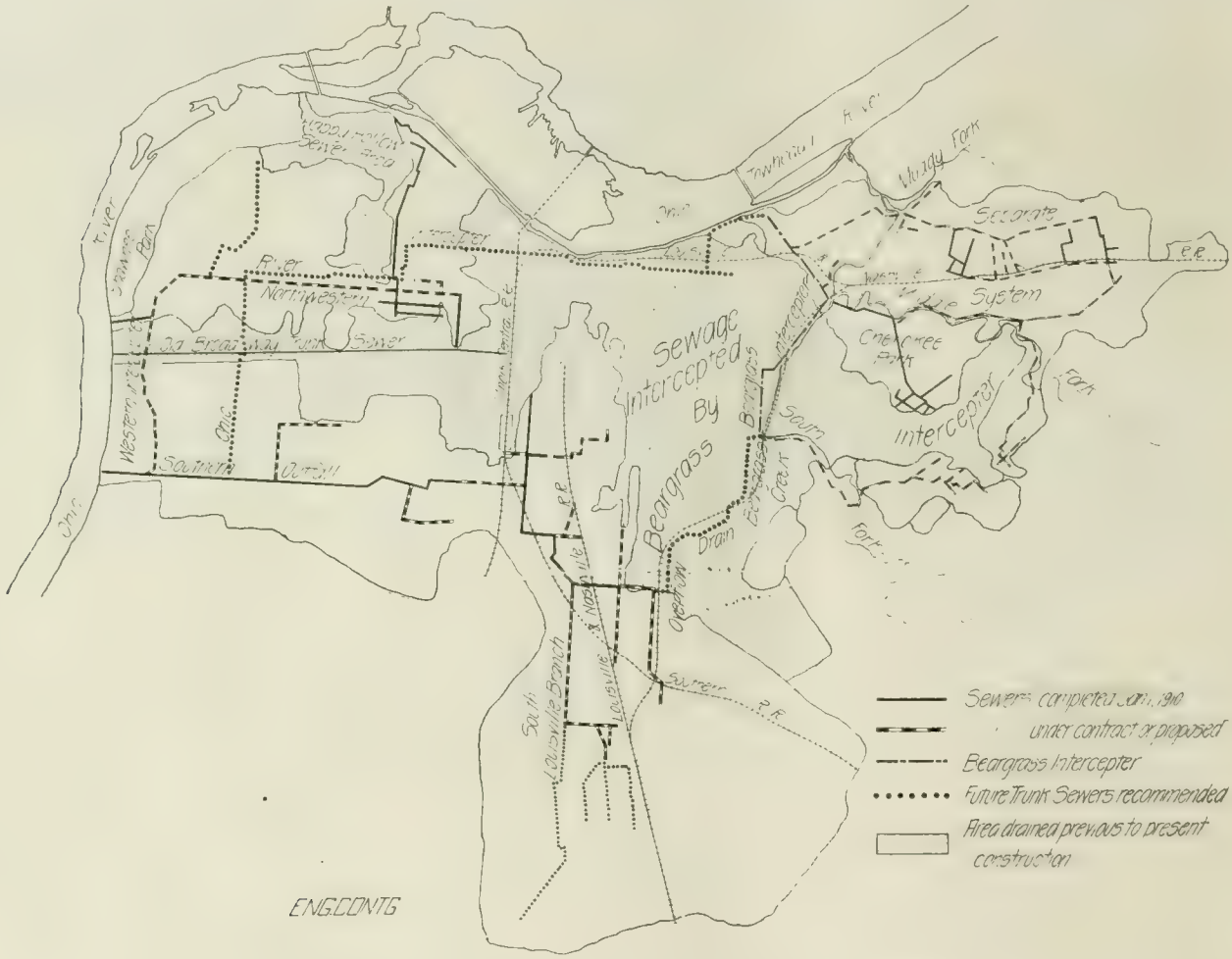


Fig. 2—Map Showing Plan of New Sewer System for Louisville, Ky.

The Southern Outfall is the largest trunk sewer in the city. It is about 5 miles long and is horseshoe shaped in its largest section being 15 ft. 6 ins. in horizontal diameters and 15 ft. 2 ins. in height. It will drain, when first put to use, about 7,000 acres, most of which is now improved land.

The crown of the sewer at its outlet is 378 ft. above sea level datum and, after the 9-ft. stage is established in the river below the falls, it will be below the surface of the water at all times. The 9-ft. stage will be at an elevation of about 383. The banks of the river here are high and the last section of the sewer is on a very steep grade, and of reduced section. This part is founded on concrete piles carried to solid rock. The extreme end of the outlet structure is founded on solid concrete carried down and into the bed rock for a depth of 4 ft. This was done on account of the tendency of the river banks after heavy rains, to move toward the channel. In the center of the invert on this outlet structure,

there is a channel 3 ft. wide and 2 ft. 10 ins. deep, the bottom of which is lined with a half section of vitrified sewer pipe. This channel is used for the dry weather flow, which will have a very high velocity—the grade here being about 37 per cent. The vitrified pipe was used rather than brick because of the absence of longitudinal joints at which sewer inverts on steep grades usually show the greatest amount of erosion, and for the great wearing qualities of the pipe. Above the outlet structure and drop chamber, the grade is flattened to 1 in 2,000 for almost the entire length. The sections of the sewer are reduced at different intervals and at the upper end the diameter is 7 ft.

The South Louisville Branch Sewer is designed to drain about 2,000 acres in the southern suburbs of Louisville, and empties into the Southern Outfall and has a diameter of 10 ft. at the junction point. The section of the city which this sewer drains will eventually be developed and improved to such an extent that the run-off from storms and the amount of sewage will be large at times as to tax the capacity of the Southern Outfall. For providing relief the Overflow Drain to Beargrass Creek was designed. In this way, it is intended that in times of severe storms the overflow from nearly 2,000 acres of one of the upper watersheds of the Southern Outfall, will be diverted to the Beargrass Intercepting Sewer, to be described later. In times of dry weather and also of moderate storms, the weir arrangement at the junction of the Southern Outfall and the Overflow Drain, will cause the flow to the Ohio River to be by way of the Southern Outfall.

The Northwestern Trunk Sewer has its outlet in the Ohio River at Shawnee Park. It is so designed, however, that the dry weather flow will not empty into the river at the park, but will be carried to the Southern Outfall sewer by an intercepter. The topography and other conditions at the outlet of the Northwestern Trunk Sewer are very similar to those at the outlet of the Southern Outfall and the design is, therefore, quite similar, except that as this sewer will discharge only storm water, the outlet has not been placed so low and no special dry weather flow channel has been provided. This sewer is designed to be high enough to discharge into the Western Intercepter and also, that it may pass under the intersecting streets at a suitable depth, it was necessary to make its height come within a 9-ft. limit. The sections are therefore wide where the largest areas are required. The largest section is 13 ft. 6 ins. wide by 9 ft. high and the reductions are gradual, the smallest section being 6 ft. wide and 6 ft. high. The lower part of the sewer from the point where the Western Intercepter takes the dry weather flow, to the river, has a length of about 1,900 ft. and passes under a hill which is parallel to the river. The deepest cut required here is about 41 ft.

The Western Intercepter already mentioned is designed to intercept the sanitary flow of the Northwestern Trunk Sewer and also that of the old Broadway sewer and carry their flow to the Southern Outfall. The Broadway sewer has its outlet, at present, in the Ohio River at the foot of Broadway and this point is now entirely unsuitable for the outlet of a sanitary sewer on account of the location of the park and the proximity of the residence district. The location of the Western Intercepter is in a valley, called Paddys Run, which parallels the river and is only about one-half mile from it. This valley is a part of Shawnee Park and heretofore the odors from the waters of the Run have been very objectionable. The sewer is 5 ft. in diameter from the Southern Outfall to Broadway and from there to the Northwestern Trunk Sewer it is 42 ins. in diameter.

The Beargrass section of the city is the eastern part, the topography of which has already been described. The Beargrass Intercepter is a trunk sewer designed to intercept all sewage formerly emptying into the several branches of Beargrass Creek. The sewage from about 7,829 acres will be discharged into the intercepter. In determining the quantity of sewage to be provided for by this sewer, the tributary area was divided into districts of three classes, residential, manufacturing and mercantile. A study was made of the topography and other conditions which will affect the nature of the future development of the city and it was decided that it was reasonable to expect that 7,141 acres would be devoted to residential, 622 acres to manufacturing and 66 acres to mercantile purposes. It was assumed that the sewage from the residential districts would average 100 gals. per person per 24 hours. From the manufacturing districts provision was made for 24,000 gals. per acre per 24 hours, and in the mercantile district allowance was made for 30,000 gals. per acre per 24 hours. Added to this was an allowance of 1,960 gals. per day per acre of leakage of ground water into the sewers. In the residential districts tributary to the Northeastern Trunk and Middle Fork Sewers, the population was estimated to become 25 persons to the acre and the remainder of the residential territory was estimated at 40 persons to the acre. In computing the sizes of sewers, it was assumed that the maximum rate of flow would be double the average rate, and the intercepter has been designed to carry this quantity when running full. The largest section is 6 ft. 6 ins. in diameter.

The branches of the Beargrass Intercepter follow, in a general direction, the three branches of the creek. They are the Northeastern Trunk Sewer, the Middle Fork sewer, and on the South Fork the sewer is called the Beargrass Intercepter. The outlet into the Ohio River is at a point near the foot of Tow Head Island and is so placed as to be about 3 ft. below the ordinary 9 ft. stage of the Ohio River.

The Northeastern sewers are designed as a separate system. Most of the sewers are small and the storm water is carried away in its own system of pipes. The sanitary sewage is carried under the main channel of Beargrass Creek by means of an inverted syphon and passing under the diversion embankment follows the old bed of the creek until its junction with the main sewer. The land near the old bed of the creek is low and marshy. Tests were made here for determining the bearing power of the soil, and it was found advisable to drive piles for the support of the sewer. Three rows are driven, one row in the center of the sewer and one row under each of the side walls. The top of the sewer here is generally above ground. In carrying out the idea of a separate system for this sewer, it was found advisable to carry the structure for each sewer on the same foundation piles and (this is a concrete sewer) it was designed so as to have the sanitary sewer directly above the storm sewer, both being part of the same structure. The storm drain, however, flows east in an opposite direction to the other, and the grades are so arranged.

The foregoing text outlines the general plan and scope of the work which will be described in more detail with data on construction, methods and costs in several future articles. With few exceptions all the work is being done by contract. The organization for carrying on the work has already been mentioned. One feature deserving further notice, however, is the close record of the work which is being kept.

A complete system of determining the costs to the contractor is being kept by the inspectors on all work. These costs are turned in each week by the Resident Engineers and are compiled by the cost keeper. The expenses of the contractor are divided into three items, namely, cost of plant and equipment, materials of construction, and labor. A loose leaf system is employed for the use of the inspectors, there being several forms to fill out each day. Copies of these forms were shown in ENGINEERING-CONTRACTING for Nov. 7, 1909.

The men in charge of the work in Louisville are Mr. Harrison P. Eddy, Consulting Engineer; Mr. J. B. F. Breed, Chief Engineer; Mr. J. H. Kimball, Designing Engineer; Mr. F. C. Williams, Resident Engineer of the Southern; Mr. Harrison P. Wires, Resident Engineer of the Northwestern, and Mr. Howard S. Morse, Resident Engineer of the Eastern Districts. We are indebted to these gentlemen for assistance in securing information from which this article and those which will follow have been prepared.

(Continued from page 521.)

the usual theoretical course and in addition twelve months of practical work, all in the space of four years, the school work being arranged so that successive groups of students will furnish continuous service to the employer.

As compared with the engineering student who takes the school work only, he will be the gainer in the following respects:

1. Because of the opportunities to observe in detail the methods of production and the conduct of business, and the results of his contact with the men who are carrying on our engineering industries, he will be able to do his school work more effectively.

2. For the same reasons, he will upon graduation be of greater use to his employer. Indeed many graduates will find good positions where they have done practical work on this co-operative plan, which they can fill satisfactorily from the start. In this regard the graduate who takes his course on the co-operative plan will possess a distinct advantage over the graduate who has taken school work only.

3. The money consideration received for this practical work will be ordinarily sufficient to meet the tuition expenses for his entire course at the university. In all cases the student of engineering will be materially benefited by thus early learning from actual experience the viewpoint of the wage earner; and the money received will be to many students an item of no small importance.

Courses in civil, mechanical, electrical, chemical and sanitary engineering are offered by the School of Engineering of the university, in all of which there is incorporated the principle of co-operation. These five courses are arranged so as to be identical for the first three terms. This permits of developing the student to a certain extent along the lines which are common to all engineering before requiring him to choose the specific course he is to pursue. These first three terms are looked upon as a probationary period in the sense that the nature of the work done by any particular student during this period will determine in the judgment of the faculty whether or not he is to be advised to continue in the School of Engineering.

Work in the Engineering Industries of the Pittsburg District.—This work is conducted under actual commercial conditions and covers four terms of three months each, distributed through the middle of the student's course at the university.

The purpose of this work is to give the student of engineering an understanding of the conditions and methods of the practical side of the profession which he expects to follow after graduation. This can only be obtained by actual contact with the engineering industries, and should be acquired at the earliest possible date. The student works side by side with other employes, and gets an insight into labor conditions. He has the opportunity to observe in detail the methods of carrying on engineering work and the conduct of business from the productive standpoint, and learns much of value in his formative years which cannot be had from either his professors or books.

While the university has made special arrangements with a number of our local concerns for the benefit of its engineering students, and will co-operate with the management of these concerns in every way possible, yet the student will be considered as a direct employe of the concern. He will serve as a regular employe for six regulation working days each week for which he will receive the regular wages of a student apprentice, and shall be expected to observe strictly the rules and regulations of the company, and shall work under existing labor laws and conditions, including those pertaining to liability for accidents.

This industrial practice will be arranged so that the student will have an opportunity, as far as practicable, to engage in work pertaining to any phase of engineering in which he may be particularly interested.

Unclassified and General Articles

Note: This section is devoted to methods and cost articles on construction work not properly coming under any of the preceding classifications.

Methods and Appliances Employed in Erecting the Chicago, Milwaukee & St. Paul Railway, Missouri River Brigde at Mobridge, South Dakota.*

In extending the Chicago, Milwaukee & St. Paul Ry. to the Pacific Coast in 1907 and 1908, the first great river to be crossed was the Missouri, which was intersected where the river sweeps through a flood plain one mile in width, twelve miles west of Glenham, South Dakota. On the bluff near the edge of the flood plain cut out by the river, a town site was located and named Mobridge on account of its situation. It was decided to construct a high bridge at this point, and the structure which was determined upon is shown in outline by Fig. 2, and is located as shown by Fig. 1. The bridge was designed and constructed by the Bridge and Building Department of the C., M. & St. P. Ry. under the direction of Mr. C. F. Loweth, Engineer and Superintendent of Bridges and Buildings.

The grade of the track was made at an elevation of 65½ ft. above the low water in order to allow for a clear headroom of 50 ft. above ordinary high water, as required by Act of Congress. At the site of the bridge the low water channel is 1,450 ft. in width, and the width of the high water channel is 100 ft. greater. The bridge over the main channel, as shown by Fig. 2, consists of three 420-ft. through pin connected truss spans, approached from the east by one 125-ft. deck span, and from the west by 283 ft. of steel trestle connecting to a long frame trestle, which has since been partially and will ultimately be entirely replaced by an earth embankment.

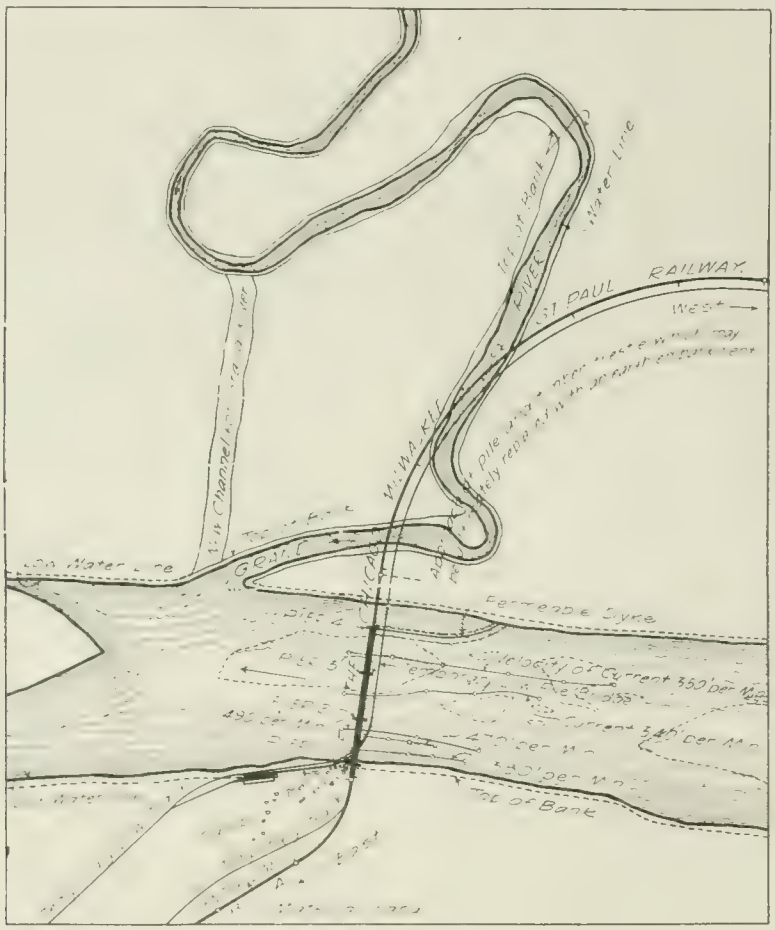


Fig. 1—Location of Bridge and Approaches at Mobridge, S. Dak.

The abutment forming the east end of the bridge is set back a safe distance from the water's edge, Fig. 2, and the trestle at the west end is protected by a permeable dyke and woven willow mattress and stone riprap, located as shown in Fig. 1.

ERECTION.

The 125-ft. deck truss at the east end and the 420-ft. main channel spans were erected on false work shown by Fig. 3, but no false work was used for the erection of the steel trestle at the west end.

A temporary pile bridge which was situated 90 ft. up-stream from the permanent bridge, as shown by Fig. 1, was driven across the river, carrying a track 13½ ft. above the low water. This bridge was put in, first to get construction material across the river for construction of the railroad during the interval in which the permanent bridge was under construction and second, to serve the construction work on the permanent bridge, although not most conveniently located for this second purpose. This pile bridge was in continuous use from the time the foundations were started until the main channel spans were swung clear of the falsework.

The main channel spans were erected on false work by means of an ordinary bridge traveler. The details of the false work for the main channel spans are shown by Fig. 4. The details show the false work to consist of pile bents *A* extending 19½ ft. above low water and supporting frame bents *B* 36 ft. 8 ins. in height, which in turn support the stringers *J* carrying the traveler track *F* and also the stringers *I* carrying the pony bents *C* which support the railway main track *G*. Bents *A*, *B*, and *C* are the several stories in the main bent *D*, which supports the truss at the panel points. Main bent *E*, located midway between panel points, carries the traveler and railway track only, and is of somewhat lighter construction, but consists of three stories similar to bent *D*.

Such of the pile bents *A*, which formed the lower story of the false work, as were driven in the ground from *E* to *F*, Fig. 3, which was above water and dry during their construction, were driven by a track driver running on a temporary track which was laid on the bents already driven, the track driver driving one bent in advance, piles being cut off and capped, and stringers and ties placed on the cap to permit the pile driver to move forward.

The piles for the false work, from *F* to *G* and *G* to *H*, Fig. 3, were carried out on the temporary pile bridge Fig. 1, on push cars and rolled off into the stream at a point opposite where they were to be driven. The pile bents *A*, Fig. 4, from *F* to *G*, were driven by a pile driver mounted on a scow located as shown in Fig. 6. On one side of the scow a longitudinal timber *A*, Fig. 6, was attached at a distance from center of the leads which would give the correct spacing of the piles from center to center of pile bents. The scow was placed with this timber bearing against the piles in the last bent driven, and the pile *B*, in the new bent driven. The driving of the remaining piles in the new bent followed, the scow being allowed to float down stream each time a distance equal to the spacing of the piles. The scow was moved down stream the proper distance each time and held in its true position by a rope *C* running from the winch head on the engine to the temporary pile bridge, and also by a rope *D* running from the winch head on the opposite side of the engine through a sheave on the deck of the scow and then to one of the piles in the last bent driven. This served to hold the scow tight against the pile bent last driven and prevented its rotation in the current.

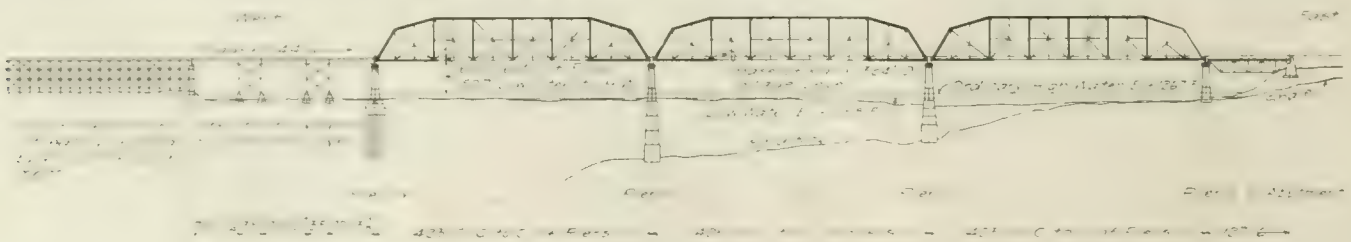


Fig. 2—Elevation of Bridge at Mobridge, S. Dak.

As shown by Fig. 4, the frame bent *B*, consists of nine 12x12-in. posts, the four outer

*Extracted from a paper by J. H. Prior, Assistant Engineer, Bridge Department, C., M. & St. P. Ry., presented to the Western Society of Engineers.

posts on each side being braced as a unit and in such a manner that these four posts could be lowered from the track on the completed bents *A* with a derrick car and braced back to the finished portion of the false work so as to support the stringers and track, thus completing a panel of false work. The half-bents mentioned, consisting of four outer posts together with their bracing, were assembled to a template on a platform on shore, the platform being near enough to the track to be within reach of the derrick car, and were then picked up by the derrick car and carried out and put into place.

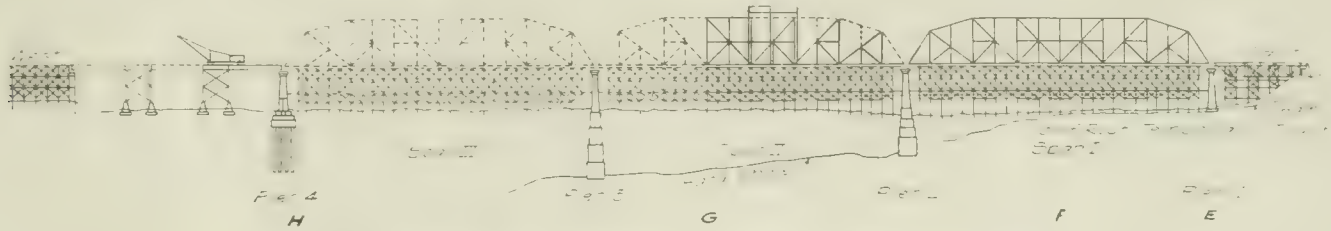


Fig. 3—Elevation of Falsework for Bridge at Mobridge, S. Dak.

The piles for the falsework bents from *G* to *H*, Fig. 3, were driven from a scow in the manner just described, but the frame bents *B* for this portion of the false work were assembled in a horizontal position on top of the pile bents and then erected into position by the derrick car one panel at a time in advance of the completed portion of the falsework, the derrick car operating from the railway track which rested on the steel floor beams and stringers. In order to permit the derrick car to operate from the railway track, it was necessary to carry on the erection of the steel floor fast enough to place the floor beams and stringers next to the end of the false work structure as soon as the bents upon which they rested were erected. As soon as erected, the bracing of Fig. 5 was placed giving stability to the bent. The pony bents *C*, Fig. 4, were not used in this portion of the falsework, the derrick car being carried by the steel floor beams and stringers, each panel of which was placed as soon as the frame bents were raised into position. Although Fig. 5 is not a sketch of this portion of the false work, it shows at *D* how the steel floor was placed from which the derrick car was operated. The material for this portion of the false work was that which had been previously used in span *I*, Fig. 3, and was now available as span *J* had been erected and swung clear of the false work.

The traveler which spanned the truss, Fig. 7, moved longitudinally on the traveler track *F*, Fig. 4, and Fig. 7. The railway main track *G* was supported by the pony bents *C*, Fig. 4, Fig. 5 and Fig. 7, until the erection had proceeded to a point where the pony bents *C*, together with the stringers which they support, were removed, and the track placed with the steel stringers and floor beams of the permanent bridge as shown at *D* and D^1, Fig. 5.

As shown in Fig. 5, the bents detailed in Fig. 4, are placed 15 ft. centers. This permitted of the use of the Railway Company's standard bridge material to a great extent without cutting, and made the second-hand timber from the bridge only slightly less valuable than new material. It was possible to make the intermediate bents *E* of lighter construction than the bents *D* at the panel points as they carry only the traveler and the railway track, the dead load of the trusses being carried by bents *D*.

The traveler used in erecting the 420-ft. spans is shown by Fig. 7, and consists of three bents 85 ft. high, made long enough to erect one full truss panel of 60 ft., or two sub-panels of 30 ft. each, without moving, and extending 3 ft. beyond the panel point at each end, in order to afford a platform for the men while making the connections at three separate panel points.

The traveler was supported by a runway on each side consisting of two rails marked traveler track F, shown by Fig. 7. A runway of two rails instead of one gave a wider platform for the engines, increased the stability of the traveler, and afforded a place for the men to stand while driving the pins and a place for them to work when the main track *G* was loaded with cars. Figure 7 shows an outline of the traveler. The detail drawings for this traveler from which the material was ordered and the traveler was framed were made in advance, but as in a device of this kind, it is not practicable to make a scientific frame structure with determinate stresses without a greater expenditure than is justified by its purpose, the details are not reproduced in this article.

As shown by Fig. 7, the traveler consists of three bents which support the stringers *D* which in turn carry the tie beams *K*, *L*, etc., from which is suspended the tackle by which the loads are handled b means of a U-bolt shown at *E*. The maximum load for which the traveler was designed, was a top chord section which weighed 52,000 lbs.

The general arrangement of the traveler lines is shown by Fig. 7. The traveler power was furnished by four 30 H. P. hoisting engines on the platforms, two on each side. Each engine had two drums and three spools as shown by Fig. 7, in a diagramatic manner. Tie beams *L*, *M* and *N* are similar to the tie beam *K*. Tie beam *K* is carried by the stringers *D*, and has passed through it a U-bolt *E* which carries the blocks *a* and *b* which are rove with six parts of ⅝-in. diameter steel cable, the lead line *ab*, of which passes through a snatch block *d* at the top of the traveler, thence to the snatch block *e* at the bottom of the traveler and thence to the forward hoisting drum *q* of the engine. From the tie beams *L* and *M*, Fig. 7, are suspended four part tackles, a^2-b^2 and a^2-b^2, and are suspended in a similar manner to the tackles from the tie beam *K*, the lead lines a^3-b^3 and a^2-b^2, of which pass through the snatch blocks *d* and *f*, respectively at the top of the traveler, thence to the snatch blocks *e* and *h*, respectively, at the bottom of the traveler, and thence to the rear hoisting drums *p* and *r* of the engines, respectively. The blocks b^1 and a^1, suspended from tie beam *N*, have similar lines arranged as shown by Fig. 7.

The tie beam *K*, in addition to transmitting the load in the tackle to the stringer *D*, acts also as a strut and prevents the lateral pull of the tackle when hanging at an angle with the vertical, from overturning the stringer *D* or pulling it laterally from its true position.

There are two runner lines from each engine which were used to raise some of the lighter members; such as the line *m*-*n* at *T*, Fig. 7, which passes from the load which it is supporting to a sheave *m* through a sheave *n*, through a sheave *t* and thence to the winch-head *X* on the engine.

In making the drawing Fig. 7, some minor details of the traveler were slightly changed to simplify the drawing. One two-sheave blocks being shown at points *D* and *N* instead of the two one-sheave blocks used at these points on the traveler.

The runner lines run out to about the points shown by Fig. 7, but were shifted some to suit conditions. The traveler was only used for the erection of trusses, the floor system and bottom laterals having been put in with a derrick car. Figure 7 shows the heavy top chord section being placed in its final position. The chord was run out on a flat car *H* to a point opposite its position in the truss. The tackles *a*-*b* to a^3-b^3 from the tie beams *K*, *L*, *M*, etc., were attached to the chord by a chain sling. The lead lines on all tackles were hauled in until the chord was lifted clear of the car. By increasing the velocity of haul of the lead line of the tackles in position *u* over those in position *y*, the load is given a considerable lateral movement bringing it to the position *W* at a low velocity but remaining under control

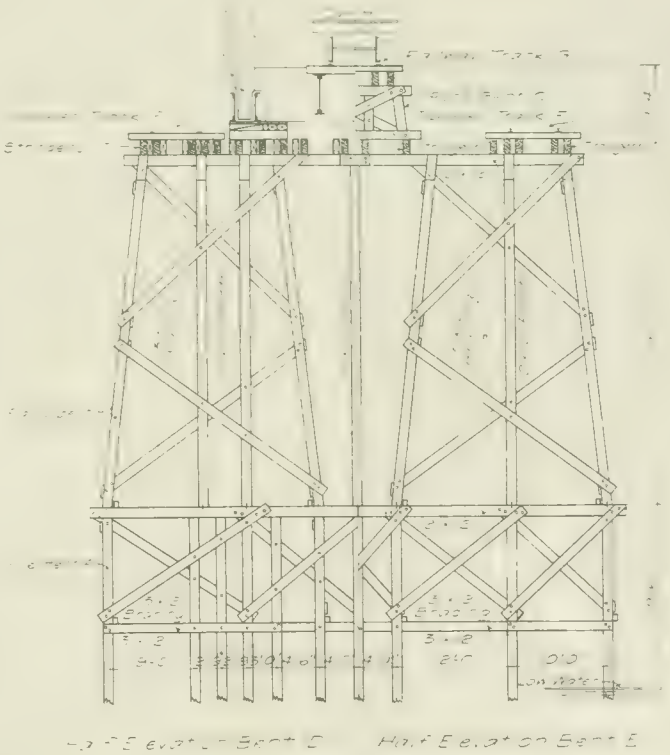


Fig. 4—Detail of Falseworks Bent.

of the tackle *y*. This makes it impossible for the load to swing laterally with a velocity which would injure the traveler if the lateral drift of the load were not controlled. After reaching position *W* it was lowered into place, connections made and pins driven.

The lighter members were raised as shown at *T*, Fig. 7, by means of a tackle from one side of the traveler only and when raised from the car were prevented from swinging laterally with any great amount of force by the snub-line *l*, which was snubbed around some timber in the traveler and played out under control, thus governing the lateral motion of the member.

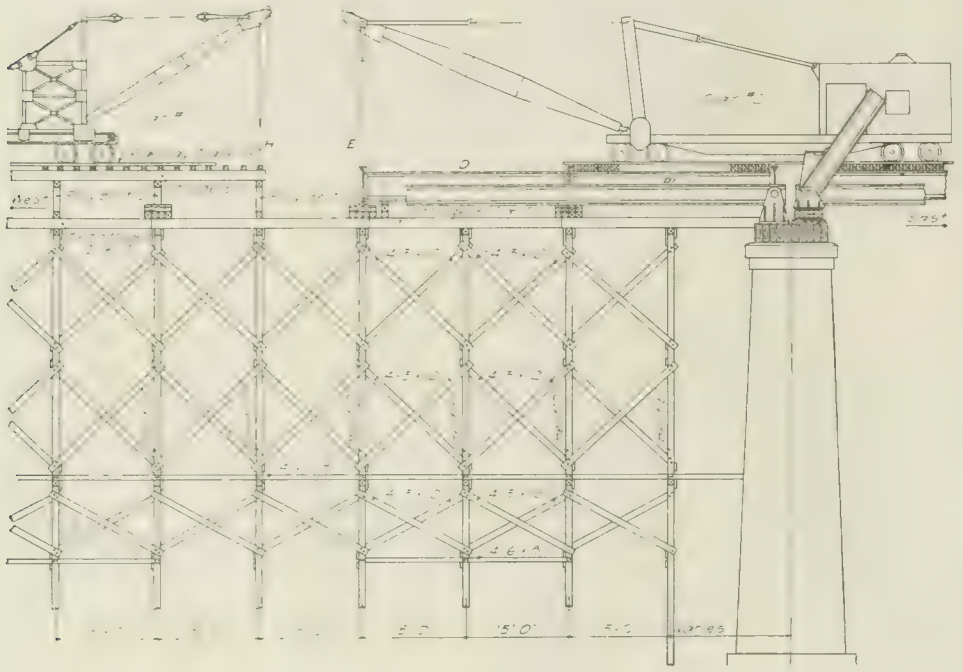


Fig. 5—Sketch Illustrating Method of Erection from E to G, Fig. 3.

The traveler received its motion on its runway longitudinally from one end of the span to the other by means of a line having its ends fastened to the piers at the ends of the span and containing enough slack to permit its being wound when required three or four times around one of the spools of the hoisting engine, as shown at *Z*.

Each bent of the traveler was framed in six sections on a platform on shore. These sections were carried out to a point on the false work where the sills of the traveler had been previously placed and bolted together. The three bents were placed partly one above the other as shown by Fig. 8, the feet of the bents being chained in their true position to the sills of the traveler, which in turn were fastened to the false work. The first bent was raised by means of auxiliary bent, *Z*, 42 ft. high, Fig. 8, by means of the seven-part block and tackle, one end of which was fastened to the top of the traveler bent and the other end of which rested on the top of the auxiliary bent, the lead line of which passed over the top of the auxiliary bent, thence down to a snatch block fastened to the false work, and thence to a spool on the engine of the derrick car. The end of the tackle nearest the auxiliary bent was a three-sheave block held by a double 2-in. manilla pendant rope passing over the top of the auxiliary bent and fastened to the false work. The bent was raised into position by hauling on the lead line, which caused the tackle to pull on the top of the traveler bent until it was revolved through the angle *A* to a vertical position. The second and third bents were raised in a similar manner except that the traveler bents already erected were used instead of the auxiliary bents.

The material yard was located as shown by Fig. 1, about one-quarter mile from the east end of the bridge. The steel was shipped to the material yard from the shops in gondola cars as fabricated and was unloaded by a derrick car. It was sorted and piled in the material yard as it was unloaded. The heavy material was unloaded on the temporary track at *C*, Fig. 1, and the lighter material was strung through a distance of a mile from *A* to *B* and beyond on both sides of the main track.

The 420-ft. spans from points *E* to *G*, Fig. 3, were erected on the bents shown in Fig. 4, on which the pony bent *C* was used. First, on account of their great weight, the shoes built up bottom chord sections and posts L^2-M^2, were erected with the traveler, the material being carried out on flat cars running on the railway track *G*, Fig. 4, which rested on the pony bents *C*, then lifted from the flat cars and placed in their proper location by the traveler tackles *a*-*b* to a^3-b^3, Fig. 7, in the manner similar to that previously described for the top chord. Following this the floor system and bottom laterals were put in by a derrick car in the following manner. In order to place bottom laterals and floor beams, the pony bents *C* and stringers *L* of Fig. 5, just in advance of the portion of the floor already placed and occupying approximately the position of the steel floor beams and stringers about to be erected, were removed by derrick car No. 1, Fig. 5, which had been backing away from the portion of the structure already erected. This derrick car No. 1 removed the temporary floor in advance of the portion of the steel work about to be erected and placed the material from the temporary floor upon the falsework alongside, where it could be picked up and carried off the structure when the floor was connected. After derrick car No. 1 had removed the panel of temporary floor immediately in front of it, it moved backward and picked up the next panel of floor to the west. Simultaneously with this, derrick car No. 2, Fig. 5, had been operating as follows: A load of floor beams and stringers were pushed out on a flat car in front of the derrick car and unloaded on the false work alongside of the track as near as possible to their final position longitudinally. The flat car in front of the derrick car was then pulled out and the derrick car returned and placed the floor beams and stringers, which it had just unloaded, in their final position.

During the entire time that the floor system and bottom laterals were put in by a derrick car, the gap or the break in the track between points *H* and *E*, Fig. 5, was open. After the floor beams, stringers and bottom laterals were placed, the track was restored and all material erected from this stage in the erection onward was brought out under the traveler on cars and erected by the traveler.

The steel floor having been placed, the end connections of the floor beams formed a convenient support to which all vertical posts could be fasteend and be made secure without much guying. These posts, together with the other web members and the remainder of the bottom chord, were next erected in the following manner. Enough material for one full panel of bottom chord and web members was run out at one time on flat cars on the railway track *G*, Fig. 7 and Fig. 4, and erected by the traveler. Pins were then driven, except top chord pins.

Starting then with the center of the span and working to the east end, the top chord sections, batter posts and top struts were put in, the pins being driven as the several panel points were reached. The traveler was then started back to the center of the span putting in the top laterals and completing the sway bracing of the span which it had just erected. The movement of the traveler continued past the center of the span to the west end, erecting the remainder of the top chord, batter posts and bracing. The pins were driven with a steel ram 6 ins. in diameter by 16 ft. long and weighing 1,600 lbs., suspended from the top of the traveler and operated by men working from whichever platform in Fig. 7 was just below the pin to be driven.

All bottom chord splices were riveted before the span was swung, and all other connections were riveted after the span was swung. Two crews of nine men each were used in the traveler, one crew on each side. An average of about 14 days was required to erect each span, counting from the time that the first work was done in placing the shoes until the span was swung clear of the false work.

The portion of the bridge from *G* to *H*, Fig 3, was erected in a similar manner to the portion from *E* to *G* except that in this portion the false work pony bents *C*, Fig. 4, and Fig. 5 were omitted, the steel floor beams and steel stringers being placed on the falsework stringers *I*, Fig. 4 and Fig. 5, and the track laid on top of the steel stringers. The laying of the ties and rails on top of the steel stringers completes the track in the panel so that the derrick car can run out on this portion of the track which rests on the erected portion of the steel floor and erect in a similar manner the floor beam and stringers another panel ahead of the completed portion of the structure as shown in the right hand portion of Fig. 5.

On acocunt of the danger of the approaching high water, the erection of the steel followed closely on top of the erection of the false work, from the point *G* to *H*, Fig. 3.

One derrick was either employed in upending the frame bents *B*, Fig. 4, which were assembled on tops of the pile bents *A* below or else was employed in placing the stringers. As soon as the panel of falsework had been completed, this car moved back to pick up and place the steel floor beams and stringers necessary to complete the panel. In this way the erection of the false work and the erection of the steel upon it were carried on practically simultaneously.

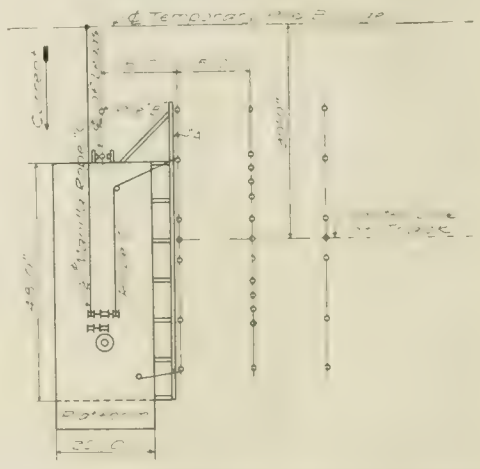


Fig. 6—Sketch Showing Method of Driving Piles for Falsework.

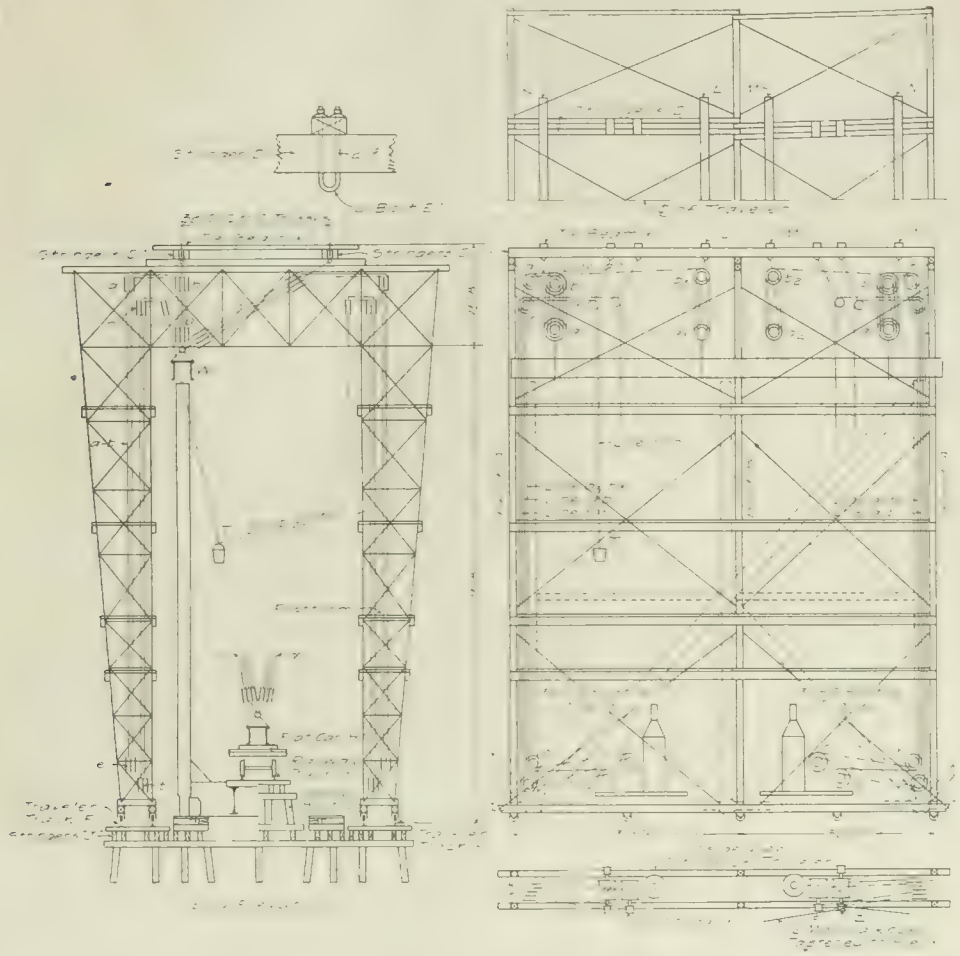


Fig. 7—Traveler for Erecting 420-ft. Spans.

The end posts, or the end top chord section, at one end are the last members of the truss to be erected as previously described. This is due to some features of camber blocking shown in 13, 14, and 15 of Fig. 9. In 15 in full lines at B is shown an outline of the truss when subjected to the dead load of its own weight. In dotted lines at C is shown to an exaggerated scale an outline of this truss when resting on the camber blocking, each panel being distorted as is shown in dotted lines and to an exaggerated scale at D in such a manner as to make the diagonal distance b less than the diagonal distance c and less than the true fabricated length of the member which will be located in the diagonal b. It is a simple matter to give each panel the shape shown at A be means of camber blocking as the rectangle, the top and bottom of which are formed by the top and bottom chords respectively and the sides of which are formed by the posts, approximates a four-sided figure each side of which consists of a stiff member but which is hinged at the corners. As the length of the diagonal distance b is less than the member occupying this position, by decreasing the amount of camber blocking, the panel at A can be brought toward a position shown by light lines E in which the distance center to center of end pins on diagonal b is exactly equal to the distance center to center of end pins of the member which occupies this position in the structure, allowance is, of course, made for the conditions of sag, temperature, etc., under which the member is being erected. This use of the camber blocking permits making the necessary adjustments so that all members of the truss can be erected except the closing side. If the center section of top chord 13, Fig. 9, is chosen for the closing member, any error between the fabricated length of the top chord and the space left for it in the truss in amount equal to e would make it necessary to alter the elevation of truss by the amount d equal to $\frac{f \times e}{g}$, but if the end post is chosen as a closing member the total amount of vertical movement required for a similar error of like amount is shown in 14, Fig. 9, to be $\frac{f \times e}{g}$ or about three-fifths of the foregoing. An advantage is also obtained through the pin connection at either end of the end post which permits of the use of the large force available from a pilot nut driven by a ram to force the last member into position.

The steel trestle approach at the west end, Fig. 3, for which no false work was built was erected as follows: As the bridge was erected from the east toward the west, it was necessary to carry the material for the steel trestle through the 420-ft. spans. As the portals and the transverse bracing for these spans limited the clear head room, it was impossible to bring out columns for the steel trestle suspended from the boom of the derrick car, without fouling the transverse bracing of the trusses. Two columns, therefore, were loaded on a flat car which was pushed out ahead of the derrick car to a point near the west end of span III, Fig. 3, adjoining the trestle approach. The columns were then lifted from the car by the derrick car boom, one column being placed each side of the track resting on the floor beams, as there was sufficient room to store these in this position for a few hours. Following this, two panels of transverse bracing for one bent and laterals for one girder span were loaded on a flat car in the same manner, pushed out and unloaded on a few temporary timbers laid from the top flange of the stringers to the bottom chord of the truss. The lateral bracing for one girder span which had been placed on the same car with the transverse bracing for the bents, was unloaded by being merely thrown from the car onto the track between the rails, members being light and containing no large projecting gusset plates, their position between the rails did not affect the clearance for cars moving over them.

The flat car was then pulled in the clear, the derrick car returned and picked from its position one column to the top of which had been fastened longitudinal and transverse guy lines. The derrick car moved forward with the column at the end of the boom on the portion of the structure already completed, the length of the boom, 80 ft., permitting it to place the column a full span in advance of the completed portion of the structure. The remaining column of the same bent was placed in a similar manner and the two upper panels of transverse bracing were placed by being carried out on the boom of the derrick car and lowered by runner line into place. When the connection of these two upper panels had been bolted and driven the column was stable transversely, and longitudinal guy lines made it also stable longitudinally.

This completes any panel to the situation shown by the position of the derrick car by

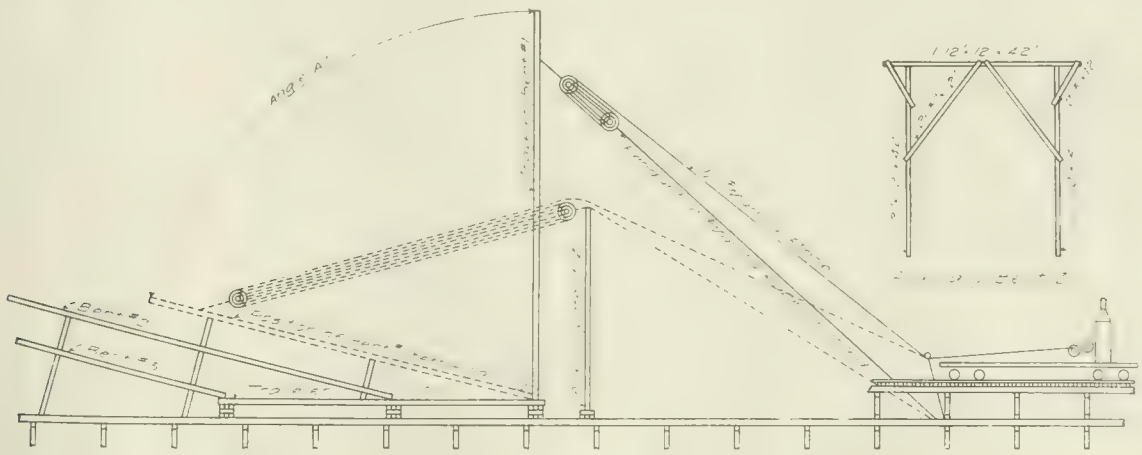


Fig. 8—Sketch Showing Method of Raising Traveler Bents.

Fig. 3. As shown by this figure the girder was then brought forward on the boom of the derrick car and lowered into position, being held by the tackle until the ends were bolted and until the nearest end of the girder had been guyed. The second girder of the span was then placed in a similar manner. The girder cross frames were then placed with a runner line from the boom of the derrick car, and the top and bottom laterals were placed by hand and bolted to the lateral plates which had in turn been bolted to the girder before it was lifted from the car. Next the derrick car returned to shore and brought forward, suspended from the boom, ties for the girder

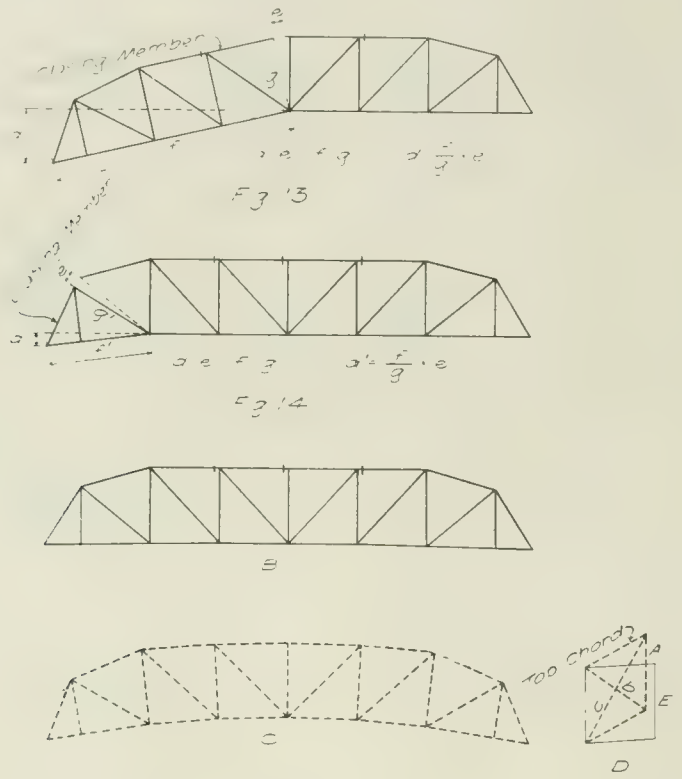


Fig. 9.

span. These ties were lowered to the deck and simultaneously the bridge carpenters commenced separating the ties and laying the track rails while the iron men were placing the longitudinal tower bracing with the boom. This operation completes the erection of the bridge.

Material for this article was obtained by the writer in his work as assistant engineer in charge of the drafting room of Bridge and Building Department of the C., M. & St. P. Ry.

The Universal Portland Cement Co. has recently adopted an accident relief plan for the benefit of its employes, corresponding to one which has been made operative among all the subsidiary companies of the United States Steel Corporation. Under this plan an employe injured in the performance of his services is paid weekly a fixed proportion of his wages, determined on terms of service and whether he is married or single. In case of permanent disablement stated sums based on wages are paid for stated injuries, and in case of death stated sums, also based on wages and on the number of those dependent on the worker, are paid to the family. The money for this fund is to be furnished entirely by the company. This plan will be tried for one year and its operation studied for future action.

An aeroplane flight from Albany to New York city, a distance of 137 miles, was made on May 29, 1910, by Glenn H. Curtiss, in the time of 2 hours and 32 minutes, giving an average speed of 54.06 miles per hour. One stop of about an hour was made at Poughkeepsie, N. Y.

The Average Car-Mile Cost of Operating Seventy-Five Electric Railways in New York State, Second District.

All steam and electric railways in New York State report to one of two public service commissions. The commission in charge of the "first district" receives the reports of all railways in the city of New York. The commission in charge of the second district receives the reports of railways operating in New York State outside of New York City. The commission's report for the second district for the year ending Dec. 31, 1908, includes an itemized statement of the operating expenses of each of 75 electric railways. Very few totals or averages, however, are given in this report, but the data are so important that we have expended no slight amount of labor in ascertaining the totals for these 75 railways, from which we have deduced the average operating expenses, using a Thatcher cylindrical slide rule for the latter purpose.

Of the 75 electric railways reporting, 72 had a total of 85,445,439 car miles; the other 3 did not report their car mileage for the year 1908, but from previous reports we are able closely to approximate their car mileage, and thus find that the grand total was 85,642,000 car miles for the 75 railways.

The average operating expense during 1908 was as follows per car mile:

	Cents per car mile
Maintenance of Way and Structures:	
1. Track and roadway	1.502
2. Electric line	0.453
3. Buildings and fixtures	0.091
Total Maintenance of Way, etc.	2.046
Maintenance of Equipment:	
4. Steam plant	0.060
5. Electric plant	0.068
6. Cars	0.765
7. Electric equipment of cars	0.609
8. Miscellaneous equipment	0.039
9. Miscellaneous shop expense	0.125
Total Maintenance of Equipment	1.669
Operation of Power Plant:	
10. Power plant wages	0.345
11. Fuel for power	0.176
12. Lubricants and waste	0.023
13. Miscel. supplies and expense	0.039
14. Hired power	2.463
Total Operation of Power Plant	3.046
Operation of Cars:	
15. Superintendence of transportation	0.335
16. Wages of conductors	2.507
17. Wages of motormen	2.579
18. Wages of miscel. car service men	0.250
19. Wages of car house men	0.448
20. Car service supplies	0.124
21. Miscel. car service expense	0.324
22. Hired equipment	0.045
23. Cleaning and sanding track	0.125
24. Removal of snow and ice	0.109
25. Undistributed expense	0.063
Total Operation of Cars	6.901
General Expense:	
26. Salaries of general officers	0.333
27. Salaries of clerks	0.281
28. Printing and stationery	0.046
29. Miscel. office expense	0.064
30. Store expenses	0.046
31. Stable expense	0.033
32. Advertising and attractions	0.138
33. Miscel. general expense	0.344
34. Damages	0.985
35. Legal expense due to damages	0.048
36. Miscel. legal expense	0.072
37. Rent of land and buildings	0.050
38. Rent of tracks and terminals	0.197
39. Insurance	0.208
Total General Expense	2.845
Grand Total Operating Expense	16.498
Taxes Accrued	1.222
Total Operating Expenses and Taxes	17.720

There were 4.108 passenger fares collected per car mile, the average rate being 5.692 cts. per passenger, making a passenger revenue of 23.39 cts. per car mile. Additional revenue from operating (express, freight, advertising, etc.) brought the total operating revenue to 24.742 cts. per car mile. Hence the operating ratio (16.498÷24.742) was 66.7 per cent.

The track mileage was as follows:

	Miles
First track	1,784
Second track	598
Total trackway	2,382
Switch, sidings and car house	147
Grand total track	2,529

The rolling stock was as follows:

Passenger Cars:	
Closed	1,809
Open	1,240
Combination	50
Semi-convertible	621
Combined with express	40
Total Passenger Cars	3,730
Other Cars:	
Baggage	12
Express and freight	155
Miscellaneous	4
Total Other Cars	171
Service Cars:	
Snow plows	173
Sweepers	49
All others	348
Total Service Cars	570
Grand total	4,591

The 3,931 revenue cars are equivalent to 1.65 cars per mile of trackway.

The following statistics are per mile of trackway (2,382 miles of first and second track):

	Per mile of trackway
Car miles	35,953
Operating expense	$5,932
Operating revenue	8,899
Maintenance of Way and Structures:	
1. Track and roadway	$576
2. Electric line	127
3. Buildings and fixtures	33
Total Mn. of Way and Strs.	$736

The number of car miles per mile of trackway (35,953) is less than half the number on the average steam railway in America, the latter being 78,540 car miles per mile of trackway (see Gillette's "Handbook of Cost Data," 2d edition, page 1,460).

There were 3,931 revenue cars, and they averaged as follows per car:

	Per car
Car miles	21,783
Maintenance of Equipment:	
6. Cars	$167
7. Electric equip. of cars	131
9. Miscel. shop expense ($90,000)	22
Total Maintenance	$320

We have prorated the item (9) of miscellaneous shop expense.

It will be seen that the maintenance of each operating car cost $320. This is almost exactly the same as the average maintenance cost for the electric cars of all the railways in Massachusetts (Gillette's "Handbook of Cost Data," page 1449), whose first cost averaged $4,000, and half of which cars were open cars used only in the summer. About 40 per cent of the electric cars in this second district of New York state were open, and it is

highly probable that the average first cost was about the same as in Massachusetts. This would indicate that 8 per cent of the first cost of cars is annually spent in maintenance; but, as nearly half the cars are idle at any given time (the open cars not running when the closed cars are in use, and vice versa), it would appear that the annual maintenance would approach 16 per cent of the first cost if all cars were in service throughout the year.

The number of car hours is not reported for all the roads of the second district, but an average of more than half the car mileage shows 8.7 car miles per car hour. This is a rather high schedule speed, and accounts largely for the fact that conductors' and motormens' wages aggregate only 5.077 cts. per car mile, as contrasted with 6.962 cts. for the New York City Ry. Co. lines (see ENGINEERING-CONTRACTING, May 4, 1910), whose average schedule speed was 7.56 miles per hr.

In studying the operating expenses it will be noticed that only a small percentage of the electric power was generated by the railway companies. Unfortunately the number of kilowatt hours used is not reported. In this, as well as in several other respects, the reports made by the Commissioners of the First District is much more satisfactory. The reports of neither district give the average weights of equipped cars, which is an exceedingly important factor in judging the economy of operation. The old railroad commission of New York State used to require reports of the *maximum* weights of cars of each class, but this was futile, for it is the *average* weight that determines the resistance to acceleration, which is often the main resistance encountered in operating street cars. The average weight also makes it possible to estimate the first cost with considerable accuracy, and the first cost largely determines the cost of maintenance.

It is to be hoped that future reports of the Public Service Commission of the Second District of New York will give the number of employes of each class and their respective wages. With these suggested additions, the report will be entirely admirable and hardly susceptible of much improvement until an appraisal shall be made of the physical property of the electric railways. This must inevitably be done, for without such an appraisal no precise interpretation of the maintenance costs is possible, to say nothing of the impossibility of a scientific determination of the reasonableness of rates.

The Street Railway Association of New York has distributed the following compilation of operating statistics (for 1908), relative to the 75 electric railways under consideration:

Maintenance of way and structures	$ 1,754,505
Maintenance of equipment	1,422,599
Cost of power	2,608,755
Conductors and motormen	4,351,391
Other transp. and traffic expense	1,558,187
General expense, incl. insurance	1,551,335
Damages and legal expense	884,625
Rentals	214,567
Taxes	1,046,913
Interest	1,270,515
Total	$19,663,342
Operating revenue	$21,194,486
Surplus	$ 1,531,144

This statement would show a low surplus, or true profit, if the item of interest, $4,270,515, were known to be a fair rate of interest on the actual cost of reproducing the property. This interest, however, amounts to $1,792 per mile of trackway, which capitalized at 4½ per cent, is $39,825. The question then remains whether a less amount than $39,825 would reproduce a mile of trackway and its equipment. There is not the slightest doubt, as we shall show in a subsequent issue, that such trackway (with its 1.65 cars per mile and its corresponding power equipment) could be reproduced for less than $30,000 per mile, or about 75 per cent of the $39,825. Hence if we deduct 25 per cent of the $4,270,515 interest and add it to the $1,531,144 surplus, we shall have $2,598,800, which is approximately the true profit, and this is 12¼ per cent of the gross operating revenue. This is not an enormous profit—probably less than the average derived from sales in mercantile or manufacturing businesses.

As shown editorially in our issue of May 25, this method of viewing profits as a percentage of gross receipts is the only rational one, but it necessitates a knowledge of the money invested or the cost of reproduction. The interest (4½ per cent or thereabouts) on the invested capital should be regarded as a part of the actual cost of producing any article, whether it be a cubic yard of concrete or a car mile of transportation. Having deducted this interest, operating expenses and taxes from the gross operating revenue, we have left the true profit, which should be rated as a percentage of the gross operating revenue, in order to make equitable comparisons not only with other public service corporation profits but with the profits of other classes of business entirely. We have previously pointed out that it is fundamentally fallacious to fix the profits of a public service corporation as a percentage of the cost of reproduction, for this is merely an invitation to extravagance of construction and a tax on those who, by inventiveness or otherwise, are able to accomplish the same result with a less expensive plant.

Advices from Goldfield, Nev., state that $5,000,000 of capital has been secured in Europe for the construction of the proposed railroad between Goldfield and a connection with the Nevada Northern. On the southwest it is planned to make a connection with Tonapah & Tidewater R. R. C. B. Zabriskie, 100 William St., New York City, President of the Bullfrog Goldfield R. R. and Secretary of the Tonapah & Tidewater R. R., is reported to be head of the new line.

A bill has been introduced in Congress to extend for 18 months the time for the construction of the East Washington Heights Traction R. R., Central National Bank Bldg., Washington, D. C. This additional time is granted with the provision that the track extension from the present eastern terminus to Branch Ave. be completed within six months.

Method of Constructing Two Public Comfort Stations in Small Cities with Some Costs of Construction and Operation.*

PUBLIC SANITARY STATION, BROOKLINE, MASS.†

This structure was built during 1909 and is located on public land in Village square, through which several lines of street cars to and from Boston pass at the rate of one per minute in both directions during the rush hours. It is also located in the most densely settled part of the town, at the junction of several main avenues on which there is much teaming. The location would therefore seem to be as nearly ideal as anything of the sort could be in a town of about 27,000 population.

The details of the design are shown by Figs. 1 and 2, by which it will be noted that a room

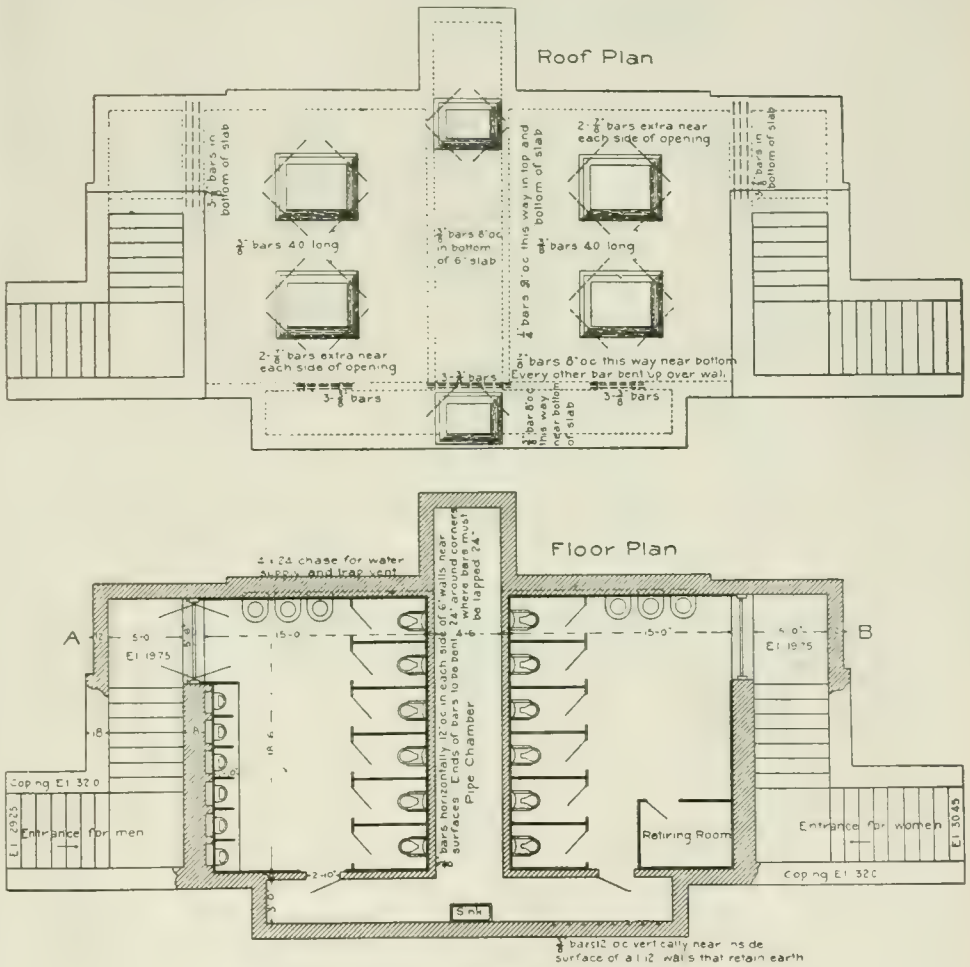


Fig. 1—Plan of Public Comfort Station, Brookline, Mass.

15x18.5 ft. in dimensions, with 6 water closets, 6 urinals, 2 lavatories and a bubble drinking fountain is devoted to men, and a room of the same size containing 6 water closets, 2 lavatories, a bubble drinking fountain and a small retiring room is designed for women.

The structure is built of Portland cement concrete mixed in the proportion of 1:2½:5, reinforced as shown by the drawings. The floor of the men's side is placed 9 ft. below the walk, the ceiling is 8.5 ft. high and a roof covering with from 2 to 3 ft. of loam, the entrances and grading so designed as to render the sanitary as inconspicuous as possible. It will be noted that the entrances are designed with covered vestibules and right-angle turns in the stair cases, thus securing the maximum of privacy. The ground over and adjoining the sanitary has been planted with shrubbery.

The sanitary is well lighted during the day with six light shafts arranged as shown, in which are placed 2¾-in. luxfer prism sidewalk

*Condensed from papers read before the Boston Society of Civil Engineers and printed in the Journal of the Association of Engineering Societies for April, 1910.

†Alexis H. French, Town Engineer, Brookline, Mass.

lights spaced 4 ins. on centers. During dull weather and at night it is lighted by electric lights controlled by suitably arranged switches.

The roof and walls are waterproofed by the application of a heavy coat of roofer's pitch and also with five layers of roofer's felt combined with hot pitch for a distance of 2 ft. below the roof and by the use of three layers of felt to a level of 4 ft. below the roof. No special precaution was taken to waterproof the bottom, as the level of ground water was much below that elevation.

On account of its non-absorbent character and freedom from stain, the gray Tennessee marble was used for the water closet partitions, urinal stalls and wainscoting, the height being 6½ ft. in the case of the water closets and 6 ft. elsewhere. White vitreous 3x3x½-in. tiles were used in the main rooms on account of their non-absorbent character and great durability.

A feature of the design which it is expected

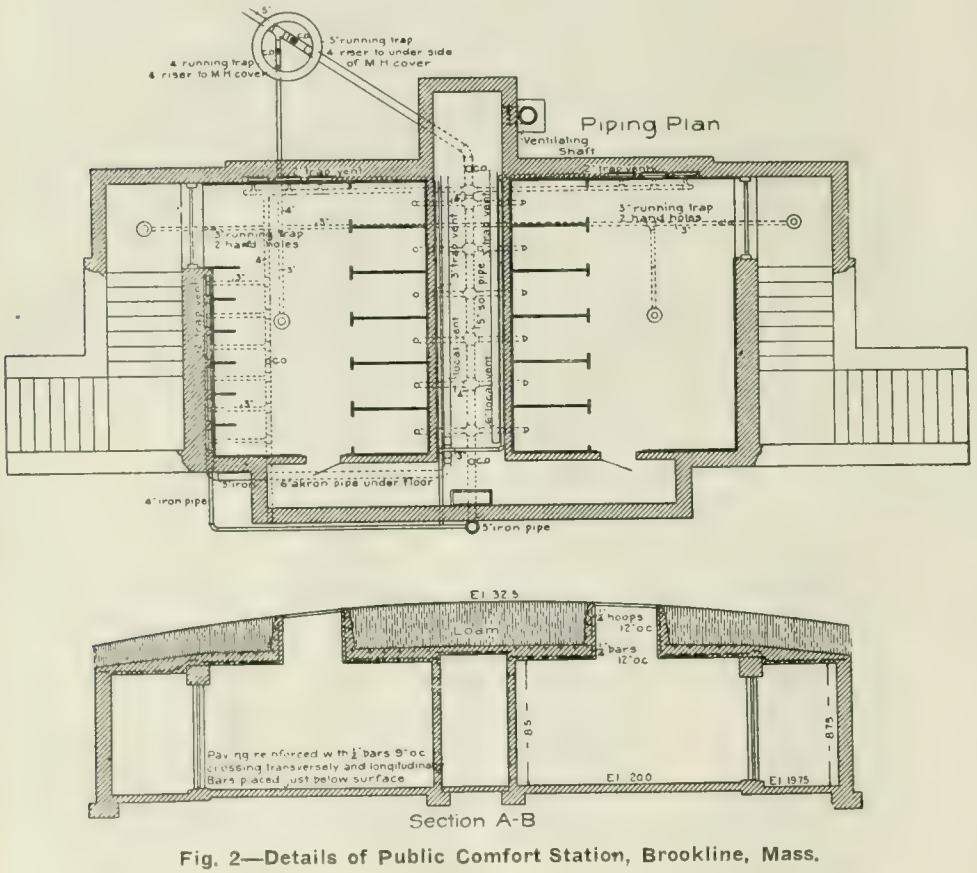


Fig. 2—Details of Public Comfort Station, Brookline, Mass.

will work well in operation is the pipe chamber and passageway, in which are located the main soil pipe with its branches and cleanouts, the trap ventilation, water closet tanks and connections, ventilating fan and conduits, slop sink and space for the storage of supplies. Such pipes as are placed below the floor of the main rooms are made accessible by cleanouts with brass cleanout screws.

Brass floor drainers are placed in the vestibules and in the center of each main room, with waste pipes connected with the main drain below the main trap in the manhole, so that a stoppage of this trap will not cause the sewage to set back into the sanitary.

The type of water closet adopted is the "Sanitas Keystone" for the men's side and the "Sanitas Keystone Hygic" for the women's side, both designed and made by the Sanitas Manufacturing Company of Boston. They are syphon jet closets and are especially well adapted for a public sanitary because of the form of the bowl and its rim, and the unusually large water area. The exterior of the closet is commendable from its simplicity and in that it does away with the space behind the bowl, which too often serves as a hiding place for dirt. The closet is also provided with an unusually large local vent.

The water closets are so designed that each closet contains a bowl and a push button device for operating the tank that has been satisfactorily used at the south terminal station in Boston for ten years, modified to meet modern plumbing requirements. These also have a large local vent connected with a copper ventilation pipe placed in the wall behind the urinals and leading to the ventilation fan.

A system of ventilation has been adopted, but not yet installed, consisting of an electrically operated fan to be placed in the pipe chamber near the ventilation shaft, with ducts leading to each closet and urinal, so that the air in the sanitary can be exhausted through these fixtures at the rate of once in fifteen minutes. It is believed that this will be ample to keep the air good under the worst conditions.

The building is heated from the hot water system in the fire station plant, only 10 to 15 ft. away, and is designed on the basis of 1 sq. ft. of radiation for each 40 cu. ft. space to be warmed. In addition to this, a 9-ft. radiator is placed in each light shaft to aid in the warming and to keep the snow melted in winter.

PUBLIC SANITARY STATION AT LAWRENCE, MASS.*

For a long time agitation for a public station for both sexes had been carried on in our city, and in 1907 its construction was made possible by a vote of the city council authorizing the park commission to spend $12,000 for what the order termed a "comfort station," and the city engineer was directed to prepare plans for it.

Considerable opposition to its construction developed after the order appropriating the funds was passed, especially when the yearly expense of running it was considered, which expense would amount to considerably more than half of the usual appropriation for the maintenance of our public parks. There are probably now many prominent citizens who, if they expressed their opinions, would be opposed to its continuance. One man, a would-be mayor, told me would make a swimming pool of it if ever he had a chance; and another, an ex-mayor, said he would fill it in if he should happen to again occupy the mayor's chair. He had an idea that no decent woman would visit it. I told him that it was not used much by the so called foreigners, but that nicely dressed women, apparently of the English speaking races, used the station largely, and it was with a good deal of pleasure that we could refute the charge that only foreigners would use it, and say that it was really a convenience station to all classes of our citizens. The attendants tell me that the women's side is used by a better class than the men's. I mention these things to show that no matter how good a piece of work may be, how much it may be needed, or how economically it may be carried out, there is always adverse criticism if the public has to foot the bills, and I presume these conditions prevail not alone in Lawrence but are common to most municipalities. The staion in Lawrence was opened to the public on December 30, 1907, and within a week it was estimated that between five and six hundred persons used the station daily. On special days and Sundays the place is visited by four or five thousand on each side, and its necessity and value have been proven beyond the possibility of contradiction.

The attendants examine every closet after it has been used and the station now is in as perfect condition as when first constructed. Not a dollar has been expended on repairs, and no plumber has been called in to remove any obstructions or remedy any defects.

The interior of the building was made as white and as spotless as possible, so that no dirt could exist there without being plainly seen. The interior walls are of brick and all exposed surfaces are built of white enameled brick, with a base of three courses of chocolate colored enameled brick. The closet bowls are set in the usual open plumbing style; the urinals are of solid porcelain and run to the floor, so that the smallest boy can use them properly; the water closet and urinal partitions are of white Italian marble, said to be harder and less absorbent than any marble quarried in the country; the floors are of terrazzo, made of bits of stone embedded in cement, the prevailing color being white, with a neat mosaic border, all on a foundation of concrete; the ceiling is of concrete, painted white with one coat of "Bay State Brick and Cement Coating," followed by a coat of "enamel" of the same brand. It would have been better to have put on two coats of the first, as the ceiling did not come out quite as white as was desired.

The main toilet rooms are lighted by day by two skylights in each, 3x4 ft. in size, and at night by electric lights inclosed in Holophane globes. The effect of the whole is bright, fresh and clean. The electric lights are divided into five circuits, which are regulated from a switchboard in the main pipe room. These circuits are men's room and light at foot of stairs, women's room and light at foot of stairs, the transparency on men's side, the transparency on the women's side, and the attendant's room and pipe room.

The station has also a "Gamewell Police Signal Box," which serves as a call box for the officer on that beat during the hours the station is open. This box connects only with the police station and, aside from that, the station has no telephone.

The general plan of the station includes the two main toilet rooms, about 15x25 ft. in size, with a 9-ft. post. Each of these rooms contains six water closets. In addition to the closets the women's room has three lavatories and also a long seat built against the wall. The closet slips are 2 ft. 10 ins. by 4 ft. 10 ins. in size from center to center of the marble partitions. The men's room has two lavatories and eight urinals. The two radiators in each of the toilet rooms are inclosed in white marble, with white porcelain enameled registers to allow the circulation of the air. A man would not be likely to try to spit through the registers and he certainly cannot spit behind the radiators.

In addition to the main toilet rooms there are two attendants' rooms and two pipe rooms. The main pipe room, 5 ft. wide, with its floor grade 3 ft. below that of the toilet rooms, runs through the center of the structure. This main pipe room should have been at least a foot wider, for unless the plumber utilizes every inch of width, as he did not in

*Arthur B. Marble, City Engineer, Lawrence, Mass.

our case, and carefully sets the heaters, there will hardly be room enough for a man to get by the large heater into the space beyond. In this main pipe room are all the pipes, flush tanks and vents connected with the water closets, together with a Gurney heater, which in the winter heats the rooms and the water for the lavatories; also a small jacket heater for heating water and maintaining ventilation in summer. The small heater is run continuously all summer and burns two tons of coal. A total of about 8 tons of coal is used in both heaters for the year. Directly in front of the heaters (the door from the attendants' room opening between the two) is the coal bin, with a capacity of 6 tons. The bin is fed through a coalhole in the roof. On the side of the men's room back of the urinals is another pipe room, with its floor 2 ft. below that of the toilet room, in which are located the flush tanks and piping for the line of urinals. There are four flush tanks in this room, one for each two urinals, and they discharge automatically at intervals of about two minutes.

The ventilation of the station is secured entirely through the water closet seat vents, which are about 13 sq. ins. in sectional area and pass through the wall back of the closets to the main galvanized iron vent pipe, which is connected with a cylinder that surrounds the smokestack and reaches the open air near the top of the copper ventilator that stands on the roof of the station and extends to a height of about 15 ft. above the ground.

The seats of the closets are of wood, entirely cut away in front. We at first thought of having a porcelain seat, but they were said to be very unpleasant to sit on, so we adopted the kind described.

The attendants' rooms are 7x12 ft. in size, with a quartered oak wardrobe filling the entire width at one end. These rooms are large enough for one or two chairs and also a couch, which we thought might be needed in case of any sudden illness. These rooms furnish a convenient place for the attendant to sit apart from the general toilet room, and is so located as to command a view of nearly that entire room. There is a door leading into the pipe room from both attendants' rooms, so that in case of a disturbance on the women's side the male attendant can be called in without his having to pass around on the outside. With the door locked on the women's side the protection for that side is as perfect as though there were no door there. The attendants' rooms are ventilated each by a window hinged at the bottom, opening into the stairway landing. The men attendants of course do the heavy work, caring for the heating apparatus, taking out the ashes and shoveling snow in winter. They receive $14 for a week of seven days. The women receive $10.50 for a week of the same length. Both the male and female attendants keep the brass work polished on their respective sides.

The structure was built underground so as not to disfigure the Common, and also to avoid the expense of exterior architectural ornamentation. Nothing appears above ground except the copper covered ventilator and smokestack, which is rather ornamental, and the stone parapets with the wrought iron fences which inclose the entrance stairways. Over each entrance is a wrought iron arch carrying a transparency bearing on one the word "men," and on the other, "women." These transparencies show milk white glass letters by day and are illuminated at night.

The outside walls of the structure are built of concrete and the roof is a flat slab of reinforced concrete, both walls and roof being covered with Warren Brothers' water-proofing material. As the walls are lined with brick inside, an air space was left between the outer and inner walls, and this air space would probably have kept the interior walls dry without any water-proofing. The excavation was somewhat wet as we neared the floor grade, and two broken stone drains were laid across under each toilet room floor, terminating in an open pipe laid through the wall into the main pipe room. The main pipe room is drained of ground or surface water into the trap of the main drain. With these drains and the bed of cinders under the concrete floors, no dampness ever shows on the terrazzo. To further protect the walls against dampness they were backed up with cinders.

The interior of the station can be washed out with a hose, if desired, and the floors are drained into a cesspool in the center of each toilet room, and in the landing at the foot of the stairs. The last named cesspool also takes the rain water which finds its way down the stairs.

In addition to the conveniences sure to be found in such a station, paper and liquid soap are furnished free of charge. The paper is delivered from two Springfield paper holders in each toilet room. The paper used costs about $7 per month and the soap about $25 per year. A roller towel was at first hung up in each toilet room and nickel plated rollers were attached to the walls for them to run on. Of course they never should have been even thought of, but the Park Commission was impressed with the idea that the popular demand required them. However, they were soon discarded as unsanitary, and the material was cut up into individual towels, and given to the attendants, who take care of them and let them out for 1 ct. each. The attendants have the proceeds. After this toweling is worn out it is intended to let the attendants furnish and care for the towels and have, as now, what they make out of them, the Park Commission regulating the price charged for their use.

One closet on the men's side is reserved as a pay closet, but it does not amount to very much. In the first four months after the station was opened this closet was used but once. A charge of 5 cts. is made for the use of this closet, and this charge includes a towel. The men's side of the station is open from 7:30 in the morning to 11:30 at night, and the women's from 8 to 11. Two men and two women are employed as care takers, and the annual expense for maintenance is about $3,200.

Bids were received for building the convenience station ranging from $9,776 to $15,324; bids for plumbing, heating and marble work, from $2,997 to $3,933; and for electrical work, from $160 to $317. The totals of the actual cost were as follows:

C. E. Trumbull Co., contract for general building work	$ 9,776.00
Extras	224.38
Merrimack Supply Co., plumbing, etc., heating and marble work	2,997.00
Extras	71.73
Geo. D. Fitts, electrical work	160.00
Inspector	312.00
Water Department, piping	43.97
Blue prints	47.86
Police signal box	150.00
Incidentals	104.89
Total	$13,897.83

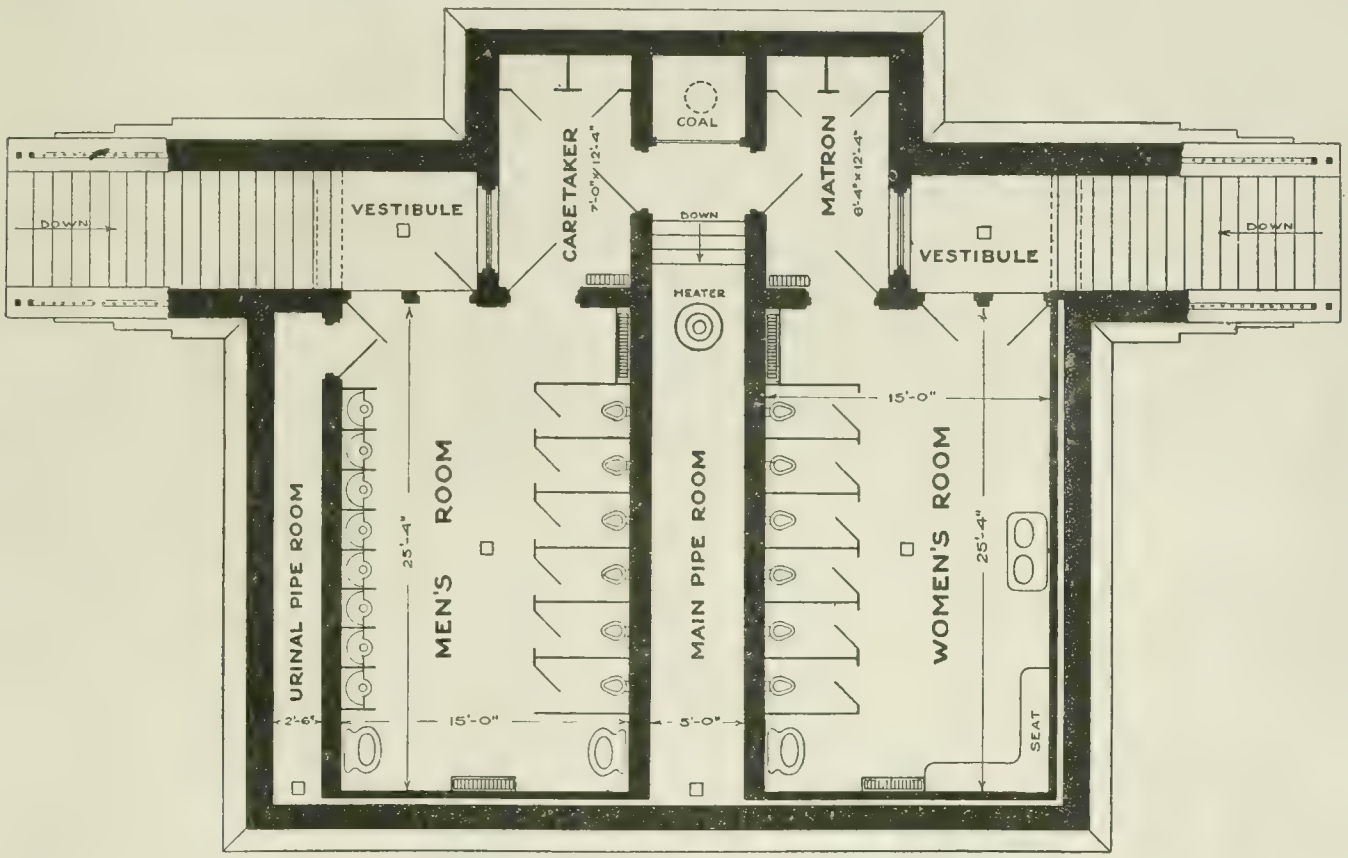


Fig. 3—Public Comfort Station, Lawrence, Mass.

Directory of Principal Civil Engineering Societies.

American Railway Bridge and Building Association—Secy., C. H. Lichty, 215 Jackson Blvd., Chicago, Ill.

American Railway Engineering and Maintenance of Way Association.—Secy. E. H. Fritch, Monadnock Block, Chicago, Ill.

American Society for Municipal Improvements.—Secy. A. Prescott Falwell, 239 West 39th St., New York, N. Y.

American Society for Testing Materials.—Secy. Edgar Marburg, Univ. of Pa., Philadelphia, Pa.

American Society of Civil Engineers.—Secy. C. W. Hunt, 220 W. 57th St., New York, N. Y.

American Society of Engineering Contractors.—Secy. Daniel J. Hauer, Park Row Building, New York, N. Y.

American Street and Interurban Railway Association.—Secy. B. V. Swenson, 29 W. 39th St., New York, N. Y.

American Water-Works Association.—Secy. J. M. Diven, Charleston, S. C.

Boston Society of Civil Engineers.—Secy. S. E. Tinkham, 60 City Hall, Boston, Mass.

Canadian Society of Civil Engineers.—Secy. Clement H. McLeod, Montreal, Can.

Engineers' Club of Philadelphia.—1317 Spruce St., Philadelphia, Pa.

Engineers' Club of St. Louis.—Secy., A. S. Langsdorf, Washington University, St. Louis, Mo.

Engineers' Society of Western Pennsylvania.—Secy., E. K. Hiles, 803 Fulton Bldg., Pittsburg, Pa.

National Association of Cement Users.—Pres., Richard L. Humphrey, Harrison Bldg., Philadelphia, Pa.

New England Water-Works Association.—Secy. Willard Kent, Narragansett Pier, R. I.

Roadmasters and Maintenance of Way Association.—Secy., W. E. Emery, P. & P. U. Ry., Peoria, Ill.

Society for the Promotion of Engineering Education.—Secy., Henry H. Norris, Cornell University, Ithaca, N. Y.

Technical Society of the Pacific Coast.—Secy., Otto Van Geldern, 865 Pacific Bldg., San Francisco, Cal.

Western Society of Engineers.—Secy., J. H. Warder, Monadnock Block, Chicago, Ill.

Coming Meetings.

American Society for Testing Materials.—Annual meeting, Atlantic City, N. J., June 28-July 2.

American Society of Civil Engineers.—Annual Convention, Chicago, Ill., June 21-24.

Society for the Promotion of Engineering Education—Annual Meeting, Madison, Wis., June 23-25.

Personals.

Purdy & Henderson, civil engineers, have removed their engineering office from 609 Crary Building to 1142 Henry Building, Seattle, Wash.

Mr. William S. Twining has resigned his position as Chief Engineer of the Philadelphia Rapid Transit Co. and will be associated with the firm of Ford, Bacon & Davis of New York City.

Mr. Charles E. Perkins, for the past eighteen years Chief Engineer of the Public Works of the State of Ohio, has opened an office at Akron, O., where he will engage in the practice of Civil Engineering. Mr. Perkins retired from the state work on May 21.

The U. S. Civil Service Commission, Washington, D. C., will hold an examination on July 13-14, to secure eligibles from which to make certification to fill vacancies as they may occur in the Reclamation Service in the positions of assistant engineer at salaries of $1,500 per annum and upward, and junior engineer at salaries of $900 and upward.

The New York State Public Service Commission, Albany, N. Y., will hold an examination on June 25, to fill the position of civil engineer on grade crossing work with the Public Service Commission, Second District, at a salary of $2,000 to $2,400. An examination will be held at the same time to secure an Engineering Draftsman at $4 to $5 per day.

Mr. Robert H. Fuller, for the past four years Secretary to Governor Hughes of New York, has been appointed a member of the New York State Water Supply Commission, succeeding Dr. Ernst Lederle, who resigned from the commission in January to become health commissioner of New York City. Mr. Fuller before becoming Secretary to the Governor was engaged in newspaper work.

Mr. J. P. Forde, for a number of years Resident Engineer for the Canadian Pacific Ry. at Rebelstoke, B. C., has been appointed supervisor of construction of the Canadian Northern R. R. in the province, by the British Columbia government. In view of the fact that the government guaranteed the bonds of the Canadian Northern R. R. for the line that will be built in British Columbia, it is the intention, through Mr. Forde, to closely watch construction work, and it will be his duty to see that the standards of grading and tracklaying stipulated in the agreement are lived up to.

Mr. W. D. Hodge, heretofore connected with the Engineering Department of the Kansas City Southern Ry., has been appointed Chief Construction Engineer of the Denver, Laramie & Northwestern and will superintend an extension of that road into the Northwest.

The firm of Grossmann & Proskauer, Engineers, Old Colony building, Chicago, has been consolidated with the Central Engineering & Construction Co., 75 Monroe street, Chicago, and will continue to do a general engineering business under the last mentioned name.

C. D. Purdon has been appointed Chief Engineer of the Cotton Belt (St. Louis Southwestern) R. R., with headquarters in St. Louis. He succeeds M. L. Lynch, retired. Mr. W. T. Eaton, heretofore assistant Chief Engineer, has been appointed Chief Engineer for the Texas lines of the Cotton Belt, with headquarters at Tyler, Tex.

Franklin Clement Robinson, a leading chemist and health authority, died May 25 from Bright's disease at the Maine General Hospital at Portland, Me. Prof. Robinson was born at East Orrington, Me., in 1852, was graduated from Bowdoin College in 1873 and for two years studied chemistry in Harvard. He was professor of chemistry at Bowdoin and State Assayer. He was formerly president of the American Public Health Association and was an author of several standard text books.

Mr. A. W. Buel, until recently associated with Mr. Virgil G. Bogue, M. Am. Soc. C. E., of New York City, has opened offices at 15 William street, New York City, where he will engage in a civil engineering practice, making a specialty of bridges and structural work. During the greater part of the past year Mr. Buel has been absent from New York engaged in revising the design and completing plans for the two steel travelers for "Ohio River Bridge No. 1," Allegheny Co., Pa., a cantilever bridge of 750 feet span. Plans for the bridge are now completed, but Mr. Buel is still retained as consulting engineer for the contractors on erection.

John Stoughton, Erection Superintendent for the Dominion Bridge Co., of Walkerville, Ont., died May 31 at his home in Detroit, Mich., of apoplexy. He was the builder of the Victoria bridge over the St. Lawrence River at Montreal, and had supervised the erection of the majority of bridges both on this side and on the Canadian side of the water passes that separate the United States from the Dominion. Recently he returned from Victoria, B. C., where he had been planning and constructing bridge work. He was about to retire from active business, and several months ago purchased a large farm between Birmingham and Pontiac, Mich. He was 67 years of age.

Mr. Arthur E. Morgan, formerly Supervising Engineer of U. S. Drainage Investigations, and Mr. L. L. Hidinger, formerly Drainage Engineer U. S. Drainaeg Investigations, have organized the Morgan Engineering Co., of Memphis, Tenn., and will engage in the practice of hydraulic and drainage engineering with special reference to the reclamation of swamp lands. Associated with the firm are Mr. C. F. Brown, of Salt Lake City, Utah, formerly Drainage Engineer of the U. S. Drainage Investigations; Mr. Otto Kochtitzky, of Cape Girardeau, Mo., Chief Engineer of the Little River Drainage District; Mr. Gerardo Immediato, of Mont Clair, N. J., who has had charge of important hydraulic developments in Mexico and South America, and the Abbott Bros. of Ferriday, La., the latter having for the past twenty years been engaged in the development of rice lands and in the design and installation of pumping plants. The consulting staff includes Mr. S. M. Woodward, Professor of Hydraulics at the Iowa State University, formerly Supervising Engineer of the United States Drainage Investigations.

Catalogs Worth Having.

Engineers and contractors should have on file the latest catalogs of machines, tools and supplies that they use. In sending for catalogs reviewed or advertised in this paper, you will confer a favor on us if you will write directly to the advertisers and state that you saw the catalog mentioned in ENGINEERING-CONTRACTING. If you are in the market for tools, machinery or supplies, tell us and we will notify promptly the leading manufacturers.

Jeffrey Conveying Machinery.—Paper, 3½x6 ins.; 24 pp. The Jeffrey Mfg. Cofifi Columbus, O.

Illustrations of conveyor belts, bucket conveyors, grab buckets and other installations by the company named.

Russell Cars.—Paper, 10¾x7¾ ins.; 8 pp. The Russell Wheel & Foundry Co., Detroit, Mich.

Illustrations and descriptions of heavy duty dump cars.

Drafting Tools.—Several folders. D. T. Kelsey, 77 Livingston St., New Haven, Conn.

Illustrates and describes several useful novel tools for the drafting room.

Antihydrine.—Paper, 6x9 ins., 4 pp., folder. The Antihydrine Co., New Haven, Conn.

A list of applications of this waterproofing material with directions for use.

Lifting Jacks.—Paper, 4⅛x9¼ ins.; 100 pp. The Joyce-Cridland Co., Dayton, O.

"Lifting Jacks" is the title of an attractive 100-page catalog just issued by this company. Besides listing their complete line of jacks for all purposes, the catalog also contains discussions of the construction and recent improvements in this line of jacks. It discusses the relative merits of various types of jacks, such as hydraulic, lever, automatic, automatic geared, screw, telescoping, etc., for different classes of service and recommends the most suitable jack for the different lines of work. The catalog contains complete information concerning the dimensions, weight, price, etc., of the various jacks, and should be on file with anyone who is interested in the purchase of jacks for any purpose.

Electric Cranes.—Paper, 12x9 ins.; 70 pp. Shaw Electric Crane Co., Muskegon, Mich.

An excellent and complete catalog which is fully illustrated with half tone engravings of different sizes and classes of electric cranes. A table of capacities and spuds of standard cranes is given.

Case Road Roller.—Paper, 9x12 ins.; 28 pp. J. I. Case Threshing Machinery Co., Racine, Wis.

A good catalog devoted to steam rollers and Troy dump wagons.

Sewage Treatment.—Paper, 5⅜x8⅞ ins.; 24 pp. Merritt & Co., Camden, N. J.

Reprint of a report by Geo. T. Hammond dealing with the features and efficiency of machinery in pumping stations connected with sewerage systems. Contains the results of investigations.

Brick and Cement Coating.—Paper, 5x7 ins.; 16 pp. Wadsworth, Howland & Co., 82 and 84 Washington St., Boston, Mass.

A booklet on the Bay State Brick and Cement Coating, a substance composed of a cement base carried in volatile oils, used both to resist dampness and as a decoration on the interior and exterior of the above named classes of walls.

Drawing Tables.—Paper, 4⅜x7¼ ins.; 8 pp. R. E. Kidder, 35 Herman St., Worcester, Mass.

An illustrated catalog on a drawing table, which has many advantageous improvements.

Centrifugal Pumps.—Paper 8¾x5¾ ins.; 40 pp. Lawrence Pump & Engine Co., Lawrence, Mass.

A complete catalog on "Vortex" Centrifugal Pump, with tables of hp. and tables of prices.

Portable Crushing Plants.—Paper, 8¼x10⅜ ins.; 16 pp. Catalog No. 66.

Sturtevant Newago.—Paper, 8¼x10⅜ ins.; 32 pp. Catalog No. 77. Stationary Screening Machinery.

Sturtevant Ring Roll.—Paper, 8¼x10⅜ ins.; 32 pp. Catalog No. 79. Grinding Machinery.

Sturtevant Crushers.—Paper, 8¼x10⅜ ins.; 28 pp. Catalog No. 62. Jaw Crushers.

Laboratory Machinery.—Paper, 8¼x10⅜ ins.; 12 pp. Catalog No. 67.

Sturtevant Rolls.—Paper, 8¼x10⅜ ins.; 22 pp. Catalog No. 65.

Emery Mills.—Paper, 8¼x10⅜ ins.; 20 pp. Catalog No. 64.

The Sturtevant Mill Co., 140 Clayton St., Boston, Mass.

The above named catalogs are from a set gotten up by the named company and each treats separately of machinery connected with the different lines of crushing and screening stone and ores.

Starrett Tools.—Paper, 5¼x7½ ins.; 232 pp.

New Starrett Tools.—Paper, 5¼x7½ ins.; 32 pp.

The L. S. Starrett Co., Atheol, Mass.

A very complete catalog with supplement on fine machine tools, measuring tools and tools for drafting. Prices are given.

Hardware.—Cloth, 7½x11 ins.; 186 pp. Wiebusch & Hilger, Ltd., 106-110 LaFayette St., New York.

A complete catalog of American and foreign hardware and cutlery.

Good Roads.—Paper, 6x9⅛ ins.; 24 pp. The American Asphaltum & Rubber Co., 600-614 Harvester Bldg., Chicago.

A description of the various products of the above company, especial reference being made to the waterproofing of macadam roads.

The government of Venezuela has entered into a contract with Dr. Ildefense Aguerreverre of Caracas to build the steel dock at Puerto Cabello. It will cost $193,000 and be completed by July 5, 1911. It must also be modern and will be divided into five sections, with a capacity of 4,000 tons. Work will begin soon.

Engineering-Contracting Monthly Review Index of Civil Engineering Literature.

A classified index and review of the civil engineering papers, articles, reports, pamphlets and books published during the month just passed is given in the succeeding pages. The literature indexed and reviewed—with the exception of books—relates solely to civil engineering. In the section devoted to Book Reviews all books in all branches of engineering are listed as received and such of them as seem worthy are reviewed as fully as due regard for conciseness will permit. In choosing books for review rigid selection is exercised. Next to careful choice of books for review timeliness of review is sought. All books are reviewed within a month of their receipt. The same statement is true of the articles and papers that are indexed. Also, as in choosing books for review, the choice of articles and papers for indexing is based on merit. Numerical strength in "titles indexed" is not sought; excellence of selection is sought.

The purposes of the Monthly Review Index are: First, to inform civil engineers and contractors of the articles and papers of merit that are published each month, in such a way as will give a clear idea of their character and scope; second, to supply the user with the date and place of publication, the length of each article and the cost at which it can be secured. The name, adopted abbreviations, place of publication and price per number of each periodical examined for civil engineering articles are given in the list immediately following. The other information is given in the index proper for each article separately.

Books reviewed will be sent post paid on receipt of price by the Book Department of ENGINEERING-CONTRACTING; periodicals, etc., containing articles indexed should be ordered direct from the publishers.

LIST OF PERIODICALS INDEXED.

American Architect (Am. Arch.), New York, N. Y.; w; 7x10 in.; 15 cts.
American Builders' Review (Am. Bldrs. Rev.), San Francisco, Cal.; m; 7x10 in.; 50 cts.
American Carpenter and Builder (Am. Car. & Bldr.), Chicago, Ill.; New York, N. Y.; m; 7x10 in., 20 cts.
American Engineer and R. R. Journal (Am. Engr. & R. R. Jl.), York, N. Y.; m; 7x10 in.; 20 cts.
American Gas Light Journal (Am. G. L. Jl.), New York, N. Y.; w; 10x13 in.; 10 cts.
American Institute of Electrical Engineers Proceedings (Am. I. of E. E. Proc.), New York, N. Y.; m; 4x7 in.; 50 cts.
American Machinist (Am. Mchst.), New York; w; 7x10 in.; 15 cts.
American Society of Civil Engineers Proceedings (Am. Soc. C. E. Proc.), New York, N. Y.; m; 4x7 in.; 75 cts.
American Society of Mechanical Engineers Journal (Am. Soc. M. E. Jl.), New York, N. Y.; m; 4x7 in., $1.
Annales des Ponts et Chaussees (An. P. & C.), Paris, France; m.
Applied Science, Toronto, Ont.; m; 6x9 in.; 20 cts.
Architects and Builders' Journal (Arch. & Bldrs. Jl.), Baltimore, Md.; m; 9x12 in.; 20 cts.
Architects and Builders' Magazine (Arch. & Bldrs. Mag.), New York, N. Y.; m; 5x8 in.; 20 cts.
Architect and Engineer of California (Arch. & Engr.), San Francisco, Cal.; m; 5x7 in.; 15 cts.
International Railway Congress Bulletin (Int. Ry. Cong. Bul.), Brussels; m; 50 cts.
California Journal of Technology (Cal. Jl. of Tech.), Berkeley, Cal.; m; 4x7 in.; 25 cts.
Canadian Architect (Can. Arch.), Toronto, Ont.; m; 7x19 in.; 20 cts.
Canadian Cement and Concrete Review (Can. Cem. & Conc. Rev.), Toronto, Ont.
Canadian Engineer (Can. Engr.), Toronto, Ont.; w; 7x11 in.; 20 cts.
Canadian Machinery and Manufacturing News (Can. Mach. & Mfg. News), Toronto, Ont.; m; 7x10 in.; 15 cts.
Canadian Mining Journal (Can. Min. Jl.), Toronto, Ont.; bi-w; 7x10 in.; 20 cts.
Canadian Municipal Journal (Can. Mun. Jl.), Montreal, Que.; m; 6¾x10 in.; 10 cts.
Canadian Society of Civil Engineers Proceedings (Can. Soc. C. E. Proc.), Montreal; m; 4x7 in.; 50 cts.
Carpentry and Building (Carp. & Bldg.), New York, N. Y.; m; 11x8 in.; 10 cts.
Cassier's Magazine (Cas. Mag.), New York; m; 5x8 in.; 25 cts.
Cement, New York, N. Y.; bi-m; 5x8 in.; 25 cts.
Cement Age (Cem. Age), New York, N. Y.; m; 4¾x8 in.; 15 cts.
Cement and Engineering News (Cem. & Eng. News), Chicago, Ill.; 7x10 in.; 25 cts.
Cement Era (Cem. Era), Chicago, Ill.; m; 7x10 in.; 10 cts.
Cement Record (Cem. Rec.); m; 4¾x8 in.; 15 cts.
Cement World (Cem. Wld.), Chicago, Ill.; m; 9x11 in.; 10 cts.
Chemical Engineer (Chem. Engr.), Chicago, Ill.; m; 4x7 in.; 15 cts.
Clay Worker (Cl. Wkr.), Indianapolis, Ind.; m; 7x10 in.; 20 cts.
Compressed Air (Comp. Air), New York, N. Y.; m; 5x7 in.; 10 cts.
Concrete, Detroit, Mich.; m; 6x9 in.; 15 cts.
Concrete Age (Conc. Age), Atlanta, Ga.; m; 9x11 in.; 10 cts.
Concrete and Constructional Engineering (Conc. & Cons. Eng.), London, England; m; 5x7 in.; 25 cts.
Concrete Engineering (Conc. Eng.), Cleveland, O.; m; 7x10 in.; 10 cts.
Contractor (Contr.), Chicago, Ill.; bi-w; 7x10 in.; 20 cts.
Cornell Civil Engineer (Cor. Civ. Engr.), Ithaca, N. Y.; m; 4x7 in.; 25 cts.
Domestic Engineering (Dom. Engr.), Chicago, Ill.; w; 6x9 in.; 10 cts.
Electrical Age (Elec. Age), New York, N. Y.; m; 7x10 in.; 10 cts.
Electrical Review (Elec. Rev.), New York, N. Y.; 8x10 in.; 10 cts.
Electric Railway Journal (Elec. Ry. Jl.), New York, N. Y.; w; 7x10 in.; 10 cts.
Electrical World (Elec. Wld.), New York, N. Y.; w; 7x10 in.; 10 cts.
Electric Traction Weekly (Elec. Trac. Wkly.), Chicago, Ill.; w; 7x10 in.; 10 cts.
Engineer (Engr. Lon.), London, England; w; 4x11 in.
Engineer (Engr.), Chicago, Ill.; bi-w; 7x10 in.; 20 cts.
Engineering (Eng.), London, England; w; 8x11 in.
Engineering-Contracting (Eng.-Contg.), Chicago; w; 7x10 in.; 10 cts.
Engineering Digest (Eng. Dig.), New York; m; 5x8 in.; 20 cts.
Engineering and Mining Journal (Eng. & Min. Jl.), New York; w; 7x10 in.; 15 cts.
Engineering Magazine (Eng. Mag.), New York; m; 5x7 in.; 25 cts.
Engineering News (Eng. News), New York; w; 8x11 in.; 15 cts.
Engineering Record (Eng. Rec.), New York; w; 8x11 in.; 10 cts.
Engineers' Club of Philadelphia Proceedings (Engr.'s Club, Phila. Proc.), Philadelphia; qr; 4x7 in.; 25 cts.
Fire and Water Engineering (F. & W. Eng.), New York, N. Y.; 8x11 in.; 10 cts.
Le Genie Civil, Paris, France; w.
Good Roads Magazine (Gd. Rds. Mag.), New York, N. Y.; m; 7x10 in.; 10 cts.
Industrial Magazine (Ind. Mag.), Cleveland, O.; m; 4x7 in.; 10 cts.
Industrial World (Ind. Wld.), Pittsburg, Pa.; w; 7x10 in.; 10 cts.
Insurance Engineering (Ins. Eng.), New York; m; 4x6 in.; 25 cts.
Iron Age, New York, N. Y.; w; 7x11 in.; 15 cts.
Iron Trade Review (Iron T. Rev.), Cleveland, O.; w; 7x10 in.; 15 cts.
Irrigation Age (Irr. Age), Chicago, Ill.; m; 7x9 in.; 10 cts.
Journal Association of Engineering Societies (Jl. Assoc. Engr. Soc.), Boston, Mass.; m; 4x7 in.; 30 cts.
Journal Franklin Institute (Jl. Frank. Inst.), Philadelphia, Pa.; m; 4x7 in.; 50 cts.
Journal New England Waterworks Association (Jl. N. E. W. W. Assoc.), Boston, Mass.; q; 4x7 in.
Journal Western Society of Engineers (Jl. W. Soc. Engrs.), Chicago, Ill.; bi-m; 4x7 in.; 50 cts.
Journal of Electricity, Power and Gas (Jl. Elec., P. & G.), San Francisco, Cal.; w; 7x10 in.; 10 cts.
Journal of Worcester Polytechnic Institute (Jl. W. P. I.); m; 4x7 in.; 20 cts.
Machinery, New York, N. Y.; m; 7x11 in.; 20 cts.
Marine Review (Marine Rev.), Cleveland, O.; w; 7x10 in.; 15 cts.
Mines and Minerals (Mi. & Mls.), Scranton, Pa.; w; 7x9 in.; 20 cts.
Mining and Scientific Press (Min. & Sci. P.), San Francisco, Cal.; w; 7x11 in.; 15 cts.
Mining Reporter (Min. Rep.), Denver, Colo.; w; 7x10 in.; 15 cts.
Mining World (Min. Wld.), Chicago, Ill.; w; 7x10 in.; 10 cts.
Modern Machinery (Mod. Mchy.), Chicago, Ill.; m; 7x10 in.; 10 cts.
Municipal Journal and Engineer (Mun. Jl. & Eng.), New York, N. Y.; w; 7x10 in.; 10 cts.
Municipal Engineering Magazine (Mun. Eng. Mag.), Indianapolis, Ind.; m; 4x7 ins.; 25 cts.
Ores and Metals (O. & M.), Denver, Colo.; bi-w; 6x10 in.; 10 cts.
Pacific Building Engineer (Pac. Bldg. Engr.), Seattle, Wash.; w; 9x11 in.; 15 cts.
Popular Mechanics (Pop. Mech.), Chicago, Ill.; m; 5x7 in.; 10 cts.
The Polytechnic (Poly.), Troy, N. Y.; m; 5x8 in.; 15 cts.
Power and Engineer (Pwr. & Engr.), New York; m; 7x10 in.; 20 cts.
Railway Age-Gazette (R. R. Age-Gaz.), New York; w; 8x11 in.; 15 cts.
Railway Master Mechanic (Ry. M. M.), Chicago; m; 7x10 in.; 10 cts.
Railway and Engineering Review (Ry. & Eng. Rev.), Chicago, Ill.; w; 9x11 in.; 10 cts.
Railway and Locomotive Engineering (Ry. & Loco. Eng.), New York, N. Y.; m; 7x10 in.; 20 cts.
Railway and Marine World (Ry. & M. Wld.), Toronto, Ont.; m; 7x10 in.; 15 cts.
Railway Engineering and Maintenance of Way (Ry. Eng. & M. W.), Chicago, Ill.; m; 7x10 in.; 10 cts.
Roadmaster and Foreman (Rd. & For.), Chicago; 7x10 in.; 10 cts.
Rock Products (Rk. Prod.), Chicago, Ill.; bi-w; 9x11 in.; 10 cts.
Rose Technic, Terre Haute, Ind.; m; 4x7 in.; 15 cts.
School of Mines Quarterly (Sch. Min. Quart.), New York, N. Y.; qr; 4x7 in.; 50 cts.
Schweizerische Bauzeitung, Zurich; w.
Scientific American (Sci. Am.), New York; w; 9x14 in.; 10 cts.
Scientific American Supplement (Sci. Am. Sup.), New York, N. Y.; w; 9x14 in.; 10 cts.
Sibley Journal of Engineering (Sib. Jl. Eng.), Ithaca, N. Y.; m; 4x7 in.; 20 cts.
Stevens Institute Indicator (Stev. Inst. Ind.), Hoboken, N. J.; m; 4x7 in.; 20 cts.
Street Railway Bulletin (St. Ry. Bul.), Boston; m; 6x10 in.; 10 cts.
Surveyor (Surveyor), London, England; w; 6x11 in.; 10 cts.
Technology Quarterly (Tech. Qr.), Boston; qr; 4x6 in.; 35 cts.
U. S. Department of Agriculture Bulletin (Dept. Agr. Bul.), Washington, D. C.; 4x7 in.
U. S. Geological Survey Bulletin (Geo. Surv. Bul.), Washington, D. C.; 4x7 in.
Zeitschrift d. Oest, Ing. u. Arch. Ver., Vienna; w.
Zeitschrift d. Ver Deutscher Ing.; Berlin; w.

ROAD AND STREETS.

Suggestions for a Rational Formula for Street Pavement Crowns.—Eng. News, May 5, 1910. 2⅓ pp.

Compares analytically the several formulas for pavement crowns and from the analysis works out a rational formula with empirical constants. A notably interesting article.

Up-to-date Roads.—By R. O. Wynne Roberts. Surveyor, May 13, 1910. 6 pp.

A valuable article dealing with the problems which confront the modern road engineer. A new formula for the camber of hanging roads is given and one of the theories of the transmission of pressure imposed by loaded wheels on the road surface to the subsoil is discussed. The use of bituminous binders is also dealt with and a number of simple working tests for testing tar are given.

Wood Block Creosoting.—Mun. Jl. & Eng., May 25, 1910. 1½ pp.

Gives in a handy tabular form a comparison of the specifications for creosoted wood block of 14 cities of the United States.

A Few Remarks in Regard to Surface-Spraying of Roads With Tar and Making in Situ Tar-Macadam.—B. T. Aitken. Surveyor, May 20, 1910. 1¾ pp.

A brief discussion of the main points which go to make an efficient treatment of the surfaces of road with prepared tar and tar compounds. The author also describes the methods particularly formed by him for the condition of tar macadam.

Standardization of Tar for Paving Purposes.—Eng.-Contg., May 25, 1910. 2⅔ pp.

Describes the means employed in Edinburg, Scotland, to secure a standard tar for paving processes.

Sand-Clay Road Construction in Kansas and Some Data on Its Cost.—Eng.-Contg., May 18, 1910. ¾ p.

An excellent article describing the methods to be followed in constructing sand-clay roads. Figures of costs are given.

Method of Resurfacing Worn Out Macadam Roads in New Jersey.—Eng.-Contg., May 18, 1910. ½ p.

Describes the method of resurfacing worn out macadam roads which after experiment has given the best results in New Jersey.

Road Repairs and Maintenance Work on the Metropolitan Park Commission of Massachusetts in 1909.—Eng.-Contg., May 11, 1910. ½ p.

Gives a statement of the summary of cost of road repairs and maintenance for the Metropolitan Park Commission of Mass. The costs are itemized.

Methods of Constructing Bituminous Macadam Roads to Resist the Destructive Action of Heavy Motor Traffic.—Eng.-Contg., May 11, 1910. 1¾ pp.

This article is an outline of the various methods that have been employed for constructing roads to resist heavy motor traffic. Conclusions are given summarizing the relative advantages and disadvantages of the methods described.

Methods of the New York State Commission of Highways for Testing Stone Used in Road Construction.—Eng.-Contg., May 4, 1910. ½ p.

This article describes briefly the methods employed by the above named commission for testing road stone.

Paving Roadways Having Steep Gradients.—Eng.-Contg., May 4, 1910. ¾ p.

Presents a table showing grades of various streets paved with granite blocks and gives arguments showing that this type of paving is most satisfactory for steep grades.

Experimental Concrete Road.—Cem. Era, May, 1910. ½ p.

A description of the methods and materials employed in the construction of an experimental piece of concrete road in New York State. A table of detailed costs of the construction is given.

SEWERS.

Sewage Disposal Plant at Lancaster, New York.—Eng. Rec., May 7, 1910. 1 p.

Shows general plans and describes main structural features of grit chambers, septic tank and contact beds for a filter plant for a city of 4,000.

The Disinfection of Water and Sewage.—Eng. Rec., May 14, 1910. 1¼ pp.

Discusses results obtained from chemical disinfection in a number of cities with estimates of cost of disinfection with chloride of lime. Some useful data.

Removal of Organic Matter From Sewage by Screens and Tanks.—Eng. Rec., May 21, 1910. 2 pp.

An excellent summary of practice and results in screening sewage.

Sewage Purification Results at Plainfield, N. J., 1909.—Eng. News, May 5, 1910. ½ p.

Briefly describes the plant and gives tabular summary of monthly average results of chemical and bacterial analyses of raw sewage and effluent.

Separation of Sewage Solids.—Mun. Jl. & Eng., May 25, 1910. 1 p.

Describes several methods and appliances for removing from sewage the coarser suspended matters. Several of the appliances used are new to this country. The matter is taken from a paper read before the Royal Institute of Public Health of Great Britain.

Leicester Sewage Work.—By E. George Mawbey. Surveyor, April 29, 1910. 3 pp.

A description of the sewage works of Leicester England. The system consists of classification by sedimentation tanks and single contact beds and final purification by broad irrigation on heavy clay land. The method of operation and the results obtained are given in some detail.

The Massachusetts State Board and Slate Beds.—By W. J. Dibdin. Surveyor, May 13, 1910. 2 pp.

A reply to certain statements in the "Review of 21 years experiments upon the Purification of Sewage at the Lawrence Experiment Station" at Lawrence, Mass., as to the priority of the use of superposed plates in a tank for the preliminary treatment of sewage.

Some Data on the Quantity and Cost of Bleaching Powder for Disinfecting Sewage or Effluent.—Eng.-Contg., May 11, 1910. ⅓ p.

Gives data on the amount of bleaching powder required for sewage disinfection and presents estimates of cost of operation of a plant for disinfecting sewage.

WATERWORKS AND HYDRAULICS.

Hydroelectric Plant of the Central Georgia Power Company.—Eng. Rec., May 14, 1910. 2½ pp.

General description of the 18,000 k.w. capacity plant with a head of 100 ft. The chief structural features are a concrete dam 1,070 ft. long and from 35 to 127 ft. high. Drawings of dam and power house details are given.

Deoxidizing Water to Prevent Corrosion of Steel Mains.—Eng. Rec., May 21, 1910. 1½ pp.

Describes character of corrosion of Coolgardie steel pipe line and outlines the remedial measures proposed. Plan proposed to prevent internal corrosion is to deoxidize water. Alternative plans are discussed and one plan is recommended and described. A notably interesting article.

The McCall Ferry Hydro-Electric Plant on the Susquehanna River.—Eng. Rec., May 28, 1910. 6½ pp.

An extended general description of the structures forming this 135,000 h.p. plant, with illustrations of special features of the construction plant and steel forms for concrete dam and a general outline of construction methods.

A Deep Well Sunk by Caisson.—Eng. Rec., May 28, 1910. ¾ p.

Illustrates caisson used and describes method of sinking it for a well 11 ft. in diameter and 72 ft. deep.

The Progress of the Los Angeles Aqueduct.—Eng. Rec., May 21, 1910. 3¼ pp.

General review of the work which has been done up to date on this 217-mile water supply conduit, with views along the work.

Curved Masonry Dams in New South Wales.—Eng. News, May 19, 1910. 3⅔ pp.

Describes designs of 13 curved dams of various sections with plans and tables of details and gives notes on behavior of these dams in respect to cracking and movement.

Water Filtration in Theory and Practice. By Geo. C. Whipple. Can. Engs. May 6, 1910. 8 pp.

An address given before the under-graduate society of Applied Science at McGill University.

The Western High-Service Reservoir of the Water Works at Baltimore, Md.—Eng. News, May 26, 1910. 3⅓ pp.

The reservoir has a capacity of about 210,000,000 gals. General description of structure and methods of construction with sections of embankment.

Water Softening at McKeesport.—Mun. Jl. & Eng., May 25, 1910. 1½ pp.

An abstract of a paper read before the American Water Works Association by Mr. Alexander Potter, the designing and constructing engineer for the plant. The plant has to overcome unusual hardness and acidity in the water. Some data as to the results obtained, and the amount and cost of chemicals used are given.

Concrete Pipe at Toronto.—By Francis F. Longley. Mun. Jl. & Eng., May 25, 1910. 1½ pp.

Describes the construction of 36 in. to 72 in. concrete pipe lines at the filtration plant at Toronto, Ont. The methods of handling the pipe, securing flexible water tight joints with tar and burlap, and constructing manholes are described.

The Electrically Driven Water Works Plant at Mattoon.—By H. W. Clark. Mun. Eng. Mag., June, 1910. 2 pp.

A description of the electrical installation for pumping water at Mattoon, Ill. The supply is obtained from nine 10 in. tubular wells, 65 ft. deep, and is pumped into a receiving reservoir and from there into the stand pipe and distributing systems. This is one of the few plants in this country which uses electricity for pumping water.

Experience With and Results for Municipal Water Softening.—Alexander Potter. Mun. Eng. Mag., June, 1910. 6 pp.

An interesting paper dealing mainly with the operations and results obtained at the municipal water softening plant at McKeesport, Pa.

Toronto Filtration Plant.—By Francis F. Longley. Mun. Jl. & Eng., May 18, 1910. 6 pp.

A description of the plant installed for the city of Toronto, Ont., for purifying lake water. The plant is to have a capacity of 6,000,000 gallons per day. Interesting features of the article are descriptions of the method of draining the site during construction, a novel central drain, and the sand handling equipment. Drawings showing details of sand workers and sand bins are given.

The Los Angeles Aqueduct.—By Edward P. Bailey. Mun. Jl. & Eng., May 11, 1910. 4 pp.

General descriptive article on the equipment now under construction to supply the city of Los Angeles with water from the Owen river. A number of illustrations are given of typical features of this work.

Equipment and Cost of a Fire Service Water Supply System at Winnipeg, Manitoba.—Eng.-Contg., May 25, 1910. 1 p.

Describes the construction of a fire service pumping plant and distributing mains and gives general itemized costs of the system.

Method and Cost of Constructing a Water Supply Tunnel Through Rock by Day Labor With Costs of Supplementary Structures.—Eng. Contg., May 25, 1910. 6⅓ pp.

Describes the method of constructing a tunnel nearly 5,000 ft. long for water supply, gives details as to power and plant employed, and complete costs of excavating the tunnel.

Method and Cost of Constructing Two 18-in. Cast Iron Water Mains by Day Labor for the Fort William, Ontario, Water Supply.—Eng.-Contg., May 18, 1910. ⅔ p.

Gives itemized cost of constructing 10,200 ft. of supply main and some 12,000 ft. of pressure main, both of cast iron pipe 18 in. in diameter.

Day Labor vs. Contract Work on the Los Angeles Aqueduct.—Eng.-Contg., May 18, 1910. 1¼ pp.

This is an article by the assistant chief engineer of the work named, comparing the cost of day labor work with the bidding prices received from contractors for the same work.

Experience With and Results From Municipal Water Softening.—Eng.-Contg., May 11, 1910. 2 pp.

Describes the water purification and softening plant at Keysport, Pa. Results obtained are given and a tabular statement is presented showing the character of water treated, amount of chemicals used, and cost of treatment.

The Los Angeles Aqueduct: Structural Details, Economic Studies, Working Organization and Service Constructions.—Eng.-Contg., May 4, 1910. 4½ pp.

This article outlines the main structural features of the Los Angeles Aqueduct; describes the working organization and the various service lines and plants constructed for the work.

Keokuk Hydroelectric Plant.—Elec. Wld., May 19, 1910. 2 pp.

A description of the power plant and dam now under construction on the Mississippi River 140 miles above St. Louis.

Rebuilding Dam at Hauser Lake, Mont.—Contr., May 1, 1910. 4¼ pp.

A description of the construction of a dam across the Missouri River in Montana which is to replace a dam which was washed away two years ago.

Some Extracts From and Notes Upon a Recent Report on the Purification of the Water Supply of Sacramento. Can. Engr. May 27, 1910. 1½ pp.

A short summary of the report of Prof. Hyde in favor of treating the water of the Sacramento River by sulphate of alumina coagulation, rapid mechanical filtration, and disinfection by the use of calcium hypochlorite.

DRAINAGE AND IRRIGATION.

Field Work in Locating Irrigation Ditch and Canal Lines.—Eng. News, May 26, 1910. ¾ p.

Outlines sequence of operations and methods of making locating surveys for ditch lines.

Some Experiments on the Durability of Cement Drain Tile.—By Prof. W. H. Day. Mun. Eng. Mag., June, 1910. 2 pp.

A description of tests conducted at the Agricultural College at Guelph, Ont., regarding the solubility of cement and the probable durability of cement drain tile.

Method of Lining an Irrigation Canal With Cement Plaster, With a Discussion on Cement Plaster Versus Lime and Cement Plaster.—Eng.-Contg., May 18, 1910. 1½ pp.

This article describes the method of lining an irrigation canal by plastering it with cement mortar. A discussion is presented of the relative advantages of cement mortar and of cement and lime mortar for the purpose named.

Method and Cost of Lining Earthen Channel With Concrete.—Eng.-Contg., May 4, 1910. ⅔ p.

Illustrates section of lining of covered channel for the Los Angeles Aqueduct. Describes the method of construction and gives complete unit costs. Illustrations of the form and of the method of handling it are shown.

Laying 12 Miles of Pipe in Colorado.—Cem. Era, May, 1910. 3 pp.

Showing the method of building concrete pipe lines in a rough mountainous country.

Absorption Tests of Drain Tile.—Con. Rec., May, 1910. 1½ pp.

Giving a description of the methods of the tests and a table showing the results. Tests were made on cement tile and on clay tile.

RIVERS, HARBORS AND CANALS.

Construction of the New York State Barge Canal Through Little Falls.—Eng. Rec., May 7, 1910. 5⅓ pp.

A general descriptive article on the special prism and lock work at the city named where a change in level of 40 ft. occurs. Plans of locks are features of most value.

The North Shore Channel of the Sanitary District of Chicago.—Eng. Rec., May 14, 1910. 4½ pp.

A good general description of the route, channel section and structural features of this branch of the Chicago Drainage Canal which is now under construction. General methods of excavation are outlined and maps and views of the work given.

The Scoop-Wheel Pumping Plant at Schellingwoude, Holland.—Eng. News, May 19, 1910. 3 pp.

Describes and illustrates pumping plant consisting of 6 scoop wheels 27 ft. in diameter with test data.

The Problems of Winter Navigation on the St. Lawrence River. By H. T. Barnes. Can. Engr. May 13, 1910. 2 pp.

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Preparing Foundation for a Big Dam. Contr May 15, 1910. 2 pp.

A description of the contractors' work on the Missouri river near Helena, Mont.

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A discussion of the effect on velocity and profile of water surface of loading a stream with sand.

Some Notes on Sliding Sluice-Gates, Charles River Basin, Boston-Cambridge, Mass.—Eng. News, May 26, 1910. 1⅓ pp.

Describes the sluice gate construction at the work named with special description and illustration of grease cup for lubricating screw stems. Results of tests are given of co-efficient of friction between sluice gates and frame.

Condensed Facts on the Panama Canal.—Eng.-Contg., May 18, 1910. 1⅔ pp.

This article assembles the various facts and statistics regarding the Panama Canal. Tables of excavation, of expenditures and of equipment are given.

Method of Stream Gaging by Use of Rod Floats With an Outline of the Reductions.—Era, May, 1910. 3½ pp.

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How a Pier Was Built and Its Cost.—Cem. Era, May, 1910. 2¼ pp.

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The Waterproofing of Extensive Railroad Bridge Floors.—Eng. Rec., May 14, 1910. 1¼ pp.

Describes general construction of bridges crossing streets for new Chicago terminal of C. & N. W. Ry., and gives details of concrete floor construction and of water proofing.

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Valuation of the Puget Sound Electric Railway.—Eng.-Contg., May 25, 1910. 4⅓ pp.

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Cost of Operating the New York City Railway Co. Lines—218 Miles of Electric Street Railways.—Eng.-Contg., May 4, 1910. 1½ pp.

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Interesting description of the methods employed to support a 520 ft. center span and the ends of two 260 ft. side spans while rebuilding three river piers. Drawings are given of the falsework and special appliances employed.

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Framework of New 22d Regiment Armory, New York City; a Three-Hinged Arch Roof With Cantilever Skewback Supports.—Eng. News, May 5, 1910. 2⅔ pp.

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Effect of Sewage and Sewage Gases on Concrete.—By Sydney H. Chambers. Surveyor, April 27, 1910. 2 pp. Mun. Eng. Mag., June, 1910. 3 pp.

An abstract of a paper read before the Concrete Institute of Great Britain. Investigations were conducted by the author to determine the effect of sewage and sewage gases on concrete, and the conclusion was reached that the gases in solution in sewage and those expelled from its decomposition do under certain conditions act injuriously upon Portland cement concrete. The conditions under which this action takes place were found to be as follows: (1) When a high degree of putrescence of the sewage prevails; (2) in a moistened surface, which held or absorbed the putrid gases; (3) in the preserves of a free air supply. The discussion of the paper is given in The Surveyor of May 6, 1910.

Plant Cost of Machine Mixed Concrete.—Eng.-Contg., May 25, 1910. ⅓ p.

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Method and Cost of Placing Concrete Lining Inside Iron Lining of River Section of Pennsylvania Railroad, North River Tunnels, New York City.—Eng.-Contg., May 11, 1910. 4⅔ pp.

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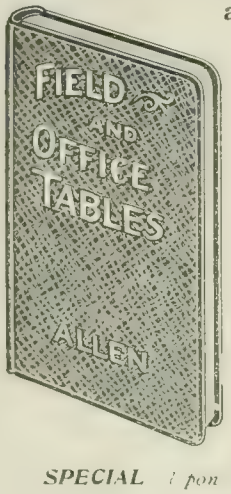

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MISCELLANEOUS.

A Large Sand and Gravel Washing Plant.—Eng. Rec., May 7, 1910. ⅔ p.

Illustrates layout and describes general structural features of a 700 cu. yd. per day capacity gravel washing plant.

Reinforced Concrete Barges on the Pacific Division of the Panama Canal.—Eng. Rec., May 28, 1910. 2½ pp.

Gives complete general plans for reinforced concrete barge 24x64 ft. to carry centrifugal pumps. The construction is described and data on live and dead loads given. A good article.

The New Timber Treating Plant of the Eppinger & Russell Co. at Jacksonville, Fla.—Eng. News, May 12, 1910. 2½ pp.

Shows layout and describes various structural units and operating features of a plant having a yearly capacity of 2,000,000 ties and 10,000,000 ft. B. M. of lumber.

Washington Street Market, Newark, N. J.—Mun. Jl. & Eng., May 25, 1910. 2 pp.

General article describing a public market at Newark, N. J. A feature of the market is that the show cases as well as the refrigerators are cooled by ammonia refrigerating machine.

Town Scavenging and Refuse Disposal.—By Hugh S. Watson. Mun. Eng. Mag., June, 1910. 3 pp.

Describes the methods employed in a number of English cities for the utilization of heat from refuse destruction. In many of the cities the steam generated by destructors is used for pumping water in sewage or for electric lighting or traction.

Depreciation and Reserve Funds of Electrical Properties.—Eng.-Contg., May 25, 1910. 2¼ pp.

A general discussion of the subject named in the title.

First Cost and Cost of Operating Power Plants for Driving North River Tunnels of Pennsylvania Railroad, New York City.—Eng.-Contg., May 25, 1910. ⅓ p.

Gives the first cost of the power plant used in the tunnels named and also the cost of operating one power house for twenty-four hours. Some notably interesting figures on power plant costs for contract work.

A Rational Method of Determining Reasonableness of Rates Charged by Public Service Corporations and a Discussion of the Theory of Profits.—Eng.-Contg., May 25, 1910. 1⅓ pp.

An editorial discussing the method of determining reasonable rates to be charged by Public Service corporations and an analysis of the distinction between profits and interest on invested capital.

Cost of Generating and Distributing Electricity for Lighting and Power, New York Edison Co.—Eng.-Contg., May 11, 1910. 1⅓ pp.

Analysis of the cost to the New York Edison Company of producing and distributing for lighting and power purposes.

Railroad Location Surveys and Estimates

By F. LAVIS, M. Am. Soc. C. E.
Resident Engineer Pennsylvania Railroad Tunnels.
Formerly Locating Engineer Choctaw, Oklahoma & Gulf Railroad, etc.

In an exhaustive review of this book, the "Railroad Gazette" says: "Once in a while a scientific book appears that combines the threefold elements of mastery of the subject, clearness of expression and elegance in the use of English, a combination as rare as it is attractive. The book at hand is of this sort, and the interest of the reader or student is held through every line of the text. **It is one of those rare productions in which there is not a wasted word and whose scientific value is high in that it tells clearly and concisely just what every student and engineer should know.**"

The contents include chapters on: Resumé of Methods and Explanation of Terms—Reconnaissance—Organization and Equipment—The Preliminary Survey, Field Work—Maps and Office Work—Location—Suburban Rapid Transit Railways—Estimates and Tables of Quantities—Surveys in Tropical Countries and Notes on Modifications of Organization and Equipment—Trigonometrical and Curve Formulae, Table of Level Cuttings, etc.

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Cost of Power for Various Industries Under Ordinary Conditions.—Eng.-Contg., May 4, 1910. 3¼ pp.

This paper is a very full discussion of the costs of various kinds of power for industrial plants. The various items going to make up costs are analyzed. A table is given showing average costs of power of different kinds under comparable conditions.

Some Driving Records in Tunnel Construction.—Contr., May 1, 1910.

Being some records taken from a paper delivered by Mr. R. B. Woodworth before the Railway Club of Pittsburg and showing by comparison, the progress made in tunnel driving in the last half century.

Insurance Company Compiles Valuable Figures.—Cem. Era, May, 1910. 2 pp.

This article is a compilation of figures showing the comparative costs, depreciation, life, and earning values of three classes of buildings, namely, concrete, brick and frame buildings.

The Compensation of Workmen. By H. L. Gantt. R. R. Age Gaz. May 6, 1910. 4 pp.

A discussion relating to the principles involved in fixing the compensation of workmen. From the standpoint of a man who has been training workmen in the metal trades.

BOOK REVIEWS.

Handbook of Cost Data.—By Halbert P. Gillette. Myron C. Clark Publishing Co., Chicago, Ill. Flexible Leather, 4¾x7 ins.; 1854 pp.; illustrated; $5.

The first edition of this book, published some five years ago, met with exceptional favor from engineers and contractors. It may be fairly said to have opened up a new field of engineering data by giving in collected and carefully analyzed form the mass of data on costs of engineering compiled by the author from his own work and that of other engineers and contractors. Since the publication of this first edition the mass of cost data has been enlarged very materially, and the 600 pages of the first edition has increased to 1854 pages in the second edition. In reality the increase is much greater than these figures would indicate, since a finer type and a larger page are used for the second edition, making, roughly, a page of this edition equal to a page and a half of the old edition. In a measure this wealth of new matter proves embarrassing, as it makes a book of too great a size to be a convenient book for the pocket. This, however, is a hindrance which most readers will be willing to overlook in consideration of the additional data which are made available for their use.

The present Handbook is divided into 15 chapters, and a list of their headings, with the number of pages embraced by each, will give a fair idea of the scope and of the amount of the data presented. The list is as follows: Principles of Engineering and Cost Keeping, 118 pp.; Earth Excavation, 52 pp.; Rock Excavation and Quarrying, 87 pp.; Roads, Streets and Pavements, 217 pp.; Stone Masonry, 55 pp.; Concrete, 110 pp.; Water-works, 161 pp.; Sewers, 143 pp.; Timberwork, 124 pp.; Buildings, 54 pp.; Railways, Steam and Electric, 348 pp.; Bridges and Culverts, 246 pp.; Steelwork, 29 pp.; Engineering and Surveying, 34 pp., and Miscellaneous, 63 pp. A comparison of the contents of the new edition with the old indicates that the author has worked to fill the gaps in the first edition, and has succeeded in very large measure.

The book is primarily a collection of cost data, from actual practice. It gives the costs of work done under very many conditions and under varying qualities of management. In so far as possible these variations have been indicated in the text leading up to the tabulations of cost. With these in mind and with attention to the author's remarks on the meaning and limitations of cost data there would seem to be little excuse for a misuse of the data presented. Cost data, like test data, or any other kind of data used in engineering design and construction, have to be used with intelligence. The greater the intelligence and experience of the user are the more certain and exact will be his use of these data. The book before us is without qualification the most complete collection of engineering cost data ever published.

Cost Keeping and Management Engineering

By HALBERT P. GILLETTE and RICHARD T. DANA

This is the first book ever published on the subject of cost keeping on contract work. Its authors are pioneers in the field, and, although they have written much that has appeared in the form of articles—particularly in the pages of *Engineering-Contracting*—this book is the first presentation on the subject in a complete and logical sequence.

In the opening chapter the authors endeavor to reduce the **management of men** to a science, by laying down **ten fundamental laws of management,** each of which is fully discussed.

The second chapter contain 17 **fundamental rules for securing minimum cost.** These two chapters are wholly novel and of far reaching importance to all men who are, or hope to be, in charge of other men.

The authors then proceed to describe and illustrate their own systems of cost keeping, which they have developed on their own contract work and have also been installed on the work of other contractors, giving both the **punch card reports**—a form of report which they were the first to devise and the more common blanks to be filled in with pencil.

The last chapter contains numerous systems of cost keeping developed by other engineers and contractors, and is a **veritable mine of suggestive hints** as well as of examples of excellent blanks for special purposes.

The following is the list of chapters:

CHAPTER I—The Ten Laws of Management.
CHAPTER II—Rules for Securing Minimum Cost.
CHAPTER III—Piece Rate, Bonus and Other Systems of Payment.
CHAPTER IV—Measuring the Output of Workmen.
CHAPTER V—Cost Keeping.
CHAPTER VI—Office Appliances and Methods.
CHAPTER VII—Bookkeeping for Small Contractors.
CHAPTER VIII—Miscellaneous Cost Report Blanks and Systems of Cost Keeping.

Cloth, 6x9 inches, 360 pages. Price $3.50 net, postpaid.

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A History of the Logarithmic Slide Rule and Allied Instruments.—By Florian Cajori. Engineering News Pub. Co., New York. Cloth, 5x 7½ ins.; 126+X pp.; illustrated; $1.

We find from this little book that some 256 different slide rules have been designed since 1800 and that the bibliography of the slide rule dates back to 1620 and comprises something over 200 articles and books important enough to be listed. With these facts before us one's first thought is changed to a belief that perhaps there is use for a history of this useful little instrument. The book written by Mr. Cajori is purely a history, not at all a manual on the use of the slide rule, and only to a small extent an explanation of its use. So far as we can judge the author has been at the pains of considerble research to make his statements and dates accurate, and for those who incline to such records his book should prove of interest.

Hydraulic Excavation Tables.—U. S. Reclamation Service, Washington, D. C. Cloth, 4¼x 6½ ins.; 117 pp.; paper, $1; cloth, $1.25.

This volume contains 39 tables, partly original and partly modified from existing tables, and compiled specifically for the use of the engineers of the Reclamation Service. Roughly, there are eight tables of mean velocity of water in open channels computed from Kutter's formula; seven tables of areas of trapezoidal channels; seven tables of quantities per 100 ft. of channel, and four tables relating to discharges over wiers; tables of trigonometric junctions, etc. Altogether the list comprises about all the tables to be used in irrigation work. An introduction explains the use of the tables when necessary.

Cotton Mill Map of Alabama and Georgia.—By H. E. Anchutz, Montgomery, Ala. Two folding maps in cloth covers. 3½x6 ins. $1.

As the title implies, this is a map of the states of Alabama and Georgia, showing the counties, county seats, and only such cities, towns and villages to which cotton mills are adjacent. It gives the location of every cotton mill in the two states, and each mill is indicated by a solid square. These squares are numbered, and by referring to the index and the key number, the address, number of spindles, kind of power used, and consumption of cotton per year in bales can be ascertained. Under each town or village where a mill is located is given one, two, or all of the letters, "W. P. T." This indicates whether the mill is reached by Western Union, Postal Telegraph, or Long Distance Telephone. All railways are plainly marked. The map also shows the exact location of all water powers, both in operation or available. This map has been designed to show the things that are needed by the mill owner and operator, cotton broker, cotton buyer, mill and electrical supply men and their traveling representatives, and all dealers in cotton products and machinery, as well as to show the man interested where water powers are awaiting development, or are in operation.

The Field Practice of Railway Location.—By Willard Beahan. Engineering News Pub. Co., New York. Cloth, 6x9 ins.; 252 pp.; illustrated; $3.

Before the appearance of the first edition of this book the best methods to be used in railroad location were largely a matter of tradition. Chief engineers experienced in location taught their methods to assistants, who, in turn, developed and improved them. In this way a distinct branch of civil engineering came into existence; one depending less on theory than on the experience of a generation of pioneer locating engineers. Wellington's great work placed on a sound basis the entire subject of economics as applied to railroad location. Every book on the subject must necessarily follow his theories. But it remained to the engineer in the field to work out direct and efficient methods for applying these theories.

This book is prepared primarily to meet the needs of chiefs of party. It is broad in its scope and covers both theories and methods. The details of the work of a party in making surveys are treated briefly. The greater part of the book is devoted to broad questions of organization, economics, management and care of parties, and matters generally of importance to the man in responsible charge of location.

The reader naturally makes comparison with another notable book on location that has appeared recently, namely, "Railroad Location Surveys and Estimates," by F. Lavis. In this

Two "System" Books

These two books will not exactly meet your needs in every particular. No book on systematizing construction work can; but there is a wealth of suggestions in these books which can be used to advantage on your own construction work, no matter what kind it may be. We are speaking of "Bricklaying System" and of "Field System," by Gilbreth. One review of "Bricklaying System" pronounced it the only practical treatise on bricklaying ever written, and a remarkable book in that it described methods of greatly reducing the cost of laying brick, in spite of the fact that the art is as ancient as the pyramids.

The "Field System" is a series of rules and instructions for the guidance of superintendents and foremen, the object being to secure uniformity of procedure and economy of performance on general contract work.

The "Bricklaying" contains 330 pages (6x9 inches) and its price is $3.00 net, postpaid.

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work the details of conducting surveys in the field are exhaustively treated, the book being written primarily for this purpose. It is unusual to find two books that so completely supplement each other. Together they make as complete a library on railroad location as the practicing engineer is likely to need.

The divisions of the subject are presented in the order in which they would occur in practice. The chapter on preliminary survey is preceded by chapters on character of road, reconnaisance and organization of parties; while the discussion of geology and topography, the locomotive, cost and capitalization, lead naturally to the chapter on located line.

No claim is made to originality in methods or theories. The author states that his purpose is to record the methods of a vanishing generation of locating engineers "before they shall have all passed away." The economic units and principles are those of Wellington.

There are two essentials of good location on which the author insists frequently. Their value is so self-evident that universal acceptance would seem to be a matter of course. Yet much poor location has resulted in the past through ignorance of these simple principles, or through indifference to them. "Never diverge from a straight line between controlling points unless you can show definite and sufficient economic reasons for doing so." And again, "the direction and location of the drainage is a frame-work on which you must hang your located line."

The author believes that too much stress cannot be laid on the necessity for thorough reconnaisance. Reconnaisance is of value not only in its influence on the final location, but as an economical means of avoiding unnecessary preliminary surveys.

It is stated that no locating engineer can be truly successful unless he is "in reality" a good topographer. And by this is meant, not that the engineer should be able to make neat maps, but that he must have an "eye for country" and must possess excellent judgment in matters pertaining to topography. Topography depends on geological structure. Hence, there is included in the book an excellent chapter by John C. Branner entitled "Geology in its relation to topography."

As a whole, the book is one of principles rather than methods. It is well suited to the needs of the locating engineer, and in scarcely less degree to the needs of the railroad officer responsible for the economic success of a railroad location.

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The Doings of the Week.

The railroad bill, which has been under almost continuous discussion in the Senate since March 15, was passed by that body on June 3 by a vote of 50 to 10 and now goes to the House.—H. S. Kerbaugh, Inc., Philadelphia, Pa., has been awarded Barge Canal Contract No. 63 by the New York state superintendent of public works, the contract calling for the improvement of the canal for a distance of 12 miles at the west end of Monroe county, New York, and the contract price being $1,990,000.—It is now given out that the placing of a $30,000,000 Chinese loan for railroad building by American and European bankers is contingent on the ability of the Chinese government to raise the money at home. The $30,000,000 loan was arranged for the commencement of building operations of two trunk line railroads in China, one running north and south from Hankow to Canton and the other east and west from Hankow to Schuzean.—Secretary Ballinger has postponed giving a decision in the Hetch-Hecky Valley controversy in connection with the proposed municipal water supply for San Francisco, until May 1, 1911.—Among the cities which are planning extensive municipal improvements, requiring special bond issues, are Kansas City, Mo., and Cleveland, O. The former will vote July 19 on issuing $3,500,000 of bonds and the latter will vote July 22 on issuing $2,250,000. The Cleveland bond issue is to be used for the elimination of grade crossings.—Among the sub-contracts let recently for work on the Western Maryland R. R. extension are the following: R. W. Hill & Co., New York city, for grading between Connellsville and Herd Tract; R. Galrards, Connellsville, Pa., for grading from Herd Tract to Indian Creek; W. H. McCourt, Akron, O., for grading between Indian Creek and Ohiopyle; Connestoga Contracting Co., Pittsburg, Pa., 500,000 cu. yds. of excavation and 10 miles of line work; Foley Brothers, Pittsburg, Pa., six miles of road; John Connelly, Pittsburg, Pa., considerable masonry work between Cumberland, Md., and Meyersdale, Pa. Among the other railroad construction contracts let during the past week are the following: John Scott & Sons, St. Louis, Mo., for the extension of the Arkansas Central & Eastern R. R. from McGreagor to Stuttgart, Ark., a distance of 18 miles, the contract including clearing, grubbing, grading, bridging and track laying; the Clifton-Applegate Co., Missoula, Mont., for 15 miles of the 40 mile extension of the Big Blackfoot Ry. to the north of the Clearwater River in Montana, and White Bros., Missoula, Mont., for the remaining 25 miles of the extension; Rose & Ellis, for grading four miles of the Abilene Southern Ry. out of Hamlin, Tex.; Foley, Welch & Stewart, for making a 2 mile rock fill in Rainy Lake near Port Arthur, Ont., to replace a wooden trestle; the B. & M. Construction Co., 1001 Schofield Bldg., Cleveland, O., for the construction of the 26 miles line of the Alliance & Akron Short Line Ry. from Alliance northwest to Akron, O.—At the end of May, of the 3,732 miles of line to be built for the Grand Trunk Pacific R. R., there is now in operation 1,017 miles of main line and 315 miles of branch line. There is now under actual construction and contracted for completion this year 210 miles of main line and 440 miles of branch line. The longest continuous stretch is from Fort Williams on Lake Superior to Edson, 146 miles west of Edmonton, a distance of about 1,300 miles.

Railroad Construction in New England.

It has been so long since a new steam railroad, with actual prospects of construction, has been proposed in Massachusetts, that when such an event occurs it is worthy of notice. For some little time there have been rumors that the Grand Trunk Ry. wished to secure an entrance to Providence, R. I. Early this year officials of the Grand Trunk made an application to the State Legislature of Rhode Island for a charter for the Southern New England Ry. The application met with some opposition from the New York, New Haven & Hartford R. R. whose field would be invaded, but early in April it was favorably acted upon by the Rhode Island legislature, thus giving the Grand Trunk the right to construct the portion of the line in that state. On June 7 the State Railway Commission of Massachusetts gave a hearing on the application for permission to construct that portion of the Southern England Ry. in Massachusetts. In the meantime the engineering work had been under way and at the hearing on June 7, engineers of the Grand Trunk submitted estimates showing that the 58 miles of line in Massachusetts would cost $3,500,000 or about $60,000 per mile. This estimate included the following items: Right of way, $192,381; grading, $1,163,287; bridging, $1,047,221; tracks, $536,769; station buildings, $26,000; telegraph lines, $17,433 and water service, $9,000. The plans show that the line will leave the New London & Northern R. R. at Palmer, Mass., and by an almost straight line will enter Providence, R. I. To reach Palmer, the Grand Trunk will use the tracks of a subsidiary company, the Central Vermont R. R. This latter road gives the Grand Trunk a direct line from Montreal to Windsor, Vt. From Windsor to Brattleboro, Vt., 34 miles, the Central Vermont runs over the Boston & Maine tracks, but it owns the strip of tracks from Brattleboro to South Vernon, a distance of 10 miles. From South Vernon to New London, Conn., the Central Vermont runs over its own tracks. Now the Boston & Maine R. R. which is said to be controlled by the New York, New Haven & Hartford R. R., operates over the Central Vermont tracks from White River Junction, Vt., to Windsor, some 16 miles and from Brattleboro to South Vernon. Immediately on the announcement of the plans of the Grand Trunk to Boston & Maine put engineers in the field to locate a line from Windsor, Vt., to West Lebanon, N. H., where a connection could be made with two division lines of the B. & M., thus doing away with its use of the C. V. tracks from White River Junction. The B. & M. also placed engineers in the field for a branch line between Brattleboro at Hinsdale, N. H., to connect its Connecticut & Passumpsic Division with its branch operating between South Vernon and Keene, N. H., and in that way avoid using the C. V. tracks from Brattleboro to South Vernon. No definite announcement has been made by the Boston & Maine as to its intention to construct the branch lines. The Grand Trunk, however, is going ahead with the plans and it is very probable that it will have actual construction work started this year. If it does Massachusetts will see more new steam railroad construction than it has had for the last decade.

Clever Advice.

The Aztecs, basing their opinion on the yellow press reports, of their time, believed that Cortez's Spanish cavalrymen were half man, half horse; many estimable residents of country towns have almost as strange an idea regarding a railroad grading gang, as witness the following news note from a recent issue of the Shakoopee, Minn., Tribune: "The scene of the reconstruction of the C., M. & St. P. railroad has shifted as far west as Prior Lake during the past fortnight and will soon be here. About two-hundred dago workmen are working along the roadbed which will probably be opened in July. The work is progressing very rapidly and most likely we will have the workmen in our own city within the next week, if so we hope that those who are interested in the work of these people will be clever enough to remain at a safe distance from a quarrel which we hear is apt to arise at any time. The quarrels usually arise between the different nationalities and as this band of workmen consists of besides what we commonly call dagoes, Polanders and Arabians the officials are trying their best to keep them as far apart as possible."

Stronger Bridges and Culverts In Iowa.

The state of Iowa for the next year or so would seem to offer quite a few opportunities for the builders of small bridges and culverts. The Iowa legislature has passed a bill requiring that all culverts and bridges be made strong enough to support traction engines. Heretofore the law has been that the owners of such engines must take the responsibility for any damage resulting from the breaking down of a bridge or culvert under the passage of a traction engine. If the bridge was weak it was up to the owner of the engine to reinforce it by laying planks, across which the wheels of the traction outfit could pass. This part of the law was stricken out, so that as it now stands the responsibility rests on the tax payers, and in the case of damage suits the counties will have to pay. As a result many of the present bridges and culverts undoubtedly will be reconstructed in order to make them strong enough to support traction engines.

Construction work on the Arizona & Eastern is progressing rapidly, according to reports from Phoenix, Ariz. Shattuck & Edinger, Los Angeles, Cal., the contractors, have 450 head of stock at work and will add 180 head more at once. Five grading camps have been installed between Phoenix and the Agua Friar River. Right of way difficulties have all been straightened out and it is expected by July 15th to have grading completed to the Hassayampa River. L. H. Long, Tucson, Ariz., is Chief Engineer.

The Camden & Trenton Traction Co., of Trenton, N. J., have been incorporated with a capital stock of $675,000, the incorporators being Frysinger Evans, Eugene A. Martin and Charles R. Renz.

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Railroads—Steam and Electric.

ARKANSAS.

The McCrory & Beedeville Southern Ry. Co. has just completed surveys for its projected 14-mile line from McCrory, Ark., on the Iron Mountain & Southern Ry. to Beedeville, Ark., and is now clearing the right of way. The company will do its own construction work. Grover G. McCrory, McCrory, Ark., is Chief Engineer and Clayton Hailey, McCrory, Ark., as President.

ILLINOIS.

McCann Bros. Construction Co., Bridgeport, Ill., has 12 miles of grading to let at Bridgeport. Good material and good prices; two way pay.

KANSAS.

The Oklahoma & Kansas Railway Co. is about to start surveys for its proposed electric line. This line will connect Columbus and Galena, Kan., with Baxter Springs, Kan. It will then extend South through Sunny Side, Lincolnville and Hattanville, Okla., to Miami, Okla. The W. K. Palmer Co., engineers, Kansas City, Mo., have been retained as Consulting Engineers.

MISSISSIPPI.

Surveys have not been made as yet, nor has all of the capital been secured for the construction by the projected 44 mile line of the Newton Northwestern R. R. This road projects a line from Newton, Miss., through Conchalta, Walnut Grove and Carthage. It is thought that the company will be ready to let contracts in about four months. D. L. Ragland, Newton, Miss., is President. H. C. Majure, Newton, Miss., is also interested.

NEW YORK.

The Long Island R. R., J. R. Savage, chief engineer, Jamaica, N. Y., is now grading for a second track between Whitestone Junction and Whitestone Landing. It is the company's intention, however, to install only a long passing siding between Flushing — Bridge Street—and College Point at this time.

OHIO.

The Alliance & Akron Short Line Ry. Co. has awarded the contract for the construction of its projected 26 mile line from Alliance northwest to Akron to the B. & M. Construction Co., 1001 Schofield Bldg., Cleveland, O. L. C. Marble, Columbus, O., is Chief Engineer of the railroad and Chas. G. Keith, Alliance, O., is President.

Contracts for the construction of the proposed line of the Cincinnati, Portsmouth, Pomeroy & Pittsburg Electric Ry. will not be let before Sept. 1 of this year. As previously noted in these columns the company projects a 466-mile line along the Ohio River Valley, from Cincinnati, O., to Pittsburg, Pa. C. P. Sanborn, Huntington, W. Va., is Chief Engineer.

OREGON.

The Coos Bay Rapid Transit Co., incorporated last March, with a capital stock of $1,000,000, projects a line extending from the water front in North Bend, back one-quarter mile, and then to the water front in Marshfield, and with streets covered in Marshfield, covers a distance of approximately 5½ miles. The company has expended in clearing and grading up to this time approximately $25,000, and it is hoped to have the road completed and in operation by Nov. 1, or at the latest by the first of the year. An order has been placed with the Colorado Fuel & Iron Co. for 600 tons of 70-lb. rails, together with necessary fastenings, for partial delivery about June 15th to 20th. On May 26th contract was also entered into with the American Car Co. for two 40 ft. cars, interurban style, delivery to be made about Oct. 1. The offices of the company are at North Bend, Ore. W. P. Evans is president; M. E. Everitt, vice president; A. W. Myers, treasurer, and C. G. Hockett, secretary.

PENNSYLVANIA.

We are advised that the Pittsburg & Susquehanna Valley R. R. has not as yet prepared any plans for the construction of a railroad from Fernwood to Utahville.

Sub contracts for work on the extension of the Western Maryland R. R. from Cumberland, Md., to Connellsville, Pa., have been let as follows: The Connestoga Contracting Co., House Bldg., Pittsburg, Pa., 500,000 yds. of excavation and 10 miles of line work, and Foley Brothers, Pittsburg, six miles of the road; John Connelly, of Pittsburg, for a large amount of masonry between Cumberland and Meyersdale, Pa.

UTAH.

Regarding the construction of proposed second track Ogden to Farmington, Utah, by the Oregon Short Line Railroad Co., we are advised that nothing further has been done toward the construction of this line, and no actual work has yet been started. No contracts have been let.

WISCONSIN.

Surveys have been completed and the capital has been secured for the construction of an extension by the Fairchild & Northwestern Ry. west from Fairchild, Wis., to a connection with the Chicago, Milwaukee & St. Paul Ry., at Caryville. The projected length is 30 miles. No decision has been reached as to when construction contracts will be let. H. J. Bernier, Minneapolis, Minn., is Engineer. N. C. Foster, Fairchild, Wis., is President.

CANADA.

M. P. Cotton, Vancouver, B. C., as previously noted, has the contract for constructing the Burnby line of the British Columbia Electric Ry. from Vancouver to New Westminster, B. C. The contract includes 100,000 cu. yds. of earth excavation and six small trestles.

Power Developments, Levees, Drainage and Irrigation Works.

CALIFORNIA.

The directors of the Hallwood Irrigation District will let contracts for the excavation of its main ditch and laterals, which have a total length of about 13 miles, some time in September or October, after the harvest and hot weather are over. This will give ample time for the completion of the work so that the water may be used for the season of 1911. The yardage is estimated at 85,000. The main ditch is 20 ft. wide at top. The intake is through a concrete tunnel 120 ft. long, 6 ft. in the clear, with a capacity of 7,000 in. and will contain 205 cu. yds. of concrete. To safeguard the water-right, this latter work is now under way and will be finished in July. The acreage served is at present about 3,000, but the full capacity of the ditch which will serve 7,000 acres or more, will no doubt be reached soon. E. E. Long, Marysville, Cal., is secretary of the district.

COLORADO.

The Clay Creek Reservoir & Irrigation Co., C. N. Scott, secretary, Lamar, Colo., which early in May awarded a contract for constructing a dam and canals in Clay Creek, 12 miles south of Lamar, is also to construct an irrigation system on Rule Creek near Las Animas, Colo. The last system will be about 40 per cent larger than the Clay Creek proposition. The Kaw Valley Construction Co., care H. C. Byrnes, Lamar, Colo., has the cantract for the Clay Creek work. This includes 90,000 cu. yds. of earth excavation, 6,000 cu. yds. of rock excavation, 290,000 cu. yds. of embankment and 4,000 cu. yds. of concrete masonry.

ILLINOIS

The Meredosia Lake Drainage & Levee District, of which Charles W. Brown, Jacksonville, Ill., is Engineer, on June 2 awarded the contract for 102,194 cu. yds. of levee work and 74,352 cu. yds. of ditch work to J. M. O'Meara & Son, Cullom, Ill., at 12.9 cts. per cu. yd. for the levee work and a similar bid for the ditch work. Other bidders on the work were as follows: Templeton & Hamilton, of Morocco, Ind., whose bid was for the ditch work alone at 11½ cts., amounted to $8,550.47; Lewis & Davis, of Champaign, Ill., who also bid only for the ditch work at 14 cts., amounting to $10,409.28; T. M. O'Meara of Cullom, Ill., whose bid on ditch work was at .0997 cts., amounting to $7,412.90; E. D. Barr of Potterville, Mich., whose bid was for the ditch work at 22 cts., amounting to $16,357.44; A. R. Putnam of Valparaiso, Ind., whose bid for ditch work was at 9 cts., amounting to $6,691.68, and for levee work 20 cts. and 22 cts. for the various portions as designated, the amount for this part of the work amounting to $20,231.26.

IOWA.

W. J. Bowen & Sons, Nashua, Ia., owning water power rights near Waverly are to let a contract for building a concrete dam and concrete flumes. It is expected to have the work started about July 1.

MICHIGAN.

The Muskegon Dock & Dredging Co., Muskegon, Mich., has been awarded the contract at $8,583 for repairing piers at Pentwater, for the U. S. Government. The work includes cutting down and removing old work, oak piles and timber, pine or Douglas fir plank and timber, screw bolts, drift bolts, angle irons, spikes, dredging and stone. Bids were opened at the U. S. Engineer's office at Grand Rapids, on June 3.

MINNESOTA.

Bids are asked by C. J. Hemmingson, County Auditor, Hallock, Minn., until June 20, for constructing two ditches as follows: County Ditch No. 19 at Donaldson, 86,137 cu. yds., estimated cost $15,964; and County Ditch No. 18 at Caribou, 85,445 cu. yds., estimated cost $13,072. O. L. Hamery, Crookston, Minn., is engineer for Ditch No. 19, and J. E. Dishington, Warren, Minn., is engineer for Ditch No. 18.

RHODE ISLAND.

As noted in our last issue bids are being asked by Lt. Col. J. S. Sanford, U. S. engineers, Newport, R. I., until 11 a. m., June 23, for repairing breakwater at Sakonnet harbor. The work will consist of two classes, first: furnishing and placing about 1,500 tons of stone in the breakwater, wherever necessary, and, second: replacing and rearranging stone heretofore delivered on the breakwater but which has been displaced by wave action. The new stone must be of granite or gneiss of good quality, and must be quarry stone of angular shape in pieces weighing at least 1½ tons each, with at least 10 per cent weighing 5 tons or over, except that smaller stones must be used where necessary to fill up openings and give firm bearings.

Items Concerning Contractors and Their Work

RAILROADS, POWER DEVELOPMENTS, LEVEES, DRAINAGE AND IRRIGATION WORKS.

(Confirmed Reports continued.)

SOUTH DAKOTA.

Bids were opened June 1, by the Constructing Quartermaster at Fort Meade, S. Dak., for the construction of a concrete dam, spillway, valve chambers, etc. Bids were asked on two types of dam, A and B. Bartlett & Kling, Cedar Rapids, Ia., at the following unit prices being the only bidders: Earth excavation, 36 cts. per cu. yd.; rock excavation, $1.80 per cu. yd.; rip rap, $1.40 per cu. yd.; 16 in. C. I. pipe without valves, $5.84 per lin. ft.; 12 in. C. I. pipe without valves, $4.67 per lin. ft.; 4 in. vitrified drain pipe, 50 cts. per lin. ft.; concrete, $7.35 per cu. yd.; valves and fittings lump sum of $875. Type "A" dam requires 16,000 cu. yds. of concrete, and type "B" requires 6,000 cu. yds.

TENNESSEE.

As noted in our last issue bids are being asked by Mayor M. L. Walker, U. S. Engineer, Memphis, Tenn., for about 160,000 cu. yds. of levee enlargement in the Reelfoot and White River Districts. The Reelfoot District work includes 60,000 cu. yds. all river side enlargement, near Slough Lgd., Tenn. This work will be built to grade with 8 feet crown 3 to 1 slopes on both sides and a foot topping added on the 8 foot crown. The grubbing will be measured from the toe of the old slope to a line 4 feet beyond the new slope line. The average height of old levee is 10.5 feet; average height of new 8-ft. crown above old levee, 1 foot. The White River District work includes 100,000 cu. yds. all landside borrow and landside enlargement located 10 miles below Helena, Ark. This work will be built to grade with an 8-foot crown; 3 to 1 slopes on both sides and a 1-foot topping will be added on the 8-foot crown. The average height of old levee is about 14 ft. and the average height of new 8-ft. crown over old levee is about 1½ ft. Work is to be completed not later than Feb. 1, 1911.

Alabama Notes.

FROM CORRESPONDENTS AND OTHER SOURCES.

The Birmingham & Edgewood Electric Ry. Co., of Birmingham, Ala., is stated to be securing funds in New York City for the extension of its Shades Valley car line to the top of Shades Mountain. Right of way has been secured and the extension will be built if financial arrangements can be perfected. George Troupe Brazelton, Birmingham, Ala., is interested.

The McCartin Constructing Co., of Birmingham, has been incorporated, with a capital stock of $5,000, and will engage in a general constructing business. John McCartin is President and Eugene Fries Secretary and Treasurer.

Surveys are to be made soon for a projected railroad from the Decaturs to Fall City in Winston county. The projected length of the line is 60 miles. Capt. C. H. Bassett, New Decatur, is interested.

Construction work is to be started soon on the railroad from Baldwin County to Pensacola. As projected the line will first be built from Milview, Fla., to Lillian, Ala., crossing Perdido Bay on a bridge 3,300 ft. long. Charles Barclay, Bay Minnette, Ala., is interested.

The Louisville & Nashville R. R., J. E. Willoughby, Engineer of Construction, Louisville, Ky., has been making surveys of a line from Hayes' Mill, four miles north of Athens, beginning at the main line there and going east several miles from the main line, passing by Holland's Gin and thence by Elkton, Tenn., leaving Elkmont, Veto, Prospect and Aspen Hill to the west. It is said this survey is being made with a view of straightening the main line, avoiding the tunnel north of Prospect, Tenn., and the steep hill just north of Elkmont.

The Union Springs & Northern Ry., W. M. Blount, President, Union Springs, Ala., is reported to have purchased the Tallassee & Montgomery R. R. This is a short line from Milstead to Tallassee. The Union Springs & Northern recently began an extension from Fort Davis to Milstead, 30 miles, and the idea of the sale is to build on to Alexander City, on the Central of Georgia, thus giving a line through from Union Springs to that point.

The Pensacola-Mobile-New Orleans R. R., now under construction from Pensacola, Fla., to Mobile, Ala., has been granted, by the Federal Government, permission to trestle and bridge Appalachee, Tensas and Mobile Rivers. The road plans to enter Mobile from the eastern shore on a trestle over the Appalachee River. Draw bridges will be placed on Tensas and Mobile Rivers. Of the 45 miles of line, 16 have been graded and ballasted and are ready for the steel rails. A large order has been placed for rails and as soon as the rails are received extension will be taken up rapidly. Henry McLaughlin, Pensacola, Fla., is President.

Arkansas Notes.

FROM CORRESPONDENTS AND OTHER SOURCES.

John Scott & Sons, St. Louis, Mo., have been awarded the contract for the extension of Arkansas Central & Eastern R. R. from McGreagor to Stuttgart, Ark., a distance of 18 miles. The contract includes clearing, grubbing, bridging, tresseling and track laying. Work will be commenced at once, and the contract calls for its completion within six months from May 18.

It is reported here in Fort Smith, Ark., that construction work will be commenced shortly on the proposed Fort Smith-Van Buren Railroad. The line will cross the river over the new free bridge now under construction.

The Louisiana & Northwestern Ry. Co. has completed arrangements for the extension of the road from Magnolia, Ark., to Prescott, by way of Waldo. Propositions are now before the cities along the right of way and if accepted construction work will be started immediately. J. A. Knox, Homer, La., is Chief Engineer of the company.

The Warren & Ouachita Valley Ry. Co. has filed a certificate with the Secretary of State of Arkansas increasing the present capital to $500,000. W. S. Hobbs, Warren, Ark., is General Manager.

California Notes.

FROM CORRESPONDENTS AND OTHER SOURCES.

The Board of Works of San Francisco has recommended to the Supervisor that the Stockton St. tunnel at San Francisco be constructed. The plans, as drawn, provide for a tunnel the width of the street to be lined with white brick with ample pavements on either side for pedestrians. The cost, including reimbursement for damaged property, it is stated, will be in the neighborhood of $450,000.

A special meeting of the stockholders of the proposed Vallejo & Northern Ry. is to be held at Vallejo on June 28 to vote on a proposition of increasing the capital stock from $2,500,000 to $10,000,000. It is reported that grading work on the projected line will be started next month.

Orlin Hudson, City Engineer of Richmond, Cal., has started to make preliminary surveys for the two sites proposed for the location of a municipal wharf preparatory to placing a proposition before the city in the form of a bond election for securing funds for the purpose. The two propositions suggested consist of either boring a tunnel through the Potrero ridge of hills and building a wharf on the other side or improving the present water front lying at the mouth of the Cutting canal.

Arthur S. Bent, Los Angeles, has been awarded the contract for increasing the size and capacity of the Sweetwater reservoir near San Diego. The contract price was about $150,000 and the work calls for the raising of the dam 15 ft. A reinforced concrete buttress 27 ft. thick will be built across the Sweetwater canyon, a distance of 300 ft. It will be 113 ft. high, and will require 15,000 bbls. of cement.

The Truckee Lumber Co., Flood Bldg., San Francisco, will, it is said, have construction work started in July on a railroad from Orville to its timber holdings in the mountains, in the Berry Creek district. The proposed road will be 30 miles in length.

Keller & Kerckhoff, whose franchise to build a railroad to Del Mar, from San Diego, Cal., expired May 12, have applied to the City Council for an extension of one year and it is expected that the body will act in favor of the same.

Colorado Notes.

FROM CORRESPONDENTS AND OTHER SOURCES.

The Denver City Tramway Co., of Denver, is to extend its 17th Ave. line out that street to Dahlia, across Dahlia to 19th Ave. in Denver, and thence to Krameria St.

The Colorado & Southern Ry., H. W. Cowan, Chief Engineer, Denver, Colo., is reported to have awarded the contract for constructing its line from Pueblo to Walsenburg. The road will cost about $3,000,000, and has been projected for some years.

Representatives of the Northern Colorado Power Co. have been conferring with B. D. Sanborn of Greeley regarding the purchase of the Boyd Lake reservoir, located four miles northeast of Loveland. It is said that if the power company secures the reservoir it will install a pumping plant and furnish water for irrigation for 10,000 acres lying between Loveland and Greeley, which was recently incorporated into an irrigation district to use water from this reservoir.

Surveys are being made for a railroad to be built from Monte Vista on the Denver & Rio Grande to Saguache. The line will be about 40 miles long and is backed by a Cheyenne syndicate. J. B. Cosgriff, Continental Bank, Salt Lake City, Utah, is interested.

According to advices from Denver, Colo., arrangements have been made with the Callahan Construction Co. for the immediate construction of the proposed Collbran branch line of the Rio Grande Junction Road. As planned the route will start at a point on the Rio Grande Junction, at a point 8 miles north of Palisade, and penetrate the Plateau Valley for a distance of 25 miles. Location surveys have been made, right of way has been secured and the sale of bonds, amounting to $550,000, necessary for the work, has been arranged for. J. J. Yeckel is President of the company and Paul Blount, Denver, Colo., is Engineer.

Denver capitalists have organized the Montezuma & Western Ry. Co., and have taken over the Argentine Tunnel Ry. Co. and the Transcontinental tunnel, which was designed to connect Clear Creek with Summit County, and will proceed to complete the tunnel at once. When this work has been accomplished the new company will proceed to construct a railroad from Denver to Leadville, which will be only 122 miles in length, as against 276 miles via the Rio Grande and 213 miles via the Colorado Midland road. Allied with the new railroad company is the Denver and Montezuma Development Company, which will take care of the mining interests which will be developed in the Argentine estate by the construction of the railroad, and the Argentine Construction Company, which has secured the contract to build the road. The officers and principal stockholders in the three

companies are George W. Brooks, D. W. Brown, A. J. Woodruff, Whitney Newton, Zeph Charles Felt, W. W. Booth, F. T. Henry and Edwin Van Cise of Denver and C. S. Birkins, president of a national bank of Idaho Springs. It is understood that the new combination has secured control of the Argentine Central Railway, extending from Silver Plume to the top of Mt. McClellan, and will also operate that road with the extension to Gray's Peak, planned for this year and next.

The Chicago, Burlington & Quincy Ry. has acquired nearly all right of way and will let the contracts at once for the construction of the line from Denver and Cheyenne, Wyo., 30 miles. Another line on which it is expected construction will commence soon lies between Hudson, Colo., on the main line to Denver and Greeley, Colo. This eventually is planned as a part of the Burlington's direct line between Denver and the Wyoming system. From Greeley the Colorado & Southern line to Wellington will be used and north of Wellington the new link will be built reaching Cheyenne, thus giving the Burlington a direct line from Orin Junction to Denver, and connecting the Denver and Cheyenne lines with a cross road.

Georgia Notes.

FROM CORRESPONDENTS AND OTHER SOURCES.

The Chattahoochee Valley Ry., J. A. Avary, General Manager, West Point, Ga., is said to be preparing to take steps soon for securing an entrance to Columbus, Ga. The southern terminus of this line is Jester, Ala., 18 miles above Columbus, and a road is now being built from Motts, on the Central of Georgia, to Goat Rock, on the river, which latter place is only seven miles from Jester. It is contemplated to fill in the gap between the latter places and come into Columbus from Motts over the Central of Georgia.

The State Railroad Commission held a hearing June 2 on the application of Middle Georgia Interurban R. R. Co. for authority to sell stocks and bonds for the purpose of constructing a railroad from Griffin, Ga., through Jackson, Indian Springs and Monticello.

Illinois Notes.

FROM CORRESPONDENTS AND OTHER SOURCES.

Representatives of the proposed Pana-Decatur interurban line have been in Pana with a view to selecting a site there for the power house and station. J. J. Pierpont, Pana, is interested.

Steps are being taken for financing an extension of the Peoples Traction Co., from Galesburg. Considerable work toward securing the right of way and subscriptions to stock has already been done. A. P. Higgins, Galesburg, Ill., is President and the Knox Engineering Co., Chicago, Ill., are the Managing Engineers.

Business men of Alexis have closed a deal with the Rock Island Southern R. R. Co., W. W. McCullough, General Manager, Monmouth, Ill., for a branch line to Alexis. A stock subscription of $50,000 and right of way is to be given.

The Illinois Traction System, Champaign, has announced its intention of building a cut-off from Streator to Mackinaw Junction to connect with the main line, giving Ottawa, now connected with Streator, Morris and eventually Joliet a direct route to St. Louis.

The Chicago & Alton R. R., W. D. Taylor, Chief Engineer, Chicago, has completed detailed plans for an improvement in Chicago which will involve the expenditure of about $1,000,000. The company has acquired land for an extension of its terminal warehouses and an office building to be erected at 2 Van Buren St.

The C. L. Gray Construction Co., of East St. Louis, has increased its capital stock from $750,000 to $1,500,000 and the number of directors from seven to eleven.

The East St. Louis Belt Terminal Ry. Co., incorporated several months ago, has applied for a right of way at East St. Louis. The incorporators of the company include John L. Flannigen, representative in the Illinois Legislature, Albert E. Meints and Fred W. Kraft of East St. Louis, and Charles T. Smiley of O'Fallon, Ill.

The Clay County Commissioners, Louisville, Ill., have appointed Henry Strigle, Thomas Tetrick and Ernest Price commissioners to superintend the drainage canal soon to be constructed in the eastern part of Clay County.

The Chicago, Burlington & Quincy R. R. has purchased 160 acres of land near Beardstown containing sand pits and is said to contemplate the expenditure of $100,000 in constructing a new yard and making other changes and betterments.

The Jacobs Engineering Co., of Ottawa, Ill., has been incorporated with a capital stock of $30,000 and will engage in an excavating business and deal in excavating machinery. The incorporators are William F. Jacobs, Charles C. Jacobs and W. C. MacFarlane.

The Chicago, Milwaukee & Gary Ry., I. W. Troxel, Chief Engineer, Chicago, has been making surveys between Aurora and Joliet with a view of building its own line between these cities. The road has a lease of the Elgin, Joliet & Eastern Ry. tracks between these cities which has a year more to run, and it is understood that this lease is not to be renewed.

Reports in the vicinity of Geneva, Ill., are to the effect that the Chicago & Northwestern Ry. has plans well under way for the establishment of four-track way to West Chicago. After this work is completed the tracks will be elevated from Geneva to Chicago, eliminating grade crossings and the curve at Geneva.

The Kelsey-Brewer Syndicate of Grand Rapids, Mich., has purchased the property of the Kankakee Electric Light Co., of Kankakee, and plan to expend several hundred thousand dollars in improving the plants at Kankakee and also give the city a system of ornamental lights.

Indiana Notes.

FROM CORRESPONDENTS AND OTHER SOURCES.

The Gary & Southern Ry. has received shipments of steel rails for its interurban line between Gary and Crown Point. Grading work on the line has been under way for some time. Ahlborn Brothers Construction Co., Hammond, Ind., have the contract for the work.

It is stated that the Fort Wayne & Springfield Traction Co., now building a line from Decatur to Portland, will extend the road from that city eastward to Minster, O., by way of Ft. Recovery.

In our last issue we mentioned that Harold Keith, County surveyor, Goshen, had completed his estimate of the widening, deepening and staightening of Rock Run. Additional information, as follows, is now available. The work will require 425,000 cu. yds. of excavating. There are 485 stations in the main stem, with 100 ft. to the station. The main drain is 16 ft. wide at the head and 60 ft. wide at the source. The average depth is 7 ft. The total length of main trunk and laterals is 12.2 miles. The four large laterals are 2,300, 3,700, 3,800 and 6,000 ft. long.

The Louisville & Northern Ry. & Lighting Co. of New Albany, Ind., is considering building a 1½ mile extension from its New Albany terminals to the New Albany Park and Fair Association grounds. The extension would cost about $20,000.

The Beers-Offutt Construction Co., of Fort Wayne, has been incorporated with a capital stock of $10,000, and will engage in a railroad construction business. G. W. Beers, D. N. Beers, and H. C. Offutt are directors.

Plans are stated to have been approved by the Wabash R. R. for laying 40 miles of double track between Detroit and Montpelier this summer. The work will be in charge of W. S. Danes, Peru, Engineer of Maintenance-of-Way.

The receiver for the Indianapolis, Newcastle & Toledo Traction Co., 30 Union Trust Bldg., Indianapolis, has asked permission to issue $35,000 worth of receiver's certificates to raise funds for extending the tracks of the company.

The management of the railroads formerly controlled by John R. Walsh, of Chicago, has decided to build a short line to tap the Clinton coal fields of Indiana. The new line will be constructed this summer, and will start from a point near Bernice, in Vermillion County, and extend east and south to the Clinton district.

Iowa Notes.

FROM CORRESPONDENTS AND OTHER SOURCES.

The City of Davenport has voted favorably on extending the franchises of the Tri-City Ry. Co. and the light and gas companies at Davenport. The owners of the companies were also granted the right to construct the new interurban into Davenport. This interurban line has been projected for some time. It is to connect Davenport and Muscatine, and three routes are proposed: One leaves Davenport and runs to Blue Grass, from Blue Grass to Sweetland Center, and then into Muscatine; the second route proposed is the river route through Buffalo, Montpelier and Fairport into Muscatine, while the third route is a proposed combination of parts of the other two, the line to run from Davenport to Buffalo, then out to Blue Grass and Sweetland Center and into Muscatine. Surveys have been made, it is stated, over all three of these routes, but further and more detailed surveys are to be made at once. Jos. F. Porter, Davenport, Ia., is interested.

The Charles City & Western Ry. of Charles City has completed its car barn at Charles City, has purchased one electric car and a freight motor and the steel rails, ties, graders, etc., with necessary equipment to construct 18 miles of track. The road has been surveyed from Charles City to Marble Rock and likewise to Alta Vista.

The Iowa City Electric Street Ry. Co. has been organized at Iowa City with a capital stock of $100,000 and will this summer build a line to Rundell's addition in Iowa City. A further extension will be made in 1911. J. O. Schulz, Secretary Commercial Club, Iowa City, is President.

The City of Creston has raised its allotment of $40,000 to secure the construction of Creston, Macksburg & Winterset Interurban.

Committee of the stockholders of the Sioux City & Spirit Lake Interurban R. R. have started soliciting subscriptions in Sioux City, Ia., and other cities along the right of way in order that preliminaries may be disposed of.

Commercial clubs of Hawarden, Rock Rapids, Doon, Ia., and Luverne, Minn., have launched a movement toward securing the extension of the Doon Branch of the Chicago & Northwestern R. R. to Hawarden, thus opening a through line to Sioux City, Ia.

A bond issue of $300,000 has been authorized by the stockholders of the Albia Interurban Co. to extend the line to Buxton, 12 miles north of Albia. The engineering and construction is in charge of the Engineering Construction & Securities Company, of Chicago, of which C. Q. Ross and C. B. Judd, of Atlantic, Ia., are President and Chief Engineer, respectively.

An official of the Chicago, Rock Island & Pacific Ry. is quoted as stating that the matter of constructing a line between Forest City, Ia., and Rockford is still under consideration. As proposed the line would pass through Nora Springs, Mason City and Clear Lake, Ia.

Kansas Notes.

FROM CORRESPONDENTS AND OTHER SOURCES.

W. B. McKinley of Champaign, Ill., principal owner of the Illinois Traction System, and promoter of the Kansas City to St. Louis electric line, has purchased the Atchison electric light and power plant and the nine miles of street railway in Atchison. The Topeka street railway system was also recently purchased. It is the plan of Mr. McKinley to connect Atchison, Topeka, Kansas City and St. Louis by a system of electric lines.

A report from El Dorado, Kan., intimates that the Atchison, Topeka & Santa Fe Railroad Co. will extend its Madison branch from Gridley to Hamilton this year. The extension

will intersect the Fredonia branch and connect with the Howard branch. It would give that country a more direct route to Kansas City. Incidentally it would give the Santa Fe four lines from Kansas City to Emporia.

Advices from Lerado, Kan., state that surveyors are running lines for the construction of a railroad from Lerado to Turon, through Stafford County, and construction work is to commence as soon as surveys are completed.

A preliminary survey is being made for the projected north and south railroad from Beatrice, Neb., to Wichita, Kan., by way of Abilene, Kan. A meeting will be held at Newton, Kan., to arrange for final surveys and financing the project.

Construction work has been resumed on the proposed line of the Kiowa and Hardtner R. R. in Kansas. T. E. Luttgerding is Superintendent of the company. It is expected that the line will be pushed through to completion.

The first eight miles of the Cherryvale, Oklahoma & Texas R. R., from Caney, Kan., has been graded and the outfits have been moved below Cotton Creek to take up work on the final stretch of the section to Wann, Okla. It is expected that grading work to that place will be completed by July 1, when track laying will be commenced.

Louisiana Notes.

FROM CORRESPONDENTS AND OTHER SOURCES.

Booth & Flinn, Ltd., Pittsburg, Pa., who have the general contract for the construction of a gas line from Shreveport, La., to Little Rock, Ark., for the Arkansas Natural Gas Co., have placed an order for 269 miles of 10-in., 12-in., 16-in., and 18-in. steel pipe. Work on the pipe line is to be started immediately, and is to be completed by March next year. The main line will extend from Caddo Parish, La., to Little Rock, Ark. The main branch lines will supply gas for domestic use and for manufacturing purposes to a large number of cities and towns of that section.

Good progress is being made with the construction of the Sunset-Central's 51-mile branch line from Lafayette to Baton Rouge, La., and it is probable that the extension will be opened for traffic about August. This road is being built with a view of forming connection with the Yazoo and Mississippi Valley road, Louisiana Railway and Navigation Company's lines and the Baton Rouge, Hammond and Eastern at Baton Rouge, and the Alexandria branch of the Morgan line and the Louisiana Western, at Lafayette.

A special tax of 5 mills has been voted by the citizens of Cottonport, La., to be appropriated to the Gulf Belt Northwestern Railway Co., providing the line is constructed through this city within two years.

The Mineral Wells Electric Ry. Co. has been organized at Shreveport, La., for the purpose of building and operating a street and suburban railway. S. B. Cantey, of Fort Worth, Tex., is president; N. C. Blanchard, former governor of Louisiana, vice president, and W. C. Fordess, of Fort Worth, secretary. The other incorporators are D. T. Bomar, of Fort Worth, and L. R. Smith, of Shreveport.

Michigan Notes.

FROM CORRESPONDENTS AND OTHER SOURCES.

The Chicago, Milwaukee & St. Paul Ry. is reported to be making final surveys for a line to the Iron River and Stambaugh Districts of the Menominee iron range. The company plans to extend the Crystal Falls branch into the Iron River valley, touching the new Chicogoan mine and various promising explorations en route. The length of the extension by the proposed route is about 17 miles.

Common Council of Detroit, Mich., has adopted two resolutions permitting the Detroit Union Railway to loop the Ghene street line by constructing a new track on Grand avenue and to double track the Mack avenue line from Baldwin avenue east to the city limits.

The Grand Trunk Ry. has completed plans for improvements in Pontiac involving the expenditure of $62,000. Of this sum, $25,000 will go for a new brick freight house, and the remainder for increasing the trackage.

Missouri Notes.

FROM CORRESPONDENTS AND OTHER SOURCES.

A special election is to be held at Kansas City, on July 19, to vote on a city bond issue totalling $3,650,000 for the following purposes: Parks and boulevards, $650,000; market houses, $50,000; fire department, $100,000; water works, $1,000,000 river front, $75,000; workhouse, $50,000; street paving plant, $50,000; incinerating plants, $100,000; tuberculosis hospital, $50,000; sewers, $300,000; Chace school, $25,000; armories, $250,000; art museums, $200,000; Twelfth street trafficway, $475,000; bridges, $200,000; hospital for poor children, $75,000.

The Intercity Viaduct Freight Ry. Co., a new company, has asked the city council of Kansas City, for a 30-year franchise to transfer and deliver freight from all railroads entering the city to a central warehouse. J. W. Reinhart, Kansas City, is interested.

At a meeting of the stockholders of the St. Louis, St. Charles & Northern Traction Association, held at Middleton on June 2, it was voted to build the line from St. Charles by way of St. Peters, Old Monroe, Troy, Olney, Marling, Middletown and Mount Carmel to Laddonia.

According to an estimate by Charles Martin, Civil Engineer, the total cost of lowering the railroad crossings at St. Louis, Mo., would be about $1,360,000.

Grading has been commenced on the projected 45-mile line of the Laclede, Dallas & Western from Phillipsburg to Buffalo, Mo., and will, it is said, be pushed through to an early completion. Davis & Blair, Joplin, Mo., have the contract. The officers of the railway are: B. B. Coffee, president; Sam T. McDermott, vice president; J. R. Kelley, treasurer; W. F. Farren, secretary, and Meservey G. German, general counsel.

St. Louis Items.

BY A. B. KOENIG.

It looked like the week before election in East St. Louis, Ill., last Tuesday with the crowd gathered around the Mayor's office waiting for a chance to talk about the respective merits of brick and creosote block as paving materials for State street. A victory for the brick advocates was won. Speeches were made by Mrs. M. V. Recklein, N. A. Schein, Fred W. Kraft, George Ferold, T. P. Bates, Phil Traband and others. All of the orators grew fervent in praise of the side they championed, and bitter in denouncing the other. The contract involves spending $280,000. When the work is completed State street will be a boulevard all the way to the city limits at Edgemont. The car tracks will be moved to the center of the street and trees planted along the edges. It is expected that Belleville will take up the improvement at Edgemont and make the street a splendid roadway for automobiles and other vehicles.

M. B. Burgher, city engineer of Hannibal, and a party of four left that city on June 6 for St. Charles, Mo., for the purpose of making a survey for the proposed interurban line, between St. Charles and Laddonia, a distance of sixty miles, which will, in all probability, be later extended to Paris, making the length of the road 90 miles.

Bills to improve six sections of street in the slum district were passed by the House of Delegates last Friday. The council already has passed the bills and they become law when signed by the presiding officer of each house and the mayor. For many years an effort has been made to get street improvements in the Ghetto but bills have always been defeated. The Health Department has claimed muddy streets have done much to prevent a cleaning up of the district. Seventh, Eighth, Tenth and Eleventh streets, from Biddle to Cass; Thirteenth, from Franklin to Biddle, and Biddle, from Seventh to Broadway, are the streets to be improved. Brick is to be used in each case. A public hearing was held in the House on the bills, and a protest was made, but a favorable report was made by the Public Improvements Committee on the recommendation of the Health Department and the Board of Public Improvements, and more than a two-thirds vote was given the bills. Four Democrats, Delegates Igce, Brennan, Golden and Gallagher, voted against the bills. The Board of Public Improvements submitted new bills to the Assembly for the improvement of Twelfth street in two sections, from Franklin to Hebert street, and Gay street, from Twelfth to Thirteenth, with wood blocks, Twelfth street is considered in its mile and a half of length as two separate propositions, partly to prevent the defeat of the whole because of a partial protest and partly to make the work easier to control by dividing the contract. Twentieth street, in four sections, from Washington Ave. to Salisbury street is included in the list, the material being brick. The sections are Washington to O'Fallon, to Cass, to Branch to Salisbury. Other streets included in the new bills are: McPherson, from King's Highway to Union, wood blocks; Natural Bridge road from Grand to Spring, and from Spring to Fair, brick; Adelaide, from Conde to 590 feet east, asphalt and Waldemar from Forest to McCausland, telford.

Wm. O'Connor can use an outfit of about six teams on the Santa Fe R. R. at Stanfort, Mo. In addition to this he will give them the privilege of boarding about 20 of his own men at $4.00 per week. Tents and everything will be furnished.

A. G. Jennings spent a couple of days in town last week. At the present time he is building the interurban line from Wichita to Newton, Kas. (28 miles). Commenced track laying on it the other day. He also has the contract for grading the yards for the new Union Depot at Joplin, Mo. In addition to this he is ballasting 21 miles of the Pittsburg and Joplin electric line. He says he is able to handle more work and is looking for it.

We have not heard from our old friends Hannon & Hickey lately, but from all accounts and reports they are getting along fine with every one of their contracts.

While on our recent visit west we met Wm. Bates of the McIntyre-Tiese Const. Co. in Wichita, Kas. Billy was looking prosperous, in fact better than we ever saw him look in our life and we have known him for a long while.

J. W. (Doc) Skinner came in from his bridge work on the Big Four R. R. in Southern Indiana and returned after getting another nice bridge and pile driving contract on the Iron Mountain R. R. south of here.

The Board of Public Improvements last Friday reconsidered its action of Tuesday in rejecting all bids on the dead animal contract and awarded the contract to the East St. Louis Rendering Company, paying the city $425 a month. Bids had been rejected because the contract by which the city was to furnish Chesley Island for a plant had been declared illegal by the Law Department, but the board, finding the other bids were legal, and all except President Reber opposing the use of Chesley Island for the plant, decided to award the contract. The contract is to run to 1929. It is to be effective not later than six months from the day of the award, the company having option to begin sooner if ready. The price exceeds the cost of collection but from $500 to $1,000 a year, and contrasts strikingly with the past expenditure for disposing of dead animal. A few years ago the city was paying several thousand dollars a year for the disposal, besides collecting the animals at its own expense, and when the new administration took charge the city was considering itself lucky to find a contractor willing to accept them without pay. The bill authorizing the purchase of Chesley Island is still pending.

Judge Wm. Bates of Memphis, Tenn., came in while we were out west. Failed to get any information from him. Sorry we missed you Judge. Come around again soon.

The Terminal Railroad Association and other railroads using the Mill Creek Valley at Compton avenue have agreed to accept the ordinance now pending in the House of Delegates for the abolition of the Compton avenue viaduct, if the city will assume the damages to private property. The bill requires

the Terminal, the Frisco, Wabash and Missouri Pacific to abolish the Compton crossing by erecting a steel viaduct over the valley. The roads agree to assume the damages to all railroad property adjoining the viaduct. One piece of property owned by a private individual, if damaged, is to be taken care of by the city. The city's share of the damages is estimated to be less than $2,000. The viaduct is to cost about $375,000. A similar proposition is under consideration for the elimination of the Ewing avenue viaduct by the same railroads, and for the separation of the grades at Union and King's Highway on the Terminal belt line on the north side.

Montana Notes.

FROM CORRESPONDENTS AND OTHER SOURCES.

The Dakota & Montana Ry. Co. has filed its articles of incorporation at Helena, Mont. This company is incorporated by William Wallace, Jr., R. F. Gaines and T. B. Weir, all of Helena, Mont., and proposes building and operating a line of railway from some point to connect with the Dakota & Montana Ry. in Custer county and with the Northern Pacific Ry. line in the same county. The capital stock is $10,000, all of which has been subscribed.

Great Northern R. R. officials have decided to start work at once on track improvement near the Cascade tunnel and expect by the end of summer to have changed tracks and built snow sheds that will make impossible any further trouble at that point. The work will be done under the direction of Alex. Stewart, Seattle, Wash., Assistant Chief Engineer of the company.

Thomas M. Ward, C. E., has completed a survey for the construction of a railroad from Anaconda, Mont., across the Great Continental Divide to French Gulch. Three lines were run before the route was found which was satisfactory. It connects with the B., A. & P. road at the Allen spur, and also with the Stuart branch of the Northern Pacific Railroad near the Mill Creek stock yards, making two transcontinental connections. The line of track starts from the west side of the creek and runs along the foothills for a mile or more and then crosses to the east side of the valley, and by a series of curves approaches the crest of the range and by a short cut will head into the mountains for a 1,500 ft. tunnel.

The Northern Pacific has secured most of the right-of-way necessary for the proposed new line between Logan and Bozeman, Mont., and also a site for the construction of repair shops where the proposed new line will cross the present line a few miles east of Belgrade, Mont. Construction work will begin soon, it is said.

According to reports from Mandan, N. Dak., bids have been received by the engineers of the Northern Pacific Ry. for the construction of the Mott-Terry extension of the Western Dakota Ry., in Montana. Work on this line will be commenced some time this summer and together, with the 125-mile line between Mandan and Mott, the line when completed will give the Northern Pacific 350 miles of new track. The cost of the work is estimated above $12,500,000.

The Cannon Ball branch of the Chicago, Milwaukee & St. Paul Ry. will, it is said, be completed and in operation about July 1. The road runs from Mobridge, S. Dak., across the two Dakotas, terminating within a few miles of the Montana border.

The Big Blackfoot Ry. Co. has awarded contracts for the extension of its line 40 miles up the Blackfoot River. The Clifton-Applegate Co., Missoula, Mont., will build the 15 miles of line from the present terminus at McNamara Landing to the mouth of the Clearwater River. White Brothers, 1st National Bank Bldg., Missoula, Mont., will construct 25 miles from the Clearwater up the Blackfoot toward Nevada Creek. Work is to be started immediately and it is expected that the 40 miles will be completed this season. The Clifton-Applegate Co. has been building the line from Bonner to the landing at the mouth of Camas Creek and the new contracts will be an extension of this work.

Nebraska Notes.

FROM CORRESPONDENTS AND OTHER SOURCES.

The Chicago, Rock Island & Pacific R. R. is said to be planning to build a 5-stall roundhouse at Vine St., in Lincoln, Nebr.

The City Council of Hastings has granted the Omaha, Western & Lincoln R. R. Co. a franchise for the use of certain streets for entrance to the city. The franchise is for 50 years, and is for passenger and express traffic only. The road is to be completed in five years from date of franchise. F. E. Schaaf, Lincoln, Nebr., is interested.

The Nebraska, Kansas & Southern R. R. Co., which projects a line between Garden City and Stockton, Kans., has made a proposition to the Commercial Club of Hastings, Nebr., for an extension of the line to that place.

Surveyors of the Chicago, Burlington & Quincy R. R., according to reports, are running lines from Burwell, Nebr., into the Black Hills.

New York Notes.

FROM CORRESPONDENTS AND OTHER SOURCES.

The Village Trustees of Bolivar have granted a franchise to South Western New York Traction Co. for its proposed electric railway to connect Bolivar with Wellsville. The franchise is for a term of 50 years. The new line is to be 15 miles long.

E. M. Graves, Cleveland, O., has been awarded Barge Canal Contract No. 73, calling for the dredging of the channel of the Hudson river from Northumberland to Stillwater. The contract price was $767,467.

The Greenwich Knitting Co. of Greenwich, has purchased additional water rights in the Battenkill with the object of some time in the near future of building a new and higher dam.

The New York State Public Service gave a hearing May 31 at Albany on the application of the New York, New Haven & Hartford R. R. Co. for authority to purchase at par the entire stock of the Westchester Northern R. R. Co., with a capital stock of $1,000,000. The former company owns all of the stock of the New York, Westchester & Boston Ry., which, when built, will have a connection with the Westchester Northern in White Plains.

The New York, Westchester & Northern R. R. Co., mentioned in our last issue in these columns, has been given authority by the upState Public Service Commission to construct its line from a connection in White Plains with the New York, Westchester & Boston Ry. to Lewisboro, on the Connecticut border, and also a branch road from Pound Ridge to connect with the New Haven road at the Connecticut border.

The New York State Public Service Commission has approved the application of the New York Central & Hudson R. R. for permission to build a cut-off line on its Rome, Watertown & Ogdensburg division, between Sanford and Watertown. The cut-off will be 4½ miles of double track and will take long freight trains from factory streets in Watertown.

The Hydraulic Power Co., of Niagara Falls, has increased its capital stock from $500,000 to $12,000,000. The stockholders include: Arthur Schoelkopf, Jacob M. F. Schoelkopf, Geo. W. Olmsted, George B. Matthews, Paul A. Schoelkopf, G. P. Hugo Schoelkopf and Hans Schmidt.

Announcement was made June 1 by President Louis Mazzolla of the Excavators' Union of New York City, that the members of the union had begun a general strike for 22 cents an hour, and that 1,500 men stopped work during the day and more men would strike on the next day.

The Erie R. R., according to present indications, will open the Bergen Hill, N. J., cut-off for regular passenger traffic on July 1. The new cut, which has been in course of construction for the last four years, cost about $6,000,000, and was made for the purpose of obtaining relief from the congested Bergen tunnel, by which the railway reaches its Jersey City terminal. The Bergen cut accommodates four tracks and will add greatly to the facilities of the Erie in and out of New York.

Ohio Notes.

FROM CORRESPONDENTS AND OTHER SOURCES.

Right of way is being secured for the extension of the lines of the Springfield & Washington Ry. Co., G. W. Baker, General Manager, Washington C. H., O., from its present terminus at South Charleston to Chillicothe. As proposed the extension will pass through South Salem, Jeffersonville, Washington C. H., New Holland and Clarksburg. The necessary capital for construction purposes is said to have been secured and it is proposed to have work started this summer.

The Norfolk & Western R. R. has a considerable part of the work of double tracking its line from Columbus to Kenova well under way. John T. Adams, Columbus, O., has contracts for 10 miles of the new work near Chillicothe.

The Portsmouth Street R. R. & Light Co., Geo. A. Youngman, Chief Engineer, Portsmouth, is said to be considering plans for extending its line to Hanging Rock, making use of an old survey made some years ago, and rights of way which were secured at the time. The line would connect at Hanging Rock with the Ohio Valley Electric Co. line.

Irwin Brothers, Hamilton, have been awarded the contract by the County Commissioners at Hamilton for the construction of the Stout levee from the Trenton bridge on the east side of the Miami River to Middletown. The contract price was $25,477.

The City of Cleveland will vote on July 22 on the issue of $2,250,000 bonds for the elimination of grade crossings and the erection of a tuberculosis sanitarium at Warrensville.

Committees have been appointed by the promoters of the Crosstown Line Ry. of Columbus, O., to secure a charter and right-of-way for the projected line on Fifth Ave., from Shepard to Arlington. The company is to be capitalized at $10,000. William Cushing, President of the Columbus Saw Mill Co., Columbus, O., is interested.

The Mahoning Valley R. R. Company has begun construction work on the five miles of new track on Poland Ave. All the old single track will be taken up and a new double track installed from Cedar St. to the city limits of Youngstown, O.

The necessary capital is stated to have been secured to assure the construction of the proposed traction line connecting Minster with the main line of the Western Ohio Ry. Co. F. D. Carpenter, Lima, O., General Manager of the Western Ohio Ry., is interested in the new line.

The Ohio Engineering & Contracting Co., of Pomeroy, O., has been incorporated with a capital stock of $5,000, William T. McCormick being the principal incorporator.

Oklahoma Notes.

FROM CORRESPONDENTS AND OTHER SOURCES.

The necessary capital for the construction of the Enid-El Reno interurban line is reported to have been promised. Judge Whittinghill of Enid, has recently returned from Europe, where he went to finance the line.

The Muskogee Gas & Electric Co., of Muskogee, which is controlled by H. M. Byllesby & Co., Chicago, Ill., has increased its capital stock from $1,500,000 to $4,000,000, with a view, it is said, of installing a large hydroelectric plant on the Grand River 30 miles from Muskogee. The project has been under consideration for some time and preliminary surveys have been made. H. E. Hoagland, Muskogee, is Superintendent.

The Clinton, Oklahoma & Western Railroad recently completed between Clinton and Butler, Okla., is to extend its line, according to reports, on through Korn Colony, and to either Chickasha or Anadarko, Okla. Farmers along the right of way have already subscribed a bonus of $30,000 for the project. The line, if built to Chickasha, will cross every line in Oklahoma, west of Guthrie, except the Santa Fe.

Oregon Notes.

FROM CORRESPONDENTS AND OTHER SOURCES.

The City of Ashland voted June 1 on granting a franchise to J. R. Anderson, Pasadena, Cal., for installing and operating a gas plant at Ashland.

Preliminary surveys have been made for a railroad from Oregon City to Molalla, and it is said that farmers in the vicinity of Oregon City will build the road themselves if they cannot get some company to do it.

The Coos Bay Rapid Transit Co., organized some months ago to build an electric railway between Marshfield and North Bend, has started grading at the terminal grounds located between the two cities. It is announced that the rails have been ordered for the road and clearing and grading on the right of way has been started. The road is to be finished within four months after the question of franchises in both cities is settled.

The Oregonia Construction Co. has been incorporated with a capital stock of $1,000,000, the incorporators being Henry Hoeck, C. G. Hockett and L. D. Kinney. The principal office is at Coos Bay.

H. W. Silkie, who has the contract for constructing 14 miles of the Oregon Trunk Line from Bend, Ore., to the lava beds, is preparing to begin work. His headquarters for the work will be at Bend.

Pennsylvania Notes.

FROM CORRESPONDENTS AND OTHER SOURCES.

The Delaware County & Philadelphia Electric R. R. Co., Clifton Heights, has commenced work on the 69th St. extension at Penn Boulevard and Baltimore Ave., East Lansdowne.

A company has been chartered to construct a line from terminus of the Lykens & Williams Valley Street Ry. line at the eastern end of Dauphin County to Jonestown, three miles away. J. W. Moyer, Pottsville, Pa., owner of the Lykens & Williams Valley Co. is President.

Additional sub contracts for work on the Western Maryland R. R. extension have been let as follows: R. W. Hill & Co., New York City, for grading between Connellsville and Herd Tract; R. Galiardi, Connellsville, for grading from the Herd Tract to Indian Creek; W. H. McCourt, Akron, O., for grading between Indian Creek and Ohiopyle.

The Scranton & Lake Ariel R. R. Co., has been chartered with a capital stock of $120,000, and proposes to construct a 12 mile electric railroad from Moscow to Ariel Borough by way of Hollisterville and Hamilton. The incorporators are as follows: John J. Brown, president; Valentine Blumm, W. J. Davis, John J. Holland, L. P. Wedeman, George Wedeman, John Godwin, E. J. Lynett, F. W. Wollerton, A. G. Rutherford and E. A. Brown, all of Scranton and J. D. Williams, of Jermyn.

The Interstate Railways Company, a holding concern, has announced that a deal embracing the amalgamation of the trolley lines in Wilmington, Del., and Chester, Pa., and electric lighting plants of Wilmington will go into effect June 15. The plant will be taken over by the Wilmington Light & Power Co. The concerns included are the Chester Traction Co. and the trolley line from Darby to Wilmington; Delaware County (Pennsylvania) Railway; Wilmington City Ry. and the Wilmington City Electric Ry. All of the plants will be operated on a lease.

Plans are under way for the construction of an extension of the Buffalo, Rochester & Pittsburg R. R. from Mt. Jewett to Kane, Pa., to replace the 12-mile, narrow gage between the two cities. Motor cars will probably be operated on the new stretch for a start.

The Pennsylvania R. R. is preparing to construct double track line from Elwyn to Wawa, Pa., and other improvements are planned by the company at Lenni, Pa.

The Philadelphia & Reading R. R. is planning on closing the passing sidings along the Lebanon Valley branch in order to give the company a 3-track line between Harrisburg and Reading, Pa. To effect a result between Sheridan and Womelsdorf about 2,000 ft. of track will be built, requiring the removal of about 12,000 cu. ft. of earth and rock, also the construction of a bridge. This portion of the work will cost $17,000.

South Dakota Notes.

FROM CORRESPONDENTS AND OTHER SOURCES.

The South Dakota Central Ry. Co., which operates 103 miles of line between Sioux Falls, S. Dak., and Watertown, is to expend $40,000 to $50,000 this summer in improving the road bed and track.

The Business Men's Union of Watertown, S. Dak., in conjunction with the towns of Astoria, Arco, Ivanhoe, Hendricks and Tyler, Minn., is making an effort to have the Chicago & Northwestern Ry. build a 20-mile spur from Tyler, Minn., to Astoria, S. Dak.

The Winnipeg & Gulf R. R., which projects a road from Winnipeg to the Gulf, passing through Fargo and Sioux Falls, S. Dak., is reported to have purchased the rights of the Brookings & Sioux Falls Ry. Co. The Brookings & Sioux Falls Co. planned on constructing an electric railroad to connect the two cities and intermediate points. It is reported that the survey for the proposed Winnipeg-Gulf railroad is practically completed between Sioux City and Fargo, the route from Fargo running through Rutland, Webster, Watertown, Brookings and Egan.

Tennessee Notes.

FROM CORRESPONDENTS AND OTHER SOURCES.

The Memphis Street Ry. Co., T. H. Tutwiler, president, Memphis, Tenn., has several routes under consideration for the construction of a cross town line in Memphis. Present plans contemplate a line running from Railroad Ave., north to Jackson Ave.

The City Commissioners of Memphis have rejected the proposition of the railroad for the construction of subways and have submitted a counter offer. The first offer made by the railway companies was that they would stand the physical cost of constructing eleven subways, the city to pay the cost of paving approaches and also the damage to abutting property. Estimates made by City Engineer Weatherford fixed the railroads' share of expense at $1,000,000 and that of the city at $600,000.

The Memphis Union Depot Co., of Memphis, opened bids June 7, for the construction of the main building and sheds of the $3,000,000 union station which is to be erected in Memphis.

The Bristol Belt Line Ry. Co., of Bristol, Tenn., has formally taken over the Holston Valley R. R., extending from Bristol through Holston Valley and across the Holston River, a distance of 12 miles. For the present it will be operated as a separate property from the city lines, and it will not be changed to an electric line before next fall. B. L. Dulaney, Bristol, is President.

Texas Notes.

FROM CORRESPONDENTS AND OTHER SOURCES.

Surveys are being made for a proposed extension of the Santa Fe Central R. R. from Torrence to a connection with the Pecos Valley line of the Atchison, Topeka and Santa Fe, probably at Roswell, a distance of about 100 miles. The Santa Fe Central runs between Torrence and Santa Fe, connecting at the latter place with the Denver & Rio Grande.

Announcement has been made that the Pecos Valley Southern R. R. will be finished to Saragosa, Tex., from Pecos City by July 1. The distance is 30 miles. Track is already laid about one-half this distance. It is proposed to extend the road to Alpine, about 100 miles, where it will connect with the Southern Pacific. The route of the new line is up the valley of Toyah Creek, where large irrigation enterprises have been established.

Final location surveys are now being made on the route of the proposed extension of the St. Louis, Brownsville & Mexico Ry. (Frisco system), from Brownsville, Tex., to Tampico. It is stated that the construction of the line will be started this fall. The distance is about 300 miles. The route will run inland about 30 miles from the gulf coast. The construction of a number of large bridges will be necessary.

The power house for the Galveston-Houston interurban line, now under construction for the Stone & Webster syndicate, is to be located on the north side of Clear Creek in Harris county, according to a recent decision of Mark Lowd, Houston, southwestern manager of the Stone & Webster Engineering Corporation.

Charles Clarke & Co. of Galveston has finished delivering to the Gulf, Colorado & Santa Fe at Bolivar a shipment of 200,000 ties cut and prepared at Morgan City, La. The delivery of these ties has been by barges, a space of time occupying four months being taken for the delivery. The ties were delivered at an average of 50,000 a month.

A tract of several thousand acres of land near Brownsville is to be developed by J. T. Beamer, of Washington, La., and L. A. Smartt, of San Juan, Hidalgo county, Texas.

C. G. Patton, Houston, has commenced work on his contract for the construction of bridges and culverts on the line of the Temple & Northwestern Ry. between Temple and the Leon River. Over one-third of the line between Gatesville and Hamilton has been completed by the grading crews and with favorable weather prevailing, the entire line will be graded in 90 days.

F. L. Dormant, consulting engineer, of Houston, has been directed by the Mayor of Houston to prepare plans for the filling in of the city ditch on Calhoun Ave., and the construction of underground drainage. It is proposed to fill in the ditch from Baldwin St. to a point where Calhoun Ave. crosses the tracks of the San Antonio and Aransas Pass Ry. and in its place to lay either a brick or a concrete sewer for drainage.

The Black Bayou Ry. Co. has been chartered with a capital stock of $50,000 and proposes to construct a line from Myrtis, Caddo parish, Louisiana, to the southwest corner of Cass county, Texas, beginning at the village of Rossman, thence into Marion county in a westerly direction to Mosely, about six miles east of Jefferson, a total distance of 22 miles. The incorporators are S. H. Chatten, F. H. Brown and C. C. Rossman of Kansas City, Mo.; R. L. Trigg, S. M. Ragland, Robert Tucker, J. G. Hoffman and S. A. Collom of Texarkana, W. H. Welch and J. P. Cook of Myrtis.

Preliminary matters are well along for the construction of a street railway in Greenville, for which A. Price, N. T. Lause and A. Emanuel, representing Dayton, O., capitalists, some two months ago applied for a franchise. The work of constructing the line will start some time next month. Five miles of line will be built at once, and in order to reach the main residence sections of the city some eight or nine miles of car line will be required. The system will cost about $200,000 when completed.

Rose & Ellis have the contract for grading four miles of the Abilene Southern Ry. out of Hamlin.

Citizens of Bridgeport, Tex., have accepted the proposition of the Chicago, Weatherford & Brazos Valley Ry. Co. to subscribe a bonus of $12,000 and eight miles of right-of-way to secure the construction of that road through Bridgeport to Weatherford, Tex.

The Gulf, Texas & Western has been completed into Seymour, Tex., placing in operation 75 miles of the projected route. The line will ultimately extend to Jacksboro, Tex., and connection will be made with the Santa Fe at either Lubbock or Plainview. F. M. Bowman, Dallas, Tex., is General Manager of the company.

Offices of the construction crews of the Cotton Belt have been opened at Gatesville, Tex., and materials are on hand for the immediate starting of work on the proposed extension to Hamilton, Tex.

Advices from Denison, Tex., are to the effect that the construction gangs of the Missouri, Oklahoma & Gulf Ry. have arrived and are preparing to start grading for the pro-

posed yards and terminals at that point. All work will be completed ready for steel by August 1.

Citizens of Taylor have voted to donate $50,000, seven miles of right-of-way and terminal facilities toward the building of the proposed Taylor-Somerville & Gulf R. R.

Headquarters of the surveying crews of the Texas North & South Ry. are to be established at Fredericksburg and Gillespie, Tex., and final surveys will be made over the preliminaries from Seymour to San Antonio, Tex. Grading contracts will be let shortly, it is said.

B. H. Talmadge, Vice President and General Manager of the Enid, Ochiltree & Western R. R., is quoted as stating that construction work is progressing rapidly on the western end of the proposed line and that steel will be laid into Wilcox, Tex.

R. E. B. Bledsoe, Somerville, Texas, has been appointed chairman of committee to raise the necessary bonus in that city for the construction of the railroad between Taylor and Somerville.

Considerable progress is being made in building the San Antonio, Rio Grande & Tampico, projected to run from San Antonio, Tex., to Tampico, approximately 500 miles. It will, according to a statement made by the promoters, open up a new artesian belt and will benefit San Antonio a great deal. It is intended that 40 miles of the road will be in operation by September.

According to an announcement made by Edward Kennedy, President of the Altus, Lubbock & Roswell R. R., in Houston, Tex., the contract for completing the line from Memphis, Tex., to Lubbock by laying the necessary steel and building bridges and grading right-of-way from Lubbock to Roswell, N. Mex., has been let to the Texas Construction Co. The portion of the projected line between Altus and Hollis, a distance of 60 miles, has been sold to the Wichita Falls & Northwestern Ry.

The St. Louis, Brownsville & Mexico Ry. Co. is planning the construction of a large wharf into the bay at Seadrift, Texas, to accommodate San Antonio Bay and Guadalupe River traffic. E. C. Burgess, Kingsville, Tex., is Engineer Maintenance of Way and Construction.

Citizens of Lexington, Tex., have succeeded in raising several thousand dollars toward the necessary bonus to secure the construction of the proposed Taylor-Somerville R. R. through that place. City of Taylor has voted a bonus of $50,000 toward the project.

Citizens of Palestine, Tex., and Dallas are promoting the construction of a railroad between the two cities, traversing the 100 miles of the most populous agricultural district of Texas.

The Uvalde & Crystal City R. R., now under construction, has engineers in the field making preliminary surveys from Gardendale southeast to either Corpus Christi or Aransas Pass. This road is now completed and in operation from Crystal City to Carrizo Springs. From Gardendale west towards Crystal City, over 18 miles has been graded, and from Crystal City east towards Gardendale seven miles have been graded. The entire distance is 41 miles, and the gap between the two graded sections is being rapidly closed up.

Utah Notes.

FROM CORRESPONDENTS AND OTHER SOURCES.

Satisfactory progress is reported in financing the Iron Mountain, St. George & Grand Canyon R. R. Co., which was incorporated some time ago to construct a line from Thermo, on the Salt Lake Route, to Cedar City, through St. George to Kingman, Ariz., crossing the Colorado River about four miles below Rioville. A number of branches will be built, one from Big Sandy to the rim of the Grand Canyon via the oil and timber belt, and other short ones to the different mines along the line. Iron and Washington counties of Utah have offered free right-of-way to the first railroad building through their section.

According to reports from Junction, Utah, plans are on foot for the construction of a railroad from Marysvale, south along the east and west fork of the Sevier River to Junction, Utah.

Advices from Salt Lake City, Utah, are to the effect that the Gould System is planning the construction of a cut-off from the main line at Riverton to the Bingham-Garfield branch at Welby, Utah; thence to the Western Pacific, making a through line from all points west of Garfield. C. A. Blake, Salt Lake City, Utah, is Division Engineer of the Denver & Rio Grande Ry.

Washington Notes.

FROM CORRESPONDENTS AND OTHER SOURCES.

The Puget Sound Bridge & Dredging Co., Seattle, has been awarded the contract by the city of Olympia for the improvement of the Swantown Slough. The contract price was $61,309, the itemized bid being as follows: 15 cts. per cu. yd. for dirt; piling, $7.50 each; rock work, $2.25 per cu. yd.; brush, $3 per cord, scow measurement.

The Copper River Northwestern Ry., now under construction in Alaska will be in operation to the Bonanza mines at Kennicutt by Nov. 30. At present between 3,000 and 4,000 men are at work on the construction of the line. The company will operate 130 miles of the line this summer from Cordova to the mouth of the Chitna, hauling freight and supplies. Track-laying is in progress from the Miles glacier northward and the 100 miles of new line between Tiekel and the Kennicutt mines will be finished on time.

The Tacoma Railway & Power Co., L. H. Bean, General Manager, Tacoma, is making plans for an extension of its lines to the Bismarck section of the city.

The Grays Harbor Construction Co. will start work at once on the contract for constructing the Willapa branch of the Union Pacific in Washington. The road will extend south from Cosmopolis, Wash.

Nearly all right-of-way has been secured for the proposed extension of the Sunnyside (Wash.) branch of the Northern Pacific from Grandview to a point on the main line near Gibbon, a distance of 13 miles, and condemnation proceedings have been started for the rest of it in order that construction work may be started without further delay. A. R. Cook, Tacoma, Wash., is Engineer Maintenance of Way lines west of Paradise.

The Oregon & Washington Ry. Co. is to construct a spur track 1,800 ft. in length to the site of the proposed Lake River docks, 500 yds. north of the Ridgefield depot in Vancouver, Wash. The work includes the construction of a 300-ft. dock, which will cost, it is estimated, about $10,000.

Secretary of State, Olympia, Wash., has refused Maurice D. Leehey, Seattle, Wash., a charter for a railroad to be known as the Alaska Central Ry., on account of there being one corporation by that name on record.

Advices from Tacoma, Wash., are to the effect that contracts will be let at once for the construction of a 12-mile sea wall along the Tacoma water front and a tunnel 2,900 ft. in length for the projected Point Defiance line of the Northern Pacific.

West Virginia Notes.

FROM CORRESPONDENTS AND OTHER SOURCES.

The Charleston, Clendennin & Ganley R. R. Co. has been chartered and proposes to build a line from a point on Elk River opposite the mouth of Blue Creek to a point on Elk River opposite the mouth of Big Buffalo Creek in Clay county. The point at Blue Creek is where the Kanawha & West Virginia crosses the Elk River. The proposed line, it is believed, will connect with the K. & W. Va.

The Chesapeake & Ohio R. R., H. Pierce, engineer of construction, Richmond, Va., according to reports, is shortly to award contracts for the extension of the Guyan Valley branch from the mouth of the Big Huff, in Logan county, through Wyoming county, to connect with the Piney branch, in Raleigh county. The route will be up Big Huff creek by the town of Oceana, on the Clear fork, and thence up to the Laurel fork of Guyan River, a distance of 33 miles to a juncture with the Piney extension.

The Moorefield & Virginia Ry. Co., recently chartered to build 20 miles of line from Moorefield to Peru, Hardy county, W. Va., has elected the following officers: President, William B. Cornell, Romney, W. Va.; vice-president, C. B. Welton, Moorefield, W. Va.; secretary and treasurer, Eugene W. Ailes, Washington, D. C.; general manager and chief engineer, William Trapnell, Romney, W. Va.

Wisconsin Notes.

FROM CORRESPONDENTS AND OTHER SOURCES.

The Grant R. R. Co., of Mount Hope, Grant county, has been incorporated with a capital stock of $25,000 and proposes to build a line 20 miles long to connect Fennimore and Bagley, in the southwestern lead mining district of Wisconsin. W. E. Lewis, George Monroe, and J. F. Morse are stockholders.

Excavation work has been started at Superior, for four oil tanks to be erected by the Standard Oil Co.; contracts for the erection of the tanks, it is said, will be let shortly at the Duluth, Minn., office of the company.

The C. Reiss Coal Co. has had plans made for the complete rebuilding of the lake front docks at Manitowoc and the work will be done this summer if the city provides adequate facilities for the company to reach its upriver docks.

Work has been started on the development of the water power at Johnsons Falls, four miles from Crivitz for the Crivitz Pulp & Paper Co.

The Board of Public Works of Racine has awarded a contract to S. O. Dixon at 20 cts. per cu yd. for dredging 25,000 cu. yds. of material from the river in that city. The board also awarded a contract for building a retaining wall on Marquette St. to N. F. Reichert at $5.73 per cu. yd.

The first of two scows being built at the shipyards at Manitowoc for the Great Lakes Dredge & Dock Co. has been launched. It is constructed of steel, with a capacity of 600 yds., 137 ft. 4 ins. in length, 32 ft. beam, with a depth of 11 ft. 9 ins. The cost is $25,000, and when the sister ship is finished the company will have completed a $50,000 contract. The scows are used by the Great Lakes Co. in dredging and other work.

The State Railroad Commission has granted the Western Construction Co. a permit to build a railroad from Gilmanton down through the Waumandee valley.

Canadian Notes.

FROM CORRESPONDENTS AND OTHER SOURCES.

Detailed plans for the improvement of the harbor at Montreal have been approved by the Minister of Marine. These plans as previously noted in these columns contemplate the expenditure of the $6,000,000, appropriated at the recent session of the Canadian Parliament. About $2,000,000 will be expended this year, the main item being the elevation of tracks in the east end, furnishing a twelve-month railway service, and obviating level crossings in the approaches to the docks. Major G. W. Stephens, Montreal, Que., is chairman of the Harbor Commission.

J. A. Boyd, Sault Ste. Marie, Ont., has been awarded the contracts for improvements to be made to the New Ontario dock at Sault Ste. Marie. These will include a fill and enlargement of the freight sheds to double their present capacity. S. I. Penhorwood, Sault Ste. Marie, is superintendent for the company.

The Canadian Northern R. R. is said to be contemplating the commencement of construction on a railway from Hawkesbury, where the Canadian Northern crosses the Ottawa River, into Montreal. The line would give the C. N. R. a direct route between Ottawa and Montreal, and is said to present no engineering difficulties. The line would be along the north bank of the Ottawa from Hawkesbury, almost in a straight line to St. Eustache, where it crosses the Back River into Montreal.

The Canadian Pacific Ry. is reported to have obtained control of the Washington County

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CHAS. S. HILL
C. T. MURRAY
F. A. SMITH
} EDITORS

MYRON C. CLARK . . . . . PUBLISHER
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CONTENTS.

EDITORIAL:
"What Are the Facts Respecting the Disintegration of Concrete by Sea Water, Alkali, Sewage, Etc.?" 539
Methods and Cost of Calking and Grummeting Joints in Cast Iron Lining of the Hudson River Tunnels, Pennsylvania R. R. 540
Cost of Clearing Land 540

CONCRETE SECTION:
Method and Cost of Constructing Three Short-Span, Single-Track Concrete-Arch Bridges, Lake Champlain & Moriah Railroad 21
Method of Inspecting and Testing Cement for the Louisville Sewer Work, with Costs 541

EARTH AND ROCK SECTION:
Drilling Records at the Crushed Stone Plant of Dolese & Shepard, Chicago 544
Method and Cost of Excavating a Mine Shaft by Raising 544
Time and Material Costs of Excavating 35 Cu. Yds. of Rock in Trench Bottom 544
A Four-Wheel Scraper Holding 1 Cu. Yd. 544
Design of Tunneling Shields and of Steel Lining Used in Constructing the River Sections of the Pennsylvania R. R. Hudson River Tunnels 545

ROADS AND STREETS:
Groove Wooden Block Pavement for a 6 Per Cent Street Grade 550
Comparative Cost of Macadam and Stone Block Pavements at Belfast, Ireland 550
The Patching of Macadamized Roads and a Special Type of Roller for Doing the Work 551
Concrete Pavement Construction at Mason City, Ia. 551
A Comparison of the Specifications for Creosoted Wood Paving Blocks of Fourteen American Cities 552

WATER WORKS AND SEWERS SECTION:
Details of the Design of the Sewers of Louisville, Ky. 553

RAILWAYS SECTION:
Gang Organization for and Cost of Track Laying by Machine, Erie R. R. 559
The Treatment of Depreciation of Street Railway Properties 560

"What Are the Facts Respecting the Disintegration of Concrete by Sea Water, Alkali, Sewage, Etc."

We quote the heading of this editorial from a letter written by one of our subscribers. The question cannot be answered definiteively. All the facts are not known and there is not full agreement among engineers and chemists on the significance of those that are known. The disintegration of concrete by sea water has been studied for a quarter of a century. Just recently records of failure of concrete structures in the alkali districts of the western United States has directed attention to the study of the effects of alkali. Individual failures of concrete sewer works from disintegration by sewage and sewage gases are recorded from time to time. Within a few years engineers interested in drainage work have witnessed a clamorous attack on the ability of concrete pipe to withstand long without dissolution the action of even ordinary ground water. Finally these matters have been given wide announcement by engineering and trade publications.

Examples of actual disintegration of concrete from any of the causes mentioned are not numerous, but they have been given general application, partly by careless reasoning and partly by intention by interests antagonistic to concrete. In this way it has been easy for those unacquainted with the circumstances to be lead to believe that concrete is not permanent. There is no reason of course for such apprehension. No general failures have occurred from the causes mentioned; indeed there have been very few when the total number of concrete marine structures, sewers, conduits, etc., is considered. Concrete is a generally durable material for engineering structures. The facts do not permit any other conclusion. Conversely the usefulness of concrete for water-carrying and submerged works makes it important to recognize that occasional want of durability is shown to exist, and imperative to find a means of guarding against such danger.

Considering first the case of disintegration of concrete by alkali, the foremost fact to be noted is that for many years concrete has been used in irrigation and drainage work in the alkali soils of the western United States and only a few failures have been reported. These failures, recorded chiefly in Montana and Colorado, demonstrate with certainty that concrete can be completely disintegrated by alkali water and that no brand of cement is less susceptible to damage than others. They also show conclusively two other facts: (1) That porosity of the concrete increases the chances of disintegration and (2) that porous brick and porous stone suffer equally. Incidentally it may be noted that these conclusions are supported by records of experience in the alkali regions of India. From the evidence hitherto published it is doubtful if any other definite conclusions are warranted.

The practical fact to be set down at present so far as concerns the disintegration of concrete by alkali is that the alkali solution must penetrate the concrete if it is to be dangerous. The exact action of the alkali salts within the concrete mass is not agreed upon. Some observers regard it as being purely physical, like, say, the action of frost; others incline to the belief that it is largely chemical, and still others are of the opinion that it is partly chemical and partly physical. The truth is that the evidence at hand does not permit certain judgment. It is known, however, as certainly as may be that the condition of porosity is essential to the disintegrating action of alkali whether the material be concrete or brick or stone. The obvious preventative is, then, to provide against the penetration of the concrete by the destructive salt laden water, and this brings us around to the undetermined problem of making an impermeable concrete.

Really, however, matters are not in such a bad way as this conclusion might indicate. An impermeable concrete can be made; a rich, well proportioned, well mixed concrete is essentially water tight with the possible resources of waterproofing compounds yet in reserve. A rich dense concrete has been found ample to resist the attack of sea water in all ordinary instances and this is in fact the only precaution accepted by general practice in marine concrete work.

Turning now to the disintegration of concrete in sewerage works we find a number of cases mentioned where such action has been observed but only a few cases where the causes have been carefully studied. As good a summary of the observed effects of sewage on concrete as we know is that of Mr. Rudolph Hering, which we quote as follows:*

There are cases where an acid water or an acid sewage has destroyed a cement structure by contact, and also cases where such a contact in no way injured the structure, but where serious injury has been caused by gases above the waters after escaping from them; so that, in one case the cement has deteriorated only below the water surface, and in the other it has deteriorated only above it.

The speaker has mentioned the effect of acid upon concrete structures as being complex, so far as it is governed, not only by an acid in the liquid, but by gases subsequently arising from it. An acid liquid, as in the case of the sewage sometimes discharged from factories, is known to disintegrate cement pipe. The preventive, as in the former case, if practicable, is to exclude the objectionable element, or to give the cement a protective coating or lining.

The effects of the gases produce an entirely different condition. The most serious of these is that of the sulphuretted hydrogen which may be converted into sulphuric acid in the sewer above the water, and in some cases, as found in a Los Angeles sewer by the City Engineer, Homer Hamlin, sulphur crystals adhere to the bricks of which the sewer was built.

The Los Angeles sewage produced no deterioration of the cement below the water surface, the speaker finding it hard and sound. This condition differed radically from the effects of alkaline sewage where the deterioration was chiefly below the water surface. The escaping sulphuretted hydrogen was converted into sulphuric acid within a short distance of its escape from the sewage, as was distinctly discernible on the surface of the brickwork in the arch. This acid transformed the carbonate of lime in the cement joints into sulphate of lime, a soft, friable gypsum, which gradually caused the complete destruction of the binding quality of the mortar.

In this case, no doubt, a good forced ventilation might have prevented the formation of sulphuric acid, or the sewer might have been given a vitrified lining, or at some time it may be possible to apply a coating which will protect sewers from this sort of destruction. In Los Angeles, for other reasons, the sewer was abandoned for one built in another locality.

Some interesting experience in this direction is reported from Germany. In a Berlin brick sewer, where the mortar was a 1:3 mixture, flakes up to ½ in. in thickness and 2 in. in diameter peeled off the bricks. The thickest peeling was at the cement joints. Upon the mortar was observed a soft white material (gypsum) looking like freshly made lime mortar. Below the water level, the mortar and the bricks were sound, as they were in the Los Angeles case.

To ascertain the cause of this trouble, experiments were made by hanging in the sewer, well above the water level, samples of three materials: marble, cement mortar, and pulverized carbonate of lime. The results are given in Table I.

TABLE I.

Sample.	When suspended in sewer air.	Percentage of SO_3. When observed. 1897.	May, Jan., 1898.	May, 1901.
Marble	Nov., '96	0.019	0.051	0.420
Cement mortar	Feb., '97	0.116	0.200	0.440
Carbonate of lime	Feb., '97	0.010	0.048	1.440

It was found that the sulphuric acid contents in these materials were increased in quantity, as follows:

In the marble, in 14 months, about 20 times;
In the cement mortar, in 11 months, about 4 times;
In the cement mortar, in 4 years, about 6 times;
In the carbonate of lime, in 3 months, about 5 times;
In the carbonate of lime, in 11 months, about 140 times.
In the carbonate of lime, in 4 years, about 250 times.

In the summer of 1901 an analysis of the sewer air gave 200 parts in volume of sulphuretted hydrogen per million parts of air, which was considered an average condition.

At the sewage department of Charlottenburg

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(Berlin), equal parts of sulphuretted hydrogen and air were passed through cotton at a temperature of 30° cent. (85° Fahr.). Water was then filtered through it, and the presence of sulphuric acid was demonstrated. As a further demonstration, a thin water layer covering the bottom of a closed bottle and containing some fine sulphur powder suspended in it, on being exposed to a temperature of from 20° to 30° Cent. for two weeks, showed a strong reaction of sulphuric acid.

That sulphur is formed directly from sulphuretted hydrogen is shown by the fact that sulphuretted hydrogen when dissolved in water frequently shows sulphur powder on the surface formed by oxidation ($H_2S + O = H_2O + S$); and very fine sulphur powder exposed to air and water is known to be directly converted into sulphuric acid ($S + 3O + H_2O = H_2SO_4$).

The Berlin examinations, therefore, give a confirmation of and an explanation for the Los Angeles case. The sulphuretted hydrogen escaping from the sewage rises to the brick arch, which has a coating of moisture condensed upon the surface. The air converts it first into sulphur, and this is subsequently converted into sulphuric acid.

It had been suspected that bacterial action was responsible for the latter conversion, but Winogradski, in his work on "Sulphur Bacteria," reports that he obtained the same result without it.

It is interesting to add that in 1897, when the foregoing experiments began, the bricks were also subjected to analysis. The porosity was found to vary from 8.5 to 14.3 per cent in bricks of different manufacture. All bricks showed on the surface white exudations of carbonate of lime, but they were very slight upon the densest and very marked upon the most porous brick, and in the latter case the pieces could be easily taken off with a knife.

This phenomenon is explained by Bretschneider as follows: From the layer of moisture on the brick the sulphuric acid enters the pores and is diffused by capillarity through fine cracks and the pores into the interior of the mass. It converts the lime into gypsum, which by this conversion is doubled in volume. Unless the material of the brick can resist the resulting expansion, when some of the gypsum oozes out to form a coating, it cracks and peels off, as above mentioned, to the depth to which the sulphuric acid has formed the gypsum.

It has been observed that the destruction of mortar does not progress in an arithmetical ratio, but gradually decreases, as indicated in Table 3. This is partly explained, also by Bretschneider, by the increased ventilation through additional house connections, which in Germany are used as sewer ventilators, the greatest destruction taking place where there were fewest connections. Secondly, he believes that the percolation of ground-water through the sewer masonry gradually decreases by a closing of the pores on the extrados of the arch, and finds that the surface of the bricks on the interior thus becomes dry and the formation of sulphuric acid ceases.

In Osnabruck, Prussia, a sewer was built in peaty ground in 1903, the ground-water level standing about at the springing line. In half a year signs of destruction were visible, and within several years it became serious.* The cause of the disintegration was laid to iron pyrites (FeS_2) which formed 17 per cent of the peat. The greatest destruction was found on the outside of the sewer and between high and low ground-water level, which is explained by the fact that the conditions for an energetic oxidation were most favorable when both air and water were present at the same time. The least destruction, in fact, almost none, was observed in the interior.

This case is explained by some as being due to the pyrites being oxidized in contact with air into free sulphuric acid (SO_4) and sulphate of iron ($FeSO_4$), and by the further fact that the ground water contained from 5 to 57 parts per million of sulphuric acid.

The same case is explained differently by Bretschneider. He maintains that the destruction of the cement mortar required that a sufficient amount of sulphuric acid should form directly upon and in the structure, and believed the acid dissolved in the ground-water was too weak for the purpose. He assumed that the sulphuretted hydrogen contained in the ground-water, which is abundant in the peat, rises into the pores of the damp soil around the structure, and is there first converted into sulphur, as above mentioned, and then, after being exposed to more air and more moisture, there is a further conversion into sulphuric acid, when adjoining the structure or when absorbed into the same. It will be seen that in Osnabruck, the disintegration resulted from acid peaty water and also from sulphuretted hydrogen gas.

Structures in Charlottenburg have been protected against injury from sulphuric acid and other organic acids in peat or similar soils by a complete covering of three layers of asphalt paper.

The foregoing data seem to indicate the following inferences:

1.—When the immediate agent of destruction is carried by water, disintegration will be found below the permanent water surface. If such water is flowing inside of a structure, as in a sewer (acid or alkali factory waste), the disintegration will be inside and as far as the water penetrates the material. If the water is ground-water in alkali soil, swamp or peat, the disintegration will be on the outside (Great Falls and Osnabruck), and chiefly between high and low ground-water levels, and may penetrate porous material toward the inside of the structure.

2.—When, on the other hand, the agent of destruction is caused by gases (generally sulphuretted hydrogen) arising from waters, whether on the outside (Osnabruck) or the inside (Los Angeles and Berlin) of a structure, the disintegration will take place above the permanent water surface.

Methods and Cost of Calking and Grummeting Joints in Cast Iron Lining of the Hudson River Tunnels, Pennsylvania R. R.*

Details of the metal lining used are given in another column of this issue and the methods of erecting this lining were described in our issue of May 18, 1910.

After the metal lining had been built completely across the river in both tunnels, the work of making it water-tight was taken up. This consisted in calking into the joints between the plates a mixture of sal-ammoniac and iron borings which set up into a hard rusty mass, and in taking out each bolt and placing around the shank under the washer at each end a grummet made of yarn soaked in red lead. These grummets were made by the contractor on the works, and consisted of three or four strands of twisted hemp yarn, known as "lath yarn," making up a rope-like cross-section about ¼-in. in diameter. Usually, one of these under each washer was enough, but in wet gravel, or where bolts were obliquely in the bolt-holes, two were used at each end. After pulling the grummets in, all the nuts were pulled up tight by wrenches about 3 ft. long, with two men on one wrench. Bolts were not passed as tight unless the nut resisted the weight of an average man on a 2½-ft. wrench.

Before putting in the calking mixture, the joints were carefully scraped out with a special tool, cleaned with cotton waste, and washed with a stream of water. The usual mixture for sides and invert was about 2 lbs. of sal-ammoniac and 1 lb. of sulphur to 250 lbs. of iron filings or borings. In the arch, 4 lbs. of sal-ammoniac and 3 lbs. of sulphur to 125 lbs. of filings was the mixture. A small hand-hammer was used to drive the calking tool, but, in the sides and invert, air hammers were used with some advantage. The success of work of this kind depends entirely on the thoroughness with which the mixture is hammered in; and the inspection, which was of an exceedingly monotonous nature, called for the greatest care and watchfulness on the part of the Company's forces, especially in the pocket iron, where each bolt had to be removed, the calking done at the bottom of the pockets put in, the bolts replaced, and the rest of the pockets filled. The results have been satisfactory, as the leakage under normal air and prior to placing the concrete averaged about 0.14 gal. per lin. ft. of tunnel per 24 hours, which is about 0.0035 gal. per lin. ft. of joint per 24 hours. With each linear foot of joint is included the leakage from 1.27 bolts. Afterward, when the concrete lining was in, the leakage was found to be about 0.05 to 0.06 gal. per lin. ft. of tunnel per 24 hours, which compares favorably with the records of other lined tunnels. The typical gang employed on this work was as follows:

	Per day.
In Pocket Iron—	
1 General foreman at	$5.00
1 Mixer at	3.00
1 Nipper at	3.00
5 Caulkers at	3.00
10 Grummeters at	3.00
In Pocketless Iron—	
1 General foreman at	5.00
1 Mixer at	3.00
1 Nipper at	3.00
3 Caulkers at	3.00
12 Grummeters at	3.00

The average amount of calking and grummeting done per shift with such a gang was (with pocketless grooves), 348 lin. ft. of joint and 445 bolts grummeted; and in pocket iron: 126 lin. ft. of joint and 160 bolts grummeted.

*Extract from "The New York Tunnel Extension of the Pennsylvania R. R. The North River Tunnels," by B. H. M. Hewett and W. L. Brown. Proceedings American Society of Civil Engineers, Vol. xxxvi, p. 690.

Cost of Clearing Land.—The following method was employed in clearing land of Douglas for stumps. A gin pole was erected in the middle of a 15 to 20-acre tract and a 60 H. P. logging engine is anchored near the outside of the plot. A 1⅛-in. cable was passed through the pulley at the top of the gin pole and hitched to the stumps in turn, each of which was hauled to the big pile which soon surrounded the base of the pole. When all the stumps had been drawn to the pile, the whole was fired and the small refuse cleaned up and burned before. The cost of operating one machine for a week, during which time an average of four acres was cleared, was as follows:

Engineer, per week	$ 23.00
Fireman	12.00
Hook tender	24.00
Assistant tender	21.00
Signalman	18.00
Line assistant	21.00
Shovelman	12.00
Laborer	12.00
Water team	16.00
Wood, 15 cords, at $3.80	57.00
Powder	200.00
Dynamite	15.00
Fuse	7.00
Caps	1.00
Total for four acres	$439.00

Cost per acre, $109.75.

Added to the above is the cost of slashing the small growth which is put at $50 an acre, and the final gleaning which can usually be done for $10 an acre. This makes a grand total of $169.75 per acre for making the land ready for grading, or in the case of agriculture, ready for plowing. About two days was usually taken in moving from one plot of land to another, including the setting up of the gin pole, anchoring and making ready for starting. There is a small cost which should be allowed for burning the piles amounting to nearly $10 an acre. The cost of plant was as follows:

Sixty horsepower donkey engine	$3,750.00
1,300 feet 1¼-in. wire cable	400.00
4,000 feet ⅝-in. haul-back rope	300.00
Other sundries	100.00
Total	$4,550.00

These data are compiled from the *Canadian Engineer* for Jan. 28, 1910.

The Otis Co. of Palmer, Mass., has applied to the County Commissioners at Springfield, Mass., asking for permission to construct a dam across the Chicopee River, to be used in connection with a power house. It is proposed, according to the plans and specifications of the company, to erect the dam about one-eighth of a mile west of the company's mills, in the village of Three Rivers, in the town of Palmer.

Concrete and Reinforced Concrete Section

Note: This section is devoted to methods and cost of constructing concrete and reinforced concrete structures. It will cover the selection, testing and proportioning of concrete materials; laboratory tests of concrete; concrete mixing, transportation and placing; fabrication and placing of reinforcement, and form construction and erection. It will also contain articles on new and interesting developments in the design of reinforced concrete.

Method and Cost of Constructing Three Short-Span, Single-Track Concrete Arch Bridges, Lake Champlain & Moriah Railroad.

The following costs are for constructing three reinforced concrete arch railway bridges in the northern part of New York by company forces. The prices of labor and materials were as follows:

Common labor, per day	$1.30
Carpenter foreman, per day	3.00
Boss carpenter, per day	[illegible]
Common carpenters, per day	1.75
Stationary engineer, per day	2.00
Foreman reinforcement, per day	2.00

A 10-hour day was worked for five days and a nine-hour day on Saturday. Tailings were used for concrete aggregate and cost only the freight and labor for loading, both of which are included in the labor costs given.

Lumber for forms cost $18 per M. ft. B. M. unplaned; the planing was done on the job and is included in the labor costs for forms. Cement cost $1.20 per bbl. after deducting credit for return of bags.

Bridge 1.—The plans for this bridge are shown by Fig. 1. It will be noted that it was founded on earth and required a spread footing. The pressure on foundation bed fell within 3 hrs. per square foot. The bridge contained 560.7 cu. yds. of concrete and was estimated to cost $7,000. The actual itemized cost was as follows:

Item.	Total.	Per cu. yd. concrete.
Temporary constructions—		
Materials	$ 10.51	$0.019
Labor	255.42	0.455
Miscellaneous	525.27	0.936
Total	$ 791.20	$1.410
Excavation		
Materials	$ 4.12	$0.001
Labor	374.94	0.668
Total	$ 379.06	$0.669
Forms		
Materials	$ 923.95	$1.647
Labor	1,228.92	2.191
Total	$2,152.47	$3.838
Mixing Concrete		
Materials	$ 55.19	$0.098
Labor	251.73	0.449
Total	$ 306.92	$0.547
Placing Concrete		
Materials	$ 135.20	$0.241
Labor	242.51	0.432
Total	$ 377.71	$0.673
Reinforcing		
Materials	$ 397.37	$0.708
Labor	198.34	0.354
Total	$ 595.71	$1.062
Cement	$ 780.75	$1.392
Superintendence	312.50	0.557
A round total	$5,696.72	$10.146

The concrete work proper, therefore, cost as follows per cubic yard:

Forms	$3.838
Mixing	0.547
Placing	0.673
Reinforcement	1.062
Cement	1.392
Total	$7.512

Superintendence prorated say $0.445

Grand total $7.957

In comment on these figures it may be noted that the item "materials" for forms includes the lumber used in trestles. Referring to "miscellaneous" charges under "preliminary construction," $262.23 of the total were paid for specifications and plans, or 4.6 per cent of the total cost. Superintendence cost 5½ per cent of the total.

Bridge 2.—The plans for this bridge are shown by Fig. 2. It is a much simpler structure than Bridge 1, being founded on rock and having plain abutment and wing walls. A feature of the design is the expansion joint placed across the barrel of the arch about mid length. The bridge contained 1,804 cu. yds. of concrete and its estimated cost was $10,500. The actual itemized cost was as follows:

Item.	Total.	Per cu. yd. concrete.
Temporary Construction		
Materials	$ 60.07	$0.033
Labor	915.72	0.508
Miscellaneous	796.10	0.441
Total	$1,771.90	$0.982
Excavation		
Materials	$ 27.20	$0.015
Labor	411.84	0.228
Total	$ 439.04	$0.243
Forms		
Materials	$ 965.91	$0.535
Labor	1,568.76	0.869
Total	$2,534.67	$1.404
Mixing Concrete		
Materials	$ 514.10	$0.285
Labor	572.12	0.316
Total	$1,086.22	$0.601
Placing Concrete—		
Materials	$ 31.25	0.017
Labor	$34.09	0.462
Total	$ 865.34	$0.479

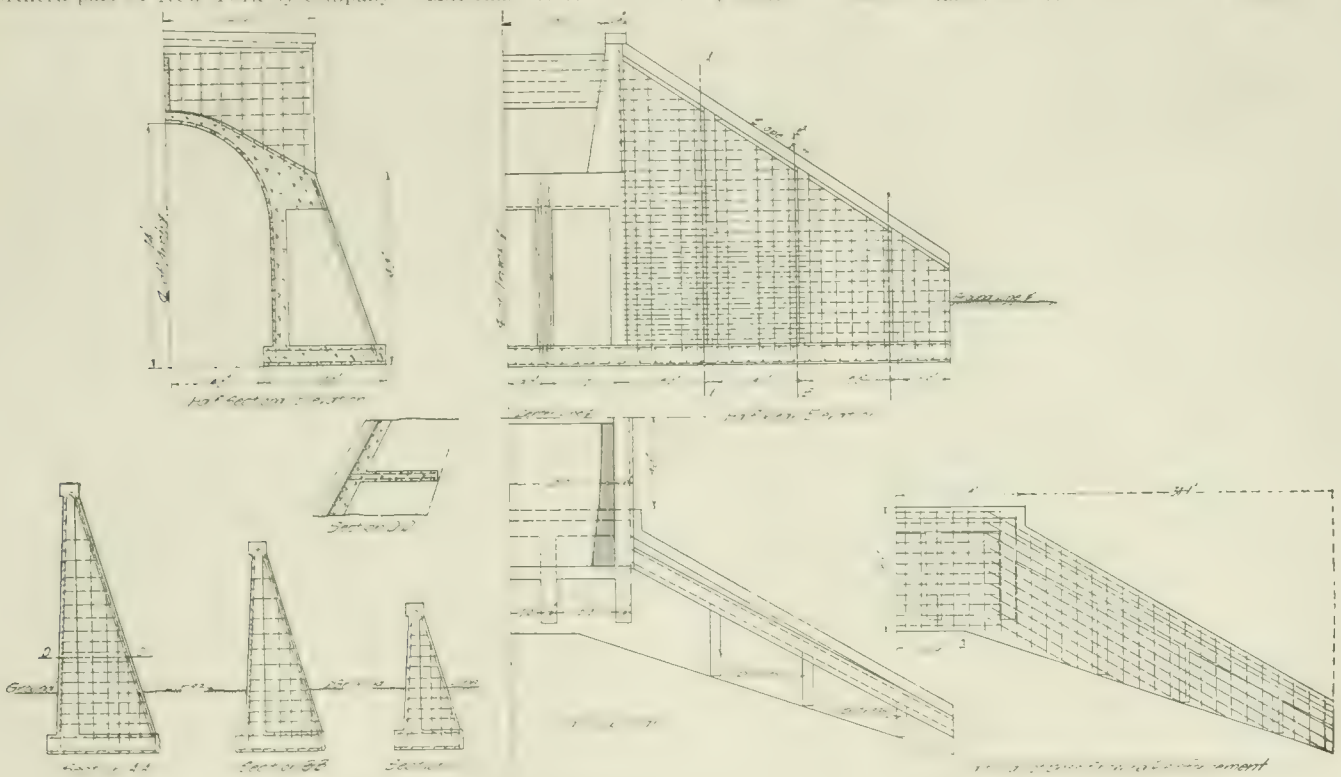


Fig. 1—Concrete Arch Bridge No. 1, Lake Champlain & Moriah R. R.

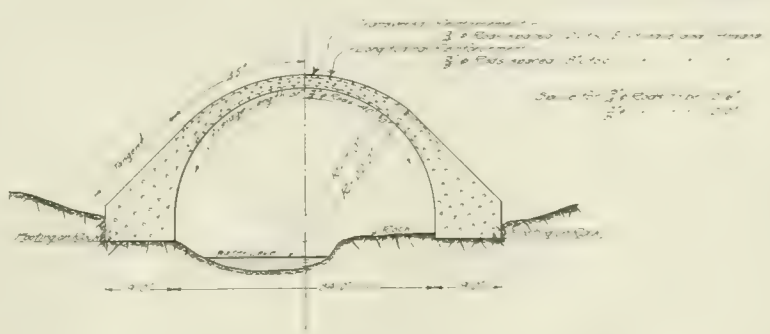
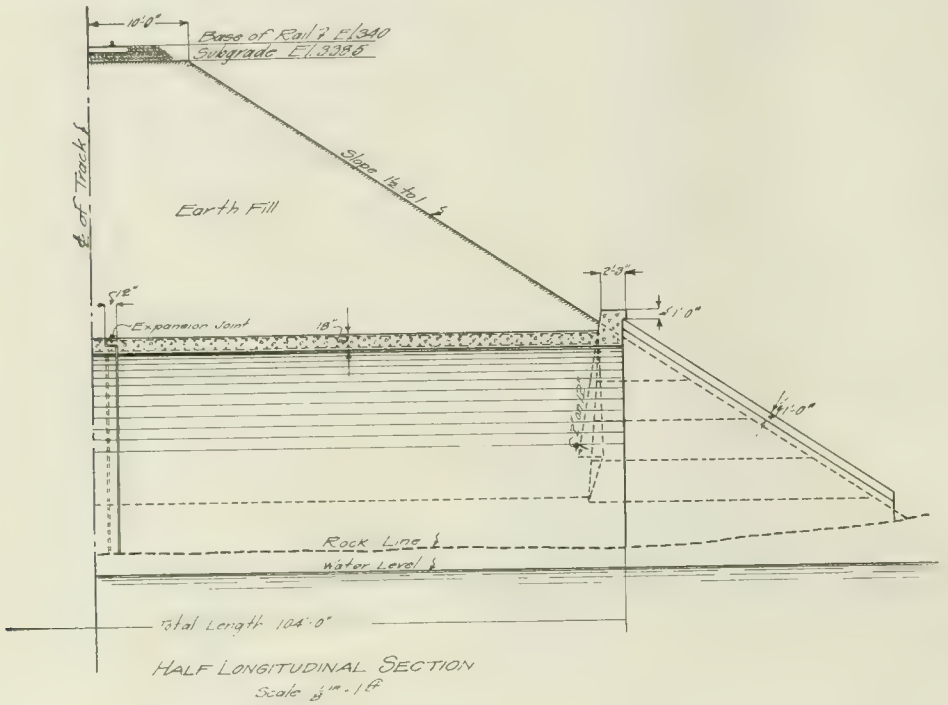


Fig. 2—Section of Concrete Arch Bridge No. 2, Lake Champlain & Moriah R. R.

Reinforcing—		
Materials	$ 210.12	$0.116
Labor	56.70	0.031
Total	$ 266.82	$0.147
Cement		
Materials	$1,675.40	$0.928
Labor	19.91	0.011
Total	$1,695.31	$0.939
Superintendence	$ 538.49	$0.299
Grand total	$9,197.79	$4.044

In the above items "materials" for forms include trestle lumber and "miscellaneous" charges include $262.23 for plans and specifications. The charge for plans and specifications was 2.85 per cent and the cost of superintendence was 5.85 per cent of the total cost. The influence of complexity of forms on form costs and cost of placing concrete is indicated by comparing these costs for Bridges 1 and 2.



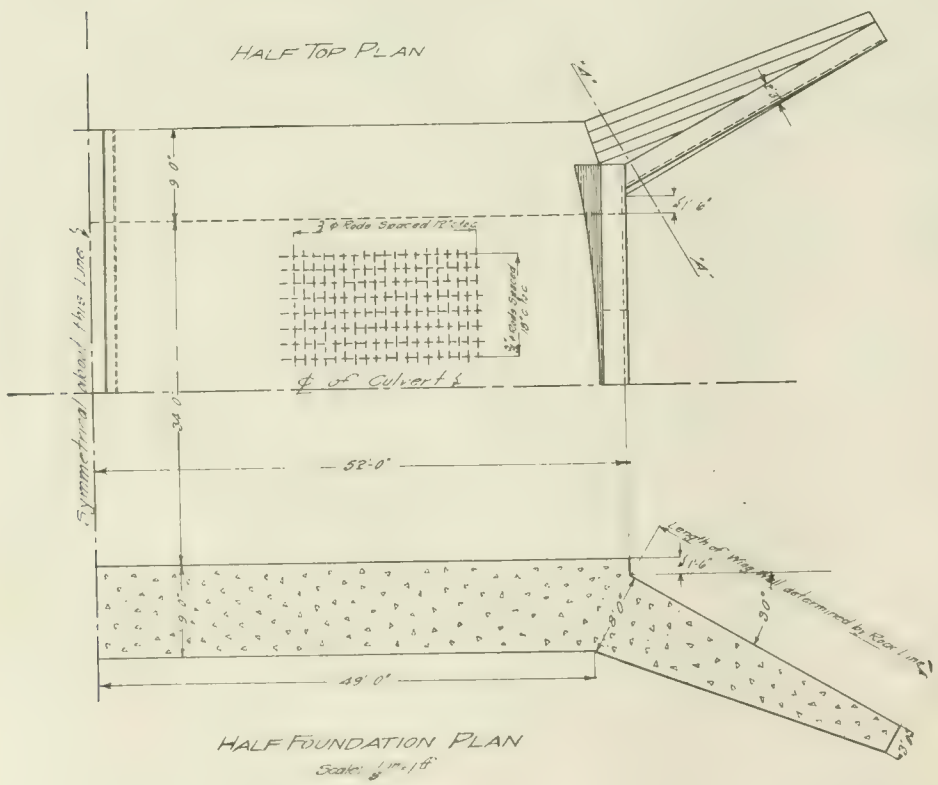


Fig. 3—Details of Concrete Arch Bridge No. 2, Lake Champlain & Moriah R. R.

The concrete work proper, therefore, cost as follows per cubic yard:

Forms	$1.404
Mixing	0.601
Placing	0.479
Reinforcing	0.117
Cement	0.939
Total	$3.540
Superintendence prorated say	0.225
Grand total	$3.795

Bridge 3.—The plans for this bridge are shown by Fig. 3. It is founded on rock just below the surface, with plain abutment and wing walls. A notable feature of the design is the extension upward of the abutment walls to form a cross wall between spandrel walls and the bracing together of the spandrel walls by two intermediate diaphragm walls as shown by the drawings. There is an expansion joint across the spandrel walls over the center pier. This bridge contained 1320.7 cu. yds of concrete and was estimated to cost $7,500. The actual itemized cost was as follows:

Item.	Total.	Per cu. yd. concrete.
Temporary Construction—		
Materials	$ 34.71	$0.026
Labor	186.38	0.141
Miscellaneous	538.66	0.408
Total	$ 759.75	$0.575
Excavation—		
Materials	$ 3.77	$0.003
Labor	797.57	0.603
Total	$ 800.84	$0.606
Forms—		
Materials	$ 912.51	$0.691
Labor	1,036.49	$0.785
Total	$1,949.00	$1.476
Mixing Concrete—		
Materials	$ 487.50	$0.369
Labor	678.04	0.513
Total	$1,165.54	$0.882
Placing Concrete—		
Materials	$ 1.05	$0.001
Labor	510.19	0.386
Total	$ 511.24	$0.387
Reinforcing—		
Materials	$ 396.83	$0.300
Labor	45.88	0.035
Total	$ 442.71	$0.335
Cement	$1,221.20	$0.924
Superintendence	$ 176.78	$0.134
Grand total	$7,027.06	$5.319

The concrete work proper, therefore, cost as follows per cubic yard:

Forms	$1.476
Mixing	0.882
Placing	0.387
Reinforcing	0.335
Cement	0.924
Total	$4.004
Superintendence prorated say	0.100
Grand total	$4.104

As with bridges 1 and 2, materials for forms include lumber used for trestles. The cost for plans and specifications was $262.23, and is included under "miscellaneous" preliminary construction charges. Plans and specifications cost 3.7 per cent and superintendence cost 2.5 per cent of the total cost.

The bridges described were designed by the firm of Wm. Barclay Parsons under the direction of Mr. Eugene Klapp of that firm. We are indebted to Mr. Klapp for the data from which this article has been prepared.

Method of Inspecting and Testing Cement for the Louisville Sewer Work with Costs.

The following methods are employed at the testing laboratory of the Commissioners of Sewers of Louisville, Ky., for inspecting and testing the large amounts of cement to be used in the construction of that city's new $4,000,000 sewer system.

Sampling.—Each lot of cement is tagged at the time samples are taken. The practice of tagging has varied according to the character of the work, and the location of storehouses and other conditions. Upon small work where the cement is taken from the storehouse and delivered onto the work in small lots, it has been found advisable to tag each bag. This is done as the cement is unloaded from the car or the team into the storehouse, at which time samples are taken for the laboratory. After acceptance, cement is taken from the storehouse to the work, as required, and the inspector upon the work, having been informed of the identification number of the lots which have been passed or rejected, knows from the tags upon the bags whether or not the cement has been tested and accepted. Upon the larger work, where the contractor stores his cement in warehouses from which it is used exclusively for but one of his contracts and which are located close to the site of the work, it has been necessary to use only sufficient tags to identify each individual lot as the inspector is able to visit the warehouse at frequent intervals and thus keep under his personal supervision the work of removing the cement from storage.

Rejections.—Of the whole number of carloads of cement tested (825 car loads or 146,437 bbls. up to Dec. 31, 1909) 74 or about 9

per cent, have been rejected for the following reasons:

62 carloads for quick setting.
5 carloads for coarse grinding.
6 carloads for retrogression in strength.
1 carload for low specific gravity and excess of sulphuric anhydride.

In each case when cement has been indicated by the tests to be of inferior quality, duplicate tests are at once commenced to make sure that no errors have crept into the laboratory work. It is also customary to order retests whenever the results of tests appear questionable, even though they may warrant passing the cement. In some instances three or four additional tests have been made at the request of the manufacturers whose representatives have always been welcomed to observe the making of the duplicate tests, and to make such suggestions as they deemed pertinent.

The large number of rejections, due to quick setting, was apparently due to shipping of cement without due seasoning. While some of the samples gave a satisfactory test when brought to the laboratory, a rapid change went on, so that within a month after the arrival of the shipments they had so changed as to become quick-setting. In some cases samples of cement would set in as short a time as 3 or 4 minutes. The change that was going on within this cement is shown very clearly by tests of samples that were taken from different parts of the same bag in a number of instances. For example, a sample taken near the surface, which was more or less exposed to the atmosphere, set in six minutes, while another sample taken from the center of the same bag required 2 hours and 34 minutes in which to acquire the initial set. This entire shipment was rejected and a few tests were carried on afterward, one of which, two months later, showed that the cement was still unfit for use on account of the short time in which it acquired its initial set.

In view of the importance of uniform methods and proper conditions in the laboratory, special attention has been given to securing uniform results of tests. Whenever an opportunity has been afforded by a visit of an expert from the cement factories, during which he has made tests, his work has been duplicated by the regular laboratory force for the sake of comparing results. Table 7 shows the results of a series of tests upon one brand of cement, the tests being made in duplicate, one by a representative from the mills, the other by an assistant in the laboratory. It will be seen from this table that in the main the results obtained by each tester varied within reasonable limits and that those of the laboratory assistant and the representative of the mills agreed with each other fairly closely.

TABLE I. RESULTS OF DUPLICATE TENSILE STRENGTH MORTAR TESTS.
(Pounds.)

A 7 days Mortar (1-3)				B 7 days Mortar (1-3)			
Average	Maximum	Minimum	Difference between max. and min.	Average	Maximum	Minimum	Difference between max. and min.
97	120	77	43	108	120	96	24
127	142	113	29	138	149	127	22
151	169	134	35	151	169	134	35
272	283	261	22	283	312	255	57
150	165	135	30	151	168	134	34
131	141	120	21	136	141	131	10
166	177	155	22	166	177	155	22
151	161	140	21	151	161	140	21
166	177	155	22	166	177	155	22
151	161	140	21	151	161	140	21
166	177	155	22	166	177	155	22
151	161	140	21	151	161	140	21
166	177	155	22	166	177	155	22
151	161	140	21	151	161	140	21
166	177	155	22	166	177	155	22
151	161	140	21	151	161	140	21
166	177	155	22	166	177	155	22
151	161	140	21	151	161	140	21
166	177	155	22	166	177	155	22
151	161	140	21	151	161	140	21
Average			27				31

A—Represents Sewerage Commission Cement Tester.
B—Represents Cement Co.'s Chemist.

There is necessarily a variation in the results of the tests for tensile strength, both of neat cement and mortar, although with care and skill in manipulation the variations may be materially reduced. After making a large number of tests it has been decided that for the ordinary routine work of the laboratory the difference in strength between the highest and lowest tests of mortar briquettes, either 7 or 28 days old, shall not exceed 60 lbs. If this amount is exceeded, a new test is immediately started. In cases of special experiments, or shipments of cement, the quality of which is particularly doubtful, and other cases requiring great accuracy, judgment is based upon tests in which the limit of variation is materially less than that adopted for the ordinary routine of the laboratory.

Whenever tests of neat cement at the end of seven days show a tensile strength exceeding 800 lbs., a new test is at once started, experience having proven that in most cases, if the manipulation and conditions have been good, cement testing above 800 lbs. in 7 days will show retrogression in 28 days. In all cases at least 40 briquettes are made up from each car load tested, 8 for each period of time in case of both neat and mortar tests, and where the tests are made for the purpose of passing upon the quality of the cement, all results are booked and judgment passed upon the average. In experimental work, 8 briquettes are made up for each test of tensile strength, but only those breaking within 5 per cent of the mean are used in the tabulations.

Storage to Prevent Quick Set Test and Lumpy Cement.—The specifications require that the contractors shall hold cement in storage long enough to allow for tests of 28 days' duration. It was found, however, during the winter of 1908 and 1909, that in several of the warehouses the dampness of the atmosphere had penetrated so as to cause the cement to become somewhat lumpy. In some cases this was due largely to the fact that doors and windows had been left open, allowing the damp air to enter freely; but it was also found that in other warehouses in which the cement seemed to be well protected, there was also some deterioration in quality. Permission was given to contractors, therefore, to cut down their storage during the winter and spring, so that the cement might be used in a shorter time if found satisfactory at the end of the 7-day test. Cements, however, which upon the results of the 7-day tests did not give promise of fulfilling all the requirements, were held for the full 28-day test.

Samples of the lumps of cement were tested and in some cases were found to have lost nearly all of their original strength. The fine material in the same bags was found to be of good quality and was allowed to be used after the lumps had been screened out. There appeared to be no difference in the effect of the dampness upon the different brands of cement in storage, all of them seeming to suffer to about the same extent.

The cost per barrel of testing including entire cost of equipment has been 4.2 cts. Charging 66⅔ per cent of the cost of equipment reduces the cost of testing per barrel to 3.7 cts.

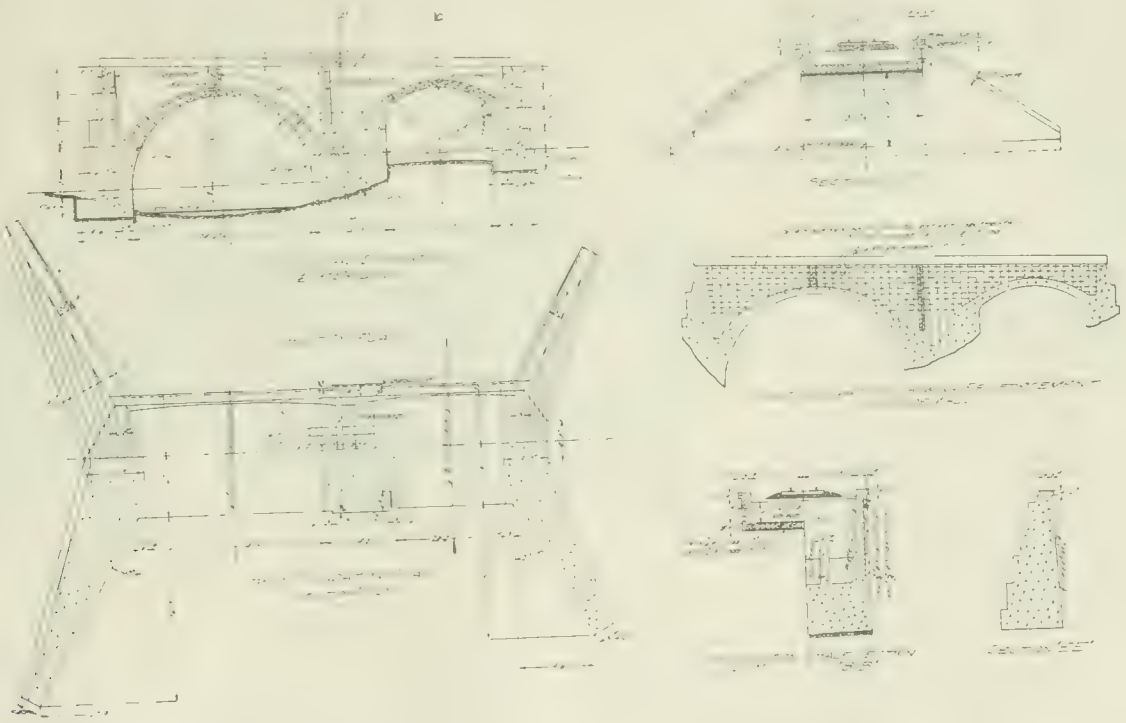


Fig. 1—Concrete Arch Bridge No. 3, Lake Champlain & Moriah R. R.

The National Rys. of Mexico, James M. Reid, Chief Engineer, City of Mexico, according to reports, will coon resume construction of the short line to connect Tampico with the City of Mexico. At the time the Mexican Central Railroad passed into the hands of the government, two years ago, it was constructing the Tampico-City of Mexico line. It had about 50 miles graded and some track laid from a point on its line some 25 miles from Tampico. Construction ceased when the road became a part of the National Railways of Mexico. The survey for this line calls for a low-grade route, notwithstanding the fact that it must mount from sea level nearly 8,000 ft.

Earth and Rock Section

Note: This section is devoted to methods and costs of excavating earth and rock and building embankments. It will cover the grading of roads and railroads, diking and canal work, dredging, building reservoirs and earth dams, sewer and water pipe trenching, quarrying, etc.

Drilling Records at the Crushed Stone Plant of Dolese & Shepard, Chicago.

In our article of June 1, describing the stone crushing plant of the Dolese & Shepard Co., at Gary, Ill., we published a table showing the results of a 30-day run of six well drilling machines. We wish to add here, that the holes for the well-drilling machines are made in one row from 18 to 22 ft. back from the ledge and are spaced on an average of 10 ft. apart, that is not less than 8 ft., or more than 12 ft. The spacing for the tripod air drills is 8 ft. and two rows are made, the second row being not more than 18 ft. from the ledge.

We also wish to make a note in connection with the above mentioned article with special regard to the washing plant shown. This plant was designed by the J. C. Buckbee Co., engineers, of Chicago. The main plant was also designed and built under supervision of this firm of engineers.

Method and Cost of Excavating a Mine Shaft by Raising.

The following data on methods and cost of opening a mine shaft by raising or excavating from the bottom upward are given in the *Mining and Scientific Press* for June 4, 1910.

The shaft is a five-compartment shaft for the Giroux Consolidated Mines Co., Ely, Nev. The size of the new shaft, which is in limestone, is 17 ft. 2¾ ins. x 10 ft., measured inside the timbers. A cage compartment is 10 ft. x 5 ft. 8 ins.; two skip compartments are each 5½ x 5 ft.; two others, for pipes and ladder-way, are each 5 ft. x 4 ft. ½ in. In opening this shaft 948 ft. of the work was done by raising, the starting-point having been on a cross-cut that had been driven from the 1,000-ft. station of the Alpha shaft. After cutting a 14x18-ft. station and installing an air-hoist, the raising began July 5, 1909. The raise was made 13x12 ft. in the clear, was supported by timbering in square sets, which divided the space into four compartments, the one at each end being used as a chute. The chute lining was braced by 8x8-in. stiffners. The lagging on the wall-sides of the cage, ladder, and pipe compartments was likewise stiffened by 4x6-in. timbers. Everard Arnold, construction engineer at this property, in describing this work says: "Over the two center compartments the last two sets were always bulkheaded with 8x12-in. timbers, and from the lower bulkhead the cage sheave-wheel was suspended. After a round of holes had been blasted and the loose ground picked down, the average time required to hoist, plumb, and block a set of timbers was 2 hr., although the operation was occasionally performed in 1 hr. 30 mins. When possible the chutes were kept almost full in order to minimize the chances of injury should men have happened to fall. For the purpose of protecting the lower timbers of the chute, breakers or platforms of 10x10-in. timbers were spiked to the girts at intervals of seven sets. On these breakers the rock piled up and formed its own slope. Trouble was often caused by large rocks dropping into the chute, and on reaching the gate they would have to be blasted."

The air-hoist was used in raising timbers from the foot of the raise; and two pressure blowers, running in tandem, served to keep up ventilation. When the raise reached a place as high as the 770-ft. level from the Alpha shaft, a connection was made and this level then served for the removal of rock and as an entrance to the raise instead of the 1,000-ft. level. In accomplishing the 948 ft. of raising, three shifts per day for 180 days were required, the work having been in direct charge of William Hogan, mine superintendent. The raise cost $71.21 per foot, classified as follows:

Item.	Per ft.
Raising	$16.64
Trimming	5.09
Timber framing	1.56
Teaming	0.54
Hoisting	15.15
Air compresson	10.09
Supplies	17.24
Blacksmithing	1.59
Machine shop	0.11
Prop. underground exp.	3.11
Total	$71.21

General underground expenses, $3.44. As it is estimated that 75 per cent of the timber used in raising will be available for other work, the ultimate cost of the raise will be thus reduced to $63.71 per foot.

The part of the shaft from the surface to a depth of 15 ft. was opened by sinking, so that the collar-set and three shaft-sets could be installed and concreted. With the raise finished to the surface, and the installation of temporary hoisting equipment, sinking was commenced at the 1,000-ft. station, and a compartment 10x5 ft. 8 in. was sunk 200 ft. and this was temporarily timbered. After cutting a sump below the 1,200-ft. station the lower 200 ft. of the shaft was enlarged to the size of the upper part by raising. A pump station is to be excavated at the

A new piece of equipment to be tried at these mines in sinking is a Hulett grab-bucket for handling debris. The bucket, to be suspended from a skip, is designed to take up the rock from the bottom of the shaft, after the blast, then to be hoisted to the first station above, and there dumped into a loading pocket. General Manager Frank P. Mills plans to experiment with it as a possible means of more economical shaft sinking.

Time and Material Costs of Excavating Thirty-Five Cu. Yds of Rock in Trench Bottom.

The trench was 2½ ft. wide and 5¾ ft. deep and the rock, a bastard granite, was found in the bottom of an average depth of 2¾ ft. The drilling was done by hand using 1¼-in. drills, 1 man holding and 2 men striking with 8-lb. hammers. A total of 96 ft. of hole was drilled or 3.2 ft. per cu. yd. of work. The time required was 3.1 hours per lin. ft. of hole. The time work of excavating 35 cu. yds. was:

Item.	Per cu. yd.
297 hrs. drilling	9.92
126 hrs. mucking	3.43
Total	$13.35

The materials used were as follows:

Item.	Per cu. yd.
53 lbs. 60% dynamite, lbs.	1.5
Explosives	2.

A batch of 120 drills were sharpened, or 4 per cu. yd., or 1 per 0.75 ft. of hole drilled. The amount of explosive used per foot of hole was ½ lb. Labor estimating does not include backfills. The above data are furnished by Edward B. Roberts, Engineer-Contractor, Boston, Mass.

A Four-Wheel Scraper Holding 1 Cu. Yd.

While the ordinary "wheeler" is an economic tool for comparatively short haul work, its limit of distance is soon reached. Consequently a good many attempts have been made to build a "wheeler" that would approach a dump wagon in capacity, but usually the attempt has been without success. For more than three years, however, there has been in successful use a type of self-loading wagon, known as the "Maney four-wheeler." It differs from the ordinary wheel scraper not only in that its bowl or pan is mounted on four wheels, but in that the bowl is tilted backward when the load is dumped, as shown in Fig. 1. The mechanism for tilting the bowl in any desired position is simple, and is entirely in the control of the driver, who rides on a seat at the rear end of the four-wheeler. By means of levers he controls sprocket chains that mesh into sprocket wheels driven by the rear axle. Therefore it is the team and not the man that does the real work of dumping the bowl, as well as of inclining it in the proper position for loading. This makes it possible for the driver to load and dump a cubic yard or more of earth, for the bowl has a capacity of 31 cu. ft., as it measures 25x45x48 ins.

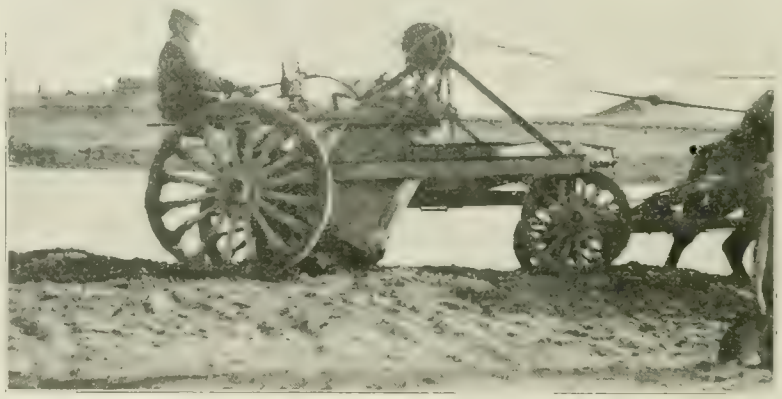


Fig. 1—Maney Four Wheeled Scraper.

At the rear end of the bowl is a gate that prevents the spilling of earth while loading or traveling to the dump. By regulating the backward inclination of the bowl during dumping, the earth can be spread in layers of any desired thickness, or it can be dropped in a heap.

Overwinding of the sprocket chains is prevented by a simple automatic trip, and, indeed, all possible causes of difficulty or breakage have been provided for by the inventors, who themselves were contractors and perfected the invention on their own jobs of earthwork.

We have before us a number of unusually good letters from contractors who have been using these four-wheelers on railroad, levee, reservoir, street, road and other work. From 2 to 4 head of stock are used to pull the loaded four-wheeler, but while loading a snap team of 2 to 4 horses is used, depending on the character of the earth. We are informed that the Maney four-wheeler weighs no more than a dump wagon, hence the number of animals required to pull it when loaded should be no

more than on a loaded dump wagon traveling over soft earth roads. One western contractor gives a cost of 7 cts. per cu. yd. for short hauls; another mentions 10 cts. as being his cost. Another built 170,000 cu. yds. of reservoir and embankment, mostly hardpan, for 14 cts. per cu. yd. (including 1 ct. for freight in moving the plant to and from the job). This

Fig. 2—View Showing Traction Engine Hauling Two Loaded Maney Scrapers.

gives a net cost of 13 cts. per cu. yd. for the work, and as the average haul was 400 ft. this was a good record for 8-hour day work at high wages.

Captain O. W. Bell, Const. Q. M., U. S. A., states that a 16-HP. traction engine will load a scraper in 1¼ mins., when the traction engine is used instead of a snap team. This would mean 480 scraper loads in 10 hours. He used three horses to haul each four-wheeler, and states that the loads averaged 29 cu. ft.

Recently certain contractors have been using traction engines not only for loading but for hauling these Maney scrapers. Fig. 2 shows an engine taking two loaded scrapers to the dump. Under favorable conditions, four or more Maneys have been thus handled by a traction engine. When a traction engine is used it is not necessary to plow the ground, which is an added element of economy. In building embankments that require rolling, like dykes and reservoirs, it has been found that grooved rollers can be dispensed with, for the wheels of the four-wheeler are more effective. The axle of the rear wheels is made longer than that of the front wheels, so that the wheels do not track. This adds greatly to the effectiveness of the Maney as a roller, and it also keeps the road between the "pit" and the "dump" in good condition.

The manufacturers of this self-loading wagon, or Maney four-wheeler are the Barron & Cole Co., Barron Bldg., 200 West Broadway, New York City.

Road Dragging With Automobiles. Automobiles have been used at Madison, S. Dak., for hauling a King road drag for maintaining Main St. at that city. Mr. C. A. Trimmer, City Engineer, informs us that this street is a common earth road having a small amount of local gravel mixed with the black loam surface soil and while it is well crowned and graded and is very solid, it will, after a hard rain or during a wet period, be cut up slightly on the surface and would be left rather rough upon drying out. The use of a king drag at the proper time smoothes the surface and leaves a very satisfactory roadway. This work has heretofore been done with teams, but in this instance two automobiles were secured, a pulley block attached to the chain on the drag and a piece of 1-in. rope about 30 ft. long passed through the block and one end attached to the rear axle of each automobile, in which manner the work was accomplished.

Design of Tunneling Shields and of Steel Lining Used in Constructing the River Sections of the Pennsylvania R. R. Hudson River Tunnels.*

TUNNELING SHIELDS.

During the period in which the original contract drawings were being made, considerable attention was given to working out detailed studies for a type of shield which would be suitable for dealing with the various kinds of ground through which the shield-driven tunnels had to pass. This was done in order that, when the contract was let, the engineer's ideas of the requirements of the shields should be thoroughly crystallized, and so that the contractor might take advantage of this long-thought-out design, instead of being under the necessity of placing a hurried order for a piece of plant on which so much of the safety as well as of the speed of his work depended. Eventually, the contractor took over these designs as they stood, with certain minor modifications, and the shields as built and worked gave entire satisfaction. The chief points held in view were ample strength, easy access to the working face combined with ease and quickness of closing the diaphragm, and general simplicity. A clear idea of the main features of the design can be gathered from Fig. 1.

The interior diameter of the skin was 2 ins. greater than the external diameter of the metal lining of the tunnel, which was 23 ft. The skin was made up of three thicknesses of steel plate, a ¾-in. plate outside and inside, with a ⅝-in. plate between; thus the external diameter of the skin was 23 ft. 6¼ ins. The length over all (exclusive of the hood, to be described later) was 15 ft. 11 7/16 ins. The maximum overlap of the skin over the erected metal lining was 6 ft. 4½ ins. and the minimum overlap, 2 ft.

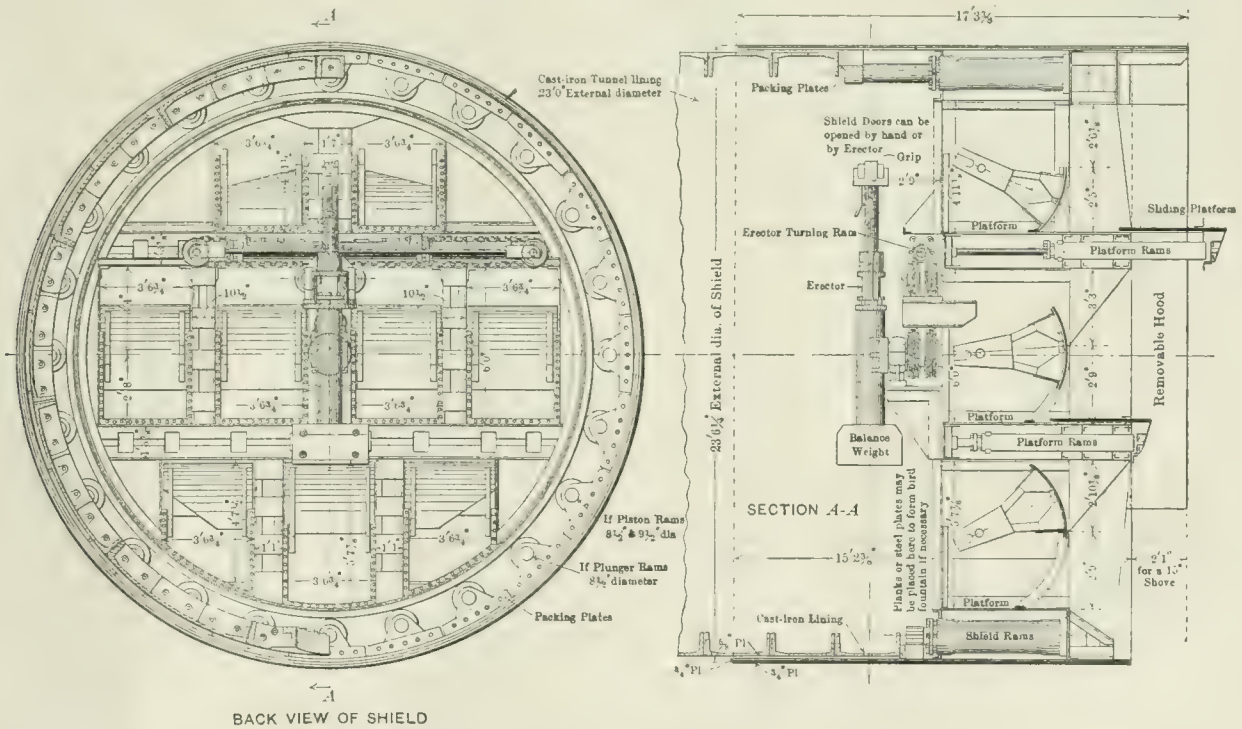


Fig. 1—Proposed Shield for Subsegment Tunneling.

There were no inside or outside cover-plates, the joints of the various pieces of skin plates being butt-joints covered by the overlap of adjoining plates. All riveting was flush, both inside and outside. The whole circumference of each skin plate was made up of eight pieces, each of which extended the entire

*Rearranged from "The New York Tunnel Extension of the Pennsylvania R. R. The North River Tunnels," by B. H. M. Hewett and W. L. Brown. Proceedings American Society of Civil Engineers, Vol. XXXVI, p. 690.

length of the shield, the only circumferential joint on the outside being at the junction of the removable cutting edge (or of the hood when the latter was in position) with the shield proper.

Forward of the back ends of the jacks, the shield was stiffened by an annular girder supporting the skin, and in the space between the stiffeners of which were set the 24 propelling rams used to shove the shield ahead by pressure exerted on the last erected ring of metal lining.

To assist in taking the thrust of these rams, gusset-plates were placed against the end of each ram cylinder, and were carried forward to form level brackets supporting the cast-steel cutting edge segments. The stiffening gussets, between which were placed the rams, were also carried forward as level brackets for the same purpose. The cast-steel segmental cutting edge was attached to the front of the last mentioned plates.

The interior structural framing consisted of two floors and three vertical partitions, giving nine openings or pockets for access to the face; these pockets were 2 ft. 7 ins. wide, the height varying from 2 ft. 2 ins. to 3 ft. 4 ins. according to their location. The openings were provided with pivoted segmental doors, which were adopted because they could be shut without having to displace any ground which might be flowing into the tunnel, and while open their own weight tended to close them, being held from doing so by a simple catch.

For passing through the varied assortment of ground before entering on the true subriver silt, it was decided to adopt the forward detachable extension, or hood, which has so often proved its worth in ground needing timber for its support. This hood extended 2 ft. 1 in. beyond the cutting edge, and from the top down to the level of the upper platform. Additional pieces were provided by which the hood might have been brought down as far as the lower platform, but they were not used. Special trapezoidal steel castings formed the junction between the hood and the cutting edge. The hood was in nine sections, built up of two ¾-in. and one ⅝-in. skin plates, as in the main body of the skin, and was supported by bracket plates attached to the forward ends of the ram chambers. The hoods were bolted in place, and were removed and replaced by regular cutting-edge steel castings after the shields had passed the river lines.

The floors of the two platforms, of which there were eight, formed by the division of the platforms by the upright framing, could be extended forward 2 ft. 9 ins. in front of the cutting edge, or 8 ins. in front of the hood. This motion was given by hydraulic jacks. The sliding platform could hold a load of 7,900 lbs. per sq. ft., which was equal to the maximum head of ground and water combined.

The weight of the structural portion of each shield was about 135 tons.

The remainder of the shield was the hydraulic part, which provided its motive force and gave the power to the segment erector. The hydraulic fittings weighed about 58 tons per shield, so that the total weight of each shield was about 193 tons. The hydraulic apparatus was designed for a maximum pressure of 5,000 lbs. per sq. in., a minimum pressure of 2,000 lbs., and a test pressure of 6,000 lbs. The actual average pressure used was about 3,500 lbs. per sq. in.

There were 24 shoving rams, with a diameter of 8½ ins. and stroke of 38 ins. The main ram was single-acting. The packings could be tightened up from the outside without removing the ram, a thing which is of the greatest convenience, and cannot be done with the differential plunger type. Some of the chief figures relating to the shield rams, with a water pressure of 5,000 lbs. per sq. in., are:

Forward force of one ram, lbs. 275,000
Forward force of 24 rams (all), lbs. 6,600,000
Forward force of 24 rams ..... 3,300 tons of 2,000 lbs.
Equivalent pressure per square inch of face, lbs. 105
Equivalent pressure per square foot of

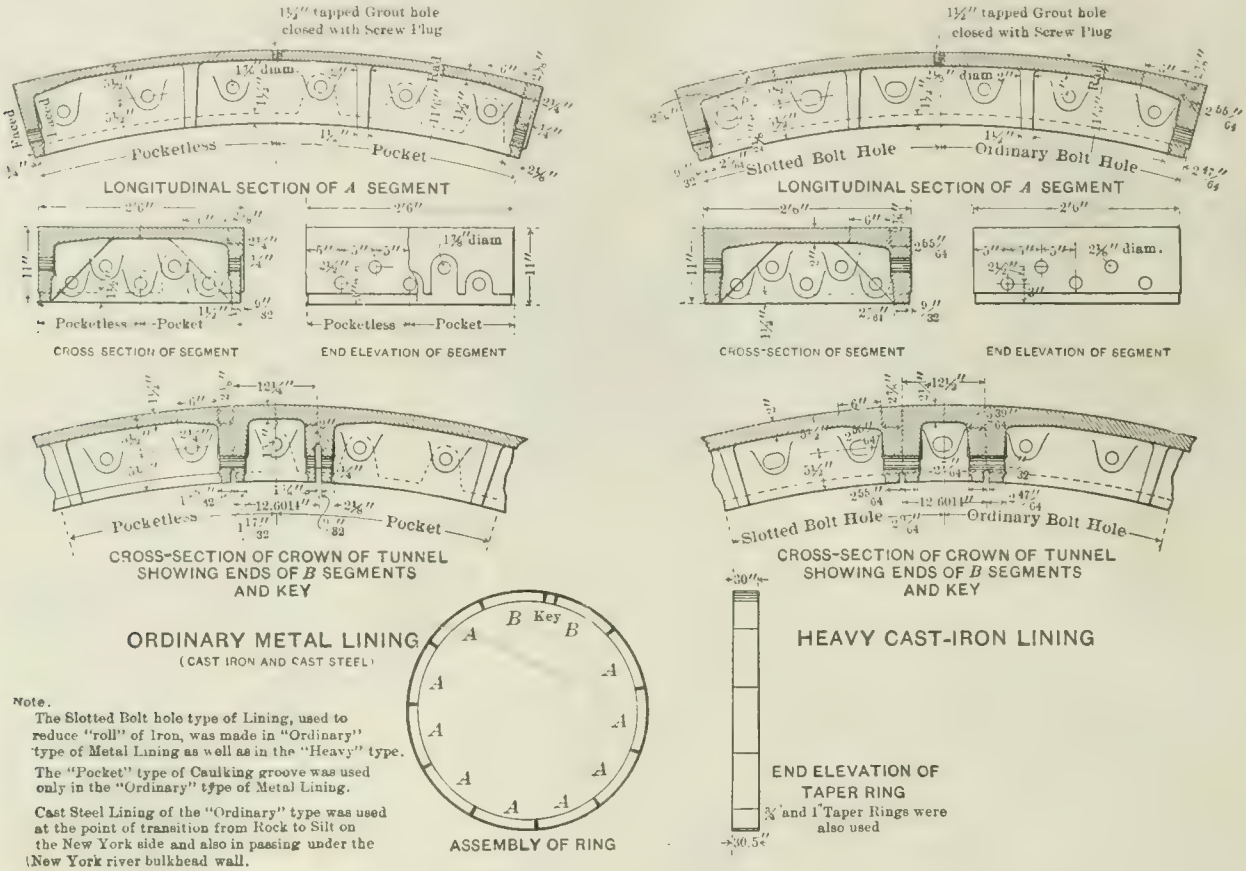

1½" tapped Grout hole closed with Screw Plug
LONGITUDINAL SECTION OF A SEGMENT
Pocketless
Pocket
CROSS SECTION OF SEGMENT
END ELEVATION OF SEGMENT
CROSS-SECTION OF CROWN OF TUNNEL SHOWING ENDS OF B SEGMENTS AND KEY
ORDINARY METAL LINING
(CAST IRON AND CAST STEEL)
Slotted Bolt Hole
Ordinary Bolt Hole
HEAVY CAST-IRON LINING
ASSEMBLY OF RING
END ELEVATION OF TAPER RING
¾" and 1" Taper Rings were also used
Note.
The Slotted Bolt hole type of Lining, used to reduce "roll" of Iron, was made in "Ordinary" type of Metal Lining as well as in the "Heavy" type.
The "Pocket" type of Caulking groove was used only in the "Ordinary" type of Metal Lining.
Cast Steel Lining of the "Ordinary" type was used at the point of transition from Rock to Silt on the New York side and also in passing under the New York river bulkhead wall.

Fig. 2—Details of All Types of Metal Lining.

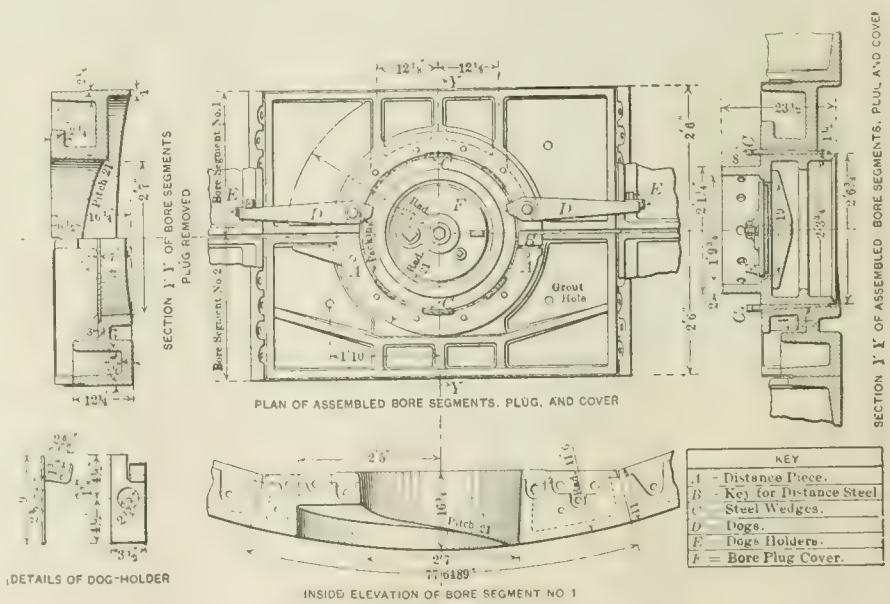

SECTION 1'-1' OF BORE SEGMENTS PLUG REMOVED
PLAN OF ASSEMBLED BORE SEGMENTS, PLUG, AND COVER
SECTION 1'-1' OF ASSEMBLED BORE SEGMENTS, PLUG AND COVER
DETAILS OF DOG-HOLDER
INSIDE ELEVATION OF BORE SEGMENT NO 1
KEY
A - Distance Piece.
B - Key for Distance Steel
C - Steel Wedges.
D - Dogs.
E - Dogs Holders.
F = Bore Plug Cover.

Fig. 3—Bore Segment of Metal Lining.

face, lbs. 15,200
Pull-back force of one ram. lbs..... 26,400
Pull-back pressure on full area of ram, lbs. per sq. in..... 480

The rams developed a tendency to bend, under the severe test of shoving the shield all closed, or nearly so, through the river silt, and it is probable that it would have been better to make the pistons 10 in. in diameter instead of 8½ ins.

Each sliding platform was actuated by two single-acting rams, 3½ ins. in diameter and having a stroke of 2 ft. 9 ins. The rams were attached to the rear face of the shield diaphragm inside the box floors, and the cylinders were movable, sliding freely on bearings in the floor. The front ends of the cylinders were fixed to the front ends of the sliding platforms. The cylinder thus supported the front end of the sliding platform, and was designed to carry its half of the load on the platform. Some of the leading figures in connection with the platform rams, at a working pressure of 5,000 lbs. per sq. in., are:

Forward force of each pair of rams (in each platform), lbs.....96,000
Total area of nose of sliding platform, sq. ins. 1,060
Maximum reaction per sq. in. on nose, lbs. 90
Maximum reaction per sq. ft. on nose, lbs..13,040

Each shield was fitted with a single erector mounted on the rear of the diaphragm. The erector consisted of a box-shaped frame mounted on a central shaft revolving on bearings attached to the shield. Inside of this frame there was a differential hydraulic plunger, 4 ins. and 3 ins. in diameter and of 48-ins. stroke. To the plunger head were attached two channels sliding inside the box frame, and to the projecting ends of these the grip was attached. At the opposite end of the box frame a counterweight was attached which balanced about 700 lbs. of the tunnel segment at 11 ft. radius.

The erector was revolved by two single-acting rams fixed horizontally to the back of the shield above the erector pivot through double chains and chain wheels keyed to the erector shaft. The principal figures connected with the erector, assuming a water pressure of 5,000 lbs., per sq. in., are:

	Pounds.
Weight of heaviest tunnel segment.....	2,584
Weight of erector plunger and grip.....	616
Total weight to be handled by the erector ram	3,200
Total force in erector ram moving from center of shield.....	35,000
Total force in erector ram moving toward center of shield.....	27,500
Weight at 11-ft. radius which is balanced by counterweight	700
Maximum net weight at 11-ft. radius to be handled by turning rams.....	1,884
Total force of each rotating ram, at 5,000 lbs. per sq. in.....	80,000
Load at 11-ft. radius, equivalent to above	3,780

When the shield was designed, a grip was also designed by which the erector could handle segments without any special lugs being cast on them. A bolt was passed through two opposite bolt holes in the circumferential flanges of a plate. The grip jaws closed over this bolt and locked themselves. The projecting fixed ends of the grip were for taking the direct thrust on the grip caused by the erector ram when placing a segment.

It happened, however, that there was delay in delivering these grips, and, when the shield was ready to start, and the grip was not forthcoming, Mr. Patrick Fitzgerald, the Contractor's Superintendent, overcame this trouble by having another grip made.

In this design also, a self-catching bolt is placed through the segment and the grip catches the bolt. In simplicity and effectiveness in working, this new design eventually proved a decided advance on the original one, and, as a result, all the shields were fitted with the new grip, and the original design was discarded.

The great drawback to the original grip was that the plate swung on the lifting bolt, and thus brought a great strain on the bolt when erecting a plate in the crown, whereas in the new one, the plate was held rigidly at right angles to the erector arm. The original design was able to handle both *A* and *B* segments, and key segments, without alteration; in the new design, an auxiliary head had to be swung into position to handle the key, but this objection did not amount to a practical drawback.

The operating floor from which the shield was controlled, and at which the valves were situated, was placed above the rams which rotate the erector, and formed a protection for them. The control of the shield rams was divided into four groups; the seven lower rams constituted one group, the upper five, another, and the six remaining on each side, the other two. Each group was controlled by its own stop and release valve. Individual rams were controlled by stop-cocks.

The control of the sliding platform rams was divided into two groups, of which all the rams on the upper floor made one, and all those in the lower floor, the other; here, again, each group had its own stop and release valve, and individual platforms were controlled by stop-cocks arranged in blocks from which the pipes were carried to the rams.

The in-and-out movements of the erector ram were controlled by a two-spindle, balanced, stop and release valve, controlled by a hand wheel. The erector rotating rams were controlled by a similar valve, with four spindles, also operated by a single hand-wheel. Both wheels were placed inside the top shield pockets, and within easy reach of the operating platform.

The hydraulic pressure was brought through the tunnel by a 2-in. hydraulic pipe. Connection with the shield was made by a flexible copper pipe, the 2-in. line being extended as the shield advanced.

TUNNEL LINING.

General Type.—The main ruling type adopted for the tunnels under the Hudson River and in the soft water-bearing ground for some distance on the shoreward side of the river lines, consists of two parallel metal-lined tunnels, circular in cross section, each tunnel being 23 ft. outside diameter, and the two tunnels 37 ft. apart from c. to c. The metal lining is of cast iron (except for a few short lengths of cast steel) and of the usual segmental type, consisting of "Rings" of iron, each ring being 2 ft. 6 ins. in length, and divided by radial joints into eleven segments, or "Plates," with one "Key," or closing segment, having joints not radial but narrower at the outside circumference of the metal lining than at the inside. The whole structure is joined, segment to segment, and ring to ring, by mild-steel bolts passing through bolt holes in flanges of all four faces of each segment. The joints between the segments are made water-tight by a calking or sal-ammoniac and iron borings driven into grooves formed for the purpose on the inner edges of the flanges. The clearances between the bolts and the bolt holes are also made water-tight by using grummets or rings of yarn smeared with red lead, having a snug fit over the shank of the bolt and placed below the washer on either end of each bolt. When passing through ground more or less self-sustaining, the space outside the iron lining (formed by the excavation being necessarily rather larger than the external diameter of the lining itself) was filled with grout of 1:1 Portland cement and sand forced by air pressure through grout holes in each segment. These holes were tapped, and were closed with a screw plug before and after grouting.

Having thus stated in a general way the main ruling features of the design, a detailed description of the various modifications of the ruling type will be given.

The two main divisions of the iron lining are the "ordinary" or lighter type and the heavy type. The details of the ordinary iron are shown in Fig. 2 which shows all types of lining. It was on this design that the contract was let, and it was originally intended that this should be the only type of iron used. The dimensions of the iron are clearly shown on the drawing, and it will be seen that the external diameter is 23 ft., the interior diameter, 21 ft. 2 ins., the length of each ring, 2 ft. 6 ins. and the thickness of the iron skin or web, 1½ ins. The bolt holes in the circumferential flanges are evenly spaced through the

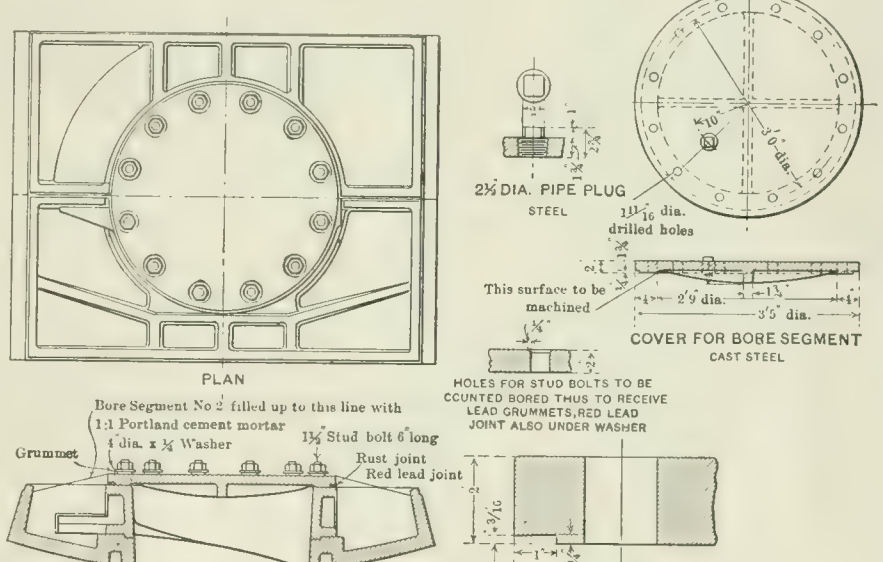

PLAN
Bore Segment No 2 filled up to this line with 1:1 Portland cement mortar
4" dia. x ¼ Washer
Grummet
1½" Stud bolt 6" long
Rust joint
Red lead joint
CROSS-SECTION
2½ DIA. PIPE PLUG
STEEL
1 11/16 dia. drilled holes
This surface to be machined
2'9" dia.
3'5" dia.
COVER FOR BORE SEGMENT
CAST STEEL
HOLES FOR STUD BOLTS TO BE COUNTED BORED THUS TO RECEIVE LEAD GRUMMETS, RED LEAD JOINT ALSO UNDER WASHER
DETAIL OF RUST JOINT GROOVE

Fig. 4—Cover for Bore Segment.

circle, so that adjacent rings may be bolted together in any relative position as regards the radial joints, and, as a matter of fact, in the erection of the tunnel lining, all the rings "break joint," with the exception of those at the bore segments, as will be described later. This type of iron, when the original type was modified, came to be known as the ordinary pocketless iron; that is, the weight is of the ordinary or lighter type, in contradistinction to the heavier one, which later supplanted it, and the calking groove runs along the edges of the flanges and does not form pockets around the bolt holes, as did the groove in a later type.

Each ring is made up of eleven segments and a key piece. Of these, nine have radial joints at both ends, and are called *A* segments; two, called *B* segments, have a radial joint at one end and a non-radial joint at the other. The non-radial joint is placed next to the key, which is 12.25 ins. wide at the outside circumference of the iron and 12.50 ins. wide at the inside.

The web is not of uniform thickness. The middle part of each *A* and *B* segment is 1½ ins. thick; at the distance of 6 ins. from the root of each flange, the thickness of web begins to increase, so that at the root it is 2⅜ ins. thick. The web of the key plate is 1¾ ins. thick.

The bolts are of mild steel, and are 1½ ins. in diameter; there are 67 in one circumferential joint and 5 in each radial joint. As there are 12 such radial joints, there are altogether 60 bolts in the cross-joints, making a total of 127 bolts per ring.

This original type of ordinary iron was modified for a special purpose as follows: It was known that for some distance on either side of the river and especially at Weehawken, the tunnels would pass through a gravel formation, rather open, and containing a heavy head of water. It was thought that, by carrying the calking groove around the bolt holes, it would be possibe to make them more waterproof than by the simple use of the red-leaded grummets. Hence the "Pocket Iron" was adopted for this situation, the name being derived from the pocket-like recess which the calking groove formed when extended around the bolt hole. The details of this lining are shown on Fig. 2, and the iron (except for the pockets) is exactly like the pocketless type.

On the New York side, in both North and South Tunnels, two short lengths were built with cast-steel lining. This was done where unusual stresses were expected to come on the lining, namely, at the point where the invert passed from firm ground to soft, and also where the tunnels passed under the heavy river bulkhead wall.

The design was precisely the same as for the ordinary pocketless iron, and Fig. 2 shows the details. After the tunnels had entered into the actual under-river portion, several phenomena led to the fear that the tunnels, being lighter than the semi-liquid mud they displaced, might be subject to a buoyant action, and therefore a heavier type of lining was designed. The length of ring, number of bolts, etc., were just the same as for the lighter iron, but the thickness of the web was increased from 1½ to 2 ins., the thickness of the flanges was proportionately increased, and the diameter of the bolts was increased from 1½ to 1¾ ins. This iron was all of the pocketless type, shown in Fig. 2. Table I gives the weights of the various types of lining.

The weights in Table I are calculated by assuming cast iron to weigh 450 lbs. per cu. ft., and cast steel 490 lbs. In actual practice the "ordinary" iron was found to weigh a little more than the weights given, and the "heavy" a little less.

The silt in the sub-river portion averaged about 100 lbs. per cu. ft., so that the weight of the silt displaced by the tunnel was about 11,548 lbs. per lin. ft.

Taper Rings.—In order to pass around curves (whether horizontal or vertical), or to correct deviation from line or grade, taper-rings were used; by this is meant rings which when in place in the tunnels were wider than the standard rings, either at one side (horizontal tapers or "Liners"), or at the bottom ("Elevators").

In the original design a ½-in. taper was called for, that is, the wide side of the ring was ½ in. wider than the narrow side, which was of the standard width of 2 ft. 6 ins. As a matter of fact, during construction, not only ½-in., but ¾-in. and 1-in. tapers were often used.

These taper rings necessitated each plate having its own unalterable position in the ring, hence each plate of the taper ring was numbered, so that no mistake could be made during erection.

The taper rings were made by casting a ring with one circumferential flange much thicker than usual, and then machining off this flange to the taper. This was not only much cheaper than making a special pattern for each plate, but made it possible to see clearly where, and what, tapers were used in the tunnel.

Taper rings were provided for all kinds of lining (except the cast steel), and the lack of taper steel rings was felt when building the steel-lined parts of the tunnel, as nothing could be done to remedy deviations from line or grade until the steel section was over and cast iron could again be used. Table II gives the weights of the different kinds of tapers used.

Cast-Steel Bore Segments and Accessories.—The following feature of these tunnels is different from any hitherto built. It was the original intention to carry the rolling load independent of the tunnel, or to assist the support of the silt portion of the structure by a single row of screw-piles, under each tunnel, and extending down to firmer ground than that through which the tunnels were driven. Therefore, provision had to be made whereby these piles could be put down through the invert of the tunnel with no exposure of the ground.

This provision was afforded by the "Bore Segments," which are shown in detail in Fig. 3. There are two segments, called No. 1 and No. 2 respectively. These two segments are bolted together in the bottom of two adjacent rings, and thus form a "Pile Bore." As the piles were to be kept at 15-ft. centers, and as the tunnel rings were 2 ft. 6 ins. in length, it will be seen that, between each pair of bore-segment rings, there came four "Plain" rings. The plain rings were built up so that the radial joints broke from ring to ring, but with the bore-segment rings this could not be done, without unnecessarily adding to the types of segments.

The bore segments were made of cast steel, and were quite complicated castings, the principle, however, was quite simple. The segments provided an opening just a little larger than the shaft of the pile, the orifice being 2 ft. 7 ins. in diameter at the smallest (lowest) point, while the shaft of the pile was to be 2 ft. 5¼ ins. In order to allow of the entry of the screw-blade or helix of the pile, a slot was formed in the depth of Bore Segment No. 1, so that, when a pile was put in position above the bore, the blade, when revolved, would enter the slot and thus pass under the metal lining, although the actual orifice was only slightly larger than the pile shaft.

The wall of the pile orifice in Segment No. 2 was made lower than that in No. 1 so as to allow the blade to enter the slot in Segment No. 1. When the pile is not actually in process of being sunk, this lower height in No. 2 is made up with the removable "distance piece." This had a tongue at one end which engaged in a recess cast to take it in Segment No. 2 and was held in place by a key piece at the other end of the distance piece. Details of the distance piece and key are shown in Fig. 3.

The flanges around the pile bore were made flat and furnished with twelve tapped holes, six in Segment No. 1 and six in Segment No. 2, for the purpose of attaching the permanent arrangements in conjunction with which the pile was to be attached to the track system, independently of the tunnel shell, or directly to the tunnel. It was never decided which of these alternatives would be used, for, before this decision was reached, it was agreed that,

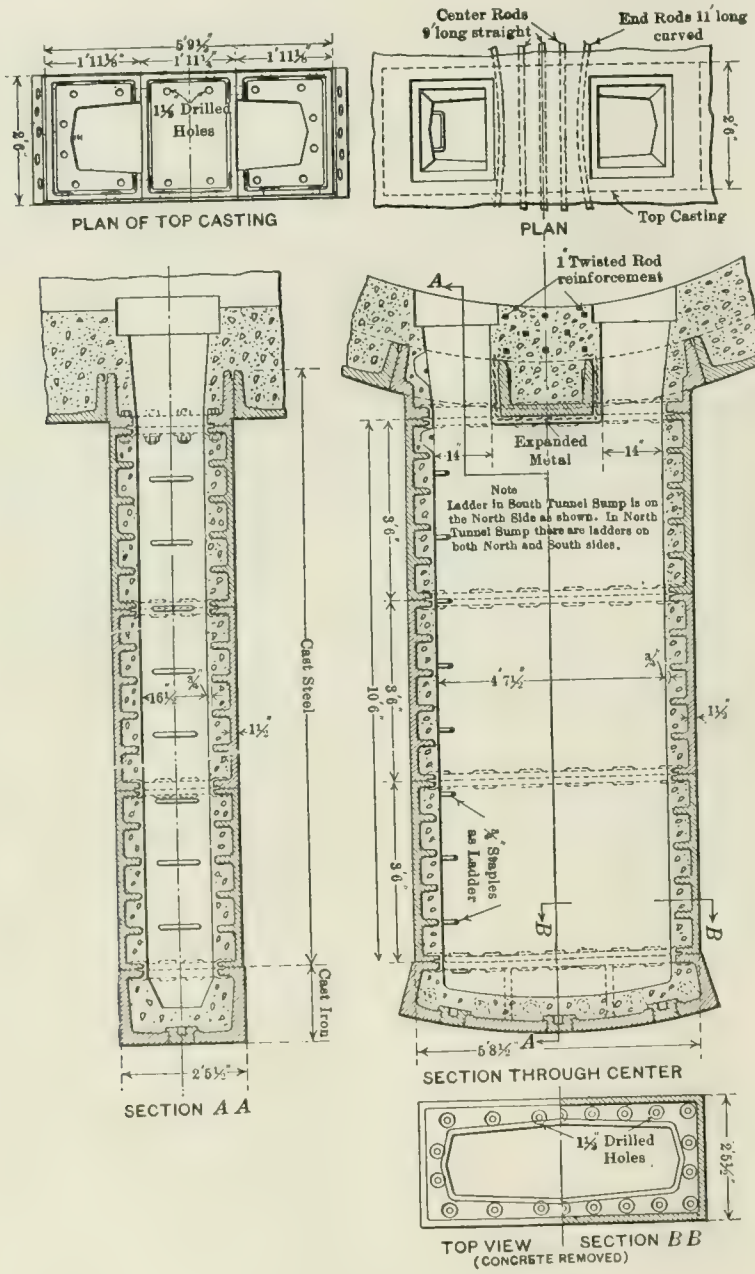


Fig. 5—Details of Sumps.

TABLE I.—WEIGHTS OF TUNNEL LINING, DIAMETER AND WEIGHTS OF BOLTS, ETC.

Reference No.	Type of Lining.	Weight of one "A" Segment in lbs.	Weight of one "B" Segment in lbs.	Weight of one key, in lbs.	Weight of one complete ring, in lbs.	Diameter of bolts in ins.	Weight of 1 bolt and 2 washers in lbs.	Weight of bolts, nuts and washers per ring, in lbs.	Total weight of one ring, Segment and bolts, in lbs.
1	Ordinary cast iron without calking pockets....	2,063	2,068	480	23,183	1½	6.62	840.7	24,024
2	Ordinary cast iron with calking pockets.....	2,038	2,043	469	22,897	1½	6.62	840.7	23,738
3	Ordinary cast steel without calking pockets..	2,247	2,252	522	25,249	1½	6.62	840.7	26,090
4	Heavy cast iron without calking pockets.....	2,579	2,584	606	28,985	1¾	10.50	1,333.5	30,319

WEIGHTS OF VARIOUS TYPES OF LINING PER LINEAR FOOT OF TUNNEL.

Reference No.	Type of Lining.	Weights of complete rings (segments only), in pounds.	Weights of bolts, nuts, and washers, in pounds.	Weights of segments and bolts in tunnel complete, in pounds.
1	Ordinary cast iron without pockets..	9,273.0	336.3	9,609.6
2	Ordinary cast iron with pockets.....	9,158.8	336.3	9,495.2
3	Ordinary cast steel without pockets..	10,099.6	336.3	10,436.0
4	Heavy cast iron without pockets.....	11,594.0	533.4	12,127.6

at any rate for the present, it was better not to put down piles at all.

To close the bore, the "Bore Plug" was used. This is shown in Fig. 3. It was of cast steel, and was intended to act as a permanent point of the screw-pile, that is, the blade section was to be attached to the bore plug, the distance piece and key were to be removed, and the pile was to be rotated until the blade had cleared the slot; the distance piece and key were then to be replaced and sinking resumed.

The plug was held in place against the pressure of the silt by the two "dogs," while the dogs themselves were attached to the tunnel, as shown in Fig. 3. The ends of the dogs, which rested on the flanges of the metal lining of the tunnel, were prevented from being knocked off the flanges (and thus releasing the plug) by steel clips.

It was expected that it might be desirable to keep the lower end of the piles open during their sinking, so that the bore plugs were not made permanently closed, but a seating was formed on the inner circumference of the plug, and on the seating was placed the "Plug Cover," made of cast iron, 18¾ ins. in diameter and 3 ins. thick, furnished with a lug for lifting and a 3-in. tapped hole closed by a screw-plug, through which any soundings or samples of ground could be taken prior to sinking the piles. This plug cover was held in place by a heavy steel "Yoke" under it, which engaged on the under side of the flange, on top of which the cover was set. The yoke was attached to the cover by a 1¾-in. tap-bolt, screwed into the yoke and passing through a 2-in. hole bored in the center of the cover. This rather peculiar mode of attaching the cover was adopted so that the cover could be removed by taking off the nut of the yoke, in case it was desired to open the end of the pile during the process of sinking.

The plug was a fairly close fit at the bottom of the orifice, that is, at the outside circumference of the tunnel, where the bore was 2 ft. 7 ins. in diameter and the plug 2 ft. 6¾ ins. but at the top of the bore-segment there was more clearance, as the plug was cylindrical while the bore tapered outward. To fill this space, it was intended that steel wedges should be used while the shield was being driven, so that they would withstand the crushing action of the thrusting shield, and, when the shield was far enough ahead, that they should be removed and replaced by hardwood wedges. This method was only used in the early weeks of the work; the modification of not using the shield-jacks which thrust against the bore segments was then introduced, and the wooden wedges were put in, when the bore plugs were set in place, and driven down to the stage of splitting.

When it was resolved not to sink the screw-piles, the bores had to be closed before putting in the concrete lining. This was done by means of the covers shown in Fig. 4. The bore plug and all its attachments were removed and the flat steel cover, 2 ins. thick and with stiffening webs on the under side, was placed over the circular flanges of the pile bore. The cover was attached to the bore segments by twelve 1½-in. stud-bolts, 6 ins. long, in the bolt holes already mentioned as provided on these flanges.

When these were in place, with lead grummets under the heads of the bolts and the grooves caulked, the bore segments were water-tight, except in Bore Segment No. 2, at the joint of the distance piece; and, to keep water from entering here, this segment was filled to the level of the top of the flanges with 1:1 Portland cement mortar.

The weights of the various parts of the bore segments are given in Table III.

Sump Segments.—In order to provide sumps to collect the drainage and leakage water in the subaqueous tunnels, special "sump segments" were installed in each tunnel at the lowest point. The details of the design are shown in Fig. 5. The segment was built into the tunnel invert as though it were an ordinary *A* segment. In building the sump, three lining castings were bolted, one on top of the other, and attached to the flat upper surface of the sump segment; meanwhile, the bolts attaching the sump segment to the adjacent tunnel plates were taken out and the plate and lining segments were forced through the soft mud by hydraulic jacks, the three 6-in. holes in the bottom of the sump segment being opened in order to minimize the resistance. The sump when built appeared as shown in Fig. 5, the top conection being made with a special

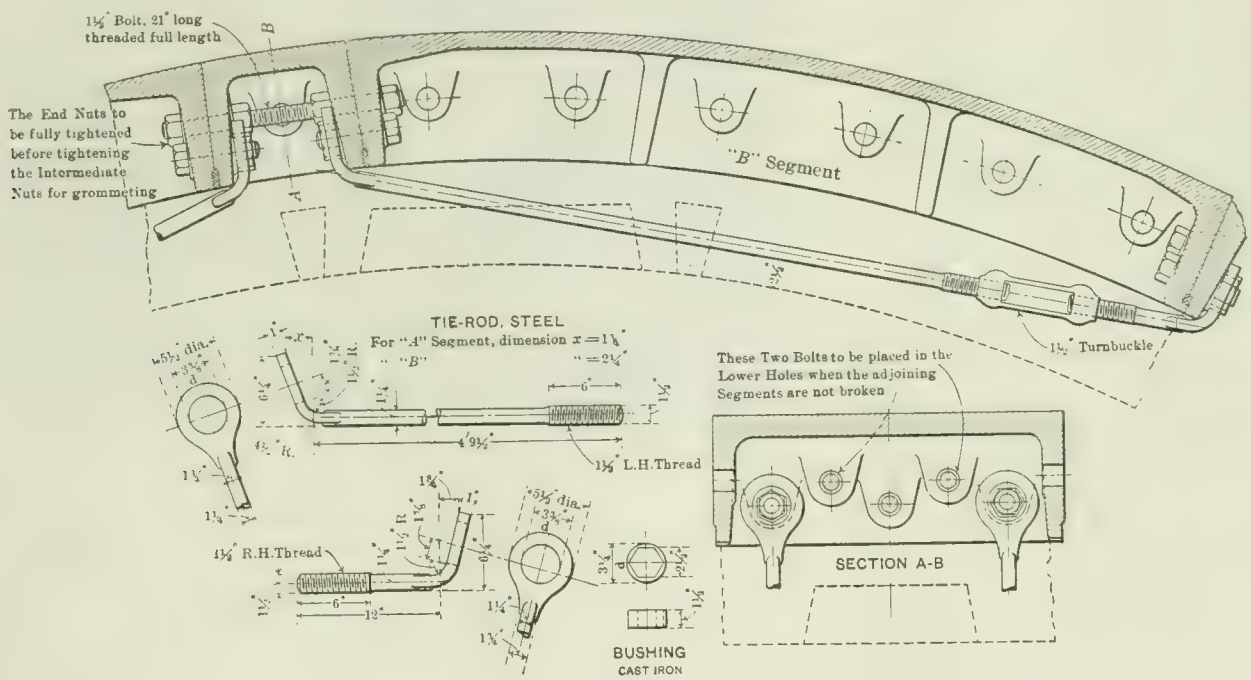

1¼" Bolt, 21" long threaded full length
The End Nuts to be fully tightened before tightening the Intermediate Nuts for grommeting
"B" Segment
1½" Turnbuckle
TIE-ROD, STEEL
For "A" Segment, dimension x = 1⅛"
" "B" " " = 2¼"
1½" L.H.Thread
4½" R.H.Thread
These Two Bolts to be placed in the Lower Holes when the adjoining Segments are not broken
SECTION A-B
BUSHING
CAST IRON

Fig. 6—Method of Reinforcing Cracked Segments.

TABLE II.—WEIGHTS OF CAST-IRON TAPER RINGS, IN POUNDS PER COMPLETE RING.

Classification.	Weight of cast iron per complete ring, in pounds.
Ordinary pocketless ½-in. taper.....	23,767.7
Ordinary pocketless 1-in. taper.....	24,352.4
Ordinary pocket, ½-in. taper.....	23,481.7
Heavy pocketless ½-in. taper.....	29,564.8
Heavy pocketless ¾-in. taper.....	29,854.7
Heavy pocketless 1-in. taper.....	30,144.6

TABLE III.—WEIGHTS OF BORE SEGMENTS AND ACCESSORIES, IN POUNDS.

Part.	No.	Material.	Weight, in lbs.
Bore Segment No. 1	1	Cast steel	3,001.0
Bore Segment No. 2	1	Cast steel	2,428.0
Distance piece	1	Cast steel	121.5
Key	1	Cast steel	34.3
Plug	1	Cast steel	1,192.4
Yoke	1	Cast steel	57.3
Dogs	2	Cast steel	106.0
Slot cover	1	Rolled steel	6.4
Plug cover	1	Cast iron	162.0
Dog holders	2	Rolled steel	6.4
Complete weight of one pair, without bolts			7,620.4

casting, as shown. The capacity of each sump is 500 gals. which is about the quantity of water entering the whole length of each subaqueous tunnel in 24 hours.

TABLE IV.—WEIGHTS OF SUMP SEGMENTS.

Past.	No.	Material.	Weight in pounds.
Middle top casting..	1	Cast steel	880
End top castings ..	2	Cast steel	1,718
Lining castings	3	Cast steel	18,232
Sump segment	1	Cast iron	3,560
Total weight per sump, exclusive of bolts			24,390

Turnbuckle Reinforcement for Cast-Iron Segments.—During the period of construction, a certain number of cast-iron segments, mostly in the roof, but in some cases at Manhattan in the invert, behind the river lines, became cracked owing to uneven pressures of the ground. Before the concrete lining was put in, considerable discussion occurred as to the wisest course to pursue with regard to these broken plates. It was finally thought best not to take the plates out, as more harm than good might be done, but to reinforce them with turnbuckles, as shown in Fig. 6. The number of broken segments was distributed as follows:

North Manhattan Tunnel, 87, chiefly in silt (not under the river).

South Manhattan Tunnel, 7, chiefly in silt (not under the river).

North Weehawken Tunnel, 24, chiefly in sand (not under the river).

South Weehawken Tunnel, 48, chiefly in silt, under the Fowler Warehouse.

An order has recently been issued by Chairman Geo. W. Goethals of the Isthmian Canal Commission specifying the amount of lubricants of the various kinds which will be allowed for the use of dredges. The allowances given in the following list are monthly allowances and are based on the maximum requirements of the largest vessels in the classes shown when operated continuously. A corresponding reduction in the consumption of lubricants will be expected on the smaller vessels of a class and when vessels are not at work the entire month:

	Per month. Gals.	Lbs.
Sea-Going Suction Dredges—		
Marine engine oil	375	...
Locomotive engine oil	20	...
Stationary engine oil	100	...
Valve oil	20	...
Kerosene oil	100	...
Lard oil	5	...
Yellow lubricating grease	...	100
Gear grease	...	200
Graphite	...	5
Waste, cotton	...	350
Ladder and Dipper Dredges—		
Marine engine oil	60	...
Locomotive engine oil	25	...
Stationary engine oil	25	...
Valve oil for ladder dredges	5	...
Valve oil for dipper dredges	20	...
Kerosene oil	75	...
Lard oil	5	...
Yellow lubricating grease	...	50
Gear grease	...	125
Waste, cotton	...	100
Graphite—5 lbs. every three months.		
Suction Pipe Line Dredges—		
Locomotive engine oil	50	...
Stationary engine oil	50	...
Valve oil	20	...
Kerosene oil	75	...
Lard oil	2.5	...
Yellow lubricating grease	...	50
Gear grease	...	50
Graphite	...	5
Waste, cotton	...	100

Cost of Testing.—In constructing the Hudson River Tunnels of the Pennsylvania R. R. a cement-testing laboratory was established at the Manhattan Shaft offices, under the charge of a cement inspector who was furnished with assistants for sampling, shipping and testing cement. All materials used on the work, such as bricks, sand, stone, waterproofing, etc., were tested here, with the exception of metals, which were under the charge of a metal inspector reporting directly to the head office. This department cost about $10,000 for salaries and $3,000 for apparatus and supplies, or about $13,000 in all. There were 800,000 bbl. of cement tested, and samples from 2,100,000 brick.

Roads and Streets Section

Note: This section is devoted to methods and costs of road and street construction. It will cover road building in all its details, the construction of pavements, sidewalks and gutters, the testing and use of paving materials and the machinery and tools used in road building and paving.

Groove Wooden Block Pavement for a 6 Per Cent Street Grade.

A portion of James street, at Hamilton, Ont., was paved last year with creosoted wooden blocks. On account of the grade these blocks were grooved. The grade is 6 per cent and is at the head of the main street in the city just before it reaches the high bluff and incline railway shown in the accompanying cut. There is a large amount of traffic over this street from two different roads besides the incline railway.

The blocks are laid at right angles to the center line of the street, each block having a groove ½ in. wide and 1 in. deep, the groove being laid at right angles to the center line of the street. The wooden blocks were laid on the flat grade approaching with cement grout,

View Showing Incline on James St., Hamilton, Ont., Having Groove Wood Block Paving.

but on the grade asphalt filler was adopted. The crown was laid very flat, rising only about 2 in. in the center. After the first few weeks, when the surplus asphalt filler had been worn off, there were no complaints whatever about the slipperyness of this pavement, and heavily loaded teams go up and down without any difficulty as the grooves give the caulks of the horses shoes a firm foot hold. The previous pavement has an ordinary macadam, but on account of the amount of water coming down the street from freshets or heavy rainfalls it was unsatisfactory. Mr. Andrew F. Macallum, City Engineer, to whom we are indebted for this importation, states that since the wooden blocks have been laid they have had no trouble whatever in any way.

Comparative Cost of Macadam and Stone Block Pavements at Belfast, Ireland.

The selection of the proper kinds of pavement for a roadway involves the consideration of the relative values in use of the different kinds of pavements available and their adaptability to the varying conditions to which the street to be paved is subjected. This question was quite fully discussed in our issue of Jan. 12, 1910. In a paper read at the Irish Road Congress, held at Dublin, Ireland, April 20 to 22, 1910, Mr. James Munce, Assistant City Surveyor of Belfast, Ireland, also considers this question and gives comparative figures as applied to Belfast on macadam and stone block pavement. The matter that follows this has been taken from Mr. Munce's paper, the costs being figured out on the basis of American Monetary units.

For many years the cost of repairing macadam roads in Belfast was a steadily increasing item in the expenditure of the composition and was becoming so serious that some means of reducing it became imperative. Over four miles are added annually to the mileage kept in repair by the corporation. So the construction of new streets had to be considered as well as the alteration of old ones in order to reduce the cost of maintenance.

When the macadam roads in Belfast were costing about $89,900 to repair, had they been paved $22,000 would have sufficed. In 1883 the average quantity of broken stone used was 955 tons per mile per annum, on about 40 miles. Gradually some of the streets of heaviest traffic were paved, and in 1898 the average had fallen to 500 tons per mile on a length of over 65 miles. The extension of the city in 1898 at once increased the length of macadam roads to 111 miles, but many of the roads added were ordinary country roads of light traffic.

It was not suggested, however, that every street should be paved, but only those costing over 12 cts. per square yard per annum for repairs.

It was found that the scavenging of the macadam roads cost about two-thirds of the sum spent on repairs, so 12 cts for repairs meant a cost of 8 cts. for scavenging, or a total of 20 cts. per yard.

Mr. Munce states that a very liberal estimate of the first cost of a 4x4x6-in. set paving on a 9-in. concrete foundation is $4.08 per sq. yd. including all contingencies. The average cost per year of this pavement would be as follows:

	Cents.
Interest on first cost $4.08 per sq. yd. at 3 per cent	12.20
Sinking fund on portion to be renewed in 40 years at 3 per cent	2.38
Maintenance	.50
Scavenging, including watering	4.80
Total	19.88

The inference for Belfast is that where a macadamized street costs 20 cts. per yard per annum, it is cheaper to pave it.

The older pavements in Belfast are of sets 7 in. deep, 3½ in. to 4 in. wide, and 7 to 9 in. long; but the use of this size ceased many years ago, and 4x4x6 in. deep is the size chiefly adopted now.

A few streets are paved with 4-in. cubes, but it was found that they did not stand the heavy traffic so well as the deeper stones. All the set pavements are laid on a bed of Portland cement concrete, 6 in. to 9 in., or in some cases 12 in. deep, according to the subsoil, and the nature of traffic expected. The sets are laid in 1 in. thick of compo, mixed dry in the proportion of 5 parts of sand to 1 of cement, and spread over the concrete as required by the paviors.

The sets are paved as close as possible, the roughness of the sides giving quite sufficient space for jointing. The pavement is slightly rammed and any loose stones replaced by others. The whole is then flooded with grout, mixed 3½ of sand to 1 of cement, well brushed into the joints—the water gets to the compo bed from the grout. The whole is then well rammed and covered off with sea gravel. Traffic is not permitted over it for a week.

Pavements executed in this way are in good order today without repairs after 20 years' traffic, and in some cases nearly double this time.

Mr. Munce gives the following actual examples of saving or replacing a macadam by stone block pavement:

Macadam, 1,698 Sq. Yds.	Per year.
Actual cost of repairs at approx. 24 cts. per sq. yd.	$ 412.55
Actual cost of scavenging, at approx. 18 cts. per sq. yd.	309.42
Interest on first cost of 60 cts. per sq. yd. at 3 per cent.	30.92
Total actual annual cost	$ 752.90
Total cost for 25 years	$18,822.50
Paved with 4 in. x 4 in. x 6 in. sets on 9 in. concrete	
1,698 sq. yds. at approx. $4	$ 6,792.00
	Per year.
Interest on first cost at 3 per cent.	$ 206.28
Sinking fund at 2¾ per cent.	188.50
Repairs 1 ct. per sq. yd.	16.98
Scavenging at approx. 6 cts. per sq. yd	103.14
Total annual charge	$ 514.90
Total cost in 25 years	$12,869.00
Deduct value of blocks at end of 25 years, 1,698 sq. yds. at approx. $2.16	$ 3,713.52
Net cost of block paving in 25 years.	$ 9,156.48
Macadam	$18,822.50
Paving	$ 9,156.48
Saving to taxpayers in 25 years through paving	$ 9,666.02

Mr. Munce also gives the following data as showing the actual cost of paving with 4 in. x 4 in. x 6 in. sets on 6-in. concrete:

	Per sq. yd.
Excavation, including cartage, 10-27 cu. yd. at 7 cts.	$0.200
Concrete, 1-6 cu. yd. at $3.60	.600
Sets, .27 ton at $4.80	1.300
Paver, 1-3 hr. at 17 cts. per hour	.056
Laborer, 1-3 hr. at 9 cts.	.030
Rammer, 1-6 hr. at 10 cts.	.016
Labor grouting in concrete bed, 1-3 hr. at 9 cts.	.030
Water	.010
Watching, etc.	.040
Use of tools and plant at 10 per cent.	.240
Cement, 26 lbs. at $7.20 per long ton	.090
Sand, 140 lbs. at 80 cts. per long ton	.050
Foreman, 1 to squad of 6 pavers	.016
Total	$2.67
Contingencies	.240
Total per sq. yd.	$2.918

The above is the actual cost without profit on allowance for re-setting curves, gullies, altering bends of same and such like works which depend on the street.

For 9 ins. concrete and 2-27 cu. yds. gravel cementing in cost to 4 cts. and 1/12 cu. yd. concrete amounting to 30 cts.

Mr. Munce gives the following figures as showing the annual charges on two types of stone block pavement:

4 in. x 4 in. x 6 in. paving on 6-in. concrete for private streets; 25 year term:

First cost, 1,000 sq. yds. at $2.92	$2,920
	Per year.
Interest at 3 per cent.	$ 88.68
Sinking fund at 2.74 per cent.	80.96
Repairs at approx. 1 ct. per sq. yd.	10.00
Scavenging at 4 cts. per sq. yd.	40.00
Total	$219.64

Or about 21.9 cts. per sq. ft. per year.

Random sets on 6-in. concrete, for 25-year term:

First cost, 1,000 sq. yds. at $2.40	$2,400
	Per year.
Interest at 3 per cent.	$ 72.90
Sinking fund at 2.74 per cent.	66.64
Repairs at 2 cts. per sq. yd.	20.00
Scavenging at 4 cts. per sq. yd.	40.00
Total	$199.54

Or about 19.9 cts. per sq. yd. per year.

The area covered by one ton of sets paved tightly is given by Mr. Munce as follows:

3½ in. to 4 in. wide, 7 in. to 9 in. long, 7 in. deep—3 yds.

3½ in. to 4 in. wide, 7 in. to 9 in. long, 6 in. deep—3⅔ yds.

3 in. to 3¼ in. wide, 7 in. to 9 in. long, 5 in. deep—4½ yds.

4 in. to 4¼ in. wide, 7 in. to 9 in. long, 6 in. deep—3⅔ yds.

4 in. to 4¼ in. wide, 7 in. to 9 in. long, 5 in. deep—4½ yds.

He states that these areas are very nearly correct, but as stones from different quarries vary up to 5 per cent or more, discretion must be exercised in using them.

Mr. Munce also states that to lay 1,000 sq. yds. of set paving will require the material and labor as follows:

Sets, 275 tons. This will vary with the specific gravity of stone.
333 hours of paver.
333 hours of laborer attending.
[illegible] hours of rammer.
333 hours of laborer preparing compo and grouting.
One week of foreman.
62½ tons gravel, 12½ tons cement, for compo bed and grouting.
Concrete or pitching for foundation, whatever is decided upon.

The Patching of Macadamized Roads and a Special Type of Roller for Doing the Work.*

The author has pleasure in submitting to the Conference a few remarks on the system he has adopted for the repair of macadamized roads. He has long been of opinion that the systematic repair of roads by patching does not receive the attention its importance demands, and simple as the operation is, and notwithstanding its economy, it is not generally carried out in a scientific manner. It will probably not be denied that the patching of a road is desirable, although there may be a difference of opinion as to the extent to which the practice should be carried out. Some authorities appear to be satisfied with repairing holes, which become a source of danger, while others attempt patching by filling up the inequalities with loose material, leaving the traffic to either consolidate it or to scatter it about, according to the state of the weather and the condition of the roads. The author's contention is that the patching of a road should commence immediately it begins to show any appreciable signs of wear, and that it should be regularly and systematically continued up to about the time when it becomes necessary to remacadamize the surface. The result of such a practice is, undoubtedly, not only to maintain a better surface, but to lengthen the periods for re-coating, and consequently, to reduce the cost of maintenance.

The author's experience is that systematic patching generally adds something like 20 per cent additional life to a road. For instance, a road on which patching is not properly carried out, and which usually requires recoating once in five years, will, under the same conditions of traffic, and with systematic patching, last at least six years.

The author believes that the main reason why the patching of roads is neglected is, that it is generally found impracticable with the plant available. It was certainly so in his case. He had charge of about 60 miles of macadamized town roads, for which two ordinary 10-ton steam rollers were provided. These rollers were usually employed on re-surfacing, and occasionally upon patching. But proper patching was found to be impracticable, especially during the summer months. Frequently, when it was most needed, the rollers were urgently required for other work; and when they could be spared they were found too unwieldly to properly carry out the repairs. Moreover, it was necessary that a roller should be accompanied by a water van and a horse and cart, and this was costly and inconvenient.

The author came to the conclusion that what was required was a special roller to be used almost entirely for patching purposes. Such a roller it was thought should be as capable of rolling in a patch and leaving it quite uniform with the adjoining surface. It should be small and compact in order to be as little conspicuous in the streets as possible. It should be capable of being quickly and easily reversed, in order that small patches could be consolidated quickly. It should be heavy enough to carry out any work which could be generally done by a 10-ton roller, and at the same time should be capable of being lightened for working on roads, where a heavy roller would be a disadvantage. It should carry at least 200 gallons of water in order to avoid the necessity of a water cart. It should be powerful enough to draw a load of road metal, thus saving team labor, and it should be capable of travelling about six miles an hour, and should be mounted on springs so as to be as noiseless as possible.

All these conditions are embodied in the roller which the author now uses for patching purposes. It is about 12 ft. long and 5 ft. 6 ins. wide over all. The rolling wheel is 3 ft. wide, and can be weighted from about 5 tons to 9 tons, according to the work it is required to do. The driver and two men are employed with the roller, and they are kept almost exclusively engaged on patching. They leave the depot each morning with about three tons of road metal and binding material, and when this is exhausted the roller travels back for a further quantity. It is surprising to find how small a quantity of stone is required to maintain an even surface to a road if the repairs are not neglected. The best time for patching is after a fall of rain, but if the work is to be successful it must be carried out continuously, except of course in frosty weather. When a road about to be patched is in a dry condition, water is sprayed on to the surface from the tank carried by the roller, and the smallest of holes are then detected. Each hole is picked over in order to loosen the old crust. The patching and binding material are then applied, and the patch watered from the roller tank, and well rolled until thoroughly consolidated. The system has proved most economical and is satisfactory from every point of view.

*Paper by J. S. Pickering, Borough Engineer, Cheltenham, read before the Irish Road Congress, held at Dublin, Ireland, April 20-22, 1910.

Concrete Pavement Construction at Mason City, Ia.

During last summer some 6,000 sq. yds. of Portland cement concrete pavement was laid at Mason City, Ia., under specifications prepared by Mr. F. P. Wilson, City Engineer, at a cost to the property owners of $1.26 per sq. yd. This pavement was laid in a number of wide alleys where traffic is very heavy. The pavement stood the severe winter in good shape and is now in first class condition. As a result contracts were let this year for 45,000 sq. yds. of the same kind of pavement, the contract price in this case being $1.25 per sq. yd., this price including 7 ins. of excavation. Plans are also under way in the city engineer's office for about two miles of this pavement to be laid next spring. The prices for material and labor for the 45,000 sq. yds. now under construction are as follows:

Crushed rock delivered on the street ..... $1.35 per cu. yd.
Sand delivered on the street ..... 0.85 per cu. yd.
Cement on the work ..... 1.20 per bbl.
Labor ..... $2.50 per day

The pavement includes a 1:2:5 Portland cement concrete foundation, 5 in. thick after compacting. The specifications require that the concrete for the foundation shall have such a consistency that when rammed the mass will not shake like jelly, but will when struck, compact within the area of the face of the hammer without displacing the material latterly. The concrete is required to be placed immediately in the work and is spread and thoroughly compacted by ramming until free mortar appears on the surface, which is made smooth and parallel to the surface of the finished pavement. No re-tempering of the concrete is permitted and concrete in which the mortar has begun to set is rejected. It is required that extreme care be taken that the sub-grade is kept moist while this concrete is being put in place, and it is further specified that no concrete shall be laid when the temperature at any time during the day or night falls below 35° F. above zero.

The wearing surface is 2 ins. thick, made of 1 part Portland cement and 2 parts of coarse, clean, sharp sand. Before the mortar has begun to set it is finished off to a smooth surface and corrugated. The corrugations in the wearing surface are made at an angle of 90 degrees unto the crub and are 4½ ins. by 9 ins. by ⅜ in. deep. It is required that the corrugations shall present a slightly rounded upper edge and that no sharp corners be left.

An expansion joint 1 in. in width is left next to the curb on each side of the street or alley, also an expansion joint ½ in. in width left every 25 ft. across the pavement at right angles to the curbs. The expansion joints are filled with an asphalt paving filler applied while heated to a temperature of about 400° F. This filler is applied so that the expansion joints are thoroughly filled clear to the top of the surface of the pavement. Care is also taken to make the expansion joints of practically the same width throughout this depth. After the pavement has been completed it is kept sprinkled for one week, or longer, if deemed necessary.

A Comparison of the Specifications for Creosoted Wood Paving Blocks of Fourteen American Cities.

A study of the various specifications for creosoted wood paving blocks now in force in a number of cities of the United States has been made by Mr. C. Marshall Taylor, Chemist of the International Creosoting & Construction Co., of Galveston, Tex. In connection with this investigation a table was prepared giving in a tabulated form the various sub-divisions of each item covered by the specifications of various cities. This table and a brief discussion of the specifications have been published in the form of a paper, and from this paper we have taken the matter that follows:

In studying the specifications Mr. Taylor found that some of the cities were very minute in their details, while others had omitted much that seems essential in a paving specification. It was found that the size of the blocks vary from 3½ to 4 ins. in depth; 3 in. to 4 in. in width and 5 in. to 10 in. in length.

Almost in every instance second growth timber is not allowed. The wood is usually specified to be at least 90 per cent heartwood, but in one case 25 per cent sapwood is allowed. In most cases Southern long leaf yellow pine is the wood usually specified, though Southern black gum, Norway pine and tamarack are allowed in certain instances. When a variety of woods is allowed the specification is made that all the blocks should be of one variety of wood.

Mr. Taylor found that in the specifications the actual treatment of the blocks is not very clearly indicated in most cases, excepting that the seasoning process should not be excessive and should in no way injure the fiber. The quantity of preservative required varies from 16 lbs. to 22 lbs., the average being 20 lbs. Mr. Taylor found that the most of the stress in all the specifications examined indicates that more particular attention has been paid to the quality of the oil. Most of the specifications require this to have a specific gravity of 1.12 at 60° F.; one is lower, being 1.10 at 25° C. The distillation of the oil, states Mr. Taylor, follows the old retort method and consequently is allowable for many variations due to the difference in actual distillation. The specifications usually allow not over 40 per cent to distill over below 315° C.

Nearly all of the specifications call for pure coal tar creosote, and yet require a gravity of approximately 1.12 at 68° F. and also that not more than 35 per cent shall distill over below 315° C. Discussing this part of the specifications, Mr. Taylor states: "Allowing a variation which would exist in distilling an oil by the old retort method and that used by the U. S. Forest Service, it seems impossible to fulfill both the specifications of having a pure coal tar creosote and also of getting the required gravities and distillations as given in the specifications," according to the Forest Service the lowest percentage of distillations of pure creosote oils at 315° is 42 per cent. This discrepancy, states Mr. Taylor, as to the

TABLE SHOWING THE REQUIREMENTS OF VARIOUS CITIES FOR CREOSOTED WOOD PAVING BLOCKS.

CITY	Size of Block	Method of Seasoning.	Lbs. of Oil	Gravity	Distillation Regulations.	Statements Concerning the Oils.	Position of Thermometer in Paving Pitch.	Further Statements Concerning the Oil.	Absorption Test.
Boston	3"x8"	Southern L. L. Pine	20	1.12@68 Fahr.	Not more than 35% over at 315 C. Not more than 50% at 350 C.	Antiseptic Water Proofing	1" above Oil	"Oil is to be free from adulteration, it is not to be mixed with or contain any foreign material."	Not to increase over 3% in weight
Minneapolis	4"x8"x6" 4"x8"x5" 4"x8"x4" 4" deep 3" width 6" to 10" long	Heat and Vacuum.	16	1.12@20 C.	315	Pure, Heavy Creosote Oil from Coal Tar only	1½" above Oil	Shall not contain more than 3% of matter insoluble in "Benzine."	
Philadelphia	3" deep 3" to 4" width 6" to 10" long 3" deep 3" to 4" width 6" to 10" long	Heat and Vacuum.	20	Not given	Not mentioned.	Antiseptic and Water Proof Mixture			Gain not over 3½%
Toledo	3½" deep 3" to 4" width Long, width Vary	Dry Heat or Superheated Steam in Closed Coils.	16	1.10@68° F.	Up to 600° F. shall not lose more than 35%	Antiseptic and Water Proof Mixture	1" above Oil	Absolutely soluble in benzine Pure, Coal Creosote	Gain not over 4%
St. Louis	3½" deep 3" to 4" wide 6" to 10" long	Southern Long Leaf Yellow Pine.	20	1.10@38° C.		Best Grade of Coal Tar Creosote	½" above Oil	Not over 5% Free Carbon	
New York	3½" deep 3" to 4" wide 6" to 10" long	Sou. L. Leaf Yellow Pine, Sou. Black Gum, Norway Pine, Tamarac	20	1.12@68 F.	Not over 35% up to 315 C. Not over 50% up to 350 C.	Antiseptic and Water Proof Mixture	1" above Oil	"The oil is to be free from adulteration."	Gain not over 3½%
Pittsburg	3½" deep 3" to 4" wide 6" to 10" long	Same as New York.	20	1.12@68 F.	Same as New York	Antiseptic and Water Proof Mixture	1" above Oil	"The oil is to be free from adulteration."	Gain not over 3½%
Mobile	3" deep 3" Wide 6" to 8" long	Superheated Steam or Dry Heat.	20	1.12@68° F.	Not over 10% up to 600° F.	Heavy Creosote Product		Absolutely soluble in Benzol	Gain not over 3%
Indianapolis	3"x3"x3"	Superheated Steam and Vacuum.	20	1.12@68 F.	Not over 35% up to 600° F.	Heavy Creosote Product		Above the Oil Absolutely soluble in Benzol	
Des Moines	3½"x11"x6" 3"	Heat and Vacuum.	20	1.12@20 C.		Pure and Heavy Creosoting Oil	½" above Oil	Not more than 3% insoluble in absolute alcohol or "benzine."	
Chicago	Not less than 7 ins. per inch	Sou. L. Leaf Yellow Pine, Tamarac, Southern Black Gum	20	1.10@25° C.		Pure Coal Tar Product free from any adulteration		Not more than 3% insoluble in benzine	
Baltimore	3"x9"x8"	Long Leaf Yellow Pine or Black Gum	20-22	Not given.	Not more than 5% tar or 5% carbolic acid	Antiseptic and Water Proof Mixture		Shall not contain more than 5% tar or 5% carbolic acid	Gain not over 3%
Cincinnati	3½"x3"x6"-8"	Southern Long Leaf Yellow Pine	Dry Heat of Superheated Steam in Closed Coils and Vacuum	20	1.10@68 F.	Not more than 35% up to 315° C.		1" above Oil	The oil must be free from adulteration
Detroit	4"x8"-8"	Long Leaf Yellow Pine							

impossibility of the oil meeting the requirements for distillation also exists for that of gravity. Taking the portion of a creosote oil which comes off at 300° C. Mr. Taylor states that it is evident from figures of the U. S. Forest Service that the greatest majority of the oil of a pure coal tar creosote has a gravity less that of even 1.09, the average being about 1.045. These gravities were taken at 60° C. Reducing the 1.09 gravity down to 15° C. it would have a gravity of 1.126 and that of 1.045 would have a gravity of 1.081.

The accompanying tabulation shows the different specifications of the various cities. In reproducing this table from Mr. Taylor's paper we have left out several subdivisions and have embodied them in the text as follows:

Second growth timber: Not allowed in all the cities except Mobile, where it is specified that the blocks if of record growth must be from live trees. Baltimore did not mention this item in its specifications.

Heartwood: Boston, Minneapolis, Philadelphia, Toledo, New York, Pittsburg, Mobile, Baltimore and Cincinnati specify 90 per cent; St. Louis specifies 75 per cent; Minneapolis does not mention the matter.

Physical properties of the oil: Boston—Liquid at 25° C. No deposit at 22° C. Des Moines—Entirely liquid at 25° C. No deposit at 22 °C. These were the only notes under this subdivision.

Per cent water allowed: Two references in the table: Minneapolis, 2 per cent; St. Louis, 3 per cent.

Remarks: Minneapolis—Correction is made for emergent stem of thermometer; Des Moines—Gravity of residue above 600° F. to be over 1.15.

Cost of Earth Road Maintenance With the King Road Drag.—The following data on the maintenance of earth roads by the use of the King road drag was given in the report of the Committee on Roads and Pavements of the Iowa Engineering Society. The committee gave the information in the form of a report from Mr. P. Ransom, of Owasa, Iowa, who, it is stated, has perhaps as efficient a township organization for dragging roads as any man in the state of Iowa. His report verbatim is as follows: "I have had charge of the road work in this township for six years and in the spring of 1906 I organized the farmers to drag roads on stations whereby I could call them up by 'phone and start each one out with the drag at the same time all over the township. We have steadily followed this plan up to the present time, dragging our roads after every bad storm, with the gratifying results of having nice smooth roads at an average cost per year as follows: In 1906-7-8, about $4 per mile. In 1909 it was $6. The cost varies of course according to seasons. By dragging our roads regularly we keep them well crowned, which turns the water off into the side ditches on the hills and grades alike, while under the old system of grading our roads a little once a year without maintenance, the water washed deep ruts in the wheel tracks down the hills, and the grades became flat and gullied out so they would hold water instead of shedding it. I believe the road drag not only to be a very economical maintainer of dirt roads, but a great money saver in the long run if proper planning and preparation by grading goes in advance of it. For example, in the spring of 1906 we built numerous new grades which have been maintained with the road drag only since then, and are in fine condition and well crowned; we have built new grades every year since and the drag is taking care of them. Our intention is to continue this plan till every rod of road in the township is graded to completion, and I firmly believe with but few exceptions, road dragging will be the only maintenance necessary thereafter. By past experience of four years, I estimate the cost of maintaining our roads with the drag after they are all graded, to be $5.00 per mile for each year. Our tax levy for road funds being about $20 per mile, it can be readily seen that we would enjoy a saving of $15 per mile over the old system, except in the matter of culverts and drainage."

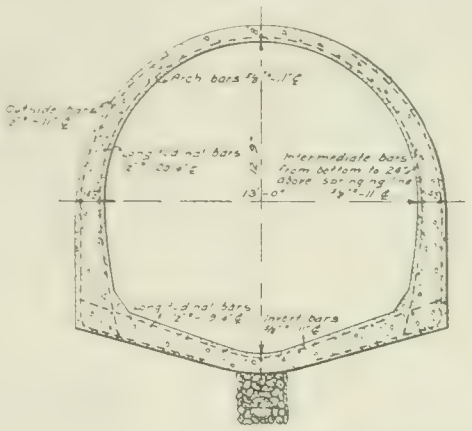
Water-works and Sewer Section

Note: This section is devoted to methods and costs of constructing sewers and water-works. It will cover the construction work for all details of water supply and sewerage, including sewage purification and water filtration.

Details of the Design of the Sewers of Louisville, Ky.

In ENGINEERING-CONTRACTING, June 8, 1910, was published a general outline of the scheme and purposes of the new system of sewers now under construction in Louisville. In this article are shown some of the details of the design, which are in some cases original with this new system, and which in all cases are interesting to study, inasmuch as modern design of sewers is here illustrated in a great many branches.

Sewers.—In the design of all combined sewers and storm-water drains, the quantity of storm water which will reach the sewer has been estimated by the McMath formula. This



13'-0" SECTION.

Fig. 1—Horseshoe Type of Concrete Sewer.

formula as originally constructed was based upon the observed flows of storm water in the sewers of St. Louis, and is used as being the formula apparently best adapted to the conditions in Louisville. It takes into account the maximum rate of rainfall to be provided for (which has been assumed to be 2.25 ins. per hour), the average slope of the territory drained, and the proportion of rainfall reaching the sewers as influenced by the amount of pavement and impervious territory within the tributary basin. The average slope was assumed in most cases to be 4 ft. per thousand. In the eastern portion of the city where there are steep slopes, this factor was materially increased. The factor depending upon the impervious area varied from 0.4 to 0.75. In addition to storm water an allowance was made for .016 cu. ft. per second for sewage and ground water.

For the determination of the sizes of sewers, Kutter's Formula was used, and a coefficient of 0.013 was adopted as being conservative for the smooth concrete channels. The required size of a sewer depends somewhat upon the smoothness of the interior surface and because of the smooth finish possible by the use of concrete this material is particularly favorable for this class of structures. A further argument in favor of the use of concrete is the fact that it is much less expensive than brick or stone masonry. It is also possible because of the building of monolithic structures, to vary the thickness of walls in a way which cannot be done with brick or stone masonry because of the fixed dimensions of the blocks, and thus reduce slightly the thickness where not required and increase it where needed. In this way an additional reduction in expense is effected by reducing the quantity of masonry required per lineal foot of sewer.

The only serious danger in the use of concrete is that it may be affected by acid in the sewage. Fresh sewage is normally alkaline and practically the only source of acid is the waste liquors from manufacturing establishments. A careful examination was made of the sewage in various sewers about the city and of wastes from many manufacturing establishments. As a result of these investigations it was decided that it was perfectly safe to use concrete in the construction of the sewer system and its use was, therefore, adopted.

In certain places where the velocity of flow in the sewers will be great, the bottom or invert of the concrete sewers has been lined with vitrified brick masonry, at additional expense, on account of its superior wearing qualities and the size has been increased to correspond with the increased roughness of the interior surface.

The concrete has been composed almost wholly of sand and gravel dredged from the Ohio River, although in some localities it has been possible to use sand from the trenches. The contract specifications do not permit the use of broken limestone as a constituent part of the concrete. The reason for excluding the use of limestone, which is very common and comparatively inexpensive in this locality, is that it cannot withstand erosive action as well as the river gravel. Comparative tests of concrete containing river gravel and broken limestone were made very early in the studies upon the sewer system, and it was found that while the concrete composed in part of river gravel would wear as well as, and in many cases better than ordinary sewer brick, the concrete made of broken limestone would not withstand the abrasive tests nearly as well. Some gravel has been obtained from the sewer trenches which was of proper size for use in the concrete, but in some cases the pebbles were so soft and friable that they could be broken between the fingers and many were also partially disintegrated. The use of gravel from the trenches was finally discontinued.

The minimum thickness of concrete used upon the sewers and drains is 5 ins. at the crown of the arch and 6 ins. in the center of the invert. In reinforced structures the steel

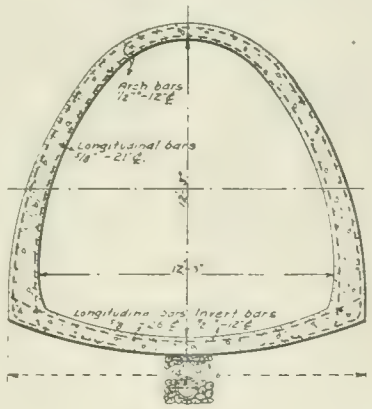


Fig. 2—Semi-Elliptical Section of Concrete Sewer.

reinforcement is required to be at least 1½ ins., but is rarely more than 2 ins. from the surface of the concrete. Plain concrete has been used in sizes up to and including 66 ins. and reinforced concrete in the structures as small as 39 ins. in diameter, the decision as to which material should be used depending upon the foundations, depth of cut, convenience in placing, and other local conditions.

Typical sections of combined sewers of the separate system, and of sewer in tunnel construction are shown by Figs. 1 to 4. The shapes are of the horseshoe and the semi-elliptical types in concrete sewers. The semi-elliptical type is so named because it is a slight variation from the horseshoe type and is narrow at the top of the arch and very broad at the invert. The advantage of this is to allow room for better backfilling, and provide a greater stability against vertical loads than is afforded by the horseshoe type.

Outlet Structures.—In fixing the elevation of

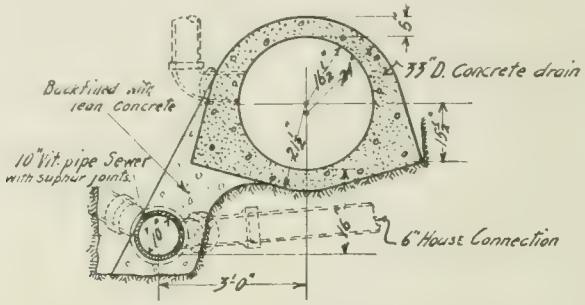


Fig. 3—Typical Section of Separate System.

the outlets in all cases the intention has been to empty the sewage under the surface of the river. The establishment of a 9-ft. depth of water in the Ohio River, as fixed by the Government's movable dams, has made possible the fixing of the outlets and the accomplishment of the above purpose.

The banks of the river at the outlets for both the Southern Outfall and the Northwestern Trunk sewers is high and steep and the designs for the drop chambers and outlet structures are similar.

Figure 5 shows the profile and sections of this structure. At these places there has been a strong tendency of the river bank to move towards the river after the falling of the water in the late spring or summer. The bank is composed largely of silt, which becomes saturated when the river is high, and when wet it is very heavy and has little stability. Underlying the silt is a bed of coarse sand and gravel, through which large quantities of water are continually flowing toward the river. The action of this water at the surface of the gravel probably tends to assist the sliding action of the silt above. In anticipation of any such action and consequent effect upon the sewer at its outlet, the foundaton was carried down to bed rock. For a short distance, 15 ft., the rock was excavated for a depth of 4 or 5 ft. and the foundation carried to this depth, thus forming a key to further guard against any movement.

The drop chamber was built upon piles to assist in resisting any possible movement, as well as to support the structure in case by any chance it should be undermined by the action of the river. These piles extend to the rock, where it was within 20 ft. below the masonry, and 20 ft. into the ground further up the bank, in all cases penetrating a long distance into the gravel underlying the silt.

The outlet structure is 8 ft. in width and 8 ft. high, having a semi-circular arch, vertical side walls, nearly three ft. in height, and a comparatively flat but curved invert. At the end of this structure, two wing-walls were built, projecting out into the river, each making an angle of 45° with the axis of the sewer. The drop chamber is provided with arch, short side walls and invert of the same dimensions as those of the outlet structure. In the center of the invert, however, there is a channel 3 ft. wide and 2 ft. 10 ins. deep, the bottom of which is lined with half-round vitrified sewer pipe. This channel is provided for the dry weather flow, which will have a very high velocity. The vitrified pipe lining was used rather than vitrified brick because of the absence of longitudinal joints at which sewer inverts on steep grades usually show the greatest amount of erosion, and for its great wearing qualities. The beam on each side of this channel will make inspections of the structure practicable. On account of the high velocities which will be obtained during the lower stages of the river, both of these portions have been lined with brick as high as the spring of the arch.

At the Northwestern Trunk Sewer the outlet chamber is founded on caissons carried to solid rock.

The Beargrass Intercepter outlet and the 34th Street Outlet are of somewhat similar design. The latter outlet is merely a new outlet replacing an old one for an existing sewer. The concrete foundations of the outlet chamber are carried into the rock and keyed there to prevent possible movement. Piles are used for the balance of the sewer foundations to a point where solid ground is encountered. Figure 6 shows the 34th Street Outlet. A good idea of the location of the mouth under the water surface is given by the contours in the figure. The section of the outlet was widened and made lower so that no interference with navigation would be possible on account of the existence of the sewer.

Junction Chambers.—A typical junction chamber is shown by Figs. 7, 8 and 9. In all junction chambers, the top or crown of the sewer is carried continuously and the bottom or invert is raised in amount equal to the difference of the vertical diameters of the adjoining sewers. All branch sewers are so designed that their crowns near the junction shall be at the same elevation as the crown of

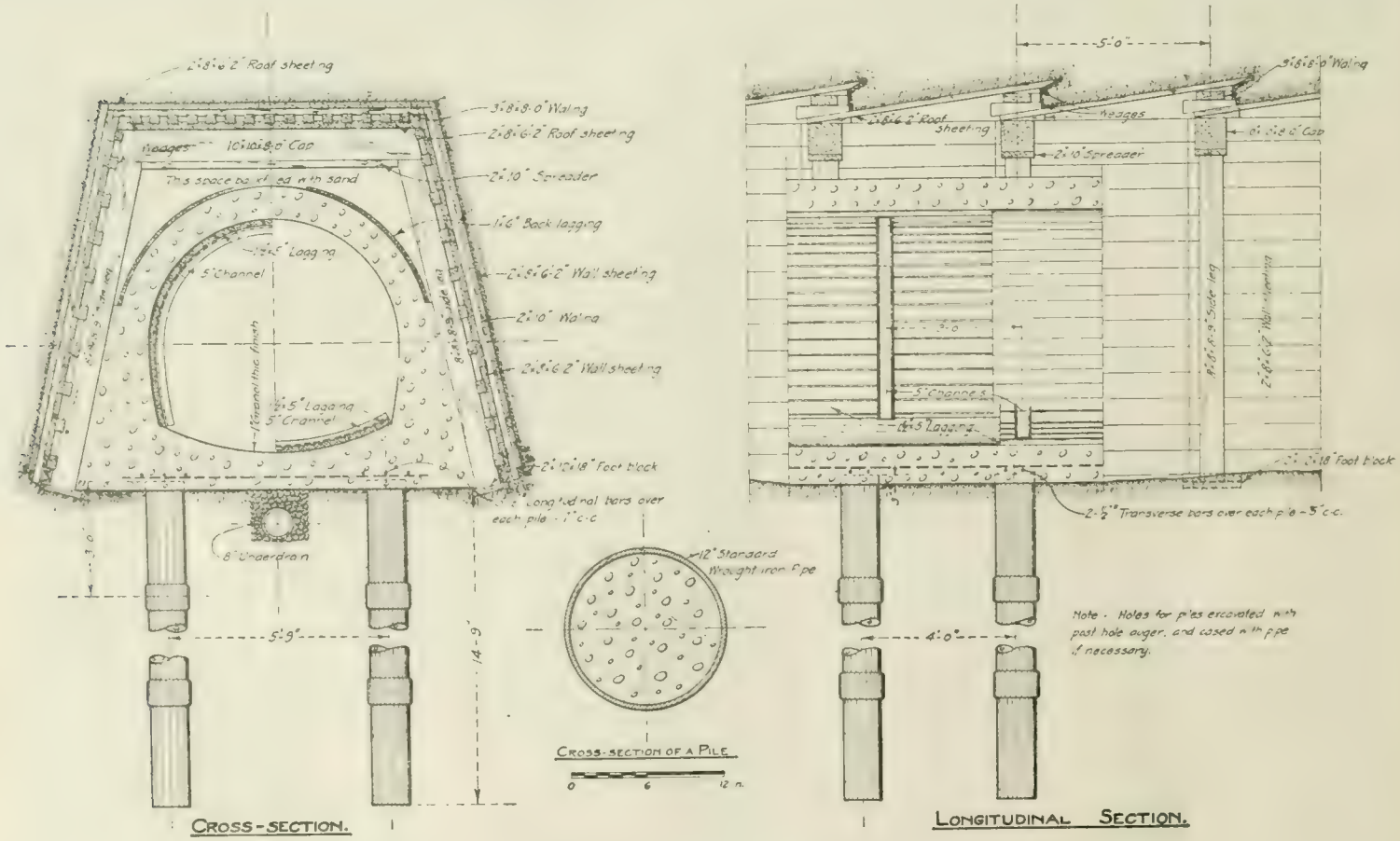

Cross-section.
Longitudinal Section.
Cross-section of a Pile
12" Standard Wrought Iron Pipe
8" Underdrain
Note. Holes for piles excavated with post hole auger, and cased with pipe if necessary.

Fig. 4—Section of Sewer in Tunnel Construction.

the main or trunk sewer, but where necessary the branch sewers for a short distance pitch down nearly to the bottom of the trunk sewer, so that the sewage may be admitted without undue disturbance.

Inverted Syphons.—There are two cases in which trunk sewers are carried under Bear-

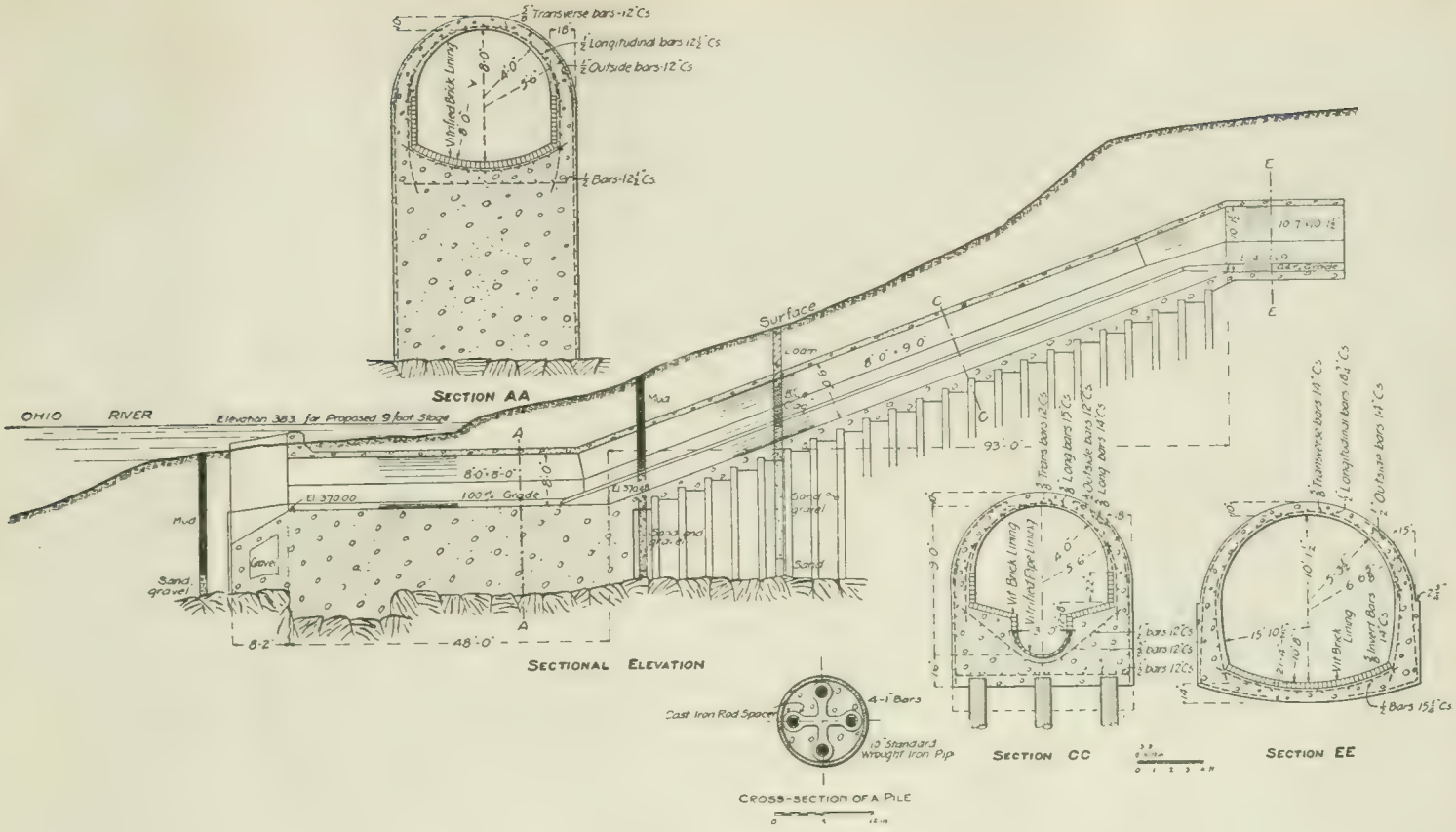


Fig. 5—Details of Outlet Structure—Southern Outfall Sewer.

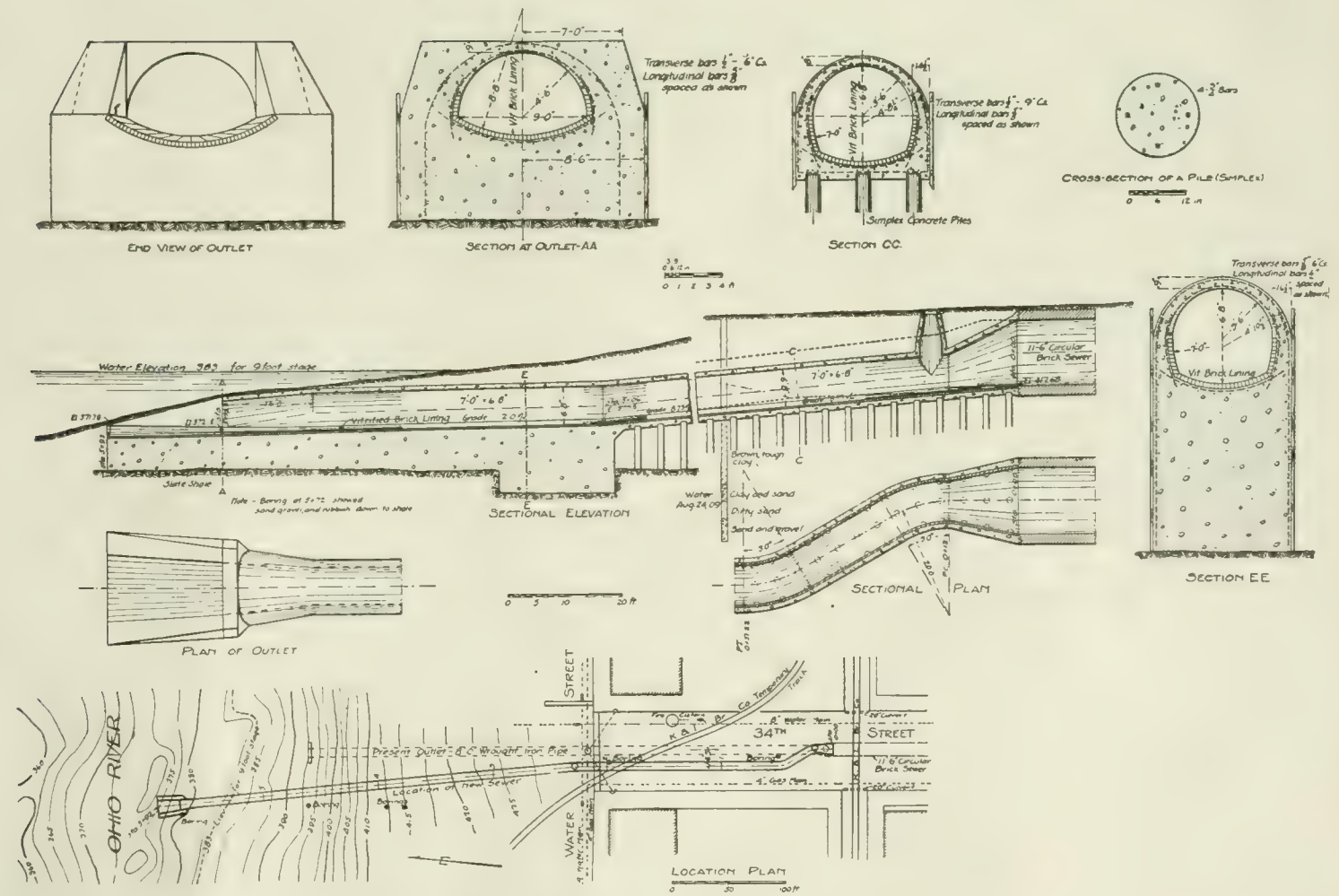


Fig. 5—Details of 34th Street Outlet.

grass Creek by means of inverted syphons. It should be noted that here the design of the syphons has been with the idea of intensifying the flow, or increasing the velocity by using a number of smaller pipes. The areas of all pipes being taken together would provide for

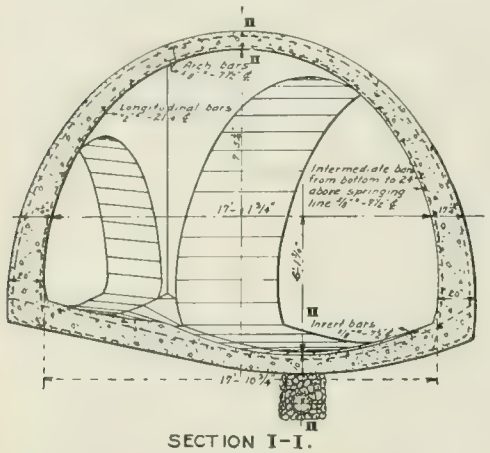


Fig. 7—Transverse Section of Junction Chamber.

the full capacity of the sewer proper; but provision is also made in this way to use only the number of pipes required for different quantities of sewage.

The Northeastern Trunk Sewer is carried under the creek and the levee embankment in the form of a syphon, shown by Fig. 10. The sewer, 48 ins. in diameter, is replaced for a distance of about 800 ft. by the syphon which is composed of three pipes, two or which are 30 ins. and one 18 ins. in diameter. These are vitrified clay pipes incased in a generous amount of concrete. At the eastern or inlet end of the siphon there is a chamber into which the sewage will flow and from which it may enter the siphon pipes. The arrangement is such that any one, two or all of the pipes may be put in service according to the quantity of sewage flowing. It is intended that the entire flow shall be confined to the 18-in. pipe as long as the quantity of sewage does not exceed its capacity. When this quantity is exceeded one of the 30-in. pipes will be substituted for the 18-in. pipe. In this way only such pipes will be in use as are required to carry the quantity of sewage flowing, changes being made from time to time to correspond with the increase in flow due to the growth of the city. The entrance to each pipe is controlled by a sluice gate set in the masonry and also by stop planks and overflow chambers so that in case of emergency the sewage will flow automatically into a second or third pipe when the one in use is overcharged. Provision is also made to allow an automatic overflow into Beargrass Creek. If at any time the siphon is out of order or if it needs repairs or cleaning, the entire flow may, for a short time, be turned into the creek by a special 30-in. conduit. A concrete gate-house is built over this chamber from which the various gates of the siphon may be opened and closed.

At the outlet or western end of the siphon there is a special chamber in which any or all of the pipes may be closed by means of stop planks. Just west of the creek and at the lowest point of the siphon a third chamber is provided for the purpose of draining and cleaning any of the pipes. Each pipe is so arranged that a section 4 ft. long may be removed after the sewage has been emptied into a sump and pumped out into the creek. From this chamber the siphon can be thoroughly cleaned in either direction to the inlet or outlet chambers.

Figure 11 shows the cast iron pipe used to carry the Middle Fork sewer under Beargrass Creek to its junction with the Beargrass Interceptor. This structure consists of two 12-in. pipes carried under the creek with the same invert grade as that of the sewer. In addition to these there is provided a 36-in. iron pipe dipping down from the grade of the sewer beneath the bottom of the creek. This pipe will act as an inverted siphon but will not be put into use until the flow in the sewer exceeds the combined capacity of the two 12-in. pipes. At each end of this semi-siphon there is a concrete chamber giving access to the sewer to facilitate cleaning when found to be necessary. There is also provided an emergency outlet into the creek through which the sewage may be turned when the siphon is being cleaned or repaired. A sluice gate provided in the westerly chamber also makes it possible to shut off any back water from the Beargrass Intercepter at such times. The three pipes are surrounded by concrete, the top of which is coincident with the bottom of the concrete invert channel of the creek when it is improved.

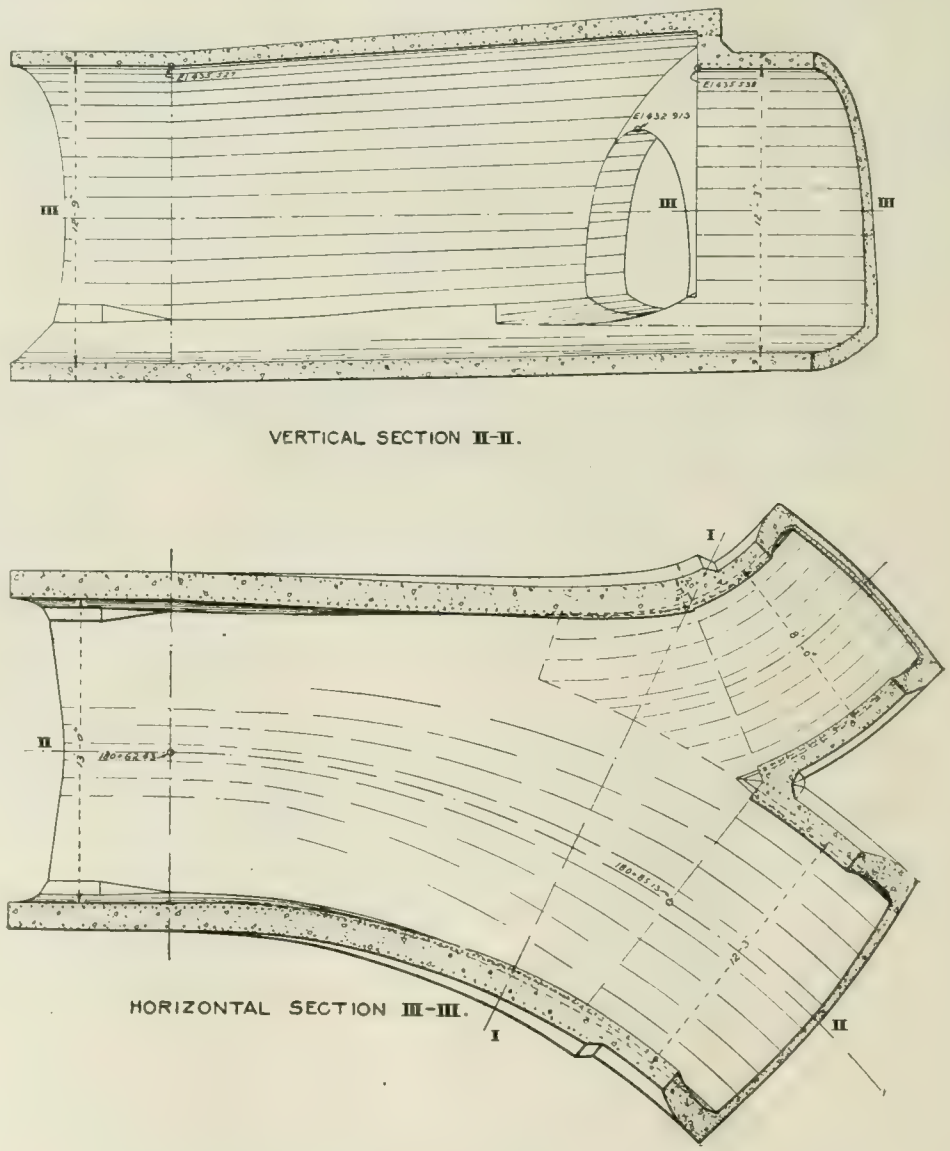
Several small inverted syphons pass under Beargrass Creek, carrying combined sewage and storm water to the Beargrass Intercepter. An arrangement is made, by means of a floating hollow sphere attached to a lever which operates a small gate, to shut off the flow to the Intercepter whenever the capacity of that sewer is being too severely taxed. In such case the sewage, instead of passing through the siphon, overflows through another pipe directly into the creek.

Drain and Sewer Design.—One of the unique designs is that of the Northeastern Trunk Sewer, where it lies along the old bed of Beargrass Creek. This creek has now been diverted into a cutoff channel and although the sewage flows in the same direction as the creek formerly flowed, the storm water drainage is required to flow from the district in the opposite direction. In providing for these conditions the sewer was designed and built as a double decked affair, shown by Fig. 12. This method of construction proved particularly advantageous because the bearing power of the soil in this vicinity is low, and either structure, built separately, would require a pile foundation. By combining the two structures in one, only a single pile foundation was necessary. The sewer is placed over the drain and the two are separated by a chamber which is very low at the upper end but which gradually increases in height, due to the difference in grade and elevation of the two chambers. The elevation of the invert of the sewer is near the surface of the ground nearly the entire distance.

Manholes.—Figure 12 shows a typical manhole for the sewer and drain described above, including the entire section of the structure. This manhole serves as an entrance to the drain only, and Fig. 13 shows the type used for entrance to the sewer. In this manhole it is necessary to provide a tight cover, as shown, to prevent the floods of the Ohio River from submerging the land behind the levee by passing through the sewers and overflowing at the manholes. The immediate district wherein these tight manholes are used is so low that no connections to the sewer have been provided for, and so there is no other outlet at which the floods in the river might overflow.

The double manholes shown by Fig. 14 are used in connection with the separate system of the Northeastern section.

Sulphur Joints.—A large part of the separate system is built of vitrified pipe. The drain pipe have joints of Portland cement, while the sewers are made with sand and sulphur joints in order to prevent, as far as possible, the admission of ground water, and this reserve as far as possible the full capacity of the



Figs. 8-9—Longitudinal Sections of a Concrete Sewer Junction Chamber.

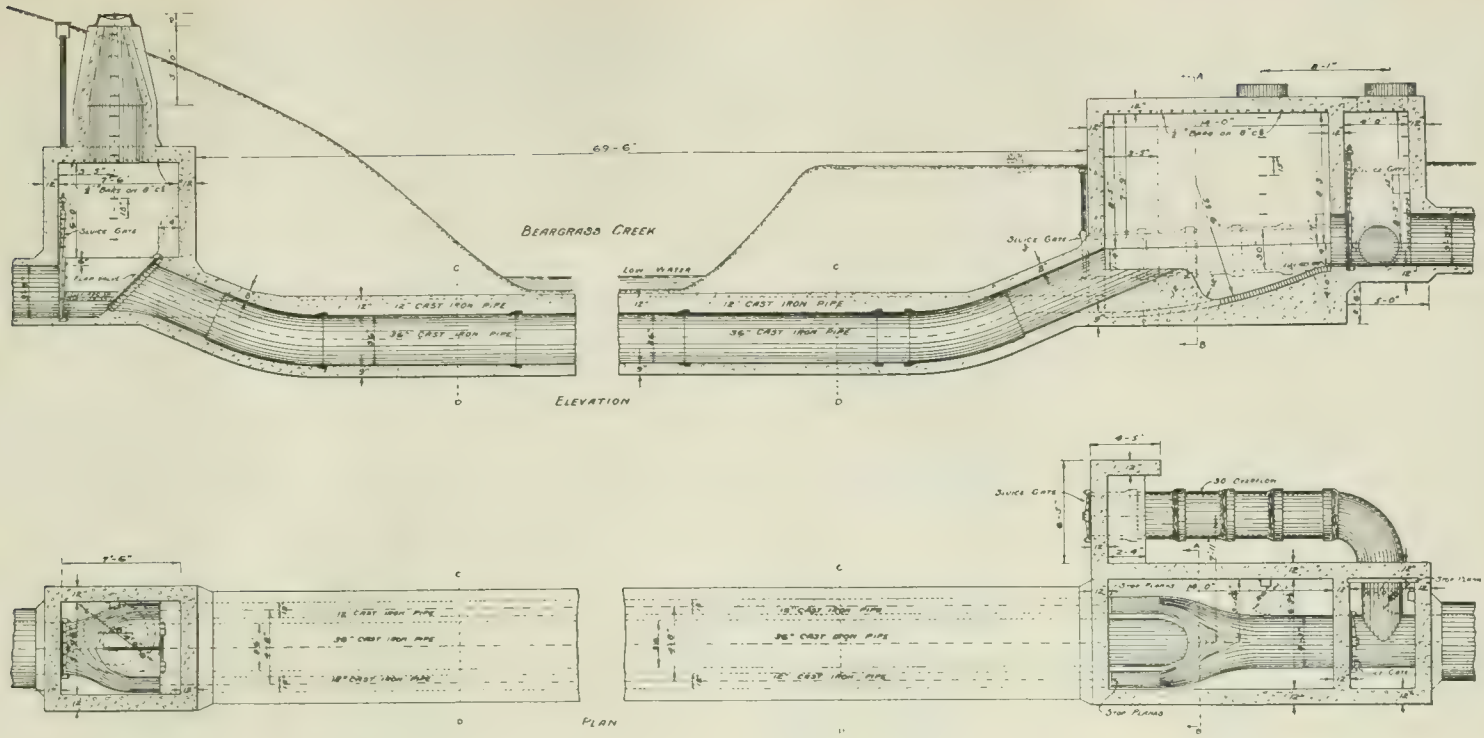


Fig. 10—Syphon Carrying Middle Fork Sewer Under Beargrass Creek.

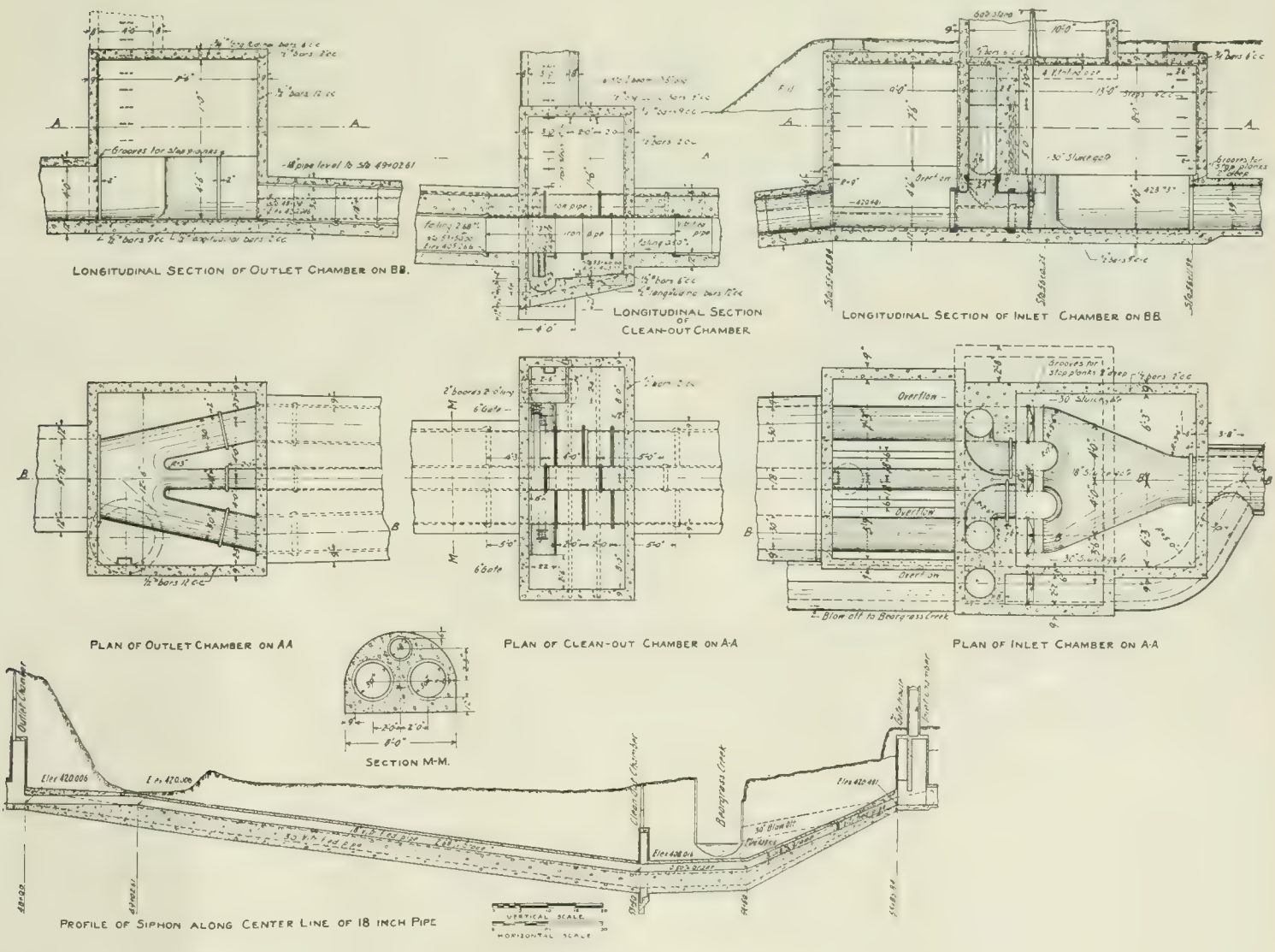

LONGITUDINAL SECTION OF OUTLET CHAMBER ON BB.
LONGITUDINAL SECTION OF CLEAN-OUT CHAMBER
LONGITUDINAL SECTION OF INLET CHAMBER ON BB
PLAN OF OUTLET CHAMBER ON AA
PLAN OF CLEAN-OUT CHAMBER ON A-A
PLAN OF INLET CHAMBER ON A-A
SECTION M-M.
PROFILE OF SIPHON ALONG CENTER LINE OF 18 INCH PIPE

Fig. 11—Syphon Carrying Northeastern Trunk Sewer Under Beargrass Creek.

sewers for house sewage. In the beginning of the work a mixture of sulphur and sand in equal parts was tried, a very fine molding sand from a local pit being used. From the first this mixture gave trouble, several radial cracks appearing on each joint as soon as the joint was poured, indicating excessive shrinkage of the mixture. It was also found that about twelve hours after pouring, the entire joint loosened, permitting the easy separation of pipes. All materials and methods used were then subjected to careful examination.

The sand used contained a considerable percentage of clay and was therefore washed, by which process a large portion of the clay was removed. Using the washed sand and the utmost care in making joints gave no better results than before. Finally, sand of about the same grade as that already in use, but with less clay in it, was obtained from the same local pit. To ascertain what sands were best adapted to this work, test joints were poured, as follows: Using (1) Molding sand containing little clay, 10 parts to 10 parts sulphur; (2) Ohio River sand, screened through No. 20 sieve, 10 parts to 10 parts sulphur. (3) Molding sand 6 parts to 4 parts screened Ohio River sand and ten parts sulphur.

The last named mixture gave the best results, there being in it as much Ohio River sand (screened through No. 20 sieve) as could be carried in suspension in the fluid mixture.

Further experiments have been made on other contracts by varying the proportions of sand and sulphur and also the proportion of the two grades of sand. These experiments have confirmed the results of the former tests, i. e., that with local materials the mixture composed of six parts molding sand, 4 parts Ohio River sand screened through No. 20 sieve, and 10 parts sulphur gives best results. With this mixture the loosening of the points has entirely disappeared and radial checks occur only very rarely and do not appeal to allow the ground water to enter the sewer.

In making these joints three or four lengths of pipe were placed in a wooden cradle located on the surface of the ground, carefully fitted together, lined up and calked with jute, the pipe at one end of the cradle being so braced that these pipes could be forced firmly together by wedging, before the joints were made. "Pipe jointers," made of square, braided asbestos, were then so placed around the pipes at each joint and fastened, as to prevent the liquid from running out of the bells. After these jointers were secured in place, the joints were poured.

Some care is required to regulate the temperature of the sulphur-sand mixture because while it begins to melt at a temperature of about 200° F. and becomes thin and suitable for pouring at about 260°, if the temperature is allowed to rise more than 25° to 40° higher, it again becomes thick and plastic, in which condition it cannot be poured. The facts are shown clearly by the following tabulation:

Physical Condition of Sulphur and Sulphur-Sand Mixtures at Different Temperatures.

Condition.	Temperature Fahr. Sulphur.	Sulphur-Sand.
Began to melt	176°	201°
Fluid	212°	261°
Slightly vicid	234°	302°
Would not pour	248°	315°

It is interesting to note to what extent the admixture of sand with sulphur affects the temperatures at which it changes its condition.

After pouring, the mixture hardens very rapidly so that an interval of time of perhaps one minute the asbestos jointers can be removed. While the jointing mixture is still warm it is coated with hot tar pitch as a further safeguard against leakage. Within five minutes after the joints are poured the entire length of three or four pipes, as the case may be, can be removed from the cradle and placed in position in the trenth. Although the joints attain an almost incredible strength in this short interval of time, care must be exercised in moving the pipe so that the joints and bells of the pipe shall not be unnecessarily strained.

The joints between sections of pipe were poured in the trench. When water was encountered in the work, care was taken to hold its level below the pipe joints. Otherwise the liquid mixture skipped the portion of the joint submerged in water.

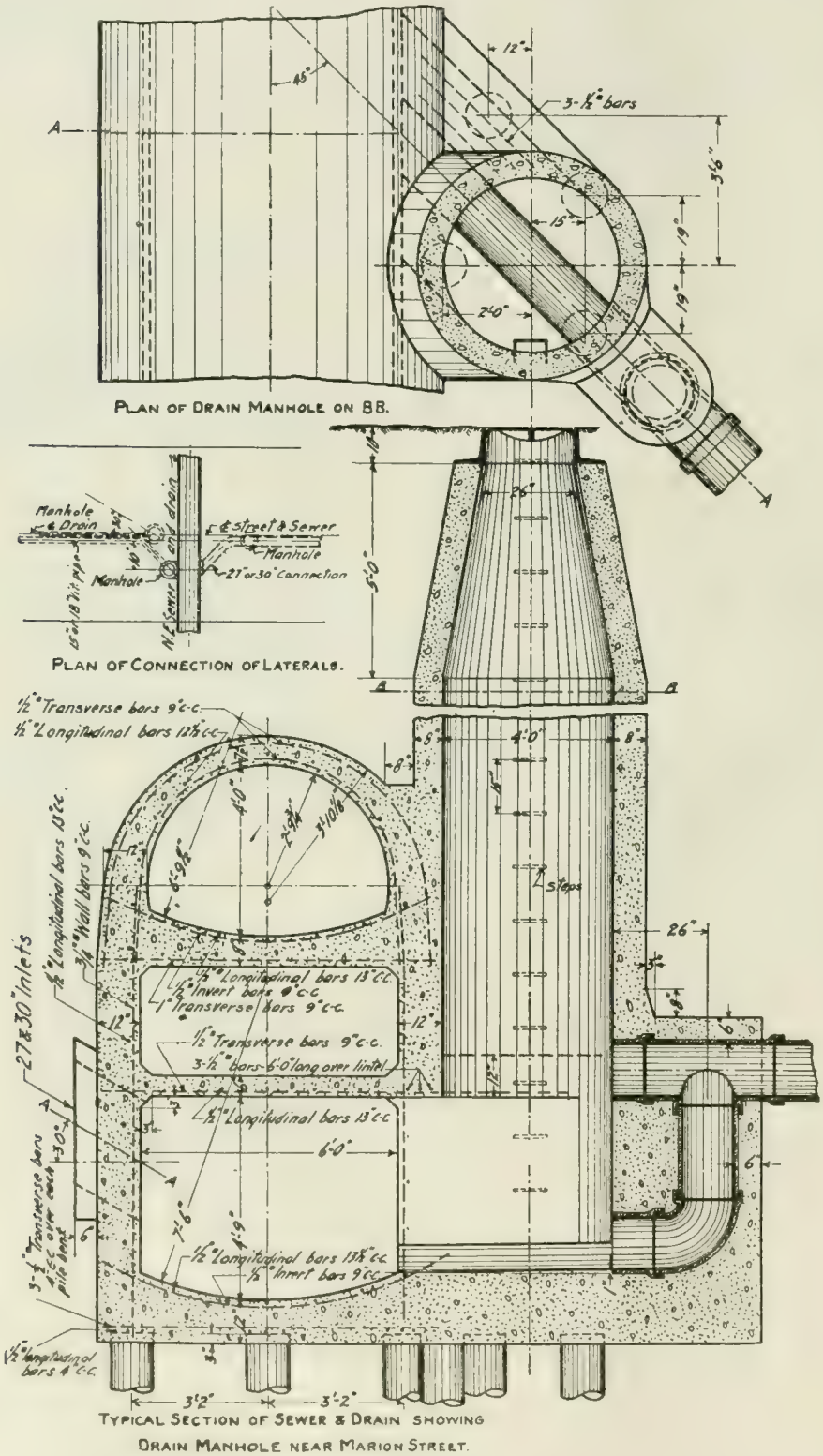

PLAN OF DRAIN MANHOLE ON BB.
PLAN OF CONNECTION OF LATERALS.
TYPICAL SECTION OF SEWER & DRAIN SHOWING DRAIN MANHOLE NEAR MARION STREET.
Steps
Tight manhole

Fig. 12—Section Showing Sewer and Drain on One Pile Foundation, with Drain Manhole.

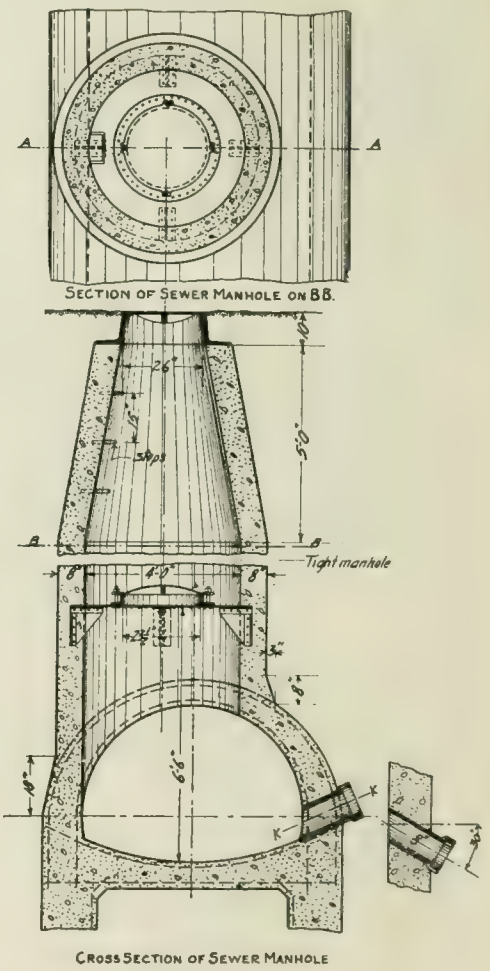


Fig. 13—Sewer Manhole for Sewer as in Fig. 12, Showing Water-tight Cover Inside of Manhole.

This method of jointing pipe aids materially in the inspection of the work, since perhaps three-fourths of the joints are made on the ground surface, where they are readily accessible. The larger proportion of the work of pipe jointing which can be performed on the surface of the ground regardless of conditions in the trench has, in many instances, tended toward better progress and economical work.

Experience has proved that a total length of 8 or 9 ft. of pipe on the cradle was most satisfactory. In other words, when 2 ft. lengths of pipe were used four pieces of pipe, and when in 3-ft. lengths only three pieces could be advantageously jointed at one operation. After a fair trial of make-shift jointers, it was decided that an asbestos jointer, with spring clamp, facilitated the work and gave best results. A substantially built cradle, with the templets holding the pipes accurately placed as to line, was found to be both necessary and economical. Coal heaters, copper kettles and generous sized ladles all tended to better work and progress.

Good briquettes made of sulphur and sand of the proportions used on the work, showed a tensile strength of from 520 to 640 lbs. per sq. in.

About two years' work remains before the completion of the system, as outlined, can be accomplished.

Further articles will take up some features of the construction work, and the proposed improvement of Beargrass Creek. Among those to whom we acknowledge indebtedness for information in preparing this article are Mr. Harrison P. Eddy, Consulting Engineer; Mr. J. B. F. Breed, Chief Engineer; Mr. J. H. Kimball, Designing Engineer, and Messrs. F. C. Williams, H. P. Wires and H. S. Morse, Resident Engineers.

At the annual meeting of the stockholders of the Statesville Air Line R. R., at Statesville, N. C., it was decided to have work started soon on the proposed line from Statesville to Mt. Airy, N. C. The line will be 60 miles long and $357,000 of bonds have been voted towards its construction. D. M. Ausley is interested.

The Northern Pacific Ry. Co. has secured a strip of land 3,500 ft. long and 500 ft. wide, doubling the holding of the company at that point between East Seventh street and a point near Plum and Commercial street, where Dayton's Bluff draws near the Northern Pacific's old property, in St. Paul, Minn. The newly acquired property will be used for freight terminals.

Keeping a complete record of the cost to the contractor of constructing the Hudson River Tunnels of the Pennsylvania R. R. at New York City cost the company $12,000 for salaries for recording clerks.

The Pittsburg Trust Co., of Pittsburg, Pa., through Judge Edward A. Mann, is reported to have filed in the District Court at Santa Fe, N. Mex., a complaint against the New Mexico Central R. R. Co. to foreclose the mortgage given to secure an issue of $2,000,000 in bonds and asking for a receiver to sell the property in its entirety. This road extends from Santa Fe to Torrance, 116 miles, and the action is reported to be preliminary to extensions of the line.

The Nebraska & Dakota Ry. Co., incorporated with a capital stock of $500,000 and headquarters at Pierre, S. Dak., and a business office at Chicago, Ill., proposes a line to run from Murdo, S. Dak., to Burwell, Neb., in the counties of Lyman, Mellette, Todd and Tripp, South Dakota, and Rock Loup and Garfield in Nebraska, a distance of 180 miles. The incorporators include: Albert Martin, B. McWilliams, Paul Miller, J. H. Christensen, Samuel C. Ware, Charles J. Reublings of Chicago, and L. L. Stephens, Pierre, S. D.

Railway Section

Note: This section is devoted to methods and costs of constructing railways. It will cover road-bed and track construction, contractor's plant and organization, surveying methods and permanent way structures.

Gang Organization for Cost of Tracklaying by Machine, Erie R. R.

The following data on tracklaying by machine are given by Mr. C. K. Conrad, Assistant Engineer for the work in the low-grade freight line from Guymard to Highland Mills of the Erie R. R., in the *Railroad Age-Gazette* for June 3, 1910. A Hurley, tracklaying machine was used.

After many trials with fewer men, it was found that the best results were obtained with 50 men, working as follows:

1 General foreman.
1 Foreman.
1 Lineman stretching a light rope at proper offset distance from center line.
2 Tie spacers.
1 Tie marker, placing marks on ties so that center of tie will be set midway between rails.
1 Clamp man, applying hoisting clamp to rails before lowering.
1 Clamp man on ground disengaging hoisting clamp and steadying rail.
8 Spikers, four to each rail.
4 Nippers, two to each rail.
2 Bolters, one to each rail.
1 Assistant working rail conveyor, as rails leave the friction rolls.
1 Bolter, removing bolts as rails leave the roll.
1 Foreman.
1 Watchman (night).
4 Feeding ties to dogs at rear of machine.

7 Total on machine.

2 Breaking out ties.
8 Spacing ties.
1 Watching and guiding ties.

11 Total attending to the ties.

1 At rear hoist.
1 Advancing rails on rollers.
2 Placing angle bars, and one bolt on front end of rail.
2 Bolting to forward rails.
1 Tightening bolts.

1 Total feeding the rail.

1 Clamper, holding angle bars for bolts.
2 Barmen, holding rail to gage.
1 Spike peddler.

25 Total in front of wheels of machine.

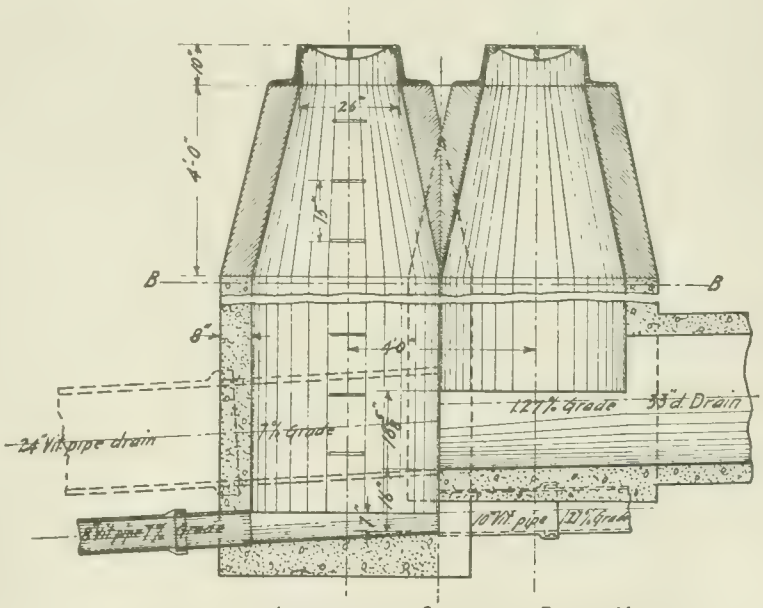
1 Engineer, in charge of the machine.

Cost of Laying Track.—Nearly all of the second track on the Erie & Jersey was laid by hand. As most railway companies are familiar with this cost on their own line, it seems advantageous to compare it with the cost of the first track in order to give a correct idea of what the cost with the machine would be under the same conditions.

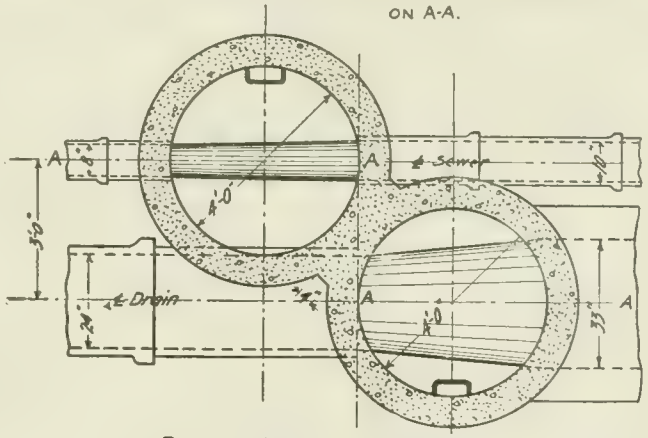
With a machine laying a mile per day the cost was as follows:

Laying Track by Machine.

1 General foreman at $5.00	$ 5.00
1 Engineer at $5.00	5.00



LONGITUDINAL SECTION OF DOUBLE MANHOLE ON A-A.



PLAN OF DOUBLE MANHOLE ON B-B

Fig. 14—Details of Double Manhole on Separate System.

1 Fireman at $2.25		2.25
1 Foreman at $3.50		3.50
50 Laborers at $1.50		75.00
1 Watchman (night), at $2.25		2.25
Machine, coal and oil		3.00
Full bolting and spiking after passage of machine:		
1 General foreman at $5.00	$	5.00
1 Foreman at $3.50		3.50
50 Laborers at $1.50		75.00
Loading materials—ties:		
1 Foreman at $3.00		3.00
35 Laborers at $1.50		52.50
Engine and crew		35.00
Rails and fastenings:		
1 Foreman at $2.00	$ 2.00	
20 Laborers at $1.50	30.00	
Total	$ 32.00	
6,963 lin. ft. of rail and fastenings loaded:		
This gives per mile of track	$ 48.53	
Engine and crew	35.00	
Total rail and fastenings		$ 83.53
Total per mile of track		$380.53
Laying Second Track by Hand.		
Spacing ties, spiking and full bolting 3,000 ft.:		
2 Foremen at $3.00	$ 6.00	
74 Laborers at $1.50	111.00	
Total	$117.00	
Per mile		$205.92
Loading ties:		
1 Foreman at $3.00	$ 3.00	
35 Laborers at $1.50	52.50	
	$55.50	
Unloading ties:		
1 Foreman at $3.00	$ 3.00	
6 Laborers at $1.50	9.00	
	$12.00	
Engine and crew	35.00	
		$102.50
Loading rail and fastenings, same as for machine		$ 48.53
Unloading rail and fastenings:		
2 Foremen at $2.00	$ 4.00	
28 Laborers at $1.50	42.00	
Total	$ 46.00	
Above worked four hours	18.40	18.40
Total per mile of track		$375.53

It should be realized, of course, that these figures do not represent the cost of continuing the work day by day; but they are representative figures for each class of work under similar conditions. The cost of laying the first track of a double track railway by hand is variable, depending largely on the accessibility of the roadbed for teams, as the ties are usually transferred from the tie car to the front by this means. The second track should be laid at a fairly regular cost.

So far as the track laid by machine is concerned, it is not possible at this date to determine which track was so laid. When laying down grade there is a tendency to open the joints. Clips for the proper temperature expansion are a necessity. From the experience with the machine the following may be accepted: (1) On a new line 25 miles long, or more, the machine will prove economical. (2) The track laid with the machine will be as satisfactory as track laid by hand. (3) The organization will be reduced in number by 150 to 200 men. (4) It is feasible to lay one mile of track per day up to a limit of 12 or 15 miles from the supply base. (5) The danger of injury to men is largely reduced.

The Treatment of Depreciation of Street Railway Properties.*

Each street railway corporation in the United States is today in possession of a blank form of the Internal Revenue Bureau, one line of which, under the heading "deductions" from gross income, is as follows:

"5-b. Total amount of depreciation Jan. 1 to Dec. 31, $——."

A footnote states: "The deductions authorized shall include all expense items under the various heads acknowledged as liabilities by the corporation making the return and entered as such on its books from Jan. 1 to Dec. 31 of the year for which the return is made. This form properly filled out and executed must be in the hands of the Collector of Internal Revenue for the district in which is located the principal office of the corporation making the return on or before March 1."

Therefore, the subject of depreciation has been removed from the realm of theory. Heretofore a few states have required returns to be made on this subject through their commissions having jurisdiction, notably the Public Service Commissions of New York and Wisconsin. The Interstate Commerce Commission has required a depreciation charge only by companies the greater part of whose operated mileage is in states where this is required.

Therefore, street railway companies must now decide whether for the year ended Dec. 31, 1909, they will refuse to acknowledge as a liability the amount of current depreciation and in that event possibly cut themselves off from claiming depreciation for this period as a part of the cost of operation in any case of proposed rate regulation, imposition of additional service or limitations of rate of return on capital; or, on the other hand, by adopting a reasonable plan for charging depreciation offer proof that this is a conservatively managed business.

DIVERGENT RULINGS OF PUBLIC AUTHORITIES.

As to what this charge for depreciation should include, there is some divergence in the rulings of the four authorities in question, as follows:

1. The Interstate Commerce Commission provides for electric carriers two accounts called "depreciation of way and structures" and "depreciation of equipment," while for steam railroad companies no charge is required for depreciation with respect to way and structures, but merely for equipment.

2. With regard to the Public Service Commissions of New York it was originally intended that the State railroad commissions having jurisdiction over electric railways would follow the practice adopted by the Interstate Commerce Commission, but these commissions have so enlarged and amplified it as to be in effect a different classification. Thus all replacements under the heading of "way" are to be charged to the proper maintenance accounts and not to the depreciation account. The New York commissions also, as to electric light and gas companies, provide that depreciation is to be charged in operating expenses under general and miscellaneous expenses rather than under maintenance.

The United States and New York commissions, therefore, do not agree as to the policy of charging depreciation as between steam and electric transportation, or as between public utilities frequently under one capitalization.

The Public Service Commissions of New York have under operating expenses two accounts, namely, "depreciation of way and structures" and "depreciation of equipment." They provide that the "amount estimated to be necessary to cover such wear and tear and obsolescence and inadequacy as have accrued during any month shall be based on a rule determined by the accounting corporation." Apparently, they provide that such an account shall cover not only the actual renewals necessitated by complete depreciation, but also the month's accruals of present or incomplete depreciation due both to wear and tear and also to the so-called obsolescence and inadequacy. This double renewal charge is not financially practicable under present rates of fare and has not been forced.

3. The law under which the Wisconsin commission is working seems to be tempered with common sense, recognizing that a difference exists between theory and practice. This law provides that: "Every public utility shall carry a proper and adequate depreciation account whenever the commission, after investigation, shall determine that such depreciation can be reasonably required" * * * and that "the commission shall provide for such depreciation in fixing the rates, tolls and charges to be paid by the public."

Under the uniform classification of accounts of the Wisconsin commission it is provided that: "Every electric railway shall carry a proper and adequate depreciation reserve to cover the full replacement of all tangible capital in service. There shall be opened a depreciation account, to which shall be charged monthly, crediting the depreciation reserve, an amount equal to one-twelfth of the estimated annual depreciation of the tangible capital in service of the railway, or as near that amount as the finances of the property will permit."

As tangible property comprises all land and its improvements, it is conceivable that the intent of the commission is to allow for the appreciation of value of real estate, which seems to be contrary to the orders of the other commissions.

4. The Bureau of United States Internal Revenue, which has in charge the collection of the new corporation tax, apparently treats the subject of depreciation as differentiated between complete depreciation or abandonment or destruction due to obsolescence, inadequacy, age, action of the elements or otherwise, and incomplete or partial depreciation due to wear and tear and obsolescence.

Complete depreciation, unless already charged out under the depreciation account or the maintenance accounts, is provided for apparently under one of the deductions from gross income as follows:

"5 (a). Total amount of loss sustained Jan. 1 to Dec. 31, $——." The definition covering this item is as follows:

"Losses.—The deduction for losses must be in respect of losses actually sustained during the year and not compensated by insurance or otherwise. It must be based upon the difference between the cost value and salvage value of the property or assets, including in the latter value such amount, if any, as has in current or previous years been set aside and deducted from gross income by way of depreciation as defined in the following section and not been paid out in making good such depreciation."

The ruling on "depreciation" provides for the year's accrued or incomplete depreciation due to exhaustion, wear and tear or obsolescence. Complete depreciation due to exhaustion and wear and tear is apparently to be charged under the heading of "expense of maintenance and operation," and complete depreciation due to obsolescence, etc., under the above deduction for losses unless formerly provided for by the depreciation fund. This ruling is as follows:

"Depreciation.—The deduction for depreciation should be the estimated amount of the loss, accrued during the year to which the return relates, in the value of the property in respect of which such deduction is claimed that arises from exhaustion, wear and tear, or obsolescence out of the uses to which the property is put, and which loss has not been made good by payments for ordinary maintenance and repairs deducted under the heading of expenses of maintenance and operation or in the ascertainment of gross income. This estimate should be formed upon the assumed life of the property, its cost value, and its use. Expenses paid in any one year in making good exhaustion, wear and tear, or obsolescence in respect of which any deduction for depreciation is claimed must not be included in the deduction for expense of maintenance and operation of the property or in the ascertainment of gross income, but must be made out of accumulative allowances deducted for depreciation in current and previous years."

This ruling seems to be carefully drawn, although I doubt the propriety or practicability of making an allowance for incomplete or accrued depreciation due to the so-called obsolescence or inadequacy. In the first place, there is no adequate standard for gaging the probable life of any part of the construction or equipment of a street railway, the discarding of which depends on its becoming obsolete or inadequate. A careful distinction should be made between the useful life of the article in question based upon wear and tear or the action of the elements and the useful life before becoming obsolete or inadequate. Wear and action of the elements are dependent upon service and time; obsolescence and inadequacy are dependent upon changes in the art, which may take place within one year or 50 years. Considering the property as a going concern, an article cannot be said to be 50 per cent obsolete by the use of any present standard; it is either obsolete or not obsolete, 100 per cent obsolete or a proper standard. On the other hand, an article can be said to be 50 per cent worn out either by wear and tear or by the action of the elements.

Furthermore, obsolescence and inadequacy usually occur for business or economic rea-

*A paper by Frank R. Ford of Ford, Bacon & Davis, read at the mid-year conference Jan. 26-28 of the American Street and Interurban Railway Association.

sons. The new standard will produce more net profits than the old one, even allowing for interest and depreciation on the new standard, together with interest on the old. If this were not so the old article would not become obsolete. Consequently, from a business standpoint, renewals due to depreciation from obsolescence can be capitalized. In the street railway business the notable examples of obsolescence from a change in the art have been the change from horse to the cable system, and from the cable to electric. From the rates of fare in force it would generally have been impossible to have made these changes out of income, and certainly so with the increased length of ride and use of transfers of today. If a provision had been in force at the time requiring such a change we would probably still be burdened with the older system in the same manner as the city of Edinburgh is today suffering from the operation of its cable system.

From the standpoint of the public, if renewal or change of the whole system due to obsolescence before wearing out has to be charged to income, either the present rates of fare must be raised or the replacement cannot be made. It would appear, therefore, that the publics' interest is thus served by capitalizing such charges, if otherwise not financially practicable.

The very rulings of these public service commissions that obsolescence shall be charged to income has already had the effect of increasing largely the useful life of all physical property and of delaying changes in the art.

Three different policies of providing for the upkeep of physical property out of income may be followed:

1. Charging out when the expenditure is made.

2. Charging out over a period of expenditure, and

3. Accruing in advance of need.

I believe that a combination of these three methods will produce the most satisfactory results and will correspond with the best steam railroad practice of the past 25 years.

Apart from the technicalities of accounting, I think that depreciation should be divided and charged as follows:

1. Complete depreciation.

(a) That due to wear and tear should be charged to proper maintenance accounts.

(b) That due to obsolescence, inadequacy, age or destruction by any cause should be written off from current income or from past accumulations of profit and loss account, if financially practicable, or, if not, such obsolescence or inadequacy should be capitalized.

2. Incomplete depreciation.

(a) That due to wear and tear, if likely to fall due in large amounts at irregular intervals, should be provided for by a depreciation fund.

From a practical standpoint the method which I have used in working out this problem recently for a street railway property operating both on paved streets and private right-of-way, has been as follows, referring to the balance-sheet accounts of the physical property:

Right-of-Way Real Estate.—Appreciation over original cost is estimated to provide partly for depreciation of the intangible propery included in the balance sheet.

Track and Roadway.—Renewal of ties, special work and paving is charged direct to maintenance. To provide for the renewal of rails, including the labor, ballast, joints, ties and paving occasioned by such renewal, there is charged annually to a depreciation fund such an amount as will provide the cost of the renewal when it is made, the remaining life of each section of track construction being estimated.

Electric Line.—Renewal of poles, wire and fixtures is made through maintenance.

Real Estate Used in Operation of Road.—Appreciation over original cost it is estimated will more than provide for depreciation on buildings.

Buildings. — Repairs and renewals are charged to maintenance. Depreciation due to obsolescence or inadequacy will be more than covered usually by appreciation on real estate; if not, upon discarding the building any net depreciation should, where financially practicable, be written off.

Investment Real Estate.—Appreciation is estimated to provide partly for depreciation of intangible property.

Power-Plant Equipment.—Renewal necessitated by wear and tear is provided for from maintenance. Any articles retired through age or inadequacy should, where financially practicable, be written off.

Shop Tools and Machinery.—Renewals are made from maintenance. An annual inventory is taken and book values increased or decreased accordingly.

Cars, Including Electrical Equipment.—Physical wear and tear are provided for from maintenance. Any car or class of cars upon being retired should be written off, where financially practicable, unless provided for by car equipment trust or other sinking fund.

The depreciation fund should be available in cash when needed. With this in mind, it may be invested in the company's salable securities and in some cases in additions to property.

The depreciation fund is essentially a financial problem, the solution of which is apparently by law left to the directors of the corporation, as they are empowered to determine the amount of current income to be set aside for working capital and the amount of dividends to be declared. It is questionable if utilities commissions can lawfully impose rules for the charging of depreciation in cases where the physical property is fairly maintained and securities properly issued. I believe that no hard and fast rule can be laid down for charging a fixed amount to such a fund month by month or year by year; the proper amount to be charged should be known, and if in lean years this amount is not laid aside, in prosperous years the deficiency should be made up. It might even be necessary to use this fund for other purposes than renewal of physical property, due to business contingencies unforeseen.

This program, I believe, will provide for the upkeep of the physical property until another change in the system occurs, such as from the cable to electric, if it ever does.

For the company mentioned, to which we have applied this policy of charging depreciation, I find that it results in a charge to depreciation fund of about 3 per cent of the gross earnings in addition to charges for renewals in the maintenance account, which, with current repairs, usually average about 10 per cent of the gross earnings, making a total of 13 per cent, to which must be added the amount written off for the abandonment of property due to obsolescence or otherwise, so that the total would probably be 15 per cent of gross earnings. The proper amount to be charged to a depreciation fund varies with every property, and should be carefully estimated as a factor of the physical cost, although it has been here stated, for convenience, as a factor of the gross earnings.

On the other hand, the theoretical depreciation fund arrived at by guessing at obsolescence and assuming a given life for each article of the construction and equipment based on the past 25 years' physical history of horse, cable and electric railways during their development to the present apparently well settled standards will involve a charge of usually from 10 per cent to 25 per cent of the gross earnings. Adding to this the current repairs and renewals covered in the usual maintenance accounts, of some 10 per cent of gross earnings additional, the total charge for maintenance, renewals and depreciation will amount to from 20 per cent to 35 per cent or more of the gross earnings. With the present insufficient return upon the capital actually invested in street railway enterprises, it would not be reasonable to expect these corporations to make appropriations for depreciation based upon this theory of obsolescence.

Referring to the methods currently employed for providing for the upkeep of the property from earnings, an examination of the public reports of a number of street electric railway companies in the United States, Canada and Great Britain shows that there is no standard practice; each company is apparently actuated by its financial condition and managerial opinions. The range of methods employed to return income into the property is as follows:

METHODS OF CHARGING RETURNS INTO PROPERTY FROM INCOME.

1. From the current year's income.
    1. Actual cost in operating expenses charged for
        1. Maintenance.
        2. Renewals.
        3. Extensions, additions and betterments.
    2. Apportioned in operating expenses for
        1. Renewals.
        2. Depreciation.
        3. Car and equipment obligations.
    3. Apportioned in fixed charges for
        1. Renewals.
        2. Depreciation.
        3. Car and equipment obligations.
        4. Sinking funds, if permanently to retire capital.
        5. Contingent funds.
    4. Apportioned from net income or surplus for
        1. Renewals.
        2. Depreciation.
        3. Extensions, additions and betterments.
2. From accumulated profit and loss from operation.
    1. Apportioned to physical uses for
        1. Renewals.
        2. Depreciation.
        3. Extensions, additions and betterments.
    2. Apportioned to adjust accounts of
        1. Assets affecting maintenance, renewals, etc.
        2. Liabilities affecting maintenance, renewals, etc.
3. From profit and loss other than operation not applicable to dividends.
    1. Premium on securities sold. Held and used for extensions, additions, etc.
    2. Profit on assets sold and reinvested in property.

The rights of stockholders as to preservation of original investment and return upon securities are involved in any consideration of depreciation or the return of income into property. Should stockholders, who in early years have taken the risk and have provided for and outlived early losses of operation, be subject to the obligation of providing for wholly theoretical wasting of capital in the future?

Provision for charging depreciation has been made in the new franchises which have recently been granted to the street railway companies at Chicago and Cleveland. In the Chicago franchise, beginning February, 1910, it is provided that there shall be set aside 8 per cent of the gross earnings as a renewal fund, in addition to 6 per cent and as much more as may be necessary for current repairs or maintenance. The total charge for current maintenance, depreciation and renewals in Chicago will, therefore, as a minimum, be 14 per cent of the gross earnings.

In the Cleveland franchise it is provided that an average of about 5 cents per car mile shall be applied to maintenance, depreciation and renewal account, which is about 22 per cent of the gross earnings.

From the published reports of the twenty largest electric railway companies in the United States and Canada it is apparent that thirteen are making specific charges to income for depreciation or renewals; these, in percentage of gross earnings are as follows:

In all of the above cases these charges do not represent the entire return into the property from income. When we include all charges for maintenance, reserves, depreciation and other funds, special appropriations and unappropriated surplus these figures are increased largely.

City.	Year ending.	Depreciation— Amount.	Per cent gross earnings.
Baltimore-United Rys. & El. Co.	Dec. 31, 1908	$813,751 B.F.	11.9
Milwaukee Elec. Ry. & Lt. Co.	Dec. 31, 1908	475,127 E.	10.0
Minneapolis-Twin City R. T. Co.	Dec. 31, 1908	544,000 C.	8.5
Buffalo-Internat. Trac. Co.	Dec. 31, 1908	403,280	7.7
St. Louis-United Rys.	Dec. 31, 1908	321,500	5.0
Montreal St. Ry.	Sept. 30, 1909	175,000	4.5
Detroit United Ry.	Dec. 31, 1908	300,000 A.	4.2
Toronto Railway	Dec. 31, 1908	150,000	4.2
Washington Ry. & Elec. Co.	Dec. 31, 1908	150,323 B.	4.0
Washington-Capital Traction Co.	Dec. 31, 1908	70,117 B.	3.8
Boston Elevated Ry.	Sept. 30 1909	200,000	1.4
Brooklyn Rapid Transit Co.	June 30, 1909	148,806 G.	.7
Kansas City Ry. & Lt. Co.	May 31, 1908	829,814 D.	13.7

NOTES.

A. Also set aside $50,000 to contingent liability reserve, including which the percentage of gross earnings is 4.9.
B. Renewals and betterments.
C. Including interest on fund, which consists of company bonds, this percentage is 9.
D. Written off surplus applicable to 1908 and prior years.
E. Includes Milwaukee Light, Heat & Traction Co.
F. Subject to further distribution by directors.
G. In the last six years $5,400,000 discount on bonds has been written off.

For the last year obtainable for various groups and individual street railways of this and foreign countries the total amounts returned into the property from income have been the following percentages of gross earnings:

RETURN INTO PROPERTY FROM INCOME.

Company, State, etc.	Kind of service.	Year ending.	Per cent gross earnings.
United States Census, 1907	939 electric railway companies, including small amount of electric light	Dec. 31, 1907	17.1
United States Census, 1902	799 companies, all electric railways, including some electric light	Dec. 31, 1902	17.4
State of N. Y.—District No. 1	Electric railways	June 30, 1907	11.7
State of N. Y.—District No. 2	Electric railways	June 30, 1907	19.9
State of Massachusetts	Electric railways	Sept. 30, 1908	15.3
United Rys. & Elec. Co., Baltimore	Urban and suburban railway	Dec. 31, 1908	21.7
Brooklyn Rapid Transit Co.	Surface and elevated railway	June 30, 1909	19.3
International Tract. Co., Buffalo	Urban, suburban & interurb. railway	Dec. 31, 1908	19.3
Twin City Rapid Transit Co.	Urban and suburban railway	Dec. 31, 1908	18.1
Kansas City Ry. & Lt. Co.	Railway and electric light	May 31, 1908	17.8
Boston Elevated Railway	Surface, elevated, subway railway	Sept. 30, 1909	18.6
American Cities Ry. & Lt. Co.	5 electric railway and light companies, Birmingham, Memphis, Little Rock, Knoxville and Houston	Dec. 31, 1908	14.9
Capital Tract. Co., Washington	Urban and suburban railway	Dec. 31, 1908	14.1
Philadelphia Rapid Transit Co.	Surface, elevated, subway railway	June 30, 1909	9.7
Great Britain and Ireland	Municipal and company railways	Dec. 31, 1907	28.7
Great Britain and Ireland	Municipal railways	Mar. 31, 1908	31.2
Great Britain and Ireland	Company railways	Dec. 31, 1907	22.2
Glasgow Corporation Tramways	Municipal railways	May 31, 1909	42.6

The ability of large manufacturing corporations to make the consumer pay for the charge for depreciation and the great difference between the financial condition of those properties and that of street railway properties are shown by a recently advertised letter of the Western Electric Company to its bankers, dated Jan. 21, 1910, from which I quote the following:

"The stated net profits are after deducting liberal charges for depreciation, pusurant to the well-known policy of all companies controlled by the American Telephone & Telegraph Company. This is evidenced by the fact that the book valuation of real estate and plants covered by the mortgage has been reduced to 51 per cent of their actual cost."

Under the present well-known conditions of the street railway industry this method of treatment is an impossibility today. After all is said, the treatment of depreciation is largely a financial problem.

Harbor Improvements in Argentina—The Argentine Government has approved a contract with the Port Argentine Great Central Railways Co. (Limited), by which the latter agrees to construct, within the next five years, a deepsea harbor, where boats drawing 30 ft. can enter in ordinary low water, on the estate called Rincón de Lopez, near Punta de Lopez, near Punta de las Piedras on Samborombon Bay, nearly opposite Montevideo. This company is capitalized at $19,466,000 in shares and $38,932,000 in debentures. The Paris banking firm which is now building the Letschberg tunnel to connect with the Simplon has subscribed all the money necessary to complete the first section of the port, and a French banking syndicate has contracted to build the port works and will send dredges to Samborombon Bay at once to begin operations.

The port will be composed of a series of parallel docks, of the same level as the entrance channel and situated on either side of it, with embankments to be built along the channel to allow the ships to pass freely and to facilitate loading and unloading. The docks are to be 1,640 ft. apart, 3,215 ft. in length, and 1,050 ft. in width. The entrance channel runs east by west, almost parallel with the coast line; its total length will be nearly 50,000 ft.; its depth will be 328 ft. in the middle and 33 ft. along the walls. The moles are to be hard Austrian wood, already contracted for. There are to be thirteen storage sheds of wood and galvanized iron, to be built at the same time as the docks, whose capacity will be approximately 100,000 tons, representing a total movement of 800,000 tons per year. Three railways will be laid down in front of these sheds, and the goods will be loaded into the cars from the ships in the docks and channel by cranes. The motive power will be electricity, supplied by a central power house with installations for 500 HP., which can be increased as the port works are extended. It is planned to build several short railways in the port for use of various steamship companies. The port dues are not to exceed those of Buenos Aires.

The company will have the exclusive use of all land situated within 9.3 miles around the port; land necessary for custom-houses and other government buildings, coal deposits, streets and parks, and other public purposes being reserved for the Government. All such structures and public improvements are to be laid out in accordance with a plan to be approved by the President of the Republic. Not less than $15,572,000 must be spent on the entrance channel. The port is to be called "Puerto Argentino," and will become the property of Argentina after 99 years.

A model city will be built by the company around the new port. Land is being sold there now for $2.50 a sq. ft., and its value is rapidly rising. The 9.3 square miles bought by the company cost it $316,322.

Earth Road Construction in Iowa.—During the past year Poweshiek county, Iowa, has been constructing earth roads by means of a county road grading gang. The operation of this gang is briefly described in the Report of the Committee of Roads and Pavements of the Iowa Engineering Society. Poweshiek county is a rolling county and a large per cent of the work there consisted in reducing heavy grades and filling across the low stretches of road between the hills. The road machinery consisted of an elevating grader, blade grader, road roller, slips, plows, etc. This crew was equipped with a sleeping tent for the men, horse tent, and a cook wagon. Camp was moved for each two miles of road. The past season was a very unfavorable one for this kind of work and the work was not started until late. These two circumstances combined to keep down the road mileage actually constructed below what was anticipated. About nine miles of road was graded at a cost of between $600 and $700 per mile. In Sioux county, under the direction of the highway commission a stretch of earth road was graded between Alton and Orange City, preparatory to graveling. This road was three miles long. The cost for the three miles being about $1,300, or at the rate of $433 per mile. This includes the cost of shipping the outfit from Onawa and considerable tree trimming and similar expense.

Another stretch of road 1½ miles long, out of Ruthven, was constructed at a total cost of $850, or at the rate of $586 per mile. The figures given for all of this work include a considerable amount of hilly road and the filling of the low stretches.

Directory of Principal Civil Engineering Societies.

American Railway Bridge and Building Association—Secy., C. H. Lichty, 215 Jackson Blvd., Chicago, Ill.

American Railway Engineering and Maintenance of Way Association.—Secy. E. H. Fritch, Monadnock Block, Chicago, Ill.

American Society for Municipal Improvements.—Secy. A. Prescott Falwell, 239 West 39th St., New York, N. Y.

American Society for Testing Materials.—Secy. Edgar Marburg, Univ. of Pa., Philadelphia, Pa.

American Society of Civil Engineers.—Secy. C. W. Hunt, 220 W. 57th St., New York, N. Y.

American Society of Engineering Contractors.—Secy. Daniel J. Hauer, Park Row Building, New York, N. Y.

American Street and Interurban Railway Association.—Secy. B. V. Swenson, 29 W. 39th St., New York, N. Y.

American Water-Works Association.—Secy. J. M. Diven, Charleston, S. C.

Boston Society of Civil Engineers.—Secy. S. E. Tinkham, 60 City Hall, Boston, Mass.

Canadian Society of Civil Engineers.—Secy. Clement H. McLeod, Montreal, Can.

Engineers' Club of Philadelphia.—1317 Spruce St., Philadelphia, Pa.

Engineers' Club of St. Louis.—Secy., A. S. Langsdorf, Washington University, St. Louis, Mo.

Engineers' Society of Western Pennsylvania.—Secy., E. K. Hiles, 803 Fulton Bldg., Pittsburg, Pa.

National Association of Cement Users.—Pres., Richard L. Humphrey, Harrison Bldg., Philadelphia, Pa.

New England Water-Works Association.—Secy. Willard Kent, Narragansett Pier, R. I.

Roadmasters and Maintenance of Way Association.—Secy., W. E. Emery, P. & P. U. Ry., Peoria, Ill.

Society for the Promotion of Engineering Education.—Secy., Henry H. Norris, Cornell University, Ithaca, N. Y.

Technical Society of the Pacific Coast.—Secy., Otto Van Geldern, 865 Pacific Bldg., San Francisco, Cal.

Western Society of Engineers.—Secy., J. H. Warder, Monadnock Block, Chicago, Ill.

Coming Meetings.

American Society for Testing Materials.—Annual meeting, Atlantic City, N. J., June 28-July 2.

American Society of Civil Engineers.—Annual Convention, Chicago, Ill., June 21-24.

Society for the Promotion of Engineering Education—Annual Meeting, Madison, Wis., June 23-25.

Contract News Section

of

ENGINEERING-CONTRACTING

A Consolidation of Engineering-Contracting—Contract News—Engineering World—The Dirt Mover.

Containing Items of Interest to Railroad, Public Works and Other Contractors.

Municipal Ownership in Vienna.

The city of Vienna, Austria, which has developed municipal ownership to a degree far beyond that of any other great city, is not having exactly a happy time with its many enterprises, according to a special correspondent of the Chicago Daily News. The city owns and operates not only gas and electric light plants and street railways but also such diversified undertakings as slaughter houses, a brewery, cemeteries, funeral undertaking and funeral insurance, life insurance and savings banks, besides several other minor enterprises. The first undertaking acquired by the city was the street tramway system. This was in 1903 and was only accomplished after a long and bitter fight with the stockholders of the company. Altogether, according to the correspondent of the News, the city has invested $28,000,000 in the tramway system and greatly developed and improved the service for an average yearly return of about $500,000. This, it may be remarked, is considerably less than the city would have received without any investment at all, for the old company's charter provided for the payment to the municipality of 9.8 per cent of the gross earnings. The old company also paid about $200,000 a year to the municipality for taxes. To add to this showing it may be stated that the fares have been raised all around. The next undertaking was the erection of municipal electric works at a cost of $12,000,000, the original estimates for the power plant being exceeded by nearly $5,000,000. In connection with these works the city bought out two private companies for a total of $5,000,000. The electrical works last year showed a clear profit of $1,000,000, but this is stated to be due largely to the fact that the tramways are charged an exorbitant price for the power supplied. As to the consumers, they have never received any reduction in price for electricity supplied for lighting purposes. An entirely new plant for manufacturing gas was erected by the city, and last year it showed a profit of $700,000, but the consumers could have gained nothing by this, for gas for all purposes, lighting, heating and power, costs in Vienna about 97 cts. per 1,000 cu. ft., which is said to be the highest price in all Europe, with the expection of Paris. Another undertaking of the municipality was the purchase of omnibus lines. This investment resulted last year in a loss of about $88,000, which it is estimated will be doubled this year. The public slaughter houses were also a losing investment of the municipality. It was thought that these would keep down the wholesale price of meat by providing a regular market, and also by competing with the butchers would give the public cheap meat. It is stated that neither of these expectations were fulfilled, and that in addition the slaughter houses entailed a loss to the city of $188,000 last year, which will probably be considerably increased this year. The most unfortunate venture of the city, not so much from the financial loss, but from the scandal involved, was the municipal brewery. The brewery has been carried on with a steady annual deficit. The latest acquisition of the municipality was two of the largest funeral undertakings in the city, which in fact almost monopolized that trade. In the first year this project netted $45,000 but much dissatisfaction is said to exist because the tariff for the cheaper classes of funerals has not been reduced in accordance with public demands.

The Doings of the Week.

At the state election in Oklahoma on June 11, the amendment to the constitution providing for the repeal of the clause that prohibits the purchasing of new railroads by established lines was defeated by a majority of about 20,000.—Announcement has been made that three of the most important branch lines of the Chicago, Milwaukee & Puget Sound R. R. are to be opened for traffic this month. These are the Gray's Harbor, Worden and St. Mary's branches. The St. Mary's branch will be opened within a few days. It reaches the timber and mining activities along the St. Mary's River, while the Worden branch goes into the wheat region of the Big Bend country.—The first train crossed the Miles Glacier bridge over the Copper River in Alaska on May 30, four months ahead of the original schedule. The completion of this important link in the Copper River & Northwestern Ry. gives through rail connection to within 23 miles of the mouth of the Chitina.—The State Road Commission of Maryland and the highway division of the Maryland Geological Survey were consolidated last week in accordance with a bill passed by the last Legislature. In the future all road work will be done under the supervision of the Road Commission.—Two good sized railroad construction contracts are to be let shortly. One of these is the contract for constructing the 86-mile line from Virginia, Minn., to Duluth, Minn., for the Canadian Northern Ry., which has been mentioned a number of times on this page. The other contract is for the construction of double track from Pueblo, Colo. to Walsenburg, a distance of 50 miles, for the Colorado & Southern and the Denver & Rio Grande. Bids for the latter work are to be in by June 20. Bids for the Minnesota work have already been taken and it is expected that an announcement as to the award of the contract will be made shortly.—Haney, Quinlan & Robertson, of Toronto, Ont., have just been awarded the contract for Sec. 4 of the Ontario-Rice Lake Division of the Trent Canal in Canada, the contract amounting to about $1,000,000.—A large drainage job is now being advertised by the Drainage Commissioners of Bolivar County, Mississippi. The bids are to be opened at Cleveland, Miss., at 2 p. m., July 5, and the work calls for approximately 1,155,000 cu. yds. of earth excavation in connection with the improvement of the channel of the Bogue Phalia.—Among the railroad construction contracts let recently are the following: The Carland Construction Co., Toledo, O., for constructing the new line of the Ohio Electric Ry., from Hamilton, O., to Middletown; Ramage, Wolfe & Co., Fairmount, W. Va., for constructing seven miles of road between Clarksburg, W. Va., and Mount Clare for the Clarksburg & Western Traction Co.; A. Guthrie & Co., St. Paul, Minn., for grading 40 miles of line between Frannise, Wyo., and Fromberg, Mont., for the Chicago, Burlington & Quincy R. R.; J. H. Flick Construction Co., Chicago, Ill., for constructing the interurban line from St. Joseph, Mo., to Savannah, Mo.; Hughes O'Rourke Construction Co., Dallas, Tex., for three bridges for the St. Louis Southwestern extension from Gatesville, Tex., to Comanche.

The Contractor and the Stage.

Playwrights have begun to recognize the dramatic possibilities of engineering and in several successful plays produced recently the plots have been based upon construction work. In several of these plays the hero or the near hero is a civil engineer and the contracting profession is not represented by even a spear carrier. After seeing one of these plays a contractor decided that he would write a play in which the hero would be a plain but honest contractor who would cop the girl and the wealth in the last act and live unhappily ever after. He wrote his play and has given us the privilege of giving a synopsis of it. This we have done for the purpose of showing that there are strong dramatic possibilities in the life of a contractor. The plot of the play, in brief, is as follows: Tom Jones, a young contractor, is in love with Mame Brown, daughter of Dunne Brown, president of the Hot Air Line. Brown awards Tom the contract for building a 100 mile railway, one of the conditions being that if the work is completed by 10 a. m., Nov. 15, Tom secures the daughter as a bonus; if the work is unfinished at that time Dunne Brown gets the road for nothing. Goodrich Mudd, 1st vice president of the road, is also in love with Mame but is spurned by her, as he already has two wives. He plots to foil Tom and is ably assisted by J. Little Work, 2d vice president of the road. Bill Smith, assistant chief engineer of the road, is a friend of Tom's and comes to his rescue at various critical moments. A summary of the four acts follows:

Act 1. Grading camp at night. Enter foreman, skinners, hoboes, waterboys, etc., singing, "It's 14 miles to the nearest drink, and you have to walk all the way." Supper; song, "What, beans again?" Mule skinners by light of banjo torches skin two mules that had died from fright of the sight of oats.

Act. 2. Scene in Tom Jones's tent. Enter bill collectors for feed men, grocerymen, butchers, etc., etc. "I'm busted." Bill Smith: "Take this $10,000, my last month's pay." It begins to rain; it pours; high water; floods; tempest; hurricane. Glanders in the stock. Steam shovel busted. Concrete mixer blown-up. "There's deviltry in the air."

Act 3. Scene 1, headquarters of chief engineer. "We allow no rock in this estimate, it's all earth." "My God! it cost me $1.25 per cu. yd." Scene 2. Court. 56 experts on one side, 56 on the other. "The judge finds that this is rock and holds you to the terms of the contract."

Act 4. Site of bridge, 9:45 a. m., Nov. 15. Pile drivers, hoists, cableway from distant cliffs to bridge site, etc. Tom Jones discovered tied beneath hammer on ponderous pile driver. Goodrich Mudd and J. Little Work prepare to let hammer drop. Mame Brown and Bill Smith appear on distant cliff. "My God! We're too late." "Quick, the cableway bucket." Bang! Bang! Just in time. Ten minutes to finish the work. In with a pile. "Who'll run the engine?" "I, Mame Brown." "It's down. The railroad is completed. I've won my bonus."

The United Railways & Electric Co., of Baltimore, Md., has completed plans for the extension of its lines to Orangeville, Baltimore county, Md.

Confirmed Reports by Engineers and Contractors

RAILROADS, POWER DEVELOPMENTS, LEVEES, DRAINAGE AND IRRIGATION WORKS.

Railroads—Steam and Electric.

ALABAMA.

The Tuscaloosa Mineral Ry. Co. now has surveys in progress for its projected 18-mile line from Tuscaloosa east via Holt to Brookwood, Ala. The capital for construction has not been secured as yet, and the time for awarding construction contracts has not been decided upon. W. Finnell, Tuscaloosa, Ala., is Chief Engineer, and F. G. Blair, Tuscaloosa, is President. A. S. Vande Graff, Tuscaloosa, Ala., is also interested.

COLORADO.

The Colorado & Southern Ry. Co., in connection with the Denver & Rio Grande R. R. Co., has asked for bids on construction of double track from Pueblo to Walsenburg, a distance of approximately 50 miles; bids to be in on June 20. H. W. Cowan, Denver, Colo., is Chief Engineer of the Colorado & Southern Ry.

The Plateau Valley Ry. Co., which projects a 24-mile railway along Plateau Creek from Collbrain to the Rio Grande Junction R. R., near Palisade, has completed surveys, and has secured the promise of the necessary capital for the construction of the line. Construction contracts are to be let shortly. Paul Blount, 322 Century Bldg., Denver, Colo., is Chief Engineer, and J. J. Yeckel, Century Bldg., Denver, is President.

GEORGIA.

The Western of Georgia R. R. has completed surveys and has secured the capital for the construction of its projected 36-mile line from Franklin, Heard County, via Herman to Aberdeen, Fayette County, Georgia. The date for awarding construction contracts has not been set as yet. R. M. Hull, Newman, Ga., is Chief Engineer.

ILLINOIS.

The Decatur Southern Traction Co. has completed surveys and has secured the capital for the construction of its projected 32 to 33-mile line from Decatur to Pana, Ill. Construction contracts are to be let within 60 days. R. McCalman, Decatur, Ill., is Chief Engineer and J. Nordeus Child, New York, is President. J. J. Pierpont, Pana, Ill., is also interested.

IOWA.

We are advised that active operations on the proposed Davenport-Muscatine interurban line will not be commenced for at least six months or a year. Joseph F. Porter, president of the Tri-City Ry., Davenport, Ia., is interested.

KANSAS.

The Continental Construction Co., Caney, Kan., which has the contract for constructing the first 50 miles of the Cherryvale, Oklahoma & Texas Ry., including bridging, track laying, etc., has completed the grade for the first six miles. The contract includes 578,000 cu. yds. of earth excavation and embankment, 63,000 cu. yds. of rock excavation, 1,444,000 cu. yds. of over haul, one 80-ft., one 150-ft. and one 200-ft. steel bridge and 3,100 lin. ft. of wood trestles. B. J. Dalton, Lawrence, Kan., is chief engineer.

MONTANA.

White Brothers, First National Bank bldg., Missoula, Mont., who have the contract for constructing 35 miles of line for the Big Blackfoot Ry. from Clearwater to a point east of Ovondo, have let sub-contracts to the following: A. L. Walker, Missoula, Mont. M. Tobin, Hamilton, Mont.; C. L. Rummelhort, Hamilton, Mont.; S. J. Wallace, Hamilton, Mont.; and Meredith & Davis, Hamilton, Mont. They still have about 500,000 cu. yds. to be sub-let, but sub-contractors are coming in rapidly. The work is very good team work and the prices are good. The contract includes 1,000,000 cu. yds. of earth excavation and 200,000 cu. yds of rock excavation. Matter of bridges is undecided as no decision has been reached as to channel changes. It is expected that further extensions of the Big Blackfort Ry. will be made in the very near future.

NEW YORK.

The New York State Public Service Commission is now passing upon the application of the Southwestern New York Traction Co., for a certificate of convenience and necessity and for leave to issue bonds for the construction of its 15-mile line from Bolivar to Wellsville, N. Y. It is expected that favorable action will be taken by June 18. The construction of the line will not begin until this approval and consent, which is a preliminary requirement by the New York State law, is obtained. C. M. Van Kuren, Bolivar, N. Y., is President, and A. J. Matson, Bolivar, is secretary.

OKLAHOMA.

The Erick Northeastern R. R., which projects a 42-mile line from Erick, Okla., to Cheyenne, Okla., has secured the capital for the construction of its line, and construction contracts will be let soon. The road will also be built from Erick, Okla., to Englewood. C. P. Banning, Erick, Okla., is President.

Dan Sweeney & Co., Stillwater Okla., who have the contract for constructing the section of the Oklahoma Public Service & Interurban Lines between Stillwater and Morrison, Okla., as noted in our June 1 issue, intend to sub-let eight or ten miles of this work. Sub-contractors can see Mr. Sweeney at his camp at Stillwater. C. R. Cain has been awarded one of the sub-contracts on the work. Mr. Sweeney's contract includes 272,000 cu. yds. of earth and rock excavation. The M. B. Ryan, Bridge Co., Shawnee, Okla., has the bridge work.

OHIO.

The Loramie & Minster Ry Co. has completed surveys and has secured the capital for the construction of its projected three-made line from Minster to Loramie. The company will construct the line itself. John Ratterman, Lorain, O., is President, and J. W. S. Reigle, Findlay, O., is Engineer.

WISCONSIN.

Alex McGravyock has finished his work on the Burlington and has moved his plant to West Allis on the Northwestern. He would like to have some of his old employes on the work. E. J. McLonne will have charge of the work.

Power Developments, Levees, Drainage and Irrigation Works.

COLORADO.

Bids are asked by the Rio Grande Reservoir & Ditch Co. at its office, Room 420 Symes Building, Denver, Colo., until 2:00 p. m., July 2d, for the furnishing of materials for and the construction of a storage reservoir at Santa Maria Lake, Mineral County, Colorado. The work will consist mainly of a 48-inch diameter continuous wood stave pipe 8,000 ft. long, a concrete lined canal 8,000 ft. long; a hydraulic fill, or earth dam containing 265,000 cu. yds. outlet tunnel 600 ft. long, outlet canal 3,000 ft. long, spillway, diversion dam, valve chamber, valves, etc. Bids will be received for any portion of the entire work as above stated. Plans, specifications and form of contract may be seen and proposal blanks obtained at the office of the company, and at the office of Thomas W. Jaycox, Consulting Engineer, No. 1608 Broadway, Denver, Colo.

ILLINOIS.

Contract was let on June 9 to the Western Concrete Bridge Co., 1st National Bank bldg., Chicago, Ill., for the reconstruction of the concrete dam for the Danville Water Co. The contract prices were as follows: Concrete, including coffer dam and removal on sections of present dam, $11.80 per cu. yd.; earth excavation, $1 per cu yd.; shale excavation, $2.50 per cu. yd.; extra steel reinforcement, 3 cts. per lb.

IOWA.

C. H. Sternberg & Sons, Chicago, Ill., have been awarded the contract at 5.94 cts. per cu. yd. for constructing the Pigeon Creek Ditch extension of 14 miles, for the Commissioners of Pottawattamie County. Bids for the work were opened June 5 at Council Bluffs, Ia. The work is divided into seven sections as follows: Section 1, 80,480 cu. yds.; section 2, 58,520 cu. yds.; section 3, 74,550 cu. yds.; section 4, 75,450 cu. yds.; section 5, 83,400 cu. yds.; section 6, 77,800 cu. yds. section 7, 28,000 cu. yds.

KENTUCKY.

The Eclipse Mining Co. is to let contracts at once for eight miles of railroad from Marion, Ky., to the Comodore Mines. Ed. F. W. Kaiser, Louisville Loan Bldg., Louisville, Ky., and Jno. W. Wilson, Marion, Ky., are interested.

John R. Gaines, County Surveyor, Court House, Louisville, Ky., is now making a survey for a system of drainage canals in the flat lands of Jefferson county. This system will be divided into two projects, one to include what is called the Mill Creek Valley, and the other the Pond Creek Valley. The Mill Creek project is pretty well under way and the commissioners will probably be able to let contracts on this work, by July 15th. The estimate for this whole work calls for the expenditure of about $90,000, of which $35,000 is available. Estimates on the Pond Creek project have not been completed but it will probably reach $150,000, of which about $40,000 will be available this year. Efforts are being made to get things in shape to let contracts on this work by August 1st or 15th.

LOUISIANA.

Bids are being asked by Maj. H. Burgess, U. S. Engineer, 3338 St. Charles Ave., New Orleans, La., until 11 a. m., June 27, as previously noted, for constructing about 350,000 cu. yds. of earth work in Lower Texas Levee District for the Fourth District of the Mississippi River Commission. The work is in the Loyd, Buck Ridge and Elk Ridge levees, situated in Tensas Parish, La., about 27 miles below Vicksburg, Miss. The work begins at lower end of the Burn levee recently enlarged, and extends down-stream to the upper end of Elk Ridge levee enlarged in 1904. The levee is to be enlarged on the river side. The Loyd levee contains 115,000 cu. yds.; the Buck Ridge levee contains 115,000 cu. yds., and the Elk Ridge levee contains 120,000 cu. yds.

MASSACHUSETTS.

The following bids per ton of 2,000 lbs. were received June 6 at the office of the U. S. Engineer, at Boston, Mass., for furnishing riprap stone in dike at Long Beach, Plymouth Harbor, Thomas Fitzgibbons, Beverly, Mass., $2.94; Lawler Bros., 16 City Sq.,

Charlestown, Mass., $3.44; Rowe Bros. Co., Richmond, Me., $3.97; The Breakwater Co., 1222 Arcade Bldg., Philadelphia, Pa., $2.43.

MINNESOTA.

Jerry Sherwood, Litchfield, Minn., was awarded the contract for 251,159 cu. yds of dredge work in connection with construction of Ditch No. 12 for Redwood County, bids for which were opened June 2 at Redwood Falls, Minn. Contract for County Ditch No. 11, all tile work, was let to Christ Anderson, Redwood Falls, Minn. The work is located in township of Delphi and Kintise, Redwood County, Minn.

R. A. Putnam, Valparaiso, Ind., has been awarded the contract for all open ditch work for Drainage District No. 1, of Des Moines County, bids for which were opened at Burlington, Ia., on June 9. The contract price ranged from 5 1-5 cts. to 8 cts. per cu. yd. The work includes: 6,900 ft. of 80 ft. ditch, 98,500 cu. yds.; 144,000 ft. of 60 ft. ditch, 1,208,500 cu. yds.; 8,300 ft. of 40 ft. ditch, 53,500 cu. yds.; 3,500 ft. of 20 ft. ditch, 5,800 cu. yds.; 45,200 ft. of 10 ft. ditch, 103,150 cu. yds.; 900 ft. of 8 ft. ditch, 9,100 cu. yds.

MISSISSIPPI.

Bids are asked until 2 p. m., July 5, by the Drainage Commissioners of Bolivar County, Miss., at Cleveland, Miss., for the improvement of the channel of the Bogue Phalia. The proposed improvement is nine miles in length and requires the excavation of 1,155,000 cu. yds. of earth. W. W. Boone, Cleveland, Miss., is Chief Engineer. The official advertisement will be found elsewhere in this issue.

NEW YORK

The Caldwell-Wilcox Co., Newburgh, N. Y., has been awarded contract 44 by the Board of Water Supply of New York City. This contract calls for furnishing, delivering and installing six 6-ft. by 15-ft. sluice-gates, twenty-five 5-ft. by 13-ft. sluice gates, four 5-ft. by 8-ft. back pressure sluice-gates, seven 5-ft. by 8-ft. sluice gates, six 5-ft. by 6-ft. sluice gates, three 4-ft. by 5-ft. sluice gates, eight 3-ft. by 5-ft. sluice gates, three 30-in. by 42-in. sluice gates, two 18-in. by 24-in. sluicegates, with operating mechanisms, 2 sets of drive-shafting and all appurtenances.

The Dravo Contracting Co., Pittsburg, Pa., was awarded Contract No. 80 by the Board of Water Supply of New York city. This contract, bids for which were opened May 24, calls for the construction of the Breakneck Tunnels, portions of the Hudson River Division of the Catskill Aqueduct, comprising about 710 ft. of plain concrete conduit, known as aqueduct in open cut, or cut-and-cover aqueduct, 17 ft. high by 17 ft. 6 in. wide inside, and a tunnel on the hydraulic gradient, about 1,055 ft. long, 17 ft. high by 13 ft. 4 in. wide inside, connecting by a shaft about 590 ft. deep with a deep pressure tunnel 14 ft. inside diameter and about 700 ft. long. The work is located in the Towns of Fishkill Dutchess County, and Phillipstown, Putnam County, N. Y.

Bids are asked until noon, June 27, by Col. W. M. Black, U. S. Engineer, Army Bldg., 39 Whitehall St., New York, for dredging in Newton Creek, N. Y., and Wallabout Channel, N. Y. The Newton Creek work consists in dredging a channel to a depth of 18 ft. below mean low water; in widening the channel at the bends and in the bridge approaches to the same depth, if so directed; and in removing the rocky shoal in the entrance to 19-ft. depth below mean low water. The rocky shoal in the entrance has been broken up by drilling and blasting and it is believed to be reduced to such sizes as are removable by the dipper of a dredge capable of satisfactory removing this class of material. The contractor will be required to remove all material encountered except unbroken ledge rock. The work calls for the removal of the following estimated amount of materials: Mud, sand, clay, etc., 46,000 cu. yds., scow measurement. Broken rock and boulders ½ cu. yd. in size or larger, 35 cu. yds. solid measurement. The amount of money available is $9,000.

OHIO

Bids are asked by the Director of Public Service of Lorain, O., L. B. Johnston, Clerk, until noon, June 21, for furnishing the necessary labor and materials for the ofllowing improvements in Black River: approximately 100,000 cu. yds; making fill on city property east of Black River and north of Erie Avenue Viaduct, approximately 15,000 cu. yds.; bids for these improvements will be considered either separately or combined.

W. J. Irwin, Greenville, O., and L. E. Irwin, Hamilton, O., composing the firm of Irwin Bros., have, as noted in our last issue, been awarded the contract for the construction of the Stant levee and road. The work is located along the east side of the Miami River from Trenton to Middletown, and includes 68,000 cu. yds. of earth for the levee and 12,200 sq. yds. of concrete slope. The excavation is team work.

PORTO RICO.

As previously noted, bids are being asked until 2 p. m., July 25, by B. M. Hall, Chief Engineer, Porto Rico Irrigation Service, Guayama, Porto Rico, for the construction in Porto Rico, of the Carite dam, containing 150,000 cu. meters of earth and loose rock, the Toro Negro dam, containing 15,000 cu. meters of earth and loose rock, and the Dona Juana Canal, 1 1-3 mile long. The estimated total cost is about $160,000. The approximate quantities involved in the construction of the Carite dam and appurtenances are as follows: Grubbing and clearing, 7 acres; excavation for outlet culvert, open cut, Class 1, 880 cu. meters; Class 2, 500 cu. meters; Class 3, 2,000 cu. meters; concrete in outlet culvert, 360 cu. meters; excavations of cutoff trenches, open cut, Class 1, 5,600 cu. meters; Class 2, 2,300 cu. meters; Class 3, 300 cu meters; backfilling and puddling cut off trenches, 8,200 cu. meters; concrete in diaphram, 400 cu. meters; concrete in spillway linings, 100 cu. meters; concrete in spillway weir, 40 cu. meters; handling and placing reinforcing steel and iron work, 20,000 lbs.; excavation for spillway, open cut, Class 1, 70,000 cu. meters; Class 2, 60,000 cu. meters; Class 3, 30,000 cu. meters. Alternate bids will be taken in the Carite Dam and appurtenances, the approximate qualities being the same except for the last three items. Under the alternative plan these items are as follows: hydraulic fill for spillway and borrow excavation, 120,000 cu. meters, embankment, and such excavation in spillway, 30,000 cu. meters. Plans, etc., may be obtained from the Bureau of Insular Affairs, War Department, Washington, D. C., on the deposit of $1.

CANADA.

The contract for the construction of section No. 4 of the Ontario-Rice Lake division of the Trent Canal has been been awarded to Haney, Quinlan & Robertson, care M. J. Haney, C. E., Toronto, Ont.

Extensions to the Cuba R. R. Co., in Cuba, totaling 180 miles, are to be opened within six weeks. This includes a line from Marti to Bayamo and San Luis with a 40-mile branch, giving the port of Manzanillo, on the Gulf of Guayacanabo, its first connection with the island by rail.

The Commercial Club of Beatrice, Nebr., has appointed a committee of which B. H. Begtole is a member, to take steps toward securing the construction of an extension of the Missouri Pacific railroad from Virginia to that city.

It is reported that the Maine Central R. R. has let a contract for the construction of an extension of its line from Rumford Falls, Me., to Lake Megantic, Compton County, where it will make a connection with the Quebec Central giving a much shorter route from the States to Quebec. T. L. Dunn, Portland, Me., is Chief Engineer of the M. C. Ry.

The Northern Pacific Ry. has completed surveys for a line running from Edgeley, N. Dak., through Burnstad in Logan county and Linton and Emmonsburg in Emmons county. This line will connect with the line now under construction running west of the river from Cannon Ball through Mott in Hettinger county and thence to connect with the main line of the Northern Pacific at Forsyth, Mont.

Stockholders of the Nevada United Mines Co., at a special meeting held at Denver, Colo., amended articles of incorporation so as to increase the capital stock to $3,500,000 and authorized a special bond issue of $500,000 to provide funds for the construction of a railroad from Ely, Nev., to the mines.

Surveyors are making rapid progress running lines for the proposed Esmond Branch of the Great Northern to Towner, N. Dak., or Rugby, and construction work will be completed this summer, it is said.

E. Heigho, President of the Pacific & Idaho Northern, Weiser, Ida., has announced that construction work will be completed from the present terminus into Meadows, a distance of 16 miles, this fall.

Construction work is to be started in July on the extension of the Rapid City, Black Hills & Western R. R., to the Coalfields. It is hoped to complete the work this summer. W. E. Moore, Rapid City, S. Dak., is General Manager.

The Tallahassee & Gulf R. R. has been incorporated with capital stock of $10,000. J. H. Norfleet, Ocklockee, Fla., is president and general manager. Others interested are P. D. Camp, J. M. Camp, Franklin, Va., and P. J. Norfleet, Newberry, Fla.

The Louisville & Nashville R. R. is now having plans made for a new depot and station to be erected on Alcaniz and Wright Sts., at Pensacola, Fla. The building, with sheds, will cover two blocks in length by half a block in width and will cost, it is estimated, nearly $250,000, including the money spent for the site.

The House of Representatives of the State Legislature of Massachusetts has passed the bill permitting the New York, New Haven & Hartford R. R. to purchase and operate the Berkshire Street Railway, in Berkshire County. The bill, which stipulated that certain short extensions of the Berkshire company's line shall be made, has already passed the Senate.

A. Guthrie & Co., St. Paul, Minn., have been awarded the contract for constructing the 40 mile line between Frannie, Wyo., and Fromberg, Mont., on the Chicago, Burlington & Quincy R. R.

Condemnation proceedings have been begun by the Great Northern preparatory to building a branch line of 350 miles from Haucks siding on the Billings & Northern to a junction with the main line at a point near Mondak on the Montana-Dakota line.

The extensions of the Mexico Northwestern Ry., to the Pacific Coast, noted a short time ago in these columns, will require a great deal of heavy work as the route selected is a difficult one. The Mexican Central R. R., before it became a part of the National system made a number of surveys in an endeavor to seek a practicable route over the mountains to the coast. As a result of these surveys, it was found that the grades encountered on both sides of the Sierra Madre would be very heavy, not only for short distances, but for long stretches, as well. The cost of construction through the country will be large and special locomotives for work on heavy grades will probably have to be provided.

Items Concerning Contractors and Their Work

RAILROADS, POWER DEVELOPMENTS, LEVEES, DRAINAGE AND IRRIGATION WORKS.

Alabama Notes.

FROM CORRESPONDENTS AND OTHER SOURCES.

Surveys were started early this month for a new railroad from Decatur to the town of Falls City, located at Clear Creek falls, in Winston county, some 50 to 70 miles from Decatur. The survey was commenced at Basham's gap for the purpose of determining the best route to cross the mountain and the amount of grade required. When this is ascertained the survey will then be continued until it is completed all the way to Decatur. Later the road may be extended on from Falls City to Tuscaloosa. Dr. D. W. Day, Hartselle, is interested in the project, and is said to have secured the greater part of the money to finance it.

Permanent surveys have been made for the construction of an 18-mile line connecting Woodstock with Tuscaloosa, Ala. C. L. Fennell of the latter city is Engineer.

The Business Men's Club of Birmingham, Ala., has submitted a proposition to the business men of Selma offering to raise $100,000 toward the construction of a railroad up the old Cahaba valley from Selma to the Birmingham District providing the Selma business men succeed in raising $50,000 toward the project.

The Louisville & Nashville R. R. Co. has surveys under way for the proposed line of railway from Athens, Ala., to Nashville. Arrangements for the construction work have not yet been made. J. Werness, Louisville, Ky., is Assistant Engineer.

Arkansas Notes.

FROM CORRESPONDENTS AND OTHER SOURCES.

The Fort Smith, Subiaco & Eastern R. R., which has 6 miles of line in operation from Paris to Subiaco, and is completing an extension from the latter place to Scranton, has been granted a charter for an extension of 23 miles from Scranton eastward to Dardanelle. An amendment has also been filed to the articles of incorporation of the company increasing its capital stock from $150,000 to $500,000. Henry Stroup, Paris, Ark., is General Manager.

Track laying on the extension of the Warren & Ouachita Valley R. R., from Banks to Hilo, a distance of 15 miles, is progressing rapidly. K. G. Morley has charge of the work.

John Scott & Sons, St. Louis, Mo., have started grading near Stuttgart on their contract for the extension of the Arkansas Central & Eastern R. R., from McGregor to Stuttgart, 18 miles. The building of the road will be superintended by A. M. Van Auken, Constructing Engineer.

The City Council of Jonesboro, Ark., on June 6 took up the matter of granting a franchise for a street car system for that city.

The stockholders of the proposed interurban line from Bentonville to Rogers have approved the survey of the promoter, J. D. Houseman, of St. Louis, Mo., and it is said that construction work will be started this month.

The Memphis, Dallas & Gulf R. R., which projects a line from Memphis, Tenn., to Dallas, Tex., and has construction work under way on one section of the line near Nashville, Ark., has purchased the Ultima Thule, Arkadelphia & Gulf R. R. and the Antoine Valley R. R., both Arkansas lines. The first named is a short strip of road which connects with the Iron Mountain road at Dalesville, Ark., and runs to Sparkman. The Antoine Valley line runs from Sparkman to Allenhurst.

California Notes.

FROM CORRESPONDENTS AND OTHER SOURCES.

F. E. Trask of Los Angeles has been appointed chief engineer of the Arrowhead Reservoir & Power Co. and will for the present, at least, have charge of the work of the company as to the construction of the Little Bear valley dam and any other work under way.

Contracts for irrigation canal work near Willows have been let to the following: R. F. Ball of Fresno, for work to extend from the Jacinto Road, about four miles north of Willows, to the railroad track at Willows. This work will be in enlarging the old canal to carry a greater depth of water, and in constructing the immediate laterals to the canal. Just south of this contract, C. Harlinger of Willows has the contract for a section of the canal covering a distance of two miles. South of him is C. Scott of Willows, who will continue the work for a distance of two more miles.

The Oro Construction Co. has been incorporated at Oroville and will engage in general contracting business. The company has several large contracts in sight. The incorporators are H. P. Badgley, O. R. Adolfsen, A. B. Larsen and H. G. Lodge.

The Southern Pacific Ry. Co. is reported to be securing right of way for a new line into Southern California by way of Owens River Valley. The new line, it is said, is to be along the aqueduct route, which is presumed to have been built for the express purpose of connecting at Keeler with the Carson & Colorado, thence joining the main line of the Southern Pacific at Reno. But in addition to making this connection, the main line will push on across the Owens River Valley into Lida Valley, tapping a rich stock and mining region; thence almost due east to Goldfield and on to Austin, Nev., where connection will be made with the Nevada Central, a Southern Pacific property, which would be the link connecting with the main line of the Union Pacific at Battle Mountain.

Business men of Novato, San Rafael, San Anselmo, Kentfield, Larkspur and Corte Madera are raising $125,000 to begin the construction of a railway from Corte Madera through Ross Valley towns to Novato. W. L. Courtright, San Rafael, is interested.

Colorado Notes.

FROM CORRESPONDENTS AND OTHER SOURCES.

The Kaw Valley Construction Co., of Lamar, has been incorporated with a capital stock of $250,000, the incorporators being H. C. Byrnes, William Pasho and H. Stivers.

The Valley Ditch Co. has established offices at Las Animas and is preparing to begin work on a project on Smith canon, twelve miles south of Las Animas. This proposition will cover 28,000 acres and will cost $1,500,000 when completed. The district is formed under the Carey act. A large dam and canal will be built and it will take two years to finish the work.

The San Luis Valley R. R. & Power Co. has applied to the City Council of Pueblo for a franchise to operate gasoline motor cars over certain streets of the city. The new road will connect the city with a park, two miles from the city limits.

Advices from Greeley state that the Water Supply & Storage Co., owning Chambers Lake, will rebuild the dam in the Upper Pondre with concrete. The lake is a natural reservoir and supplies water for the ditch which runs into Weld county as far as Ault and Pierce. The dam, which is now of earth and wood, was constructed many years ago with the Sky Line ditch, which runs into lake.

Plans are under way at Greeley for the organization of a development company to take over the power privileges at Chamber's lake, the Stove Prairie reservoir and the power available from the Laramie River, and to form a power line to carry electricity from the mountains to northern Colorado for the operation of railroads, electric light plants and factories.

It is proposed to build a reservoir with a capacity of between 10,000,000 and 12,000,000 cu. ft. to irrigate the northern part of Weld county and the southern part of Kimball county, Neb. The site of the reservoir will be in Kimball county and the project will be completed within ten months. J. Hall Ubanks, Denver, is interested.

According to reports from the vicinity of Placervile, Colo., enginers are making good progress locating the Denver & Rio Grande line from the above city to Paradox Valley.

The Consolidated Construction Co., recently organized to absorb the Boston-Colorado Power company and the Park Irrigation & Water Co., has decided to construct the proposed Gilpin & Clear Creek District R. R. into the Gilpin and Clear Creek Mining districts. The road, it is said, will be broad gaged throughout from Pocatello, on the Moffat road, to Black Hawk, and on to the new extensions.

At a recent meeting of the City Council of Pueblo, Colo., the ordinance to grant the Kansas Colorado R. R. Co. an extension of franchise to construct a line to Turkey Creek stone quarries was defeated. It is said that about $150,000 of Pueblo capital is tied up in the project.

Georgia Notes.

FROM CORRESPONDENTS AND OTHER SOURCES.

Business men of Carrollton have raised $25,000 and will secure an additional sum of $25,000 for building a railroad from this city to some point on the Southern Ry. or Seaboard Air Line. A charter for the road has already been secured.

The Georgia Power Co. has purchased the Etowah Power Co. and it is understod that it will be combined with the other extensive holdings of the Georgia Power Co. on the Tulula, Chestet, Chattahoochee and Etowah rivers. The Georgia Power Co. has already secured permission from the railroad commission of Georgia to issue $6,000,000 of stock and $6,000,000 of bonds with which to pay for, develop and extend its various properties. The company has also applied to the mayor and City Council for a franchise to do business in Atlanta. S. Fahs Smith, York, Pa., is interested.

The Brinson Railway Co. of Savannah, Ga., capitalized at $1,500,000, has been granted a charter to take over the holdings of the Savannah Valley Railroad and projects a system from Savannah to Athens, Ga., through the counties of Chatham, Effingham, Screven, Vurke, Richmond, Jefferson, McDuffie, Warren, Wilkes, Oglethorpe and Clarke. As proposed the route will pass through Springfield, Sylvania, Waynesboro, and Louisville, north through Thomson to Washington and thence to Athens by way of Lexington. The incorporators are George M. Brinson, Y. E. Bageron, W. C. Myers and John E. Foy of Savannah; James Imbrie of New York, J. T. Walker, E. T. Comer and W. J. Walker of Screven county, Robert M. Hitch and R. L. Denmark of Savannah.

The City Council of Columbus has voted to have the Columbus R. R. Co. extend its traction lines to Riverdale cemetery.

About 12 miles of line on the Moultrie & Western Ry., now in course of construction, have been completed and placed in operation to Hartsfield. From Hartsfield the road will be built to Sale City, in Mitchell county,

where it will cross the Flint River & Northeastern Railway. J. N. Pidcock, Whitehouse, N. J., is interested in the road.

Illinois Notes.

FROM CORRESPONDENTS AND OTHER SOURCES

Farmers of New Boston Township and Millersburg Township have petitioned the Commissioners of Mercer County at Aledo for the formation of a drainage district.

The Wabash R. R. has announced that its yards at Edwardsville are to be enlarged.

The Joliet & Southern Traction Co., H. A. Fisher, President, Joliet, has been granted a 50-year franchise by the City Council of Aurora to enter that city and the company is considering the construction of new tracks.

Stock company of Elgin, Ill., is to be formed to construct the belt line around that city at a cost of $250,000 for which plans are now underway. As proposed the new line will encircle Elgin, crossing the Illinois Central at Coleman, then the Elgin, Joliet & Eastern Chicago, Milwaukee & St. Paul and the Chicago & Northwestern.

Chicago, Milwaukee & St. Paul R. R. is purchasing a large tract of land at Franklin Park, Ill., preparatory to the establishment of extensive freight yards. The work, it is said, will involve an expenditure of $440,000.

Advices from Decatur state that the Decatur, Sullivan & Mattoon Interurban Co. has closed a deal with the Central West Development Co. of Missouri by which the latter concern undertakes to finance and construct a trolley line between Decatur and Mattoon. The plans involve the placing locally of about $200,000 in bonds, the company taking the remainder of the stock and selling it. The Central West Development Co. now has a 100-mile line under construction out of Mexico, Mo.

The Chicago, Wheaton & Western R. R. has secured a majority of the frontage along the Aurora, Elgin & Chicago R. R., to gain an entrance into St. Charles for a Chicago car service via Geneva.

Indiana Notes.

FROM CORRESPONDENTS AND OTHER SOURCES

Advices from Gary, Ind., state that the old Lake Shore tracks south of the present Baltimore & Ohio elevated right-of-way at Gary are to be extended by the U. S. Steel Corporation westward, crossing the Calumet River and past the sites of the American Car & Foundry Company and the American Bridge Company to the Baltimore & Ohio interchange yards at Clerk.

Advices from Owensville state that the Wabash levee to be built for Gibson and two other counties will be 40 ft. at the base, 6 ft. at the top and 9 ft. high. It will cost about $240,000.

The Pennsylvania R. R. has purchased two acres of land back of the Panhandle shops in Logansport and will build yards in that vicinity.

Iowa Notes.

FROM CORRESPONDENTS AND OTHER SOURCES.

The Commercial Club, of Missouri Valley, Ia., is advocating the construction of an interurban line to pass through Missouri Valley, Calhoun, Magnolia and Beebeetown.

The Commercial Club of Iowa City has begun a canvass of the city, to secure $100,000 with which to purchase stock in the proposed Iowa City-Ottumwa Interurban Ry. Co. It is believed that Ottumwa will duplicate this, and thus insure the building of the line.

The following drain contracts are to be let in the vicinity of Mason: On June 24, at the home of J. C. Hunt, seven miles southeast of Mason, in Ingham township, the county drain commissioner will receive bids for the cleaning out of Bashford drain; 70 ft. of 15-in. sewer pipe will be required, beside bids for some teaming. On June 16 at the home of Perry Aseltine in Wheatfield the contract for the mutual drain will be let. The main drain is 67.5 chains in length with a fall of 17.95 ft. and an average depth of 4½ ft. This has two branches, the first 5.61 chains long, the second 29½ chains long. The total length is one mile 90.44 rods. The main drain will be open, the branches of No. 1, 6-in. hard tile drain. One concrete retaining wall will be necessary, and three catch basins. The drain will be let in sections.

The Forest City, Fertile & Mason City R. R. Co., with headquarters at Watertown, S. Dak., and the privilege of a business office at Forest City, Iowa, has been incorporated under the laws of South Dakota. The company is capitalized at $400,000, and proposes the construction of a line of road 30 miles long in the counties of Winnebago, Hancock, Worth and Cerro Gordo, Iowa. The line is to start at Forest City, Iowa, running in an easterly direction to Fertile, and from there in a southeasterly direction to Mason City. The incorporators of the company are: P. O. Koto, C. N. Christopherson, C. S. Isaacs, Forest City, Ia.; A. M. Sheimo, Baldwin, Wis.; A. L. Sherin, M. J. Hawley, Watertown, S. Dak.

The General Construction Co., has its outfit on the ground for performing its filling contract at the location of the new Bettendorf Shops at Bettendorf, Ia. The work includes about 18,000 cu. yds. of fill. George H. Boynton is president of the construction company.

It is believed that the Illinois Central R. R. will shortly issue orders for the laying of a double track between Sioux City and Hinton.

Kansas Notes.

FROM CORRESPONDENTS AND OTHER SOURCES.

A project is under consideration for the construction of an interurban line with the following proposed route: Hutchinson, Haven, Mt. Hope, Andale, Goddard, Viola, Conway Springs, Anson, Wellington, Geuda Springs and Arkansas City; a spur between Wichita and Goddard and a line running from Conway Springs to Anthony, running through Milan, Argonia, Danville and Harper. J. M. Frantz, Conway Springs, Kan., is interested.

The Oklahoma & Kansas Electric Ry. Co., of Baxter Springs, has been chartered with a capital stock of $1,000,000, and proposes to build a line from Galena, Kan. to Miami, Okla., and branches and connecting lines from Columbus to connect with the interurban Southwest Missouri and Southeast Kansas from Joplin. The incorporators are: Charles M. Jones, Charles L. Smith, E. B. Morgan, M. C. Harper, T. F. Cole, J. J. Fribley, John M. Cooper, L. M. Perkins, E. W. Dow, all of Baxter Springs, Kan.; William Houk and H. C. Compton of Joplin, Mo.; J. Shoman of Galena, Kan., and W. L. McWilliams of Miami, Okla. W. K. Palmer, Kansas City, is Chief Engineer, as noted in our last issue.

It is stated that improvements to cost $200,000 will be made immediately to the electric railway system at Atchison. This system was recently purchased by W. B. McKinley, Champaign, Ill., as mentioned in our last issue.

According to a statement of E. S. Alnutt, of Belleville, President of the Motor Grand Traction Co., which project a north and south interurban railroad from Chester, Neb., to Wichita, Kan., the work of construction will be commenced immediately beginning at Canton and proceeding north to Salina, and as soon as this is well under way, construction work will then be taken up at Belleville and pushed south to Salina.

The Kansas & Southeastern R. R. Co. has been granted a charter with a capital stock of $100,000 and headquarters at Pratt, Kan., to construct a line from Kinsley to Pratt through Edwards, Stafford and Pratt Counties.

Kentucky Notes.

FROM CORRESPONDENTS AND OTHER SOURCES.

It is undecided yet as to the route of the proposed extension of the Brooksville & Wellsburg Ry.; one line being proposed from Mt. Olivet, Ky., to Brooksville and probably to Flemingsburg, via Bee Lick and Johnson Creek Valley.

Engineers said to be working under orders of the Ferguson Contracting Co., New York City, have completed surveys of a railroad on Middle Fork, Beech Fork and Greasy, and are now surveying a road up Cutshin. It is reported in Kentucky they intend to build a road up one of these forks in Leslie county, and are ascertaining which one has the best grade.

Committee of Hickman, Ky., in charge of raising the required $20,000 and right-of-way to insure the construction of the Chicago, Memphis & Gulf R. R. from Tiptonville, Tenn., toward Hickman, has announced that the new road is now a certainty, as most of the money has already been subscribed.

The construction of a hydro-electric development on the Dix River, north of Harrodsburg is proposed by Eastern capitalists. About 12,000 H. P. may be developed with an expenditure of about $1,250,000. It is planned to furnish the electricity to a number of Central Kentucky towns.

Louisiana Notes.

FROM CORRESPONDENTS AND OTHER SOURCES.

The company which proposes to build an electric railway from New Orleans to Algiers, La., is reported to have been financed to the extent of $1,500,000 by New York capitalists. H. C. Warmoth, New Orleans, La., is interested.

Reynolds, Watson & Co., 217 LaSalle St., Chicago, Ill., have purchased 34,000 acres of land near New Orleans, and will drain it and convert it into farms. This is part of a comprehensive scheme of Chicago capitalists for the reclamation of Trembling prairie swamp lands located 20 miles of New Orleans. F. W. Hodson, former secretary of agriculture and commissioner of stock of Canada, who recently resigned as land agent of the Union Pacific, is in charge of the project.

Work is under way on the reclamation of an 11,000-acre tract of land at Grand Cheniere for Belgium capitalists. It is expected that the tract will be colonized by the first of the year. Chas. D. Babbit, Gueydan, La., is the engineer in charge of the work.

D. K. Jeffries & Co., of Chicago, Ill., who have extensive timber interests in Concordia Parish, La., are planning the construction of a 5-mile railroad which will ultimately extend to Alexandria, La., to connect with Natchez.

Frank Jones, of Oak Grove, La., owner of some 8,000 acres of timber land in and near Oak Grove, is planning to build a standard gage railroad from Terry's Switch, on the E. & G. branch of the Iron Mountain, to run in a westerly direction to within one mile of Boeuff River, a distance of six miles. Fifty-six-pound steel has been procured, which is to be furnished by Aug. 1. Surveying on this line will begin at once. Mr. James intends to connect with Phin Kimball, a large capitalist, who is building a line from LaArk to within one mile of Boueff River, coming east, which will be completed this fall. E. J. Hamley, of Lake Providence, has recently purchased 8,000 acres of land about two miles east of Oak Grove, in East Carroll, where he will put a big sawmill. He expects to build a road from the mill to Lake Providence, and eventually connect with Janesline.

Michigan Notes.

FROM CORRESPONDENTS AND OTHER SOURCES.

The Grand Trunk Ry. has completed plans for a $50,000 freight house to be erected at Durand this summer.

The Detroit United Ry. Co., Detroit, has accepted various resolutions adopted by the city council giving the company permission to construct and operate at the will of the people a line out Hamilton boulevard, a loop on Grandy Ave., in conjunction with Chene St., and a double track on Mack Ave., where it is now a switch line. The company has placed its orders for the necessary materials and as soon as they can be assembled will begin the work of constructing the lines.

Advices from Lansing quote J. W. Ewing and J. S. Mudge promoters, as stating that the construction of an electric line from Lansing to Grand Lodge which was started nearly five years ago but discontinued after

several miles of track had been graded is soon to be resumed.

Minnesota Notes.

FROM CORRESPONDENTS AND OTHER SOURCES.

Plans for the depression of the H. & D. division of the Chicago, Milwaukee & St. Paul through Minneapolis, Minn., are now in the hands of the City Council waiting their decision.

The Duluth, Missabe & Northern Ry. is using all possible dispatch in pushing the reconstruction of its line between Hibbing and Mitchell a change made necessary by the Buffalo & Susquehanna strippings, which will cut the present yards of the line. The new construction is, however, temporary as the trains will soon pass over the new line now under construction to connect with the Coleraine Branch.

The Twin City Rapid Transit Co., W. J. Hield, General Manager, Minneapolis, is said to be working out plans for the construction some time this year, of a line of track on Maryland Street, St. Paul, from Lake Como to Hazel Ave., thus with a small connecting link around the south end of Lake Como, giving direct and rapid transit from Stillwater, Wildwood and suburban St. Paul to Minneapolis. The prospective construction of this line is said to be part of the extensive improvements of the street car company, involving an outlay of more than $1,000,000.

Duluth and the Ranges.

BY PETER E. MEAGHER.

F. R. Jones of Jones Brothers, General Contractors, was a caller at this office recently. They have a mine stripping contract here in Minnesota, and he said they were getting along very nicely on the same. Their other contracts in Iowa and Ohio are in good condition.

George Slater, representing the Illinois Steel Co., was a caller here recently, looking after business in his line.

A new constructing firm has come into this section of the country. That is, it is a very old firm, but has taken in some new members. The name of the firm is Dale & Bumgardner Co., and it is composed of Mr. Dale and Mr. Bumgardner, who have been in the contracting business for the past 25 years, and their general superintendents, F. C. Peabody and J. H. McMenney. They are working at the present time on the Soo Line, and have also been awarded a contract recently by the Northern Pacific Ry. Co. for some steam shovel work at Staples, Minn. We wish to congratulate the new members of this firm on being taken into partnership with such reliable contractors as Dale & Bumgardner, and they have our good wishes for a very successful business career.

Pastoret & Lawrence, general contractors, were callers at this office a few days ago. They have started on three or four jobs in Duluth, and have also started their big sewer job at Rice Lake, Wis. They were recently awarded some small sewer contracts by the city of Duluth.

Long & Erickson, Railroad Contractors, were callers at this office recently. They are engaged on several railroad contracts at the present time, and are also figuring on some new work.

Contractors Johnson and Curtiss, of the contracting firm of Johnson, Rodgers & Curtiss, were visitors at this office a few days ago. At the present time they have some railroad work on the Soo Line in Minnesota, and report that the same was getting along very nicely.

The last week or ten days, Duluth has been a point of attraction for a large number of contracting firms. The reason for the same was that the Canadian Northern Railway Company has called for bids for the extension of their railroad from Virginia, Minn., to Duluth, Minn., a distance of 86 miles. This is a very nice contract, and the work consists of about 300,000 yds. of rock, two or three steam shovel jobs, one tunnel, 600 ft. long, and a great deal of grader, wheeler and station work. It will be announced in about ten days who the successful bidder on this work is. Work is to be started immediately, and there will be a lot of work for sub-contractors. Any sub-contractors in the market for work, if they will send this office their names and the size of outfits they have, we believe that we will be able to place them. This work will take about 1½ years to finish.

P. McDonnell, the Duluth contractor, was awarded a $100,000 paving job by the city of Duluth last week, and is to start on the same immediately. He was also awarded a $68,000 paving job at Iron Mountain, Mich., and a $28,000 paving job by the city of Virginia, Minn. These two contracts are also to be started at once.

Captain Roberts of Roberts-Kingston Contracting Co., which has some stripping contracts in the iron country here, was a caller at this office a few days ago.

Greer Thompson, General Superintendent for the Drake & Stration Co., was a caller in this city last week, and reported that they were very busy on their stripping contracts on the Iron Range.

Charles Jacobson, Railroad Contractor on the Soo Line, was a caller recently. He said his work was getting along in very nice shape, and that he was figuring on some new work, which he was successful in getting, he would have to start immediately.

C. J. Frederickson, concrete and bridge contractor, was awarded several very nice contracts by the Great Northern Ry. on their system between Duluth and Spokane, Wash., and has already started on the work.

H. L. Bartlett Co. were awarded last week a $60,000 paving contract by the city of Virginia, Minn., and will start on the same immediately.

C. J. A. Morris came up to look over his dock contracts in this city.

The labor situation in this vicinity at the present time is in a very satisfactory condition as far as the labor agencies and the contractors are concerned. The class of laborers here at the present time is very good and there is enough to fill all positions offered. There is quite a bit of work in sight, and taken all together the coming season looks very prosperous for the laboring man.

J. D. O'Connell, Contractor, who was awarded a $60,000 paving contract by the city of Two Harbors, was a caller here last week. He said that he had already started on this work, and intended to rush it as fast as possible.

Contractors and others when in this vicinity are invited to make the labor and equipment offices of Peter E. Meagher, 409 West Michigan St., Duluth, Minn., their headquarters while here.

Mississippi Notes.

FROM CORRESPONDENTS AND OTHER SOURCES.

The Illinois Central R. R. has purchased 100 acres of land in the northern part of McComb City, Miss., in the basin of a stream as a site for large reservoirs. Material from excavation will be used to build a dam. Concrete spillways will be constructed to guard against floods. A pumping plant will be installed, with pipe lines to distribute water to the machine shops, roundhouse and other steam-using plants.

The Sumter & Northwestern R. R. Co., has been incorporated under the laws of Mississippi, and will probably build a short line from Sumter, Ala. to Meridian. The incorporators are: John Alexander, Aurora, Ill.; George C. Hixon, Chicago; J. M. Hixon, La Crosse, Wis.; T. E. Brittingham, Madison, Wis., and F. J. Hughes, Sumter, Ala.

The Batesville & Southwestern Ry. Co., recently chartered , proposes the construction of a line from Batesville to Charleston, in Tallahatchie county, where connection will be made with the road already running into Charleston. The road is said to have been financed and prospects are good that construction work will be started shortly. Judge Edward Mays, T. Lama Ross, Lucius Mays, all of Jackson, and J. C. Longstreet of Grenada, were the incorporators.

The Board of Supervisors at Scranton, granted a franchise to W. D. Bullard and his assigns to build an electric railway over the new automobile road lately completed to the Alabama state line. A further franchise was granted him over the public road leading from the automobile road at Orange Grove to Moss Point, and over the telephone road from Moss Point to Pascagoula.

The Pascagoula & Northern R. R. plans to have its first train in operation on its new line between Scranton and Evanston, 35 miles, on June 4. The present plan of the company is to eventually extend the road to Memphis. The Pascagoula Northern was first built by W. Denny & Co. to transport timber in the northern portion of the country, and was later made a standard-gage road.

Missouri Notes.

FROM CORRESPONDENTS AND OTHER SOURCES.

An ordinance is before the City Council of Kansas City granting the Metropolitan Street Ry. Co. a franchise for a cross town line along Chestnut Ave. The ordinance provides that the construction of the line begin at 15th St. and Chestnut Ave. and extend north along Chestnut to Lexington Ave. This part must be completed and in operation in eight months. Construction of the remainder of the line, between Lexington and Guinotte Aves., is to begin within six months after the grading of a traffic way through North Terrace Park has been completed by the park board.

Swift & Rust have been awarded a contract by the Wabash R. R. for constructing 250 ft. of dike at the Baker-Ducan bend in the Missouri River near De Witt. The work will require 1,500 cu. yds. of stone and 700 cords of brush.

The Board of Public Improvements of St. Louis, Mo., will probably recommend that the Municipal Assembly appropriate $100,000 for the construction of a revetment to protect the land owned along the river by the city and to protect the city's water supply carried by the conduits.

Excellent progress is being made by the promoters of the proposed railroad from Joplin, Mo., to the Southwest, touching Shawnee, Okla. The starting point of the road is Joplin, the great mining district of the middle west. It will proceed southwest to Tulsa, thence to Sapulpa and Shawnee and on through Norman and Chickasha. Already 40,000 ties have been ordered to be used between Tulsa and Joplin and the grade is completed. At the completion of this gap in the line both Tulsa and Joplin will give a bonus of $25,000 each. William Demland and Daniel Kennedy, Shawnee, Okla., are interested.

Surveys are stated to have been made, some of the right-of-way secured, and plans for construction are well under way for the projected line from Kansas City to St. Louis, which is to be built by W. B. McKinley, head of the Illinois Traction system. In connection with this project Mr. McKinley has recently purchased the electric railway systems at Atchison and Topeka, Kans.

The J. H. Flick Construction Co., 84 Van Buren St., Chicago, Ill., has been awarded the contract for constructing the interurban line from St. Joseph to Savannah, Mo.

St. Louis Items.

BY A. B. KOENIG.

The L. J. Smith Construction Co. expect to finish ballasting the Missouri Pacific R. R. in Colorado this week and as soon as through will move their outfit to ballast the Wichita Division of this same road.

L. A. Nutter, General Superintendent of the L. J. Smith Construction Co., stopped off a day here on his way to Kansas City from Wynne, Ark.

Minor Meriwether, well-known attorney and receiver of the city of Memphis during the reconstruction period died here last week at his home, 3716 Dolmar boulevard, at the age of 84. Mr. Meriwether's suggestion resulted in the Tennessee Legislature abolishing the charter of Memphis when it was unable to meet its obligation after the war.

Costello Bros. have their steam shovel and team outfit at work on the Big Four R. R. near

Oaklandon, Ind. The Costello boys are making rapid progress with all of their jobs on this line.

Chas. Nagel is getting ready to get out riprap for the Government north of the city.

The cost of sewer construction shows no signs of reducing. The bills proposed for the two sections of North Harlem Joint Sewer district not only were much higher than the estimate of the Board of Public Improvements, but were about $28,000 more than the city was offered a contract for the work six months ago. Two bids were received for the first section of North Harlem Joint Sewer district. John F. McMahon offered to do the work for $164,588.15 and the Fruin-Colnon Contracting Co. submitted a bid of $191,405. The estimated cost was $141,000. On the second section the Southern Construction Co. offered to do the work for $158,910.80; John F. McMahon bid $162,483.35 and Fruin-Colnon Contracting Co. bid $173,778.90. The estimate was $148,000. The cost of cement has increased so much that contractors have refused to bid on the work within the estimates of the board. The aggregate of the two low bids yesterday is $323,498.95, while the low bid for the work six months ago was $295,189.25.

The decrease in building operations in this city for May of this year, as compared with the corresponding month last year shows up favorably with any of the other large cities of the country. The percentage of decrease here was much smaller than in many of the other cities. The fact became known recently when the monthly reports of the building departments of forty-two cities were made public. The decrease here for May was 13 per cent. The total operations for the month were $1,581,717, against $1,823,926 for May, 1909. In Chicago the falling off was 40 per cent, and in New York 23 per cent. San Francisco showed the greatest loss of any of the large cities. It was 62 per cent. Philadelphia had a falling off of 9 per cent and Cleveland 31 per cent. The total building operations for the principal cities of the United States for May, 1910, were $61,804,336, against $75,494,067 for the corresponding month of 1909.

M. J. Roach of Memphis, Tenn., has moved his largest outfit from Gale, Ill., onto the big levee job at Rosedale, Miss.

Mr. Gifford of List & Gifford left here for the south to begin on their double track work on the Iron Mountain R. R. between Bald Knob, Ark., and Poplar Bluff, Mo.

C. H. Hilliard, 136 Hardin Ave., Jacksonville, Ill., has 200,000 yds. of slip, wheeler and machine work on the Springfield & Jacksonville Interurban Line to sublet.

John Kuert & Co. have started their concrete work on the McCoupin County R. R. the other day.

The Ferguson Contracting Co., 318 Commerce Bldg., Kansas City, are advertising in the local dailies for a team outfit to do 40,000 yds. of grader and scraper work, either by contract or day.

A. B. Koenig is going to leave here Monday night to spend a week fishing at the Club house at Corning, Ark. Several of our local contractors who are expert fishermen and fly casters will be with Koenig. A liberal supply of bait has been shipped to Corning the past week and there is not much danger of this party suffering from this source.

Jas. Ward has his outfit at work at Madisonville, Ky.

E. Y. Sutherland, 2208 Salisbury St., St. Louis, has finished his pile driving and trestle work on the Iron Mountain R. R., between Chester and Thebes, Ill. He has two pile drivers idle and is in the market for this kind of work.

New York Notes.

FROM CORRESPONDENTS AND OTHER SOURCES.

The Auburn & Syracuse Electric R. R. Co., T. H. Mather, Chief Engineer, Syracuse, will, it is said, have work started soon on its cut-off between Skaneateles and Auburn.

The Schenectady Ry. Co., of Schenectady, has been granted permission by the State Public Service Commission to sell its right in the franchise to operate on Central Ave. from Watervliet Ave. to the western boundary line of Albany to the United Traction Co. of Albany. The commission has approved the agreement by the Schenectady company as agent of the United Traction to use the latter's tracks in Albany, Troy, Watervliet and Green Island. The commission also authorizes the Schenectady company to lease to the United Traction the franchise granted in Watervliet to operate on 19th St., 6th Ave. and 25th St.

The State Public Service Commission has authorized the Mohawk Gas Co. to operate in the town of Niskayuna.

The Cortland & Auburn R. R. Co. of Cortland, which proposes the construction of a railroad between Cortland and Auburn, has elected the following officers and directors: President, Benjamin L. Webb; vice president, N. A. Bundy; general manager, N. A. Bundy; treasurer, Elliott L. Stone; secretary, W. D. Tisdale. It is reported that construction work will be started this season.

The Pennsylvania R. R. is planning to have work started soon at Newark, N. J., on its Market St. terminal to be built in connection with other proposed improvements which are to furnish a high-speed line between Newark and New York, with terminals at Military Park. The Newark terminal will be just south of the site of the present Market St. station.

The Allied Industries Co., of Newark, N. J., has been incorporated with a capital stock of $550,000 and proposes to engage in a general contracting business, constructing railroads, bridges, etc. The incorporators are Wm. W. Wilson, Pearl River, Rockland County, N. Y., David T. Gately, 373 Sixth Ave., Brooklyn, N. Y., and Nathan G. Wells, Penn Yan, N. Y

The Frontier Electric Ry. Co., which proposes to build an electric railway from Buffalo to Niagara Falls, has applied to North Tonawanda for a franchise through that place. The line will be built on private right of way, and will follow the Erie R. R. from Tonawanda to Buffalo. The rest of the route will be over the right of way of the Buffalo Thousand Islands & Portland R. R. The franchise obtained by the promoters of the railroad years ago would be used by the new company. Right of way has been obtained in Tonawanda, and the company has bought most of the property in North Tonawanda that will be needed.

L. B. Cleveland, of Watertown, at present engaged in the construction of a retaining wall for the New York Central & Hudson River R. R. along River St., at Watertown, has been awarded the contract by this company to build the subways for the entrance of the trains to the new station at that city.

The Boston & Albany R. R., F. B. Freeman, Chief Engineer, Boston, Mass., on June 8, filed a petition with the Public Service Commission asking for authorization to issue $2,000,000 bonds. The proceeds of the bonds are to be used for the payment of work already done or under way and for improvements to be made this year. Among the items are: Grand Junction railroad, third tracking and additional main tracks, $168,000; East Cambridge developing delivery yard, $50,000; Chelsea, new freight house, $6,500; Worcester, elimination of grade crossing and new passenger station, $400,000; four-tracking layout, South Worcester, $215,000; signals and interlocking, $331,000; bridge renewals, $250,000; third-tracking and additional main tracks connecting third track between East Greenbush and Rensselaer, $125,000; passing tracks and sidings at West Brookfield, Westfield, Washington, Canaan, State Line and East Chatham, $49,000; engine facilities at Beacon Park, West Springfield, North Adams Junction, Hudson and North Adams, $43,200; enlarging team delivery yard at Natick, $5,000; team and coach yard at South Framingham, $35,000; 60-car yard at Westfield, $10,000; widening track centers and additional two-track tunnel for eastbound main tracks at State Line, $150,000; and buildings at West Springfield, Becket and Westboro, $34,000.

The Brooklyn & Jamaica Bay Railway Co., has filed articles of incorporation with the Secretary of State at Albany. The company which has a capital stock of $100,000 plans the construction and operation of a railroad, a surface road from the intersection of Montauk and Liberty Aves. in Brooklyn, to a point at the mouth of Spring or Mill Creek, where it empties into Jamaica Bay, in Queens County and also to a point on Jamaica Bay in Brooklyn, where Montauk Ave. would end if extended. The directors of the company are as follows: Horace J. Subers of Ashbourne, Pa.; Nelson S. Easton, Daniel Von Wien, Edward S. Churchill, Marvin D. Hubbell and J. Douglass Wetmore of New York City and Frederick B. Langston, John Woodenbury and Richard F. Sears of Brooklyn.

A committee appointed by the State Legislature of Massachusetts to investigate the feasibility of constructing a railroad between Boston and Buffalo, N. Y., has reported such a project advantageous to the business world.

The New York & Hudson River R. R. is reported to have tentative plans under way for the construction of a large roundhouse at Brighton, near Rochester, and the establishment of freight yards near it. The plan proposes the removal of the present East Rochester freight yard.

The International Surface Contact Co., of New York City, has been chartered under the laws of Delaware, with a capital stock of $1,500,000, and proposes to operate and maintain surface railways.

The Hoosick Falls R. R. Co., of Hoosick Falls, N. Y., has been incorporated with a capital stock of $100,000 and proposes the construction and operation of railway lines, etc. The incorporators include Charles L. Livingstone, 149 Broadway; John G. Parker, Grand Central Station; Edward C. Brown, Grand Central Station, all of New York, N. Y.

The Rochester Belt Line Ry. Co., of Rochester, N. Y., has filed articles of incorporation with a capital stock of $2,500,000, and proposes the construction of a freight belt line around the city. It will be about 15 miles in length and will make possible interchange of traffic among the various lines entering the city. The Board of Directors include the following: Henry C. Brewster, President of the Traders National Bank; V. M. Smith, President of the Rochester Trust and Safe Deposit Co., Rochester and Frank A. Dudley, Niagara Falls, N. Y.

Ohio Notes.

FROM CORRESPONDENTS AND OTHER SOURCES.

The Pennsylvania R. R. has submitted its proposition to the City Council of Alliance for doing away with grade crossings over its line through the city.

The Carland Construction Co., Toledo, has been awarded the contract for constructing the new line of the Ohio Electric Ry. from Hamilton to Middletown. The old road will be followed from Hamilton to near Four Mile creek, then a fill will be made across the low land to Coke Otto. After the line is constructed through Coke Otto, the tracks will follow the C., H. & D. to Trenton. From Trenton there will be a cut to Elk Creek and then a fill east to Middletown. The line will be completed during the summer.

The City Council of Columbus has passed ordinances for the elimination of grade crossings at five points on the west side at Columbus touched by the tracks of the Baltimore & Ohio Southwestern R. R. The work will cost about $375,000.

The Columbus Railway & Light Co. has been granted a franchise to lay tracks and operate an extension of the Schiller St. line at Columbus from the present terminus at Parsons Ave. east in Schiller St. to Lockbourne Ave.

City Landscape Architect Rettig of Cleveland is preparing plans for an outer harbor at Gordons Park, Cleveland.

The Fifth Avenue Ry. & Light Co. has been organized at Columbus with a capital stock of $10,000 and proposes to build a line in 5th Ave., Columbus, from East Columbus to Grand View at Marble Cliff. It is estimated that such a line would cost $200,000. A. C. Wolfe, E. W. Yantes, J. E. Fippin, J. W.

Jennings and W. Cushing, all of Calumbus, are interested.

The Central Dredging Co., of Cleveland, has been incorporated with a capital stock of $100,000. E. M. Graves, the dredging contractor, of Cleveland, who was recently awarded a large contract on the New York State Barge Canal, is one of the incorporators.

The Western Ohio Railroad Co. has been incorporated with a capital stock of $10,000 and headquarters at Lima, O., and proposes the construction and operation of railroads. The incorporators are Frank H. Ginn, Albert E. Green, G. M. Cummings, Grover Higgins and John M. Garfield.

W. C. Phelps, Cleveland, has been in Sandusky, to look over the matter of building an electric line to Cedar Point from some point near Rye Beach, where it would connect with the Lake Shore Electric. Mr. Phelps has a franchise for such a line.

A promoting organization has been formed at Akron with C. Keith as President and Arthur Wright, secretary, for doing the preliminary work for a new electric line between Alliance and Akron. About $5,000 of stock subscriptions have been secured and this sum will be used for preliminary work.

Plans have been completed by D. H. Burnham & Co., Architects, Chicago, Ill., for the new terminal station to be erected at Third and Rich Sts., at Columbus, for the Ohio Electric railway. The building proposed is to be two stories high but built to carry many more. It is to cost not less than $175,000. The site has already been cleared.

Fred Bimel, of Portland, vice-president of the Cincinnati, Bluffton & Chicago railway; John C. Curtis, of Huntington, general manager of the C., B. & Q.; Henry George, of Chicago, a director of the same road; John Romer, of St. Henry, and W. D. Hawkins, of Portland, are said to be back of a project to build a steam railway from Bellefontaine, O., to Portland, Ind., a distance of 60 miles.

Oklahoma Notes.

FROM CORRESPONDENTS AND OTHER SOURCES.

The Oklahoma Union Traction Co., A. A. Small, President, Tulsa, Okla., is stated to have secured the necessary capital for the completion of its lines, and will, it is said, have work started shortly on an interurban line between Tulsa and Sapulpa. This line will require the construction of a bridge over the Arkansas.

The promoters of the Kansas City, Tulsa & Southwestern, which projects a line from Kansas City to Paris, Tex., have decided to build a line from Joplin to Tulsa. It is reported that the line has been financed and that grading work will soon be started over a route already surveyed. The principal officers of the Kansas City, Tulsa & Southwestern are Tulsa men. Col. C. B. Lynch is president of the company.

The Hines Chicago Construction Co. of Oklahoma City, has been granted a state charter. This company was organized for the purpose of constructing the International & Great Southern R. R., for which a charter was taken out in 1904, but nothing further has since been done. It is understood one line of the new road is to go northwest from Oklahoma City to Buffalo, in Harper County, and thence on to Trinidad, Colo. The Hines Company has a capital stock of $50,000, and the following directors: P. A. Hines and F. J. Karasek of Chicago, and Ed Glasgow of Oklahoma City.

The Chicago, Rock Island & Pacific Ry. has had surveyors in southwestern Oklahoma and the Texas Panhandle running a line for a contemplated extension of its Chickasha-Mangum line west from Mangum into the Texas Panhandle country. The rapid construction of the Wichita Falls & Northwestern R. R. north and northeast into what has heretofore been Rock Island is believed to have something to do with the activity of the Rock Island.

Advices from Wakita, Okla., are to the effect that the Atchison, Topeka & Santa Fe R. R., has decided to reconstruct the old Hutchinson & Southern (Hog) Railroad, as far as Ponca City or Blackwell. The work will include laying new ties and steel and resurfacing the roadbed. R. W. Reece, Wakita, Okla., will be in charge of the work.

Grading work has been started just north of Stillwater on the Morrison Division of the Oklahoma Public Service & Interurban lines. The section will be 13 miles long, and Dan Sweeney & Co., Oklahoma City, have the grading contract.

Oregon Notes.

FROM CORRESPONDENTS AND OTHER SOURCES.

The Oregon Valley Land Co., according to advices from Lakeview, Ore., has awarded the contract for constructing the Drews Valley reservoir dam to E. S. Burney at about $125,000. The dam when completed will be 65 ft. high with a base of 140 ft. and the top 12 ft. wide. It will be built of rock entirely, the lower part being faced with solid masonry while the upper part will be faced temporarily with lumber.

The Oregon Trunk Line Ry. has opened headquarters at Bend, for the construction of the 125 mile section, the contract for which was awarded a short time ago to H. C. Henry, of Seattle, Wash. J. J. Cryderman, Division Engineer of the Oregon Trunk Line is the representative of the railroad and Malcolm McPhee will be in charge for the contractor.

The City Council of Eugene has granted a franchise to J. F. Mounce to build a steam railroad over certain streets of the city to be used in connection with a steam line which he proposes to build from Eugene to the Coast. Surveys have been under way for some time.

The Oregon Trunk Line has placed an order with F. L. Botsford Lumber Co. of Portland, for 500,000 railroad ties to be used in construction of the line into central Oregon. The ties are to be distributed as required in the construction of the road towards Klamath Falls.

According to an announcement reported to have been made by President Francis H. Clarke, of the Coos Bay & Oregon Central R. R., construction work will be started on the line from Coos Bay to Boise, via Roseburg, Ore., before September 1. Surveys have already been completed and financial arrangements are being made with comparatively little trouble.

H. C. Henry, Seattle, Wash., who has the contract for constructing the 126 miles of Oregon Trunk Railway from Madras south to the north of the Klamath Indian Reservation has let the last sub-contract to Nelson Bros. With one exception, every contract is in lengths of from two to 12 miles. All the contractors, with the exception of Nelson, have their camp outfits on the ground and are ready to start work at once. The camps at present are not ready to take care of a great influx of labor, but have had no difficulty in getting filled to their present capacity.

Pennsylvania Notes.

FROM CORRESPONDENTS AND OTHER SOURCES.

Sub-contracts for work on the Western Maryland R. R. extension have been let by the Carter Construction Co., the general contractor, as follows: Beginning at Cumberland, Md., the eastern end of the connecting link: Mile 1 to 21, John B. Carter Co., Indianapolis, Ind.; mile 29 to 32, Head & Right, Chicago, Ill.; mile 33 to 35, Fisher & Caroza, Baltimore, Md.; mile 36 to 43, Conestoga Construction Co., Pittsburg, Pa.; mile 44 to 46, Ryan & Wannington, Springfield, Mass.; mile 47 to 50, Patton & Lapsley; mile 54 to 58, American Engineering Co., Indianapolis, Ind.; mile 62 to 67, Foley Bros., Pittsburg, Pa.; mile 69 to 71, Handon & McCourt Co., Akron, O.; mile part of 71 to 77, F. W. Stanley Construction Co., Conneaut, O.; mile 78 to 80, W. M. Bates, Memphis, Tenn.; mile 81 to 83, R. Galiardi, Connellsville, Pa.; mile 84 to 87, Robert Will Construction Co., New York city, N. Y. The Hagerstown Cement Co. has secured the contract to furnish 250,000 bbls. of cement.

The Johnstown Passenger Ry. Co., G. Nelson Smith, Chief Engineer, Johnstown, will soon have work started on the extension of its Southwest line. The supervisors of Upper Yoder township have granted the company permission to construct its trolley extension from the limits of the city in the Eighth ward to the new suburban residence town of Southmont, thus removing the last official barrier to the construction of the road.

The Sylvan Dell Park Ry. Co., has been incorporated with a capital stock of $24,000 and headquarters at Williamsport and proposes the construction of a 1½-mile line from South Williamsport to Sylvan Dell Park.

The Mt. Washington Incline Plane Co., of Pittsburg, Pa., recently chartered with a capital stock of $5,000, will take bids shortly for the construction of an incline plane from a point in Bailey Ave., 775 ft. east of William St. to a point in Carson St., where it intersects Brownsville Ave., Pittsburg. A. B. McGrew, F. B. Maloy, M. O'Herron, W. J. Munson and J. G. McCalmont of Pittsburg are interested.

Texas Notes.

FROM CORRESPONDENTS AND OTHER SOURCES.

Good progress has been made in the construction of the Galveston-Houston interurban line, the status of the work on June 1 being about as follows: The hydraulic fill on Galveston island, consisting of 120,000 cu. yds., for which the North American Dredges Co. was the contractor, has been completed, and the work of grading and track laying will be pushed on that portion during the summer. The causeway also is well under way. Concrete piling has been driven from the island end to a point where the first arch will be built, this being a considerable way toward the center. On the mainland end the piling has been driven to a point about midway between the first arch and the land. Piling for nineteen of the arch piers has been driven, leaving only five, including the two lift piles, to be completed. Upon several of these concrete has been poured, while a number have been brought above the waterline. On the mainland, J. C. Kelso of Galveston has completed about 21 per cent of the grading. This includes a large portion of the 16-mile strip between a point two miles this side of the causeway approach to Clear Creek. At Dickinson's bayou, piling for the bridge at that point is being driven. On the 19-mile extension between Clear Creek and Brays bayou, Harty & Ford began work about May 15.

The Houston Electric Co., David Daly, Manager, Houston, is to extend its Arkansas Pass line for 13,000 ft. in the Third Ward at Houston at a cost of about $60,000.

C. D. Alexander of Dallas and associates are reported to be negotiating for the purchase of the Bartlett-Florence Ry., a 24-mile line, with the view of extending it west from Bartlett to Marble Falls, Tex., and east from Florence to some point not as yet decided upon.

The Pecos & Toyah Lake Irrigation Co. of Pecos has been incorporated with a capital stock of $1,500,000, the incorporators being J. N. Levin, R. S. Johnson, T. H. Beauchamp, all of Reeves and Pecos counties.

A horseback survey has been made of the country between Temple and Marble Falls to obtain information as to the practicability of a line of railway to connect the two points named. In the event that the country is found to lend itself readily to construction that is of not too costly a character a project will be launched, having for its object a line connecting Temple and Del Rio via Marble Falls, Fredericksburg and Kerrville.

Bids were opened June 15 by O. Owen, Port Arthur, for building in Lake Sabine, opposite Port Arthur, Tex., in 4 ft. of water, an island 700 ft. by 700 ft., formed of concrete or wood revetment, dirt fill, approached by causeway 2,000 feet by 100 feet, wood revetment, dirt fill.

The Galveston, Harrisburg & San Antonio Ry. has applied to the State Railroad Commission for authority to issue $5,384,000 of bonds for the Galveston-Victoria division. This portion of the lines never has been bonded, comprising the old San Antonio and Gulf lines

and that new portion between Stockdale and Cuero. The bonds are being issued for general improvements over the lines and if granted will be issued on the valuation of the lines made at the time of their sale in 1904, plus the betterments. This old portion of the line extends from San Antonio to Stockdale, while the Gonzales branch is also an older portion that was purchased several years ago. The new portion, completed in 1906, extends from Cuero to Stockdale, a distance of 38 miles. There are other little branches and roads acquired in the general purchase several years ago.

Track laying out of Temple on the Temple Northwestern Ry., will be started about July 1. All grading work for the entire line between Temple and Hamilton will be ready for the steel by Sept. 10. W. J. McDaniel, Temple, is President. D. J. Grigsby, Dallas, is the Contractor.

Cane growers, whose property adjoins the Indiana co-operative canal at Brownsville are considering means of securing an extension of the St. Louis, Brownsville & Mexico Ry. into their irrigation area. In order to secure the extension the cane growers must furnish right-of-way through the city of Brownsville so that the St. Louis, Brownsville & Mexico Ry. would be enabled to make connection with the road connecting Brownsville and Point Isabel. From some point on this road they must give right-of-way to the terminus they select and must turn it over to the railroad company graded and ready for the ties.

C. S. Fowler & Bro., according to advices from San Antonio, have purchased the O'Connor ranch in LaSalle county, one of the largest ranches in Southwest Texas. The purchase price was about $500,000 and the land is to be used for colonization purposes.

The Crystal City & Gardendale R. R. Co. has filed its charter. The company has a capital stock of $45,000, and proposes to build a line to run from the junction of the International & Great Northern at Gardendale, LaSalle county, to crystal City, Zavalla county, the line to extend through LaSalle, Dimmitt and Zavalla counties, a total distance of 40 miles. The incorporators include Mason Williams, H. L. Howard, S. P. Brundage, Eli Howell, Adolph Groos, W. F. McCaleb, all of Bexar county and A. R. Ponder of Crystal City.

The Naples & Northwestern Ry. Co., has been chartered with a capital stock of $100,000 and proposes to build a line from Naples to Sylvester in Titus County, a distance of 85 miles. The incorporators include Max Krosse and F. T. Atkinson, Cincinnati; Frank Stacke, W. W. Southworth, J. R. Conley and Charles B. Todd, all of Naples.

Officials of the Velasco, Brazos & Northern R. R. (Houston & Brazos Valley) have been conferring with the State Railroad Commission with a view of registering bonds on a 4-mile extension of road from Velasco along the Brazos River to the lighthouse, and on additional values upon the entire line of 20 miles length due to improvements and betterments.

Citizens of Dimmitt have offered to give a bonus of $50,000 and right-of-way for the construction of the Hereford North & South R. R., to that place. Hereford has offered a bonus of $100,000 to the same road and it is now thought that the road will be built.

The Houston Electric Co., operating a street railway project at Houston, is to expend $16,000 in stringing an extra overhead copper wire in the business section of the city, to prevent electrolysis.

Capitalists of Fort Worth are considering a project for the construction of an interurban line from Corsicana via Fairfield to Crockett. W. J. Miller, Fairfield, is interested.

Agreements have been signed at Weatherford for the building of the Chicago, Weatherford & Brazos Valley from that city to Bridgeport. Weatherford gave $60,000 bonus, Peaster $7,000; Poolville, $15,000; Booneville $4,500; Bridgeport $12,000. The work of grading is to be started July 4.

Surveys have been started at Cotulla and are being run in both directions from that place for the proposed line of the Corpus Christi of Del Rio R. R. The survey will be completed about July 1. Arrangements have been made to take up as soon as the survey is finished the matter of bonuses and right of way. J. H. Collins, 88 LaSalle St., Chicago, Ill., is stated to be in charge of the surveys.

The Hughes-O'Rourke Construction Co., of Dallas, has been awarded the contract for the bridges for the St. Louis Southwestern extension from Gatesville to Comanche. This work consists of three bridges with 135-ft. spans across the Leon River, with several culverts and smaller bridges along the line. The concrete abutments of the three bridges range from 50 to 75 ft. in height, and are heavy work. This work is to be completed to Hamilton ready for operation of trains by Sept. 15. Thompson & Scott, St. Louis, Mo., general contractors for the extension line, started grading at Gatesville.

Good progress is being made on the construction of the proposed line of the Uvalde & Crystal City R. R. It is now complete from Crystal City, Ark., to Carizo Springs. From Gardendale west towards Crystal City about 18 miles has been graded and from Crystal City east towards Gardendale seven miles has been graded. The entire distance is 41 miles and the gap between the two graded sections is being rapidly closed up.

About three-fourths of the main line of the Santa Fe R. R. between Denver and Galveston, Tex., have been completed. The two links which will be built this year are between French and Clovis, N. Mex., and Clovis, on the cutoff to Coleman, Tex., a total distance of 250 miles.

Rumors from Quanah, Tex., are to the effect that the Chicago, Rock Island & Pacific Ry., has preliminary surveys under way for the construction of a line from Chattanooga, Okla., to Quanah, where a connection will be made with the Quanah, Acme & Pacific, now under construction to Roswell, N. Mex., and thereby get a shorter route to El Paso, Tex.

The construction forces of the Paris & Mount Pleasant Ry. Co., have completed 25 miles of grading on the proposed 55-mile line and R. W. Wortham, Paris, Tex., of the company is preparing to file an application for the issuance of bonds. As projected the route is from Paris to Mt. Pleasant, Texas.

Commercial Clubs of Dallas and Coleman, Tex., are taking active steps toward securing right of way and necessary bonus to insure the construction of the Santa Fe line from Cleburne to Coleman, the terminus.

Grade revision work on the Santa Fe between Temple and Coleman, was started early in June at Temple, with 200 men and a steam shovel. The work is being done under the supervision of J. P. Shortall of Chicago, superintendent of the C. H. Sharp Construction Co., which has the contract for the work.

The City Commissioners of Palestine are considering an application by private parties to grant them a franchise for the construction of an electric street car line. The proposition provides for early construction of the line, two miles to be completed the first year and two miles each succeeding year thereafter until eight miles have been completed.

Utah Notes.

FROM CORRESPONDENTS AND OTHER SOURCES.

The Salt Lake & Ogden Ry., E. A. Vail, Chief Engineer, Salt Lake City, which was recently changed from a steam to an electric line, is to at once double track its entire line of 50 miles.

H. A. Strauss, C. E., President of the Falkenau Electric Co., Chicago, Ill., has been making an investigation as to the feasibility of constructing an interurban electric line between Salt Lake City and Payson. If the report is favorable a company will be organized to construct and operate the line. S. L. Chipman, American Forks, and A. J. Evans, are interested.

Division Superintendent A. F. Brewer, of the Oregon Short Line Ry., at Salt Lake City, Utah, is preparing for the construction of three spurs in Brigham City in order to add to the facilities for the increasing business at this city.

Virginia Notes.

FROM CORRESPONDENTS AND OTHER SOURCES.

Announcement has been made at the Lynchburg, Va., office of the company that the Rockfish Valley Ry. will be built up the Rockfish river valley from a point on the Southern railway not far from North Gardens.

Northern capitalists have purchased land two miles north of Lynchburg and will develop it for building purposes. It is understood that the Lynchburg Traction & Light Co. will extend its line to the property.

The Graham Electric Ry. Co., of Graham, Va., has been incorporated with a capital stock of $50,000, the officers of the company being as follows: J. F. Dudley, President, William Mitchell, vice-president; R. B. Williamson, Secreatry and C. W. Keister, treasurer, all of Graham, Va.

West Virginia Notes.

FROM CORRESPONDENTS AND OTHER SOURCES.

The Burnsville, Glenville & Parkersburg Electric Ry. Co., of Parkersburg, W. Va., has been incorporated with a capital stock of $10,000 and proposes to build an electric line from Burnsville by way of Glenville to Parkersburg. The incorporators are: N. J. Bartlett, J. B. Supler, Clarksburg, W. Va.; L. W. Bartlett, C. E. Hines and Henry Sipes of Buchannan, W. Va.

Ramage, Wolfe & Co., Fairmont, W. Va., have been awarded the contract by the Clarksburg & Weston Traction Co., which projects a line from Clarksburg to Weston, for constructing seven miles of road between Clarksburg and Mount Clare. The contract amounts to about $85,000 and work has been started.

The City Council of Sistersville has granted a new franchise to the Parkersburg & Ohio Valley R. R. and it is said that the line will be completed at once to Friendly and later to Williamstown.

A committee from Hedgesville, of which A. C. Dunham was chairman, has been in conference with the officials of the Hagerstown Ry. Co., Hagerstown, Md., in an attempt to have the company extend its electric railway from Williamsport to Winchester, by way of Hedgesville.

The State Line & Southern Ry. Co., has been chartered in West Virginia to build a road from about 800 ft. west from the west river bank of the Monongahela River at the West Virginia-Pennsylvania line to a point near Rivesville in Marion County. The company is capitalized at $10,000. The incorporators are Samuel D. Brady, H. M. Schrader, R. E. Kerr, of Parkersburg; B. M. Laughead, of Morgantown; Charles Morris, of Fairmont. Mr. Brady is chief engineer and Mr. Morris right-of-way agent for the Buckanon & Northern.

Washington Notes.

FROM CORRESPONDENTS AND OTHER SOURCES.

The directors of the Oregon & Washington R. R., J. D. Farrell, General Manager, Seattle, Wash., have filed resolutions with the Secretary of State, announcing intention to construct a branch from near Winlock, 67 miles easterly to Sulphur Springs, all in Lewis county.

The Vancouver, Camas & Washougal Traction Co., has filed articles of incorporation with the secretary of state. The company is capitalized at $100,000 and has its headquarters at Vancouver, Wash. A charter for 50 years has been granted the company which proposes the construction and operation of a line from Vancouver to Washougal in the southern part of the state. H. C. Phillips, W. D. Smith and E. M. Rands, all of Vancouver, Wash., are the incorporators.

The Alaska Northern R. R., O. G. Labrea, President, Spokane, Wash., according to reports is shortly to let contracts for the construction of 170 miles of railroad running

from its present interior terminal into the Matanuska coal fields in Alaska and to a point on the Susitana River, in the direction of the Iditarod gold fields. The road will follow the old survey of the Alaska Northern to Mile 146. From that point, one branch will run out to the Matanuska coal fields, 38 miles, and the other branch will run toward the Iditarod.

According to a statement reported to have been made by George Donald, President of the Toppenish, Simcoe & Western R. R. the line will be pushed on from Toppenish to a point near Lyle on the Columbia River. About 20 miles of the road has already been constructed.

The Puget Sound and Baker River R. R. Co., a subsidiary concern of the English Logging Co., is planning the construction of its logging road from timber holdings in Skagit County to Deep Water and both LaConner and Anacortes, Wash., seek to be the terminal.

The Northern Pacific will shortly begin laying 90-lb. rails on its lines between Pasco and Walla Walla to enable faster operating time and use of heavier power equipment.

Wisconsin Notes.

FROM CORRESPONDENTS AND OTHER SOURCES.

All right of way has been secured for the projected interurban line from Janesville to Madison and it is planned to have construction work started in July and completed in December. This is the line being promoted by the Cincinnati Construction Co. and officers of the company together with J. J. Hartley of Philadelphia and E. M. Maxwell of Cincinnati, who are under contract to build the line, were in Janesville recently going over the route.

It is stated that an engineer employed by the State Railroad Commission to investigate street car conditions in Milwaukee has reported that additional franchises permitting the Milwaukee Electric Railway & Light Co. to build cross town lines at Milwaukee, crossing the Menominee River are needed.

The capacity of the switching yard at Milwaukee having been about reached, officials of the Chicago, Milwaukee & St. Paul Ry. are considering building a cutoff at or near Brookfield. By building a cutoff west of the city the Milwaukee road could divert through freight trains consigned to Chicago or Eastern points or coming from Chicago and consigned to Western points. The Milwaukee freight yards could be used almost exclusively for handling local business.

Stockholders of the Chicago, Racine & Milwaukee R. R., have decided to increase the capital stock of the company from $100,000 to $250,000.

The Board of Public Works, of Milwaukee, has awarded a contract to A. T. Bues, at 12½ cts per cu. yd., for dredging in the inner harbor for the city. About $25,000 worth of work will be done.

The McGavock Construction Co., of Beloit, Wis., has about 200 men at work on its contract for grading for the C. & N. extension from Milwaukee to Sparta, Wis. The company has the contract for the 6½-mile section between Jonesville and Oxford, near Portage, Wis.

Canadian Notes.

FROM CORRESPONDENTS AND OTHER SOURCES.

Michael McCormick, of Sudbury, Ont., has started work on his contract for building the Canadian Pacific spur line into Byng Inlet. The spur line will be 1½ miles in length, starting from mile 64 on the Toronto-Sudbury branch. There are now about 50 men employed on the work and it is expected that the line will soon be completed. The railway company is also starting to erect a big coaling dock at Byng Inlet into which they will run a spur line.

J. S. Gregory, St. John, has been awarded the contract for dredging the Oromocto Shoals near Fredericton.

Grading work on the Canadian Northern line from Strathcona, Alta., to Camrose, which is the final connecting link on the colonization extension which will join Strathcona and Calgary next summer, will be started shortly and the grade built for 25 miles this fall.

It is reported at Montreal that the Canadian Northern Ry. will purchase St. James Methodist church on St. Catherine St. and build terminals on the site. To reach this part of the city it will be necessary for them to tunnel under the mountain.

As a preliminary for the improvement of the harbor at water front at Toronto, the Board of Control has passed a resolution that a committee consisting of the Board of Control and the Chairmen of the Works, Property, Parks, Fire and Light, Legislation and Island Committees be recommended to Council to go into the whole question of placing Toronto's water front and harbor under a commission.

The Canadian Northern Ry. will let contracts on June 15 for the construction of a 61-mile section between the south side of New Westminster railway bridge and Chilliwack. A start will be made opposite New Westminster, B. C., where the railway company has acquired an area of over 2,000 acres. Other sections of the road between Chilliwack and Yellowhead Pass will be placed under contract just as soon as the final surveys have been approved. T. Turnbull, Winnipeg, Man., is Assistant Chief Engineer.

The Canadian Pacific Ry. has purchased the Government House property at Toronto for $800,000, but will not take it over until 1912. The purchase is supposed to be a part of a big scheme of improvements at Toronto.

The Canadian Northern R. R. is stated to have opened bids for work on the construction of its line from Hawkesbury, Ont., to Montreal. The line will cross the river at Hawkesbury and run easterly through Carillon, St. Andrews and St. Eustache to Hochelaga and Montreal. Both the route and location maps have been approved by the Railway Commission.

The contract for district four of the Trent Valley Canal, to the south of Campbellford, has been awarded to Hanly, Quinlan & Robertson of Toronto and Montreal. The total amount of the contract is something over $1,000,000. The same contractors were awarded the contract for district six last month, involving an expenditure of $600,000.

Mexican Notes.

FROM CORRESPONDENTS AND OTHER SOURCES.

The National Rys. of Mexico, James M. Reid, Chief Engineer, City of Mexico, according to reports, will soon resume construction of the short line to connect Tampico with the City of Mexico. At the time the Mexican Central Railroad passed into the hands of the government, two years ago, it was constructing the Tampico-City of Mexico line. It had about 50 miles graded and some track laid from a point on its line some 25 miles from Tampico. Construction ceased when the road became a part of the National Railways of Mexico. The survey for this line calls for a low-grade route, notwithstanding the fact that it must mount from sea-level to an altitude of nearly 8,000 ft.

An organization with the following officers has been formed at the City of Durango to secure the construction of a railroad to connect Durango and Gutierrez: Carlo Bracho, president; Fortino de la Barcena, vice president; Jaime Gurza, secretary; Ricardo G. Saravia, assistant secretary; Manuel de la Parra, treasurer.

The Candelaria Mining Co., operating silver mines at San Pedro, Chih., has been making surveys for a 3-mile spur from the Mexico Northwestern Ry. to the plant.

Dr. Coe, an engineer of City of Mexico, is now in the field to select the route for the projected railroad of the Vera Cruz, Tabasco & Campeche R. R. Two routes for the road have already been located. Both have Santa Lucrecia and Campeche as the terminal points. Both routes run from Santa Lucrecia to the town of Hato de Oro, and from Salto on the Tulija river to the city of Campeche. The only difference is between Hato de Oro and Salto.

The Gigante Mountain Tunnel & Ry. Co., is stated to have secured a concession for a railroad from Guadalajara to San Felipe, Mexico, and thence to some point on the Gulf of Mexico. The line will be about 600 miles long. John M. Wiley, New Orleans, La., is President.

Engineers of the Mayo River Power & Land Co., of Denver, Colo., which last year was granted a concession for power development on the Mayo River in Sonora have engineers in the field in Sinaloa collecting data with a view to possible future hydro-electric developments in that state. R. M. Jones, Denver, Colo., is engineer.

It is expected that Engineer Robert Gayol, City of Mexico, Consulting Engineer to the Federal Government in the project for the Canalization of the Rio Nazas, will shortly make a report on the scheme. Plans for the work were completed some time ago by S. Pearson & Son, City of Mexico.

Advices from Chihuahua, Mex., state that it is rumored that the Kansas City, Mexico & Orient R. R. Co., and the Mexico Northwestern Ry. Co. will combine on a line of railroad from Minaca, Chihuahua, to Topolobampa, thus making but one line through the Sierra Madre instead of two. Engineers of the companies are to go over the proposed route at once. W. W. Colpitts, Kansas City, Mo., is Chief Engineer of the Kansas City, Mexico & Orient.

BIDS ASKED

Bridges.

Bids are asked on following work, the notes being arranged alphabetically by states:

St. Jose, Cal.—Until 11 a. m., June 27, by J. G. McMillan, County Surveyor, for the construction of a reinforced concrete bridge on Almaden road over Guadaltipe Creek, about 3 miles south of San Jose.

San Luis Obispo, Cal.—Until 10 a. m., July 6, by Board of Supervisors, for the construction of a steel concrete highway bridge across Salina River at Rector Crossing on the Santa Margarita and Pose Road. H. H. Carpenter is clerk of the Board.

Bridegport, Conn.—Until 4 p. m., June 17, by M. A. Kenny, director of public works, for the construction of a reinforced concrete arch bridge, 77 ft. span, requiring about 2,500 cu. yds. of concrete, on Boston Ave., Bridgeport, Conn.

New Hampton, Ia.—Until 1 p. m., June 15, by F. N. Lentz, county auditor, for a 60 ft. steel highway bridge with concrete floor, at Alta Vista, Ia.

Jeffersonville, Ind.—Until 11 a. m., July 16, by Board of County Commissioners, for the construction of a bridge over Logan Creek. Peter Machand is Auditor of Clark County.

Lawrenceburg, Ind.—Until noon, July 5, by County Commissioners, for the construction of a bridge over Hogan Creek. W. S. Fagaly is Auditor of Dearborn County.

Holton, Kan.—Until noon, June 16, by Board of County Commissioners, for the construction of three county bridges. W. A. Douglas is chairman of the Board and J. W. Martin is county clerk.

Taylor Falls, Minn.—Until 1 p. m., June 24, by Board of Village Trustees and Council, for the construction of a steel arch bridge between the villages of St. Croix Falls, Wis., and Taylor Falls, Minn., over the St. Croix River.

St. Joseph, Mo.—Until June 28, by L. M. Stallard, highway engineer, for Contracts No. 149, 150, 151, 152, for concrete culverts; Contract Nos. 157 and 158, for bridge repairs.

Schuyler, Neb.—Until noon, June 27, by Board of County Commissioners, for furnishing necessary labor and material for the construction of a wagon bridge over the Platte River near this city. M. F. Shonka is County Clerk. Official advertisement of this work will be found elsewhere in this issue.

New York, N. Y.—Until noon, June 21, by Borough President of Richmond, for the furnishing of all the labor and material for the construction of subway ducts and appurtenances in Jay St. from Richmond Terrace to South St. and other streets, together with all work incidental thereto. The work includes the following: 10,750 lin. ft. of double subway duct, each of 3.65 ins. interior diameter, all complete; 67 junction boxes, complete; 40 hand holes, complete; 2 manholes, complete; 16 cu. yds. of concrete pavement foundation taken up and new concrete foundation laid in its place; 96 sq. yds. of iron slag block pavement taken up and relaid with cement grout joints and sand cushion; 720 sq. ft. of cement sidewalk removed and replaced with new cement sidewalk similar thereto; 20 cu. yds. of additional excavation.

Hamilton, O.—Until 10 a. m., June 25, by Board of County Commissioners, for the partial repair of the superstructure of the Woodsdale bridge over the Mississippi River. J. E Brate is county auditor.

Huron, O.—Until 10 a. m., July 9, by County Commissioners for the construction of a highway Rolling Lift Bridge over the Huron River at Huron, O. The work is estimated to cost $50,000. A. C. Schultz is county surveyor.

Sidney, O.—Until noon, June 18, by County Commissioners for the construction and material of a superstructure for one steel highway bridge, 63-ft. span and 16-ft. roadway, across Plum Creek, Franklin Township, near Deweese School. H. T. Ruese is county auditor.

Pittsburg, Pa.—Until noon, June 15, by R. J. Cunningham, County Controller, for the construction of the following reinforced concrete arch bridges: Bridge No. 1, Boggs Run, Moon Township; bridge No. 4, Lick Run, Bethel Township; bridge No. 2, Piney Fork, North Branch, Bethel Township; bridge No. 7, Sewickley Creek, Marshall Township.

Pittsburg, Pa.—At once by Department of Public Works for the construction of three river piers of the North Side Point Bridge crossing the Allegheny River. The work includes about 16,000 cu. yds. of stone and concrete masonry. N. S. Sprague is superintendent Bureau of Construction.

Aiken, S. C.—Until 11 a. m., June 17, by Jesse Green, for repairing Crofts Mill bridge across Saws Creek on Crofts Mill Road.

Sussex, Va.—Until noon, June 16, by county clerk, for the construction of three steel bridges in Sussex County.

Appleton, Wis.—Until 2:30 p. m., June 24, by Board of Public Works for increasing the width of the roadway on Lake St. draw bridge over the United States government canal.

Buildings.

Bids are asked on following work, the notes being arranged alphabetically by states:

Demopolis, Ala.—Until 3 p. m., July 18, by James Knox Taylor, supervising architect, Treasury Department, Washington, D. C., for the construction complete, including plumbing, gas piping, heating apparatus, electric conduits and wiring, of the United States Post Office at Demopolis, Ala.

Monterey, Cal.—Until 11 a. m., June 20, by Arthur Cranston, constructing quartermaster, for the material and labor necessary for the construction of concrete assembly hall and for electric wiring and plumbing and heating of same.

Washington Barracks, D. C.—Until 2 p. m., June 20, by constructing quartermaster, for the construction of an addition to the post guardhouse at Washington Barracks, D. C.

Washington, D. C.—Until 2 p. m., July 5, by Department of Interior, Office of Indian Affairs, Washington, D. C., for furnishing material and labor for the construction of a superintendent's cottage and two employes' cottages at Turtle Mountain Reservation, North Dakota.

Washington, D. C.—Until July 6, by Department of Interior, Office of Indian Affairs, for the necessary labor and material for installing a heating plant and making repairs to the dormitory at Sisseton School, South Dakota.

Atlanta, Ga.—Until noon, July 11, by Robert F. Maddox, Mayor, for the installation of new heating and ventilating plants in 9 of the brick public school buildings of Atlanta, Ga. Official advertisement of this work will be found elsewhere in this issue.

Fort Des Moines, Ia.—Until 3 p. m., June 20, by constructing quartermaster, for the supply and installation of pews and fixtures in Post Chapel.

Independence, Ia.—Until 2 p. m., June 23, by Board of Education, for the erection and completion of a high school building; also for steam fan, heating and ventilating and plumbing apparatus. Harry E. Netcott, Independence, Ia., is architect.

Sioux City, Ia.—Until 7:30 p. m., July 6, by Independent School District, T. C. Prescott, secretary, for the erection of a 4-room brick school building in the Lowell district of the Independent District of Sioux City, Ia.

Fort Howard, Me.—Until 10:30 a. m., July 5, by constructing quartermaster, for the construction, plumbing, steam and electric wiring of guard house and one quarters for four officers; for the construction, plumbing and wiring of fire station and extension to the ordnance repair shop.

Columbus, O.—Until 1 p. m., June 27, by Board of Trustees of Girls' Industrial Home, Columbus, O., for furnishing the labor and material for completing the heating and lighting plant, including steam engines, generators, additions to switchboard, changes in water supply, reinforced concrete coal storage pocket, steel water storage tank, steam heat and electric conduits, underground electric wiring, wiring lamps and fixtures in twelve buildings, reinforced concrete electric light poles, induced draft fan, economizer and other changes and additions to the steam heating and electric lighting for the Girls' Industrial Home at Hyatts, Ohio, located in Delaware County, Ohio.

Wagner, S. Dak.—Until 8 p. m., July 1, by Wagner Masonic Building Association, H. D. James, secretary, for construction of a Masonic Temple building in Wagner, S. Dak. A certified check for $700 must be filed with each bid.

Bremerton, Wash.—Until 11 a. m., July 12, by U. S. Marine Corps, Quartermaster's office, Washington, D. C., for the construction of a marine barracks and officers' quarters at the navy yard, Bremerton, Wash.

Calgary, Alta.—Until June 20, by Hodgson & Bates, Grain Exchanges, Calgary, Alta., for the erection and completion, excepting plumbing, heating, electric wiring or elevators, of a business block on 7th Ave. and 1st St., for Beveridge Bros., Judge Travis and G. J. Ryan.

Regina, Sask.—Until noon, June 18, by R. S. Knight, Inspector, Supply Officer, for the erection of an officer's quarters at R. N. W. M. P. Barracks, Regina. Story and Van Egmond, Regina, are architects.

Winnipeg, Man.—Until 5 p. m., June 22, by William Wallace Blair, 400 Nanton Bldg., Winnipeg, Man., architect, for the construction and completion of a hotel building at Riverside near Proctor, British Columbia or the Canadian Pacific Railway Co.

Ottawa, Ont.—Until noon, June 25, by Department of Indian Affairs, Ottawa, Ont., for the erection of a brick school house on concrete foundation for the Oneida Indian Reserve, Ont. J. D. McLean is Secretary of the department.

Roads and Streets.

Bids are asked on following work, the notes being arranged alphabetically by states:

East Hartford, Conn.—Until 8 p. m., June 16, by E. E. King, East Hartford Fire District, for the construction of about 4 miles of concrete, tar or flagstone walks.

Waukegan, Ill.—Until 8 p. m., June 16, by Board of Local Improvements, for the construction of roads as follows: Docket No. 357: The improvement of a portion of County St., from the north line of Franklin St., to the south line of Ridgeland Ave., by grading, curbing and paving. Docket No. 357: The improvement of a portion of County St., from the south line of Ridgeland Ave. to a point fifteen (15) ft. south of the north line of Ridgeland Ave., by grading, curbing and paving. Docket No. 358: The paving and otherwise improving that portion of McAlister Ave. situated between the north line of Tenth St. and the southerly line of Liberty St., produced, including certain portions of all intersecting streets between said points. Docket No. 362: The improvement of a portion of County St., from the north line of Water St. to the south line of Washington St., by grading, curbing and paving; all in the City of Waukegan, Lake County, Illinois. Fred W. Buck is President of the Board.

Albia, Ia.—Until 2 p. m., June 27 (readvertisement of bids), by city clerk, for the construction of paving in this city. Hall & Adams, Centerville, Ia., are engineers.

Fort Madison, Ia.—Until June 16, by city council for the construction of vitrified brick block pavement on a concrete foundation with pitch or asphalt filled joints. The work includes 16,000 sq. yds. L. G. Kiel is city clerk.

Brazil, Ind.—Until 7:30 p. m., June 21, by city clerk, for the construction of cement sidewalks on National Ave. Jacob Prevett is City Clerk.

Delphi, Ind.—Until noon, July 5, by County Commissioners for the improvement of highways in Deer Creek and Jackson townships. M. G. Haun is Auditor of Carroll county.

Indianapolis, Ind.—Until 10 a. m., June 20, by Board of Public Works, for the improvement of Sherman Drive St. to property line Michigan St. by grading and paving the roadway.

Kokomo, Ind.—Until 10 a. m., June 27, by Board of Public Works, for the grading, paving, curbing and laying sidewalks on Taylor St. Benjamin Havens is City Clerk.

Marion, Ind.—Until 2 p. m., July 5, by County Commissioners, for the construction of a road in Fairmont township. A. Y. Stout is Auditor of Grant County.

Vernon, Ind.—Until 11 a. m., July 5, by County Commissioners, for the construction of 25.6 miles of road in Campbell township. T. L. Thomas is Auditor of Jennings County.

Detroit, Mich.—Until 2 p. m., June 16, by Board of County Road Commissioners, for the construction of concrete roads on Mack and Gratiot Roads. John S. Haggerty is chairman of the Commission.

St. Joseph, Mo.—Until June 28, by L. M. Stallard, Highway Engineer, for contracts Nos. 153, 154, 155, 156 for grading Smith, Parker, Turner and Karnes Roads, respectively.

Melford, N. H.—Until 1 p. m., June 17, by H. C. Hill, State Engineer, Concord, New Hampshire, for the construction of 1,800 ft. of stone road in Melford.

Wakefield, N. H.—Until 1 p. m., June 17, by H. C. Hill, State Highway Engineer, Concord, N. H., for the construction of 6½ miles of native stone highway in Wakefield.

Camden, N. J.—Until 8 p. m., June 21, by Committee of Streets and Highways, E. Francis, chairman, for furnishing material and labor for performing the following work: For curb, gutter and crossing stones, paving and repaving material furnished and delivered or work performed from July 16, 1910, to July 16, 1911; for inlets, sewer pipe, traps, manholes, heads and covers and manholes, material furnished and delivered or work performed from July 16, 1910, to July 16, 1911; for cleaning sewers, from July 16, 1910, to July 16, 1911; for repair of brick and cement sidewalks and paving new sidewalks from July 16, 1910, to July 16, 1911, also for the construction of the following sewers: In and along Morgan St., from Master St. to Sixth St., along Sixth St. to Woodland St., on Woodland St. to Broadway, and on Fairview St., from Sixth St. to Broadway, and on Linden St., from 11th St. east.

Albany, N. Y.—Until 3 p. m., June 20, by Board of Contract and Supply, for the improvement of Swan St. from the north line of Sheridan Ave. to the south line of Clinton Ave. The work includes grading, curbing and paving the carriageway with granite blocks. Isidore Wachsman is secretary of the board.

Albany, N. Y.—Until 3 p. m., June 20, by Isidore Wachsman, secretary, Board of Contract and Supply, for unloading and hauling trap rock, oiling macadam pavements and repairing brick pavements.

Brooklyn, N. Y.—Until 11 a. m., June 22, by borough president, for 30 street improvement contracts, the largest being as follows: For regulating and repaving with asphalt pavement on a concrete foundation the roadway of St Johns Pl. from New York Ave. to Albany Ave., together with all work incidental thereto. The engineer's estimate of the quantities is as follows: 7,640 sq. yds. of asphalt pavement outside railroad area (five years' maintenance); 975 sq. yds. of asphalt pavement within railroad area (no maintenance); 1,060 cu. yds. of concrete for pavement foundation, outside railroad area; 135 cu. yds. of concrete for pavement foundation, within railroad area; 3,550 lin. ft. of new curbstone, set in concrete; 710 lin. ft. of old curbstone, reset in concrete; 44 noiseless covers and heads for sewer manholes.

Watertown, N. Y.—Until 8 p. m., June 17, by Board of Public Works, for the construction of about 6,000 sq. yds. of pavement in High St. with curbing, grading, culverts, sewers, catch basins and all other work connected therewith. E. W. Sayles is city engineer.

Cambridge, O.—Until noon, June 17, by County Commissioners for the grading and macadamizing of about one-half mile of road in Millwood Township. The estimated cost of the work is $4,704. J. C. Wonders is State Highway Engineer, Columbus, O.

Canton, O.—Until 10 a. m., July 6, by Board of County Commissioners, for the draining, grading and paving with brick one mile of road in Lexington Township in this county. J. H. McConnell is auditor of Stark County, Ohio.

Columbus, O.—Until noon, June 29, by County Commissioners, John Scott, clerk, for the construction and completion of the following street work: Engineer's Estimate No. 85: Grading and macadamizing the James T. Lazell Joint County Road on the line between Franklin and Delaware Counties, from the Columbus and Delaware Pike to the Wilson Pike, a distance of 3,705 ft., and located in Sharon Township, Franklin County, and Orange Township, Delaware County, Ohio, as follows: 1,800 cu. yds. excavation and berme; 1,900 tons crushed limestone; 725 tons crushed limestone screenings; 36 lin. ft. 10-in. cast iron pipe; clearing and grubbing. Engineer's Estimates Nos. 86-87: Grading, macadamizing and surface treating the James T. Lazell Joint County Road as above described. Engineer's Estimate No. 86: 1,800 cu. yds. excavation and berme; 1,775 tons crushed limestone; 400 tons crushed limestone screenings; 36 lin. ft. 10-in. cast iron pipe; clearing and grubbing. Engineer's Estimate No. 87: 9,900 gallons Heavy asphalt oil, carbo-via. tarvia "X."

Columbus, O.—Until noon, June 29, by County Commissioners, for all labor and material necessary for grading, macadamizing and improving roads as follows: Engineer's Estimate No. 74: The Westerville Road, from the north corporation line of Linden to the Mifflin and Blendon Township line, a distance of 13,706 ft; 4,400 cu. yds. excavation and berme; 10,100 tons crushed limestone; 3,200 tons crushed limestone screenings; 48, lin. ft. 12-in. cast iron pipe (laid); 60 lin. ft. 10-in. cast iron pipe (laid); 180 lin. ft. 10-in. first-class vitrified sewer pipe; grubbing all trees, stumps, etc. Engineer's Estimate No. 88: The Jackson Pike, from Greenlawn Ave. to the Frank Road east; 4,940 cu. yds. excavation and berme; 2,800 tons crushed slag; 2,090 tons crushed limestone; 1,200 tons crushed limestone screenings; 76 lin. ft. 12-in. corrugated pipe; 40 lin. ft. 18-in. corrugated pipe. Engineer's Estimate No. 89: Surfacing the Jackson Pike, from Greenlawn Ave. to the Frank Road east; 29,700 gallons Tarvia "X" or Carbo-Via. John Scott is clerk of the Board.

Charleston, S. C.—Until 11 a. m., July 9, by Bureau of Yards & Docks, Navy Department, Washington, D. C., for the construction of gravel paving at the United States Navy Yard at Charleston, S. C.

Leesburg, Va.—Until June 17, by County Clerk, for the construction of two miles of macadam road from Purcellville toward Silcott Springs, Loudoun County.

Milwaukee, Wis.—Until 10:30 a. m., June 16, by Board of Public Works, for the work of grading and macadamizing the roadway, paving the gutters with stone, from Dondulac Ave. to Locust St. in 22d Ward. Charles J. Poetsch is chairman.

Waukesha, Wis.—Until July 11, by Board of Public Works, for furnishing necessary material and labor for paving with tar macadam pavement and a combination concrete curb and gutter White Rock Ave., East Park Ave., Cook St. and Center St.; Lincoln Ave. with brick pavement on a concrete foundation between the tracks of a double track railway and with tar macadam between tracks and gutter. Morgan

R. Butler is City Engineer. Official advertisement of the work will be found elsewhere in this issue.

Sewers.

Bids are asked on following work, the notes being arranged alphabetically by states:

Corydon, Ia.—Until 7:30 p. m., July 11 (readvertisement of bids asked June 6), by J. J. C. Bower, town clerk, for drilling an artesian well. A certified check for $300 must be filed with each bid. The Iowa Engineering Co., Clinton, Ia., engineers.

Knoxville, Ia.—Until June 27 (readvertisement of bids recently rejected), by city clerk, for the construction of sanitary sewers in this city. Hall & Adams, Centerville, Ia., are engineers.

Pella Ia.—Until 8 p. m., July 6, by A. C. Kuyper, City Clerk, for the construction of six miles of 8 to 15 in. pipe sewer and disposal plant. Two checks for $500 each required for the two parts of the work. Iowa Engineering Co., Clinton, Ia., engineer.

Bushnell, Ill.—Until 7 p m., June 20, by city clerk, for the construction of a system of sewers for the city. The work includes the following approximate quantities: 9,240 ft. of 6-in. vitrified sanitary pipe sewer, average excavation 8 ft., and 9,506 ft. of 10-in., 10,085 ft. of 12-in., and 734 ft. of 15-in. average excavation 10.5 ft., with proper number of flush tanks, manholes and 2 disposal tanks. W. H. Dawson is city clerk.

Boston, Mass.—Until 10 a. m., July 7, by Capt. A. M. Miller, Constructing Quartermaster, for the extension of sewer system at Fort Warren, Boston Harbor, Mass.

Burlington, Kan.—Until June 28, by city clerk, for the construction of sanitary sewers, including sewage disposal works. Burns & McDonnell, Scarritt Bldg., Kansas City, Mo., are engineers.

Sabetha, Kan.—Until July 12, by city clerk, for the construction of sanitary sewers, including sewage disposal works. Burns & McDonnell, Scarritt Bldg., Kansas City, Mo., are engineers.

Munising, Mich.—Until 8 p. m., July 7, by James Tracy, City Clerk, for 6,834 ft. of 8 to 24 in. vitrified pipe, 1,985 ft. of 2½x3 ft. and 3x3½ ft. concrete sewers, 2 bulkheads, 19 manholes, 19 catch basins, 1 lamp hole and 7 or more catch basin covers. W. G. Kirchhoffer, Madison., Wis., is engineer.

Portland, Me.—Until noon, July 1, by Commissioner of Public Works, for the construction of Section 2 of Morrills Corner Sewer. A certified check for $500 must be filed with each bid. Bion Bradbury is Commissioner of Public Works.

Crete, Nebr.—Until 2 p m., June 20, by F. A. Novak, city clerk, for the necessary material and labor for construeting a sewer system in this city, sanitary and storm combined. The estimated cost of the work is $40,000. P. A. Edquist, 832 New York Life Bldg., Omaha, Nebr., is special engineer.

Fort Totten, N. Y.—Until 2 p. m., June 15, by Capt. W. E. Cole, Constructing Quartermaster, for the construction of an extension to post sewer for camp sites at Fort Totten, N. Y. The work includes approximately 1,582 ft. of 6-in. vitrified pipe.

Lebanon, O.—Until noon, June 24, by Village Clerk M. E. Gustin, for building the following sewers of vitrified tile: Cheery St., East St., High St., Jackson St., Columbus Ave., Summit St., Chillicothe Ave., Pleasant St. The work includes approximately 6,900 ft. of 8 and 10 in. sewer pipes.

Lorain, O.—Until noon, June 21, by Director of Public Service, for the necessary labor and material for the construction of sewers in East 25th St., from Elyria Ave. to Denver Ave., and in Oberlin Ave., Brownell Ave., Fourth and Fifth Sts.

Apache, Okla.—Until 5 p. m., June 27, by town clerk, for the materials and machinery required for the construction of the sewer, water and electric light systems. Certified check for 5 per cent of the amount bid must accompany each proposal. Southwestern Engineering Co., Lee Bldg., Oklahoma City, Okla., is engineer.

Hugo, Okla.—Until 8 p. m., July 5, by W. T. Echols, city clerk, for the construction complete of a complete sanitary sewer system and all appurtenances including disposal plant. H. C. Blanchard is engineer.

Jefferson, O.—Until June 27, by city council, for the construction of general sewers. T. B. Miller is clerk.

Oklahoma City, Okla.—Until 5 p. m., June 20, by Robert Parman, city clerk, for the construction of a lateral sewer in Capitol Hill, Westbrook Addition, Weaver's Addition, Guernsey Park Place and Pleasant View Addition of Oklahoma City.

Huron, S. Dak.—Until 8 p. m., June 20, by Board of City Commissioners, for the construction of lateral sewers from 8 to 15 in., in Ohio, Iowa, Montana, Idaho, Dakota and Idaho Sts. S. S. Oviatt is City Auditor.

LaFollette, Tenn.—Until June 29, by Board of Public Works, for the construction of sewer from Aspen St., southward on Tennessee Ave., to Beech St., and from there diagonally with drain to Indiana River.

Water Supply.

Bids are asked on following work, the notes being arranged alphabetically by states:

Fort Morgan, Ala.—Until 1:30 p. m., June 21, by Lieut. Edwin F. Barlow, Constructing Quartermaster, for the construction of a reinforced concrete cistern, capacity 11,500 gals., at Fort Morgan, Ala.
Ia., engineers.

Ellensdale, Minn.—Until 8 p. m., June 28, by village council, for drilling a deep well for said village. C. R. Torgerson is village recorder.

Brooklyn, N. Y.—Until 2 p. m., June 22, by Department of Water Supply, Gas and Electricity, for furnishing, delivering and laying high pressure fire service mains and appurtenances in Livingston and Remsen Sts. and in Elm and Gallatin Places.

Lorain, O.—Until noon, June 21, by Director of Public Service, for furnishing necessary labor and material for the improvement of the water works system. The work includes a new 48-in. cast iron or 51-in. steel riveted intake pipe from the present filter house to a point about 2,800 ft. in Lake Erie; furnishing and placing necessary specials, valves and fittings; furnishing and placing a new intake crib with necessary excavating and filling.

Cherokee, Okla.—Until June 30, by city clerk, for the construction of a water works, electric lighting and sanitary sewer system. Burns & McDonnell, Scarritt Bldg., Kansas City, Mo., are engineers.

Hyde Park, Vt.—Until noon, June 15, by village trustees, for laying about 5 miles of water pipe. N. G. Wood is chairman of the trustees board.

Louisa, Va.—Until July 2, by J. J. Porter, for boring 10-in. artesian well at this city for town and county purposes.

Miscellaneous.

Bids are asked on following work, the notes being arranged alphabetically by states:

Denver, Colo.—Reservoir.—Until 2 p. m., July 2, by Rio Grande Reservoir & Ditch Co., for furnishing materials and labor for the construction of a storage reservoir at Santa Maria Lake, Mineral County, Colo. The work includes dam, tunnel, pipe, canal, etc. Work is also noted under Confirmed Reports. Official advertisement will be found elsewhere in this issue.

Louisville, Ky.—Heating Plant.—Until 3 p. m., June 15, by Samuel D. Jones, business director, Louisville School Board, for the erection of boiler house and installation of heating apparatus for the Broadway School building east of Barret. Brinton B. Davis is architect.

Excavation, Earth and Rock.

Bids are asked on following work, the notes being arranged alphabetically by states:

Boston, Mass.—Drain—Until 11 a. m., July 9, by Bureau of Yards & Docks, Navy Department, Washington, D. C., for the construction of a drain at the United States Navy Yard, Boston, Mass.

Cleveland, Miss.—Drainage.—Until 2 p. m., July 5, by Board of Drainage Commissioners of Bolivar County, Miss., for the improvement of Bogue Phalia. The work includes over a million cubic yards of material. Official advertisement of the job will be found elsewhere in this issue. Also noted under Confirmed Reports.

Greenwood, Miss.—Ditch Work—Until noon, June 20, by G. W. Holmes, president of the Lake Henry Drainage District, Leflore County, Miss., for the construction of 11 miles of open ditches to be dug with steam dredge. The work includes approximately 200,000 cu. yds. of dirt.

Chillicothe, Mo.—Ditch Work—Until 2 p. m., June 28, by Thomas Hurst, county surveyor, for the construction of one main ditch, two laterals, including 5 steel bridges and one dam in Drainage District No. 15. A. W. Shelton is clerk of the County Court.

Lorain, O.—Dredging and Filling—Until noon, June 21, by Director of Public Service, for (1) dredging in Black River, including approximately 100,000 cu. yds.; (2) making fill on city property east of Black River and north of Erie Ave. viaduct, including approximately 15,000 cu. yds. L. B. Johnson is clerk. The work is also noted under Confirmed Reports.

Materials, Machines, Supplies, Etc.

Bids are asked on following work, the notes being arranged alphabetically by states:

Washington, D. C.—Sodium Nitrate—Until July 1, by William Crozier, Chief of Ordnance, U. S. Army, War Department, Washington, D. C., for furnishing 2,000,000 lbs. sodium nitrate.

Washington, D. C.—Traveling Crane—Until 11 a. m., July 2, by Bureau of Yards and Docks, Navy Department, Washington, D. C., for furnishing one 15-ton 3-motor traveling crane at Navy Yard, Mare Island, Cal. R. C. Hollyday is chief of the Bureau.

Washington, D. C.—Cast Iron Lintels—Until 10 a. m., July 5, by R. V. LaDow, Superintendent of Prisons, Washington, D. C., for furnishing and delivering at the United States Penitentiary, Leavenworth, Kan., cast iron lintels for attic story windows, east cell wing.

Washington, D. C.—Ladder—Until 2 p. m., July 1, by District Commissioners, for furnishing and installing a 75-ft. aerial extension ladder and raising mechanism on one truck used in the fire department, District of Columbia.

Washington, D. C.—Electrical Material—Until 10:30 a. m., June 24, by Capt. F. C. Boggs, General Purchasing Officer, Isthmian Canal Commission, Washington, D. C., for furnishing under Canal Circular 590 fixtures, fittings, arc lamps, carbon, fuses, wire conduit, tape, etc.

Washington, D. C.—Locomotive Crane, Etc.—Until 10:30 a. m., June 28, by Capt. F. C. Boggs, General Purchasing Officer, Isthmian Canal Commission, Washington, D. C., for the furnishing under Canal Circular No. 589 of locomotive crane, steel plates and lumber.

Washington, D. C.—Lumber—Until June 17, by Capt. F. C. Boggs, General Purchasing Officer, Isthmian Canal Commission, Washington, D. C., for furnishing in accordance with Canal Circular Bulletin, 50,000 ft. b. m., rough spruce and 20,000 ft. b. m., spruce lumber.

Rock Island Arsenal, Ill.—Boilers—Until June 29, by Commanding Officer, Rock Island Arsenal, Rock Island, Ill., for furnishing four horizontal tubular boilers, 100 lbs. steam working pressure, 72-in. by 18 ft.

Jeffersonville, Ind.—Quartermaster's Supplies.—Until 10 a. m., June 18, by Depot Quartermaster, for furnishing and delivering quartermaster's supplies.

Jeffersonville, Ind.—Quartermaster's Supplies.—Until 10 a. m., June 20, by Depot Quartermaster, for furnishing and delivering quartermasters' supplies.

Ft. Leavenworth, Kan.—Gravel and Cinders—Until 11 a. m., June 17, by William Davis, Capt., Quartermaster, for furnishing and delivering f. o. b. cars, freight prepaid, at Fort Leavenworth, Kan., or in wagons, 5,300 cu. yds. of cinders and 500 cu. yds. of bank gravel.

New Orleans, La.—Willows—Until 11 a. m., June 24, by Lieut-Col. Lansing H. Beach, U. S. Engineer, Custom House, New Orleans, La., for furnishing willows at South or Southwest Pass, Mississippi River.

Revere, Mass.—Boilers.—Until 8:30 p. m., July 1, by A. H. Adams, chairman of the Town School Committee, for the installation of two new boilers and otherwise improving the heating system in Shurtleff School.

Kansas City, Mo.—Castings, Sewer Pipe, Etc.—Until noon. June 22, by E. Winstanley, Purchasing Officer, for furnishing the following supplies for one year ending July 1, 1911: Iron castings, bronze castings, fuel oil, lumber, coal oil, gasoline, vitrified paving block, cement, lime, sand, sewer pipe, street push brooms, etc.

New York, N. Y.—Pipe and Specials.—Until 2 p. m., June 22, by Department of Water Supply, Gas and Electricity, 21 Park Row, for furnishing and delivering cast iron pipe special castings and valve box castings.

Fort Sam Houston, Texas.—Pipe Fittings—Until June 16, by Capt. Fred H. Gallup, for furnishing 3½ gross brass bands, 120 bushings, 48 yards canvas, 600 pounds asbestos cement, 24 flue and 12 tube cleaners, 72 air cocks, 12 cleanout doors, 60 elbows, 144 faucets, 12 gauges, 50 pounds grease, 72 hangers, 27 Tobasco heaters, 12 iron hoes for heaters, 24 sheets galvanized iron, 20 pounds packing, 100 feet black pipe, 12 scoop shovels, 24 thermometers, 173 valves and 16 wrenches.

Basic City, Va.—Motor and Pump—Until June 20, by W. M. Page, treasurer of town, for furnishing an electric motor and pump, capacity 880 gals. per minute, with a total head of 225 ft.; 60 cycle, three phase, 2,200 volt induction motor.

Winnipeg, Man.—Sewer Pipe & Junctions—Until 11 a. m., June 16, by Board of Control, M. Peterson, secretary, for the supply of a quantity of sewer pipe and junctions.

Winnipeg, Man.—Cement.—Until 11 a. m., June 16, by Board of Control, M. Peterson, secretary, for furnishing 25,000 or 30,000 barrels of cement f. o. b. cars city yard.

CONTRACT LET.

The following contracts have been let recently:

BRIDGES.

Pueblo, Colo.—Bridges—G. A. McKenzie, Canon City, at $3,500, for the construction of two bridges over Beaver and Four Mile Creeks.

Wilmington, Del.—Bridge.—H. M. Lockwood, of Middletown, at $3,160, for the building of a concrete bridge at Noxentown mill dam, in St. George's hundred.

Forreston, Ill.—Bridges—W. H. Shons, Freeport, at $1,945, for the construction of five bridges of concrete.

Peoria, Ill.—Bridge—Edward Cooney of Tremont, at $1,155, for the construction of a concrete arch bridge over a branch of Lost Creek, near Meyers' Station.

Quincy, Ill.—Bridges—Van Deusen Bridge Co., Keokuk, Ia., at $1,600 for the construction of a steel bridge over Bear Creek, in Riverside Township.

Crown Point, Ind.—Bridge—Scheizer Rolling Lift Bridge Co., Monadnock, Bldg., Chicago,

Ill., at $74,904, for the construction of a reinforced concrete substructure and iron superstructure of a bridge over Grand Calumet River in Hammond. Bids were opened June 6.

Greencastle, Ind.—Bridges—O. J. Larkin, R. F. D., Cloverdale, Ind., at $2,994, for the construction of four small bridges, one 80 ft. span steel bridge and three small concrete reinforced bridges 10, 12 and 16 ft. Bids were opened June 6.

Hartford, Ind.—Bridges—George Saunders Co., Muncie, Ind., at $6,100, for the construction of a steel bridge over the Salamonie River, 120 ft. in length; Hackedorm Co., at $5,629, for the construction of a 100 ft. bridge over the Salamonie River.

Brazil, Ind.—Bridges—Bedford Steel Co., at $1,195, for the construction of the 60-ft. steel bridge over Jordan Creek; W. H. Rupert, for the construction of a 50-ft. cement bridge over Billy Creek.

Gretna, La.—Bridge—Midland Bridge Co., Kansas City, Mo., at $6,500, for the construction of the bascule bridge over Harvey's Canal.

Gretna, La.—Bridge—Midland Bridge Co., Kansas City, Mo., at $6,500, for the construction of a steel bridge at Herry Canal. Bids were opened June 1.

Hazlehurst, Miss.—Bridge—E. P. Allbury & Son, New Orleans, La., at $11,975, for the construction of a steel bridge over Pearl River, at Rockport.

Scranton, Miss.—Bridge—Austin Bros., Atlanta, Ga., at $2,886, for the construction of a steel bridge over Dog River, known as Brown's bridge.

Farmington, Mo. — Bridges — Stupp Bros. Bridge & Iron Co., St. Louis, Mo., at $16,935, and Vincennes Bridge Co., Vincennes, Ind., at $2,696, for the construction of the following bridges: One span over Big River of 230 ft. and 390 ft. steel trestle; one span 100 ft. across Doe Run Creek; one span 100 ft. across St. Francis River, and two spans of 26 ft. each across Indian Creek. Bids were opened June 7.

Maryville, Mo. — Bridges — Standard Bridge Co., Omaha, Neb., at $15,000, for building and repairing 45 bridges. Bids were opened June 8.

Smithfield, N. C.—Bridge—Austin Bros., Atlanta, Ga., at $2,975, for the construction of an iron bridge. Bids were opened June 6.

Wahpeton, N. Dak.—Bridges—Hewett Bridge Co., Minneapolis, Minn., at $2,470, for the building of three bridges and repairing one. The work includes buildng one wood bridge, two steel bridges and repairing one bridge. Bids were opened June 8.

Jamestown, N. Y.—Bridges—Mahoney & Swanson, at $50,000, for the construction of the concrete bridges over the Chadakoin River at Fairmount Ave. and Windsor st.

Mincola, L. I., N. Y.—Bridge—A. M. Hazel, 11 Broadway, New York, at $1,905, for repairing the bridge at Wreck Lead, near Long Beach.

Syracuse, N. Y.—Bridge—National Construction Co., city, at $5,057, for the construction of a steel plate girder bridge. Bids were opened May 31.

Van Wert, O.—Bridges—Capitol Construction Co., at $2,512, for the construction of a bridge across the canal on the line between Van Wert and Allen Counties, at the Ludwig Road crossing, south of Delphos; Croghan Construction Co., at $1,185, for labor and material for moving the canal bridge, Delphos, from First St. to 10th St.

Warren, O.—Bridge—N. H. Merwin, Diamond, O., for the construction of a bridge at Farmington, O. The superstructure will be of concrete. Bids were opened June 6.

Philadelphia, Pa.—Bridge — Richard Walsh, 5922 Tacony St., city, at $35,479, for the construction of a highway bridge on line of Fox St., over P. G. & N. Railroad. The work includes concrete abutments and piers, steel beam floor encased in concrete, concrete parapets, granolithic sidewalks and asphalt driveway. Bids were opened June 1.

Tacoma, Wash.—Bridge—Creelman, Putnam & Healy, at $49,780, for the construction of a reinforced concrete bridge across Buckley gulch on North 21st St.

ROADS AND STREETS.

Whipple, Ariz.—Roads, Walks, Drainage, Etc.—Henry Rockmark, Prescott, Ariz., at $6,825, for the construction of roads at $1,490, for the catch basins, and at $600 for the construction of bridge. Johnson-Shea Co., of Prescott, Ariz., at $6,758, for the construction of concrete walks, at $484, for the oiled walks, at $2,262, for curbs and gutters, at $400, for concrete culvert, at $500, for steps and blocks. Bids were opened June 4.

Little Rock, Ark.—Paving—M. D. L. Cook, at $43,000, for the construction of 19,000 sq. yds. of asphalt pavement on a concrete foundation of concrete. The work includes 8,000 cu. yds. of excavation. E. A. Kingsley, engineer.

Fort Scrfven, Ga.—Roads, Walks, Etc.—Geo. M. Gadsden for the construction of roads in rear of N. C. O. and Bachelor's quarters, and walks around same at New Barracks. Bids were opened June 1.

Davenport, Ia.—Grading and Sewers.—Hydraulic Concrete Construction Co., at $0.10 per sq. ft., for the construction of brick pavement on three streets in this city, Lillie Ave., Tenth St. and Eighth St.; T. W. Kinney, at $0.11¾ per sq. ft., for the construction of cement sidewalks on the streets; William Carlin, at $0.24 per cu. yd., for grading Lillie Ave., between Pleasant and Lombard; William Kahl, at $0.28 per cu. yd., for grading Tenth, between Warren and Myrtle; William Carlin, at $0.28 per cu. yd., for grading Eighth St., between Farnam and Grand Ave.

Boise, Idaho.—Paving.—Contracts for paving work in Paving District No. 15, bids for which were opened May 28, have been let as follows: J. Gustaffson, Boise, Idaho, was awarded the contract for 30,622 sq. yds. of concrete pavement and 1,383 sq. yds. of oil macadam, his bid being as follows: Excavation 70 cts. per cu. yd.; completed concrete pavement, $1.15 per sq. yd.; gutter plates in place, 5¼ cts. per lb.; completed oil macadam along street car tracks, $1.00 per sq. yd. The Coast Contracting Co., Tacoma, Wash., was awarded the contract for 27,204 sq. yds. of concrete pavement and 1,005 sq. yds. of oil macadam, its bid being as follows: Excavation, 60 cts. per cu. yd.; completed concrete pavement, $1.09 per sq. yd.; gutter plates in place, 8½ cts. per lb.; completed oil macadam along street car tracks, $1.34 per sq. yd. The Pacific Paving Co., Seattle, Wash., was awarded the contract for 90,084 sq. yds. of asphalt pavement and 12,207 sq. yds. of oil macadam, its bid being as follows: Excavation, 40 cts. per cu. yd.; completed asphalt pavement without guarantee, $1.68 per sq. yd.; completed asphalt pavement with five years guarantee, $1.78 per sq. yd.; gutter plates in place, 6 cts. per lb.; completed oil macadam along street car tracks, $1.40 per sq. yd.

Bloomfield, Ind.—Road—J. P. Wright & Co., city, at $6,200, for the construction of a gravel road in Fairplay township. Bids were opened June 9.

Bloomfield, Ind.—Road—J. H. Blackwood, Jr., Sandborn, at $1,785, for the construction of a gravel road in Stafford township. Bids were opened June 9.

Brazil, Ind.—Road.—Gibbons & Son, at $5,000, for the construction of a gravel road in Washington Township, length 8,308 ft.

Crawfordsville, Ind.—Road—Patrick H. & John Lane, city, at $9,865, for the construction of M. Wood's highway. The work includes grading, paving and draining. Bids were opened June 7.

Delphi, Ind.—Road—J. F. Peirce, Delphi, Ind., at $6,800, for the construction of a gravel road. Bids were opened June 6.

Fowler, Ind.—Road—Albert E. Gray, at $9,575, for the construction of three miles of the Hess stone road in Union township, Benton county.

Kentland, Ind.—Road—Jas. Conel, at $5,950, for the construction of the Jas. Whitaker road, Newton county. Bids were opened June 6.

Lebanon, Ind.—Road—Geo. T. Miller, city, at $18,407, for the construction of the Hames A. Hunt gravel road in Eagle township. The work includes 8,357 sq. yds. of brick street, 312 ft. circular curb, 690 ft. of marginal curb, 4,500 ft. old curb reset, two miles of gravel road. Bids were opened June 1.

Madison, Ind.—Road—Stang & Davies, at $797, for the construction of 900 ft. of pike road. Bids were opened June 7.

Monticello, Ind.—Road—B. B. Baker, city, at $12,379, for the construction of the K. J. Mills road. Bids were opened June 7.

Mt. Vernon, Ind.—Road—Mt. Vernon Construction Co., city, at $5,060, for the construction of seven-eighths miles of gravel road. Bids were opened June 7.

Rockville, Ind.—Roads—Peter Platter, at $5,375, for the construction of three gravel roads in Raccoon township. Bids were opened June 7.

Rushville, Ind.—Brick Streets—Adams Bros. Contracting Co., Zanesville, O., at $7,649, for the construction of two brick streets in city and suburbs, about two miles in all. Bids were opened June 7.

Valparaiso, Ind.—Roads—W. B. Hutchinson, at $8,080, for the construction of a macadam road in Portage, Westchester township, being 2.09 miles in length; Ray Demass, at $5,990, for the construction of a macadam road in Liberty township, being 1.74 miles in length. Bids were opened June 7.

Washington, Ind.—Road—M. H. Wilson, city, at $2,648, for the construction of a gravel road known as the Taylor road. Bids were opened June 11.

Winamac, Ind.—Road—J. M. Anderson, Medaryville, Ind., at $1,040, for the construction of a road in Pulaski County. Bids were opened June 7.

Shreveport, La.—Paving.—City Council has awarded contracts to the following for the construction of pavement in the city: Filbert Paving & Construction Co., for 83,979 yds. of Filbertin; Hot Spring Construction Co., for 38,344 yds. of wood block; Southern Bitulithic Co., for 98,269 yds. of bitulithic.

New Bedford, Mass.—Paving.—Warren Bros., Boston, Mass., for the construction of 13,900 sq. yds. of bitulithic.

Springfield, Mass.—Paving.—Warren Bros., Boston, Mass., for the construction of 3,300 sq. yds. of bitulithic.

Baltimore, Md.—Paving.—Warren Bros. Co., Boston, Mass., for the construction of 5,600 sq. yds. of bitulithic.

Bay City, Mich.—Roads.—William Carlson, at $1,089, for the extension of the Garfield Road and at $2,295, for the extension of the Fraser Road.

Albert Lea, Minn.—Paving—Fielding & Shepley, St. Paul, Minn., at $28,324, for the paving of Main St. Bids were opened June 7.

Duluth, Minn.—Paving.—P. McDonnell, at $99,636, for laying sandstone blocks on Garfield Ave., from the lower end of the viaduct to the approach of the interstate bridge.

Virginia, Minn.—Paving.—H. L. Bartlett, city, for the construction of 26,000 sq. yds. of bitulithic.

Jackson, Miss.—Paving—Following contracts have been awarded by this city for the construction of pavement: Southern Bitulithic Co., Nashville, Tenn., at $2.15 per sq. yd., bitulithic. R. S. Blome Co., Chicago, Ill., at $1.98 per sq. yd., granitoid; Copeland & Inglis, Birmingham, Ala., at $2 per sq. yd., brick; McPoland & O'Gara, Birmingham, Ala., at $205 per sq. yd., wood block. Bids were opened June 7.

Jackson, Miss.—Paving.—City Council has awarded contracts for paving in this city as follows: Southern Bitulithic Co., 11,000 yds. of bitulithic; Blome Co., 10,000 yds. of granitoid; McGowen & O'Hara, 11,000 yds. of creosoted wood blocks; Copeland & English, 11,000 yds. of vitrified brick.

St. Joseph, Mo.—Paving.—Young Bros.' Construction Co., at $1,132, for the grading and macadamizing of 18th St., from the north side of Faraon to the southeast corner of block 5, Landis' addition, and the southwest corner of block 1, Kemper's addition.

Harrison, N. J.—Paving.—J. F. Shanley Co., city, for the construction of 6,554 sq. yds. of bitulithic.

Albany, N. Y.—Roads.—State Highway Commission has awarded the following contracts for repairing and constructing roads; bids opened June 6: T. F. Shaughnessy Co., Albany, at $24,400, repair contract No. 76, London section 2, county highway No. 119, Albany County, with residuum; Alonzo Schaupp, Albany, N. Y., at $10,789, repair contract No. 78, Delmar-Slingerlands county highway No. 92, Albany County, with residuum; Alonzo Schaupp, Albany, N. Y., at $9,790, contract No. 75, West Mohawk river county highway No. 108, Montgomery County, with residuum; County Construction Co., Troy, at $15,361, for repairing the Troy-Brunswick road, sections 1 and 2; J. E. Consalus, Albany, N. Y., at $46,916, contract No. 72, Saugerties-Woodstock, Ulster county road, sections Nos. 1 and 2, with residuum; Kennedy & Easton Construction Co., Albany, N. Y., at $1,576, contract No. 82, section No. 2 of the Waterford county highway; Santononi Contracting Co., Albany, N. Y., at $31,505, contract No. 77, Loon Lake-Pottersville-Taylors county highway, Warren County, with bermuda; R. Hopkins, Troy, at $7,436, Granville-Troy Stage county highway, Washington county.

Utica, N. Y.—Paving.—Board of Contract and Supply awarded the following contracts to the Barber Asphalt Co., for paving at $1.79 per sq. yd.: Asphalt with artificial curb—Conkling Ave., Winner Ave., George Place, Springdale St., Leeds St.; asphalt with natural or stone curb—Canal St., Cedar St., James St. and Jay St.

Watertown, N. Y.—Timbering & Paving—Owego Bridge Co., Owego, N. Y., at $5,300, for retimbering Arsenal St. viaduct with creosoted wood block pavement on viaduct. Bids were opened June 3.

Whitesboro, N. Y.—Paving.—Warren Bros. Co., Boston, Mass., for the construction of 24,700 sq. yds. of bitulithic.

Bellefontaine, O.—Paving.—Hamilton Bros. & Hoskins, at $32,224, for paving South Main St.

Cincinnati, O.—Road—August Silk, 5th and Broadway, city, at $7,024, for the construction of Montgomery pike.

Springfield, O.—Paving.—Peters Bros., Chicago, Ill., at $61,043, for paving Yellow Springs St., with sheet asphalt with Bolin brick between the car tracks and for 18-in. on either side of the rails.

Bartlesville, Okla.—Paving—Kansas Bitulithic Co., Kansas City, Mo., for the construction of 8,000 sq. yds. of bitulithic.

Albany, Ore.—Paving.—Warren Construction Co., Portland, Ore., for the construction of 22,275 sq. yds. of bitulithic.

Portland, Ore.—Paving.—Pacific Bridge Co., city, for the construction of 8,176 sq. yds. of bitulithic.

Portland, Ore.—Paving.—Warren Construction Co., city, for the construction of 47,500 sq. yds. of bitulithic.

Portland, Ore.—Paving.—Pacific Bridge Co., Portland, Ore., for the construction of 16,162 sq. yds. of bitulithic.

Portland, Ore.—Paving.—Warren Construction Co., city, for the construction of 12,186 sq. yds. of bitulithic.

Portland, Ore.—Paving.—Oregon Hassam Paving Co., for the paving of Eleventh and Milwaukee Sts., from Hawthorne St. to Holgate St.

Minersville, Pa.—Paving.—McConnell & Fitzpatrick Co., Pittson, at $2.19 per sq. yd., for the paving of a portion of Sunbury St. with brick.

Philadelphia, Pa.—Paving.—Edwin H. Vare, for the completion of the Southern Blvd., for which $400,000 is available; McNichol Paving &

Construction Co., for the completion of the Northeast Blvd., for which $300,000 is available.

Scranton, Pa.—Road.—John Harrigan, New York, at $1.39 per sq. yd., for the construction of the new county road in this county with Genasco.

York, Pa.—Paving.—Juniata Paving Co., city, for the construction of 4,300 sq. yds. of bitulithic.

Wilkesbarre, Pa.—Paving.—Herrick Construction Co., Stroudsburg, at $75,000, for the paving of Truesdale Road, from Warrior Run to Nanticoke, Clark's Cross Road, two miles of the Middle Road, completing it from Wilkesbarre to Nanticoke, Barney & Orchard Sts., Warrior Run and Spring Sts., Newton. The roads will all be macadamized with the new standard binder.

York, Pa.—Paving.—Standard Bitulithic Co., New York, N. Y., for the construction of 14,466 sq. yds. of bitulithic.

Seattle, Wash.—Grading.—Olson & Mellen, at $135,770, for grading and regrading of Dexter Ave., and others adjoining the Westlake improvement.

Princeton, W. Va.—Paving—T. Towlee & Co., city, at $35,000, for the construction of brick and tarvia pavements in this city, also at $30,000 for the construction of sewers, sanitary. Bids were opened June 8.

Tacoma, Wash.—Grading.—Lister Construction Co., at $2,184, for the grading of North 14th St., and 16th St., between Cedar St. and the west line of Baker's addition.

Winnipeg, Man.—Macadam.—The City Engineer of Construction, Winnipeg, has been awarded the following contracts for constructing macadam for the city: On lane in rear of Emily St., $860; on lane west of Gladstone School, $955; on lane between Rose and Royal Sts., $1,148; on lane between Agnes and Victor Sts., $3,739.

Winnipeg, Man.—Granolithic Walls.—Board of Control on June 6 awarded the following contracts for granolithic walks: Thos. Jacobson & Son, Winnipeg, on Pine Ave., $3,823; on Sherbrooke St., $1,527; on Nena St., $963; on Elmwood Ave., $1,280; Tweed Ave., $935; Dufferin Ave., $1,493. J. Devitt, Winnipeg, Langside St., $2,024. Engineer of Construction, Winnipeg, on Burrows Ave., $3,913; Bannatyne St., $622; Princess St., $1,331; Bannatyne Ave., $176; Pembina St., $1,769; Manitoba Ave., $540; Preston Ave., $347; Higgins Ave., $1,246; South Side Bannatyne Ave., $180; Main St., $1,406; Glenwood Crescent, $753; Pembrina St., $211; Bannatyne Ave., $676; Kelvin St., $323; West Side Victoria St., $746; Harbison Ave., $943.

SEWERS AND WATER SUPPLY.

Macon, Ga.—Sewer.—R. S. Clemons Co., city, at $5,632, for the construction of the new auxiliary system of sewers, which will be laid in the Vineville, North Highlands and newly annexed parts of the city.

Muscatine, Ia.—Sewer.—J. H. Seldon, by the Rock Island Railroad, for the construction of its share of the Papoose sewer extension.

New Hampton, Ia.—Sewer and Water Main—Fraser & Danforth, Rochester, Minn., at $0.55 per ft. for the construction of 4,000 ft. of 8-in. sewer, and at $0.48½ per ft. for the construction of 3,000 ft. of 4-in. water mains. The work includes manholes, flush tanks, hydrants and valves at $40, $68, $34, $34.50 and $14.50 respectively. Bids were opened June 1.

Batesville, Ind.—Water Mains.—Bourbon Copper & Brass Works, Cincinnati, O., at $3,130, for the extension of the water mains in this city.

Baldwin, Kan.—Sewer System.—Squire Electric & Construction Co., for the installation of a sewer system in this city.

Osage, Kan.—Sewer System.—Boyd Construction Co., Kansas City, Kan., at $41,000, for the construction of a complete sanitary sewer system in this city.

Hubbill, Mich. Sewers—The Pearce Hardware and Furniture Co., Lake Linden, Mich., at $1.87 per ft. for 300 ft. of 30-in. sewer tile; at $0.14 per ft. for 100 ft. of 8-in. sewer tile; at $14 for one 30x30 Y; at $14 for one 30x30x20 Y, and at $7.48 for one 30x18 reducer.

Baltimore, Md.—Sewers.—Board of awards on May 25 received the following bids on sanitary contract No. 52, lateral sewers in district 19-A: William McCarthy & Co., Pittsburg, Pa., $105,878; B. F. Sweeten & Son, city, $110,005; D. V. Ault & Co., city, $122,631; Irwin Bros., Greenville, O., $133,654.

Ann Arbor, Mich.—Sewers.—Following contracts have been awarded by the board of public works for the construction of six sewers: Koch Bros. for the construction of sewers in districts No. 41, 36, 37 and 40; E. L. Schneider, for the construction of two sewers in the city.

Bellefontaine, O.—Sewers.—W. H. Ralston, Mt. Vernon, at $2,419, for the construction of sewers in South Main St.

Middletown, O.—Sewer—Garver Construction Co., Hamilton, O., for the construction of 6,850 ft. of concrete sewer on Michigan Ave. Bids were opened June 7.

Portland, Ore.—Sewers.—Bechill Bros., at $19,576, for the construction of the Powell St. sewer system; William Lind, at $18,683, for the construction of the East Eighth, East Ninth and East Tenth St. systems.

Aberdeen, S. D.—Sewer.—J. J. Dunnegan, at $16,000, for the construction of about 32 blocks of sewer in this city this summer.

Morristown, Tenn.—Sewer System.—Edwards Construction Co., Hickory, N. C., at $40,000, for the construction of sewers; Municipal Engineering & Construction Co., Chattanooga, Tenn., for the construction of the outfall and disposal plant.

Milwaukee, Wis.—Sewers.—Geo. E. Zimmerman, 3102 McKinley Blvd., city, at $1.34 per lin. ft., for the construction of pipe sewers in Elm St., from 41st St. to 47th St., and in 47th St. from 12½ ft. south of Elm St. to Elm St., and in Elm St. from 47th St. to 48th St.; C. J. Culley, 2018 Cedar St., city, for the construction of a pipe sewer in 25th St. from Vliet St. to Cold Spring Ave., at $1.35 per lin. ft.

Ottawa, Ont.—Water Works.—Gordon Law, at $1,650, for the flexible joints for the water works intake. The bid is at $165 per joint.

EXCAVATION, MISCELLANEOUS, MATERIALS.

Mobile, Ala.—Soil—A. C. Spotswood, at $2.25 per cu. yd., for furnishing and placing top soil at Fort Morgan, Ala. Bids were opened June 7.

Whipple Barracks, Ariz.—Ice Plant—Henry Rockmark, Prescott, Ariz., at $15,050, for the construction of an ice plant in this city; The Frick Machine Co., Waynesboro, Pa., at $8,450, for the installation of the machinery. Bids were opened May 31.

Fort Smith, Ark.—Steel Cages.—Diebold Safe & Lock Co., at $16,000, for furnishing steel cages for the new county jail. The cages are to be made of solid sheets of chrome steel instead of bars.

Hot Springs, Ark.—Elevator—Otis Elevator Co., St. Louis, Mo., at $4,984, for removal of old elevator and installation of new modern electric elevator complete in old Administration Bldg., Army and Navy General Hospital. Bids were opened June 8.

Denver, Colo.—Building.—John W. Tomlinson, at $102,063, for the building of the addition to the county hospital.

Fort Dupont, Del.—Boiler Pump, Etc.—Camden Heating Co., Camden, N. J., at $6,993, for furnishing and installing in the pump house at this place two Babcock & Wilcox water tube boilers; one Cochran feed water heater and one Copes feed water regulator, and making necessary removals and changes in piping. Bids were opened May 23.

Franklin, Ind.—Voting Machines—Empire Voting Machine Co., Rochester, N. Y., at $10,500, for furnishing 14 voting machines. Bids were opened June 6.

Lawrence, Mass.—Building.—Aberthaw Construction Co., of Boston, Mass., for the plain and reinforced concrete work in the additions to the Pacific Mills, this city. There will be nearly 16 acres of concrete floors, including the following: Printing bldg., 720 ft. x 85 ft., two floors and columns; Dye House, 994 ft. x 251 ft., one floor and roof; Finishing bldg., 600 ft. x 90 ft., three floors, mushroom construction; the floors of the power station, 330 ft. x 85 ft. and a coal pocket.

Lowell, Mass.—Concrete Piles.—Raymond Concrete Pile Co., New York and Chicago, for the placing of 1,400 concrete piles in the foundation of a store house to be built for the Massachusetts Cotton Mills at this city. Lockwood, Greene & Co., architects and engineers; Aberthaw Construction Co., general contractors.

Joplin, Mo.—Depot.—Manhattan Construction Co., New York, for the construction of the new union depot in this city. The contract calls for the erection of a modern building of reinforced concrete construction. The building will be 262 ft. long and 82 ft. wide.

Cincinnati, O.—Elevators—Otis Elevator Co., at $6,535, for the construction of two electric elevators in Hamilton County court house, on Court and Main Sts.

Cleveland, O.—Power Plant.—F. C. Werk, New England Bldg., city, for the construction of a power plant for operating ore handling machinery at Randall for the N. Y. P. & O. Dock Co. The building will be of fireproof construction, 115 ft. by 42 ft. in size, and will have a brick stack 150 ft. high. The contract includes the drilling of wells and installing water softening plant and compressor plant.

Fort Sam Houston, Tex.—Plumbing Supplies—F. W. Axtell Construction Co., San Antonio, Tex., at $2.10 for eight L's; at $2.25 for eight reducers; at $3.05 for eight T's; San Antonio Machine Co., at $1.65 for 16 bushings; at $1.70 for two scrapers; at $4.05 for 64 ft. shafting; at $3.95 for eight minons; at $40.65 for 37 valves, assorted; Jas. B. Clow & Son, Chicago, Ill., at $20.59 for 36 ft. biar's rod; Alamo Iron Works, San Antonio, Tex., at $17.06 for 72 ft. black pipe. Bids were opened June 2.

Toronto, Ont.—Brick Chimney.—M. W. Kellogg Co., 50 Church St., New York, N. Y., for the construction of a brick chimney at the pumping station of the filtration plant at the Island.

PROJECTED WORK.

Bridges.

Items Arranged Alphabetically by States.

Wilmington, Del.—County Engineer has been instructed to prepare plans for the construction of a new concrete bridge at Roseville over White Clay Creek, to replace the old covered bridge at that point.

Washington, D. C.—Secretary of War has authorized the construction of a bridge, viaduct and automobile highway across Riverra beaches on the ocean front joining at Atlantic City.

Rupert, Idaho.—Work on the new bridge across the Snake River will begin soon, as the State has appropriated $10,000, and Lincoln and Cassia Counties each $3,000, for the project. The remainder necessary for the work, $3,000, will be raised by public subscription.

Harmon, Ill.—Township Highway Commissioners are to hold a special election to vote on the matter of constructing a number of concrete bridges throughout Harmon Township.

Moline, Ill.—The United States Senate has passed the bill granting the Moline-Bettendorf Bridge Co. a charter to construct a bridge over the Mississippi River between the two cities. According to the plans which already have been drawn the structure will have two draw spans. The work is estimated to cost $1,000,000.

Rushville, Ill.—Bridge Committee of the County Board of Supervisors have granted county aid for the construction of two new bridges. One over Flower Creek near Birmingham and the other over Crane Creek in Bainbridge Township near Newberrytown. The estimated cost of the structures is $1,000 each.

Gary, Ind.—Bill has been passed at Washington, D. C., authorizing the Gary Land Company to construct two bridges across the Grand Calumet River in Lake County, Ind. A bill authorizing the construction by the Indiana Steel Co. of two bridges across the same river in Lake County was also passed.

Jeffersonville, Ind.—No bids were received for the construction of the county bridge over Logan Creek, and the work will be readvertised. Peter Nachand is county clerk.

Newport, Ind.—All bids received June 6 by County Commissioners for the construction of a 40-ft. girder bridge with concrete floor and abutments have been rejected because they exceeded the $1,500 appropriation. The work will be indefinitely postponed. H. T. Payne, county auditor.

Girard, Kan.—A delegation of residents of Lincoln Township have filed a petition with the County Commissioners asking for the construction of a new bridge across Cox Creek to be located one mile north of Arcadia. The Board will take up the matter later.

Topeka, Kan.—Board of County Commissioners are to hold a meeting to consider the construction of several bridges.

Quincy, Mass.—War Department has ordered Quincy, Weymouth and Hingham to rebuild the Hingham bridge which crosses the Weymouth Back River.

Flint, Mich.—City council at the last meeting ordered the resurfacing of the bridge at Fenton St. Repairs will be made also on the Stevenson St. bridge.

Deer Creek, Minn.—Village council has decided to call a special election to vote on the matter of constructing a new bridge over the creek at the Creamery. The expense of building the structure would be borne by the village and council.

Minneapolis, Minn.—Great Northern R. R. officials have notified City Engineer that construction work will be started soon on the viaducts at 15th Ave. and Fourth St. S. E., and University, between 13th and 14th Aves. S. E.

Maryville, Mo.—Board of County Commissioners are preparing for the construction of a number of steel bridges. The work is estimated to cost $20,000.

St. Joseph, Mo.—County Court has ordered the construction of a new bridge over the creek on the proposed Dittemore Road near South St. Joseph.

Newark, N. J.—United States Engineer, Maj. R. R. Raymond, has granted permission for the construction of a bridge across Absecon Channel, from Inlet to Rum Point. The plans have already been made and the cost of the structure is estimated at $1,000,000.

Plainfield, N. J.—County Commissioners have appointed a committee to investigate the necessity of building a bridge on Effingham Place, Westfield, and report will be made at the next meeting.

Trenton, N. J.—Residents of River Drive Ave. are to again take up the matter of constructing a bridge across the water power to connect the avenue with the river mall.

Drayton, N. Dak.—Plans have been prepared for the construction of the proposed steel bridge over the Red River at this place to replace the old Pontoon bridge. The new structure is estimated to cost about $53,000.

Grand Forks, N. Dak.—Petitions have been filed with the Bridge Committee of the County Commissioners for the construction of several steel bridges in District No. 4, and the matter will be taken up at once.

Cincinnati, O.—City Engineer has completed plans for the construction of the proposed viaduct over the railroad tracks at Monmouth St., and a committee of city officials and representatives of the Chesapeake & Ohio, Louisville & Nashville and S. C. & C Street Railroad Companies, to consider the matter.

Zanesville, O.—County Commissioners are to issue bonds amounting to $200,000, for the construction of the Fifth St. bridge.

Pawhuska, Okla.—County Commissioners are planning the construction of a concrete structure over William Penn Creek, near Hominy,

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CHAS. S. HILL
C. T. MURRAY
F. A. SMITH } EDITORS

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CONTENTS.

EDITORIAL:

Water Rates a False Index of the Costs of Water Service 563

When Is It Safe to Remove Forms in Large Arch Concrete Sewer Work.....563

CONCRETE SECTION:

Methods of Stuccoing With Suggestions for Finishing and Coloring Stucco.....564

Methods and Costs of Molding and Setting Concrete Fence Posts.....565

EARTH AND ROCK SECTION:

Structural Details of Two Earth Dams for the Porto Rico Irrigation Service.....568

Steam Shovel for Basement Excavation..568

General Methods of Constructing the Costs 568

Louisville Sewers with Some Data on Methods of Building the Foundations for a Twenty-Story Building in the Down-Town District of Chicago.....571

ROADS AND STREETS:

An English Formula for the Camber of "Hanging" Roads.....573

Notes on English Road Maintenance.....573

Dust Prevention by the Tarring of Road with Oil Gas Tar.....574

The Maintenance of Trunk Roads in Bedfordshire County, Ireland.....575

Tar Macadam at Mankato, Minn.....575

Notes on Road and Street Work.....575

A Corrugated Iron Culvert with Smooth Bottom Plate 596

WATER WORKS and SEWERS:

The Cost of Furnishing Water with Reference to Rates and Rate-Making.....596

Degree of Purification of Sewage by Screens and Grit Tanks and Methods and Costs of Purifying Sewage to Higher Degree Than by Fine Screens.....579

RAILROAD SECTION:

Cost of Operating the Long Island Electric Railway 582

Cost of Operating all the Surface Electric Railways in Greater New York City...583

LETTERS TO EDITOR:

A Simplification of the "Criss Cross Method" for Computing Cross Section Areas 583

Queries as to Practice in Cost Plus a Fixed Sum Contracts 584

The Standard Bag of Cement.....584

Water Rates a False Index of the Costs of Water Service.

The face value of cost figures of municipal operation is always to be accepted with caution. When the Boston Finance Commission came to investigate the manufacture of valves, hydrants and fittings at the water department shops of that city its engineers found that the book costs indicated a material saving over the market prices of similar articles. They found also that:

> The cost of holidays and other lost time for which men are paid is not included, neither is the cost of superintendence, clerical service, fuel, engineer's and firemen, and other shop labor which is indirectly involved in manufacture, but which cannot be charged to any particular job of work. Further, all interest and depreciation charges upon the plant are omitted."

In another column of this issue we publish a very interesting paper and discussion on the fallacy of setting up the water rates of various cities as an index of the comparative costs of furnishing water, or of the comparative efficiency or economy of water supply service, in those cities. It is clearly indicated that such comparisons are usually worse than valueless because of the difference in local conditions and the general failure to give any data as to these conditions. Perhaps the worst sufferers, particularly in past years, from such fallacious comparisons, have been the privately owned plants, whose rates have been held up as examples of extortion by opposing them with the lower rates of selected municipally operated plants. The unfairness of this procedure is plainly evident for the reasons stated even assuming that the rates of the municipally owned plants represent true costs. That they generally do not is indicated by the discussion; they seldom represent more than a portion of the actual cost, the remainder of which is paid by the water consumers under another guise. It is not our purpose to discuss here the advantages or disadvantages of municipal ownership of water-works; but it is worth pointing out that the nominal cost of water as indicated by the rate per thousand gallons charged by municipal plants is seldom the full charge for cost of service. This is important to keep in mind when propositions for municipal manufacture of valves and hydrants, municipal asphalt plants, municipal stone crushing plants, etc., are urged, as they frequently are, on the plea that saving to the taxpayer is bound to result as exemplified by the generally lower rates for water in cities having municipally operated water-works.

When Is It Safe to Remove Forms in Large Arch Concrete Sewer Work.

What is the reasonable time a contractor should be required to keep his forms standing under reinforced concrete sewers of, say, 10 to 15 ft. in size? Recent specifications for large concrete sewers stipulate merely that the forms shall remain in place "as long as the engineer deems necessary." What is the time, specifically, according to prevailing practice that engineers deem necessary? A compilation of such records as we have been able to get at quickly shows a range of time of from 2 to 7 days. Obviously it is a question of considerable financial importance to the contractor, whether he must keep his centers in place 2 days or 7 days. Sewer centers or forms are invariably used over and over and the sooner a section can be removed and put ahead the fewer are the centers required for the same rate of progress or the greater is the progress for the same length of centers. To hold the centers under the sewer longer than is necessary means, of course, an additional expense which gives nothing in return except, perhaps an extra assurance of safety. It is a popular maxim in engineering that "one can't be too safe," but as practical matter of fact, every experienced engineer knows that one can be too safe. This is nowhere more true than in the question of removing forms from concrete work. It is quite likely that this statement will call down criticism, but we are nevertheless convinced of its truth. No one will contend that a time schedule of general application for removing forms is possible. Concrete sets, hardens and gains strength too variably under different conditions of materials and climate to permit. The matter is further complicated by the fact that the nature of the stresses in the number to be relieved of support determines the strength and stability required to insure safety. Judgment must invariably decide when it is safe to remove forms, but it should be the judgment of caution and not of cowardice. The common defense of "forms removed too soon" offered for the majority of failures of concrete buildings has, wrongfully, we believe, emphasized the danger from this course. We are convinced that more concrete buildings have failed from poor design than from poor materials and workmanship, and more have failed from the latter cause than from removing the forms too soon. Form costs are a large item in the total cost of concrete work of any degree of complexity and every reasonable effort should be bent to reducing them. The most promising way that has developed is so to design the concrete structure and the forms that repeated and frequent re-use of forms is possible. It is evident that the degree of this possibility depends upon the alertness of the engineer in seeing when his concrete can be put on its own resources and his forms freed for further use. To return to our first question, we should be glad to learn the practice and opinions of our readers.

Data on Steam Rolling in Ireland.—In the north riding district of Tipperary, Ireland, the average cost of steam rolling, including the supplying and breaking of stone, spreading, rolling, watering and brushing, is from $1,115 to $1,160 per mile. This is based on the following data: 4½ to 5 tons of metaling, principally mountain limestone, is applied to each lineal perch of road, giving a coating averaging 5½ ins. in thickness. The cost of quarrying is about 16 cts. per ton, breaking about 24 cts. per ton, horse transport about 18 cts. per ton and spreading 8 cts. per ton, making a total of 57 cts. per ton for the stone applied to the road. Watering, sweeping, etc., costs 10 cts. per ton, rolling about 6 cts. per ton, making a gross total of about 82 cts. per ton or $3.60 to $3.80 per lineal perch of road rolled. The engine rolls about 70 tons daily.

Data on Street Work at Somerville, Mass.—During 1909 2,396 sq. yds. of new brick sidewalk and 5,390 sq. yds. of granolithic and tar concrete sidewalks were constructed in the city of Somerville, Mass. The average cost for the year for laying brick sidewalks, the work being done by the Highway Department, was $1.14 per sq. yd.; the average cost of granolithic sidewalks was $1.60 per sq. yd. The average cost for the year of setting edgestone with gravel sidewalk was $1.01 per lin. ft. During the year a portion of Medford St. was paved with granite blocks, grouted with pebbles and tarvia, the work being done by the Highway Department by day labor. The old granite gutter blocks and car track paving on the street were used with new granite blocks to complete the work. A total of 2,547 sq. yds. of granite block pavement was laid, the cost being as follows:

	Total.	Per sq. yd.
Labor, teaming, rolling	$2,455	$0.964
Paving blocks (37,970)	2,278	.894
Tarvia (7,974 gals.)	528	.207
Pebbles (200 tons)	255	.099
Changing catch basins, manholes, etc.	54	.022
Total	$5,570.45	$2.19

Another piece of work done by the Highway Department by day labor was the macadamizing of a portion of Broadway with trap rock, using tarvia for a binder. A total of 2,950 sq. yds. of pavement was constructed, the cost of this work being as follows:

	Total	Per sq. yd.
Labor, teaming, rolling	$1,085	$0.367
Stone (768 tons)	1,104	.379
Tarvia (9,562 gals.)	629	.213
Changing catch basins and miscellaneous work	68	.024
Total	$2,886	$0.984

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Concrete and Reinforced Concrete Section

Note: This section is devoted to methods and cost of constructing concrete and reinforced concrete structures. It will cover the selection, testing and proportioning of concrete materials; laboratory tests of concrete; concrete mixing, transportation and placing; fabrication and placing of reinforcement, and form construction and erection. It will also contain articles on new and interesting developments in the design of reinforced concrete.

Methods of Stuccoing with Suggestions for Finishing and Coloring Stucco.*

BY ALBERT MOYER.†

The history of stuccoes does not furnish sufficient information and data to be of practical value in the manufacture of the present day Portland cement stuccoes. There are records dating 35 B. C. of stuccoes made from vastly different materials than are of economical use at the present time, and we find that such stuccoes were almost invariably used in warm climates where the action of frost would not tend to disintegrate the rather poor material which was then available. There is every reason to believe that originally these stuccoes were intended to cover up and protect inferior building stone and sunburned straw brick. The archaeology of stucco would tend to show that from an artistic standpoint this method of decoration was a development of the wattled buildings, which were plastered with clay and different muds hardened by being baked in the heat of the sun. Therefore, in this instance, the use of clay plaster over wattled houses was to protect an inferior building material.

Today succo is used for a similar purpose, that of protection and pleasing surfaces. It would, therefore, seem advisable to recommend a material which would best serve the purpose of protection and artistic merit. Stucco or plaster should never be used as an imitation of other building material.

To cover brick with plaster and tint plaster with fresco is perfectly legitimate the plaster is passed upon as panel or canvas, but to cover brick with cement and to divide this cement into joints that it may look like stone, is to tell a falsehood, and is just as contemptible a procedure as the other is noble.

To carry out these ideas we desire to recommend only Portland cement stucco for exteriors, as this is the only hydraulic material which will stand the action of the elements. From the artistic side we would also recommend such surface finish for stucco as will cause both natural color and pleasing texture. It would be well, therefore, to expose to view the aggregates used and avoid as far as possible exposing the bonding material, Portland cement.

There is no artistic reason for allowing only the bonding material to be displayed to the eye. On very large jobs the surface can be cleaned off by means of a sand blast, and on smaller jobs the surface may be cleaned exposing each grain of sand by means of muriatic acid in dilute solution, 1 part commercial muriatic acid to 4 to 5 parts clear water

Where white aggregates are used the surface may be cleaned off with a solution of sulphuric acid, 1 part acid to 4 to 5 parts clear water. The sulphuric acid leaves a white deposit and therefore should not be used excepting where the aggregates are white.

Another method is to scrub the surface while yet green, say within 24 hours, with a house scrubbing brush and clear water. This is more difficult than the others for the reason that if the stucco is allowed to remain too long before scrubbing, it will be too hard to remove the coat of neat cement from the outside of each particle of sand or other aggregates; and if scrubbed when it is too soft the surface may be damaged and difficult to repair.

If the character of the available aggregates will not present a pleasing surface when exposed, the following surface treatment may be used:

While the last coat is still thoroughly damp, apply a Portland cement paint composed of 1 part Portland cement, 12 per cent of the volume of the cement of well hydrated lime, pulverized form, and 1 part of the volume of the cement of fine white sand. Mix with water to the consistency of cream or the ordinary cold water paint. Stir constantly and apply by using a whisk broom throwing this paint on with some force.

Keep this finish surface damp for at least six days or longer if economy will permit. Do not allow it to dry out in any one place during the week. If necessary protect by hanging tarpaulins and using a fine spray of water playing on several times during the day by means of a hose. This will give a pleasing light gray color of excellent texture.

Stucco may be applied to various building materials. There is hardly any reason at the present time for stuccoing stone buildings, the procedure at best is difficult and hardly to be recommended. Our building stone is usually an excellent material and therefore, does not require either protection or covering to produce pleasant effects.

New brick may be covered with stucco very successfully. The joints should be first raked out half an inch. The brick must be saturated with water. It is always best to start stuccoing at the top of the wall and work down between the pilasters or corners, finishing a whole strip or whole side wall from top to bottom in one day. Thus no streaks or cracks are formed where one day's work ends and another begins. By this method the wall can be kept wet ahead of the work by means of a hose.

The second coat should be put on as soon as the first coat has stiffened sufficiently to hold in place and stand the pressure of the trowel. This second coat should be well scratched and the finished coat applied while the second coat is damp. The finish coat should then be kept wet, protected from the rays of the sun and as far as possible from drying out. This can be done by hanging wet cloths over same. This rule of keeping each coat moist until the other coat is applied and protecting after applying the finish coat, must be observed in all forms of Portland cement stucco.

If the stucoc is to be applied to metal lath or wire cloth the metal should be plastered on two sides so that it is entirely encased in mortar in order to avoid rusting. If this is impracticable then the metal lath or wire cloth should be dipped in a paint made of equal parts of neat Portland cement and water. Immediately after dipping, the metal lath or wire cloth should be tacked onto a frame in the position it is intended to occupy. As soon as the neat Portland cement has hardened on the metal apply the first coat to stucco. Hair should be added to the mortar to be applied on wire mesh or expanded metal: 1 bag of cement, 1 lb. of hair.

If plaster boards are used they should be nailed on the frame work of the building, leaving at least ¼ in. joint between each plaster board. This joint to be filled in with lime putty, otherwise each plaster board will cause square cracks on the outside of the stucco the size of each board.

A convenient method of waterproofing plaster boards is easily available. The boards may be painted with two coats of any of the reputable bitumen waterproof paints to which plaster adheres. Then about 24 hours after the bitumen paint has been applied, and within six days, apply the first coat of stucco.

For stucco on terra cotta blocks great care should be exercised in keeping the blocks thoroughly saturated with water, for if the blocks are not saturated they will pull the water out of the mortar and it will crack and disintegrate. Portland cement requires water until it has thoroughly hardened, which ultimate hardening usually takes from 14 days to a month. It is not always necessary to play the hose on the wall for a month, although it would be advisable. The dews at night, the dampness in the atmosphere and the rain will furnish the necessary moisture provided the material on which the mortar has been plastered has not too great an affinity for water.

In order to prevent the porous hollow terra cotta tile from sucking the moisture from the stucco and also to furnish waterproofing and an additional bond other than that which would be given by the key, it is good practice to paint the surface of the dry terra cotta blocks after having been erected in the wall with two coats of bituminous paint, equal to such paints as Dehydratine, Minwax, R. I. W., or X-Hydro-Plastic. It is important that the first coat of stucco is placed over this paint after 24 hours and within six days.

Proportions for a good stucco should be 1 part Portland cement and 2½ parts coarse clean sand. (If coarse clean sand is not available use only 2 parts of sand.) Add 10 to 15 per cent of well hydrated lime, dry pulverized, of the volume of the cement.

If it is the desire of the owner or architect to use the exposed aggregate method interesting natural colors can be obtained by using the following materials instead of sand, the same proportions. Green, red, buff, black or white marble screenings all passing a No. 8 screen and all collected on a No. 40 screen. These different colored marble and different colored sand where obtainable, can be used singly or in a combination. When exposed by scrubbing or the acid treatment very interesting results are obtained.

In mixing stucco great care should be exercised to obtain the thorough incorporation of cement, sand and the other aggregates. The sand and cement should be mixed together dry until an even color results. This can be done by shoveling and raking while shoveling. Water should then be added being careful not to add too much water at a time and not to get the resulting motar too wet so that more sand or cement has to be added. Be very careful to bring the resulting mortar up to the proper consistency for plastering.

It is advisable to add to the mortar from 10 to 15 per cent of the volume of the cement of well hydrated lime. This should be mixed dry with the cement and sand before the water is added. The addition of hydrated lime tends to fatten the mortar making it more adhesive and impervious.

Another specification which we believe will prove of considerable value is the addition of mineral oil to wet mortar. After the water is added and thoroughly mixed with the mortar add 15 per cent of mineral oil and remix. If a light effect is to be produced use white oil, such as Oil Petrole, manufactured by the Chesebrough Mfg. Co. When the oil is to be mixed with the mortar it is always advisable to use hydrated lime as we thus have a larger amount of emulsifying material.

The color obtained by the scrubbing or acid method is limited only to the available sands or marble screenings, the color will be the color of the aggregates. An excellent green can be obtained by adding 8 per cent of the weight of the cement of cromium oxide. This should be mixed dry with the sand, cement and hydrated lime.

Always keep in mind that the surface to which the mortar is to be applied must be thoroughly saturated with water, each coat of stucco must be kept moist and the final coat must remain moist for at least one week and longer if economy will permit.

Stucco should not be troweled to a smooth surface. The artist painter would never think of smoothing the paint on his canvas by means

*Other valuable practical articles on stucco work will be found in Engineering-Contracting for Aug. 11, 1909, and Jan. 12, 1910.

†50 Pine Ave., New York, N. Y.

of a straight edge. Texture and color are necessary if artistic results are to follow. By using the suggestions above outlined, the architect is privileged to select the aggregates from which the stucco is made and has in fact as great play in the planning of the color, tone and texture as has the artist in mixing the paints on his palette.

Methods and Costs of Molding and Setting Concrete Fence Posts.

The following notes of methods and costs of molding reinforced concrete fence posts and of fence construction with concrete posts are taken from a bulletin issued by the Office of Public Roads, Washington, D. C. While the information has been prepared especially for farmers, many of the data are of general application and so are valuable for contractors.

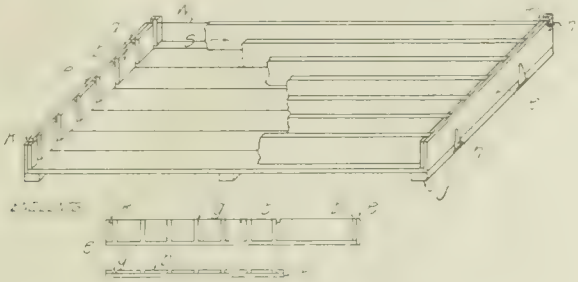


Fig. 1—Gang Mold for Square Posts Without Taper.

Wooden Molds.—Wooden molds good enough for ordinary demands are very easily made. White pine is the best wood for this purpose, but at the same time it is the most expensive. Cheaper kinds of lumber, which are easy to work with, may be used. Molds made of 2-in. planks, dressed on both sides, form neater posts, but lighter lumber may be used, if the forms are well braced.

In imitation of the manner in which tree trunks grow, concrete posts are usually made tapering in size from butt to top. While this method may add a little to the appearance of the post and effect a slight saving in concrete, this saving is largely offset by the additional cost of the carpenter's work and of the lumber used in making the molds. Theoretically, the tapering post has a better design than the one with straight sides, but for ordinary use one is as good as the other.

In making these molds, dressed lumber, planed from the rough, should be used. The proper dimensions for rough timber are 1 or 2 ins. thick and 4, 6, 8, 10, or 12 ins. wide; for dressed lumber they are ⅞ or 1⅝ ins. thick and 3⅝, 5⅝, 7½, 9½, or 11½ ins. wide.

Molds for Square Posts.—Molds for posts that are square or nearly square in cross section are simple and easy to make. They are built in three patterns: (1) For posts without taper; (2) for posts tapering on two sides; and (3) for posts tapering on all four sides.

In order to avoid a sharp, irregular edge, neater posts are made by fastening a narrow strip of canvas or leather on the inside of the side board at the bottom of the mold, so that when the mold is put together and the concrete post molded the corner of the post will be rounded. A similar effect on the upper side of the post is produced by using a trowel or an "edger"—a special tool for rounding the corners of concrete walks or curbs. Clay plastered in the corner of the mold or wooden strips tacked to the sideboard will answer the same purpose. Such strips must, however, be as small as possible or else they will crowd out much concrete, and thus cause the reinforcement to be located too far within the post to obtain the best results. Ordinarily the reinforcement should be placed within ¾ in. or 1 in. of the outside of the post.

The easiest and cheapest mold to make is the straight mold, or one for a post which does not taper. Such molds are merely long boxes built with various schemes for making the molding of the post a simple matter. On account of the amount of lumber saved and the ease with which these molds are filled, straight molds are generally made in "sets" or "gangs," by constructing several side by side with a continuous bottom and end pieces. Figure 1 shows the plan of a "gang" mold for making six posts, each of which is 7 ft. long and 5x5 ins. at both ends. On account of the rigid method of construction, all lumber used in this mold, with the exception of the 2x4 in. stringers, may be 1-in. dressed boards. The bottom is of "ship lap" cut to the dimensions indicated on the drawing and nailed tightly to the three stringers. The end pieces *E* are made up of one board each to which are nailed blocks *B* 1 in. in thickness and 5 ins. square, placed so as to allow the side pieces *S* to slip between them. The end pieces are hinged to the bottom with strap hinges *H*, in which the fixed pine is replaced by a loose pin of a nail. This arrangement allows the end piece to be removed at will. Shutter hinges or loose-pin door butts of heavy wrought iron may also be used as hinges. All the side pieces are alike and interchangeable.

The form is set up ready for use in this manner. The end pieces are placed in position by inserting the loose pin of the hinges. Lengthened wagon rods *W*, with crank nuts *N*, at one end, are dropped into the slots *K*, and the sideboards are then placed in the grooves *G*, between the blocks on the end pieces. All the pieces are then drawn together by tightening the crank nuts *N*. The slots for these rods should be faced with an iron strap and should be so centered that the rods, when tightened, will lie against the sides of the outer side pieces and act as stiffeners for them. With this arrangement, by merely loosening the crank nut on the end of the rods, when the concrete has sufficiently set, the end and side pieces may be removed without disturbing the posts and placed on a similar bottom board, and another batch of posts may be made.

By another method the end piece is hinged to the bottom like the end gate of a spring wagon bed, and the method of fastening is the same as generally used on spring wagons—spring elbow catches fastened with screws to the side boards and flush with them—so as to allow the concrete to "struck" when the molds are filled. If the molds are constructed in this way, the outer sideboards should be made of 2-in. lumber.

Posts tapering on two sides are preferable to the straight posts in some respects. A satisfactory size for this style is produced in a mold 4½ ins. deep by 6 ins. wide at the butt, 4½x4½ ins. at the top, and 7 ft. long. These posts may be made more easily in gang molds, which are built so as to make the adjoining posts lie butt to top. By considering that the end positions of every post are reversed, it is possible to build this style of mold according to the directions set forth under straight molds.

Square posts are also made tapering on all sides. A line post of a satisfactory size may be obtained by making the molds 5 ins. deep by 6 ins. wide at the butt, 3 ins. deep by 4 ins. wide at the top, and 7 ft. long. Since all the butts must be placed at one end and all the tops at the other, this arrangement causes the continuous bottom to be 1 ft. wider at one end than at the other. The variation in the length of the sideboards and of the molded posts is, however, so slight (hardly ¼ in. at the greatest) that no attention need be paid to it and all sideboards can be made the same length.

Molds for Triangular Posts.—Triangular molds without a taper are easily constructed in "sets" or "gangs." On account of their shape, they may be braced at any point and, as a result, 1-in. boards may be used in their construction. In Fig. 2, molds for three sizes of triangular concrete posts are shown. The two boards are hinged together at the ends and quarter points on the bottom by ordinary 3-in. wrought-iron strap hinges bent to conform to the shape of the mold and fastened with ¾-in. screws.

Sharp corners on the finished post are somewhat objectionable, on account of their roughness and sharpness and the possible waste of material. This undesirable feature is avoided by placing a wooden tongue or strip *T* in the bottom of the form, as shown in Fig. 2, and by rounding the corners at the upper face either with a trowel or an edger.

The manner of supporting and bracing the gang triangular mold is shown in Fig. 3. Three 2x4 joists *J* should be cut with each 4 ft. 8¾ ins. in length. Beginning at either end 3⅝ ins. should be laid off for the cleated lock piece *P*, made of a 2x4-in. board with cleats of strips 1x2x3⅝ ins. The lock piece laid under the joists, as shown, serves to bind them together. Then 1½ ins. should be marked off for the strip *U* on the end board, 3 ins. for a half brace block *b*, and afterwards 1¾-in. openings for the insertion of the hinged sideboards *S* and 6 ins. for the full brace blocks *B*, until six posts are provided for, with a half brace block, strip, etc., at the other end. The brace blocks *B* are cut from scantling 2x6 ins. They are 5½ ins. deep and are 2 ins. wide at the top and 6 ins. at the bottom, where they are nailed to the joist *J*.

The ends *E* for the molds are made from 1 x10-in. boards and are 4 ft. 1½ ins. long. They are fastened at the bottom side to the joists *J* by means of heavy, loose pin, wrought iron strap hinges, shutter hinges, or door butts *H* and at the upper side with wagon rods *W* and wing nuts *N* or with elbow catches. Until all of the molds of the gang are partially filled with concrete it is sometimes necessary to keep them from spreading open at the center by using a tie brace made from a 2-in. board with blocks 1 in. in thickness attached so as to fit the molds when the brace is in place.

Oiling the Molds.—Concrete has a tendency to stick to either steel or wood. In order to yield a smooth finish to the post, it is customary to give the inside of the molds a coating of oil. Soft soap or crude oils used sparingly serve the purpose well. Too much oil will destroy the setting qualities of the cement and will give a face roughened with pock marks. A small amount of oil, poured into a pail of water and applied with a mop or stiff broom in scrubbing out the molds after they have been used five or ten times, or as often as necessary, will prevent the concrete from sticking.

Kinds of Reinforcement.—Two kinds of reinforcement are much used—bars and wire.

Round bars 3-16 or ¼ in. in diameter are the size and kind most used in posts. The stock on hand at blacksmith shops and hardware stores is generally from steel that

Fig. 2—Sections of Mold for Triangular Posts.

stretches too easily and therefore is not the best for reinforcement. Companies which make a specialty of reinforcing materials can furnish both rods and bars which stretch only under very large loads.

The development of the wire fence has produced a material well suited for reinforcing

purposes. Of equal size, such wire will produce a stronger post than the material described above. Single No. 8 or two No. 12 wires twisted are sufficiently strong as reinforcement for ordinary line posts. In order to obtain straight wire of the necessary length the coils ordinarily placed on the market

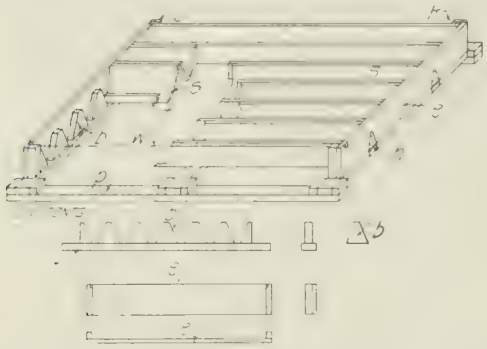


Fig. 3—Gang Mold for Triangular Posts.

should not be straightened out. Straight wire can be obtained from dealers in the same manner as baling wire—that is, either single or twisted into two or three ply cables—and of the length desired. The plain, ungalvanized fencing wire is the proper kind, for galvanization adds nothing to the strength and the metal will not rust when incased in the concrete.

Table I will be convenient in determining the size and weight of wire desired for reinforcement or for other uses:

TABLE I.—SIZES AND WEIGHTS OF WIRE FOR REINFORCING FENCE POSTS.

Gage.	Ft. to lb.
1	1.68
2	3.44
3	6.31
4	7.28
5	8.75
6	10.17
7	11.97
8	14.29
9	17.05
10	20.37
11	25.32
12	33.69
13	44.78
14	58.58
15	72.32
16	95.98
17	128.6
18	166.2
19	223
20	309.6

In order that the reinforcemnet may be placed and kept just where it belongs, there is in use a little device called the "fool proof spacer." It consists of a No. 10 wire, cut to such length that, when twisted once around each of the two reinforcing wires or rods, the ends will nearly touch the sides of the mold (Fig. 4). The distance from the twist to the end of the short wire is equal to the distance from the reinforcement to the side of the mold. In triangular molds such a spacer can be used only on the two rods or wires near the top of the mold. A shorter and similar device, with only one twist, may be used on the lower reinforcement. At least three spacers should be placed on each piece of reinforcement.

Spacers on No. 8 wire, which should be placed ¾ in. from the inside of the mold, should be made from the following lengths of wire for the various sizes of triangular posts:

	Heavy posts.	Medium posts	Light posts
Upper spacer	6½	6¼	5¼
Lower spacer	2	2	1⅞

Spacers on No. 8 wire for various sizes of square or nearly square posts should be made from the following lengths of wire:

	Straight posts: 5x5	Posts tapering on two sides: 4½x6, 4½x4½	Posts tapering on four sides: 5x5, 4x3
Bottom spacer	5¼	6¾	6¾
Middle spacer	5¼	6	5¾
Top spacer	5¼	5¼	4¾

For larger or smaller reinforcing a little additional length may be added or deducted. When the proper length has been determined, a number of spacers should be prepared and slipped on the reinforcing iron by way of preparation for placing it in the mold. This serves to hasten the work.

Reinforcing should be placed near the outside wall, where it is reasonable to expect that cracks will open. For reinforcement, metal slightly rusted is as good as metal that is not rusted, if not better. In placing the reinforcing rods in position it is a wise precaution to bend them back at the ends (Fig. 4). This takes only a little more time, but if it is done the reinforcement must be 2 ins. longer to allow the metal to be turned back 1 in. at each end of the post. New barbed wire should not be purchased for reinforcement, for while it costs more than plain reinforcement, the bond between it and the concrete is no stronger than between smooth wire and concrete. The danger section or the point where posts are liable to break is at the surface of the ground. For fences for lots and other places where posts may be subject to rubbing and crowding, short extra reinforcing pieces 2 ft. long are sometimes placed in the post to lap this danger section. The corner of triangular shaped posts which is not nearest the fence wire should in theory have heavier reinforcement than either of the other corners. If rods 3/16 in. in diameter, No. 8 wire, or two twisted No. 12 wires, are used in the other corners, a rod ¼ in. in diameter or two or three twisted No. 12 wires should be placed in the threatened corner.

Mixing a Six-Post Batch.—Table II gives approximate quantities for a batch of concrete sufficiently large to make six posts 7 ft. long and of the sizes named in the table. The

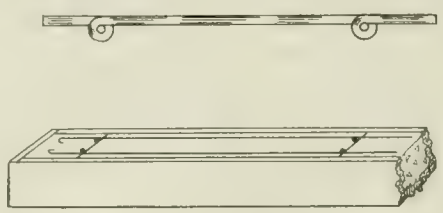


Fig. 4—Wire Spacer for Post Reinforcement.

quantities may be increased in like proportion and any desired number of posts may be made. The first of the two lines of figures given for each of the three grades, heavy, medium, and light, indicates the proportions to be used when the sand is screened from the gravel. The second line gives the proportions when "bank run" gravel is used; that is, gravel dug directly from a bank without screening the sand. In this case 1 part of cement to 4 parts of the mixture of sand and gravel should be used.

Molding.—After the molds, which as a rule lie flat, have been oiled or soaped, the concrete should be placed in them at once. If for any reason the concrete stands thirty minutes after mixing, it should be thrown away and a new batch mixed, for cement, if it has once partially set, makes weak, dangerous concrete, even though it is retempered by turning or adding water. After the molds are filled evenly to the depth of ¾ in. or 1 in., according to the spacing of the reinforcing rods or wires, the reinforcement should be laid in, properly spaced by means of at least three "fool proof" wire spacers. The concrete should then be poured in until the molds are filled within ¾ in. or 1 in. of the top, when the remaining reinforcement is fitted in place in the manner described above and the molds are completely filled. To render the concrete more compact a crow bar or a pinch bar should be placed under each corner of the mold successively and moved up and down quickly. This vibration makes the concrete more compact by shaking out the air bubbles, but there will be very few of these bubbles if the concrete is sufficiently mixed to proper consistency. If desired, the exposed corners of the post may be beveled with an "edger" and the open face given a neat finish by using a trowel immediately after the surface water has been absorbed and before the concrete has become too hard. If wooden

TABLE II.—QUANTITIES OF MATERIAL AND RESULTING AMOUNT OF CONCRETE FOR A SIX-POST BATCH.

Triangular Posts—Length, 7 Feet.

Proportions of materials by parts, measured in volume.
Materials in cubic feet,

Size of post.	Proportions of materials by parts measured in volume. Cement.	Sand.	Gravel or rock.	Materials in cubic feet, measured loose. Cement.	Sand.	Stone or gravel, Concrete tamped, cu. feet.	Water for mixing, gallons.
Heavy	1	2	4	1.4	2.8	5.6	6.2	11
	1	..	4	1.5	..	6.0	6.2	11
Medium	1	2	4	1.3	2.6	5.2	5.5	10
	1	..	4	1.4	..	5.6	5.5	10
Light	1	2	4	1.1	2.2	4.4	4.8	9
	1	..	4	1.2	..	4.8	4.8	9
Rectangular Posts—Length, 7 Feet.								
Straight, 5x5	1	2	4	1.7	3.4	6.8	7.3	13
	1	..	4	1.8	..	7.2	7.3	13
Taper on two sides, 4½ x 6, 4½x4½	1	2	4	1.6	3.2	6.4	6.9	12
	1	..	4	1.7	..	6.8	6.9	12
Full taper, 5x5, 4x3	1	2	4	1.5	3.0	6.0	6.7	12
	1	..	4	1.6	..	6.4	6.7	12

molds are used, they should be well soaked in water, so that the green concrete will not cause them to swell and thus crack the posts. The wind, the hot sunshine, and the frost are destructive to concrete, and while it is an easy matter to protect the post from the first two agents it is best to do no concrete work when the thermometer is below the freezing point, unless inside a building.

Curing.—It is a great mistake to believe that when the molding is done a concrete post is finished. The quality of the post must be determined by curing. The green post should be left in the mold until thoroughly hardened, that is usually for two or three days. For square or nearly square posts the molds proper may then be removed and used on another bottom board, but the posts must stay on their bottom board in the shade and must not be disturbed for at least a week or ten days. Posts in triangular molds may be carried out, each in its own mold, after from five to seven days, and the post may be gently slid from its mold to a smooth floor covered evenly with a cushion of sand. While green the strain of lifting or even a slight jar will cause cracks, sometimes invisible, which greatly weaken the post. During the first two days of the life of a post it must be kept wet and covered with canvas, burlap, carpet, or any clean material. Sand will serve after the concrete has be-

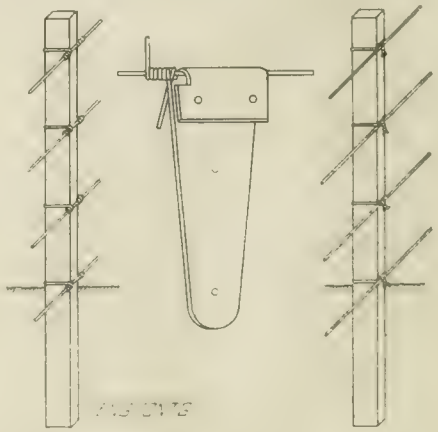


Fig. 5—Methods of Attaching Fence Wire to Concrete Posts.

come hard, but manure will stain green concrete and otherwise affect it. The sprinkling should be continued up to the eighth day. After the tenth day, if the space is needed, the post may with care be placed on end in the same manner that wooden fence rails were formerly piled. A drop of only 6 ins. often breaks a green post. The jar in hauling to the field over rough, frozen roads or in a wagon bed with a very uneven bottom has seriously

injured posts which were not well seasoned. Concrete posts gain rapidly in strength for the period of one year; they should therefore be made as long as possible before it is necessary to set them in the fence. No post should be used until it is at least 3 months old, and to meet any contingency a supply of well seasoned posts should be kept on hand.

Setting the Posts.—Experience has taught that with regard to stringers and joists, in order to get the greatest strength from the timber, one should place the beam with the narrow side against the load and with the depth extending in the same direction as the pressure. Likewise posts should be placed so that the narrow side will support the wire. The depth to which posts should be set varies with the character of the soil. Seven foot posts are usually set from 2½ ft. to 2 ft. 8 ins. deep. The earth about the post should be thoroughly compacted by tamping.

Methods of Attaching Wire.—There are numerous methods of attaching wire fencing to concrete posts. Some makers place staples or wire loops in the green concrete, others make holes in the posts. The former method is not desirable because the fastener can not be located exactly where the wire of the fencing will come when the post is set in the ground. Then too the fastener will eventually rust or break off and will thus injure the looks of the post. On the other hand, holes through the posts weaken them and therefore this method is in general unsatisfactory.

TABLE III.—COST OF MATERIALS AND LABOR AND OF THE FINISHED POSTS.

Materials.	Cost.	Number of posts.	Cost per post.
Heavy, Triangular Posts.			
1 yard of rock or gravel..	$1.60	29	$0.05½
1 yard of sand	1.00	58	.01¾
1 bbl. (4 sacks) of cement	1.50	18	.08½
3 two-ply No. 12 wire cables (weight, 1¾ lbs.)	*.02½	1	.04¼
2 men for 1 hr., at 20 cts. per hr.....	.40	5	.11
1 boy for 1 hr., at 15 cts. per hr.....	.15		
Total cost.....	...	..	$0.29
Straight, Square Posts.			
1 yard of rock or gravel..	$1.00	25	$0.04
1 yard of sand.....	1.00	50	.02
1 bbl. (4 sacks) of cement	1.50	16	.09½
4 two-ply No. 12 wire cables (weight 2¼ lbs.)	*.02½	1	.05¾
2 men for 1 hr., at 20 cts. per hr.....	.40	5	.11
1 boy for 1 hr., at 15 cts. per hr.....	.15		
Total cost.....	...	..	$0.32¼

*Per pound.

The simplest, easiest and cheapest way of fastening a wire fence to a concrete post is by encircling the post with a wire one size less than the corresponding wire in the fence proper and by twisting this wire around the strand of the fence. This is done in two ways. The fastening wire is placed around the post, twisted upon itself and then to the fence wire, or one end of the fastening wire is twisted around the fence wire, and the free end is then carried around the post and twisted on the other side to the same wire. (Fig. 5.) The latter method is known as "the Western Union twist." Either plan is good, but care must be taken to draw the fastening wire tight or else stock trying to get through the fence may raise or crush down the fencing with their heads. If any trouble is experienced, the post should be roughened at the fastening point with a cold chisel.

Expansion and contraction of the fence due to heat and cold are cared for by the tension curves or "kinks" in the woven wire fencing, and no fear may be felt in drawing the fastening wires as tight as necessary. Wooden nailing strips should never be embedded in the posts, for moisture will swell the wood and crack the concrete.

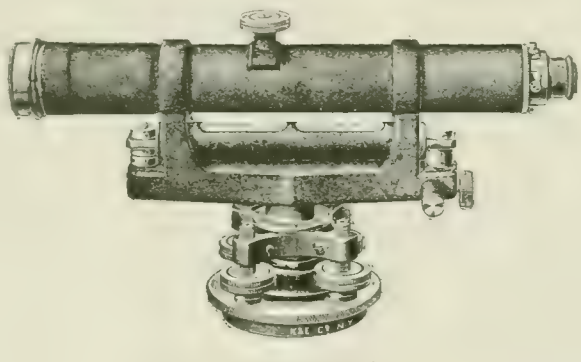
Cost of Concrete Posts.—So many elements enter into the matter of cost that no exact figure can be given. The prices of labor, molds, cement, sand, stone, gravel, reinforcement, and lumber are not the same in any two sections of the country. The cost of only two sizes of post will be considered here—Table III—the heavy, triangular and the straight, square post, each of which has a standard length of 7 ft. The figures are based on the following data: A mixture of 1 part of cement, 2 parts of sand, and 4 parts of crushed rock or screened gravel; a reinforcement consisting of two No. 12 smooth fencing wires twisted into a cable and cut to the necessary length at the factory; concrete mixed by hand; all materials delivered at the work, and all labor of men and teams paid for.

With the heavy triangular post, if considered necessary, a slightly heavier reinforcement may be used in the corner of the post away from the fence.

A New Compact Dumpy Level.

The Dumpy Level which has long been a favorite with English engineers has steadily grown in favor in this country, until at the present time there is considerable demand for such an instrument. The compactness of the Dumpy Level and its capacity to stand hard knocks and give reliable service in rough country or when carried over rough trails, accounts in a large degree for its popularity.

A Railroad Dumpy Level, recently developed and placed upon the market by Keuffel & Esser Co., New York, presents some novel features which are of interest. As shown by the accompanying illustration, this instrument is unusually compact. It is provided with a 12¼-in. telescope, very rigidly supported, and by a new arrangement of the telescope supports, a considerably longer spirit level is employed than is usually furnished with instruments of this size. The bar is made of gun metal and shaped to combine strength with light weight, while the general construction is such that the whole instrument is brought closer to the tripod plate than is ordinarily the case. The barrel of the telescope and its supports, the tube of the spirit livel and the bar are cloth finished, while the leveling arms and tripod plate are enameled.



A New Dumpy Level.

The Convention of the American Society for Testing Materials.

The thirteenth annual meeting of the American Society for Testing Materials will be opened at the Hotel Traymore, Atlantic City, on the afternoon of June 28. The programme for the first session includes the following papers: "Tests of Cast Iron Arbitration Test Bars," by C. D. Mathews; "Some Recent Tests of Cast Iron," by A. E. Outerbridge, Jr.; Notes on the Annealing of Steel Castings," by Albert Sauveur; "Untruly and Unevenly Chilled Car Wheels," by T. D. West; "The Forest Products Laboratory, Its Purpose and Work," by McGarvey Cline; reports of the committees on standard specifications for cast iron and finished castings, on standard methods of testing, and on standard specifications for hard-drawn copper wire.

The second session, on the evening of June 28, will be devoted to a consideration of the following papers: "The Closing of Blowholes in Steel Ingots," by Henry M. Howe; "Measured Strains in a Steam Boiler Under Hydrostatic Tests," by James E. Howard; "Copper-Clad Steel, Its Metallurgy and Properties," by Wirt Tassin; "Tests on Steel and Wrought-Iron Beams," by H. F. Moore; "Strength of Steel from I-Beams," by E. L. Hancock.

The third session, on the morning of June 29, is to be opened with the report of the committee on standard specifications for steel. Afterward the following papers will be presented: "Low-Carbon Streaks in Open-Hearth Rails," by M. H. Wickhorst; "Elongation and Ductility Tests in Rail Sections Under the Manufacturers' Standard Drop-Testing Machine," by P. H. Dudley; "The Influence of Titanium on Segregation in Bessemer Rail Steel," by G. B. Waterhouse; "Cupro-Nickel Steel," by G. H. Clamer; "Test of a Structural Steel Plate Partly Fused by Short-Circuited Electric Current," by A. W. Carpenter; "Further Notes on the Heat Treatment of Steel," by Wm. Campbell; report of the committee on standard specifications for cold-drawn steel.

The fourth session, on the evening of June 29, at which a very large attendance is assured, will be devoted to addresses in honor of the memory of Dr. Charles B. Dudley. Theodore N. Ely will speak of him as a railroad man, Edgar F. Smith as a chemist, Henry M. Howe as a metallurgist, Col. B. W. Dunn as a mentor, W. H. Schwartz as a citizen, and Capt. R. W. Hunt will pay a personal tribute as a lifelong friend.

The fifth session, on the morning of June 30, will be opened with a report of the committee on standard specifications for cement, which will be succeeded by a discussion of the following papers: "Aluminates, Their Properties and Possibilities in Cement Manufacture," by Henry S. Spackman; "The Effect of Sodium Silicate Mixed With or Applied to Concrete," by Albert Moyer; "Comparative Tests of Lime, Hydrated Lime, Lump Lime, and Cement Lime Mortars," by E. W. Lazell; "Tests of Reinforced Concrete Columns Subjected to Repeated and Eccentric Loads," by M. O. Withey; "The Distribution of Stress in Reinforced Concrete Beams," by A. T. Goldbeck; "A Sand Specification and Its Specific Application," by W. A. Aiken.

The sixth session, on the afternoon of June 30, will be devoted to a discussion of the reports of the committees on preservative coatings for structural materials, on the corrosion of iron and steel, on standard tests for lubricants, and on standard methods of analysis of fats and oils, and the following papers: "A Method for Testing the Protective Power of Paints When Applied to Iron and Steel," by the late M. T. Jones, Jr., and W. H. Walker; "Another Solubility Test on Protective Coatings," by G. W. Thompson; "Vermilion Paint for Railway Signals," by Robert Job; "The Painting of Cement and Concrete Structures," by Charles MacNicol, and "Classification of Fine Particles According to Size," by G. W. Thompson.

The seventh session, on the morning of July 1, will be devoted entirely to testing machines and apparatus, and there will be a special exhibit of photographs and drawings of such equipment in the testing laboratory of the University of Wisconsin. The list of papers for this session is as follows: "The 600,000-lb. Testing Machine of the University of Wisconsin," by H. F. Moore and M. O.

(Continued on page 576.)

Earth and Rock Section

Note: This section is devoted to methods and costs of excavating earth and rock and building embankments. It will cover the grading of roads and railroads, diking and canal work, dredging, building reservoirs and earth dams, sewer and water pipe trenching, quarrying, etc.

Structural Details of Two Earth Dams for the Porto Rico Irrigation Service.

The accompanying illustrations show two earth dam sections developed by the Porto Rico Irrigation Service, B. M. Hall, Chief Engineer. The larger dam shown by Fig. 1 is known as the Carite Dam and is located near Guayama; the other is the Toro Negro Dam located near Villaba. In our issue of Jan. 19, 1910, details were given of a still larger earth fill dam for the same service.

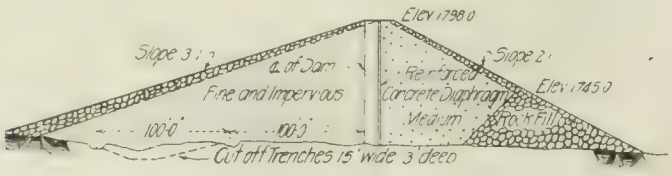


Fig. 1—Eearth Dam at Guayama, Porto Rico Irrigation Service.

The Carite Dam work calls for 150,000 cu. m. (196,200 cu. yds.) of earth and loose rock excavation. Figure 1 shows the maximum cross-section. This dam has a reinforced concrete diaphragm or cut-off wall extending straight across the dam and two cut-off trenches on lines of, roughly, equal depth of embankment. The concrete diaphragm is about 100 ft. high at the deepest point of the dam and is 4 ins. thick and is the unique feature of the work. For this wall the engineer will specify the proportions according to the materials to the end of securing a dense concrete. The sand used is required to be a well graded mixture all passing a ¼-in. screen and the coarser aggregate is also to be graded—artificially if necessary—and must all pass a ¾-in. screen and be all retained on a ¼-in. screen. In proportioning, the volume of a barrel of cement will be assumed as being 4 cu. ft. A wet mixture is required wherever practicable and in placing it is to be well worked to reduce voids and the faces next the forms spaded to bring the fine material to the surface.

The cut-off trenches will be 3 ft. deep and 10 ft. wide and are to be filled with a mixture of at least 45 per cent clay and sand and gravel, with no stones larger than 4 ins. The backfilling is to be wetted and deposited in 6-in. layers and each layer compacted by a roll weighing not less than 100 lbs. per lin. in. of tread. These requirements also apply to the cut-off trench work for the Toro Negro Dam shown in section by Fig. 2.

Generally for both dams the embankment is to be made from materials excavated from the spillways, etc. The specifications for embankment are as follows:

Proportioning the Materials.—The materials entering the dams shall be distributed approximately as shown on drawings Nos. 3 and 5. The bulk of the material will come from the spillway excavations, the rock from which will be deposited on the outer slopes. The central portion shall be composed of the finer material from spillways and borrow areas, and shall contain not less than 25 per cent and not more than 35 per cent of clay, the remainder being sand and gravel or small rock particles.

Formation of Embankments.—The dams shall conform to the slopes and dimensions shown on the drawings, and shall be built up in successive horizontal layers of not more than 6 ins. thickness. Each layer shall be thoroughly rolled and compacted, except in the rock portions. The rollers shall weigh not less than 1 ton per lin. ft. of tread and shall be composed of alternate large and small discs, whose difference in diameter shall be not less than 2 ins. and whose width shall not be more than 12 ins. A roller made of concrete will be acceptable. When necessary each layer shall be sprinkled before rolling with sufficient water to secure the greatest practicable compactness. All rock larger than 4 ins. in diameter shall be removed from the central portion into the rock portion of the dam. To effect the proper mixture for the central portion the loads from different parts of the excavation shall be deposited in such sequence and at such places as the engineer may direct and the method of spreading shall be subject to the approval of the engineer. In so far as it may be practically effected in the regular handling of the material small and large rock will be mixed to the end that large cavities may be avoided in the rock masses on either slope, but a sufficient quantity of finer material must be incorporated with the boulders in the upstream slope to practically fill the voids. All the material in the dams must be firmly bedded, and form embankments of unyielding stability.

As will be seen from the drawings it is intended that the upstream half, or that part of the dam on the upstream side of the central diaphragm shall be made as nearly impervious as is possible from the materials designated, and that puddle trenches as shown in drawing shall cut off the percolation along the bed rock or other natural formation, thus connecting the dam with the impervious formation underlying it; that part of the dam on the downstream side of the central diaphragm shall be of more porous material, the finest part of which is near said diaphragm and the most porous part of which is at the edge of the downstream rock covering, with a gradual grading between these two points as to imperviousness.

Steam Shovel for Basement Excavation.

In excavating the basement for a twelve story building on the corner of Michigan Ave. and Peck Court, Chicago, a steam shovel is being used. This shovel is making excellent progress and will take out the required amount of about 17,000 cu. yds. in the 40 working days allowed. This cut is about 134 ft. x 241 ft. and will be about 14 ft. deep.

The shovel used is a Thew shovel of 15 tons weight and it is equipped with a ⅝ cu. yd. bucket. This type of shovel makes a complete swing and can reach all material within a radius of about 15 ft. The machine rests on four wheels with wide tires, and in soft ground heavy planking is used to support it. One of the features of the machinery is the forward horizontal motion of the dipper. This motion is particularly useful in skimming off a shallow layer of material where necessary.

In starting the work the shovel dug its own pit and is now working the excavation back in parallel cuts from one side to the other. A runway has been placed so that all teams come in and pass the shovel, taking their loads, and, making a swing, pass out up the same runway. A three-horse snatch team is used for helping the loaded wagons up the runway.

An engineer and fireman are on the machine and besides these men there are only two pit men who place the planking upon which the shovel advances. The shovel is supposed to be of about 400 cu. yds. capacity per day but has often exceeded this on short runs. It has loaded 31 two-cu. yd. wagons on this work in 30 minutes. The average amount for the entire job will be about 400 cu. yds. per day of 10 hours.

The material is taken by dump wagons to the disposal station about ¾ of a mile away where it is dumped into barges to be towed out into the lake. The building which will be erected at this point is owned by S. Karpen Bros. The erection of this building is let to the Thompson-Starret Co. and the excavation work is under contract to Wm. J. Newman, of Chicago.

General Methods of Constructing the Louisville Sewers With Some Data on Costs.

The general plans of the new $4,000,000 sewer system at Louisville, Ky., were described in our issue of June 8 and in the following issue of June 15 we illustrated and described the main structural features of the work. We continue the account of this important work with a description in this issue of the general methods of construction and a presentation of a number of cost data. Articles to follow will give methods and costs of doing certain individual pieces of work.

When Louisville began sewer construction in 1908 the contractor had considerable difficulty on account of lack of laborers experienced in that class of work. Practically no sewer work had been done in that city for 20 years and as a result the contractors were compelled to train unskilled men. Today conditions are much better, a large number of Louisville laborers are trained in the work. Labor conditions are not ideal, however. Most of the common labor consists of negroes. It is often difficult to get them out on Monday morning.

When the work was first started, contract prices were low; the country had not yet recovered from the panic of 1907, and men were sometimes glad to bid on jobs wherever they could use their idle machinery. Consequently, no fortunes were made on the work. Since that time, however, conditions have gradually improved and contractors are now making a fair profit.

Some complaint has been made by several contractors on account of the time required for leaving the arch forms in place. It was held that this was one of the greatest difficulties of the work. On large sewers, 7 days were required for the concrete to set before the forms could be removed, and the next operation could be performed. This length of time

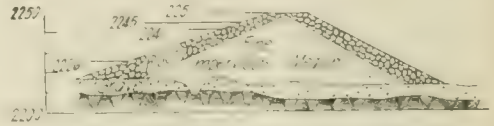


Fig. 2—Earth Dam at Villaba, Porto Rico Irrigation Service.

made it necessary for the contractors to have a very much longer ditch open than they desired, and increased the cost on all items.

General Methods.—In general the sewers are constructed in open cut. The largest sewers happen to be very deep and the cut is as deep, in places, as 50 ft. Most of the work in the city is to some extent in sand and gravel although there are places where small sewers have been built entirely in clay and very little sheeting or bracing was necessary. In the construction of the large bulk of the work, however, tight sheeting has been necessary. Where the work has been in paved streets the sheeting has been a real problem on account of much trouble due to the settlement

of the pavements, curbs, sidewalks and buildings.

In Louisville, pine lumber costs $2 or $3 more than hardwood lumber. Both kinds are used for sheeting the trenches, but pine is universally used for braces. Two inch stuff is used for sheeting, but with hardwood, 2 in. stuff means anywhere from 1½ ins. to 3 ins. in thickness. The hardwood is usually purchased in various widths for sheeting purposes as it comes a little cheaper that way. In the opinion of some, this uneveness in the sheeting is somewhat responsible for the settling of the pavements and for that reason they believe money is saved by using pine. On the other hand the hardwood is used, especially where streets are not improved, because it can be used six times where pine is used three times.

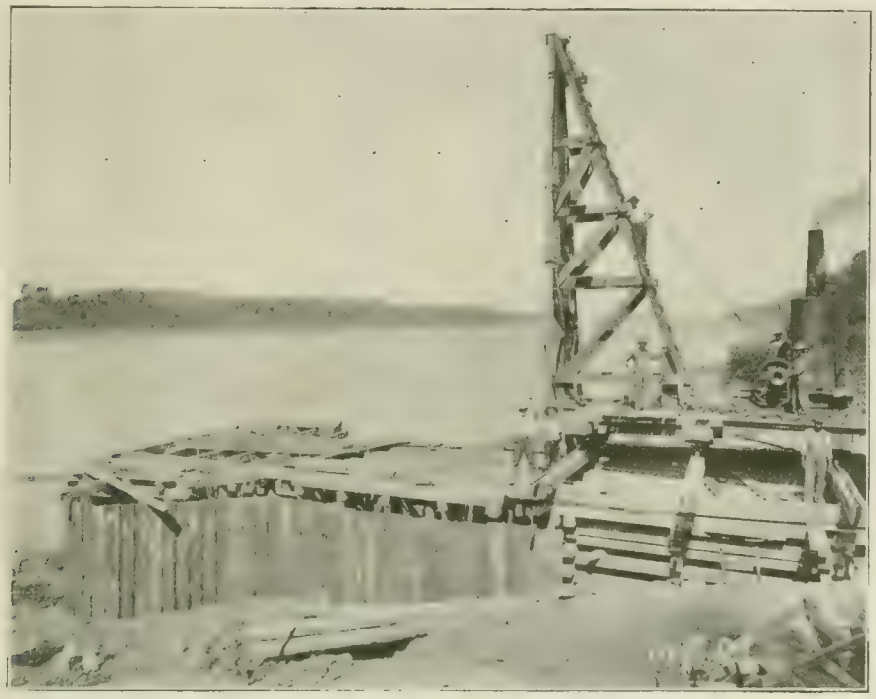


Fig. 1—Cofferdam at Outlet Structure of Southern Outfall Sewer.

In places the sand is so fine that it will sift through the cracks in the sheeting, enough to cause a settlement of the pavement. It was necessary, in such cases, to tamp sand and dirt into the space left, after pulling each piece of sheeting. In cases where large buildings were adjacent to sewers built in sand of this sort, the trenches were double sheeted and the sheeting left in place.

Types of Plant.—The popular machine in use on the heavier work is the stiff leg derrick. It is used in its various forms. Many are fitted with orange peel buckets, and nearly as many with clam shells. The derricks are used for excavation where it is desired to spoil alongside the trench, or into wagons or cars. Next, in number to the stiff leg derricks are locomotive cranes. These answer the same purposes as the derricks, and have the additional advantage of being able to move rapidly on tracks.

Several machines are used with the object of carrying the excavation immediately from the point of excavation to the back fill. These are cableways and Potter, and Carson trench machines. All carry buckets which are filled by hand. Cableways handle one large bucket and are also used to pull sheeting. The Potter machine carries two buckets, suspended by cables from a carriage which runs on a track on top of a frame made of steel trusses which straddle the trench. The trusses are supported on wheels which run on a track and the machine can be moved ahead as the excavation proceeds. The Carson machine works on the same principle as the Potter machine. It carries, however, six buckets of small size which are all raised and lowered as one unit. Some of these machines have two runways on them and operate two sets of buckets, one set being filled while the other is being dumped. These machines work very satisfactorily for excavation where the material is to be used immediately for backfill. If the work is at such a stage that no backfilling can be done, the machine must stand idle. The most satisfactory arrangement has been proved to be to use them for only a part of the excavation on big work. The point where most trouble is experienced, however, is in not having a long enough machine to cover the work desired to be kept open.

Cableways have been used on work for excavating and carrying the material immediately to the backfill. On large work, derricks operating clamshell or orange-peel buckets are usually employed to spoil all material along side of the trench which is not carried by the cableway to the backfill. An ideal cableway job, in sewer work, presented itself in the case of the Beargrass Intercepter where it lay in a narrow strip of land between the railroad tracks and the creek. South of Baxter Ave. for a distance of 1,100 ft. the work was difficult of access and much of the material was handled economically by the cableway.

Construction of Outlet Structures.—There were four outlet structures built into the Ohio River at Louisville. Three of these, the 34th St., the Northwestern and the Southern Outfall outlets, were below the falls and one, the Beargrass Intercepter, was built above the falls. The 34th St. outlet was built to replace an old structure. It was built farther out into the stream and at a small offset from the old sewer. It is of reinforced concrete, horseshoe shaped section, 7 ft. in diameter, and is lined with brick to the springing line of the arch. A portion of the lower end was carried down to bed rock and the concrete foundation was keyed into the rock to prevent any movement.

The outlet structure was built within a cofferdam which was made of two sets of 2-in. tongued and grooved sheeting, set 2 ft. apart and driven into the river-bed. A clay filling was put between the two sets of sheeting. Inside the cofferdam a single set of sheeting was driven to the ledge of rock as fast as the excavation progressed. Excavation was carried on by the use of an orange peel bucket operated by a stiff leg derrick, and also by hand. A 6-in. belt-driven Lawrence centrifugal pump and a 3-in. pulsometer were used for keeping the water out of the excavation.

The outlet structure at the Northwestern sewer is very similar in design to that at 34th St., but the foundations are somewhat more elaborate. In addition to the concrete base carried to rock, and the concrete piles used at the 34th St. outlet, the structure at the Northwestern outlet is supported for some distance on caisson foundations carried to rock. These caissons were composed of steel cylinders 5 ft. in diameter and in 4 and 5-ft. lengths. The bottom section was provided with a reinforcing band at the lower end. At the other end, and on each of the other sections, the cylinders were provided with flanges by which they were bolted together. In order to make tight joints, rubber gaskets were used, with the aid of oakum when necessary. One section was set in its proper position and the material excavated from within by hand and as fast as necessary succeeding sections were bolted on. Usually the weight of the steel was enough to force the caisson into the ground, but at times the movement was aided by hammering or by jacks which reacted upon the timbering of the trench. The ground water within the caissons was pumped out by small Nye pumps, which were lowered into the caissons. But little ground water was found, as the materials through which the caissons were driven was largely impervious, being strata of fine silt, clay and cemented clips of slate rock.

The plant installed upon this work included a 50 hp. boiler, which supplied steam for three Nye pumps and a Chicago Improved cube concrete mixer. The derrick was operated by a Ledgerwood hoisting engine.

In beginning the construction of all the outlet structures the contractor assumed that the water to be fought came from the river, but during the construction at the Southern Outfall it was demonstrated that the ground water coming from the shore was a source of more trouble than the river itself. The only difficulty experienced from the water of the river was during the season of high water. At high water the river rises sometimes 40 to 50 ft. and, of course, closes down all operations.

Fig 2.—Looking Toward Bank of River from Fig. 1, Showing Clay Cut.

On the Southern Outfall the outlet structure was enclosed in a cofferdam built of United States steel sheet piling driven to rock. When these piles were being driven, water from beneath flowed up from the lower strata in the spaces between the tongues and grooves of the piles, and overflowed at the top ends of the

piles. This indicated that the ground water beneath the river, at these points was under a head at least 15 ft. greater than river level. The accompanying views, Figs. 1 and 2, show the cofferdam at the outlet structure, the piledriver, and a view of the excavation looking toward the bank. The casings of some of the simplex concrete piles used, are also shown in Fig. 2. An idea of the elevation of the Ohio River in times of high water may be had by referring to this picture. The water during the winter of 1908-9 reached the foot of the stairway to be seen on the left.

Fig. 3—Pile Driver on a Portable Turntable for Driving Piles in Sewer Trench.

The concrete work on all the outlet structures was built in three operations, the invert and sidewalls being placed first, then the brick lining, and finally the arch constructed. Wooden forms were used.

Tunnel Work.—On several pieces of the sewer work tunneling has been resorted to in order to avoid deep cuts and closing of streets. The excavated material from the tunnels was generally handled in cars on narrow gage tracks. At the shafts the material was elevated by derricks. The timbering consisted of bents placed 5 ft. apart with 2 in. sheeting for roof and side walls. The bents were made of 8x8-in. posts and 10x10-in. caps. In places where the floor of the tunnel was quite soft the weight of the surrounding material forced the bottom upward. In such cases oak plank was placed as a base to build the concrete sewer upon.

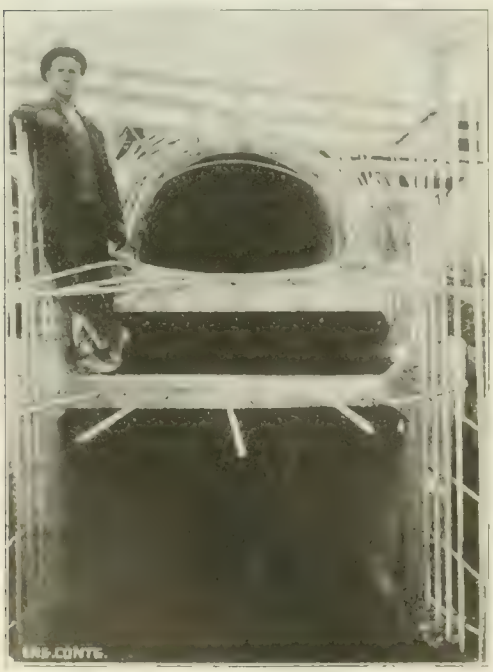


Fig. 4—Section of Concrete Sewer and Drain—A Separate System on One Pile Foundation.

A portion of the Beargrass Intercepter which was built in tunnel, was built upon concrete pile foundations. The holes for these piles were bored with an auger, making a finished hole 10 ins. in diameter. The material encountered was a fill of clay and muck. All holes were carried to gravel. Frequently the borings struck logs in the fill delaying the progress of the work materially. Vertical steel reinforcement was placed in each hole and the hole then filled with concrete. In a portion of the work where water rose in the holes, it was pumped as low as practicable and the concrete was deposited through a galvanized iron casing, the casing being withdrawn as the concrete filled the hole. In another portion of this work, the material encountered was so wet and mucky that the holes would slough in before concrete could be placed, which was prevented by the use of 12-in. wrought iron pipe casings. This pipe was used in sections 3 ft. in length, and, as conditions required, one or more lengths were placed in the holes. When these large piles were used, the number of piles in a bent was changed from three to two and if the casing extended the full depth of the hole, the steel reinforcement was omitted. The average length of the concrete piles was 11 ft.

The average rate of progress of tunneling in soft material was 4⅜ ft. in eight hours. The average amount of material was 3 cu. yds. per lin. ft. The average progress of concreting amount to 3.6 cu. yds. of concrete placed in 8 hours.

Piledriving.—On Section A, Northeastern system, the ground is low and the sewer is located adjacent to the old creek bed. The construction here involved a pile foundation and the driver used is shown by Fig. 3. The driver and the donkey engine which operate it are mounted on a platform which is in turn mounted upon a portable turntable. The weight of the machine is supported a safe distance from the trench.

The oak piles, averaging 15 ft. in length, were driven by a Vulcan Steam hammer weighing 3,000 lbs., with a 36-in. stroke, the gross weight of the hammer being 6,800 lbs. The piles were driven to a penetration of from 0.1 in. to 0.2 in. per blow and even when the penetration was as little as 1 in. per ten blows, the heads of the piles were not materially broomed. This machine drove 40 to 50 piles in a day of 10 hours. Fifty to eighty blows are required in driving a pile through this clay to solid position in gravel. After being driven, the piles were cut off at an elevation about 3 ins. above sub-grade, when the reinforcing steel and the concrete of the sewer were placed upon them. The piledriver crew consisted as follows:

1 captain.
1 engineer.
1 fireman.
2 men in lead.
3 men handling piles.
2 laborers trimming piles.
2 laborers for miscellaneous work.

The concrete work on this sewer was somewhat complicated owing to its section, which is shown in Fig. 4. A portion of the completed sewer showing the "jackets" or outside forms, is shown by Fig. 5. The concrete was mixed by a stationary Ransome mixer and was carried to the work in cars run on a portable track. The method of charging the mixer has varied according to its location. When near the Cut-off Embankment, it was placed at such an elevation that the materials could be drawn from hoppers onto a loading platform, from which they were delivered to the mixer. At Ohio St. the conditions not being as favorable for handling materials by gravity, the sand and gravel were brought to the mixer in wheelbarrows.

The structure was built in four operations, the invert of the drain being built first, after which the side walls and top of the drain were constructed. Following the completion of the drain, the side walls of the air chamber between the sewer and the drain and the invert of the sewer were built as the third operation, after the completion of which the concrete was placed in the arch of the sewer.

Fig. 5—Completed Sewer of Fig. 4, Showing Cutside Forms.

The invert of the drain was placed in long sections, steel templets being imbedded in the fresh concrete at the correct elevation about nine feet apart. The invert was finished by screeding to these temporary steel templets and floating with hand trowels. Soon after the finishing of the invert, the steel templets, which were about 2½ ins. by ¼ in. in cross-section, were withdrawn and the narrow spaces left in the invert were filled with mortar and properly smoothed. The trowel finishing of the invert was performed by finishers, who stood in the fresh concrete after it has been screeded, moving backward as the finished surface in front of them was completed. After the invert of the drain had acquired sufficient hardness to permit of walking upon it, the forms for the side walls and roof of the drain were placed in position and filled with concrete.

When this concrete had become set, the forms for the side walls of the air chamber between the drain and the sewer and the forms supporting the invert of the sewer (which is the top of the air chamber) were

placed in position and filled with concrete. The invert of the sewer was finished by screeding and floating in the manner already described in connection with the finishing of the invert of the drain. As soon as the invert of the sewer had acquired hard set, the centers were set and the concrete of the arch was placed.

All forms used upon this work, except the centers for the sewer arch, have been built of wood. The forms for the arch of the sewer were the Blaw steel centers.

The transverse reinforcement consisted of bars laid in the invert and roof of the drain and in the invert and arch of the sewer and in the vertical side walls. The side wall bars were in one piece, extending from the invert of the drain to the springing line of the sewer.

From a point about 50 ft. west of the Cut-off Embankment, the sewer curves toward the south, thus leaving the drain upon which it is supported farther west. The elevation of the drain is such that the tops of the wooden piles supporting it are below the surface of ground water at all times. The sewer, however, after it leaves the drain near the Cut-off Embankment, is at an elevation considerably above the level of ground water. It was at first intended to support this structure by cast concrete piles. Trial piles which were made did not prove satisfactory and as a substitute wooden piles were driven and cut off below the normal elevation of the ground water. Upon these piles were built transverse concrete piers 24 ins. wide and 50 ins. c. to c., extending up to the underside of the sewer invert. The sewer was then built upon this timber and concrete pier foundation. The cost to the Commission of this foundation, including both piles and piers, was about the same as the price bid for a cast concrete pile foundation.

The contractor for the construction of this work, Section A, was the Blackstaff Engineering Co. of Philadelphia, Pa. The work was carried on under direction of Mr. W. Mayo Venable, superintendent for the Company.

The cost of various operations in the work throughout Louisville are shown in the following tables.

Lining a Concrete Sewer With Brick.—This sewer was of concrete, horseshoe section and about 4 ft. in diameter. The brick lining of the invert and side walls contained 8.3 sq. yds. in 65 ft. of its length. The brick were laid on edge and 8½ bbls. of cement were used in the mortar:

6 bricklayers at 62½c hr., 3½ hrs.	$13.12½
6 helpers at 20c hr., 3½ hrs.	4.20
Cost of laying 8.3 sq. yds.	$17.32½
Cost of laying 1 sq. yd. brick lining	$2.087

Potter Machine on Trench 15 ft. Wide 21 ft. deep:

7 men excavating (sand) at $1.75 per day	$12.25
1 engineer at $3.50 per day	3.50
1 fireman at $2.00 per day	3.50
Rental of machine $200 per mo. at $8.00 per day	8.00
Av. output per day 150 cu. yds.	$27.25
Cost per cu. yd. 18c.	

Mixing and Placing Concrete by Hand.—Material had to be hauled 300 ft. in wheelbarrows, and was mixed by hand on platforms over the trench. It was poured through chutes to place. The average wages of these men were 22½ cts. per hour. The concrete men are paid more than the ordinary laborers who receive 17½ cts. per hour:

6 men turning	$10.80
2 men mixing mortar	3.60
5 men wheeling	4.00
1 man on water and cement	1.80
2 men handling chutes	.60
1 men spading	.20
20 men placing 30 cu. yds. at	$20.00

This gives a cost of $1.20 per cu. yd. for labor of placing concrete.

Knocking Down the Blaw arch forms, wooden jacket and invert forms for this sewer, moving them ahead and setting them up required 8 hours for 3 men. One man acted as foreman with two helpers. It required 4 hours to set the invert forms, 2 hours to set the jackets for the walls, and 2 hours to set the Blaw arch forms. This is for a 5 ft. sewer.

Placing the reinforcing steel required the time of the above mentioned squad of 3 men. They set the steel for the invert and sidewalls in 5 hours and for the arch in 1½ hours. The foreman was paid 25 cts. an hour and the helpers 17½ cts. There were 53 lbs. of reinforcing steel per running foot. Striking and settling Blaw forms for 60 lin. ft. of horseshoe shaped sewer, 5 foot section:

1 foreman, 8 hrs. at 25c	$ 2.00
2 helpers, 8 hrs. at $17½	2.80
Total	$4.80

Striking and settling 60 ft. of forms, cost at ½ cu. yd. per lin. ft., per cu. yd., $0.16.

Placing reinforcement for 60 lin. ft. of sewer:

1 foreman, 7½ hrs. at 25c	1.875
2 helpers, 7½ hrs. at 17½c	1.3125
Total	$3.18¾

Placing reinforcement for 60 ft. of sewer at ½ yd. per lin. ft., cost $0.106 per cu. yd., and at 53 lbs. per lin. ft., $0.002 per lb.

A summary of the cost of labor per cubic yard in constructing 60 lin. ft. of 5-ft. sewer was:

Cost per cu. yd. mixing and placing concrete	$1.20
Cost per cu. yd. striking and erecting blank forms	.16
Cost per cu. yd. placing reinforcement	.106
Total cost of labor per cu. yd.	$1.466

The work described in the above article is under supervision of the Commissioners of Sewerage of Louisville. Mr. J. B. F. Breed is Chief Engineer and Mr. Harrison P. Eddy, Consulting Engineer.

Methods of Building the Foundations for a Twenty-Story Building in the Down-Town District of Chicago.

At present there are about a dozen buildings, from 16 to 20 stories above ground, in course of construction within an area of a mile square in the downtown or business district of Chicago. Among these is the 20-story Harris Trust Building which is being erected on the site of the old building of the same name. The construction is made difficult by the limited amount of room for storage of material, by the many engineering features involved in the construction of the building itself and in the protection of the adjacent buildings. The Harris Trust Building faces north on Monroe St. and has a frontage of 90 ft. 8½ ins. on that street. It extends from the street line 189 ft. 1 in. back to the alley line. The street and alley must be kept open to traffic at all times.

The new building will rest on caissons extending to bed rock and the sub-basement will be about 44 ft. below the level of the street. The walls of the building will be carried down to this depth and in some places will be 56 ft. deep. This depth of wall will be on the alley line and is so deep to make space below the boiler room floor level for the entrance of a branch tunnel from the Illinois Tunnel. This tunnel will be used for the cars which will carry the ashes and waste from the building. The wall in the alley will be 3 ft. thick for its entire height and will be reinforced with 20-in. I-beams weighing 100 lbs. per ft. and placed vertically 3 ft. on centers. Walls with battered faces will be reinforced with square steel bars.

Consideration was taken, in designing the walls, of the heavy buildings adjacent. On the west side is the 6-story Central Trust Building with a heavy brick wall extending the entire length and on the east is the Fort Dearborn Building which is 16 stories high for a distance of 60 ft. back from the street and has additions, extending back to the alley, which are only 4 stories in height. All these adjacent buildings rest on raft foundations and precautions must be taken to prevent any settlement in their walls while carrying the foundations down for the new building. Opposite the 16-story part of the Fort Dearborn Building the foundation wall for the Harris Trust Building is kept away about 15 ft. This will allow room for shoring up that building. A sketch showing the manner of shoring the 16-story part of Fort Dearborn Building is shown by Fig. 2.

The sequence of operations in the excavation and construction of the basement and foundations is as follows: (1) The entire area of the old basement is excavated to about 12 ft. below the street; (2) A heavy timber platform is built over the area for handling the spoil from the caisson excavation; (3) After the first row of caissons is excavated they are concreted, the concrete work being carried on underneath the platform while the excavation continues to be handled from above; (4) Platform is removed and steel work started from the caissons up; (5) Excavation for the building walls is carried down as the steel work goes up; (6) Concreting walls; (7) Excavation of remaining part of basement. During the first and second operations the walls of the adjoining buildings are shored and taken care of. In describing the work the above order will be adhered to.

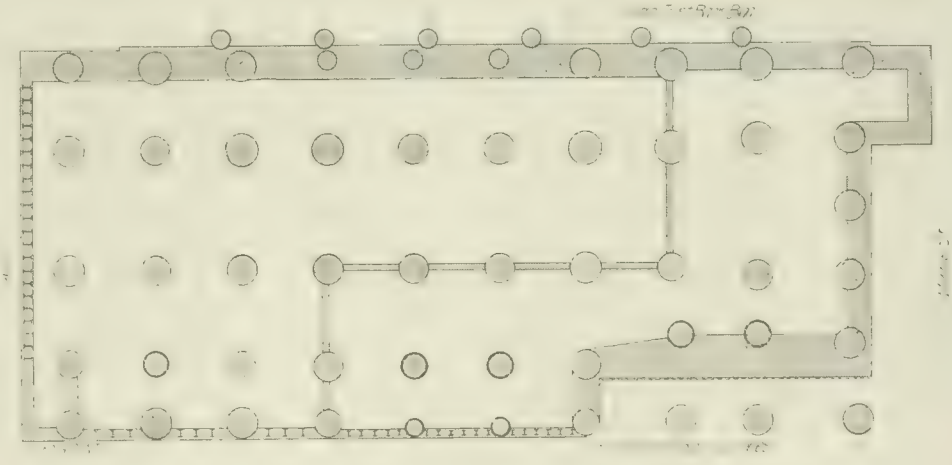


Fig. 1—General plan Showing Location of Caissons and Walls.

After removal of the old building a runway was built into the old basement and wagons drove in and out upon it. The entire area was made 4 or 5 ft. deeper than the former basement, and the old stone foundations were broken up by hand and removed. The excavation was all done by hand and was carried on in such a manner that the west part was finished first. A heavy timber platform was then started, and was built along the west part following the completion of this preliminary excavation. The platform is built of old timber and is of heavy construction being framed with 12x12-in. timbers and having a 3-in. plank floor laid on 2x12 in. joists placed about 1 ft. apart. With this platform the space for working is doubled, and teams may drive over it from the street and out at the alley, or vice versa. The caisson centers are located on the platform and holes are left at these points through which all the spoil from the caissons is handled. Over each of these holes a "head house" is erected. This is merely a raised scaffold about 7 ft. high.

Upon it is a tripod and a sheave and rope for raising the buckets. A wagon is left standing alongside each head house on the platform and when filled, a team hooks on and hauls it away, and another wagon is placed there. The caissons are worked by rows and four men are required at each one, two men on the "head house" and two men below. An arrangement for raising the buckets by steam power is made. On each tripod is a sheave attached to a nigger head. The sheaves of all the tripods, in a row of caissons, are placed in line, so that a continuous cable, running round a drum on a donkey engine at the end of the row, operates all the nigger-heads in that row and is kept going continuously. In raising the buckets all that is required is a turn or two of the rope, around the nigger head. In the same way one donkey engine can be arranged to handle the material from two or three rows of caissons by so arranging the cable as to pass over all sheaves. The caissons are carried down to bed rock which is in the neighborhood of 100 ft. below the street. The progress per 8 hour shift in this excavation is from 8 to 13 ft. in the stiff and soft clay and in the hardpan sometimes less than 1 ft. depending upon the hardness of the material encountered.

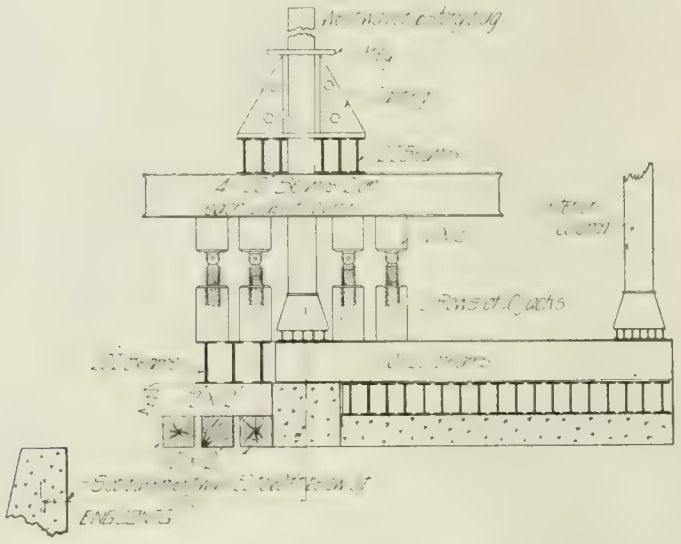


Fig. 2—Showing Arrangement of Grillage and Jacks for Shoring Up Wall of the 10-Story Fort Dearborn Building.

During the above operations of excavating the area, and of excavating the caissons, the walls of the adjacent buildings are shored. In the case of the Central Trust Building on the west, the brick wall is bored through opposite each column and is tied to the column by a bolt and a heavy iron plate placed on the outside of the wall. All along the wall a few feet from its base, holes several feet wide are made and screw jacks are inserted. The jacks are put in as close together as they can be placed. This is about 1 ft. apart. After the holes are filled with these jacks the balance of the wall is cut away for more jacks until the whole wall rests entirely upon them. Any settlement of the wall, then, is taken up on these jacks.

The brick walls on the east side which constitute part of the addition to the Fort Dearborn Building are taken care of in the same way. The 16-story part, however, rests on steel columns, which in turn rest on raft foundations, and this part is treated differently. Figure 2 shows the method of holding up this wall. It will be noted by the sketch that these outside columns of the Fort Dearborn Building rest on the 20-in. I-beams which are carried over from the interior columns. These rest on a grillage of 12-in. I-beams, and all are imbedded in concrete. This is a type of the cantilever foundation. With this kind of foundation it is possible to do considerable excavation close to the outside footings without causing a settlement in the columns of the outside wall. In this case, however, a wall 8 ft. wide at the bottom and extending about 30 ft. below these footings is to be excavated and extra precautions are taken. The wall for the new building is, at this point, located about 15 ft. away from the old building. This gives space for some cribbing on the outside of the old building. The steel columns are notched on both sides and keys 2 ins. square are placed in the notches. A casting is made, which fits around the steel column and is bolted to it. Under the shoulders, as it were, of this casting a cribbing is formed as shown in the sketch, half the weight taken up on the raft foundation and half carried down onto the ground on the outside. Any settlement will be taken up by the jacks.

While the first row of caissons is being finished the platform is built for the succeeding work. The concreting plant is started as soon as the first caissons are ready. This work is all carried on under the platform. The entire area under the platform is covered with "made up" runways. These consist of sections 16 ft. long and 4 ft. wide, which are laid side by side on the clay, or on mudsills, and which make a good floor, on which to wheel concrete. The sections are made of 1-in. material. A McKelvey mixer of 1 cu. yd. capacity is used and is operated with a 25-hp. motor. The mixer is fitted with an elevating charging hopper. All the material for concrete is dumped from wagons through the platform. About 12 men are required to feed the mixer, which is done with wheelbarrows; 6 men are used on the stone, 3 on sand, 2 on cement, 1 man tending the hopper, opening and dumping cement bags, etc., and 1 man wheeling them and receiving them from the wagons down the chute.

Inasmuch as all the material is dumped through the platform above at least four of these men could be dispensed with on the stone and sand, if bins were built so that the wheelbarrows could be loaded from them without shoveling. One operator is required to operate the loading hopper and to dump the mixer. Two-wheeled carts are used for taking the concrete from the mixer. From 4 to 6 of these carts are used according to the length of haul. Three extra men are required to help push the carts on grades and to help dump the carts into the caissons. The rate of concreting is about 20 cu. yds. per hour. It may be mentioned here that part of the lagging used for bracing the excavated caissons will eventually be saved when the excavation for the sub-basement is carried down. The steel rings, used to brace the lagging, are taken out as the concreting proceeds, and two men are kept busy taking these rings out of the different caissons, and tamping the concrete, keeping each caisson ready to receive concrete as fast as the space is needed by the concrete gang.

When the caissons are concreted the work of removing the platform begins and the erecting of the steel work, which rests directly on the caissons, is commenced. Simultaneously with this work the excavation for the side walls of the building begins. These walls will be excavated 3 ft. in depth at a time the deepest parts to be about 44 ft. below the street level. After each 3 ft. of excavation 3x12 in. planks will be placed horizontally and braced with "false sets" or, one might say, short sets of bracing, which will later be replaced by longer timbers. The excavated material from these walls will be disposed of through the Illinois freight tunnel, which runs adjacent to the work.

When the basement walls are completed the area included between them will be excavated and carried down to the required depth. This depth will be sufficient for three floors below the street. The lower one will be for the heating plant and coal storage.

By the time the basement is completed the structural steel work will be several stories high and will have provided sufficient room to carry on the balance of the work without so much trouble from the lack of space that is always experienced in the foundation work.

For the use of plans, we acknowledge our indebtedness to the architects, Shepley, Rutan & Coolidge, and also to the engineers in charge of the construction of the foundations, E. C. & R. M. Shankland. The General Contractors for the construction of the building are Wells Bros. & Co., of Chicago. The work of shoring up the Fort Dearborn Building is under supervision of the architects for that building, Jenney, Mundie & Jensen, Chicago.

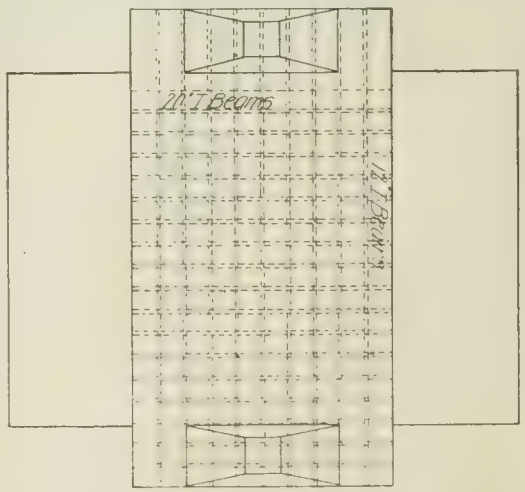


Fig. 3—Plan of Raft Foundation Shown in Fig. 2.

Work has been started clearing the right of way for the proposed connection with the Colorado & Southern and Burlington, which is through the most thickly settled section of Cheyenne, Wyo.

Roads and Streets Section

Note: This section is devoted to methods and costs of road and street construction. It will cover road building in all its details, the construction of pavements, sidewalks and gutters, the testing and use of paving materials and the machinery and tools used in road building and paving.

An English Formula for the Camber of "Hanging" Roads.

In a paper read before a recent meeting of the English Society of Engineers, Mr. R. O. Wynne-Roberts, M. Inst. C. E., gave the following formula for the camber of hanging roads:

The camber necessary to permit of the road surfaces being efficiently drained without causing the sides to be too steep for comfortable traveling depends on the materials used, the longitudinal gradients, etc. Soft, absorbent

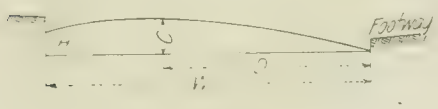


Fig. 1.

macadam requires a higher crown and steeper sides than hard, impervious metal, but the more camber that is given to a road the greater is the tendency for the traffic to keep to the centre. This necessarily causes the central portion of the road to be subjected to greater wear and tear, and when repairs are made this part is liable to be raised still higher. Many highways have excessive cambers, and need modifying so that the whole carriageway should bear a proportion of the traffic. The camber for durable detritus-bound macadam surface of level longitudinal sections should be about 4 per cent of the half width of carriageway, but when the road is tarred or covered with tar-macadam the camber can be reduced to 3, 2½, or even 2 per cent. Then for a 40-ft. carriageway, a water-bound macadam road, the crown would be $\frac{40 \times 4}{2 \times 100} = 0.8$ ft. or 9.6 in.; tar-macadam road $\frac{40 \times 3}{2 \times 100} = 0.6$ ft. or 7.2 in., or $\frac{40 \times 2.5}{2 \times 100} = 0.5$ or 6 in. respectively.

When the road "hangs"—that is, when the channels are not on the same level—the above rule will apply, but the position and height of the crown will be altered.

Let D = distance from crown to lower channel in feet.
W = width of carriageway in feet.
C = height of crown in feet above lower channel.
H = hang of road in feet
P = percentage of camber expressed as 0.02, 0.03, etc.

$$D = \frac{P \times W^2}{2 \times P \times W - H} \qquad C = P \times D$$

Example 1.—30 ft. road hangs 0.5 ft.; camber 3 per cent.

$$D = \frac{0.03 \times 30^2}{2 \times 0.03 \times 30 - 0.5} = \frac{27}{1.30} = 20.8 \text{ ft.}$$

$$C = 20.8 \times 0.03 = 0.624 \text{ ft.}$$

Example 2.—24-ft. carriageway hangs 0.75 ft.; camber = 4 per cent.

$$D = \frac{0.04 \times 24^2}{2 \times 0.04 \times 24 - 0.75} = \frac{23.04}{1.17} = 19.7 \text{ ft.}$$

$$C = 19.7 \times 0.04 = 0.788 \text{ ft.}$$

The position and height of the crown having been fixed, the contour of the road can be made to conform with a curvature on the lines shown in Fig. 2.

The distance between the crown and the channel is divided into four equal parts. Taking the elevation of the crown as unity, the above constants can be used to ascertain the other heights. Thus in the first example $D \times 20.8$, each division on the lower side will be 5.2 ft. wide, $C = 0.624$ ft.; the other points will be 0.53, 0.405 and 0.22 respectively. The upper side of the road will be $30 - 20.8 = 9.2$ ft. wide, the divisions will each be 2.3 ft. wide, and the height of the crown $0.624 - 0.5 = 0.124$ ft. above higher channel; other heights will be 0.105, 0.081, and 0.0435. In practice such small divisions will doubtless be discarded, and a gentle curve connecting the crown to the upper channel will be substituted. The above constants can, of course, be applied to lay out the contour of roads having channels on same level.

The foregoing rules must be modified when the longitudinal gradients of the road exceed, say, 1 in 200.

Notes on English Road Maintenance.*

TWO DESTRUCTIVE AGENTS.

There are two conditions of a road surface in which it is least capable of carrying the traffic: (1) when too wet, (2) when too dry—for excess or insufficiency of moisture so affects the surface as to bring it into a condition least fitted to withstand wear and tear. In the first instance the surface is so softened as readily to disintegrate, and in time of frost break up; while where there is insufficiency of moisture the matrix, by which the metal is held in position, is so dried up that it loses its holding-down power, thus allowing the stones to be easily shifted from their bed, and so ground to pieces by passing vehicles. Apart from the loss of metal entailed by either too much or too little moisture, the draught in either case is largely increased.

The road surveyor's aim therefore is to take all the care he can to combat these two agents tending to destruction, and to maintain his road in such a condition as to have a good surface no matter what the climatic conditions may be.

To enable him to attain this end there are various matters which engage his attention. Among others the selection of metal, the storage, spreading and consolidation of the same, scraping and brooming, drainage, etc. And so far as he is able to do so legally or by persuasion he must ensure free admission of sun and air to the road, where overhanging trees or high hedges are likely to produce injurious effects.

As regards his choice of metal; toughness combined with hardness is generally to be sought for. Hardness alone is not always advantageous. Flint is excessively hard, but its brittleness is against it. Again, cost in the form of freight practically puts a bar under certain conditions upon using, say, granite, where fairly good local materials are available. It may be noted that so far as the haulage of materials foreign to the locality is concerned from station or wharf, there is not a great difference whether it be granite or gravel, for a cubic yard of 2-in. Leicester granite weighs about 21 cwt., while a cubic yard of screened pit gravel, broken to the same gauge, weighs about 23 cwt. The difference in cost of wheeling out or carting from the depot and the spreading is not a serious item, but one has to take into consideration the difference in the price of the two metals delivered at the home station. For instance, take 2-in. Leicester granite, which may be put at 5s. 3d. per ton at the quarry, against 3s. 3d. per ton for Farnham gravel on bank at the Farnham pits in Surrey, and which delivered to any station in the county would not exceed 7s. 10d. per ton, yet the *minimum* cost per ton of the granite delivered in any part of Surrey may be put at 12s. 2d., giving a difference of 4s. 4d. per ton at the home station. From the maintenance point of view the latter is unquestionably preferable, but suddenly to change a long length of road surface from gravel to granite involves a heavy initial outlay and a gradual substitution of a better for an inferior metal is generally speaking to be commended.

This change should take place when the road requires refacing, not patching, and here I should like to give a few figures to the cost of the substitution of a granite for a gravel surface in my district. Taking the men's wages at £1 per week, horse hire at 8s. per day, 10-ton roller at £1 per day, and granite at the nearest station, 2 miles from the road, at 12s. 6d. per ton, the facing of the road with the granite may be put at 1s. 3d. per yard super., as against a trifle over 8d. per yard super., if gravel costing 5s. 4d. per ton at the station were employed, representing a difference in round figures of £300 in a mile of road averaging 18 ft. in width.

With wide country roads, say, 25 ft. to 30 ft. between the verges, the plan may be adopted of forming the crown, say, 15 ft. to 16 ft. in width, of the more costly material, while the haunches are made up with the local metal.

Some eminent authorities assert that it is unwise to mix materials, but so far as my experience goes good results have been obtained, and roads subjected to a medium amount of traffic have stood well when a mixture of about 3 of gravel to 1 of granite have been used, or where the gravel is particularly clean and more round than angular in shape, 4 of gravel to 1 of limestone. In such cases the granite or limestone should be of a smaller gauge than if laid alone.

Mechanical means, in the shape of the scarifier attached to the roller, has largely superseded manual labor in loosening the old surface before adding fresh metal, and the face is entirely moved to a depth of 2 in. or so. In the case of a road with a hard and fairly thick crust, and particularly if somewhat dry, this scarifying process is most advantageous; but for thin-crusted roads it is not always advisable; in fact, harm may be done by breaking up a very thin crust, as the water is then freely let into the bed, which is in many country roads little, if any, better than earth. Under such conditions, and with the help of a roller, a coating 3 in. to 4 in. in thickness laid on the unbroken road is about the best treatment, while where a roller is not used hand scoring to a shallow depth and at a time when the surface is softened with rain, should be resorted to, and a thin coating spread on the surface. And here I should like to say a word upon the importance of spreading the metal. The heaps as shot on the road should not be merely levelled down, but every stone should be moved in the spreading. By this means much greater uniformity in the texture of the surface is secured.

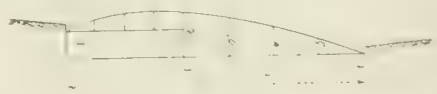


Fig. 2.

In resurfacing, the sooner the roller passes over the newly-spread metal the better. Long lengths of unrolled metal, spread from verge to verge, are not only a source of annoyance to travelers but do much harm to vehicles, while, in the case of unrolled roads, no more than two chains or so in length should be metalled at one stretch, a break of similar length being left and the next two chains metalled, and so on, thus giving horses a chance of regaining their wind at the breaks. On wide roads, one side can with advantage be dealt with at a time, provided a roller is used, and so an open road is maintained, the traffic using first the unmetalled part, and then the newly-repaired surface as soon as consolidated. In such a case care must be taken where the one side shuts on to the other to secure cohesion.

The steam road roller has made resurfacing

*From a paper by William Menzies, Surveyor of Egham Urban District, England read before the English Surveyor's Institution.

practicable at all times of the year (except when frost or snow prevail) provided there is a good supply of water within easy reach, but without it the remetalling is restricted to one period: i. e., during the winter months (and before Christmas for preference), so that the surface may be consolidated by the traffic, assisted by the winter's rain, before the drying winds of March and heat of summer come on. The roller, however, with water at hand, makes one independent of climatic conditions, and in these circumstances I strongly favor the early springtime for repairs.

The late autumn and early part of winter are times when the roads require a great deal of attention in the way of clearing, particularly if bordered by trees, and the roadmen can be well employed in this work, as well as attending to drains, water tables, channelling, etc., till the end of winter, when clearing, etc., is done with, and their time can be devoted to repairs at a period of the year when days are much longer and therefore more metal can be put on and rolled in per diem (where day work is employed) at little or no extra cost than during the dark days. Again, where the road is to be tarred, the sooner the surface is thus treated after it is consolidated and dry the better. Where water has to be fetched from brooks or ponds at a considerable distance, then the roller should be used in the autumn, otherwise the cost of drawing sufficient water thoroughly to moisten the binding material is great.

It is all-important that there should be plenty of material in stock where repairs, whether in the shape of resurfacing or patching are needed. In populous parts the store-yard has to be relied on for the supply of materials, as there are no broad grass verges, as in the case of rural districts, where depots can be made. It may be urged that the storage of materials in the yard necessitates the carting of metal from the station over the very roads for which in a short time it is needed, and then recarting it again to these particular roads; but a hand-to-mouth system of carting direct from the railway trucks on to the roads often has the disadvantage of an irregular and therefore unreliable supply at the very time when a constant supply is needed to keep the roadmen and roller fully employed. With plenty in stock advantage can at once be taken of climatic or other conditions best suited for repairs. It is also a ruinous policy to put certain materials on a road straight from the quarry with the quarry water still in them.

In rural parts the depots should be as far as is practicable at short intervals, to save either a long length of cartage, or of "run" when wheeled out. When the depots are at frequent intervals, I have a good deal of the wheeling-out done by piecework, and three men filling and wheeling at 4½d. per ton keep a 10-ton roller going, with one man spreading, two regulating, sanding, and brooming the surface, etc., the amount wheeled out generally averaging 33 tons a day.

PATCHING.

For patching only it is advisable to use a similar class of metal to that already forming the surface. The "life" of the surface can be prolonged to a very considerable extent by judicious patching, and a stitch in time will save many a nine, if the roadman has at hand the wherewithal to stitch, and applies the stitching process at the right moment. Hence the surveyor should see that a supply of materials suited for such work is within easy reach. The "lengthman" system here shows to advantage, for the man who all the year round has a certain length of road to attend to gets to know the weakest places, and can without loss of time, and often at the critical moment, do the required patching. The "lengthmen" should be picked and reliable men, for they are often in districts from headquarters, and must therefore be trusted to do the right thing at the right moment. A "lengthman" who can be so trusted is a valuable servant not only to the surveyor but to the community in general.

In the patching, the materials used should be of a smaller gauge than those employed in refacing the surface; they should be spread in a thin coating, and special care must be taken in the case of pot-holes, otherwise a hump is formed, and two new pot-holes are made by the traffic where only one existed—*viz.*, one on the running-on and the other on the running-off side of the hump.

The ever-increasing motor traffic is trying roads severely, and it will be seen on examining a surface subjected to much of this class of traffic that in the case where a hard material such as granite is used a series of these pot-holes is formed, while where a softer material is employed two parallel ruts are generally produced. With continuous wet weather it is surprising how rapidly these pot-holes and ruts are formed, and when once started they quickly go from bad to worse. To patch the former the metal immediately around the cavity should be loosened with the pick before new metal is put on, and a little "binding" is needed, while in the case of ruts the loosening is seldom required, but the new metal should be dribbled along the furrow. In both cases the roadman must be on the alert to see that any of the new metal disturbed by passing traffic—motor traffic in particular—is swept or shovelled back into its proper place.

SWEEPING.

The rotary horse-broom is an excellent device for clearing roads of mud, and it is found that a 6-ft. broom will sweep a much greater surface in an hour than a man can scrape in a day. Through the winter months the use of the horse-broom should not be stinted, and it does its work best when the mud is in a fluid state; but caution should be exercised in employing it in the early spring, or the very material which later on is wanted to hold the stones in their places may be removed.

I should like to add some remarks as regards the tar treatment, with which I am most conversant. I have found it to be a great palliative, a very good preservative of the surface, and at the same time it lessens the noise of traffic, horse-drawn in particular.

The surface to be tarred should be in excellent order, and better results are obtained on a hard road, such as granite, than on a soft one, such as gravel.

If the surface be hand painted, much time is saved by having two boilers, as one can be heating the tar while the other is being drawn from. The work is therefore much accelerated—this is a very important point—as in this climate the changes are rapid, and for the application of tar a bone-dry road is almost essential. Time should not be wasted when the surface is once dry. Wherever possible one side should be treated at a time, and an ample supply of sharp grit or chippings for covering the newly-tarred surface should be close at hand, this sanding operation following up the tarring as closely as possible, whether done by mechanical means or hand labor.

The grit should be perfectly free from all clay or earthy matter, and I have found a gauge of ⅝-in. gives the best results. Fine sand is not so good. With an open and well-drained road some little trouble arises with the tarred surface during lengthened periods of winter's rain, but where shut in by trees or otherwise and there is an excess of moisture the passing traffic churns up the face into a most objectionable black mud very difficult of removal, which sticks fast to and damages the varnish of vehicles. During dry weather in populous parts constant scavenging is necessary, as horse droppings dry very rapidly on the tarred surface and are swirled on to the footways and into the shops, etc., by passing motors.

The "life" of a road when tarred is greatly prolonged. I have carefully watched two lengths of my roads, the one having a granite and the other a flint surface, both of which were tarred in 1907, the process being repeated annually. These surfaces are subjected to heavy traffic, and I have come to the conclusion that between 1907 and now a saving of something like 9d. per yard super. on the granite and 6d. per yard super. on the flint road has been effected.

The cost of maintenance of different roads varies so much that even in the case of two districts bordering on each other it is by no means safe to assume that because the highway expenses are so much in the one case therefore the road upkeep in the other should be somewhere near the same. A large traffic in the one as against small in other; urban requirements in one as against rural needs only in the other; storage of materials in a yard as against the depot system; and many more questions affect the two cases. It is no uncommon thing to find that in one parish the cost of upkeep of the highways is entirely different on the town side of the railway line to that on the rural side.

In my own district there are two parishes, the one being urban in character and the other purely rural. They almost adjoin each other, but the cost of maintenance per annum in the one is in round figures 2¾ per yard super. of road surface as against 1½d. in the other, which again is adjacent to the main road having a large and increasing motor traffic. And while the cost of maintenance of the main road, 6 miles in length, has during the past five years been on an average 4¼d. per square yard, which is 50 per cent more than during the preceding five years, the roads of the adjacent parish, where the ordinary traffic has remained much about the same and which are but little used by motors, have only increased in cost 5 per cent in the same period. In both of these cases the wages, cost of rolling, horse hire, etc., are the same—*viz.*, roadmen 18s. to £1 per week, roller £1 per day, horse hire 8s. per horse, cart and man per day, cartage by piecework 7d. to 8d. per ton per mile, while the prices of materials are granite 12s. 6d. to 14c., flint 6s. 9d. to 7s., and gravel 5s. 1d. to 5s. 4d. per ton, at the stations.

Taking the average expenditure by the county of Surrey on the whole of its main roads for the last ten years the cost has increased during the past five by 43 per cent.

Dust Prevention by the Tarring of Road with Oil Gas Tar.*

Oil tar is a residual liquid resulting from the use of oil in the manufacture of carburetted water gas, which is used in many gas works for the enrichment of coal gas.

An analysis of the oil tar shows the following:

Specific gravity at 60°	1.0514
Water, per cent	1
Light oil 200° C. per cent	26
Pitch oil 200-240° C. per cent	36
Pitch and loss, per cent	37

The liquid is very inflammable, and great care must be taken in handling it and in its custody where left in a cart overnight.

The author desires to impress on his hearers in the most emphatic manner that oil tar must be used only on roads whose surfaces are in good order. If a road with loose patches or marked inequalities on its surface is treated, the results are certain to prove unsatisfactory, and if a road has lately been repaired with a steam-roller, sufficient time should be given for it to get thoroughly consolidated before treatment; it is also advisable if there are any recently filled in gas, water, or sewer trenches, not to allow the tar to run on to them.

The weather has a deal to say as to the results of the treatment. Warm, dry weather is indispensable to the proper drying in of the oil tar.

The author has found the following mode of treatment the most satisfactory: After the road has been properly swept, and the refuse removed, the oil tar, which has been brought to the site in water wagons with taps at their rear, is drawn off into galvanized buckets, and is swished on to the road in front of, from three to six men, according to the width of road. The sweepers proceed to sweep the liquid on in front of them, allowing none to rest in the channels or to get into the road gullies, and after having gone on a short distance, if they see that some portions look wet, they must go back and sweep it until the surface is comparatively dry. A cart should fol-

*From a paper by Fred P. Nixon presented at the Irish Road Congress at Dublin, Ireland, April 20-22, 1910.

low up with sharp grit, or coarse sand, which should be sparingly spread; this adheres to the damp surface, gives a grip and prevents horses slipping. The grit or sand should be about the size of oatmeal and spread at the rate of about one ton to 800 sq. yds. Half the road should be treated at a time, unless the whole road can be closed to traffic during, and for about an hour after, treatment.

Particular care should be taken that notice boards are placed at each end of the road under treatment, and at any side-roads, warning the public that oil tarring is in progress.

The author does not consider the macadam sides of tram lines should be treated, as the sanding and watering of the paved track spreads on to the macadam.

The roads under the author's care have not had more than two dressings in one season, the second dressing about one month to six weeks after the first, but he considers a third dressing towards the end of the summer would be very beneficial; the treatment not only prevents, to a very great extent, dust rising, but seems to bind and put a skin on the surface of the roads, which is plainly visible the next summer. The depth of penetration of the liquid varies from about 1 in. to 2 ins., according to the lentgh of time elapsed since the road has been repaired.

The road, for some little time after dressing, has a slight tarry smell from the oil tar, which is not unpleasant, and it is reported by medical experts to be an antiseptic of the coal tar series, which would destroy living organisms in manure before arriving at the dust stage, and so mitigate sore throats and diarrhœa.

Now, as to amount: the second dressing takes slightly less oil tar than the first, but on average 1 gal. will do about 7 sq. yds.

As to cost: taking all into consideration, carting from gas works (two miles), tar oil at 1d. per gallon; sand, labor, tools, supervision, and suits of oils for the men, it runs out at one halfpenny per square yard for road twice treated, or, taking a road 8 yds. wide—£29 7s. 1d. per mile.

Compared with watering for the season, the cost of which comes to (say at 1d. per 1,000 sq. yds.), £32 17s. per mile, taking road as watered four times a day for 140 days. The cost of a certain amount of scavenging is also saved.

The author does not wish it to be understood that he considers the oil tarring of roads to be a substitute for tar macadam, but for roads such as described at the commencement of this paper, it is an excellent substitue for watering in respect of cost and comfort.

The Maintenance of Trunk Roads in Bedfordshire County, Ireland.

There are two trunk roads in Bedfordshire. One of them is a portion of the London and Holyhead Road and is about 11½ miles long. This road lies chiefly upon a chalf base. It is very costly to maintain owing to the surfacing material being absorbed by the chalk during weather such as prevailed last winter. The other trunk road is a portion of the London to York Road and has a length of about 17 miles. The greater length of it is upon a gravel sub-soil and it is consequently less costly in up-keep. In a paper read at the recent Irish Road Congress Mr. W. H. Leete, county surveyor, described the methods of maintaining these roads and from his paper we have taken the notes that follow:

The roads are refaced yearly with strong material in sections, and the surface is tar dressed as soon as the new work becomes dry. If this work of tar-dressing is done in perfectly dry weather it produces a waterproof road sufficiently strong to endure the two following winters. Last season most of the rural portions of these two roads surfaces were tar-dressed, and, although the work was subject to great hindrance by frequent showers, the tar water-proofing, to a great extent, prevented the surfaces from lifting during the bad weather of last winter. Waterproofing under such bad conditions of weather is an outlay securing but slight advantages, as the full benefit, viz., the absorbtion of the tar by the warm dry road, causing a surface which will extend over two or more winters, is lost. Tar of good body and quality obtained locally at about 4 cts. per gallon was used.

In the manufacture of tar-macadam 50 lbs. of pitch to 40 gallons of tar was used. It was found that 6 gals. of tar will effectively cover a ton of dry 2¼-in. furnace slag, if the material is warmed and under warm weather conditions. If, however, the stone is not dry and warmed, 9 gals. will be necessary to cover a ton of material, and the extra amount of tar thus used is really superfluous. Overheated material will convert the tar into a varnish which will not bind the macadam, but will, if it be laid down, soon develop a loose and troublesome portion of road surface.

Tar-macadam, made up 30 years ago as described above, and laid down in the Borough of Luton main thoroughfare, has recently been broken up for tramway purposes. The main body of the material was in an excellent state of preservation, and it required considerable labor with a steel chisel to break it up. The surface of this material had been tar-dressed every second or third year and refaced with fine topping about every tenth year.

Tar Macadam at Mankato, Minn.

About four years ago the city of Mankato with the co-operation of the local gas company constructed a block of tar macadam pavement. This block proved so successful that two more blocks were constructed last year. This later work was done by contract under specifications prepared by Mr. John Wilson, City Engineer, to whom we are indebted for the information that follows.

The pavement is 30 ft. wide and one block has a grade of about 2 per cent and the other 11 per cent. The surface of the street was first excavated to a depth of 5 ins. below grade and then rolled with a 15 ton roller. Broken limestone, crusher run, was then spread over the surface to within 1½ ins. of the finished grade and then rolled until it would no longer creep under the roller, after which the whole surface was sprinkled with hot tar. The wearing surface was then applied; this consisted of the same limestone as the base, only broken to pass a 1-in. ring, and with all stone dust screened out. To each cubic yard of stone was added 18 gals. of hot tar and all mixed on a mixing board the same as concrete. The tar was heated to boiling by a steam coil passing into the tank containing it. At first the wearing surface was covered with stone dust and then rolled, but later this was found to be unnecessary and in fact not desirable, as the tar did not adhere to the roller, while the dust on being rolled seemed to destroy some of the binding qualities of the tar. The best results were obtained when the dust was spread in a thin coating after all rolling had been completed. The street was closed to traffic for a period of ten days.

The tar used was crude coal tar from the local gas plant, Pennsylvania bituminous coal is used, and the temperature of the retorts kept at about 1100° C. No attempt is made to refine the tar beyond removing the ammonia. An analysis of the tar resulted as follows:

Mineral ash, per cent	0.20
Specific gravity	1.249
Free carbon, per cent.	33.71
Amount distilled below 225° C. per cent.	0.00
Amount distilled between 225 and 270° C. per cent	6.77
Amount distilled between 270 and 360° C. per cent	17.25
Residue after heating to 360° C. per cent.	75.97

The briquette test was also made by mixing 12½ per cent by weight of tar with 87 per cent by weight of sand of such grade that it would pass a ten-in. mesh to the seive and be retained on one with 90 meshes to the inch. The briquettes were 3 ins. square and 1½ in. thick and after hardening seven days at room temperature, they were supported by the edges by two knife edges and required a weight of 213 grams on a third knife edge at the middle to produce bending and 281 grams before breaking. As might be expected from the high temperature maintained in the retorts, the free carbon was high; however, it seems to have effected the binding properties of the tar but little, judging from the character of the street.

None of the harmful effects to adjacent vegetation as reported by some have been noticed. It would seem that this effect might be due more to the volatilization of the lighter oils than to any small particles of tar that might collect on the leaves. These lighter oils would be present in very small quantities in tar with a specific gravity as high as that used in Mankato.

The stone was crushed and delivered on the street for $1.25 per cubic yard and the tar at the plant costs the contractor 3 cents per gallon. The cost of the pavement complete to the city was $0.764 per square yard. The people are all very highly pleased with the pavement and more will be constructed this year.

Notes on Road and Street Work.

Tar Spraying on Steep Gradients.—Some question has been raised as to the steepest gradient on which the spraying has been carried out without rendering a road dangerously slippery. In a recent issue of the Surveyor, Mr. Arthur C. James, Assoc. M. Inst. C. E., engineer and surveyor to the Grays Thurrock Urban District Council, states that for five successive years he has tarred a road having a gradient of 1 in 16 for a length of about 200 yds. He further adds that this is part of a main road of considerable traffic and that there has been no complaint of slipperiness.

Prices for Paving Work in Iowa Cities in 1909.—The following figures taken from the Proceedings of the 22d annual meeting of the Iowa Engineering Society show the prices paid for paving work in a number of Iowa cities in 1909:

BRICK.

	Per sq. yd.	Remarks.
Boone	$1.575-1.67	5-in. concrete base.
Cedar Rapids	1.49 -1.58	4-in. concrete, 2-in. sand.
Council Bluffs	1.935-2.075	5-in. concrete base.
Davenport	1.45 -1.64	5-in. concrete base.
Des Moines	1.34 -2.13	
Dubuque	1.65	Macadam base.
Fort Dodge	2.14[1]	5-in. concrete base.
Keokuk	1.49 -1.59	6-in. crushed stone, 2-in. sand, sand filler.
Mason City	1.90[2]	5-in. concrete base, 2-in. sand.
Montezuma	1.895	4-in. concrete base, 1½-in. sand.
Newton	1.76	Concrete base.
Oskaloosa	1.665	1-in. sand.[3]
Ottumwa	1.86	6-in. concrete base.

ASPHALT.

Davenport	1.84 -1.89	5-in. concrete base.
Des Moines	1.99 -2.48	
Waterloo	1.87	5-in. concrete, 1-in. binder, 1½-in. top.
Waterloo	2.19	6-in. concrete, 1-in. binder, 2-in. top.

[1]Brick block. [2]Purington block. [3]Under 2 courses of brick.

Prices on other types of pavement were as follows: Cedar Rapids, 12-in. tarvia macadam, $0.64 to $1.02; Clinton, creosoted wood block, 3-in. block, 1-in. sand, 5-in. concrete, $2 to $2.13; Clinton, 8-in. macadam, $1.40; Davenport, 2,304 sq. yds. of tarvia, $1.23; Des Moines, creosoted wood block, $1.99 to $3; Dubuque, macadam, $0.65; Fort Dodge, creosoted wood blocks, 3-in. block, 5-in. concrete base, $2.4375; Fort Madison, 10-in. tar mac-

adam in two courses, $0.95; Grinnell, bitulithic on 1—3—5 concrete base, $2.13; Knoxville, creosoted blocks on 5-in. base, 1-in. sand cushion, $2.35; Mason City, concrete, 2-in. top, 5-in. base, $1.29; Montezuma, concrete, $1.29.

The amount and prices of curbing constructed in 1909 were as follows:

	Lin. ft.	Price per ft.		Remarks.
Boone	6,243	$0.197		1 2
Cedar Rapids	40,717	.2975-	.35	
Clinton	4,000	.40		
Davenport	43,488	.25 -	.30	5"x18", on pav.
Dubuque	5,228	.70		
Fort Dodge	2,300	.40		6"x20"
Keokuk	1,097	.69 -	.72	
Mason City	2,000	.40		22"x5", 1:2
Montezuma	15,000	395 -		6"x20", 1:3:5
		.435		5"x20", 1:3:5
Muscatine	9,600	.575		5"x20"
Newton	5,100	30		
Oskaloosa	400	.41		
Ottumwa	9,523	.42		6"x20"
Red Oak	42,000	.35		

The prices for combined curb and gutter were as follows:

City.	No. lin. ft.	Price per ft.
Cedar Rapids	9,831	$0.34
Clinton	1,700	.60
Council Bluffs	11,858	.54-.58
Davenport	23,892	.66
Dubuque	7,150	.65
Ft. Dodge	10,190	.53
Ft. Madison	5,000	.47
Grinnell	8,000	.54
Keokuk	1,560	.65
Oskaloosa	3,197	.63
Red Oak	27,471	.51
Waterloo	47,533	.60

(Continued from page 567.)

Withey, "The Scleroscope," by A. F. Shore, followed by a general discussion on tests of metals for hardness; "Some Testing-Laboratory Accessories," by J. Madison Porter; "The Brinell Ball Test Applied to Wood," by W. K. Hatt; "Apparatus for Repeated Loads on Concrete Cylinders and a Typical Result," by H. C. Berry; "An Autographic Rubber-Testing Machine," by T. Y. Olsen; "The Work of the Structural Materials Testing Laboratories During the Past Year," by R. L. Humphrey.

The eighth session, on the afternoon of July 1, will be given up to a discussion of reports from the committees on waterproofing materials, on standard tests of insulating materials and on standard specifications for coal, and to a consideration of the following papers: "The Determination of Soluble Bitumen," by Prévost Hubbard and C. S. Reeve; "Improved Instruments for the Physical Testing of Bituminous Materials," by Herbert Abraham; "Necessary Reforms in Specifications for Petroleum Products," by Albert Sommer; "A New Machine for Testing Pitch," by T. Y. Olsen, and "Fuel Investigations of the U. S. Geological Survey During the Last Year," by J. A. Holmes.

The ninth and closing session will be held on the morning of July 2. Reports will be received from the committees on standard specifications for paving and building brick, on standard tests of road materials, on standard specifications for vitrified clay and cement sewer pipe, on standard specifications for grading structural timber, and on the magnetic testing of iron and steel. Two papers are also scheduled for this session: "A Comparison of Magnetic Permeameters," by Charles W. Burrows, and "The Exponential Law of Endurance Tests," by O. H. Basquin.

Further information regarding the convention may be had from the society's secretary, Prof. Edgar Marburg, University of Pennsylvania, Philadelphia, Pa.

Dynamite Contract, Panama Canal.—The contract for dynamite for the fiscal year 1911 has been let to the DuPont-De Nemours Powder Co. of Wilmington, Del., the amounts and prices being as follows:

45 per cent—8,540,000 lbs., at 11.7 cts.
60 per cent—5,187,000 lbs., at 12.7 cts.

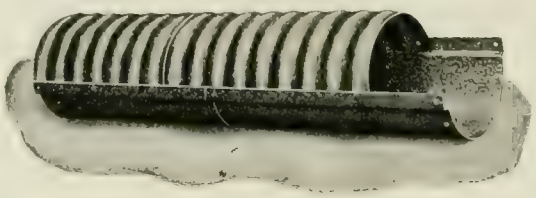
The amounts quoted are estimated as the possible requirements for the fiscal year, but not more than 50 per cent of the estimated amount need be purchased. The first deliveries will be made in August.

Water-works and Sewer Section

Note: This section is devoted to methods and costs of constructing sewers and water-works. It will cover the construction work for all details of water supply and sewerage, including sewage purification and water filtration.

A Corrugated Iron Culvert withm Sooth Bottom Plate.

The accompanying illustration shows a patent metal culvert, differing somewhat from most metal culverts, which has recently been placed on the market. One of the features of this culvert is the smooth bottom plate, which permits a free flow of water, mud, pebbles, sticks, etc.



Corrugated Iron Culvert with Smooth Invert.

In setting up the pipe, two bottom sections are bolted together, after which a short piece of corrugated top is added, then a full sized section of the top, alternately, until the desired length is obtained, the last section of the top being a short section. In this manner all joints are staggered. The top pieces are joined by a lapping of one corrugation, one end being made a small fraction of an inch smaller, for this purpose. The bolts, which are also galvanized, all come on the sides of the pipe, passing through the flange of the smooth bottom, and through the corrugated top.

The pipe can be closely nested, and when this is done can be handled with the greatest ease. The construction and method of assembling is so simple that it is stated that an unskilled laborer can set up a 20-ft. section of pipe in 20 mins., the only tool required being a wrench. The culvert is handled by the Highway Culvert Department, 201 Devonshire St., Boston, Mass.

The Cost of Furnishing Water With Reference to Rates and Rate Making.*

No argument is necessary to sustain the position that any investment for the public service, if conservatively and intelligently made, should be expected to result in earnings which will maintain the investment intact and guarantee from the investment a fair return. The returns should be commensurate with the risk involved, otherwise the public can not expect to secure service when such risks exist. Fair returns, therefore, must include:

(1) Interest on the investment necessary to construct the plant and to develop the public utility into a going concern.

(2) Depreciation and maintenance charges sufficient to maintain the investment intact.

(3) Cost of operation, including station and distribution expenses.

(4) Cost of business management including office expenses, collection charges, etc.

(5) A reasonable profit in addition to the above and commensurate with the risk involved.

It is only through the prospect of such returns that the necessary funds can be secured for the construction of public utilities.

As with other investments, the returns from public utilities, especially in the smaller communities, are frequently disappointing, and the actual earnings are often less than a "fair return." On the other hand many such utilities in the larger communities are very profitable and in some cases these profits have been so great as to warrant the feeling that they were unfair to the public and should be reduced to reasonable limits.

With the question of reasonable limits comes a marked difference in opinion according to the point of view from which the matter is considered.

In considering the adjustment of rates for the services of any public utility, popular judgment is usually based, perhaps naturally, on a comparison with similar rates in other localities. Such a comparison is also frequently the sole basis of attempted rate regulation by local authorities. Where the conditions are essentially similar in the localities compared, the results may be essentially equitable, but the mere comparison of rates, without taking into consideration, in detail, the local physical conditions, may frequently lead to most unjust and unfair conclusions.

This is especially true in the adjustment of water rates, for the conditions which control the cost of services, vary so greatly with the character of water used, the treatment necessary for rendering the supply suitable for domestic and manufacturing uses, the height to which the water is to be raised, and other factors of this character, that in many cases the fair returns for one plant should be quite different from that which might be equally fair for another.

Without discussing the matter at length the writer feels assured that the basis of rate making, above set forth, is the true basis on which an equitable adjustment of such matters must be made. In arriving at the findings on this basis, much difference will result, for estimates of valuation, depreciation, maintenance, etc., can by no means be made exact.

As illustrating the effect of varying conditions on the necessary cost of service and the necessary variations in rates due to such conditions, and as further illustrating the injustice of the attempt often made to reduce rates without due consideration of the above principles, the following data is offered concerning a case which was under litigation in the city of Chicago in 1904-5.

About 1904 the City of Chicago extended its limits taking a certain territory which received its water service from a private water company. Some of the citizens of the new ward objected to paying the rates charged by the water company, and an ordinance was passed by the Chicago City Council reducing the rates of the water company in the new ward to the rates charged by the city for similar services in adjacent territory. The company resisted this change in rates, and the following report was submitted and formed the basis on which the case was presented:

In the matter of the estimate of the "fair return" or equitable income which the water works plant of the ..... Suburban Water Company at ..... should earn, I wish to call your attention to the following facts:

The City of Chicago have attempted to force this company to reduce its rates in ....., which is now within the limits of Chicago, to those charged by the City of Chicago itself. The inequity of this will be seen by all who examine into the different conditions under which the two plants are operated, and who recognize the fact that the expense of operation, and the consequent necessary "fair return" depends almost entirely on such conditions.

The following parallel comparison of the plants owned and operated by the City of Chicago and by the ..... Suburban Water Company will serve to illustrate these differences. The latest data for the Chicago Water Works is for 1901. I therefore compare it with the Suburban works for the year ending July 31, 1902, with which such data most nearly corresponds in time.

*Paper by Prof. Daniel W. Mead, University of Wisconsin, Madison, Wis., before the American Water Works Association, New Orleans Convention, 1910.

COMPARISON OF WATER WORKS.

	Private Waterworks. 1901-2.	Chicago Waterworks. 1901.
Estimated value of works	$600,000	$34,000,000
Population served	25,000	2,000,000
Investment per capita	$24.00	$17.00
Miles of mains	62.50	1,890
Consumers	4,096	227,500
Consumers per mile	65.5	120.0
Mains per consumer	80.8 feet	44.0
Source of supply	Artesian Wells	Lake Michigan
Sanitary character	Unquestionably good	Suspicious
Height raised by pumping	226 feet	106 feet
Annual pumpage in million gallons	370.4	125,130.5
Average daily pumpage in million gallons	1.05	342.83
Annual income from works	$62,234	$3,397,928
Actual operating expenses	$34,249	$1,138,392
Depreciation 1% on valuation	4,800	300,000
6% interest on valuation	36,000	2,040,000
Total annual expenses	$75,049	$3,478,392
Net loss per annum	$12,815	$80,464
Cost of pumping 1,000 gals.	22.82 cents	2.79 cents
Income per 1,000 gals.	16.76 cents	2.76 cents
Actual loss per 1,000 gallons pumped	6.06 cents	.03 cents
Cost of operation expenses per 1,000 gallons	10.8 cents	.91 cents
Cost of operation per consumer	$9.15	$5.00

The above comparison needs little comment. It might be considered equitable when a water works can pump water at 3 cts. per 1,000 gals., to place the minimum meter rate at 10 cts. per 1,000 gals., but it should be noted that when interest and depreciation are considered the City of Chicago itself, does not receive a fair return on this basis, but received only 2.75 cts. per 1,000 gals., and sustains an actual loss of .03 cts. per 1,000 gals. pumped. Thus it is seen that Chicago itself, in order to receive a fair return on the cost of operation and investment, should raise its rates above those now charged. Such losses should be anticipated, and are due to leakage, wastage and to free water which is furnished to some extent by all plants.

The greater cost of pumping smaller quantities of water under higher heads is also well shown by this comparison. That this is not peculiar to this suburban plant, but is the necessary consequence of the conditions, is known to every water works engineer.

The City of Chicago in some of its smaller works furnishes good samples of this fact. Take, for instance, Washington Heights. At these works the station expenses were as follows:

	Operating exp.	Repairs.	Total sta. exp.	Total 1,000 gals. pumped.	Cost per 1,000 gals. on station exp.
1900	7,263.68	844.07	8,107.75	118,195	6.85
1901	8,715.18	1,262.73	10,477.91	139,176	7.47
1902	6,555.50	2,354.65	8,910.15	156,954	5.68
1903	8,485.56	747.69	9,233.25	243,565	3.79

At Norwood Park, the works also operated by the City of Chicago show expense as follows:

1900	4,948.52	138.03	5,086.55	30,200	16.88
1901	5,098.51	376.22	5,474.73	28,380	19.35
1902	4,342.37	736.90	5,079.27	28,195	20.55
1903	4,170.78	200.18	4,370.96	26,356	16.59

These figures include only station expenses. If to these were added cost of supervision, general repairs, collections, deterioration and interest on the investment, it is obvious that the cost would in every case, be increased from 20 to 40 cts. per 1,000 gals.

It should also be noted that at Washington Heights the head pumped against 109 ft., or less than one-half of the head at ..... The head pumped against at Norwood Park is unknown to me. The charges the city is making for water in these suburbs could only be sustained by a general tax or by making the other water takers of the city pay for the yearly loss thus incurred.

The details of the cost of operation of the ..... Water Works for the last three years is shown in the following table:

ANNUAL OPERATING EXPENSES.

	1902.	1903.	1904.
Fuel	$10,180	$11,700	$12,500
Taxes	5,031	3,756	2,780
Insurance	457	16	127
Legal expenses	600	1,826	1,401
Supplies	1,331	1,297	1,514
Repairs	3,522	3,575	3,135
Printing	203	288	175
Telephone	61	70	91
Oil and waste	732	610	670
Cartage	626	500	680
Miscellaneous expenses	750	585	658
Envelopes	158	106	159
Labor	10,598	11,451	11,605
Total	$34,249	$35,720	$35,495
Int. on value of work	$36,000	$36,000	$36,000
Deprec. (1% of $480,000)	4,800	4,800	4,800
	$75,049	$76,520	$76,295
Total income	62,235	70,741	76,815
M. gallons pumped	370,300	391,000	454,800
Cost per M. gallons based on operating expenses	$ 9.17	$ 9.10	$ 7.78
Cost per M. gallons based on total cost	20.30	19.60	17.89
Gross inc. per M. gals.	16.76	18.10	17.85

The foregoing table shows that the Suburban Water Company had been operated at a loss at their established rates, and that any reduction would be inequitable.

The court so held. The matter was afterwards adjusted by the City of Chicago purchasing the distributing system within the city limits, which they then connected with the city system

DISCUSSION.

Stuart Wood, Philadelphia, Pa.—A waterworks perhaps differs from any other industry in the fact that the proportion of capital employed to the operating expenses is greater than in anything else. I presume that there is no other large industry where approximately as much as one-half, or even in many cases more than one-half of the cost of furnishing the commodity is due to the costs and depreciation of the plant, as is the case with waterworks. Private waterworks companies, of course, are compelled to take this into consideration in establishing their costs; but that is always not the case with municipalities, and the accounts of the latter are not kept with the same objects in view. As a result I think it will be found that very often municipal operating costs are published which are made up simply of operating expenses, wages, fuel, and ordinary repairs. I have in mind myself one city which feels very well satisfied that it is making a profit on its waterworks, where they charge to cost of operation, interest on a little more than $1,000,000 of bonds, and the value of the works they claim to be about $10,000,000. Now of course published rates based upon such figures as that are very mesleading if they are supposed to cover the actual cost of furnishing water; and to compare such rates with those of neighboring cities is very unjust. But such a practice is very often prevalent, and I think in consideration of this fact it should impress upon our minds the very great importance of a uniform accounting which will apply to municipal as well as private plants. Such in fact is the purpose of the present legislation in Wisconsin. I think that any legislation for the benefit of waterworks ought in fairness to enforce that rule with regard to municipal and private plants alike.

W. F. Wilcox, Meridian, Miss.—I heartily agree with Mr. Wood. The reason why a great many municipalities say that they pump water for a certain figure is because their books do not show thoroughly every item of cost. I represent a municipal plant, yet I was raised a corporation man. I have had this to contend with in the management of a municipal plant, that the politicians want to show the people how little they are charging for water and how little it costs to furnish it. It is not fair to say that depreciation and similar items cost nothing. It is simply a political game. The municipal superintendent, therefore, finds himself in an attitude that is antagonistic to the politicians whenever he attempts to state the true cost of pumpage. I think that Mr. Wood's suggestion as to uniform accounts is a very timely and proper one. In our city we charge for everything the city gets from us, and we credit the city for everything we get from it. If we have the city engineer run out a line for us we pay the engineering department for it. If we have the board of public works repair a street, we pay them for it. If they get any water from us they pay us for it. We do not carry any fictitious charge on our books as to what the city owes us for water; but in fixing our rate we adopt what would be a reasonable charge if a corporation owned the plant. We also take into consideration what taxes that corporation would pay to the city. Deducting these taxes from what would be a fair charge by the corporation, leaves what we charge to the general city government, and we collect that every year in cash. Our plant supplies 30,000 people. Our total pumping cost at the station is $20.40 per 1,000,000 gals., including filtration. Our water flows by gravity during a portion of the year; but in the dry season we have to double pump water from the impounding reservoir. That runs up our cost a little bit. We figure the actual cost of operation, the interest on the bonds, and the depreciation charge. As to the latter we played a little politics on the politicians. We figured out what was the depreciation as nearly as we could get at it, and arranged so that that amount of our city bonds would come due every year. We pay off that portion of bond issue every year to take care of the depreciation. I want to call attention to one point: Municipalities in the south borrow money from 1 per cent to 1½ per cent below what their private corporate competitors do. That is one of the unfortunate things that the private plants have to contend with. I believe I am right in stating that the majority of the private companies pay 6 per cent. We pay 4½ per cent; so you can see that we have a practical advantage of 25 per cent in the time of interest.

T. C. Phillips, Chicago, Ill.—I could explain the situation at Washington Heights, which is one of our suburban stations, located about nine or ten miles from the pumping station. The section line is a 16-in. main, which is used for the service pipe line also. The Washington Heights station pumps against 60 lbs. pressure. We have found in the last few years at times we are not able to maintain 60 lbs. pressure, because every now and then our small pumps were frequently a source of a great deal of error, and did not show the actual conditions. These pumps have since been replaced by others, and the figures as compiled for 1901 and 1902 show a total ordinary expense for pumping water for the city of Chicago to be about 3 cts. per 1,000 gals. Perhaps it would be well to explain that this does not include any fund for sinking fund purposes but includes the total ordinary expenses only. With regard to the question of rates some of us believe in the city of Chicago that the present rate is too low. For instance, by the time we have our water delivered to the consumer the cost of water might be nearer a figure considerably above our present meter rate, for the reason that a very small percentage of our water is actually delivered. The purification of the water is not taken into consideration at all, I believe.

John W. Alvord, Chicago, Ill.—If anybody would say inside of the city limits of Chicago that our Chicago plant was not making money, I would not like to guarantee what would happen to him. The general impression is that our Chicago water plant is a great money winner. As Mr. Phillips has pointed out, for a number of years large portions of the money in the water fund has been used for other purposes connected with the purification and the maintenance of the purification supply. For instance, large conduits which are really sewage conduits which have no connection with the water system, but which are merely a protection to it in keeping the sewage out of the lake. The comparison is a very interesting one, something which I have wanted to see made for a long time. I understand, that in this 3 cts. the interest and the cost of the

purification is not included. That is where the whole thing lies. The distribution system of the Chicago waterworks is largely a resultant from special assessments. Having once built this through special assessments no further account is kept of the capital cost. As Mr. Wood has very well pointed out, the capital cost of furnishing and distributing water, with these fixed charges is one of the greatest items to be met and accounted for. Of course, not having to account for this item, Chicago, together with most cities, finds that its revenues are such that they can reduce the rates and have money to spend at times for other purposes. The fact has been alluded to here that so many municipal reports are unreliable, perhaps not always intentionally so, but because of the ignorance of the municipal accountants of the true principles and method by which all these capital accounts with their fixed charges should be treated for operative purposes. It seems to me there is in municipal reports such as have come under my observation for many years another curious psychological feature, if I may be allowed to term it such, the desire to make a better showing than a predecessor. This is a very insidious temptation, and while it does not always involve anything like falsification, it very often involves carelessness in going thoroughly into the matters involved. For instance, it was my lot at one time to examine the municipal business over a period of one year in one of the larger cities of our central west. Each annual report of the superintendent of that plant charged up a certain amount for coal to his engines for pumping; and it was remarkable how year by year each superintendent managed to pump water for a little bit less a year than his predecessor had done, and after each change in superintendents there was a remarkable change for that year. But, fortunately, vouchers, for the purchase of the coal were also in existence and were possible of utilization; and after comparing these along from year to year it was seen that there was a considerable amount of coal which had apparently disappeared. I took a great interest in thus securing the actual account, and computing it year by year; and after adding it to the coal pile I found that during 40 years' operation that the amount of unaccounted for coal produced a pile about 330 ft. high that would extend over a good sized city block.

Charles B. Burdick, Chicago.—It is customary in making comparisons of the cost of furnishing water to base the comparison upon the cost per 1,000 gals. That seems to be a good basis of comparison. It is true that the majority of our systems are not metered, and therefore the only place where the water can be measured is at the pump. It is also true that there is a very large discrepancy in every waterworks plant between the amount of water which leaves the main station and the amount which reaches the consumer. There are comparatively few of our plants now where all consumers are metered; and it has been found in plants that are considered as well regulated plants that all the way from 25 per cent to 60 per cent of the water pumped never reaches the consumer. Therefore, the important proposition in comparing rates for water on the basis of 1,000 gals. is to consider the percentage of loss of water in the mains and services. If the cost is based upon station pumpage the error of making a comparison of cost of that with the cost per 1,000 gals. supplied to the consumer is evident.

Leslie C. Smith, Cleveland, O.—In the discussion of this matter of the cost of furnishing water I cannot but believe that a vital part of it must hinge upon the cost under varying conditions. The cost of supply differs widely in different plants. But the matter of pumpage ought to be a common basis of comparison in all plants. So that, following the remarks of a previous speaker, it is not the cost of the water delivered that offers a correct basis of comparison between one city and another, but it is whether or not each individual department that has to do with the furnishing of this water will compare favorably with a like department in another plant. For instance, from the time the pumps take the water until that water enters the main we may call that the pumpage, and include labor, fuel, oil, waste, etc. Now, if the matter of purification enters, that is another sub-division. If that added to the cost is to be taken as a comparative basis for another city, whether it be in softening, purification or whatsoever else, right there the figures must diverge and are unfair. So must the question of supply be considered. I find the only helpful part in a comparison is in being able to select the things that apply to my own individual situation as compared with like conditions in another city, to see if I am producing and pumping as much water, and if I am supplying and delivering as much water at the same cost as another city is doing it. If not, then there arises the question in my judgment of an improvement in some particular.

S. J. Rosamond, Fort Smith, Ark.—In my city I am pumping 150,000,000 gals. of water every 24 hours, and in another city they are only pumping from 3,000,000 to 5,000,000 gals. every 24 hours, the latter would certainly present different conditions. Then if there is a different head to pump against that would make a difference. I cannot see where you can draw a fair comparison based simply on rate figures alone without taking into consideration the conditions under which the plant is operated, or the class of machinery that is used and that is necessary for that plant to meet those conditions, and all those various details that are included in the pumping stations under which the companies compared are operated. I have been up against this comparison business since 1905. It has caused me a great deal of trouble. I have had some of our aldermen quote rates from some city where the department takes no account of taxes and probably has no bonds out and have their plant paid for, and are taking no account of the capital investment, the only accounting being bare cost of fuel and salaries, which of course does not furnish a fair basis of comparison. I cannot see that such a basis could be furnished except by taking into consideration the difference in cost per 1,000 gals. for delivering water at the tap, and in ascertaining the cost of that the property investment must be considered, as well as all other proper items of cost.

Dabney H. Maury, Peoria, Ill.—It seems to me that the whole question of comparison or rates ought to be viewed from two points of view. I think it ought to be admitted that if we are considering the rates in any one location those rates should be based upon the cost, distributed among the various kinds of services, such as public and private fire protection and the individual consumers; that there should be no free water to any one, but that each of these three classes, and as nearly as possible each consumer in each of these three classes should pay his just quota of the fairly distributed charges, no more, no less. A water department ought not to make a profit on one at the expense of the other. That ought, I think, to constitute a basis for fair rates. It follows that as the conditions vary in all plants it is absolutely necessary to consider all of the conditions involved in any specific case before you can decide what ought to be a fair rate. When you come to compare one plant with another, which is the second point of view for consideration in the question of rates, it seems to me equally indisputable that you consider the service which is furnished for the rates as well as the conditions by which the supply is surrounded. The basic question which was put up for solution in the National Civic Federation investigation of municipal ownership and operation, was the cost to the consumer of a comparable unit of service. Now a great many things enter into what constitutes a comparable unit of service. Sometimes everything is included in a rate. Very often that is not the case. It may sometimes ever treble the amount of a rate in order that the service furnished for it may come up to the standard which may perhaps be fully covered by the water rate in some other towns. If a plant be built by a special assessment, that does not appear in the water rate. If a plant be municipally owned and does not pay taxes, that does not appear as against the cost of production and is therefore not included in the water rate. If there be deficient protection against fire by reason of lack of pressure, that means extra appropriations for the fire department and extra insurance premiums; and that does not appear in the water rate. If the water be impure, and by reason of fear of disease large amounts of bottled water have to be bought by the community, or even other liquids have to be consumed, that does not appear in the water rate. If the pressure is insufficient to furnish the upper stories of houses with the desired supply, with the result that increased pumping is required which has to be put in in the most expensive manner in small installations on owners' premises, and operated, therefore, at a very large unit of expense, that does not appear in the water rate. So that really when you get down to a final analysis and endeavor to compare what is being done in one city with what is being done in another, you have to take all these things into consideration, or otherwise you may be led into an unfair comparison.

Dow R. Gwinn, Terre Haute, Ind.—Personally I feel under obligations to Mr. Mead for having prepared the excellent paper which has brought out this discussion this morning. I was especially interested in the points made by Mr. Maury with reference to the question of service. I had occasion last summer to visit an eastern city where they furnish water to the metered customers at a rate of 5 cts. per 1,000 gals. That rate is frequently quoted to private companies as an argument to private companies to furnish water at the same price. I asked a friend in that city about his water rate. He told me it was very cheap indeed, very low. I said, What about your drinking water? He told me how much they had to buy and it figured up to $3 per month, or $36 per year. I asked him if it would not be cheaper if he paid a higher rate and got a better quality of water and would be relieved of buying drinking water outside. I am glad to see a growing disposition on the part of the courts to take into consideration differences arising from locality and their different conditions in the cost of producing service. The legislatures are looking at it also in that light, and it is time that they did. But in Kansas the legislature recently passed a law which provides that the city commissioners, where the government is under the commission form, can fix the water rates, and gives them full power to fix the rates to be charged by a company not only to the citizens but to the city as well for fire protection, but they are not allowed to make those rates lower than such as to enable the company to earn 10 per cent on its investment after paying operating expenses, cost of maintenance, taxes, etc., which I think is very fair indeed. It allows for cost and also for maintenance. That seems to be one of the fairest laws that I have come against for some time.

A. H. Wehr, Baltimore.—It was such considerations as have been mentioned which the committee on uniform reports and accounts have had in mind, and which emphasized the importance of the work which has been begun by the committee. The various points which have been raised in this discussion have all been carefully considered by us and also by the Census Bureau at Washington, in the attempt to arrive at some scheme of accounts which would make it possible to present for consideration all the various factors entering into the service of water supply in connection with a comparison of rates. I have in mind one matter that has always struck me as very wrong and unjust—namely, the water rates charged by the municipal department of the city of Baltimore. My company operates immediately on the outskirts of Baltimore, and a comparison is often made between the city rates and our own. After going through the old records for as much as twenty-five years back in searching through the city archives I found the extraordinary fact that a resolution had been adopted upon the recommendation of the then mayor of Baltimore, that in order to encourage the introduction of manufactures into the city large factories and con-

sumers of water should be given an especially low rate; and in accordance with the recommendation the Baltimore city council passed an ordinance directing the water board to install metered services for manufacturers and other large consumers of water; and instead of giving them the flat rate charge they were given the very low rate of 6 cts. per 1,000 gals., and that price is what they are charged today, whereas other consumers are now charged a less rate. Under the schedule rates to domestic consumers the average rate paid in Baltimore by them is less than 4 cts. per 1,000 gals., whereas manufacturers to whom it was originally intended to give an exceptionally low rate to encourage them to come to Baltimore, are paying 6 cts. per 1,000 gals. No one seems to know the difference; no one stops to inquire why that condition exists, and it is apparently not observed except by those of us who are interested in the proposition as waterworks men. When we began to analyze the figures we found that the only charge that is made based upon the cost of water is to cover coal expenses, the operating department and the interest on the bonded indebtedness. No depreciation charge has ever been made. A sinking fund is provided by direct taxes, and every year or two there is a special appropriation in the budget to cover the deficit in the various departments. That is a condition I think that is not rather unusual. It occurred to myself as one member of this committee that that city should be informed that there is no department or company that is fixing its rates today upon the proper basis We know the amount of work that has been done in connection with the fixing or gas rates and electric light rates. We have heard of a sliding scale, the Boston sliding rate, the Dougherty rate, and a number of other rates in connection with gas and electric light. It was impossible for us to embody all the various schemes of rate making and apply them to water rates fully. Before one could do that the conditions must be substantially the same in all plants. The biggest capital investment should be considered, also the capacity of your plant and whether that capacity is used in full or only in part; and the rate to my mind should be divided at least into two factors, one being fixed representing the approximate demand, and the other being variable, representing and embodying the consumption and the customer cost. The demand cost is that cost which is fixed, based and predicated entirely upon the capacity of the system; consumption cost is that cost which varies with the quantity of water consumed. The customer cost depends upon the number of customers, and runs up by jumps. As your customers increase several thousand you have to increase your force, and the customer cost increases accordingly. It has occurred to me that the proper method, or one that might be tried until found wanting, would be a fixed flat rate based upon the number of feet of the distribution system which is occupied by the premises of each and every consumer. This is fixed without regard to the quantity of water in use. When a flat rate covering these costs is once established you will find that the meter rate covering consumption cost will be very low. In that way a low rate is automatically applied to the large consumer of water, and a relatively higher rate to the smaller consumer. The entire question of rate making, it seems to me must have some basis of this character in order to be just to yourself and absolutely and fairly give you a proper comparative basis as between municipalities and private plants without regard to their location, but having regard only to the conditions under which they operate and to the variable service they furnish.

A. A. Reimer, East Orange, N. J.—It seems to me a great deal has been said about the weakness of the municipal ownership system, and I think that it deserves a little word of commendation. In our plant in East Orange we still hear rumblings of comparisons between the old rates established by the private water company from which the city purchased and the present rates. Fortunately for us those rumblings are becoming less and less numerous, for we have given every one a chance to investigate to the fullest extent the department management, the financial system in use, the system of revenue, etc., and there seems to be general contentment now. We account for everything, or try at any rate to account for every department in our water supply system. We account for the interest on the bonds; we account for the sinking fund. We pay it all ourselves. We get no help whatever from the municipality for fire protection, for water furnished to the various public buildings, for any service rendered to the municipal department. We get nothing. Therefore, in order to show the citizens what I believe to be the fair condition of the department, each year we make an estimate of the cost to the plant as it stands at the end of the year, allowing for what would be the amount of taxes if it were a private plant based on the full city rate assessed against any private consumer on his property; we charge that off. Then we take credit for water supplied to the city, at no time exceeding the immediate rate charged to the largest consumers; so that the city gets the full benefit of everything that we give to them, and we take as much benefit as we can fairly take under that statement. The question of fire protection has been thoroughly threshed out, because the system is right up to the mark on fire protection, there are no weak points in it at all; and I feel that the rates that are established now, which have just been revised I might add so far as meter charges are concerned, represent the lowest working point that we can adopt for the time being. We have just made a reduction of 14 per cent on the meter charges. Now I mentoined this simply to show that a municipal plant can take account of everything and still show a profit at the end of the year. We have to provide, however, for a possible contingency in the future. The state law of New York, as we are informed by our state attorney, forbids our making a cash charge and collecting actual cash for any service rendered the city. For that reason we have to make an assessment charge which we do not report as an actual cash item, but simply show as an addendum to our financial report, in order to give the public the correct idea of what the department stands for in its expenses. Our flat rates are 10 per cent lower than those charged by the old private company and the meter rates are about 40 per cent less than those charged by the private company formerly; yet, as I say, we show a profit after accounting for everything.

Degree of Purification of Sewage by Screens and Grit Tanks and Methods and Costs of Purifying Sewage to Higher Degree Than by Fine Screens.*

QUANTITY OF ORGANIC MATTER REMOVED BY SCREENS AND GRIT TANKS.

By passing the crude sewage through gratings or sieves, a quantity of floating and suspended organic matter is removed which varies with the size of the openings. In most cases such screens have been applied mainly to prevent injury or stoppage of pumping machinery, for which purpose a grating formed of bars spaced about 1 in. apart is generally sufficient. Latterly, however, it has been found very desirable to remove as much of the floating and suspended matter as practicable by means of much finer gratings or screens, since a large proportion of this matter is stable or slowly putrescible and tends to accumulate in the interstices of costly filters, whence it must be removed periodically at large expense. The modern process of purifying sewage may therefore be said to consist essentially of two distinct stages, the first being the removal of the suspended matter, while the second is the oxidation of the putrescible organic matter in solution.

In general it may be said that the suspended matter imparts to sewage its offensive appearance and causes the serious complaints about the pollution of natural water courses. The quantity of such matter contained in sewage varies widely in different places, and also at different seasons, days and hours in the same place. The variation in quantity and quality during 24 hours is well exhibited in the report of Messrs. Hazen and Whipple on the sewage of Paterson, N. J., made in 1906, which shows that at a number of different points in that city the dried suspended matter ranged from 45 to 641 parts by weight per million. Similarly, in the report on the purification of the sewage of Columbus, O., made in 1905 by George A. Johnson, C. E., it is shown from daily analyses extending over a period of ten months that the dried suspended matter ranged from 12 to 842 parts per million, with an average of 209 parts. Much of this suspended matter, however, is of mineral character, the average for Columbus being 130 parts of mineral to 79 parts of dried organic substance.

A large proportion of the mineral matter in sewage is so finely divided that it does not settle readily, and hence only the particles that are more than 0.01 in. in diameter are usually caught in detritus tanks. With respect to the quantity of grit collected in such tanks, comparatively few data are available. At Manchester, England, such deposit varies from 8 to 12 cu. ft. per million U. S. gallons. In Paris, France, it was at the rate of 14.3 cu. ft. in 1897, and nearly as much more was removed from the sewers directly. At two of the sewage pumping stations of Berlin, Germany, it was at the rate of 4.8 cu. ft. in 1900. At Wiesbaden the rate was 10.1 cu. ft. in 1902. At the Dorchester sewage pumping station in Boston, Mass., it was 8.4 cu. ft. during 1903, while at the experiment station of the Massachusetts Institute of Technology in the central part of Boston, it was 16.5 cu. ft. in 1906. The average of these figures is 10.7 cu. ft. per million gallons of sewage. This grit varies in weight from 95 to 117 lbs. per cu. ft. and contains more or less organic matter and water or moisture.

Taking the average weight at 107 lbs. per cu. ft., and assuming that the mass contains 27 per cent or 29 lbs. of moisture, according to some determinations, it will be found that the quantity of dried suspended matter thus caught in said grit tanks is about 835 lbs. per million gallons, or 100 parts by weight per million. This is more than one-third of the average quantity of dried suspended matter contained in the sewage of several American cities, according to the chemical analyses; and hence it follows that merely with detritus tanks properly designed and operated, a very appreciable degree of sewage purification can be effected.

The quantity of suspended matter that can be removed from sewage by screening has usually been regarded as insignificant, owing to the relatively large width of the spaces between the bars of the gratings ordinarily used. Thus, at the sewage pumping station at Providence, R. I., the matter collected on a grating whose bars are 1 in. apart was at the rate of 41 lbs. per million gallons in 1906; at the Dorchester sewage pumping station in Boston such rate was 300 lbs. in 1897, with a similar spacing; at the sewage pumping stations of the South Metropolitan systems, with the grating bars spaced 0.75 in. apart, the average rate during the four years 1905-1908 was 5.4 cu. ft. or about 324 lbs.; at the Northern Outfall works of the London sewers, it was 243 lbs. with a similar grating in 1897; at the various sewage pumping stations of the Berlin sewerage system, the rate in 1900 was 212 lbs. with bars spaced 0.6 in. apart; and at Charlottenburg it was about 200 lbs. in 1902. It should be noted that in some cases the figures were given in cubic feet instead of pounds, and that much depends on the extent to which the screenings are drained before being weighed.

In general it is found that with the usual coarse gratings at sewage pumping stations, the quantity of suspended matter arrested is from 3 to 10 cu. ft. per million gallons, and that such matter in its wet state ranges in weight from 20 to 65 lbs. per cu. ft. On being

*From Notes in Sewage Disposal, supplementing the Report on the Disposal of the Sewage of the City of Rochester, N. Y., made Feb. 1, 1907, by E. Kuichling, M. Am. Soc. C. E., Rochester, N. Y.

completely dried, it loses from 50 to 75 per cent of its weight, so that on the average it can be assumed that such coarse screenings removes about 104 lbs. of dried matter per million gallons, or about 12.5 parts by weight per million. Most of this matter is organic and more or less quickly putrescible in character; and in comparison with the total quantity of dried organic substance found in suspension in the sewage of American cities, it is still very appreciable in magnitude, particularly when its offensiveness is taken into consideration.

The trouble incidental to the handling of sewage sludge and the application of crude sewage to land, gravel and beds of broken stone, have gradually led to the endeavor to remove as much of the suspended matter as possible by mechanical means before proceeding with any further treatment. Attention has therefore been directed to the development of a satisfactory system of fine screening, whereby sewage purification will be facilitated and rendered less expensive. In 1898 experiments were made at Leeds, England, with zinc plates perforated with ⅛ in. holes, resulting in obtaining a rate of 36 cu. ft. of well-drained matter per million U. S. gallons during the day time. Its weight is not given, but from other observations it can be taken at 30 lbs. per cu. ft.

Similar results were obtained at Wiesbaden, Germany, during 1902, by passing the sewage of the entire city through a set of three screens having clear openings of respectively 0.60, 0.16 and 0.04 in. The matter thus collected amounted to 36.6 cu. ft. per million gallons on the average. In 1904 the screens were remodeled so as to pass the sewage successively through a set of four screens having openings of 1.60, 0.60, 0.10 and 0.06 in., from which 52.7 cu. ft. of matter per million gallons was obtained on the average. Experiments were also made by Riensch at Dresden in 1906 with a large revolving screen of sheet metal perforated with slots 0.08 in. wide, and it is stated that the collection therefrom has averaged 23.07 cu. ft. per million gallons during continuous service. This screen is a circular disk 15.1 ft. in diameter, which is inclined 15° from the horizontal so as to submerge about half of its surface.

A similar device was introduced in several English cities many years ago by Latham, the disk being about 9 ft. in diameter and set vertically. The triangular spaces between the cast iron spokes were closed with wire-cloth having meshes about 0.4 in. square, and the wheel was slowly rotated in an enlarged section of the outlet sewer. At Coventry the collection by such an apparatus was reported to be from 250 to 300 lbs. per million gallons. About twelve years ago another style of screen, formed of an endless belt of wire-cloth with meshes about 0.25 in. square, was invented and erected at a number of other English sewage works. In 1899 a device of this kind extracted suspended solids from the sewage of Sutton at the rate of about 1,200 lbs. per million gallons, and in 1904, a similar apparatus with meshes, 0.4 in. square extracted at Göttingen, Germany, matter at the rate of 336.6 lbs. or 14.7 cu. ft. per million gallons. From the last mentioned figures, the well-drained matter thus collected is found to weigh about 23 lbs. per cu. ft.

An interesting experiment was made in 1906 by City Engineer Mezger in a German town of 50,000 inhabitants (probably Bromberg) with a wire-cloth screen having meshes only 0.06 in. square. The whole of the sewage was passed through the apparatus, and the rates of collection were observed hourly, both when the screen was kept stationary and when it was moved like an endless belt in the outlet sewer. When kept stationary, the maximum collection in one hour was at the rate of 13,770 lbs. per million gallons; during four consecutive hours the rate was 9,514 lbs.; during 24 consecutive hours it was 5,007 lbs., and the minimum rate in one hour was 207 lbs. per million gallons. When the screen was moved through the sewage at velocities ranging from 0.5 to 2.0 ins. per second, the collection was about 14 per cent less during the four hours of greatest flow in dry weather. No determinations of the weight of the extracted matter per cubic foot were recorded, as it was found to vary considerably at different hours, and hence only the total weights per hour were given. If, however, it be assumed that the weight of said matter was 23 lbs. per cu. ft., as found at Göttingen, then the average quantity during 24 hours would be at the rate of 217.7 cu. ft., or about 8 cu. yds. per million gallons.

Other highly instructive observations on the quantity of suspended matter in town sewage that can readily be extracted by fine screens, have been made during the past two years at the sewage works of Reading, Pa. The crude sewage is here mostly domestic in character, and contains little admixture of trade wastes and no street washings, as the latter pass through a separate system of drains into the river without any treatment. The screen is a revolving horizontal cylindrical frame, 16 ft. long and 6 ft. in diameter, covered with brass wire-cloth having meshes about 1-40 in. square which is considerably finer than has heretofore been employed for the purpose. The quantity of solid matter thus collected is reported in *Engineering Record* of Dec. 26, 1908, as being 18.8 cu. ft. per million gallons on the average, but its weight and percentage of contained moisture is not given. On a visit to the plant last year, the writer was informed that the weight of the screenings, after partial drying in a centrifugal separator, was 1,500 lbs. per million gallons. This would make the condensed mass weigh 80 lbs. per cubic foot, of which probably 50 per cent is moisture. If these figures are correct, the screen actually removed 750 lbs. of fully dried matter per million gallons of sewage, or 90 parts per million by weight out of a total of 215 parts per million of suspended matter contained in the sewage on the average.

A similar reduction to parts of dried substance per million may now be applied to the figures relating to Coventry, Sutton, Göttingen and Bromberg, given above in paragraphs. Assuming that the well-drained screenings contain 75 per cent of moisture, the quantity of fully dried matter extracted per million gallons of sewage will be as follows: At Coventry 62.5 to 75 lbs.; at Sutton, 300 lbs.; at Göttingen, 84.2 lbs. and at Bromberg, 1,251.8 lbs. In parts per million by weight these figures correspond respectively to 7.5, 9.0, 36.0, 10.1 and 149.9, while at Reading it was estimated at 90.0. For the observations with fine screens at Leeds, Wiesbaden and Dresden, a similar reduction to parts per million by weight, on the assumption that the wet screenings weigh 30 lbs. per cu. ft. and contain 75 per cent of moistures, gives respectively 270.0, 274.5, 395.2 and 177.8.

During the elaborate investigation of the sewage of Columbus, O., in 1904-5, the liquid examined was passed through a screen having meshes 0.5 in. square, placed in the main outlet sewer parallel with the line of flow to facilitate its cleaning. The report states that this screen "never became clogged sufficiently to require attention. Considerable coarse material which passed through this screen was caught by the screens in the screen-chamber, necessitating the cleaning of these screens from five to six times each day. About 300 lbs. or 0.17 cu. yd. of wet screenings were thus removed on an average per million gallons of sewage." These screens are described as being two in number, set vertically near the outlet end of the chamber, and formed of "diamond mesh wire-cloth woven with No. 12 wire. The first screen had a clear opening of 0.5 in., and the second of 0.375 in." From these data, the wet screenings amounted to 4.6 cu. ft. per million gallons, and weighed 65.4 lbs. per cu. ft.

Their content of moisture is not given, but assuming the same at 75 per cent, the screenings will represent the removal of 9.0 parts per million of fully dried matter, mostly organic and offensive in character. It must also be remembered that these figures relate to the remainder left after preliminary screening, and do not indicate the proportion that would be removed if the entire volume of sewage had passed through a screen with meshes ⅜-in. square.

It is also of interest to ascertain the nature of the solid matter in crude sewage that is arrested on screens having different sizes of mesh. The most careful analysis of this kind was made by Dr. Monti in 1901 with the sewage of two densely populated districts of Berlin (Radial Systems V and VII), using the liquid that had passed through the detritus tanks and gratings at the two sewage pumping stations. The bars of these gratings were spaced 0.6 in. apart, but the quantity of matter removed thereby during his investigation was not determined. The municipal reports for 1900 give the aggregate amount removed during the year by the gratings at all of the thirteen stations, together with the pumpage, and from these figures an average of 10.62 cu. ft. of wet screenings per million gallons is deduced. This matter weighed 20 lbs. per cu. ft. and contained 56 per cent of moisture on the average. By reducing to fully dried substance, the proportions are 93.5 lbs. per million gallons, or 11.2 parts by weight per million. It can also be presumed that these figures would be at least doubled for the most populous districts.

As already stated, Monti dealt only with the screened and partly settled sewage. After mixing together samples taken at different depths in the pump well, he caused the liquid to pass through series of five wire-cloth sieves having meshes respectively 7, 4, 2, 1 and 0.5 millimetre wide (or approximately 0.28, 0.16, 0.08, 0.04 and 0.02 in. square), and also determined the total suspended matter by filtration. He found that on the average his series of sieves extracted only 13.3 per cent of the total dry suspended matter at the first pumping station, and 14.0 per cent at the second, the proportions previously removed by detritus tank and grating not being considered. As to the character of the material caught on his sieves the following brief notes are submitted:

The 7 mm. sieve (0.28-in.) caught mainly fecal matter, and large fragments of paper, cloth, vegetables, leaves, wood, etc.

The 4 and 2 mm. sieves (0.16 and 0.08-in.) caught mainly smaller fragments of vegetables leaves, bits of wood, large seeds, etc., or kitchen wastes.

The 1 mm. sieve (0.04-in.) caught mostly pulp-like matter which increased in volume on drying, and consisted of vegetable debris, cotton, linen and wool fibers, hair and muscular tissue.

The 0.5 mm. sieve (0.02-in.) caught matter of the same character as the 1 mm. sieve, but of finer grain.

On drying and weighing the suspended matter caught by the sieves and the filter at the two pumping stations, Monti obtained the following results expressed in parts by weight per million:

At Station V, caught on the 5 sieves	97
At Station V, remaining on the filter	633
At Station V, total suspended matter	730
At Station VII, caught on the 5 sieves	35
At Station VII, remaining on the filter	215
At Station VII, total suspended matter	250

also the following average and maximum proportions of dried, suspended matter caught by each sieve, expressed in percentages of the total thus caught at the two stations, together with the percentages of moisture in the several screenings:

Size of Sieve	7 mm	4 mm.	2 mm	1 mm.	0.5 mm
Av. both stations	43.6	4.0	1.1	9.0	32.0
Max. both stations	68.0	7.0	1.7	14.0	51.0
Per cent moisture	75-78	75-80	75-80	85-90	90-95

These data indicate that most of the suspended matter in sewage is usually in a very fine state of division or capable of passing through a sieve having meshes 0.02 in. square; that most of the solid fecal matter found in the liquid can be arrested on a sieve having meshes 0.25 in. square; and that a sieve with meshes 0.10 in. square is probably fine enough to extract from the sewage all suspended matter of appreciable magnitude, and especially such as is likely to become offensive under the conditions herein proposed for the disposal of the sewage of Rochester. It should also be noted that the method of determining the total quantity of suspended matter by filtration, as adopted by Dr. Monti, often leads to including much gelatinous or

colloidal substance which may add considerably to the weight on being dried, and thus tends to reduce the percentage of solid material removed by fine screens. Another significant feature is the apparent slow putrescibility of the pulpy matter caught by the two finest screens.

Many experiments have found that on transplanting small fragments of solid organic matter from sewage to a culture medium, a great multitude of bacteria is always carried along. This indicates that these micro-organisms tend to adhere to the suspended matter, and hence that a very appreciable reduction in the number of bacteria in the sewage must result from screening through a sieve having meshes 0.10 in. square.

The data given in the foregoing paragraphs relating to the efficiency of fine screens were obtained only after searching a wide range of scientific literature, as few plants of this character have yet been installed and their performance adequately studied. It is believed, however, that ample evidence has been submitted to show that a surprisingly large quantity of offensive organic matter can be extracted from sewage by properly designed screening appliances, and that the screened liquid may then be admitted safely for final disposal into bodies of water which would soon become repulsive without such screenings. It is also obvious that the cost of this operation is much less than that of sedimentation in large tanks, with the attendant difficulties of getting rid of the resulting sludge and no commensurate improvement in the general character of the effluent.

METHODS AND COSTS OF PURIFYING SEWAGE TO HIGHER DEGREE THAN BY FINE SCREENS.

From the hasty reading of recent text books, papers and discussions on the subject of sewage disposal, the majority of inexperienced readers seem to have imbibed the notion that sewage can be purified artificially and inexpensively to so high degree as to make the effluent safe for drinking. This notion is entirely erroneous, as such work has never been accomplished anywhere on a large scale. By comparatively slow filtration through permeable soil an approximation to drinking water can be attained, but it is safe to say that a proposition to supply a community with water for domestic use taken from the underdrains of a sewage filter or sewage farm, would unhesitatingly be rejected by every sanitarian. Such a supply would be comparable with the water from wells or springs in large cemeteries, which may be clear, but yet contain in solution relatively large quantities of obscure products of decomposition of organic matter, in addition to many bacteria and other micro-organisms.

To accomplish the complete purification of sewage by natural means, much time and space is needed, both above and below the surface of the ground or water. When artificial means are adopted, the attendant expense has hitherto been so great as to render it necessary to be content with a partial purification, much inferior to that attained by the comparatively slow percolation through many feet of sandy soil. Thus at Worcester, Mass., where about two million gallons per day of sewage are filtered through 18 acres of carefully prepared beds of sand, while the remaining ten million gallons per day are treated chemically, in sedimentation tanks, the average percentage of organic matter removed by filtration in 1905 and measured by the amount of oxygen required to complete the process of oxidation, was 87.9, while by the chemical treatment it was 45.4; and at Columbus, O., where about 12,000,000 gals. per day of sewage on the average are applied to broken stone sprinkling filter beds after long preliminary sedimentation in large tanks, such percentage was 67.3 during 1909. These sewage purification works represent the best practice on a large scale to be found in the United States, and there is no pretence whatever that the effluents are fit for drinking.

At Worcester, the crude sewage is applied to the coarse sand filter beds at the average rate of 91,000 gals. per day per acre, but in many other places where the sand is finer, it is necessary to adopt considerably lower rates. During the six years 1900-1905 inclusive, the average yearly cost of operating these filters has been from $6.79 to $13.12, with a mean of about $8.50 per million gallons of liquid filtered. This operating expense does not include the interest and taxes on the cost of the land and construction of the beds, which cost amounted in 1905 to $176,240, or at the rate of $4,900 per acre for a total of 36 acres. Taking such interest and taxes at 5 per cent, and the total quantity of both crude sewage and chemical treatment effluent filtered during 1905 at 1,029,000,000 gals., it will be found that to the aforesaid operating expense a fixed charge of $8.56 per million gallons must be added, thus making the total average cost rate for sewage filtration about $17 per million gallons. The cost of the chemical precipitation of sewage and disposal of the resulting sludge at Worcester was $11.89 per million gallons in 1905, and at Providence, R. I., it was $6.60 in 1906. These two works are the largest of their kind in the United States, and the said costs represent only the operating expenses, exclusive of interest, depreciation and taxes. It should also be noted that at Providence the effluent is discharged into the large body of tidal water called Providence Bay, which requires a much lower degree of purification for the sewage than is needed at Worcester.

The next method of treatment to be considered, is the application of thoroughly sedimented sewage, in the form of spray, to extensive beds of broken stone like macadam, as done at the recently completed sewage works of Columbus, O. This plant is now the largest of its kind in the world, and represents the most advanced scientific mode of partially purifying town sewage. The settled liquid is applied at the rate of 2,000,000 gals. per acre per day, and the cost of the Columbus beds, with the necessary gate house and piping for supply and under-drainage, was about $15,000 per acre for the ten acres now provided. Including the large sedimentation tanks and the land, but not taking into account the long levee for excluding flood water from the adjacent river, and the two small settling basins for the effluent from the sprinkling filters, the total cost of the plant was about $493,100.

As this plant is adapted to deal with a maximum of 20,000,000 gals. of sewage per day, the total cost for construction is therefore at the rate of $24,655 per million gallons per day; and if the fixed charge for interest, depreciation and taxes is taken at 6 per cent, the same will amount to $4.05 per million gallons treated. For the operating expense, no data are yet available, but it probably does not exceed $2 per million gallons, as the sludge from the sedimentation tanks is now simply discharged in its crude state into the Scioto River whenever the water is somewhat higher than normal. If the sludge were to be rendered portable and made available for use on land by means of filter presses, as at Worcester and Providence, the operating expense would be increased about $3, thus making a total cost of at least $9 per million gallons treated.

Reference was made in some of the foregoing paragraphs to the sludge resulting from the sedimentation and chemical precipitation of the suspended matter in sewage. As already stated, all the heavy particles and solids larger than 0.10 in. in diameter are removed by the grit-chambers and screens, and the remaining matter settles slowly in small flakes which do not consolidate. The lower part of the tank is thus gradually filled with such light flakes and coarser particles, whereupon the somewhat clarified liquid above is drawn off, and the watery sediment is removed for further treatment. This semi-liquid mass is called sludge, and from 90 to 95 per cent of its weight is water. It forms in the tanks at various rates depending on the character of the sewage, but in general it may be assumed that from 4 to 6 cu. yds. will be produced per million gallons of American city sewage by plain sedimentation. This was the average rate observed at Columbus, O., during the elaborate experiments of 1904-5. It may also be added that by the use of chemical precipitants the rate is often doubled.

The watery sludge as it comes from the tanks is more or less offensive in odor, and cannot be readily transported or stored. It accumulates so fast in large plants that the utmost ingenuity has been exerted to get rid of it promptly. By means of filter presses or centrifugal separators, the solid matter in the liquid is now usually condensed into a clay-like mass, in which form it can be transported in wagons and used either as a top dressing for cultivated fields, or for filling low places in lands adjoining the plant. After a time, however, the demand for it for such purposes may become exhausted, and the material must then be stored on the nearest available land. There are many sewage works at home and abroad where these accumulations have attained a formidable magnitude, and develop at times highly offensive odors. The sludge thus becomes the most troublesome concomitant of sewage purification processes, and its disposal is often a very serious financial burden.

DISINFECTION OR STERILIZATION OF SEWAGE.

Sewage contains many bacteria and other micro-organisms, but they are usually not such as will produce disease in human beings in consequence of drinking sewage-polluted water. When it contains those micro-organisms which cause disease, it is said to be infected, and the process by which such pathogenic organisms are killed is called disinfection. Many kinds of harmless bacteria and germs are much hardier than the pathogenic ones and survive treatments that destroy the latter, so that sewage may be thoroughly disinfected and still contain a large number of harmless organisms. If the treatment of the liquid is such as to kill all the living organisms contained therein, it is said to be sterilized. There is accordingly a marked distinction between disinfection and sterilization.

When sewage is filtered slowly through fine sand the effluent is never entirely sterile, and may even be infected, although most of the micro-organisms have been removed and the water is clear and sparkling; but when the liquid is only partly purified, as is the case in all the modern processes which have been found feasible without prohibitory cost, the number of bacteria in the final effluent is always large and sometimes is nearly as great as that in the crude sewage. It is therefore an illusion to regard these modern scientific methods of sewage treatment as being capable of producing sterile effluents in actual practice, or even effluents which are free from pathogenic germs. Many studies have accordingly been made to ascertain how such effluents might be either disinfected or rendered sterile at reasonable expense.

The first extensive investigation of the subject seems to have been instituted by the Imperial Board of Health of Germany soon after the outbreak of cholera in Hamburg, and resulted in the recommendation that hypochlorite of lime should be applied to the effluent or sewage, during the prevalence of infectious diseases in a municipality, in sufficient quantity to destroy all bacteria. Subsequently this was found to be impracticable, as the chemical mentioned could not sterilize the liquid completely, but destroyed only those classes of bacteria which are associated with cholera, typhoid fever and certain other infectious diseases. It was also found that if the process were restricted to this end merely, the quantity of chemical to be applied might be greatly reduced, thereby rendering the work feasible from a financial point of view. As the subject now stands, efforts are being made by sanitarians to secure the disinfection of sewage effluents and not their sterilization, or even the removal of all objectionable organic matter.

The present attitude of the most advanced students of the sewage problem has been set forth very clearly by Prof. E. B. Phelps, of the Massachusetts Institute of Technology, in a publication of the U. S. Geological Survey entitled "The Disinfection of Sewage and Sewage Filter Effluents." (Abstracted in ENGINEERING-CONTRACTING for Aug. 11, 1909.)

The writer has made a number of inquiries concerning cost among those who are inter-

ested financially in applying ozone to sewage effluents, and the lowest estimate made was a rate of $10 per million gallons of roughly sedimented sewage for operating expense alone, regardless of interest and depreciation on the cost of the plant. It was also conceded that this price was based only on laboratory experiments conducted on a very small scale, and not on experience with large quantities of real sewage. Assuming that such treatment and price were applied to the estimated average prospective flow of 65,000,000 gallons of sewage and storm water per day at Rochester, the annual operating expense would amount to $237,250, which represents the interest at 5 per cent on a principal of $4,745,000.

In using chlorine for disinfecting water and sewage, the least expensive and most recent method is to employ chloride of lime or bleaching powder, which is composed largely of calcium hypochlorite. This material contains from 35 to 40 per cent of available chlorine and costs at wholesale about $25 per ton. It has long been recognized as a powerful disinfectant and deodorizer, and was used more than fifty years ago to treat the sewage of London before discharging it into the Thames. Subsequently its use as a sewage disinfectant was investigated extensively by the Sanitary authorities of Germany. In the experiments at Hamburg with a chemically clarified sewage effluent, satisfactory disinfection was obtained in ten minutes with from 3 to 4 parts per million of available chlorine, whereas the crude sewage required 25 parts and an exposure of two hours. At the aforesaid price and the latter rate of application, the cost per million gallons of sewage for the bleaching powder alone would be $7.83; and if the labor and apparatus is also considered, the cost would probably exceed $10 per million gallons.

In the experiments at Berlin, the disinfection was directed to destroying the colon bacilli found in the crude sewage. These organisms are regarded as being somewhat hardier and much more numerous than the pathogenic bacteria, whence the inference that the killing of the former is reasonably certain to accomplish the death of the latter. By using bleaching powder for the purpose in various proportions, it was found that with 50 parts of available chlorine per million and two hours' exposure, the colon bacilli were presumably killed in 9 out of 20 samples, while with 150 parts and the same exposure, they were presumably killed in 15 out of 19 samples. These figures indicate some of the uncertainties attending practical disinfection. It may also be noted that in these two series of experiments, the quantity of bleaching powder used was from 2 to 6 times greater than in the case cited near the end of the preceding paragraph.

Numerous other experiments of similar character have lately been made both in our own country and abroad, but to save time and space only those conducted by Prof. Phelps in 1908 will be mentioned. On applying bleaching powder to crude sewage at Boston, Mass., at rates of 2 to 10 parts of available chlorine per million, he found that the total number of bacteria was greatly reduced after an exposure of one hour, but complete sterilization could not be effected; and if the time was prolonged to two hours the number of bacteria increased considerably. With septic tank effluent at Red Bank, N. J., he found it necessary to use 10 to 13 parts of available chlorine per million in order to obtain a liquid containing less than 100 B. coli per cubic centimeter after exposure for 45 minutes. With the effluent from an experimental sprinkling filter at Baltimore, Md., similar results were obtained with from 2 to 3 parts of available chlorine per million after exposure for two hours.

The Western Maryland Ry. is planning for extensive improvements at the water front terminal in Baltimore, Md. The work will include the enlargement of concrete warehouse at a cost of $100,000, enlargement of fireproof piers at a cost of $50,000, and the erection of a 5-story concrete fireproof building at a cost of $100,000.

Railway Section

Note: This section is devoted to methods and costs of constructing railways. It will cover road-bed and track construction, contractor's plant and organization, surveying methods and permanent way structures.

Cost of Operating the Long Island Electric Railway.

The Long Island Electric Ry. Co. was incorporated in 1894, and in 1899 it was merged into the New York and North Shore Ry. Co., which had been incorporated in 1897. The stock is now controlled jointly by the Interborough Rapid Transit Co. and the Long Island Consolidated Electric Co.

The track mileage is as follows:

	Miles.
Road, first track	17.34
Second track	7.90
Total trackway owned	25.24
Sidings, storage track, etc., owned	1.30
Total track owned	26.54
Trackage rights, 1st and 2d track	1.00

From Belmont Park to Brooklyn there are 8.28 miles of road, double track most of the way, laid with 7-in. girder rails. From Jamaica to Far Rockaway there are 9.06 miles of single track on 6-in. girder rails.

On 14.2 miles of the road, span wire construction for the overhead trolley is used; side bracket construction is used for 3.14 miles. All poles are wooden, 52 per mile.

On June 30, 1908, the rolling stock was as follows:

5 closed motor cars, 15 tons (maximum), 40 ft. long, at $3,000.
20 open motor cars, 12 tons, 40 ft. long, at $2,000.
1 open non-motor car.
5 combination motor cars.
6 semi-convertible motor cars, 12 tons, 35 ft. long, at $3,000.

37 Total passenger cars.
3 sweeper cars (motor), at $2,000 each.
1 work car (motor).
1 work car (non-motor).
1 wrecking car (motor).

The average car seated 42 passengers.

The electric power was purchased, so the station equipment consisted only of 2 transformers of 1,100 KW. total capacity, and 2 rotaries of 1,000 KW. capacity. The cost of the two rotary converters was $35,000 in 1907.

The following are the traffic statistics for the year ending June 30, 1908:

Mean number of passenger cars in use	37
Passenger car miles	963,192
Same per mile of all track	36,292
Same per passenger car in use	26,032
Freight, mail and express car miles	20,160
Passenger car hours	91,625
Passenger car miles per car hour (speed)	10.51
Passengers at 5 cts.	3,670,888
Passengers per car mile	3.82

The employees and their wages for the year were:

General Office Staff:
2 General officers.
3 Other officers.
10 Employes.

15 Total General Office $7,044

Transportation:
3 Inspectors.
2 Train clerks and dispatchers.
1 Superintendent.
27 Conductors, at 20 cts. per hr.
27 Motormen, at 20 cts. per hr.
1 Switchman.
19 Road and trackmen.

80 Total Transportation $52,872

Power:
2 Dynamo and switchboard men.
2 Linemen.

4 Total Power $3,935

Car House and Shops:
2 Car cleaners.
1 Heater tender.
3 Car house repairers.
1 Cabinet maker.
1 Machinist.
1 Electrical helper.
3 Other employes.

11 Total Car House and Shops $9,681

113 Grand total $74,532

The operating expenses for the year ending June 30, 1908, were as follows:

Maintenance of Way and Structures:	
1. Track and roadway	$12,537
2. Electric line	4,427
3. Buildings and fixtures	320
Total Maintenance of Way	$17,284
Maintenance of Equipment:	
4. Electric plant	$ 33
5. Cars	6,738
6. Electric equip. of cars	7,383
7. Miscel. equip.	55
8. Shop expenses	2,399
Total Maintenance of Equipment	$16,608
Operation of Power Plant:	
9. Wages	$ 1,765
10. Lubricants and waste	31
11. Miscel. supplies and expenses	37
12. Hired power	32,656
Total Operation of Power Plant	$34,489
Operation of Cars:	
13. Superintendence of transp.	$ 900
14. Wages of conductors	18,219
15. Wages of motormen	18,228
16. Wages of miscel. car service men	4,091
17. Wages of car house employes	869
18. Car service supplies	1,016
19. Miscel. car service expense	6,972
20. Hired equipment	1,098
21. Cleaning and sanding track	706
22. Removal of snow and ice	1,076
Total Operation of Cars	$53,175
General Expenses:	
23. Salaries of general officers	$ 2,960
24. Salaries of clerks	900
25. Printing and stationery	386
26. Miscel. office expense	283
27. Stores expenses	252
28. Stable expenses	245
29. Advertising	40
30. Miscel. general expenses	1,127
31. Damages	6,855
32. Legal expense due to damages	1,858
33. Miscel. legal expense	1,718
34. Rent of land and buildings	190
35. Rent of tracks and terminals	4,100
36. Insurance	1,603
Total General Expenses	$ 22,516
Grand Total Operating Expense	144,041
Taxes assessed	12,485

Since there were 963,192 car miles, the operating expenses were as follows per car mile, summarized:

	Cents per car mile.
Maintenance of way and structures	1.794
Maintenance of equipment	1.724
Operation of power plant	3.581
Operation of cars	5.521
General expenses	2.337
Total operating expense	14.957
Taxes assessed	1.295

The maintenance of track and roadway (Item 1) cost $500 per mile of trackway (25.24 miles), as compared with $560 for the preceding year.

The maintenance of electric line (Item 2) cost $175 per mile of trackway, as compared with $160 for the preceding year. The maintenance of cars and their electric equipment (Items 5 and 6) cost $381 per passenger car, but shop expense (Item 8) amounted to $64 additional expense per car. The average first cost of the cars appears to have been about $2,500 each. Hence the maintenance expense was nearly 18 per cent of the first cost.

The cost of maintaining these same 37 passenger cars during the preceding year (1907) was even greater, being:

Maintenance of cars	$ 7,781
Maintenance of elec. equip. of cars	13,179
Miscel. shop expenses	2,722
Total	$23,682

This is equivalent to $640 per car, and indicates that the cars were in a very run down condition.

There were 3,087,058 KW. hrs. purchased (Item 12) at 1.06 cts per KW. hr. It required 3.20 KW. hrs. per car mile.

Cost of Operating All the Surface Electric Railways in Greater New York City.

In our issue of June 8 we gave the average cost of operating the 75 electric railways in the Second District of New York State, which includes all lines not in Greater New York City. The following data have been compiled from the report of the N. Y. Public Service Commission for the First District for the year 1908. We have excluded the operating statistics of all the elevated and subway lines (Interborough Rapid Transit, Hudson and Manhattan, Brooklyn Union Elevated R. R. Co.), so that the following statistics relate only to the surface lines.

For the operating costs the elevated and subway roads, see our issues of Apr. 13 and 20.

In our issue of May 4 we gave the operating costs of the lines of the New York City Ry. Co., which form a large part (43%) of the following costs. The reader will do well to refer to our issue of May 4 for our critical comments on the operating costs of the New York City Ry. Co. Among other things, we called attention to the exceedingly high costs of equipment and track maintenance, due to the run down condition of the plant. These unusually high expenses obviously affect the averages for the entire First District.

The total mileage under consideration is as follows:

	Miles.
First track, or roadbed	631.16
Second track	521.39
Third and fourth track	2.10
Total trackway	1,254.65
Sidings, turnouts, storage, etc.	88.23
Total track	1,243.18

The Staten Island Ry. and the Staten Island Rapid Transit Co. mileage is not included, for they are operated by steam locomotives.

The equipment was as follows:

Revenue Cars:	
Closed cars, motor	2,311
Closed cars, non-motor	1,404
Open cars, motor	2,686
Open cars, non-motor	36
Combination cars, motor	459
Semi-convertible, motor	685
Parlor cars, motor	5
Mail and express, motor	20
Mail and express, non-motor	19
Freight, motor	107
Freight, non-motor	45
Total revenue cars	7,786
Service Cars:	
Snow plows, motor	36
Snow plows, non-motor	26
Sweepers, motor	126
Sweepers, non-motor	68
Work cars, motor	80
Work cars, non-motor	30
Wrecking cars, motor	28
Other service cars, motor	171
Other service cars, non-motor	15
Total service cars	580
Grand total	8,366

The total number of passenger car miles for the year was 136,087,615, which is equivalent to 117,820 car miles per mile of trackway, or 17,940 car miles per passenger car. Some of the roads did not report the number of car hours, so that the average schedule speed can not be given.

There were 5,417 passenger fares collected per car mile, and practically all were 5 cent fares. The total operating revenue per car mile was 27,005 cents, and the operating expenses per car mile were as follows for the surface electric railways only:

	Costs per car mile.
Maintenance of Way and Structures:	
1. Track and roadway	$ 1.227
2. Electric line	0.445
3. Buildings and fixtures	0.189
Total maintenance of way	$ 1.861
Maintenance of Equipment:	
4. Steam plant	$ 0.108
5. Electric plant	0.051
6. Cars	1.430
7. Electric equipment of cars	1.419
8. Miscellaneous equipment	0.098
9. Shop expense	0.245
10. Renewal of horses, harness, etc.	0.141
Total maintenance of equipment	$ 3.492
Operation of Power Plant:	
11. Wages	$ 0.309
12. Fuel	0.851
13. Water	0.082
14. Lubricants	0.026
15. Miscellaneous supplies	0.034
16. Hired power	0.886
17. Provender and stable	0.323
Total operation of power plant	$ 2.502
Operation of Cars:	
18. Superintendent of transportation	$ 0.380
19. Wages of conductors	2.935
20. Wages of motormen	3.106
21. Wages of miscel. car service men	0.505
22. Wages of car house men	0.416
23. Car service supplies	0.101
24. Miscellaneous car service expense	0.240
25. Hired equipment	0.522
26. Cleaning and sanding track	0.153
27. Removal of snow and ice	0.097
Total operation of cars	$ 8.455
General Expense:	
28. Salaries of general officers	$ 0.167
29. Salaries of clerks	0.233
30. Printing and stationery	0.052
31. Miscellaneous office expense	0.052
32. Stores expense	0.085
33. Stable expense	0.096
34. Advertising and attractions	0.006
35. Miscellaneous general expense	0.109
36. Damages	1.784
37. Legal expense incident to damages	0.530
38. Miscellaneous legal expense	0.148
39. Rent of land and buildings	0.091
40. Rent of track and terminals	0.097
41. Insurance	0.229
42. Undistributed	0.006
Total general expense	$ 3.685
Grand total	19.995

No total is given for the taxes assessed for the year, but the taxes assessed against the New York City Ry. Co. amounted to 2.384 cts. per car mile.

Maintenance of way and structures (Items 1, 2 and 3) amounted to the following per mile of trackway (1,155 miles):

	Per Mile.
1. Track and roadway	$1,446
2. Electric line	524
3. Building and fixtures	223
Total	$2,193

This is an abnormally high cost, even considering the fact that there were 117,820 car miles per mile of track.

The maintenance of the 7,586 passenger cars was as follows per car:

	Per car.
6. Cars (bodies and trucks)	$257
7. Electric equipment of cars	254
9. Shop expenses, prorated	41
Total	$552

Since 36 per cent of the cars were open cars, used only in summer this maintenance cost per car is below what it would be if all cars were in constant use, assuming that the $552 per car is fair annual average. It is, however, considerable above a fair average, due to the previous run down condition of much of the equipment. Unfortunately, neither the average weight of the cars, nor a statement, as their first cost is given, so that accurate deductions from the maintenance data are impossible.

Items 4 and 5 give no definite information, for item 16 shows that a large percentage of the electric power was purchased.

Item 10, renewal of horses, exists because about 5% of the total surface car mileage in New York City is still horse-car mileage. There were 2,579 horses in use, most of them on the New York City Ry. Co. lines.

Items 36 and 37, damages, are enormous, being more than double the amount per car mile on the electric railways of the Second District of New York.

The operating ratio is 19.995÷27.005=74%.

Table I gives a summary of the operating expenses for the different sections of the First District, both for surface and for subway and elevated lines.

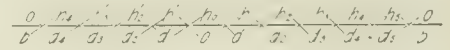
The abnormal character of the surface line maintenance expenses for 1908 is well shown by the following car mile costs for the Manhattan surface lines during 1907 and 1908.

	1907.	1908.
Maintenance of way, etc.	$ 1.63	$ 2.43
Maintenance of equipment	2.81	4.77
Operation of power plant	1.42	2.24
Operation of cars	8.71	9.21
General expenses	5.11	4.20
Total	$19.68	$22.85

LETTERS TO EDITORS.

A Simplification of the "Criss-Cross Method" for Computing Cross-Section Areas.

Sirs: While calculating a large number of irregular cross-section areas by the "criss-cross method," I found the following a much easier and shorter way. Given the cross-section notes:



By the ordinary criss-cross method, 18 multiplications are necessary to calculate the area, viz.:

Area = ½ [h'$_4$b + h'$_3$d'$_4$ + h'$_2$d'$_3$ + h'$_1$d'$_2$ + h$_0$d'$_1$ + h$_0$d$_1$ + h$_1$d$_2$ + h$_2$d$_3$ + h$_3$d$_4$ + h$_4$d$_5$ + h$_5$b—(h'$_4$d'$_3$ + h'$_3$d'$_2$ + h'$_2$d'$_1$ + h$_2$d$_1$ + h$_3$d$_2$ + h$_4$d$_3$ + h$_5$d$_4$)].

Adding the products we have:

Area = ½ [h'$_4$ (b—d'$_3$) + h'$_3$ (d'$_4$—d'$_2$) + h'$_2$ (d'$_3$ -d'$_1$) + h'$_1$d'$_2$ + h$_0$ (d'$_1$+d$_1$) + h$_1$d$_2$ + h$_2$ (d$_3$-d$_1$) + h$_3$ (d$_4$—d$_2$) + h$_4$ (d$_5$—d$_3$) + h$_5$ (b—d$_4$)].

In words: To obtain the area of an irregular cross-section:

(1.) Multiply the cut (or fill) at the slope stakes by one-half of the width of the roadbed minus the distance of the adjoining cut (or fill).

(2.) Multiply each intermediate cut (or fill) by the difference of the distances of the adjoining cuts (or fills).

(3.) Multiply the center cut (or fill) by the sum of the distances of the adjoining cuts (or fills).

(4.) Add the products and divide by two.

As will be seen, there are only as many multiplications necessary as there are cuts (or fills) given in the notes. Care has to be taken in using the alegbraic signs. In the above example if b(=½ roadbed) is greater than d'$_3$ or d$_4$, the products are +; if smaller, —. A little practice will show the great advantage of this simplification.

I saw this short method in none of the engineering handbooks nor in other publications, and found it very little known among engineers. I therefore believe that it would be for the benefit of many of your readers if you would publish it in your paper.

Yours respectfully,

O. C. KULICKA.

Pauls Valley, Okla., June 8, 1910.

TABLE I.—EXPENSES OF OPERATION PER REVENUE CAR MILE OPERATED (IN CENTS).

Company.	Total.	Maintenance of way and structures.	Maintenance of equipment.	Operation of power plant.	Operation of cars.	General.
Hudson & Manhattan R. R. Co.	37.120	6.023	3.067	12.569	10.590	4.871
Interborough Rapid Transit Co.:						
Subway division	10.051	1.234	2.143	2.398	3.444	.832
Elevated division	9.739	1.224	1.323	1.720	4.219	1.253
Brooklyn Rapid Transit:						
Elevated division	16.067	1.144	1.630	5.695	6.467	1.131
Surface	17.713	1.574	2.686	1.813	8.356	3.284
Other Brooklyn roads	18.565	.608	2.025	5.777	6.826	3.329
Manhattan surface	22.847	2.431	4.775	2.236	9.808	4.197
Bronx surface	15.754	.872	2.251	3.094	6.718	2.818
Queens surface	17.618	1.393	2.002	3.725	5.852	4.646
Richmond electric roads	17.010	2.613	2.335	3.340	6.522	2.200
Richmond steam roads	22.656	5.190	3.827	.....	*12.827	.322
Total						
Recapitulation.						
Total, underground and elevated	15.309	1.585	2.579	2.614	6.457	2.374
Total, surface street railways						
Total, steam railroads	11.299	1.231	1.649	2.828	4.480	1.111
	19.903	1.864	3.525	2.456	8.350	3.708
	22.656	5.190	3.827	.....	*12.827	.322

*Including wages of enginemen and operating and fuel costs of locomotives.

Queries as to Practice in Cost Plus a Fixed Sum Contracts.

Sirs: Will you kindly answer the following question? Under a contract where the contractor is furnishing the hand tools and being paid a commission on the cost of the work should the contractor pay a blacksmith to sharpen and maintain such tools? What is the general custom on percentage work? In this case the only clause that bears on the matter reads as follows:

That he will at his own expense, furnish all ordinary hand tools and implements, such as shovels, wheelbarrows, picks, crowbars, drills, hammers, and all other tools of similar nature, necessary or proper for the performance of the work herein provided for.

By giving your opinion on this matter you will do me a great favor.

Very truly,
A. A. W.

Hilo, Hawaii, April 29, 1910.

Sirs: Will you kindly advise the writer concerning contracts where a contractor agrees that the cost of a certain piece of work would be say $10,000 and agreed to do the work for the amount plus a bonus of $500; the contractor to receive an additional bonus of 15 per cent on any amount that he may save under the price named—$10,000—and if the cost exceeded the price named, then 15 per cent of the amount over and above the $10,000 is to be deducted from his bonus.

Under such a contract is it customary and proper for the contractor to include in his items of cost ($10,000) board for his men, building of a bunk house, equipping same, grub for men, cook, hiring of plant, cost of tools, railroad fares, traveling expenses, such as tips, hotel bills, etc.?

We ask these questions, with a view of learning the exact status and customs among contractors who work on these lines.

Very truly yours,
C. H. E.

Philadelphia, Pa., May 21, 1910.

(The editors would like to have answers from the readers of ENGINEERING-CONTRACTING to these questions.—Editors.)

The Standard Bag of Cement.

Sirs: I note in a recent issue of your Engineering-Contracting that the subject of the Standard Bag of Cement has been up for consideration and it has been suggested either that the present standard bag of cement of ninety-four pounds be adopted, or that some new standard, such as one hundred pounds should be adopted and that it be called a cubic foot.

In discussing this matter, it seems to me that some reference should have been made to the action of the Organization of City Officials for Standardizing Paving Specifications. This Organization recommended the use of the present bag, weighing ninety-four pounds, as the standard unit for cement measurement and based all of their specifications in regard to concrete on this unit.

It seems to me that the size of the cement bag is fairly well fixed and that it would be advisable for other engineers, as well as city engineers, to follow the line laid out by the city engineers and make use of the present bag of cement as the unit of measurement.

Yours very truly,
J. H. WEATHERFORD,
Chairman Cement, Concrete & Concrete Pavement.

Memphis, Tenn., May 25, 1910.

Formula for a Waterproofing Paint for Concrete.

Sirs: In your valuable number of April 27, 1910, an article by C. H. Cartlidge mentioned a method of waterproofing by a paint, made of coal tar, Portland cement and kerosene which was recommended highly, as it can be applied to concrete, which may be wet or dry. The writer desires to know the formula for this paint, as he is doing a great deal of concrete wall work in a wet district, and thinks it would be a great help to him. Any information on the above would be thankfully received.

Yours very truly,
F. D. & SONS

Chicago, Ill., June 2, 1910.

(The above query has been referred to Mr. Cartlidge, who has sent us the following reply.—Editors.)

Sirs: Replying to your letter of June 15th: The formula for the tar paint referred to in my paper on concrete trestles was taken from the "Engineering News." I do not recall the date of publication. The formula is as follows:

Coal tar, 16 parts; Portland cement, 4 parts, and kerosene oil, 1 part; all by volume.

The Portland cement and kerosene oil are mixed; the coal tar is heated until thinly fluid, and the mixture of cement and oil stirred in. Upon cooling the paint should be thin enough to flow under a brush, and is applied as any ordinary paint. If because of cold weather or too heavy a tar the paint should be thick, it is well to add more kerosene oil, but this should only be done after heating the paint. Care should be taken to use a good quality of refined tar. It is my personal opinion that the crude commercial coal tar obtained from gas manufacturers does not make as good a paint as the better grades of tar. Our practice on the C., B. & Q. road is to specify "Barrett's" refined tar for this purpose

Yours truly,
C. W. CARTLIDGE.
Bridge Engineer.

Chicago, Ill., June 16, 1910.

Personals.

Mr. E. S. Dunbar, Oroville, Cal., has been appointed Chief Engineer of the Butte & Plumas Ry., which projects a 30-mile line from Oroville to Stanwood, Cal.

Mr. E. L. Cousins, Resident Engineer of the Middle Division of the Grand Trunk Ry., has been engaged as Assistant Engineer of the City of Toronto on special work.

Mr. R. H. Howard, Chief Engineer in charge of maintenance of way of the Chicago & Eastern Illinois at Chicago, has resigned to accept a position with an eastern road.

Mr. A. A. Meyers, an Engineer of the Department of Public Works of the Netherlands, is now in this country studying methods of water storage in the interests of the rice and sugar industries in Java.

Patrick J. Burke, a pioneer in electric railway construction and a member of the Old-Time Telegraphers' Association, died recently at his home in Cheshire, Conn., aged 64 years. In early life he built telegraph lines in New York state, Missouri and other sections of the country.

Prof. L. G. Carpenter, for many years connected with the Colorado Agricultural College as head of the irrigation engineering department and director of the experiment station, has resigned his position as director of the station. He will remain with the college, however, as professor of irrigation engineering.

Mr. Guy R. Johnson, formerly Vice-President of the Alabama Consolidated Coal & Iron Co., and Mr. Blair Hughes, formerly Engineer Maintenance of Way of the Seaboard Air Line Ry., have entered into a partnership under the firm name of Johnson & Hughes and will engage in a general building and structural engineering business. The offices of the firm are in the Brown-Marx building, Birmingham, Ala.

Capt. A. H. P. Desborough, an Imperial government expert at Woolwich Arsenal, England, has also been engaged, with the consent of the Colonial office, to come to Canada for a couple of months to advise the Department of Mines as to the best regulations to adopt in Canada respecting the manufacture, storage and use of explosives. He will also give the department the benefit of his experience in connection with a government explosives testing station to be established here.

Mr. Charles E. Goad, a civil engineer, died June 10, at his home in Toronto, Ont. Mr. Goad, who was 62 years of age and a native of London, England, came to Canada 40 years ago and became well known by the preparation of fire insurance plans and maps for all the municipalities in Canada. Subsequently this work was largely extended and offices established in London, England, and South Africa. Mr. Goad also had offices in Montreal and at 15 Wellington St West, Toronto.

Mr. Lucius I. Wightman, for the past six years Advertising Manager for the Ingersoll-Rand Co., 11 Broadway, New York, has resigned his position, the resignation taking effect Aug. 1st. He will open an office in New York City as an independent specialist in machinery advertising, handling the accounts of manufacturers of machinery and engineering products. Mr. Wightman is a graduate engineer and has had much experience in practical, mechanical and electrical engineering, construction work, machine design and manufacture and machinery selling. He is the author of a text-book on compressed air, and is one of the authorities on compressed air subjects.

The U. S. Civil Service Commission, Washington, D. C., will hold an examination on July 20-21 at various cities throughout the country to secure eligibles from which to make certification to fill vacancies as they may occur in the position of United States Surveyor in the General Land Office, and other vacancies as they may occur in any branch of the service requiring similar qualifications. The entrance salary is $100 per month, traveling expenses, and subsistence while in the field. Promotions are made after satisfactory service. In the southern states employment is usually continuous, but in the northern states persons are frequently dropped during the winter months. Those who give satisfaction to the department are furloughed when conditions require a stoppage of work, but may be re-employed the next spring immediately and without further examinations.

Catalogs Worth Having.

Engineers and contractors should have on file the latest catalogs of machines, tools and supplies that they use. In sending for catalogs reviewed or advertised in this paper, you will confer a favor on us if you will write directly to the advertisers and state that you saw the catalog mentioned in ENGINEERING-CONTRACTING. If you are in the market for tools, machinery or supplies, tell us and we will notify promptly the leading manufacturers.

The Clark Meter Box.—Paper, 6x9½ ins. H. W. Clark Co., 115 South 17th St., Mattoon, Illinois.

A catalog of a housing for water meters. Shows various styles and gives complete descriptions and prices.

Traveling Electric Cranes.—Paper, 7¾x10½ ins.; 28 pp. Pawling & Hernischfeger Co., Milwaukee, Wis.

A catalog of illustrations of some of the Traveling Electric Hoists built by this firm for various classes of service.

Beams and Columns.—Cloth, 3½x6 ins. Northwestern Expanded Metal Co., Old Colony Building, Chicago, Ill.

Contains tables of strength and carrying capacities and formulae for the design of reinforced beams and column.

American and New Niagara Water Meters.—Paper, 4x9 ins.; 16 pp. Buffalo Meter Co., 290 Terrace, Buffalo, N. Y.

A complete meter catalog, well illustrated and with good description. Contains tables of dimensions and prices.

Lifting Jacks.—Paper, 4x9¼ ins.; 96 pp. The Joyce-Cridland Co., Dayton, O.

This is a valuable catalog containing cuts and descriptions of all classes of jacks with prices for the different kinds and for their parts.

Expanded Metal Lath.—Paper, 6x9 ins.; 16 pp. **Expanded Metal—System of Steel Concrete Construction.**—Paper, 6x9 ins.; 32 pp. The Expanded Metal Engineering Company, 1182 Broadway, N. Y.

The first mentioned booklet contains information regarding the various uses to which the lath is put, on ceilings, walls, fences, partitions, etc. The second describes the use of the metal where bearing area is to be provided as floors, etc. Tables of meshes and tables for calculations of spans are given.

The Milwaukee Concrete Mixer.—Paper, 6x9 ins., 24 pp. The Milwaukee Concrete Mixer & Machinery Co., Milwaukee, Wis.

A catalog giving cuts of all styles of concrete mixers made by this company, with descriptions and prices.

Barrett's Creo-Carbolin.—Paper, 7x8 ins., 24 pp. Barrett Manufacturing Co., New York, N. Y.

A catalog describing the uses and showing the applications of this wood preservative and stain.

Gas Compressors.—Paper, 6x9 ins., 32 pp. Ingersoll-Rand Co., 11 Broadway, New York, N. Y.

A catalog illustrating the different machines and parts, and describing in detail the compressors shown.

Wire Rope News.—Paper, 8½x11¼ ins., 16 pp. American Steel & Wire Co., Chicago, New York, San Francisco.

This publication is for May, 1910, and contains some interesting articles. It also has new price lists and new figures on the breaking strength of wire rope based on actual tests.

Tarvia.—9x6 ins., 40 pp. Barrett Manufacturing Co., New York.

A book of illustrations with some descriptive matter, entitled, "Good Roads—How to Build, Preserve and Make Dustless."

Reinforced Concrete Pipe.—Paper, 9¼x12 ins., 76 pp. Reinforced Concrete Pipe Co., Jackson, Mich.

A general catalog with complete descriptions, tests and photographs of this pipe in its various applications.

Contract News Section

of

ENGINEERING-CONTRACTING

A Consolidation of ENGINEERING-CONTRACTING—CONTRACT NEWS—ENGINEERING WORLD—THE DIRT MOVER.

Containing Items of Interest to Railroad, Public Works and Other Contractors.

The Doings of the Week.

The U. S. Senate on June 15 passed the House Bill authorizing the withdrawal of public land. The bill carries an appropriation of $30,000,000 for the completion of irrigation projects. ——The first train over the newly completed Grand Trunk Pacific Regina-Yorkton branch reached Yorkton, Sask., on June 15.—— Through passenger and freight traffic from Salt Lake City and Los Angeles and the east over the San Pedro, Los Angeles & Salt Lake R. R. was resumed on June 12, after an interval of five months spent in repairing the damages to the system resulting from a disastrous washout.——In order to make improvements both in the physical properties and rolling stock, the Missouri, Kansas & Texas R. R. is making plans to float several bond issues to finance the schemes of betterment. The first bond issue will be for $10,000,000. This will be a part of a bond issue of $125,000,000, which has been planned and for the ratification of which a meeting of the stockholders has been called for July 30.—The drainage of the Florida Everglades will soon become a reality for the State Board of Drainage Commissioners have awarded a contract to the Furst-Clark Construction Co., Baltimore, Md., for the construction of 184 miles of drainage canals and contracts involving 19,013,496 cu. yds. of excavation. Bids for this work were opened June 15 at Tallahasee, Fla.——One of the largest municipal contracts of the week was the one secured by the Ryan-Unmach Co., New Haven, Conn., from the city of Waterbury, Conn. This contract was for the construction of a storage reservoir dam, the work including: Concrete masonry, 25,600 cu. yds.; concrete masonry, 5,000 cu. yds.; concrete blocks, 2,960 cu. yds.; rolled embankment, 525,000 cu. yds.; crushed stone, 5,900 cu. yds.; paving, 8,900 cu. yds.; loaming on dam, 6,300 cu. yds.; loaming adjacent areas, 5,000 cu. yds. sodding, 18,840 cu. yds.; drain gate house complete, exclusive of foundation; service gate house complete.—— An aeroplane flight from New York to Philadelphia, Pa., and return was made on June 13. The total time in the air was 3 hours and 34 minutes. The trip from Gouvernors Island New York, to Philadelphia, 86 miles, was made in 1 hour and 50 minutes. The average speed going was about 47 miles per hour and an average speed returning was about 51⅓ miles per hour.——During the month of May the excavation on the Panama Canal amounted to 2,477,648 cu. yds. The amount of concrete placed was 107,043 cu. yds. as against 96,120 cu. yds. in April.——The Interborough Rapid Transit Co., New York City, has again applied to the State Public Service Commission for permission to third track its elevated structures in New York City. The company proposes to expend $30,000,000 on the work. ——The chief feature in structural steel work of this week was the opening of bids on June 15 by the Isthmian Canal Commission for building and erecting lock gates for the Panama Canal. The contract calls for about 60,000 tons of steel. There will be 46 mitering gates of two leaves each. The locks on the canal will be located at Gatun, Pedro Miguel and Miraflores. There will be 10 locks at Gatun, 6 at Pedro Miguel and 7 at the last named place. The locks will be 130 ft. wide and each gate 65 ft. wide, and nearly 7 ft. thick. The McClintic-Marshall Construction Co., Pittsburg, Pa., was the low bidder at $5,374,474.——Among the recent railroad construction contracts are the following: G. F. Bristol, Grand Rapids, Mich., sub-contract for about 5,000 cu. yds. of concrete bridge work on the Ohio Electric Ry., near Middletown, O.; The O'Boyle Construction Co., Ltd., Sault Ste. Marie, Ont., for completing roadbed and tracklaying on the Algoma Central from Mile 69 to Mile 170; Crosby, Willis & Welch, Cowley, Wyo., sub-contract for constructing the Burlington branch line from Scribner, Wyo., to Fromberg, Mont., 55 miles.

Levee Work in the South.

It will be a surprise to some to know that nearly $5,000,000 has been spent in the past two years in levee construction in Arkansas and Louisiana. According to the recently issued report of the Board of State Engineers of Louisiana for the period from Apr. 20, 1908, to Apr. 20, 1910, the contracts and agreements for levee work undertaken during the past two years by the state and the several levee districts, with 45 contracts entered into prior to April 20, 1908, numbered 238, involving the handling of 19,875,733 cu. yds. of earth and were estimated to cost $4,722,001.49. The amount and cost of levee work actually performed under those contracts and not taking into account percentages retained until completion during the two-year period by the state and the levee districts and that done by the United States Government is: By the state, 29.78 miles of new levee, 28.3 miles of enlarged levee—involving 3,350,111 cu. yds. of earth, at a cost of $699,701.55. By the levee districts, 64.25 miles of new levee, 57.36 miles of enlargement—involving 9,217,868 cu. yds., at a cost of $2,430,077.90. By the United States, 14.87 miles of new levee, 44.54 miles of enlargement—involving 4,207,722 cu. yds., at a cost of $1,003,982.51. This totals 108.90 miles of new levee, 130.20 miles of enlargement—involving 16,775,701 cu. yds. of earth, at a cost of $4,133,761.96. This work was distributed as follows: In Arkansas—On Arkansas River, 3.28 miles, at a cost of $28,329.16; on Mississippi River, 22.60 miles, at a cost of $351,508.97. In Louisiana—On Mississippi, 133.74 miles, at a cost of $2,946,059.53; on Red River, 51.16 miles, at a cost of $455,498.78; on Atchafalaya River, 18.22 miles, at a cost of $258,792.86; on Ouchita River, .06 miles, at a cost of $824; on Boeuf River, .04 miles, at a cost of $1,276; on the gulf coast, 7.27 miles, at a cost of $37,361.80; interior streams, 2.75 miles, at a cost of $54,110.86. The amounts given in the foregoing figures do not include those involved in the drainage work executed by the Red River, Atchafalaya and Bayou Boeuf Levee District during the past two years, costing $85,822.16, on which class of work some $5,643 worth still remains to be done under existing contracts. Nor do they include the work for the improvement of Bayou Lafourche, for navigation and the supply of fresh water, undertaken by the joint organization of the Atchafalaya Basin and Lafourche Levee Districts, on which some $417,548.48 has been expended from inception to date. In addition to the above, there still remains to be done under contracts of the state and the several levee districts, in force at this time, an amount of levee work estimated to aggregate not less than 2,250,985 cu. yds., and to cost (in addition to percentages retained until completion) not less than $565,497.78. Again, a considerable amount of work has, as usual, also been done in, and expenditures incurred by the several levee districts of the state and by the United States for weed-cutting, minor repairs, wooden revetments and for auxiliary works of various descriptions. Information upon which to base exact statements in regard to all these particulars is not at hand, but the sum involved is considerable. The aggregate length of levee lines is 1,263.5 miles. In addition to these, there are a number of lengths of levee line in comparatively isolated localities, and on interior streams, some parts of which are not located in any regular levee district, amounting to about 340.4 miles, making a total length of levee lines more or less protecting Louisiana, at this time, of 1,603.9 miles; that is, 155.7 miles in the state of Arkansas and 1,448.2 miles in Louisiana.

A Record for Rock Tunnel Driving.

Something of a record for tunnel driving in rock was made during the month of May in the Laramie-Poudre tunnel in Colorado. According to press dispatches the tunnel was driven from two headings a total distance of 845 ft. during the month. The heading from the west end was driven 332 ft., while the heading from the east end was advanced 513 ft. The rock is stated to be a very firm hard granite, requiring the drilling of 27 holes in the face for explosives. The tunnel as driven is 7 ft. 6 in. high and 9 ft. 6 in. wide and is nearly oval in shape. The tunnel is being driven on a grade of 1.7 per cent, sloping from the west toward the east and consequently the material removed from the west end had to be hauled up grade, whereas in the east end the loaded cars run down grade and only the empties have to be hauled up. The west end workings do not run directly out into the open air on grade but are connected with the surface by a 200 ft. incline. This was done to avoid about 1,400 ft. of waterbearing rock and wash which had it been opened up would have drained directly down the tunnel into the headway. As it is a considerable amount of water seeps in and has to be pumped out. The tunnel is being driven in connection with a hydro-electric development. The work is being done by contract, and the men are working on the bonus system, receiving an extra amount of pay for each foot driven over 250 ft. in each calendar month.

Wages and Efficiency of Labor.

Are contractors paying men a third more wages and getting a third less work from them now than five years ago? Such is the fact claimed to be responsible for the great sums by which the actual cost of the Government irrigation work has exceeded the original estimated cost. It is one of the reasons given for the latest enormous increase in the estimated cost of the Panama Canal. It is common knowledge that both prices and wages have increased in the last five years. Have wages on construction work increased 33⅓ per cent? Is it possible now to get only two-thirds the work out of men engaged in such work that we got in 1905? Certainly such facts, if they are really facts, merit investigation into causes and reasons. Are they facts? The editors would like to have from contractors figures based on their experience.

Confirmed Reports by Engineers and Contractors

RAILROADS, POWER DEVELOPMENTS, LEVEES, DRAINAGE AND IRRIGATION WORKS.

Railroads—Steam and Electric.

CALIFORNIA.

The Butte & Plumas Ry. Co. has completed surveys and has secured the capital for the construction of a 30-mile railroad from Oroville to Stanwood in Butte county. The company is constructing the road with its own forces. The line is to be primarily constructed for the Truckee Lumber Co. E. S. Dunbar, Oroville, Cal., is chief engineer. O. C. Haslett, San Francisco, is president.

OHIO

G. F. Bristol, Grand Rapids, Mich., has taken a sub-contract from J. C. Carland & Co., Toledo, O., for about 5,000 cu. yds. of concrete bridge work on the Ohio Electric Ry. near Middletown, O. Work will be started at once with two outfits. Mr. Bristol's office on the work is at Middletown, O.

OREGON.

The Carlton & Coast R. R., which projects a 14-mile line from Carlton, Ore., to Fairdale, has completed surveys and has secured the capital for construction. Construction contracts will be let about July 1. Chas. E. Ladd, Carlton, Ore., is president and M. L. Johnson, Carlton, Ore., is chief engineer.

PENNSYLVANIA.

The Tower City, River City and Johnstown Street Ry. Co. has completed surveys and has secured the capital for the construction of its projected 3-mile line from Tower City via River City to Johnstown. Construction contracts are to be let in July or August. The road is to be operated by gasoline motor cars. Walter E. Harrington, The St. James, Philadelphia, Pa., is chief engineer. J. W. Moyer, Pottsville, Pa., is president.

TEXAS.

The Morey-Fauhlaber Construction Co., 1212 Chemical Bldg., St. Louis, Mo., and Lometa, Tex., have several miles of grading to sub-let on the Lometa West extension of the Santa Fe in Lampasas County, Texas.

The survey of the projected Houston, Somerville & Western Ry. is now complete between the towns of Somerville and Taylor, Tex., a distance of 60 miles. Correspondence and bids are asked from contractors for grading the same. The line contemplated will be 125 miles in length and will run through a timbered country and traverse for the entire length a rich farming country, a part of which is at the present time overgrown with valuable oak timber. H. H. Fielder, 427 Boulevard, Houston, Tex., is President.

WASHINGTON.

We are advised that the work of constructing the Point Defiance Line of the Northern Pacific Ry. has not been readvertised. The first set of bids were considered too high and were rejected. The line is to be 42 miles long and will extend from Tacoma to Tenino.

CANADA

The O'Boyle Construction Co., Ltd., Sault Ste. Marie, Ont., has been awarded the contract for completing the roadbed and track laying on the Algoma Central from the present end of steel at Mile 69, North of the Soo through to a connection with the line extending from Michipicoten Harbor back to the Mines of the company at Mile 170.

Regarding a proposed branch line of the Grand Trunk Pacific Ry. passing through Weyburn, Sask., we are advised that at the present time the company is constructing a branch line in a southeasterly direction from Regina, towards the international boundary, for a distance of approximately 90 miles. The route being followed is about 18 miles east of Weyburn, and the citizens in the vicinity have requested the management to divert the line or accommodate them with a spur line, and they have been promised that the company would have an investigation made of the country and if it was found feasible to build the spur they request, and the amount of business from that territory would justify the expenditure, the Grand Trunk Pacific would make application for a charter.

Power Developments, Levees, Drainage and Irrigation Works.

CALIFORNIA.

The Sacramento Valley Irrigation Co., Willows, Cal., will in August ask for bids for the construction of laterals and drains in its Delevan Unit, involving 1,200,000 cu. yds. of excavation. This will be the third lot of work; the first was for 1,700,000 cu. yds. and the second 800,000. Some time this fall the company will be prepared to let a contract for 300,000 cu. yds of re-construction work on the upper end of the Central Canal, and in the early part of 1911 it will let contracts for the lateral and drainage system of the "Maxwell" and "Southern" Units, which will involve approximately 2,500,000 cu. yds. John P. Ryan, Willows, Cal., is assistant engineer.

COLORADO.

Bids are asked by the city of Boulder, Colo., until 7 p. m., July 18, for the construction of a rubble concrete masonry dam at Albion Lake Reservoir. The dam is to be 60 ft. high and the work includes about 13,000 cu. yds. rubble concrete, together with necessary excavations, gate houses, valves, etc. Fred R. Duncan is City Engineer, and M. S. Ketchum, 438 Century Bldg., Denver, Colo., is Consulting Engineer. The official advertisement will be found elsewhere in this issue.

CONNECTICUT.

The Ryan-Unmach Co., New Haven, Conn., was awarded the contract on June 14, by the city of Waterbury, Conn., for constructing a storage reservoir dam. The work includes approximately: Concrete masonry, 1:3:6, 25,600 cu. yds.; concrete masonry, 1:3:5, 5,000 cu. yds.; concrete blocks, 2,960 cu. yds.; rolled embankment, 525,000 cu. yds.; crushed stone, 5,900 cu. yds.; paving, 8,900 cu. yds.; loaming on dam, 6,300 cu. yds.; loaming adjacent areas, 5,000 cu. yds. sodding, 18,840 cu. yds.; drain gate house complete, exclusive of foundation; service gate house complete.

FLORIDA.

The State Board of Drainage Commissioners has awarded a contract to the Furst-Clark Construction Co., Baltimore, Md., for the construction of 184 miles of drainage canals in the Everglades requiring 19,013,495 cu. yds. of excavation. Bids for this work were opened June 15 at Tallahassee, Fla. Further details as to the work were given in our issue of May 18.

ILLINOIS.

The Traer Coal Co., Danville, Ill., have 40 acres of coal near Danville to be stripped of earth, gravel and shale, and would like to get figures on the work.

LOUISIANA

The Jahncke Navigation Co. of New Orleans, La., has been awarded the contract for dredging at Chefuncte and Bogue Falia rivers, La., for the U. S. Government. The price is 19½ cts. per cu. yd. and the approximate amount of dredging to be done is 30,000 cu. yds.

Following bids were received June 13, at the office of Col. Lansing H. Beach, U. S. Engineer, New Orleans, for furnishing about 10,000 cu. yds. of stone for use in connection with the maintenance of jetties and auxiliary works at South Pass or Southwest Pass, Mississippi River: Richard M. Murphy, New Orleans, La., $3.90 per cu. yd.; John Riess, New Orleans, La., $3.95; Oscar F. Barrett, Cincinnati, O., $3.95; C. C. Huthmacher, Grand Tower, Ill, $3.95; Zeb Ward, Little Rock, Ark., $3.95.

The Lake Arthur Irrigation Co. of Lake Arthur, La., recently incorporated, has holdings of about 4,000 acres of wet prairie lands, and is now investigating another tract of 8,000 acres. The company does not expect to do any development work this year.

MICHIGAN.

Bids are asked by the Board of Public Works of Sturgis, Mich., until 7 p. m., July 6, for the construction of a brick and concrete water power station and excavating for a tailrace; and also for a concrete multiple arch spillway and an earth embankment. The official advertisement will be found elsewhere in this issue.

NEW YORK.

George B. Spearin, 90 West St., New York City, has been awarded the contract at $27,579 for building a pier and bulkhead platform at the foot of Oliver St., on the East River, New York City, for the Department of Docks and Ferries. Bids were opened June 6.

NORTH CAROLINA.

Following bids were received June 14 by Capt. Earl I. Brown, U. S. Engineer, Wilmington, N. C., for 12,000 tons of stone: Balfour Pink Granite Co., Salisbury, N. C., large stone, 2,000 tons, at $1.40; small stone, 10,000 tons, at $1.40. North Carolina Granite Corporation, Mt. Airy, N. C., recommended for award, small stone, $1.35 per ton, large $1.40; Columbia Granite & Dredging Co., Washington, D. C., small $2.24, large $2.24; The Breakwater Co., Philadelphia, Pa., small $1.97, large $1.97; John Monk & S. E. Morris, Norfolk, Va., large $2.77½.

PENNSYLVANIA.

The Vipond Construction Co., Altoona, Pa., has been awarded the contract at $55,000 for constructing a storage reservoir and enlarging present dam of the Tyrone Gas & Water Co., at Tyrone, Pa. The work includes clearing 17 acres of land, about 100,000 cu. yds. of earth work, about 2,000 cu. yds. paving, masonry, etc., and about 7,000 cu. yds. of puddle work.

WEST VIRGINIA.

The following bids were received June 15 at Wheeling, W. Va., by Capt. F. W. Alstaetter, U. S. Engineer, for constructing Peircedam foundations and extension of piers for Dam No. 13, Ohio River:

	The Ohio River Contract Co., Evansville, Ind.	Curtis, Shumway & Deane, Portsmouth, O.
Cofferdam	$10,000.00	$27,345.00
Common excavation	0.60	1.75
Coal excavation	2.50	1.75
Rock excavation	3.00	3.00
White-oak timber, M	100.00	90.00
Concrete	8.00	8.00
Structural steel	.07	.05
Bolts, etc.	.07	.05
Iron castings	.07	.05
Forgings	.07	.10
Pumping and maintaining cofferdam	40.00	30.00

Items Concerning Contractors and Their Work

RAILROADS, POWER DEVELOPMENTS, LEVEES, DRAINAGE AND IRRIGATION WORKS.

(Confirmed Reports Continued.)

CANADA

M. J. Hogan, Port Colborne, Ont., has been awarded the contract for the improvement to the Port Colborne entrance of the Welland Canal for the Department of Railways and Canals of Canada.

The following are the dredging contracts in the Province of Ontario which have been let by the Canadian Department of Public Works:

Places.	Contractors.	Address.
Kincardine, Lion's Head&Pt.Elgin	The Dredging & Drainage Co. of Ont., Ltd.	Toronto, Ont.
Port Burwell	The General Cons. & Dredging Co., Ltd.	Toronto, Ont.
Byng Inlet	Manley & Co.	Toronto, Ont.
Goderich	Wm. L. Horton	Goderich, Ont.
Cobourg	The Randolph Macdonald Co., Ltd.	Toronto, Ont.
Port Hope and Whitby	W. E. Phin	Welland, Ont.
Picnic Islands	C. S. Boone Cons. & Dredging Co., Ltd.	Toronto, Ont.
Rainy River	A. F. Bowman	Southampton, Ont.
Owen Sound	R. Weddell & Co.	Trenton, Ont
Rondeau	The Windsor Dredging Co., Ltd.	Windsor, Ont.
River Thames	W. E. Phin	Welland, Ont.

Alabama Notes.

FROM CORRESPONDENTS AND OTHER SOURCES.

The promoters of the long talked of Coast electric line from Scranton, Miss., to Mobile, Ala., where a connection will be made with the Mississippi Coast electric road, are now seeking a right-of-way through Mobile County, Ala. As noted under Mississippi notes in our last issue the supervisors at Scranton have granted a franchise for the line to the Alabama state line to W. D. Bullard, of Scranton, Miss. Mr. Bullard is the attorney representing the capitalists who are building the line.

The city council of Gadsden, has extended the franchise of the Noccalula Railway Light & Power Co., until July 6. The company proposes to build a line of electric railroad from Noccalula Falls to Gadsden, Alabama City and Attalla, a distance of about five miles.

The Seaboard Air Line Ry., W. L. Seddon, chief engineer, Portsmouth, Va., according to reports, will shortly commence work on the construction of its long contemplated line into Anniston. It is stated that the work will be started at a point near Tredigar or Jacksonville and the line be completed into Anniston by the first of next year. The work will mean the construction of 17 miles of new line. It is said over $85,000 has been expended in securing cross-country rights-of-way.

Preliminary steps have been taken at Selma for the formation of a company with a capital stock of $200,000 to build the proposed railroad from Selma up the Canaba valley to the Birmingham district. About $75,000 of stock subscriptions have already been promised. It is expected that between $15,000 and $20,000 will purchase rights-of-way and cover the cost of a survey and that for $75,000 tracks could be laid for half the distance when it could be bonded for the remainder. J. C. Suttles, Brent, Perry County, is interested.

The construction of a railroad from Pensacola, Fla., to Andalusia, Ala., is proposed and a representative of New York parties has made a proposition to Pensacola capitalists that if they will raise $250,000 and secure a franchise from the secretary, which will include water front rights, the New Yorkers will build the road. There has been $200,000 raised already.

The Alabama Power & Development Co., Talladega, is to make surveys for a proposed electric trolley line from Talladega to Gadsden via Anniston.

California Notes.

FROM CORRESPONDENTS AND OTHER SOURCES.

The San Francisco & Transbay R. R. Co. has been incorporated with a capital stock of $1,500,000, of which $69,600 has been subscribed by Attorney H. H. McCloskey, San Francisco, or the interests he represents. The other incorporators, nominally, are E. Schnulenhaus, J. Comerford, A. Mulverhill and L. Block. The company purposes to build a suburban railroad 70 miles in length from Niles to connect with Redwood City across the bay, taking in Dumbarton point on the way. Besides the main line from Niles to Dumbarton point and crossing the bay with connections to Redwood and Woodside through San Francisco, a branch is to run from Redwood to Woodside, and from Dumbarton to Warm Springs.

The Truckee Lumber Co., Flood Bldg., San Francisco, has started getting out the ties and timber for its projected 30-mile railroad from Oroville to Stanwood. Stoneman Dowe, purchasing agent of the company, has established a grading camp at Oroville. The road will be known as the Butte & Plumas R. R.

Mayor M. R. Beard of Sacramento, favors making provision in the next tax levy for the extension of the city wharf. The wharf now extends from M to the south line of N St., a distance of 400 ft., and is not adequate to accommodate all the business.

The Ocean Park Amusement Co., A. R. Fraser, president, Ocean Park, has had work started on a large pleasure pier at Ocean Park, which will cost $220,000. It will be a combination of the present Pier Ave. and Marine Ave. piers, with a large extension, and will be in the shape of a horseshoe, occupying 28,000 sq. ft, of floor space.

The Oakland Traction Co., Oakland, has completed profiles for its proposed Euclid Avenue car line extension at Berkeley from University and Shattuck Ave. to the end of Euclid Ave. in the Wheeler tract. The franchise was granted on June 19, and the work of construction will commence immediately. Owing to the heavy grades met with from Hilgard St. north, low-geared cars with high-powered motors will be necessary. The company has begun gathering data for the installation of new machinery.

Announcement has been made by John D. Spreckles, President of the San Diego & Arizona R. R., San Francisco, Cal., that contract has been awarded Robert Sherer & Sons, Los Angeles, Cal., for the construction of the third section of the line in Mexican Territory. The contract covers about ten kilometers in length and includes all fills and cuts for that distance. When this work is completed the roadbed of the San Diego & Arizona line will have been finished as far as Rock Springs and the San Jacinto ranch. No engineering problems are to be met in the district. The road is to follow the San Jacinto river most of the way, being through a fairly level country. On the next section, however, the road begins to enter the mountainous district of Lower California, where the engineering work will become more difficult. Construction of the roadbed on the second section in Mexican territory is progressing rapidly and it is believed will be finished soon. The work of boring the tunnels is nearly completed.

William Hood, San Francisco, Cal., Chief Engineer of the Southern Pacific Ry., is stated to have announced that another contract would be let for the construction of the Natron extension at the Klamath Falls, Ore., end of the line. The Utah Construction Co., Ogden, as noted in Engineering-Contracting some time ago, is working on the Natron end of the extension and it is fully expected that trains will be operating as far as Hazel Dell, 40 miles from Eugene, Ore.

Preliminary steps have been taken at San Bernardino by business men for the construction of a trolley line between that city and Rialto.

W. C. Elsemore, C. E., Eureka, has made surveys at the Minor quarry near Warren Creek, Blue Lake, for a short piece of railroad in order to haul the rock to the main railroad line.

According to reports circulating in Alturas, Cal., the Nevada, California & Oregon R. R. Co., on account of some complications in securing necessary right of way for the proposed Lakeview extension, have decided to change the route.

Committee of Fourteen of Eureka, Cal., who are promoting the construction of the Humboldt & Eastern R. R., are awaiting the action of United States Government on the request of the promoters to buy 2,000,000 ft. of lumber in the National Forest, necessary for the construction of the proposed line. W. S. Clark, Eureka, Cal., is Chairman of the committee.

The construction of an electric railway from Fresno to Monterey by way of Coalinga is proposed. It is estimated that the road could be built for about $4,000,000. Among those interested are A. G. Metz and H. M. Bergine, of Monterey.

The City Engineer of Oakland has submitted to the Board of Public Works plans and specifications for a wharf at Livingston St., East Oakland, to cost $175,000.

Colorado Notes.

FROM CORRESPONDENTS AND OTHER SOURCES.

The Federal Light & Traction Co., New York, organized recently with a capital stock of $11,000,000, will take over all the holdings of the United States Light & Traction Co., which has its headquarters in Denver. The last named corporation has been the holding company for eleven subsidiary companies in Colorado, Wyoming, New Mexico and other Western states. W. L. Iliff of Denver has been president. The other officers are C. K. Durbin, vice president, and O. L. Moore, treasurer. The properties taken over by the Federal Light & Traction Co. are as follows: The Albuquerque, N. M., Gas, Electric Light & Power Co., Albuquerque, N. M., Electric Power Co.; Tucson, Ariz., Gas, Electric Light & Power Co.; Tucson, Ariz., Rapid Transit Co.; Las Vegas, N. M., Light & Power Co.; Las Vegas, N. M., Transit Co.; Sheridan, Wyo., Electric Light & Power Co.; Rawlins, Wyo., Electric Light & Fuel Co.; Montrose, Colo., Light & Power Co.; Hobart, Okla., Gray's Harbor Railway & Light Co. Mr. C. K. Durbin, Denver, will be manager of the properties.

The Havermeyer Land Co., Grand Valley, has had engineering work under way for a canal 20 miles long to carry 300 cu. ft. of water per second for irrigation purposes.

W. A. Colt is making good progress with his contract for constructing a 35 mile canal for the Desert Land, Reservoir & Canal Co. The work is located about 45 miles northwest of Los Animas.

J. L. Frankeberger, Boulder, has been making some surveys near Barr for a proposed irrigation reservoir.

The Montezuma & Western R. R. Co., incorporated a short time ago with a capital stock of $500,000, has announced at Denver that construction of its proposed line from Denver to Leadville would begin within 30 days. The company is allied with the Argentine Central Ry. of which E. J. Tuttle, Denver, Colo., is General Manager, and will

use the Argentine tunnel to get through the Continental Divide.

The Williams River Highland Co., represented by Dr. D. G. Leach, has submitted to the State Land Board at Denver a proposition for buying and irrigating every alternate section of land in Routt County, south of the Bear River, and aggregating 34,000 acres.

The litigation between the Colorado & Eastern R. R. and the Chicago, Burlington & Quincy R. R., over right of way at Denver has been settled, and now that the case has been finally disposed of it is believed that in a few weeks some announcement will be made as to the future of the little road, said to be owned by the Havemeyers and badly wanted by different roads for its valuable rights in the city. The Colorado & Eastern won the case and holds its right of way for a distance of about 700 ft. near the stock yards at Denver, over which the Burlington refused to allow it to build, as its tracks crossed at the same place. The first suit was started six years ago.

Georgia Notes.

FROM CORRESPONDENTS AND OTHER SOURCES.

The Hickson Lumber Co., of Cheraw, S. C., which recently purchased large bodies of timber in Emanuel County, proposes to construct a railroad line to cross the Georgia & Florida at Summit, and intersecting the Central of Georgia at Midville and the Savannah, Statesboro & Northern seven or eight miles above Summit. This line will run through the timber above Summit and below Summit will cross the Bruton and Pinora branch of the Central near Metter and run to the coast at Darien or Brunswick.

The Atlanta Hydro-Electric Power Co., of Atlanta, is making plans for the further financing of the company. The company will build a dam 700 ft. in length across the Tugaloo River and will develop 25,000-hp., which will be brought to Atlanta and other places between there and the source of development.

Idaho Notes.

FROM CORRESPONDENTS AND OTHER SOURCES.

Representatives of A. Welch, Portland, Ore., have been negotiating for the purchase of the Lewiston Terminal Co.'s holdings at Lewiston, Idaho, and this move has given rise to the report that Lewiston might be the eastern terminal of an electric railway extending through Walla Walla, and to Pendleton, Ore. A. Welch built the Walla Valley R. R. from Walla Walla to Milton. With his associates he now controls and operates street railway lines in Salem, Albany, Eugene and Springfield, Ore. Lines are also projected from Eugene to Springfield and from Salem, through Albany, to Eugene.

The Gilmore & Pittsburg R. R., the first section of which is now nearing completion, according to announcement from Lewiston, Idaho, is to consist of feeder lines of which 453 miles will be constructed from Salmon City, Idaho, through Lewiston to Pasco, Wash., with a line also from the Salmon River to Grangeville. The company has planned lines to Boise, Idaho, and to Walla Walla, Wash., the length of the former being figured at 250 miles. W. A. McCutcheon, Machesney Bldg., Pittsburg, Pa., is President.

The Pacific & Idaho Northern Ry., E. M. Heigho, President, Weiser, Idaho, has placed engineers in the field to locate and cross-section the route for the proposed extension north from Evergreen, the present terminus to Meadows, 16 miles distant. It is intended to have trains running into meadows by November 1.

Illinois Notes.

FROM CORRESPONDENTS AND OTHER SOURCES.

The city council of Moline has extended the franchises of the Tri-City Ry. Co. and the East Moline interurban line for 20 years. The ordinances provide for a number of extensions.

There is some talk here in Joliet of constructing a loop to connect the Chicago & Joliet line at Ingalls Park with the Joliet & Southern line at Red Mill bridge. Neither of the two roads seems to be exactly in favor of the loop, and it is reported that Col. L. E. Ingalls, Joliet, owner of the park, may build the line himself.

Good progress is being made with the construction of the interurban line of the Springfield & Jacksonville Electric Ry. Co. between Springfield and Jacksonville. Grading work has progressed so far that G. Gridley, Springfield, who has the contract for track laying, will shortly commence placing the steel from the Springfield end of the line. In the meantime E. E. Hedley, Charles Van Warmer and Oscar Bonner, sub contractors on the grading work, are making the dirt fly. The latter started work on June 7 at Riddl Hill with 70 teams. Elmer Hayden has the contract for the fencing and Al Renecker, Jacksonville, has the contract for pulling the brush along the right of way. Both of these are making good progress. Blain & Brown, who took the concrete work, have already completed three of the bridges. The officers of the company are as follows: O. J. Lucas of Latham, president; D. T. Torrence, Decatur, vice president; J. H. McFarland, Jacksonville, general manager; D. S. Benjamin, Springfield, manager of the bond department; D. B. Sims, Latham, secretary.

The city council of St. Charles is considering applications of two electric cross state railways for franchises through St. Charles and still another company is circulating a petition preparatory to applying for a franchise. The two railways applying for a franchise are the Kansas City & St. Louis Electric Railway Co and the St. Louis, St. Charles & Northern Traction Co. Both wish to run their lines down Adams St., St. Charles, to the present highway bridge over the Missouri River. The former road is headed by Judge D. C. Nevins, president, W. J. Allen, vice president, and Judge William R. Loomis, secretary, all of Kansas City. It proposes to have tracks from St. Louis to Kansas City. The proposed line is 25 miles shorter than that of the Wabash R. R., extending a total of 225 miles. The St. Louis, St. Charles & Northern Traction Co. proposes a line from St. Louis through St. Charles, Warrenton, Bowling Green to Hannibal and connecting at Hannibal with branch lines through northern Missouri counties. This company is promoted by R. E. Race of Mexico, Mo. It wishes a franchise down Adams St. in St. Charles and proposes to use the highway bridge. The third company which is now circulating a petition would pass through St. Charles after crossing the Mississippi River at Alton.

Surveys have been started by the Milwaukee Construction Co. of Milwaukee, Wis., for the proposed interurban line of the Rock River Traction Co. between Sterling and Moline. The plan is to run the interurban parallel with the bluff road from Sterling through Erie, Hillsdale and Watertown, with spurs to Morrison and Prophetstown. It is stated that the Milwaukee Construction Co. will build the road and turn it over to the stockholders. The Milwaukee Construction Co. is building the road promoted by Joseph Wright, Rock Falls, Ill., between Geneseo and Sterling. Mr. Wright is also promoter of the new line.

The Chicago & Joliet Ry., Joliet, has made surveys for a line from Collins on Meeker to the west end of the proposed E. J. & E. steel car repair shop, and on to the northeast part of the city of Joliet.

An active canvass is to be made shortly to secure local support for a proposed interurban railway between Centralia and Springfield, passing through Pawnee, Morrisonville, Hillsboro, Coffeen, Greenville, Carlyle and Hoffman, with a connecting line from Coffeen through Vandalia, Kinmundy and Flora to Mt. Carmel, and one from Greenville through Alhambra and Edwardsville to East St. Louis. Isaac A. Smith, Bank of Commerce Bldg., St. Louis, Mo., is interested.

R. E. Race, Mexico, Mo., promoter of the St. Louis, St. Charles & Northern Traction Co., mentioned elsewhere in this column, accompanied by Messrs. Berwick and Koch, consulting engineers, has made a trip extending over many miles of territory between St. Charles and Troy. It is now thought that the route of the line may be changed after running from Laddonia in a southeasterly direction, so as to shorten the distance, in which case the line will run from a point north of Moscow Mills about one mile, thence to Chain of Rocks, St. Paul, St. Peters and thence into St. Charles.

The St. Louis, Terre Haute & Quincy Traction Co., which projects a line between the places named, has elected the following officers: William Fick, of Quincy, President; Peter Simonds, of Jacksonville, Vice President· F. W. Hollenberg and S. P. Landcraft, of Quincy, respectively, secretary and treasurer.

The Cleveland, Cincinnati, Chicago & St. Louis R. R. has completed nearly all double track work between Chrisman and Danville, Ill., and is planning to extend it to Paris and eventually to Cario, Ill.

The Commissioners of the Illinois & Michigan Canal have under consideration the matter of rebuilding the dam at Dayton and the reopening of the feeder between that point and the city of Ottawa. W. L. Sackett, Morris, Ill., is a member of the Commission.

The Meyer & Thomas Construction Co., of Chicago, has been incorporated with a capital stock of $25,000 and will engage in a general contracting and construction business. The incorporators are J. A. Meyer, E. A. Thomas and H. T. Ellis.

Indiana Notes.

FROM CORRESPONDENTS AND OTHER SOURCES.

Construction work has been started at both the Rockport and Grandview ends of the traction line between those places. The line will be six miles long and W. H. Cost, Rockport, Ind., is in charge of the construction.

The Louisville & Southern Indiana Traction Co. of New Albany has under consideration the building of an extension to Walnut Ridge cemetery, a mile north of Jeffersonville, Ind.

M. M. Defrees & Son, Indianapolis, have been awarded a contract for the tunnel to connect the different tracks and portions of the grounds at Beech Grove, Ind. This tunnel is to cost $25,000 and will be completed this season.

Preliminary surveys have been made for an electric railway from Nashville to a connection with the Indianapolis & Southern R. R. The line would be seven or eight miles long and would cost about $80,000. The construction of several trestles would be required. It is proposed to use gasoline motor cars. J. A. Johnson, Indianapolis, is interested.

Herman Tapp, who has the contract for track elevation work at Fort Wayne, has begun construction. Recently Mr. Tapp advertised for 150 men by means of placards on telegraph poles, and in this way secured a man, which shows that it pays to advertise.

The Fort Wayne & Winona Traction Co., of Fort Wayne, has been incorporated with a capital stock of $100,000. J. A. Barry, Ed. G. Hoffman, E. W. Cook are the incorporators.

The Evansville & Terre Haute R. R. will commence work about July 1, laying a considerable amount of new rails between Terre Haute and Evansville. The company also has under consideration the reconstruction of several bridges and trestles along the line in addition to the track work.

A small force of men has been placed at work on the grade for the proposed traction line from Madison to Scottsburg. This road will connect with the Indianapolis & Louisville Traction Co., the last named company connecting with the Indianapolis, Columbus & Southern Traction Co. at Seymour. The work on the Madison-Scottsburg line was begun a few days ago to save a franchise, but it is said that the work will be continued and that a larger force of men will be put to work.

Iowa Notes.

FROM CORRESPONDENTS AND OTHER SOURCES.

The Iowa City Electric Ry. Co., mentioned a short time ago in these columns, has elected the following officers: J. O. Schulz, presi-

dent, Commercial Club room, Iowa City; J. H. Rohret, vice president, and D. A. Reese, secretary and treasurer. The company is an Iowa City corporation and has a capital stock of $100,000. It will this year build a line between Wright St. and several points in Iowa City.

The Chicago, Rock Island & Pacific R. R. has had engineers in the field running a line between Rockford and Forest City, a distance of 35 miles, which will connect two divisions of the road. The survey runs three miles north of Mason City, where it strikes the Iowa Central, over which the Rock Island plans to enter the city.

Steps are being taken to ascertain the feasibility of building a railroad from Waterloo south through Benton and Iowa Counties to the coal fields of Keokuk County. The route as now proposed runs from Waterloo to Garrison and thence to Van Horn in Benton County. From the latter place it extends to either Belle Plaine or Blairstown, and thence to Marengo in Iowa County. From Marengo it is proposed to build a line in a southwesterly direction to What Cheer and other points in the coal fields of Keokuk and Mahaska Counties. S. B. Howard, New York City, is now in the field.

It is reported that Rock Island surveyors are running lines preliminary to the construction of the proposed line from Rockford to Forest City, Ia., by way of Mason City.

Work has been started on the double tracking of the Great Western R. R. through Waterloo, Ia.

Kansas Notes.

FROM CORRESPONDENTS AND OTHER SOURCES.

The Kansas City, Kaw Valley & Western Ry. Co. has been organized and will take over the property of the Kansas City & Bonner Springs Ry. Co., operating about five miles of track east from Bonner Springs, and will connect with the Kansas City Western electric line, coming in over its tracks from Bethel to Kansas City, Kan. About $150,000 has already been expended in the construction of the road and it is estimated that an additional $225,000 will be necessary to complete the line. The Freeborn Engineering & Construction Co. of Kansas City Mo., has taken up the matter and guarantees to complete and operate the road, providing the citizens of Bonner Springs and Kansas City, Kan., subscribe $100,000 worth of 6 per cent first mortgage bonds.

The Interurban Construction Co., of which O. A. Boyle, Wichita, is president, has completed four miles of track on its projected interurban line between Valley Center and Wichita. J. G. Jennings is doing the grading work and is now working on the stretch of track between Sedgwick and Valley Center.

Straight Creek, in Jackson County, so called because it is so crooked, is to be straightened under the state drainage law by the farmers living along its course.

Capitalists of Hutchinson are considering forming a company to build a line of track from the city to Burrton to a connection with the Frisco. It is estimated that the line would cost about $80,000, and should it be built it would be offered to the Frisco to operate. Emerson Carey, Hutchinson, is interested.

Bennette & Co., who have been engaged on the construction of the Kiowa, Hardtner & Pacific R. R. for the past half year, have moved their grading outfit to Turon, where they have begun to throw dirt on the new line from Turon to Kinsley.

A proposition has been presented to the business men of Salina for the construction of a new north and south railroad from Beatrice to Wichita, then on to the Gulf. According to the plan the starting point of the road will be Beatrice. It will run thence to Washington, Kan., through Clay Center, Salina, McPherson, Wichita and on to the Gulf. The proposition made to the meeting was that each county through which the line will pass furnish $100 for a preliminary location of the proposed line. B. Imes, Clay Center, and Francis B. Morgan, of the Morgan Construction Co., McPherson, are interested.

Kentucky Notes.

FROM CORRESPONDENTS AND OTHER SOURCES.

The Commercial Club of Murray, Ky., has appointed committees to arrange for the construction of an electric railroad from that place to the Tennessee River.

The Owensboro City Railway Co. property of Owensboro has been mortgaged to the American Trust & Savings Company of Evansville, Ind., for $200,000. Bonds will be sold and the money used in the extension of the lines in Owensboro and the building of interurbans. The property was recently taken over by an Evansville syndicate.

The General Traction Development Co., of Cleveland, O., represented by C. B. Porter, has submitted to the directors of the Henderson Commercial Club and other business men of Henderson a tentative proposition for the developing, financing and construction of a system of interurban traction lines radiating from Henderson.

Louisiana Notes.

FROM CORRESPONDENTS AND OTHER SOURCES.

The Ouachita Development Co. of New York, of which Captain Nichols, Monroe, La., is local representative, is stated to be planning to have construction work started on its line between Monroe and Farmerville and beyond to points in Arkansas as soon as all bonuses are voted. A tax has already been voted in West Monroe and Farmerville. A complete survey of the road has already been made and the line definitely located to Farmerville. The line will require two long steel bridges. The one across the Ouachita River will cost approximately $200,000, while the one over Bayou Darbonne, near Farmerville, will be an expensive proposition. J. A. Taylor is the New York representative.

A plan is under consideration to connect Crowley with the proposed canal running from Abbeville through the Vermilion River to Lafayette. It is proposed to build a canal from Lafayette to Crowley at a cost of about $100,000. To construct the canal, irrigation ditch and roadbed from Lafayette to connect with Bayou Plaquemine Brulee, near Crowley, it is proposed to organize a drainage district consisting of the parishes of Lafayette and Acadia.

A mass meeting at Alexandria, La., passed resolutions that legislative action be taken at the current session of the state legislature for levee work as recommended by the board of state engineers. This work is the construction of a line of levee along the west bank of the Red River from Boyce to Alexandria. The approximate number of cubic yards of earth contained is 950,000 and approximate cost $166,500. It also includes the improvement of drainage in Bayou Robert and Bayou Boeuf from Bayou Rapides to the mouth of Bayou Cocodrie, the cost being $350.000. The total cost is $516,500.

Engineers of the St. Louis, Iron Mountain & Southern Ry. have completed plans for the reconstruction of the line to Greenwood and the extension of the same from that city to Gurdon, Ark. With the completion of this branch, Fort Smith will have a direct connection with New Orleans, La., and many other important southern points. E. J. Correll, Little Rock, Ark., is Engineer Maintenance of Way.

Michigan Notes.

FROM CORRESPONDENTS AND OTHER SOURCES.

The Detroit & Mackinac Ry., H. S. Waterman, chief engineer, East Tawas, Mich., has been making a survey for a branch from its main line to Rogers City. That place has offered to give right of way and land for terminals and it is said that construction work will be started so as to have the branch in operation by November.

Construction work is reported to have been started this week on a new third-rail electric railway from Lansing to Grand Ledge. J. S. Mudge and J. W. Ewing, Grand Ledge, are the promoters.

The Grosse Ile Ry. Co. has about completed preliminary plans for its loop line on Grosse Ile, a suburb of Detroit.

Minnesota Notes.

FROM CORRESPONDENTS AND OTHER SOURCES.

The Twin City Rapid Transit Co. will soon petition the St. Paul city council to relieve it from the requirement to construct a car line from Como boulevard to Rice street, as contained in the Gerber ordinance passed last January. The company claims that there is nothing to warrant such a line.

Contracts are about to be let, it is said, for the proposed interurban line between Virginia and Eveleth and Gilbert. According to a statement of E. M. Prindle, Duluth, promoter of the line, the road will start from the Duluth, Missabe & Northern tracks, in Virginia, extend west on Mesaba Ave. to the road to Gilbert, and continue to that village, about 3½ miles. Another line will extend down Larch St., in Virginia, to the Eveleth road, continuing on that road to the More hospital, just outside the city limits.

E. W. Dotten, Cromwell, has been awarded the contract at Aitkin for constructing County Ditch No. 11. The contract price is $7,934. The work calls for moving 76,103 cu. yds. of material.

C. S. Erickson, Mankato, has been awarded the contract for extending the dike at North Mankato, the work amounting to about $1,500.

The Chicago, Milwaukee & St. Paul R. R., according to a reported announcement from St. Paul, in order to handle its Puget Sound extension business, will double track its entire Hastings and Dakota division from Minneapolis across Minnesota to the South Dakota line. At Granite Falls, Minn., an eight mile cut-off will be built soon, and at Montevideo, Minn., a ten mile cut-off, and this will be the beginning of work which within the next few years will mean a double track throughout. At Granite Falls and at Montevideo heavy grades in the Minnesota River and Chippewa River valleys will be eliminated for east bound trains pulling heavy loads.

The Duluth, Missabe & Northern R. R., which has considerable construction work under way, is now laying steel on the new line between Chisholm and Wilton, Minn., and it is expected by the officials to begin train service July 20.

Mississippi Notes.

FROM CORRESPONDENTS AND OTHER SOURCES.

The Alabama & Vicksburg Ry. (a Queen & Crescent line) has filed an amendment to its charter increasing its capital stock from $1,050,000 to $2,100,000. Inasmuch as it is denied that branch lines are to be constructed, it is believed that a general improvement in the line and equipment of the company is contemplated.

The property of the Meridian Light & Railway Co., of Meridian, was formally transferred on June 15 to the Doherty Operating Co., of New York. The sale was made some time ago, and the New York company took charge, but the formal change and the election of officers took place June 15, the following being elected: President, Henry L. Doherty; First Vice President, Russell Palmer; Second Vice President and General Manager, A. B. Paterson; Secretary and Treasurer, Paul R. Jones; Assistant Secretary and Treasurer, Carl B. Gilbert. The company is to make a number of extensions and improvements and expects to have four double truck cars in Meriden shortly for the park line.

The City Council of Batesville has granted a right of way to the Batesville & Southwestern R. R. Co. from the south corporation line to the depot, along the right of way of the Illinois Central. This line is to be constructed by R. J. Darnell, of Memphis, Tenn., from Batesville to Charleston. It is hoped to have the line completed to Glenn's Ferry on Yocony River by the end of the year. Rights of way for most of the distance have been secured. The R. J. Darnell Co. also contemplates, erecting a sawmill, as it owns a large body of land on the line of the projected road.

Missouri Notes.

FROM CORRESPONDENTS AND OTHER SOURCES.

The United Rys. Co., St. Louis, is to reconstruct its line from Taylor to De Giverville Ave., St. Louis, at an approximate cost of $120,000. Nearly four miles of concrete roadbed will be constructed and white oak ties laid.

Engineers under the direction of C. H. Evers of Seattle, Wash., have commenced a resurvey of the route of the Missouri Inland Ry., which will run from Rolla to Houston. The intentions of the engineers are to survey a route about three miles east of Rolla to Little Dry Fork Creek and thence to survey in a direct line to Dillon Station on the Frisco, about five miles east of Rolla.

The Terminal Board of St. Louis, composed of the various railroads having terminals in the city, is planning to enlarge the Madison freight yards at St. Louis. The capacity of this classification yard is to be increased from 800 to 3,200 cars.

Citizens of Philadelphia, Mo., have raised $4,000 of the necessary $10,000 to secure the construction of the proposed railroad through that place and a representative of the M. C. Conners Co., Chicago, Ill., who is to have charge of the work, has been in the vicinity looking over the right of way.

Montana Notes.

FROM CORRESPONDENTS AND OTHER SOURCES.

A. Guthrie & Co., St. Paul, Minn., have sublet part of the work on the construction of the Burlington branch line from Scribner, Wyo., to Fromberg, Mont., to Crosby, Willis & Welch, of Cowley, Wyo. The work on the branch includes grading and laying the steel for about 55 miles of track that will connect the Wyoming line with that of the Great Northern at a point a short distance west of Billings, and will begin at once, so that it may be completed before the beginning of the new year.

Advices from Helena, Mont., state that John Ringling, who is interested in White Sulphur Springs, will let a contract shortly for the construction of a railroad from Dorsey to the Springs.

Surveys have been completed for the construction of the proposed Northern Pacific cut-off from Edgeley, N. Dak., through Burnstad in Logan County, N. Dak., crossing the Missouri River, where it will cross the Cannon Ball line pass through Mott, and connect with the main line at Forsythe, Mont.

According to rumors afloat in the vinicity of Boulder, Mont., the Milwaukee is planning the construction of the line, surveyed last year from Jefferson Island to Helena, by way of Boulder.

The City Council of Butte, Mont., has been considering granting a franchise to the Butte, Anaconda & Pacific Ry. Co. for the construction of the proposed "Steward spur" from the Anaconda copper mine to the Parrot supply spur on the "Neversweat."

The City Council of Great Falls, Mont., has passed the resolution authorizing the constructing of the Chicago, Milwaukee & Puget Sound Ry., through the city. This line, according to an announcement reported to have been made by Charles E. Goodnow, Assistant to President Earling of the Milwaukee, is a portion of the 400 miles of road from Melstone to Missoula, mentioned recently in these columns.

Nebraska Notes.

FROM CORRESPONDENTS AND OTHER SOURCES.

Beattie & Hubbard, Minneapolis, Minn., have placed one of their ditching outfits on the construction of 20 miles of ditch in the valley of Silver Creek in Merrick County.

The construction of a railroad from Madison, Neb., to Elgin is under consideration. At a recent meeting of the Commercial Club of Madison, Mayor W. L. Dowling, who is a member of the railroad committee, reported that the cost of a 45-mile railroad from Madison to Elgin along the survey of the Illinois Central made some 20 years ago, standard gage track with two steam locomotives, twelve freight cars, and two gasoline passenger and express cars could be built at upward of $500,000.

The Lincoln Traction Co., Lincoln, Neb., has authorized its special committee to spend $1,000 in a preliminary survey of the route of the proposed interurban line between that city and Auburn.

City Council of Fremont, Neb., is in favor of permitting the construction and operation of an interurban through that place from Omaha without demanding a royalty from the Interurban Company.

City Council of Omaha, Neb., is to hold a hearing at the next meeting on the request of the Burlington for the vacation of streets and alleys below Eighth St., from Jackson to Farnam, to provide room for the proposed large freight house the railroad is planning to erect.

New York Notes.

FROM CORRESPONDENTS AND OTHER SOURCES.

The Auburn & Syracuse Electric R. R. Co. has asked the city council of Auburn for a franchise out Genesee St., for permission to double track State and Genesee Sts. and to lay a double track in Seymour St. a distance of 300 ft.

The South Shore Traction Co., Times Bldg., New York city, which is building 54 miles of line in Queens, Nassau and Suffolk counties, on June 12 placed the first section of its line in operation. This section is nine miles long and runs from Amityville to Babylon. The route of the completed road will be from Patchogue to Blue Point, to Islip, to Bayshore, to Babylon, to Freeport, to Rockville Center, to Lynbrook, to Jamaica, to Long Island City and across the Queensboro bridge to Manhattan. Besides this main line there will be a cross island branch from Patchogue to Port Jefferson, 17 miles long, running through one of the most attractive sections of Long Island.

The Board of Estimate of New York city has granted the Third Avenue Bridge Co. of New York city an extension of time until Oct. 15 for the construction of tracks to connect the Third Ave. line with the Queensboro bridge.

The Lake Shore & Michigan Southern R. R. is said to have tentative plans under consideration for the improvement of its yards at Dunkirk. These plans are said to include the removal of the entire local yards eastward for several hundred yards.

The tunnel under Sylvan Hill near Terryville, Conn., was holed through on June 9. Work on the tunnel was started in 1907, but after excavating 300 ft. the work was stopped until June 17, 1909, since which date it has been rushed day and night. The tunnel will be lined with concrete and will be 32 ft. wide, double tracked, by 26 ft. high. The tunnel is 3,850 ft. in length and will form part of a new air line from Boston to the Hudson River, through which much of the freight on the New York, New Haven & Hartford R. R. from New England to the west will be forwarded. The tunnel straightens out the roadbed between Bristol and Waterbury, Conn., and shortens the route by about 1½ miles between those two points. The excavation required the removal of 4,600,000 cu. yds. of material.

The New York Central & Hudson River R. R. has applied to the State Public Service Commission for permission to construct a cut-off, branches and connections in the city of Rome, made necessary by the construction of the barge canal through that city. The plan proposes to change the location of the passenger station. It is understood that the work will involve the expenditure of $2,500,000, and that the proportion which the state will finally pay out of barge canal funds will be about $95,000.

The New York Central has acquired a site adjoining the Pennsylvania's new station, New York, for new terminals, and plans are being made for the construction of large warehouses with docks and freight terminals.

According to advices from New York, N. Y., the New York, Westchester & Boston, a subsidary company of the New York, New Haven & Hartford Ry., has decided not to take any definite steps toward the construction of the 45-mile line from White Plains to Danbury, Conn. The project will be indefinitely postponed, it is said.

North Buffalo Business Men's Association have entered a vigorous protest against the proposed new branch line from the main line of the Frontier Terminal R. R., to the International Bridge, Buffalo, N. Y.

The Interborough Rapid Transit Co., of New York City, has again asked for permission to third-track its elevated structures and has submitted a new plan of improvements to the State Public Service Commission. The company's proposals would entail an expenditure of $30,000,000, practically all of which would be spent on elevated lines. The company proposes to do this: To third-track the Second Ave. L from City Hall to 129th St. To complete the third-tracking of the Third Ave. L to Bronx Park. To build a two-track line from the Second Ave. line across the Queensboro Bridge. To build a connection between the east side elevated line in the Bronx and the West Farms division of the subway. To build a two-track line from Pelham Ave. to Becker Ave., the Bronx, as an extension of the Third Ave. line. To complete the third-tracking of the Ninth Ave. L to 155th St. To construct an extension to the Ninth Ave. line up Jerome Ave. to 194th St. To open the Steinway tunnel and transfer passengers to the subway free, providing a suitable franchise is obtained.

The State Canal Board at Albany on June 16 ordered that bids be asked for Contract No. 50. This contract is for the construction of a storage reservoir on West Canada Creek, about Hinckley, including dam with gatehouses, etc., the removal of buildings and incidental work. The area of the reservoir will be about six square miles. The engineer's estimate is more than $1,000,000.

Ohio Notes.

FROM CORRESPONDENTS AND OTHER SOURCES.

The Pennsylvania R. R. has submitted plans to the director of public service at Alliance for the Fifth St. subway. The plans call for a 50-ft. span, which will admit of sidewalks and a 34-ft. driveway. Plans show several proposed structures, costing from $22,000 to $30,000.

The commissioners of Fairfield County at Lancaster have decided to cut a new channel for the Hocking River and bids for the work will be asked shortly.

The Massillon-Brewster Air Line R. R. Co. has applied for a charter and proposes to build a direct line from Massillon to Brewster, the new terminal of the Wheeling & Lake Erie R. R. The officers of the company are as follows: J. J. Wise, President; Z. T. Shoemaker, Vice President; W. E. N. Hemperly, Secretary and Treasurer, all of Massillon.

Plans for changes in the tracks and the entrance of the Norfolk & Western R. R. into the city of Chillicothe, have been made and submitted to the City Engineer of that place. The plans for the new entrance to the city will necessitate a number of changes in streets.

Preliminary work has been started by the General Traction Development Co., of Cleveland, O., for the proposed new traction system from Mt. Gilead to Delaware, connecting Mansfield, Mt. Vernon, Marion, Galion and Delaware.

The Middle-West Engineering Co., Cincinnati, has been incorporated with a capital stock of $100,000. James E. Hewes is the principal incorporator.

Plans are under consideration for the construction of a hydro-electric development on the Cuyahoga River between Akron and Cuyahoga Falls. Engineers under the direction of Frank C. Downer, Chicago, Ill., have been securing data and measurements for the construction of a dam, 160 ft. deep, 250 ft. long at the base and 25 ft. wide at the top, built of concrete.

The Mahoning Valley Street Railway Co. has secured a right of way to construct a street railway from Youngstown to Mineral Ridge, five miles from there. Construction will be started soon.

Oklahoma Notes.

FROM CORRESPONDENTS AND OTHER SOURCES.

M. Parville and M. Brazon of Paris, France, representing the bond buyers who recently financed the Missouri, Oklahoma & Gulf extension from Muskogee to the Red River, in company with President William Kenefick, Kansas City, Mo., have been making a tour of inspection. Work will be started on the northern extension from Muskogee to Kansas City as soon as the survey is finished. French capitalists will also finance this end of the line.

A state charter was issued on June 14 to the Kansas, Oklahoma & Panama R. R. Co. for the new railroad out of Oklahoma City westward. The capital stock is $1,000,000. Headquarters will be at Oklahoma City, with branch offices at Sayre, Okla., and Indianapolis, Ind. The charter provides for two lines, one 135 miles in length from Oklahoma City westwardly through Oklahoma, Canadian, Grady, Caddo, Kiowa, Washita and Beckham counties, where it will connect at some convenient point, which may be either in Beckham, Washita or Kiowa counties, with a north and south line 180 miles along the southern boundary of Oklahoma north through Tillman, Jackson, Harmon, Greer, Beckham, Roger Mills, Ellis and Woodward counties. The directors are W. F. Crawford, Indianapolis, Ind.; Richard W. Ruffin, Hamilton, Ohio; D. B. Richardson, J. A. Whitehurst and G. L. Bennett, Sayre.

William Crooks of Dallas, Tex., in charge of a corps of 15 surveyors, has started from Oklahoma City to survey a railroad line from that city to Canadian, Tex. The proposed line will touch Hinton, Hobart, Sayre, Cheyenne and thence to Canadian. Eastern Oklahoma and Texas capitalists are interested.

The Atchison, Topeka & Santa Fe Ry. has awarded the contract for the grading of its new freight yards at Oklahoma City to John Acklin for $20,000. The yards will be situated north of 23rd St. and will cost about $250,000.

The St. Louis & San Francisco R. R. officials have decided in favor of constructing a spur to the proposed site of the Oklahoma Rod Company at Tulsa, Okla.

Officers of the Osage & Western Ry. are taking steps toward floating bonds for the construction of the proposed road from Pawhuska, Okla., to a point near Ponca City. Surveyors are now at work on the line pushing toward Enid. Clarence Walters, Claremore, Okla., Vice President and General Manager of the company, is reported to have announced that construction work would not be started this year.

The West Tulsa Belt Line Ry. Co. has been reorganized and as sufficient capital is now guaranteed it is expected that construction work on the proposed line will be started without delay. The following officers have been elected: J. S. Cullinan, President; J. E. Crosbie, Vice President; H. L. Stewart, Secretary and Treasurer; F. P. Dodge, Constructing Engineer.

The Cherryvale, Oklahoma & Texas R. R., promoted by Senator Porter, Caney, Kan., has decided upon a change of its route through the Cherokee Reservation. As originally planned, the line would run southeast through Dewey and Washington Counties, but now it is planned to locate a new town near Glenn, Okla., at the junction of the company's two lines.

Oregon Notes.

FROM CORRESPONDENTS AND OTHER SOURCES.

The port of Toledo formed at a special election at Toledo, Ore., has secured an engineer, Eugene Schiller of Portland, to make a survey of the bay and prepare plans for a 14-ft. channel between Toledo and deep water at Yaquina.

The Mount Hood Railway & Power Co. has secured right of way for its projected 25 mile railway from Portland to Bull Run, where a power plant is now being constructed, and the electric line will be built in the very near future. Actual construction work on the line will probably be under way within two months. From Montavilla east the line will parallel the Base Line road on the north to Rockwood, thence to Gresham and Lusted's hill in almost a straight line. From Lusted's hill the road will head for Bull Run in as straight a line as will be permitted by the contour of the land, which in that district becomes quite rugged. The tracks will cross Sandy River at a point above the confluence of the Bull Run River with the Sandy, over a cantilever bridge 2,000 ft. long, including the approaches. The longest span in the structure will be 140 ft. and it will be strung 80 ft. above the water of the stream. C. M. Raser, Sweetland Bldg., Portland, Ore., is chief engineer.

Charles Johnson, Seattle, Wash., who has a subcontract for grading between Crescent, Ore., and Carroll Springs on the Oregon Trunk Line, has established a construction camp at Crescent.

Surveys have been completed for the projected electric line across the Coast Range to Tillamook, and contractors have been over the route. This line is to be built for the United Rys. Co., of which John F. Stevens, Portland, Ore., is president. Two more electric line surveys have also been approved, these being the extension from Salem to Albany and from Tigardville to McMinnville. Between Salem and Albany the distance is about 50 miles and between Tigardville and McMinnville about 20. The United Railways Tillamook extension will require approximately 80 miles of new work.

F. B. Kidder, Eugene, Ore., one of the promoters of the Lane County Asset Co.'s proposed line between Eugene and Coos Bay, Ore., is preparing to direct the beginning of the survey from Marshfield.

Committee of citizens of Marshfield, Ore., who have charge of raising the required $150,000 bonus for the construction of the Coos Bay, Oregon & Idaho R. R. are making good progress and it is expected that the amount will be at hand in a few days.

The Bellingham & Skagit Ry. Co., of Portland, Ore., has been incorporated with a capital stock of $1,000,000 and proposes the construction of a new line. The promoters of the project are Charles M. Drummond, Josiah H. Drummond, Clark D. Chapman, of Portland, Ore.

Pennsylvania Notes.

FROM CORRESPONDENTS AND OTHER SOURCES.

Charles Crumbling, York, has begun work at McSherrystown on his grading contract for the trolley line at that place.

The entire route for the projected interurban line of the Fairmont-Pittsburg Traction Co. has been surveyed and much of the right of way secured. Construction work on some of the sections is also under way. The road is to extend from Fairmont, W. Va., to Pittsburg, 80 miles. The company has recently taken over the rights, franchises and charters of the Waynesburg & Monongahela Electric Ry., which covered Waynesburg, Marianna and Carmichaels on the Monongahela River. Another line has been secured from Morgantown, W. Va., extending in a northwesterly direction to Blacksville, and another line branching out from Fairmont to Mannington, W. Va., and thence north and east of Blacksville, while a straight line, running due north from Fairmont, passes through Blacksville on the state line of Pennsylvania and West Virginia and continues through Greene and Washington counties, by way of Waynesburg, Ten Mile, Lone Pine, Snodgrass and Bridgeville to Pittsburgh. W. M. Laws, Fairmont, W. Va., is president.

McCourt & Herndon, Akron, O., have started work on their subcontract on the Western Maryland R. R. extension at Ohiopyle, Va. Their contract calls for grading and concrete work for four miles of line and amounts to about $200,000. Over 100 men will be employed.

Extensive improvements are stated to be planned for this summer in the Pittsburg district by the Pennsylvania, the Pittsburg & Lake Erie and the Monongahela R. R. The work involves the construction of a bridge over the Monongahela River, near Brownsville Junction and new classification yards by the Pennsylvania, the elevation of the yard at Red Stone to a new grade by the Pittsburg & Lake Erie and the erection of a 70-ft. concrete arch by the Monongahela. The bridge alone will mean the expenditure of $750,000. It will be a double track affair and have a channel span of 450 ft. The Pennsylvania, the Pittsburg & Lake Erie and the Monongahela railroads are to share in the cost of the improvement, which is to benefit Brownsville Junction and Red Stone. The chief feature of the work is the construction of the bridge. It will be 10 ft. higher than the structure it is to replace and will be of unusually heavy construction. It will require 10,000 cu. yds. of masonry, among other things. The building of the bridge at a greater height than the present one has made necessary the changing of the grades at the yards at either end by the three railroads that use it. The concrete arch will carry the tracks over the approach, which crosses a roadway. The Pennsylvania in the classification yard it is to build will have 30 tracks, each half a mile long. The yard will be operated on the gravity system. The Monongahela railroad will carry out an enlargement of its yards which has been contemplated for some time. In all there will be required 300,000 cu. yds. of fill to properly ballast the new treminal point where the three roads exchange freight. The work, which has been planned under the joint supervision of the engineers of the three roads interested, will be done as a single contract. The three roads will jointly own the bridge, the construction of which will call for several thousand tons of steel.

A. De Mayo & Co., New York City, have construction work well along on the Slippery Rock & Grove City Street Ry. line and it is expected that the track between the two towns will be completed in four months. Location surveys for that portion of the line between Slippery Rock and Butler have been completed and bids for the construction of this link will be asked shortly. This link will give a connection with the Pittsburg, Harmony, Butler and New Castle lines in Butler. The line as surveyed runs through West Liberty, Isle, Prospect and via Mount Chestnut to Butler. It is reported that rights of way have been procured north of Grove City to Stoneboro and Sandy Lake. Eastern capitalists are working with the Slippery Rock & Grove City Street Railway Co. and will build to Meadville, thus giving electric railway service from Pittsburg to Buffalo via Erie. H. B. Graves, Butler, Pa., is Chief Engineer.

O. M. Hoffman, Columbia, is now selling the stock for the proposed Ephrata & Lebanon trolley line. It is stated that this work will require a month or two after which construction work will be started.

The Pennsylvania R. R. is reported to be securing right of way from the new town of Besco, on the north side of Ten Mile Creek, to Marianna, a distance of 4½ miles. The company has already built the line from Millboro to Besco, a distance of 2½ miles.

The Monongahela & Southwest R. R., it is said, will start work shortly on the construction of the proposed line from a point near the Wabash R. R. property in Snowden Township and will connect with a point on the Baltimore & Ohio R. R., opposite the Glenwood yards on the Monongahela River. Surveys for the proposed road have already been completed.

Surveys have been completed for the construction of the proposed Monongahela Short Line R. R., from a point on the Baltimore & Ohio Railroad in Snowden Township, to a point on the Pittsburg, Virginia & Charleston R. R., in Homestead. It is expected that work will be started shortly.

South Carolina Notes.

FROM CORRESPONDENTS AND OTHER SOURCES.

Surveys have been completed for the projected interurban line of the Greenville, Anderson & Spartanburg Ry. Co. of Greenville, S. C., and the towns of Greenwood, Abbeville and Due West are bidding for the line. It was found that the line by way of Abbeville was two miles shorter than via Greenwood. The cost of the two, however, the engineers reported, would be about the same. Both towns have offered very substantial inducements to the promoters of the railway. Due West also is making a strong bid for the line. To carry

it through Due West would make it four miles longer than through Abbeville.

South Dakota Notes.

FROM CORRESPONDENTS AND OTHER SOURCES.

The County Commissioners at Elk Point, S. Dak., have awarded the contract for the construction of the Dennison ditch to the Sherwood Dredging Co., of Alexandria, Minn., for 14¼ cts. a cubic yard. This ditch is located four miles east of Elk Point and is 4½ miles long, with a yardage of 45,000 cu. yds. Work is to commence within 30 days, and is to be completed by Dec. 1, 1910.

The Chicago, Milwaukee & St. Paul R. R. has purchased the "Soo" right of way through the corporate limits of Aberdeen, S. Dak., and will use it to add to its trackage facilities there.

Advices from Pierre, S. Dak., are to the effect that the Chicago & Northwestern Ry. Co. has filed with the state Land Department a plat showing the proposed route of the projected line from Dallas through Tripp County in a northwesterly direction to the southeast corner of Mellette County.

Surveys have been made for the construction of the proposed railroad from Sioux Falls, S. Dak., to Wheeler, on the Missouri River, Charles Mix County. The promoters of the project, who are business men of the first town, are now seeking financial aid to carry out the plans.

The Nebraska & Dakota R. R. Co. has filed articles of incorporation with a capital stock of $4,500,000 and headquarters at Pierre, S. Dak., and proposes the construction of a line from Murdo, S. Dak., to Burwell, Neb., through the counties of Lyman, Mellette, Todd and Tripp, S. Dak., and Rock Loup and Garfield, Neb., a distance of 180 miles. The incorporators are Martin B. McWilliams, Paul Miller, J. H. Christensen, Samuel C. Ware, Charles J. Reublin, Chicago, Ill., and L. L. Stephens, Pierre, S. Dak. Surveys for the proposed line are already under way and right of way is being secured.

Tennessee Notes.

FROM CORRESPONDENTS AND OTHER SOURCES.

The Memphis Street Ry. Co., T. H. Tutwiler, president, Memphis, Tenn., has filed an application to amend its charter giving it power to make many improvements at Memphis. The company plans several important changes including the construction of several cross city lines.

Bids were opened June 9 by J. L. Lancaster, president of the Memphis Union Depot Co., Memphis, for the construction of the union depot. The bids ranged from $550,000 to $600,000, the following contractors bidding on the work: Selden-Breck Construction Co., Memphis; Olsen & Lesh, Memphis; the Hedden Construction Co., New York city; James Stewart & Co., St. Louis, Mo.; Geo. A. Fuller Co., Chicago, Ill.; John M. Ewen Co., Chicago, Ill.; Noel Construction Co., Baltimore, Md.; Murch Brothers Construction Co., St. Louis, Mo.; Westlake Construction Co., St. Louis, Mo.; Rommer Brothers, Louisville, Ky., and the C. L. Gray Construction Co., St. Louis, Mo. The specifications call for front and side walls of stone and concrete, with rear walls of dark buff or slate colored pressed brick. All interior woodwork will be of mahogany or of that finish. Ceramic mosiac floors will be laid in the drug store, barber shop and billiard room on the first floor, while marble slabs will pave the general waiting room and main hall. The approaches to the general waiting room and floors of the terraces, including the porte cochere, will be paved in red French flint tile. The interior walls of the building will be finished in terra cotta or tile, with marble bases and trimmings, where solid marble walls are not otherwise specified.

W. J. Oliver, Knoxville, has started work on the erection of the new dam across the Watauga River for the Watauga Power Co., of which Lee F. Miller, Elizabethton, is President. The dam will be 50 ft. high and it is said will develop about 3,000 HP. The power has been contracted to the Bristol Gas & Electric Co. and will be transmitted over its lines to consumers. About 7,000 bbls. of cement will be required for the dam.

Mass meetings have been held at Alamo to raise funds for a new railroad. The road is to run from Dyersburg via Banicord, Friendship, Crockett Mills, Alamo and Bells or Fruitvale on to Jackson. It is understood that Crockett County is to raise $75,000 to help build the railroad.

The City Council of Harriman has granted a right of way to the Harriman, Knoxville & Eastern R. R., along Emory St. from its intersection with Roane St. to its intersection with Cumberland street at the eastern side of the city. The ordinance also provides for the closing of certain streets at their crossing with Emory St. It is proposed to commence the construction work within six months and complete it within 18 months and have trains in operation. The ordinance was presented by H. W. Winslow, W. A. Rockwell, and C. T. Cory as composing the Haarriman, Knoxville & Eastern R. R. Co., which has just applied for a charter.

Texas Notes.

FROM CORRESPONDENTS AND OTHER SOURCES.

A proposition is to be submitted to the promoters of the Terrell-Dallas Interurban R. R. Co. to have the company select a route north of the Texas & Pacific track between Dallas and Forney for a line. The route as now surveyed is by way of Scyene instead of Forney. C. L. Wakefield, Trust Bldg., Dallas, is one of the promoters.

The Holland-Texas Dam & Irrigation Co. of Cotulla, has been incorporated with a capital stock of $23,000, the incorporators being J. J. Newton, J. C. Cameron and J. W. Patterson.

The present status of the Tucumcari, Portales & Gulf R. R., which projects a line from Tucumcari, N. Mex., to Del Rio, Tex., is said to be about as follows: Surveys have been made, 50 miles of right of way secured and $350,000 in cash has been put up. The line is more or less located through the counties of Bailey, Cochran, Yoakum, Gaines, Andrews and Winkler to Pyote. From Pyote the projection is to be to Del Rio, without any definite route in view as yet. The first work to be done will be the building of a 57-mile section from Texico to Farwell. Contracts have also been let for grading and track laying on 50 miles running north of Pyote, Texas, and through the irrigated belt of Fort Stockton, another section running south from Pyote will be built. Surveys extending from Texico to the Rio Grande and to Faulkner, Mexico, have been completed.

The Houston Electric Co., Houston, is to expend $700,000 this year in improvements. Of this sum $75,000 will be expended for extending the South End line to the Rice Institute.

The Espejo Land & Irrigation Co., of San Antonio, has been incorporatd with a capital stock of $64,000, the incorporators being B. F. Nicholson, W. B. Tuttle and Frank Curtiss Smith.

J. F. Edwards has been elected President of the San Antonio, Rio Grande & Tampico R. R. to succeed A. B. Heddon of New York. The change is said to mean that more money will be put into the construction of the road at once. The road is being built from San Antonio to the Rio Grande, and will be eventually extended to Tampico and has been constructed for about 30 miles. Mr. Edwards was the original promoter.

The Commercial Club of Brownwood, Tex., is taking vigorous steps to secure the construction of the proposed Cleburne-Coleman R. R. to that city instead of Coleman.

Advices from Stamford, Tex., state that Col. Morgan Jones is attempting to purchase the Estacado & Gulf R. R. of W. A. Butts, with the intention of extending it from McCauley, the present terminus, to Handley and Snyder. At present Jones has a line under construction from Hamlin to Anson, which he will extend to Abilene to connect with the Abilene & Southern at that place.

The Chamber of Commerce of San Angelo, Tex., and T. K. Wilson and J. A. Loomis, large land owners on the Lipan Flat, about 20 miles south of the city, are taking up the matter of securing the construction of a railroad into that section of the country, which is one of the most densely populated farming sections in Texas.

The Missouri, Oklahoma & Gulf R. R., which is building into Denison, has laid rails to within 8 miles of Red River, and grading outfits are at work between the city and the stream. The bridge has already been completed.

The Port Brownsville Sugar Lands Co., which has acquired 51,000 acres of land near the mouth of the Rio Grande, has had surveys for a large main irrigating canal and laterals and will put all the land under irrigation. This is said to be but a part of a scheme for establishing a deep water port to be known as Port Brownsville. Edwin S. Brodnix, St. Louis, Mo., and R. L. Still, Brownsville, Tex., are interested. In addition to the reclamation project and the new port, it is understood that allied interests are contemplating a railroad to San Antonio from Port Brownsville and a system of interurban railways throughout the valley.

The award of the Commissioners fixing a price of $200,000 for the land for the dam site and lake for the construction of Elephant Butte dam and the reclamation by irrigation of 220,000 acres of land in the vicinity of El Paso has been approved, thus removing the last obstacle to the work. The work will be done under the direction of the U. S. Reclamation Service.

The Gulf, Texas & Western Ry. is said to be planning to secure an entrance to Weatherford. The building of 15 miles of track is necessary between Graford and Jacksboro to give the Gulf, Texas & Western an entrance into Weatherford over the line of the Weatherford, Mineral Wells & Northwestern, and negotiations in that direction are pending with, it is said, strong probabilities of success.

The Houston & Brazos Valley R. R. has filed with the Texas Railroad Commission formal application for an inspection and valuation of a 4-mile extension from Velasco to the Lighthouse, also additions and improvements, with a view of issuing bonds.

Surveys were started June 11 on the proposed line of the recently chartered Nuexces River Valley Ry. Co., by G. A. Hall, C. E., Philadelphia, Pa. As planned the road will extend from Beeville, Texas, to Eagle Pass, touching six county seats. Beeville, which is to be the headquarters of the company, has raised the necessary cash bonus and site for the terminals.

Preliminary surveys are now under way between Vernon, Tex., and Miami, a distance of 200 miles, for the proposed railroad from the Texas Panhandle to the Gulf. George W. Angle, of New York, is representative of the financial interests.

Utah Notes.

FROM CORRESPONDENTS AND OTHER SOURCES.

The promoters of a projected interurban line between Ogden and Logan, accompanied by Engineer Carl Schaub of Logan, have been through Blacksmiths Fork canyon with a view to selecting a site for the electric plant. The canyon is about eight miles south of Logan near the proposed route of the road. David Eccles and M. S. Browning, Ogden, are interested in the line.

The Ogden Rapid Transit Co., Ogden, is to extend its Ogden canyon trolley line through to Huntsville and other points in Ogden Valley. The line already runs as far as the Hermitage in Ogden Canyon, seven miles from Ogden. The extension will carry the road seven miles further, passing through one of the most fertile valleys in Utah.

Virginia Notes.

FROM CORRESPONDENTS AND OTHER SOURCES.

The city council of Richmond has extended the time for completion of the new Church Hill viaduct and the proposed lines of the Richmond & Henrico Ry. Co. for six months from June 30. The Richmond & Henrico Ry.

Co. is the holder of the rights and franchises of the Citizens' Rapid Transit Ry. Co. Part of the line is already completed. The company has secured a site for a power house at Louisiana street and contracts for $80,000 of machinery have been let. G. W. Trafford is engineer for the power house and W. S. Forbes, Richmond, is president.

The council committee on streets of Richmond is now considering a proposition of the Virginia Railway & Power Co. of Richmond with reference to the contemplated extension of the railway lines.

A Philadelphia syndicate has purchased a large amount of property fronting on the Boonsboro Turnpike, beyond Rivermont, involving the frontage of the Presbyterian Orphanage estate, lying in Campbell and Bedford counties, and has obligated themselves to give these properties trolley car facilities within two years. It is also stated that several Northern capitalists have been in Lynchburg recently going over the city with a view of establishing a second street railway system there.

The Norfolk & Western Ry. has plans under way for the construction within a year or two of a large steel pier at Lamberts Point near Norfolk, for its coal business.

Advices from Suffolk, Va., state that a new railroad is proposed to run across the counties of Southhampton and Sussex. The preliminary survey has been completed between Pope, on the Southern Railway, and Lumberton, in Sussex County. This distance is 12 miles, but it is expected the road will be extended to about 30 miles. The Churchland Manufacturing Co. is one of the chief promoters of the line.

The construction of a 60-mile electric railway in Lee and Wise Counties is proposed and W. G. Coults, of the Board of Trade, of Big Stone Gap, Va., has gone to Goderich and Toronto, Canada, to interview capitalists in an effort to interest them in the project.

Washington Notes.

FROM CORRESPONDENTS AND OTHER SOURCES

According to a report of the engineer in charge of the preliminary survey the proposed high line canal, which will water 300,000 acres in Yakima and Benton counties, will cost $26,000,000, or about $86 per acre. The canal is considered entirely feasible.

The Occidental Fish Co., W. B. McDonald, president, Seattle, has had work started on a large fish dock on Western avenue, at the foot of Bay street, Seattle. The total cost of real estate and improvements will be $300,000. The pier will be 250 ft. long and 62 ft. wide. It will have two stories and the roof will be entirely supported by the walls, no pillars cutting up the floor space.

An ordinance has been before the City Council of Spokane to grant a franchise to the Chicago, Milwaukee & Puget Sound Ry., and the North Coast R. R. for the erection of a union station on the site on north side of Front Ave. between Howard and Washington. The improvement will involve the expenditure of $1,000,000 by the two roads, exclusive of their right of way. In the franchise it is stipulated that construction must begin on the depot within six months after passage of the ordinance, and that the depot must be completed within three years. The railroads are given the right to erect the structure projecting over the north sidewalk on Front St., but must keep the sidewalk open beneath. The roads agree to construct concrete or masonry retaining walls on all their embankments and fills exposed to view on Front Ave. between Post and Center Sts. All viaducts over streets shall be of steel, concrete, or a combination of the two.

Harry White, Seattle, Wash., President, Alaska Anthracite Coal & Railway Co., is reported to have announced that surveys and plans have been made for the proposed line and the necessary funds for construction secured. The main line will start from Controller Bay, follow the Bering river, pass Stillwater and into Carbon mountain, a distance of about 22 miles. Branches will be run off the main line 10 miles to Bering Lake coal fields, where McDonald's mine is located, and to other mines. A large part of our preliminary work has been in the hills and mountains, and our survey is now complete to the ocean.

Construction work is being pushed with the utmost rapidity on the double tracking of the Northern Pacific's main line from Tenino to Kalama, Wash. Track between Chehalis and Centralia has been thrown open for operation and it is expected to finish the line from Centralia to Bucoda shortly. There are at present 17 steam shovels at work along the line and between 1,700 and 1,800 men are employed either on the grading or track laying. By November 1 it is hoped to have the double tracking entirely done.

H. C. Henry Contracting Co., Seattle, Wash., plans to complete the Moncton-Everett line for which it has the contract from the Chicago, Milwaukee & Puget Sound Ry., by January 1, 1911. About all right of way has been secured.

Over 200 men are at work on the 12½-mile contract of the Grays Harbor & Puget Sound Ry. from Cosmopolis to North River clearing and grading for reconstruction.

The city of Hoquiam, Wash., and Grays Harbor & Puget Sound Ry., a subsidary company of the Union Pacific, have agreed as to the right to cross the Hoquiam River at Simpson Ave. The railway company and city will erect bridge piers jointly, the former to construct its bridge at once and the city to build its structure at some future date. This will end the trouble existing for several months, and will give the Union Pacific a franchise through the city of Hoquiam.

The City Council of Hoquiam has awarded the contract for filling a large slough to M. D. Hogan, Hoquiam, at 44½ cts. per cu. yd.

West Virginia Notes.

FROM CORRESPONDENTS AND OTHER SOURCES.

According to a statement of T. Moore Jackson, at Clarksburg, W. Va., actual work on constructing the Middle Island Railroad will begin in a very short time. The construction work will be started at Sistersville and the first section to be completed will be that between Sistersville and Middlebourne. This is expected to be completed this summer and put in operation at the earliest possible date. As soon as that section is placed in operation the road will be extended up Middle Island creek to the headwaters and over the divide to Salem. All of the districts in Tyler county through which the proposed road passes have voted to take the bonds required.

The construction of 26 miles of electric railway from Beverly to Zanesville, O., thus completing the connecting link for Parkersburg to the Great Lakes, is proposed. H. D. Blodgett, of Zanesville, O., a constructor of electric lines in Ohio, was in Parkersburg, W. Va., recently in conference with some West Virginia and Eastern capitalists relative to building the line.

Wisconsin Notes.

FROM CORRESPONDENTS AND OTHER SOURCES

The city council of Manitowoc has passed orders for the docking of the river to protect the channel leading to the Rock river dock of the Soo line, and 500 ft. of dock to cost approximately $12,000 are to be built.

The State Railroad Commission of Wisconsin, Madison, Wis., has instructed the Chicago & Northwestern Ry. Co. to extend its tracks up on the land of the Union Lime Co., to the plant of the Eden Co.

The State Railroad Commission, Madison, Wis., has issued a certificate of Convenience and Necessity to the Prairie Farm & South Western R. R. Co. (Badger Short Line) to construct a railroad between Prairie Farm and Emerald, Wis., a distance of 16 miles, connecting at the latter place with the Minneapolis, St. Paul & Saulte St. Marie. George E. Scott, Prairie Farm, Wis., is President of the company.

The Ontario & Northern Ry. Co. has been incorporated with a charter of $75,000 and proposes to build a railroad from the village of Ontario in Vernon County to the village of Wilton in Monroe County, a distance of about eight miles. The directors are V. A. Stoddard, C. W. Lord, A. T. Saunders, L. R. Abbott, C. M. Sundon, H. Timmerman, Ed. Stockman, L. R. Walker, E. E. Lord, S. Sloggy, F. G. Bredlow and Levi Wallace of Ontario and Howard Teasdale of Sparta.

Canadian Notes.

FROM CORRESPONDENTS AND OTHER SOURCES.

The city commissioners of Calgary, Alberta, have accepted the routes for a number of extensions of the Municipal street railway system. The city engineer will make an estimate of the cost of the work. The extensions will mean that two new bridges will have to be constructed, one across the Elbow at the end of 2d St. east, and the other across the Elbow at the east end of 12th Ave.

The Canadian Pacific Ry. has announced its decision to continue double-tracking the main line between Winnipeg and Brandon. It was only intended to go to Portage this year, but the graders have been ordered to go on to Brandon, 150 miles.

The Highland Navigation Co., Winnipeg, propose to construct a wharf at the foot of Matheson Ave., in that city.

Contracts for the lines of the Canadian Northern R. R. to the Brazean coal fields from the south of Stettler and the line from Edmonton to the Yellowhead Pass are to be awarded shortly. In the one case the delay is caused by the non-completion of the final survey and in the other case by non-approval of the route plan by the railway commission. The line to the Brazean coal fields will start at a point south of Stettler and run in almost a straight line to destination. The line from Edmonton will run north of the Grand Trunk Pacific, some little distance in order to serve county not tapped by the G. T. P.; but when nearing Wolf Creek, the two lines will come close together, and the C. N. R. will possibly touch at Edson, but this cannot be stated definitely as the route plans have not been approved.

The Canadian Northern Ry. completed track laying from Camrose to Stettler on June 13.

According to the annual report of the National Transcontinental Railway Commission for the fiscal year ending March 31 last 63 per cent of the grading on the whole line of the Transcontinental Ry. from Moncton to Winnipeg is now finished and 45 per cent of the bridging. During the last fiscal year 521 miles of track were laid, the total track mileage on March 31 totalling 760, with an additional 165 miles of sidings. At the present date steel is laid on about half of the distance from Moncton to Winnipeg. Construction work is being vigorously pushed this summer on every section of the line, and it is expected that the road will be ready for through traffic in August or September of 1912. The line from Winnipeg to Fort William will be opened for regular traffic next August. The total expenditure on the road up to the end of the fiscal year was $71,137,993, of which $53,850,000 was for grading, $7,201,000 for rails and $8,237,038 for engineering and expense.

The Canadian Pacific Ry. Co. is preparing to continue the double tracking of the line between Portage and Brandon. J. C. Hargrave & Co., who recently completed subgrade work on the section of the line from Winnipeg to Portage, have been instructed to continue west and will proceed at once. The completion of this work will give the C. P. R. 522 miles of double track from Fort William west.

Efforts are being made to rush to completion the construction work on the National Transcontinental Ry. east of Superior Junction. The Commission has sent notices to the contractors fixing time limits on the work. Foley & Welch have already laid 26 miles of steel east of Cochrane, but are being held up temporarily by the bridge across Mistango River, now under construction. The grade is ready for a additional 52 miles of steel. Considerable steel has been laid west of Quebec and M. P. Davis has 50 miles graded. In the La Tuque district 100 miles of track have been

completed. West of Cochrane steel is down as far as Groundhog River, and an additional 100 miles will be laid by fall.

Vickers' Sons & Maxim, English shipbuilders, have filed plans at Ottawa for a $2,500,000 shipbuilding and repair plant to be located at Montreal. The plans include a floating dry dock, three large berths for the repairing and building of steel vessels, machine shops and a plant capable of doing the heaviest construction and repair work and covering some 50 acres of ground.

John Armstrong, Ottawa, Dominion Government Engineer in charge of the Hudson's Bay Railway Surveys, has gone to the Pas, where a considerable amount of preliminary work is being done in connection with the construction of the railway bridge across the Saskatchewan. Plans have been completed for a bridge, which, it is understood, will be similar to the one at Prince Albert. These are now in the hands of the department at Ottawa, and tenders will be called for as soon as they have been approved. It is expected that work will be started next month.

A street railway system is projected for Welland, Ont. C. J. Laughlin has applied for a franchise and proposes to have the line completed in five months. He will have tracks on both sides of the canal, also to Welland Junction.

Construction work will be started, it is said, in a few days on the Canadian Northern Ry. line from Strathcona, Alta., to Camrose, forming the final connecting link on the colonization extension which will join Strathcona and Calgary next summer. Contractors will push the line about 24 miles this fall. Right of way is already being secured. T. Turnbull, Winnipeg, Man., is Assistant Chief Engineer of the company.

The Canadian Northern Ry. has about completed the survey of the main line from Edmonton to the Pacific coast with some changes from the original route to gain better grades. The company is also about ready to construct a line from Victoria to Barclay Sound on Vancouver Island, a distance of 120 miles. Tenders closed June 15 for the first 60 miles of the main line east, from New Westminster to Chilliwack. The contractors will be given one year to complete this work, a small part of which is in rock.

The promoters of the Peoples Ry. Co. have been drawing up an agreement with the city of Guelph, Ont., for the proposed radial road, to be built between Guelph and Berlin. A by-law providing for the taking of $60,000 stock in the road by the city of Guelph will probably be submitted shortly to the ratepayers.

The Canadian Government steamer Stanley has sailed from Ottawa for Hudson Bay with two parties to make hydrographic surveys at Port Nelson and Fort Churchill. The report of these surveyors will determine the location of the deep water terminus of the Hudson Bay Railroad, the first contract of which will shortly be let by the Canadian Government. W. J. Stewart, head Canadian hydrographic surveyor, will have charge of the work, which will be divided between two parties, one under H. B. Pariseau and the other under A. A. G. Bachand. One party is assigned to Churchill and the other to Nelson.

The Government of Nova Scotia has granted a charter to a Canadian and London syndicate for the construction of the long projected Eastern Railway from a point on the Intercolonial at or near Dartmouth to Guysboro, with branch lines to points on the Intercolonial Railway at or near New Glasgow, and also to Country Harbor, in the county of Guysboro, and much other branch lines as the governor in council thinks fit. The proposition for the construction of the railway and branches has been made by John Bogert Bartram of Toronto, barrister; Thomas B. Fogg of Toledo, Geo. H. Raw and Sigmund Hirsch of London, England, brokers. The head office is to be in Halifax or such place in Nova Scotia as the directors determine. The capital stock of the company is to be $3,000,000. The company is to have free right of way over crown lands, and the charter is to cease unless the company be actually organized and engaged in business in two years. It is expected that the contract for the construction of the road will be signed in a few days. The syndicate has also practically completed the purchase of the Alfred Dickie Company's timber limits in Halifax and Guysboro counties.

The city council of Quebec has decided to sell the Champlain market property for $100,000 to the Transcontinental Railway Commission for a terminal site. The deeds will be signed before Sept. 1.

Mexican Notes.

FROM CORRESPONDENTS AND OTHER SOURCES.

S. Pearson & Sons, Ltd., City of Mexico, have about completed the exploration work in connection with the Nazas River dam project for the Laguna irrigation system which is to be constructed for the Mexican government. A site has practically been settled upon at Caja Pinto, where at a very satisfactory depth, there is every indication that a perfectly good and safe foundation has been found, and it will be but a short time before all operations are concluded to complete the plans for foundation as presented to the government by Frederick Adams, City of Mexico, the managing director of the construction department of S. Pearson & Sons. The dam when it is constructed, will have a storage capacity of 1,800,000,000 cu. meters of water. It is planned to hold sufficient water to more than irrigate the entire Laguna district and enable the planters there to double the yield of cotton per acre.

Work on the Conchos River dam and railway line mentioned some time ago in this paper, has been making good progress. The contractors, S. Pearson & Son, City of Mexico, have just completed the railroad, which is of standard gage, connecting La Boquilla, the town at the dam site, with Santa Rosalia, on the National Railways of Mexico in the state of Chihuahua. The total mileage of the road is 31 kilometers. The contractors have also completed the erection of 300 houses for the laborers at La Boquilla. The dam will be one on the largest in the world, exceeding in size both the Gatun and the Necaxa. It will have a capacity larger than either of the former and will be equipped with the most modern and expensive machinery. The dam's spillway will be cut through the hill, necessitating the excavation of about 250,000 cu. meters of rock, the bulk of which will be used in the construction of the dam.

The Grant Brothers Construction Co. of Los Angeles has been rushing materials and supplies for the Southern Pacific extension in Tepic across the Santiago River in anticipation of the early opening of the rainy season. The first high water in the Santiago River is expected to carry away the temporary bridge built across that stream at a point fourteen kilometers from the town of Santiago Ixcuintla, and after that it will be impossible to transport heavy supplies across the river until such time as another temporary bridge can be built at the close of the rainy season in the fall. The contractors expect to carry on construction work during the rainy season.

The Mexican government has granted a concession to V. Mistretta of Galveston, Tex., to construct a railroad through the heart of the banana-growing territory of Tabasco. Mr. Mistretta is financing the road in the United States.

Griffiths & Co., an English concern, have secured the contract for the construction of the New Chilian Ry. at $21,250,000. The railway will ultimately form part of the Pan-American Railway System which is to extend from New York to Valparaiso; but the present contract is in respect of the southern section of the Longitudinal Railway of Chili. It is to be constructed between Cabildo, north of Santiago, and Toledo, near Copiapo, a distance, in all, of 620 kilometers, or about 400 miles. At this point the northern section of the Longitudinal Railway starts, and runs thence to the port of Arica, continuing to La Paz, the capital of Bolivia, which portion of the line is also being constructed by Messrs. Griffiths & Co. in conjunction with Sir John Jackson (Chili), Limited. The route of the southern section has been surveyed by the Government engineers, and work on it has already been started by the Government of Chili. The rails to be used are calculated to weigh 35,160 tons, which will cost about $1,000,000. Tenders will be invited for this contract, and also for supplying some 40 locomotives, 300 goods trucks, and 50 passenger carriages. The construction of the railway, which will have a gauge of 3⅜ ft., involves 14,000,000 cubic yards of earthwork, 3 1-3 miles of tunnelling operations, and nearly three miles of bridges.

The Baltimore & Ohio R. R. has compelted plans for the beginning of construction work on the improvements that are to be made at Frederick, Md. Work will be started, it is thought, about July 1st.

Bids were opened June 15 at the office of the Isthmian Canal Commission, Washington, D. C., for building and erecting lock gates for the Panama Canal. The contract calls for about 60,000 tons of steel. There will be 46 mitering gates of two leaves each. The locks on the canal will be located at Gatun, Pedro Miguel and Miraflores. There will be 10 locks at Gatun, 6 at Pedro Miguel and 7 at the last named place. The locks will be 130 ft. wide and each gate 65 ft. wide, and nearly 7 ft. thick. The bids received were as follows: McClintic-Marshall Construction Co., of Pittsburg, for $5,374,474; the United States Steel Products Exports Co., $6,100,000 and $6,200,000; the Maryland Steel Co., $8,409,368, and Riter-Conley Manufacturing Co., of Pittsburg, $10,183,257.

Surveyors of the El Paso & Southwestern R. R. Co., running a line from Benson to Winkelman, have compelted their work to Mammoth, within 20 miles of Winkelman, Ariz. Thus far the new survey lies entirely on the west side of the San Pedro River. C. S. Henning, Jr., Tucumcari, N. Mex., Assistant Engineer, is in charge of the work.

Delegations composed of business men of Columbus and Mineral Springs, Ark., are taking up the matter with the officials of the Magnolia & Northern R. R. Co. of constructing their proposed line. The road as projected will run from Magnolia, through Hope De Queen via Columbus, Mineral Springs and other points. S. A. Sevier, Hope, Ark., is interested in the project.

BIDS ASKED

Bridges.

Bids are asked on following work, the notes being arranged alphabetically by states:

Visalia, Cal.—Until July 12, by Morve L. Weaver, City Engineer, for the construction of reinforced concrete conduit and bridges in this city. The work is estimated at $80,000.

Washington, D. C.—Until 2 p. m., June 27, by District Commissioners for the construction of a concrete and rubble arch bridge on the line of Peach Driveway, Rock Creek, above Military Road.

Columbus, Ga.—Until noon, July 18, by W. C. Campbell, Superintendent Public Works, for the construction of a concrete steel arch bridge over the Chattahoochee River at Dillingham St. The structure is to be of the Melan System.

Pocatello, Idaho.—Until July 17, by Board of County Commissioners, for the construction of a new steel bridge across Bear River at Soda Springs to replace the present wooden structure.

Albion, Ind.—Until 2 p. m., July 5, by Board of County Commissioners for the construction and repair of bridges, culverts and abutments. John W. Earle is Auditor of Noble County.

Crown Point, Ind.—Until noon, July 5, by County Commissioners, for the construction of a bridge in Ross Township. C. A. Johnson is Auditor of Lake County.

Greenfield, Ind.—Until 10 a. m., July 5, by Board of County Commissioners for the construction of three concrete and steel bridges in Brandywine Township and one in Sugar Creek Township. C. H. Troy is Auditor of Hancock County.

Martinsville, Ind.—Until 2 p. m., July 5, by County Commissioners, for the construction of a bridge in Gregg Township. B. E. Thornburgh is Auditor of Morgan County.

Peru, Ind.—Until 2 p. m., July 6, by County Commissioners, for the repair of Eel River bridge in the town of Mexico.

Fort Benton, Mont.—Until 2 p. m., July 11, by W. R. Leet, County Clerk, for the construction of a combination or steel bridge across a coulie three miles west of Havre, Mont. The structure will be 51 ft. long and 18 ft. wide with concrete piers 4 ft. square and 3 ft. deep. Official advertisement will be found elsewhere in this issue.

Fort Benton, Mont.—Until 2 p. m., July 11, by W. R. Leet, County Clerk, for the construction of a combination or steel bridge across Milk River at North Fork. The structure will be 200 ft. long and 18 ft. wide. Official advertisement will be found elsewhere in this issue.

Fort Benton, Mont.—Until 2 p. m., June 11, by W. R. Leet, County Clerk, for the construction of a combination or steel bridge across Shonkin Creek, 16 miles south of Fort Benton. The structure will be 80 ft. long and 18 ft. wide. Official advertisement will be found elsewhere in this issue.

Fort Benton, Mont.—Until 2 p. m., July 11, by W. R. Leet, County Clerk, for the construction of combination or steel bridge across Milk River at Yantie, Mont. The structure will be 200 ft. long and 18 ft. wide. Official advertisement of the work will be found elsewhere in this issue.

Mt. Gilead, O.—Until 11 a. m., July 7, by Clifton Sipe, County Auditor, for the necessary labor and material for the construction of a steel bridge to be known as the Watson Bridge in Peru Township.

York, Pa.—Until 11 a. m., June 27, by Board of County Commissioners, for the construction of a concrete bridge over Codorus Creek, near Larue at the site of Bridge Case No. 3. The structure as planned will have a 40 ft. clear span with 14 ft. roadway.

Buildings.

Bids are asked on following work, the notes being arranged alphabetically by states:

Santa Cruz, Cal.—Until 3 p. m., August 1, by James Knox Taylor, Supervising Architect, Treasury Department, Washington, D. C., for the construction, including plumbing, gas piping, heating apparatus and electric conduits and wiring, of the United States Post Office at Santa Cruz, Cal.

Atlanta, Ga.—Vault Shelving.—Until 3 p. m., July 15, by James Knox Taylor, Supervising Architect, Treasury Department, Washington, D. C., for vault shelving in the U. S. Post Office and Court House at Atlanta, Ga.

Brookville, Ind.—Until 1 p. m., July 21, by Board of County Commissioners, for the remodeling the court house. Charles A. Miller is Auditor of Franklin County.

Indianapolis, Ind.—Until noon, July 5, by Board of School Commissioners, for the erection of a school building at corner of Capitol Ave. and 40th Sts. R. P. Daggett & Co., are Architects.

New Bethel, Ind.—Until 2 p. m., July 2, by Henry J. Brown, Township Trustee, for the construction of a 2-story brick school. Separate bids will be received for lighting, heating and water supply. M. E. Van Arman, 909 State Life Bldg., is Architect.

Peru, Ind.—Until 2 p. m., July 26, by County Commissioners, for the cabinet work for the new court house. Charle Griswold is Auditor of Miami County.

Louisville, Ky.—Until 3 p. m., July 26, by James Knox Taylor, Supervising Architect, Treasury Department, Washington, D. C., for the construction, including plumbing, gas piping and heating apparatus, of the laundry and attendants' quarters, U. S. Marine Hospital, Louisville, Ky.

Pittsburg, Pa.—Until noon, July 15, by Lieut. Col. H. C. Newcomer, U. S. Engineer, Pittsburg, Pa., for the construction of two lock houses at Lock No. 5, Monongahela River, South Brownsville, Pa.

Fort Lawton, Wash.—Until 11 a. m., June 24, by Capt. E. C. Long, Constructing Quartermaster, 482 Arcade Annex, Seattle, Wash., for the construction of an addition to the administration building, also installation of four shower baths in barracks at Fort Lawton.

Milwaukee, Wis.—Until 5 p. m., June 27, by Board of School Directors, for the construction of an addition to the 14th District School No. 1, Windlake Ave. and Becher St.

Roads and Streets.

Bids are asked on following work, the notes being arranged alphabetically by states:

Grand Junction, Colo.—Until July 5, by Board of County Commissioners, for the construction of a county road from Kannah Creek to Palisade.

Albia, Ia.—Until 7:30 p. m., June 27, by C. C. Atchison, City Clerk, for the necessary labor and material for the improvement of portions of B Ave., North D St., Main St. and Washington St. The work includes grading, curbing, guttering and paving with vitrified blocks on concrete foundation.

Chicago, Ill.—Until 11 a. m., June 24, by Board of Local Improvements, for 26 contracts for the construction of sidewalks. C. A. V. Standish is Secretary of the Board of Local Improvements.

Beech Grove, Ind.—Until 8 p. m., June 28, by Board of Trustees, for the improvement of Alton St. E. C. Martin is Town Clerk.

Bloomington, Ind. Until 2 p. m., July 6, by Board of County Commissioners, for the construction of a highway in Washington and Bloomington Townships. Horace Blakely is Auditor of Monroe County.

Anderson, Ind.—Until 10 a. m., June 30, by County Commissioners, for the construction of a gravel road on line between Delaware and Madison Counties. Joseph Davis is Auditor of Delaware County and William T. Richards is Auditor of Madison County.

Decatur, Ind.—Until 10 a. m., July 6, by County Commissioners, for the construction of a macadam road in St. Mary's Township. H. S. Michaud is Auditor of Adams County.

Greenfield, Ind.—Until 10 a. m., June 30, by Board of County Commissioners, for the construction of a gravel road on the line between Hancock and Madison Counties. C. H. Troy is Auditor of Hancock County and W. T. Richard is Auditor of Madison County.

Indianapolis, Ind.—Until 10 a. m., July 6, by Board of Public Works, for the improvement of Washington St. from Jefferson Ave. to Beville Ave., by grading and paving the sidewalks.

Indianapolis, Ind.—Until 10 a. m., July 6, by Board of Public Works, for the improvement of 36th St. from east property line of Pennsylvania St. to the west property line of Central Ave.

Indianapolis, Ind.—Until 10 a. m., July 6, by Board of Public Works, for the grading and paving of sidewalks on Denny St. from Washington St. to Moore Ave.

Indianapolis, Ind.—Until 10 a. m., July 6, by Board of Public Works, for the grading and paving of sidewalks on Cottage Ave. from State Ave. to the first alley east of Asbury St.

Indianapolis, Ind.—Until 10 a. m., July 6, by Board of Public Works, for the grading and paving of sidewalks on Addison St. from Washington St. to the Big Four tracks.

Indianapolis, Ind.—Until 10 a. m., June 27, by Board of Public Works, for the grading and paving of sidewalks on College Ave. from 30th St. to 32d St.

Indianapolis, Ind.—Until 10 a. m., June 27, by Board of Public Works, for the grading and paving of sidewalks on Berry Ave. from Julian St., 351½ ft. south.

Indianapolis, Ind.—Until 10 a. m., June 27, by Board of Public Works, for grading and paving the sidewalks on Norwood St. from West St. to Rose St.

Indianapolis, Ind.—Until 10 a. m., June 27, by Board of Public Works, for the grading and paving of the sidewalks on Gray St. from North St. to Tenth St.

Indianapolis, Ind.—Until 10 a. m., June 27, by Board of Public Works, for the improvement of Rawls Ave. from the east curb line of Audubon Rd. to Arlington Ave., by grading and paving the sidewalks.

Indianapolis, Ind.—Until 10 a. m., June 27, by Board of Public Works, for the improvement of Meridian St. from the south line of Palmer St. to the Belt Ry. and from South property line of the first alley north of Minnesota St. to the Belt Ry., by grading and paving side walks.

Indianapolis, Ind.—Until 10 a. m., June 22, by Board of Public Works, for the grading and paving of sidewalks on Temple Ave., from Washington to New York St.

Indianapolis, Ind.—Until 10 a. m., June 22, by Board of Public Works, for the grading and paving of sidewalks on Fulton St. from Michigan to St. Clair St.

Indianapolis, Ind.—Until 10 a. m., June 22, by Board of Public Works, for the grading and paving of sidewalks on Gale St. from Washington to New York St.

Indianapolis, Ind.—Until 10 a. m., June 22, by Board of Public Works, for the improvement of Daly St. from Pine to Cruse St., by grading and paving sidewalks.

Indianapolis, Ind.—Until 10 a. m., June 22, by Board of Public Improvements, for the improvement of Tacoma Ave. from St. Clair to Tenth St., by grading and paving the sidewalks.

Indianapolis, Ind.—Until 10 a. m., June 22, by Board of Public Improvements, for the grading and paving of 36th St. from Pennsylvania St. to the west curb line of Central Ave.

Lafayette, Ind.—Until 10 a. m., July 7, by County Commissioners, for the construction of a gravel road. John P. Foresman is Auditor of Tippecanoe County.

Muncie, Ind.—Until 10 a. m., July 6, by Board of County Commissioners, for the improvement of a public highway in Center Township. Joseph E. Davis is County Auditor.

Newport, Ind.—Until 10 a. m., July 11, by Board of County Commissioners, for the construction of a gravel road in Clinton Township. H. T. Payne is Auditor of Vermilion County.

Rushville, Ind.—Until 2 p. m., July 5, by County Commissioners, for the construction of a macadam road in Noble Township. Jesse M. Stone is Auditor of Rush County.

Tipton, Ind.—Until 10 a. m., July 5, by County Commissioners, for the construction of gravel roads in Madison and Liberal Townships. J. F. Barlow is Auditor of Tipton County.

Salem, Ind.—Until 1:30 p. m., July 5, by County Commissioners, for the construction of roads in Washington, Vernon and Pierce Townships. Sam. G. Ellis is Auditor of Washington County.

Woodruff Place, Ind.—Until 8 p. m., June 2, by Board of Trustees, for resurfacing East Middle and West Drives of the town with wood block, asphalt bitulithic, bitu-mass and bitumineral. Frank Goheen is Town Clerk.

Versailles, Ind.—Until 1 p. m., July 5, by County Commissioners, for the construction of macadam roads in Franklin and Shelby Townships. Nicholas Volz is Auditor of Ripley County.

Vincennes, Ind.—Until 2 p. m., July 5, by County Commissioners, for the construction of gravel roads in Vigo and Harrison Townships. John T. Scott is Auditor of Knox County.

Albert Lea, Minn.—Until 5 p. m., June 24, by C. J. Dudley, City Clerk, for the paving of alleys with creosoted wood block, vitrified brick, sand stone or mineral rubber. The work includes 4,014.6 sq. yds. paving; 1,762.1 cu. yds. excavation; 3,440.58 lin. ft. protection curb. William Barneck is City Engineer.

Concord, N. H.—Until 1 p. m., July 1, by H. C. Hill, State Engineer, for the construction of three gravel roads as follows: In Northumberland estimated at $7,500; in Campton estimated at $11,000; in Enfield estimated at $9,000.

Fort Slocum, N. Y.—Until 11 a. m., July 12, by Constructing Quartermaster, for the construction of roads, sidewalks, curbs, gutters and drains.

New York, N. Y.—Until 3 p. m., June 23, by Commissioners of Parks, Arsenal Bldg., for repairing sheet asphalt or asphalt block roadway pavements where directed in the Borough of Manhattan.

Akron, O.—Until noon, June 23, by Director of Public Service, for grading, draining, curbing and improving Balch St., from Aqueduct St. to Maple St.; Casterton Ave., from Market St. to Ely St.; Portage Path, from Exchange St. to the west corporation line.

Columbus, O.—Until noon, June 29, by Board of County Commissioners, for the macadamizing of the James T. Lazell Joint County Road on the line between Franklin and Delaware Counties, in Sharon Township. The work includes about 3,705 ft. of road.

Mount Pleasant, Pa.—Until 8 p. m., June 24, by M. A. King, Village Secy., for paving Bridgeport St. and South Diamond St. The work includes the following: Bridgeport St., excavation, 2,512 cu. yds.; paving, 3,483 sq. yds.; straight curb, 2,592 lin. ft.; curb returns, 121 lin. ft.; rough curb, 168 lin. ft. South Diamond St., excavation, 1,870 cu. yds.; paving, 3,150 sq. yds.; straight curb, 2,070 lin. ft.; curb returns, 164 lin. ft.; rough curb, 240 lin. ft.

Pottsville, Pa.—Until 7:30 p. m., June 28, by Town Council, G. A. Berner, Secretary, 303 North Second St., for improving Centre, Railroad and Connecting streets. The work includes approximately: 7,125 cu. yds. of unclassified excavation, 14,600 sq. yds. of treated wood block or vitrfified block pavement on 6-in. concrete foundation, 6,905 sq. yds. of granite block pavement on 6-in. concrete foundation, granite blocks to be furnished by the borough, 5,288 lin. ft. of steel bound granolithic curbing, 503 lin. ft. of steel bound granolithic circular curbing, 7,140 lin. ft. of old stone curbing, to be redressed, 7,140 lin. ft. of old stone curbing to be reset, 180 lin. ft. of circular stone curbing, 500 lin. ft. of stone edging, 3,700 sq. ft. of new granolithic sidewalk, 15,000 sq. ft. of flagstone sidewalk to be relaid, 8,100 sq. ft. of new brick sidewalk, 1,000 sq. ft. of old brick sidewalk to be relaid, 2,500 sq. ft. of expanded metal for reinforcing concrete. William S. Pugh, Morris Bldg., is Engineer.

Fort Monroe, Va.—Until 10 a. m., June 27, by Capt. Ernest R. Tilton, Constructing Quartermaster, for the construction of concrete walks, brick gutters, macadam road, etc., including grading, filling and surfacing.

Milwaukee, Wis.—Until 10:30 a. m., June 23, by Board of Public Works, for the replacing of wooden sidewalks with cement concrete in the Twelfth Ward. Charles J. Poetsch is Chairman of the Board.

Wausau, Wis.—Until July 15, by Board of Public Works, for the construction of 8,000 sq. yds. of creosoted block pavement. B. C. Gowen is City Engineer and Chairman of the Board.

Sewers.

Bids are asked on following work, the notes being arranged alphabetically by states:

Hartford, Conn.—Until 11 a. m., June 27, by Board of Contract and Supply, for the construction of approximately 6,000 lin. ft. of concrete sewer ranging in diameter from 54 to 84 inches, to be known as the East Side intersepting sewer. Joseph Buths is Secretary of the Board.

Chicago, Ill.—Until 11 a. m., June 22, by Board of Public Works, for the construction of sewers in Grove and Lafayette Aves. from the first alley south of Garfield Blvd. and the 6-ft. sewer in the north side of Garfield Blvd.

Sand Point, Ida.—Until 4 p. m., July 11, by Sewer Committee, for the construction of Section No. 1 of the First District of Sand Point sewer system. Foster & Cave, Sand Point, Ida., are Engineers. Dr. R. N. Jackson is Chairman of the Committee. Official advertisement will be found elsewhere in this issue.

Indianapolis, Ind.—Until 10 a. m., June 24, by Board of Public Works, for the construction of a local sewer in and along alley east of Linden St. from Pleasant Run sewer in Cottage Ave. to alley south of Prospect St.

Indianapolis, Ind.—Until 10 a. m., June 24, by

Board of Public Works, for the construction of a local sewer in Cottage Ave. from Wright St. to Barth Ave.

Indianapolis, Ind.—Until 10 a. m., June 24, by Board of Public Works, for the construction of a local sewer in the alley of Olney St. from Nowland Ave. to 13th St.

Burlington, Kan.—Until 8 p. m., June 28, by Della Hall, City Clerk, for the construction of a complete sanitary sewer system and disposal plant. Burns & McDonnell are Engineers, Scarritt Bldg., Kansas City, Mo. Official advertisement will be found elsewhere in this issue.

Burlington, Kan.—Until 8 p. m., June 28, by Della Hall, City Clerk, for the construction of a complete sewer system and disposal works. Burns & McDonnell, Scarritt Bldg., Kansas City, Mo., are Engineers.

Sabetha, Kan.—Until 3 p. m., July 12, by P. M. Sherwood, City Clerk, for furnishing material and labor for the construction of a complete sanitary sewer system including disposal plant. Official advertisement will be found elsewhere in this issue.

Albert Lea, Minn.—Until 5 p. m., June 21, by C. J. Dudley, City Clerk, for the construction of sewers in Block 3, Block 4, Block 6, Moran's Addition and on Adams, College and Euclid Sts. The work including approximately 1,838 ft. from 6 to 18 ft. deep, 16 manholes and 58 house connections, Y's, etc.

New York, N. Y.—Until 2 p. m., June 27, by President Borough of Manhattan, for eight sewer construction contracts. The largest as follows: No. 7. For furnishing all the labor and materials required for alteration and improvement to sewer and appurtenances in 75th St., between Park and Fifth Aves. The Engineer's estimate, as follows: 450 lin. ft. of brick sewer of 3-ft. 6-in. by 2-ft. 4-in. interior diameter, all complete, as per section on plan of the work, Class 1. 267 lin. ft. of brick sewer of 3-ft. 6-in. by 2-ft. 4-in. interior diameter, all complete, as per section on plan of the work, Class 2. 150 lin. ft. of brick sewer of 3-ft. 6-in. by 2-ft. 4-in. interior diameter, all complete, as per section on plan of the work. 100 cu. yds. 6 lin. ft. of salt-gazed vitrified stoneware pipe culvert of 12-in. interior diameter, all complete, as per section on plan of the work, Class 2, of rock, to be excavated and removed. 50,000 ft. (B. M.) of timber and planking for bracing and sheeting.

Grand Forks, N. Dak.—Until 4 p. m., July 5, by Charles J. Evanson, City Auditor, for the construction of a lateral sewer and all appurtenances in the alley between Third St. and Fourth St. from DeMers Ave. to Kitson Ave.

Akron, O.—Until noon, June 23, by Director of Public Service, for the construction of sewers in Douglas St. from Bishop to Chestnut St. John W. Gauthier is Director of Public Service.

Jackson, O.—Until June 25, by W. H. Monahan, Jr., Jackson, O., for the construction of a purification works.

Jefferson, O.—Until noon, June 27, by T. B. Miller, Village Clerk, for necessary labor and materials for the construction of a system of sewers in the village.

Struthers, O.—Until noon, July 6, by L. S. Creed, Village Clerk, for the construction of sewers both sanitary and storm in Short St. and Elm St. in the village.

Youngstown, O.—Until noon, June 25, by Director of Public Service, for furnishing necessary labor and material for the construction of sewers in Fountain St. between Franklin and South Ave. W. H. McMillen is Clerk.

Youngstown, O.—Until noon, June 25, by Director of Public Service, for the necessary labor and materials for the grading and sewering of Gibson St. between Poland Ave. and Williamson Ave. W. H. McMillen is Clerk.

Avonmore, Pa.—Until 7:30 p. m., June 23, by C. H. Benninger, Clerk of Council, for 1,000 ft. of 15-in. pipe sewers; 800 ft. of 12-in.; 635 ft. 10-in. and 865 ft. of 8-in. with house branches; 7 manholes and other appurtenances. Robert H. Wilson, Saltsburg, Pa., is Borough Engineer.

Charleston, S. C.—Until noon, July 11, by J. H. Dingle, City Engineer, for the construction of sewage receiving tank, pump pit and appurtenances including vertical centrifugal pumps and electric motors with controlling devices.

Amarillo, Tex.—Until 10 a. m., June 28, by City Secretary, for the necessary labor and material for the construction of sanitary sewers. The work will consist of approximately 11,100 ft. of 15-in., 8,155 ft. of 12-in. and 30,835 ft. of 6-in. sewer pipe. E. L. Dalton is Engineer at Dallas, Tex.

Belton, Tex.—Until 8 p. m., July 5 (postponement of date from June 14) by Belton Sanitary Sewer Co., for furnishing necessary labor and material for the construction of a system of sanitary sewers and sewage purification plant. The work includes as follows: The sewerage system, approximately 4,017 ft. of 12-in., 718 ft. of 10-in., 18,680 ft. of 8-in. vitrified pipe sewers, 67 manholes, 10 flush tanks. The sewage purification plant includes approximately 3,556 cu. yds. earth excavation, 366 cu. yds. rock excavation, 118 cu. yds. reinforced concrete, 80 cu. yds. plain concrete, 500 cu. yds. broken stone, piping and accessories. Charles B. Smith is Secretary of the company.

Kenosha, Wis.—Until 2 p. m., June 24, by Street Assessment Committee, for the necessary labor and material for the construction of the following sewers: In Jay St., from Grand Ave. to Oakwood Ave., 1,700 ft. of 24-in. pipe sewer, 9 manholes; in Oakwood Ave., 625 ft. of 18-in. pipe sewer, 625 ft. of 15-in. pipe sewer, 8 manholes; in Rice Ave., from the city limits to a point 293 ft. south of Oakwood Ave., 900 ft. of 12-in. pipe sewer, 5 manholes; in Ridge St., from Oakwood Ave. to city limits, 600 ft. of 12-in. pipe sewer, 3 manholes; in Judd Ave., from Oakwood Ave. to city limits, 600 ft. of 12-in. pipe sewer, 3 manholes; in Maplewood Ave., from Oakwood Ave. to city limits, 600 ft. of 12-in. pipe, 3 manholes; North St., from Lindermann Court to right-of-way of C. & N. W. Ry. Co., 330 ft. of 10-in. pipe sewer, 2 manholes, as per plans on file in city.

Nanaimo, B. C.—Until noon, June 24, by Allan Waters, City Engineer, for excavation and laying only vitrified sewer pipes with outfalls in harbor and other incidental works of sewerage. This work is known as Contract No. 1.

Water Supply.

Bids are asked on following work, the notes being arranged alphabetically by states:

Fort Mason, San Francisco, Cal.—Until 11 a. m., July 5, by Maj. George McK. Williamson, Depot Quartermaster, for constructing an 8-in. water main from Presido of San Francisco to Fort Mason, Cal.

Chicago, Ill.—Until 11 a. m., June 29, by Board of Local Improvements, Charles A. V. Standish, Secy., for 32 street improvement contracts, including paving, construction of sewers and laying supply pipes, etc.

Brooklyn, N. Y.—Until 2 p. m., June 22, by Department of Water Supply, Gas & Electricity, 13-21 Park Row, for furnishing, delivering and laying high pressure fire service mains and appurtenances in Livingston and Remsen Sts., and in Elm and Gallatin Places. Henry S. Thomson is Commissioner of the Department.

San Antonio, Tex.—At once, by T. N. Picnot, P. O. Box 468, San Antonio, Tex., for the installation of one centrifugal pump, capacity 1,800 cu. ft. per minute, and 3 miles of wooden pipe line. Official advertisement will be found elsewhere in this issue.

Milwaukee, Wis.—Until 10:30 a. m., June 24, by Board of Public Works, for the construction of drains and water service in several streets in First, 17th and 22d Wards. Charles J. Poetsch is Chairman of the Board.

Spooner, Wis.—Until 8 p. m., July 5, by Common Council, for furnishing all material and labor for the construction of 2,500 ft. of 4-in. water main and four hydrants. George B. Sage is City Clerk.

Miscellaneous.

Bids are asked on following work, the notes being arranged alphabetically by states:

Fort Morgan, Ala.—Concrete Cistern.—Until 1:30 p. m., June 21, by Constructing Quartermaster, for the construction of a reinforced concrete cistern, capacity 11,500 gals. at Fort Morgan, Ala.

Boulder, Colo.—Masonry Dam.—Until 7 p. m., July 18, by City Council, for the construction of a concrete masonry dam at Albion Lake Reservoir, Boulder County, Colo. The dam will be 60 ft. high and the work includes 13,000 cu. yds. of rubble concrete, with necessary excavation, gate houses, valves, etc. Fred R. Dungan is City Engineer and M. S. Ketchum, 438 Century Bldg., Denver, Colo., is Consulting Engineer. Official advertisement will be found elsewhere in this issue.

Wilmington, Del.—Sea Wall.—Until June 22, by Engineer Fourth Light House District, for the construction of a sea wall at Liston Range Front Light Station, Del.

Washington, D. C.—Automobile.—Until 2 p. m., July 1, by District Commissioners, for the furnishing of one gasoline type four passenger automobile touring car.

Lewiston, Idaho.—Until 3 p. m., July 27, by James Knox Taylor, Supervising Architect, Treasury Department, Washington, D. C., for the construction, complete, including plumbing, gas piping, heating apparatus, electric conduits and wiring, of the United States Post Office at Lewiston, Idaho.

Carrollton, Ill.—Pumping Plant and Sluiceways.—Until 2 p. m., July 15, by Commissioners of the Eldred Drainage and Levee District, Carrollton, Ill., for furnishing and erecting a complete pumping plant, including sluiceways and foundations. Harman Engineering Co., 120 Fredonia Ave., Peoria, Ill., Engineers. Official advertisement of this work will be found elsewhere in this issue.

Thebes, Ill.—Electric Light Plant.—Until June 30, by City Clerk, for the installation of an electric light plant at a cost of $4,000. Fuller-Coult Co., Chemical Bldg., St. Louis, Mo., are Engineers.

Wichita, Kan.—Concrete Dam.—Until noon, June 27 (readvertisement of bids asked June 13), by William Sence, City Clerk, for the construction and material of a concrete dam across the Little Arkansas River, Riverside Park.

Alexandria, La.—Bridge Fender.—Until noon, July 28, by Alexandria & Pineville Bridge Co., for the construction of creosoted timber frame protection work or bridge fender on pile foundations. Ira W. Sylvester is Consulting Engineer at Alexandria, La.

Sturgis, Mich.—Power House and Dam.—Until 7 p. m., July 6, by Board of Public Works, for the construction of a power house and dam. J. S. Flanders is Manager. Gardner S. Williams, Ann Arbor, Mich., is Consulting Engineer. Official advertisement will be found elsewhere in this issue. Also noted under Confirmed Reports.

Chisholm, Minn.—Water Tank.—Until July 6, by J. G. Hirsch, for the construction of a 300,000 gal. elevated steel water tank. Daniel W. Mead, Madison, Wis., is Engineer.

Ellendale, Minn.—Well.—Until 8 p. m., June 28, by C. R. Torgeson, Village Recorder, for drilling a deep well for the village.

Fort Slocum, N. Y.—Vessel Repairs.—Until 11 a. m., June 22, by Peter Murray, Capt. and Quartermaster, for installing new sectional boiler surface engine, hull and deck repairs on the steamer General Barry.

West Point, N. Y.—Steam System.—Until 2 p. m., July 6, by Quartermaster, for the installation of a steam distributing system.

Ellis Island, N. Y. H.—Elevator.—Until 2:30 p. m., June 29, by William Williams, Commissioner of Immigration, for necessary labor and material required for the installation of an elevator in the tower of Main Bldg., Ellis Island.

Cleveland, O.—Power Plant.—Until 2 p. m., June 29, by John J. Boyle, Secretary County Building Commission, for the following: "A" The construction of a power plant building. "B" The installation of equipment therein. "C" The construction of a tunnel. "D" The installation of steam pipes and electrical cables connecting said power plant with said court house building. "E" The construction and installation of condenser lines and equipment.

Waynesboro, Va.—Stand Pipe.—Until noon, July 6, by Paul B. Woodfin, Town Treasurer, for furnishing all material and erecting complete a steel stand pipe 25 ft. in diameter and 80 ft. high.

Milwaukee, Wis.—Steel Oil Tanks.—Until 10:30 a. m., June 24, by Board of Public Works, Charles J. Poetsch, Chairman, for furnishing four 6,000 gal. steel tanks to be used as reservoirs for asphaltum oil.

Excavation, Earth and Rock.

Bids are asked on following work, the notes being arranged alphabetically by states:

Danville, Ill.—Stripping.—At once, by Fraer Coal Co., Danville, N. Y., for stripping earth ground and shale of an average depth of 18 ft. Official advertisement will be found elsewhere in this issue.

Lometa, Tex.—Grading.—At once, by Morey-Faulhaber Co., for the grading of several miles on the Santa Fe, in Lampasas County. Official advertisement will be found elsewhere in this issue. Noted under Confirmed Reports.

Materials, Machines, Supplies, Etc.

Bids are asked on following work, the notes being arranged alphabetically by states:

Washington, D. C.—Steel Bars and Rings, Etc.—Until July 18, by Capt. F. C. Boggs, General Purchasing Officer, Isthmian Canal Commission, Washington, D. C., for furnishing deformed steel bars, manganese steel rings for rock crusher screen, pneumatic hoist, gasoline motor and spud timbers.

Washington, D. C.—Water Meters.—Until 2 p. m., June 27, by District Commissioners, for furnishing water meters for the district of Columbia.

Atlanta, Ga.—Sewer and Water Pipe.—Until 10 a. m., July 12, by R. V. LaDow, Supt. of Prisons, Washington, D. C., for furnishing and delivering at United States Penitentiary, Atlanta, Ga., water pipe, fittings, sewer pipe, etc.

Atlanta, Ga.—Steel Bars.—Until 10 a. m., July 8, by R. V. LaDow, Supt. Prisons, Washington, D. C., for furnishing and delivering at Atlanta, Ga., steel bars for window gratings in the sun, dispensary and operating rooms of the hospital building at the United States Penitentiary.

Chicago, Ill.—Roofing Gravel.—Until 11 a. m., June 25, by Department of Public Works, B. J. Mullaney, Commissioner, for furnishing 2,500 cu. yds. of roofing gravel for top dressing of granite pavements.

Jeffersonville, Ind.—Quartermaster's Supplies.—Until 10 a. m., June 24, by Depot Quartermaster, for furnishing necessary quartermaster's supplies.

Plainview, Minn.—Cast Iron Pipe, Etc.—Until July 1, by Village Recorder, for furnishing the following: 3,450 ft. 4-in. cast iron water pipe; 2 ft. 4-in. cast iron elbows; 4 ft. 4-in. cast iron elbows; 4 ft. 4-in. by 7 ft. frost proof case 2-2½ hose nozzles fire hydrants; 1 ft. 4-in. B gate valve, hub ends; 200 lbs. jute; 1,750 lbs. pig lead.

St. Louis, Mo.—Cement, Boiler, Etc.—Until June 23, by Capt. William H. Wilson, Depot Quartermaster, for furnishing supplies, including acid, asbestos, asphaltum, balls, bars, bends, bibbs, bits, blades, books, bowls, lavatory, braces, brackets, cement, gas pipe, chain, clamps cleaners, clocks, cloth, cocks, collodion, compound, boiler, sheet and roll copper, crossovers, countersinks, couplings, ferrules, files, rubber gloves, graphite, hammers, heaters, irons, lamps, latches, leather, sewing machines, padlocks, paint, pipe, solder, staples, tees, traps, twine, valves, washers, wire, wrenches, etc.

Fort Slocum, N. Y.—Electrical Supplies and Building.—Until 10 a. m., June 25, by Capt.

ENGINEERING-CONTRACTING

A Weekly "Methods and Cost" Journal for Civil Engineers and Contractors,
WITH WHICH ARE COMBINED

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CHAS. S. HILL
C. T. MURRAY
F. A. SMITH } EDITORS

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Entered as second-class matter, April 17, 1907, at the Post Office at Chicago, Illinois, under act of March 3d, 1789.

CONTENTS.

Raising the Efficiency of Labor 585
Method of "Spotting" Foundation Piles for a Bridge Pier 585
Method and Cost of Constructing Concrete Arch and Cast Iron Pipe Culverts by Day Labor, Illinois and Mississippi Canal 586
Some Applications of Concrete and Cement to a Central Station System 587
Notes on the Influence of Tramways on Street Paving 590
Life and Cost of Maintenance of Wood Block Pavement at Hampstead, England 591
Mechanical Road Haulage (Considered Commercially) 593
Typical Structural Details of Large Concrete Sewer Work at St. Louis, Mo., with Some Notes on the Specifications 595
Methods of Construction 2,723 Ft. of the Northwestern Trunk Sewer, Louisville, Ky., with Some Costs 596
The Calumet-Sag Channel of the Chicago Drainage Canal Recommended as the Best Means of Sewage Disposal for the Calumet District 597
Depreciation in Water-Works Accounts, With Reference to Uniform Reports 598
Experience With Day Labor Work in the Maintenance and Repairs of Bridges in Chicago, Ill. 600
The Fundamental Principles of Efficiency . . 603
Economy of the Piece Work System in Handling Supplies 604
The Compensation of Workmen 605
A Machine for Cutting of Submerged Piles to Exact Elevation 605
An Efficient Derrick Used on Louisville, Ky., Sewer Work 606
Comparative Economy of Steel I-Beams with Jack Arches vs. Reinforced Concrete for Railroad Culverts and Short Span Solid Floor Bridges 607

Increasing the Efficiency of Labor.

We give space in another part of this issue to three valuable papers discussing methods of increasing the efficiency of labor. While none of these papers relates specifically to construction work, they all set forth general principles which are true of labor management everywhere. These papers are we believe full of suggestion to constructors. All construction work is confronted by a condition of high prices; with few exceptions all prices—wages, materials and supplies—are materially higher now than five years ago. In an early issue we shall have some facts to present on this question. Employers doing construction work are, however, confronted by more than the condition of high prices; it is commonly asserted that the efficiency of labor has decreased by almost as great a percentage as wages have increased. Obviously there exists in these conditions ample inducement to study methods of increasing labor efficiency.

Construction work, like the work of the field adheres steadily to the common wage system. This system furnishes small incentive to increased performance save as it comes from fear of discharge. Factory managers and shop superintendents have learned this fact widely and have substituted piece rates, profit-sharing and bonus systems of payment. A few constructors have done the same in a notable way and a few more have introduced bonus payments in special cases, but with the majority the common wage system and the "driving" foreman exist. There is a call to constructors for better labor management than this; the present conditions of increasing wages and decreasing efficiency loudly voices this call.

It does not do any longer to stamp the idea of payment in proportion to performance as a notion of the theorists. It is a vital, practical fact. Wherever it has been fairly tried in construction work it has demonstrated its value. The columns of this journal have recorded the proofs time and again. There is, moreover, reason behind the idea which can be understood by any constructor. It is the reason that makes him bend every effort upon his work, the expenditure of increased financial reward. The bonus system of payment is an incentive to the workman to do his best just as the expectation of greater profits is the incentive to the constructor in his larger sphere of action.

The three papers which we publish this week vary in character and in their immediate objects, but the great fact demonstrated by all of them is that a reward for efficiency must be held up if efficiency is to be secured. Coincident with this main fact is a second lesson, that accurate records of efficiency must be kept upon which to base the reward. It is a common excuse that such rewards cannot be devised for many kinds of construction work. They have been devised for factory work of very complicated character. We believe that they can be devised for practically every kind of construction work. This is not the thing that we wish to point out here, however, it is the fact that constructors must come to the task of studying more scientific methods of increasing labor efficiency than now prevail in most construction work.

Precautions in Interpreting Records of Test Borings.

Based on experience in making test borings for the Catskill Aqueduct, Mr. John P. Hogan gives* the following notes on interpreting and recording results:

All boring records, whether from wash, diamond drill, or shot drill holes, require the most intelligent interpretation based on extended experience for thorough understanding, provided anything more than a rock profile is desired. An inexperienced engineer can be very easily deceived by the operator, both as to character, materials encountered, and difficulty of work, and the apparent results are often deceiving in themselves.

In wash boring the tendency is always to indicate coarser material than is encountered, especially when powerful pumps are used. The finer material is dissolved and carried off and a much greater portion of the larger particles remain in the sample pail. Clay or silt shows a tendency to appear as sand, and sand to appear as gravel. This is especially true when sinking is slow and the material for feet around the bottom of the hole becomes washed out.

Remedies for this are the taking of dry samples in clay, mud, etc., and covering the discharge pipe with bagging to catch as much of the finer materials as possible. Samples are not altogether accurate as to point of taking, especially when steam pumps are used.

The percentages of core received from different holes are often used as a criterion of the relative conditions of the rocks, but there are in addition four important points to be observed, which greatly affect these percentages: (1) The type of machine and its condition; (2) The skill of the runner; (3) The skill of the diamond setter; (4) The dip of the rock.

(1) An old machine whose gears are worn or loose causes the drill rods to revolve in an orbit instead of around an axis and tends to chew up core. This is also the case when a machine is set up in a shaky position or when the core barrel or drill rods are crooked or worn.

(2) Generally speaking very hard rock should be drilled with slow revolutions and heavy pressure and soft rock with quick speed and light pressure. Reversal of these conditions usually results in grinding up the core. An inexperienced runner will drop core out of the core barrel. This necessitates grinding it up unless he can let the bit down over the top again.

(3) Different kinds of rock demand different clearances and different types of setting, which has considerable to do with the amounts of core recovered.

(4) If the bedding planes of a stratified rock lie at a pronounced angle to the vertical, the rock will core poorly. Thus a thin bedded stratified rock lying at an angle of 45° might be in an excellent position for tunneling but would show poor percentages of core. The same rock lying flat owing to its weak and thin beds would be very poor for tunneling but would give good cores.

It is important to be sure that the core barrel is straight and that the hole is started vertically. There are records of holes diverging 300 ft. in a depth of 900 ft. On the Rondout Pressure Tunnel most of the holes were drilled 20 ft. or more off line. Although great care was taken in starting these holes straight, three were encountered in the tunnel. The first diverged from the vertical 3.6 ft. in a depth of 470 ft.; the second 16.6 ft. in 440; and the third 53.6 ft. in 440.

The shot drill tends to magnify the difficulties of the ground explored as it is unable to proceed through even the smallest seam on account of loss of shot from under the bit until the seam is

The final interpretation of rock borings involves the determination of dips, strikes, and faults from the cores and the differentiation of the different strata and requires the greatest judgment and experience when the underground conditions are to be faithfully reproduced. It requires the careful consideration of trained geologists and should not be undertaken by the engineer unassisted. In the usual case, however, the advice of the geologist can be obtained only at intervals and the number and best location of holes to secure proper development is left largely to the engineer. Discussion of the process of development is beyond the scope of this article, but in the opinion of the writer the best results are obtained by locating holes so as to strike directly at critical points rather than to depend on narrowing down critical areas by a process of elimination.

The proper keeping of cores and records is the duty of the engineer and his inspectors. The rock cores should be preserved at least until the completion of the work for which the borings were undertaken and in such a manner that they can be readily identified. The following method has given satisfactory results in the preservation of over 15,000 ft. of core varying in diameter from ⅞ to 1⅞ ins. Each box 8 ft. long 1½ ft. wide and 3 ins. deep, contains a single layer. The core from a hole is laid continuously in rows from top of box to bottom, each row being separated by thin strips of boards. Elevations every ten feet are marked permanently on both core and box. Each piece of core removed for samples, test, etc., is replaced by a piece of wood of equal length. As soon as a box is filled a cover is placed on it and screwed down so that the core cannot be displaced but can be gotten at readily for inspection. On the top and end of each box the number of the hole and the elevations of core contained is painted.

*Harvard Engineering Journal, May, 1910.

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Concrete and Reinforced Concrete Section

Note: This section is devoted to methods and cost of constructing concrete and reinforced concrete structures. It will cover the selection, testing and proportioning of concrete materials; laboratory tests of concrete; concrete mixing, transportation and placing; fabrication and placing of reinforcement, and form construction and erection. It will also contain articles on new and interesting developments in the design of reinforced concrete.

Methods and Cost of Constructing Concrete Arch and Cast Iron Pipe Culverts by Day Labor, Illinois and Mississippi Canal.

The culverts were of two classes, concrete arches and cast iron pipe. The work described was done by day labor, but portions were also done by contract. The general run of wages on an 8-hour day basis, was:

Foreman, per month	$100.00
Engineers, per month	60.00
Carpenters, per day	2.50

TABLE I.—COST OF FOUNDATION FOR 10-FT. ARCH CULVERT NO. 6.

Item.	Unit.	Total.
10,794.9 cu. yds excavation	$ 0.25	$2,699
6,283.1 cu. yds. backfill	0.25	1,571
137 piles in work	4.00	548
12,934 ft. B. M. pine timber in work	28.00	362
7,189 ft. B. M. pine plank in work	20.00	144
1,197 ft. B. M. oak plank in work	40.00	48
1,620 lbs. spikes, bolts and nails	0.025	41
145.7 cu. yds. natural cement concrete	4.75	692
15.2 cu. yds. Portland cement concrete	7.50	114
477.4 sq. yds. slope paving	2.50	1,194
Sheeting pit	....	993
Total		$8,406

Laborers, per day	1.75
Water boys, per day	0.75
Teamsters with teams, per day	3.00

Arch Culverts.—The arch culverts were of two sizes, 10 ft. span and 12 ft. span, and both circular arches. The construction was substantially the same for both sizes; the following description relates specifically to the 10-ft. culvert.

TABLE II.—COST OF SUPERSTRUCTURE FOR 10-FT. ARCH CULVERT NO. 6.

Item.	Total.	Per cu. yd.
490 bbls. Portland cement delivered	$1,304.65	3.077
284.62 cu. yds. gravel delivered	535.57	1.263
Inspecting gravel	85.70	0.020
321.17 tons crushed stone	501.88	1.183
Hauling crushed stone	162.40	0.383
24.4 tons coal	31.62	0.074
Pumping	187.63	0.445
Lumber	218.53	0.514
Hauling lumber	112.60	0.265
Building and wrecking forms	489.64	1.155
Hardware	24.37	0.057
Mixing and placing concrete	555.61	1.310
Total for 423.7 cu. yds.	$4,210.20	$9.94

Barrels of cement used, 1.15.

The foundations were a concrete filled grillage 20x152 ft., containing about 134 oak piles, 18,000 ft. B. M. pine timbers, 1,500 lbs. spikes, bolts, etc., and 150 cu. yds. natural cement concrete. Three of the foundations were built with two grades; the upstream end for 25 ft. bring about 7 ft. higher than the balance of the foundation.

The body of the culvert was 3 ft. 9 ins. high, with an arch rising 2 ft. and 15 ins. thick at the crown. The radius of the intrados was 7 ft. 3 ins. and that of the extrados was 13 ft. The abutment was 5 ft. 3 ins. high and had a batter on the back of 1 ft. For some of the culverts a sort of tumble basin was provided about 25 ft. from the upper end in connection with the flashing device which was provided in some places in deep cuts. This flushing device consisted of a piece of concrete 15 ft. long and 16 ft. wide, extending from the foundation to 2 ft. above the water surface of the canal and having an opening in the front for a sluiceway from the canal and a well hole 5x10 ft. connecting with the culvert. At the lower end of the culvert there was a head wall 34 ft. long and 8 ft. high, with a coping 2½ ft. wide. At the upper end these was a U-shaped head wall, consisting of a retaining wall 3 ft. wide and 9 ft. high, extending across the foundation about 9 ft. from the upper end, and two L-shaped wings. A sill extends across the gap betwen the wings in line with outsides of the wings. A recess was left in each wing wall over the sill into which a timber is to be dropped to from the upper support of a temporary dam to be used when flushing the culvert.

TABLE III.—COST OF CONCRETE ARCH CULVERT 10 FT. SPAN.

Item.	Total.	Unit.
3,540 cu. yds. excavation	$1,081	$0.305
3,0.6 cu. yds. backfill	631	0.208
292 piles*	1,288	4.750
23,920 ft. B. M. grillage		46.670
2,877 lbs. drift bolts	1,102	0.030
1,920 ft. B. M. flooring		22.000
328 cu. yds. natural concrete	2,783	8.490
792.3 cu. yds. Portland concrete	7,378	9.31
140 sq. yds slope paving	681	4.87
Lowering culvert	1,085	
Engineering	1,193	

*Includes 96 ft. B. M. pine sheeting.

TABLE IV.—COST OF A 12-FT. CONCRETE ARCH CULVERT.

Item.	Total.	Unit.
3,072.3 cu. yds. excavation	$ 902	$0.294
1,995.9 cu. yds. backfill	326	0.163
185.9 cu. yds. natural concrete	1,287	6.920
442.32 cu. yds. Portland concrete	3,651	5.970
1,429 sq. yds. slope paving	480	3.360
13,841 ft. B. M. grillage and wales*	534	38.56
528 ft. B. M. sheeting	28	53.00
260 piles	1,233	4.74
Engineering and inspection	474	....

*Includes 1,749 lbs. spikes and bolts.

TABLE V.—COST OF 48-IN. CAST WIRE PIPE CULVERT WITH FLUSHING DEVICE.

Item.	Total.	Unit.
1,526.9 cu. yds. excavation	$ 298	$0.194
57.4 cu. yds. natural concrete	431	7.51
6.18 cu. yds. Portland concrete	56	9.06
41.1 cu. yds. masonry	361	8.78
79.9 sq. yds. slope paving	248	3.10
134 lin. ft. pipe laid	1,196	8.92
317.6 cu. yds. backfilling	34	0.107
480 cu. yds. backfilling	87	0.181

Referring to the day labor construction of the superstructure, the ground work of procedure was to build the side or abutment walls first and then the arch. For outside forms 3x6 in. x 8 ft. posts were erected on mud sills and braced to the sills with 4x4-in. timbers. The inside wall forms consisted of bents set 2 ft. apart each, carrying a segmental arch rib. The bents consisted each of two 4x4-in. posts set on the culvert floor and carrying a 4x4-in. cross-cap. The posts were braced to a 2x12-in. plank laid along the center of the floor by means of 2x4-in. braces. For the side wall lagging 2x12-in. planks were nailed to the posts; for the arch 2x4-in. lagging was used. These forms worked well except that the mud sills of the rear wall forms gave trouble by settling and after the first culvert, those sills were not used and the forms were braced to the runways.

TABLE VI.—COST OF A 48-IN. CAST WIRE PIPE CULVERT WITHOUT FLUSHING DEVICE.

Item.	Total.	Unit.
750 cu. yds. excavation	$ 187	$0.25
86 cu. yds. natural concrete	628	7.30
2.5 cu. yds. Portland concrete	22	8.80
29.4 cu. yds. masonry	257	8.75
48 sq. yds. slope paving	152	3.16
170 ft. pipe laid	1,514	8.89
1,020 cu. yds. backfilling	151	0.148

TABLE VII.—COST OF DOUBLE 48-IN. CAST IRON PIPE CULVERT.

Item.	Total.	Unit.
2,000 cu. yds. excavation	$ 790	$0.395
900.2 cu. yds. backfill	138	0.153
38.06 cu. yds. rubble masonry	394	10.35
66 sq. yds. slope paving	252	3.81
196 cu. yds. natural concrete	1,387	7.08
14.6 cu. yds. Portland concrete	112	7.64
292 ft. pipe laid	2,567	8.79
12.5 cu. yds. crushed stone	48	
Engineering and inspection	280	

All concrete was mixed in a Ransome Mixer and conveyed to the forms in wheelbarrows. At the first two culverts built a hopper was constructed at the charging end of the mixer into which a batch was shoveled from the pile in front. This method was not satisfactory, the average output for a force of about 28 men being only 45 cu. yds. in 8 hours. At the other culverts the mixer was set up at one of the piles of waste material from the excavation of the pit, a platform was built over it with a roadway leading to it from the material piles and the materials hauled to the mixer in dump carts, a charge at a time.

TABLE VIII.—TABLE OF QUANTITIES, UNIT COST, AND TOTAL COST; WESTERN SECTION PIPE CULVERTS.

	Earthwork.			Pipe Laying.			
Cul. No.	Quantity, cu. yds.	Unit cost.	Total cost.	Quantity, lin. ft.	Unit cost.	Total cost.	Culvert size, ins.
18	1,497.	$0.17	$255.12	145.0	$6.03	$ 874.88	36
19	1,558.	.21	322.74	145.4	9.01	1,309.98	48
20							2-48
22	2,504.6	.26	652.54	157'7"	9.33	1,470.03	48
23							2-48
25	2,796.4	.21	585.32	132'4"	9.72	1,286.14	48
26	2,744.5	.24	651.22	266'8"	8.94	2,382.99	2-48
27	3,035.2	.22	655.97	267'2"	8.96	2,394.61	2-48
28	1,029.8	.22	221.49	144'9"	6.21	898.23	36
29	1,705.3	.21	352.10	133'7"	8.92	1,192.05	48
31	1,665.5	.23	390.95	291'4"	8.90	2,594.33	2-48
32	1,773.3	.26	457.34	134.1	8.96	1,201.99	48
33	1,979.5	.32	627.01	133'5"	9.09	1,212.19	48
34	1,770.0	.18	327.02	170'0"	8.90	1,513.63	48
Average:				(36")			
				289'9"	$6.12	$1,773.11	
	Cu. yds.			lin. ft.			
	2,405.91	$0.23	$5,498.82	(48")			
				1,831'7"	9.04	16,557.94	

The materials were measured in the dump carts, a false end gate being used to divide the two materials. The gravel or sand was shoveled into the front end of the cast so that the crushed rock would be dumped first. The casts were dumped through a hole in the platform into an extensive chute leading to the mixer. An extension was also put onto the discharge chute of the mixer and a platform covered with steel plate and large enough to hold a full batch was built in front of the chute to receive the discharge. Wheelbarrows were run partially under this platform and loaded by shoveling and pushing the

TABLE IX.—TABLE OF QUANTITIES, UNIT COST, AND TOTAL COST; WESTERN SECTION PIPE CULVERTS.

	Natural Concrete.			Portland Concrete.			
Cul.	Quantity, cu. yds.	Unit cost.	Total cost.	Quantity, cu. yds.	Unit cost.	Total cost.	Culvert size, ins.
18				51.5	$10.96	$ 564.21	36
19				66.4	11.07	735.16	48
20							2-48
22	74.58	$8.76	$ 653.05	4.27	12.32	52.59	48
23							2-48
25	59.17	8.15	482.40	57.34	8.43	483.17	48
26	125.57	6.00	753.89	7.87	9.65	75.94	2-48
27	143.50	5.19	744.71	16.40	5.71	93.72	2-48
28	66.11	6.49	429.21	5.01	7.60	38.08	36
29	57.40	7.39	424.43	53.80	8.96	481.94	48
31	129.07	6.22	803.26	14.17	7.85	111.21	2-48
32	64.20	6.67	427.99	8.93	7.02	62.73	48
33	75.91	6.78	515.00	7.83	8.33	65.24	48
34	86.00	7.15	614.58	2.50	8.62	21.54	48
Average:—				173.85	8.25	1,433.57	
	Cu. yds.			Cu. yds.			
	881.51	$6.63	$5,848.52	296.02	$9.41	$2,785.53	

Culverts Nos. 18 and 19 were constructed of Portland cement which had been stored in bags and somewhat damaged.

concrete over the edge of the platform. The barrows were thus very quickly loaded. This method doubled the output over the first method. The concrete in the side walls was placed in sections about 27 ft. long, a crew of

Fig. 1—Switchboard of Plastered Expanded Metal.

28 men placing from 55 to 60 cu. yds. in 8 hours.

There were 424 cu. yds. of concrete in a 10 ft., and 574 cu. yds. in a 12-ft. culvert. Table II shows the cost of the superstructure for the culvert where foundation cost is

TABLE X.—TABLES OF QUANTITIES, UNIT COST, AND TOTAL COST; WESTERN SECTION PIPE CULVERTS.

	Rubble Masonry.			Slope Paving.			
Cul. No.	Quantity, cu. yds.	Unit cost.	Total cost.	Quantity, sq. yds.	Unit cost.	Total cost.	Culvert size
18	10.6	$13.66	$ 144.81	68.7	$2.87	$ 197.16	36
19	12.7	10.37	131.74	71.3	2.88	205.19	48
20				66.	3.81	251.60	2-48
22	38.42	9.11	350.19	70.69	3.67	259.37	48
23				102.81	2.79	287.02	2-48
25	26.40	8.40	221.78	63.62	3.72	236.52	48
26	67.50	7.57	511.10	103.52	3.99	413.42	2-48
27	66.33	8.09	536.76	81.56	3.49	284.25	48
28	24.68	9.65	238.24	52.94	4.11	217.40	36
29	41.10	8.83	363.00	79.90	3.19	254.85	48
31	30.66	8.27	253.67	59.38	3.66	217.33	2-48
32	58.60	7.72	452.26	93.00	3.44	319.61	48
33	65.97	7.26	478.65	101.27	3.77	381.37	48
34	29.40	8.82	259.55	48.00	3.22	154.52	48
Average:—							
	Cu. yds.			Sq. yds.			
	472.36	$8.34	$3,941.75	$93.88	$3.51	$3,140.99	

given in Table I. Table III shows the cost complete of another 10-ft. culvert and Table IV shows the cost of a 12-ft. culvert without flushing device.

Pipe Culverts.—The pipe culverts are single or double rows of 36 and 48-in. cast iron pipe with leaded joints. The pipes were placed 18 ins. below the canal bottom on a natural cement concrete footing 1 ft. thick and were buried half their height in concrete. Small rubble masonry headwalls were constructed at the ends. The sides of the approaches were paved with rubble and the bottom with concrete. Under each of the canal banks a ring of natural cement concrete 2 ft. wide was built, so that the water would not easily follow the pipe and cause a leak to develop.

The costs of several of these culverts built by day labor are shown by Tables V to X. Table V gives the cost of a 48-in. pipe culvert with flushing device and Table VI the cost of a 48-in. pipe culvert without flushing device. Table VII gives the cost of a double 48-in. pipe culvert without flushing device. Tables VIII, IX and X summarize the unit costs of 14 pipe culverts.

These tables of costs have been rearranged from data furnished by Mr. F. W. Honeus, U. S. Engineer office, Kansas City, Mo., under whose immediate direction the work was done.

Some Applications of Concrete and Cement to a Central Station System.*

The use of concrete and cement in connection with electrical structures has received considerable attention and its success as a new agent for this purpose is generally known. A description of some novel applications to various construction and repair work in a large central station system will illustrate its adaptability to the various requirements of such a system. The methods described are, with one exception, original with this company.

Reinforced Switchboard Structures.—A novel and economical method of construction was used in the building of a reinforced cement switchboard structure for the Esplen sub-station of this system. This switchboard is so located that it serves as a junction-point between the aerial and underground trunk cables to the various power houses and substations of the company. No switches excepting the hook-type disconnecting and paralleling switches are provided. In all cases, excepting in emergency, each cable continues through to its desired destination without any inter-connection with any other cable at this or any other sub-station, with the exception of one cable intended to supply the overhead lines which can be considered as feeders radiating from the station and carrying much smaller individual loads. These feeders, however, are each provided with oil circuit breakers.

The principal feature in which this cement switchboard structure varies from other concrete switch and bus-bar structures, lies in the fact that all of the structure excepting the base was plastered on metal lathing (expanded metal) instead of being poured, as is the common practice. The metal frame work consists of 3x3-in. angle irons running through the center of the board, one at each end and one located at each of the main sub-divisions between each three-phase panel, i. e., every third vertical compartment. The small channels are of 1-in. size. Over these is stretched the expanded metal, which is of about 1x⅜-in. mesh, and is tied with iron wire to the framework. A section of switchboard structure ready for plastering is shown in Fig. 1. The switchboard, as shown, is braced to the wall with 4-in. channels which, however, are used only during construction and are not necessary for the support of the board after erection.

This structure is 2 ft., 6 ins. in width, the central vertical web being 3 ins. thick; the barriers in the rear project 12 ins. and the barriers and shelves in the front 15 ins; the barriers between adjacent wires are 2 ins. thick and between each circuit of three wires, 3 ins. thick. The foundation, which was poured, was a 1-2-4 mixture. The entire structure is strengthened lengthwise by means of two 80-lb. T-rails. This stiffening was deemed advisable to permit of spanning a manhole and to guard against trouble from possible settling of an unstable earth foundation. A cement mixture consisting of 1 part Portland cement, 2 of sand, 50 per cent lime, with 1 bushel of hair to each barrel of lime, was first applied by a plasterers' trowel; the second and third applications being 1 part cement to 3 of sand, with no lime and no hair.

The greatest thickness of any web or barrier is 3 ins., and it was necessary to make only three applications of this composition to obtain the desired thickness in any plane. As a finishing coat, it was given a skim of about ⅛ to ¼ in. of Keene's cement, a hard white surface thus being obtained, which made a good body cement and resulted in a very pleasing appearance. The thickness of the Keene's cement was varied where necessary to correct any unevenness in the surface. Rough holes were left where the porcelain insulator supports were to be mounted; these were trimmed out and the insulators were then grouted in with cement.

A question naturally arises as to the relative merits of constructing a switchboard as against the usual method of pouring the concrete. This is a problem which varies with individual cases. As some of these 2-in. vertical barriers are 9 ft. long and 12 ins. wide, considerable trouble was anticipated, due to the tendency of the boards to warp or spring out of position. The work of construction was carried on without difficulty, however, and during over two years of service, the structures have shown themselves to be in every way as substantial and satisfactory as similar structures built by the method of pouring into forms.

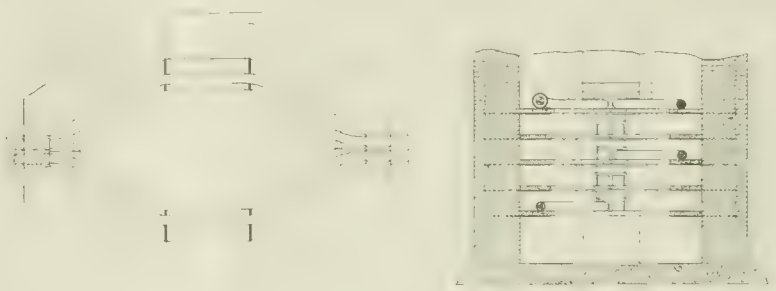


Fig. 2—Reinforced Cement Shelves in Manholes.

Where structures require heavier sections and where "knock-down" forms could be repeatedly used, it would probably be cheaper to pour than to build up by plastering; but, as a comparison, in this case, the builder's estimate of the cost of construction of the structure by the former method may be cited. For the lumber and labor for making the forms and putting them in position, exclusive of material, and cost of mixing, pouring and finishing, the estimated expense was alone two-

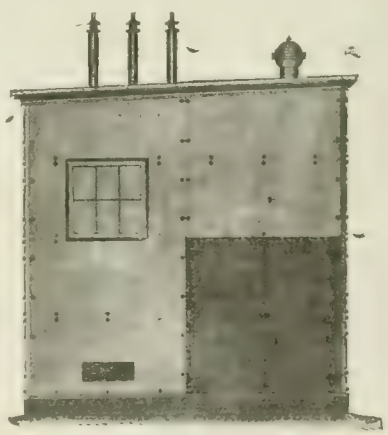


Fig. 3—Transformer Substation of Concrete Slabs.

*An article by H. N. Muller, Electrical Engineer, Allegheny County Light Co., in "The Electric Journal" for January, 1910.

thirds of the cost of this entire completed switchboard without the electrical apparatus. In this connection it might be interesting to state that it was found that the cost for slate at the quarry for use in place of concrete would likewise run about the same as the builder's estimate for making the wooden forms. An approximate estimate gives at least twice the cost for pouring this switchboard as compared with the expense of applying the cement with trowel. Erection of the iron work and stretching the expanded metal is a very simple operation, and, with the services of a plasterer and a man to mix the cement, the work is easily carried through with surprising speed and without the necessity of any previous experience.

The bus-bars and disconnecting switches are mounted upon porcelain insulator supports, which in turn are cemented into the switchboard; "rear connected" type switches are used where the conductors are to be carried through the barriers, an arrangement which is both simple and satisfactory.

Reinforced Cement Shelves in Manholes.—In an underground system where cables are carrying from 2,000 to 5,000 kilowatts, damage to such cables becomes a matter of serious consequence, and their protection from the mechanical injury, especially in manholes, is very important. For this purpose the Allegheny County Light Co. designated octagonal shaped manholes, receiving but two cables on the same horizontal plane, one turning to the right and one to the left, giving very gradual bends and resting throughout their length on reinforced cement shelves one inch thick. In the construction of these shelves expanded metal of one inch mesh is stretched in forms, into which the concrete is poured, a mixture of 1 part cement to 2 of sand being used. A plan and elevation of a cable manhole of this type is shown in Fig. 2.

The shelves are removable and are laid upon angle irons built into the manhole walls. These barriers protect the cables from being walked upon by careless workmen, or struck by ladders, falling tools, etc. They also are considered a protection above and below in case of severe short-circuit in adjacent conductors; moreover, the weight of the cables is quite uniformly distributed, which is a considerable advantage over the former method of supporting them from manhole cable-racks. These shelves cost about 10 to 12 cts. per sq. ft. They need only be manufactured and added as the multiplication of cables in the conduit line warrants.

Cement Cable Armor.—Where many cables are brought into one chamber and where insufficient clearance or bends and turns make the use of barriers impracticable, as well as the expense prohibitive, a very effective protection is obtained by the application of cement directly to the cables. A cement armor is applied by first winding ¼-in. sisal rope spirally around the cable ½ in. between centers and applying a rather dry mixture of 1 part cement to 2 parts sand. The whole adds about ⅜ in. to the radius of the cable. The cement is applied by hand with leather pad and brush. The cost runs from 1½ to 2 cts. per linear ft, depending upon the location and diameter of the cable.

This armor has been found to be of considerable protection to cables in cases where they might be accidentally struck by tools, etc., and serves also to prevent the cables from being bent and twisted by men not conversant with the proper handling of this material. It is also expected that this will prove a protection from burning in case of short-circuit on adjacent cables, as it has been found that a blow torch applied to a cable so armored stood about 4½ minutes before the lead armor began to melt; whereas, without the cement the lead melted in about one-fourth this time.

Cement is considered superior to asbestos for this work, not only because of its giving a more rigid protection against mechanical injury, but also because a short-circuit in the cable will usually manifest itself by bursting the cement, while with asbestos protection short circuits are often difficult to detect from any external appearances. Moreover, asbestos swells up when subjected to moisture and requires additional circumferential reinforcement to prevent its falling away.

Fireproof Enclosures.—It is often necessary to carry the 2,200 volt distributing circuits directly to such locations as lumber yards, basements of stores, public halls, residences and factories where accidental contact with the 2,200 volt circuit is possible, or where the danger from fire in case of blowing fuses, or short-circuits in transformers is to be guarded against. The Board of Fire Underwriters requires fireproof vaults where any oil-cooled transformers are used on the customer's premises. In order to meet these requirements and afford a protection against personal injury, this company has developed a standard form of enclosure for transformers with their switches, fuse blocks and other special apparatus used in such cases. Reinforced concrete slabs of standard size are used for these structures. These are made by pouring the concrete into forms, the inside dimensions of which are 6 ft. x 3 ft. x 2 ins. thick. Expanded metal of 1½-in. mesh is used for the reinforcement of the slabs, it being stretched in the forms before pouring. Cores are placed in proper position to provide for holes used in assembling, for ventilating ducts, switch, handle openings, etc. The slabs may thus be drawn from the forms ready for immediate assembling, except for cutting away the mesh from the various openings as required. The mesh is ordinarily allowed to remain in the ventilating openings.

In assembling the structure suitable angle iron, channel iron, etc., is employed to join the various concrete slabs, ordinary bolts being used. By this unit system a transformer enclosure of any size can be built the minimum of course being 3x3x6 ft. The foundations for these enclosures, when required, are formed by pouring the concrete, as this has been found to be the simplest and most satisfactory method of construction of this part of the structure. Iron doors are used for these structures, of such dimensions that, with their iron framework, they will replace one of the standard size slabs.

In this and similar cases where two circuits are furnished, one for the regular lighting and one for emergency, a double-throw switch is mounted within the enclosure with the switch handle projecting through one of the slabs. A diagram of connections with instructions to the local electrician, as well as the integrating wattmeter, is placed on the outside. The pilot lamp serves to light the outfit and all apparatus the same as if the apparatus were mounted on a switchboard panel.

An enclosure of this type installed outside of a factory building is made of standard slabs covered with weather-proof material. There are 13 slabs in all; the general dimensions are 6x9 ft. x 6 ft. high.

This fireproof vault is divided into two compartments, one 6x6 ft., in which the oil

Fig. 4 to 6—Methods of Repairing Timber Poles With Concrete.

Fig. 7—Example of Difficult Repairing of Wooden Pole with Concrete.

insulated transformer, the tank of the oil switch and the primary fuses are located; the second compartment, 3x6 ft., encloses what might be termed the front of the switchboard, containing the switch handle and the meters. The first compartment is locked and the key kept by the superintendent in charge of the district, while the low-tension compartment, containing the switch handle and meters is locked and the key kept by the electrician on the premises. This allows accessibility to the switches and the meter without danger of contact with the higher voltages.

This company has made about ten such installations in the last six months. The cement slabs are made on the premises of the company, which affords a rainy day job for the outside men. The cost of a standard sized slab is about $2.50; and the cost for the iron door, which is of practically the same dimension, is about twice this amount. These vaults are not only cheaper to install than one that would be poured on the premises, but they can be readily taken apart and moved to a new location or increased or decreased in size according to future requirements.

The extension of this idea, using standard sized slabs for the construction of a transformer substation is shown in Fig. 3. The framework of this proposed house is to consist of three-inch angle irons on the corners, and 5x3-in. T-irons for the center vertical supports and for carrying the roof slabs. The openings for ventilation below are obtained by placing a core in the forms, thus allowing the expanded metal reinforcement to show. The windows consist of wire-glass mounted in steel sashes with an angle iron framework. The eaves are finished off with a metal cornice, and the roof slabs are covered with tar and gravel and are laid with a pitch of one-half inch to the foot. The whole outfit is portable, except the foundation, which is poured. The particular value of such a house is that it is very flexible so far as dimensions are concerned and can be cheaply erected; and if future requirements warrant a more pretentious sub-station, this house can easily be taken apart and erected elsewhere in its entirety, or otherwise used in smaller units. The cost of such a building is practically the same as one of the same size constructed of corrugated iron. The life of corrugated iron is short; it is easily bent and perforated, and it requires frequent painting. The difficulty of painting without interruptions of the high potential circuits is one to be reckoned with. Cement also lends itself much more readily to mounting apparatus than corrugated iron.

Reinforcing poles.—The method or repairing poles suffering from butt rot, by means of concrete reinforcement offers many features of value to the maintenance department of railway, lighting and transmission companies, in fact, of all systems employing wooden poles, which are subject to decay. Fig. 4 shows the general method of doing this work, but which is modified to meet the requirements of individual cases, and upon which patents were granted to Mr. R. S. Orr, who developed this process. The rods are of Bessemer steel, ½ in. in diameter and vary in length from 4 to 6 ft. One end of the rod is bent at a right angle; this short leg is driven into the solid part of the pole above ground level, while the other end is driven into the remaining sound butt. A 1-2.5-5 mixture of concrete is then thrown in around the pole, allowed to settle into the cavities and is finished off with a richer mixture at the exposed end above the ground. This upper end of the cast is given form and finish by the use of an adjustable form.

Before this method of repair was applied to poles in service on the lines of the company, an investigation was made, to determine the effectiveness of this method of repair. Several poles which had been in service from 15 to 20 years and whose strength had become seriously impaired as the result of butt decay were carefully removed from service, reset and repaired by applying the foregoing method, using reinforcing rods and concrete. Tests were applied to prove their strength after being thus repaired. Figs. 5 and 6 represent two of these poles. The testing was done by applying a horizontal pull to the poles at a point about 27 ft. above ground level, and all of the following figures referring to the breaking tests are based on this height and direction of pull. Pole No. 1 (Fig. 4) broke under a strain of 750 lbs. at a point 20 ft. above ground, where it had been weakened by cutting a deep gain. The rope was then tied to the pole about 18 ft. above ground, the failure occuring under a pull equivalent to 1,100 lbs., applied at the standard height of 27 ft.; the break occurred at the top of the reinforced collar.

Pole No. 2, as shown in Fig. 6, was reinforced with a supplementary set of rods owing to the large cavity which extended both above and below the point of extreme decay. These rods were driven into the sound wood above the hollow part and above three feet from the ground. Under test this pole failed at a point 15 ft. above ground, the test load being 1,175 lbs.

In each of the preceding cases the poles broke above the concrete reinforcement, but pole No. 4 began to fail under a horizontal load of 1,000 lbs. at a point about four inches below ground level. The concrete broke, allowing the rods to be slowly pulled from the pole, with a gradually decreasing pressure to obtain further deflection. An interesting feature of this test was that the failure was gradual, and although the fault occurred in thise case at the point of reinforcement and the concrete collar was broken, the pole was still strong enough to support the weight of the linemen and required the combined weight of three men to pull it to the ground.

A notable application of this method of repair, in which its convenience as regards saving of both time and labor was an important feature, is illustrated in Fig. 7. This pole had become so impaired through butt rot that it could no longer be depended upon to carry its load. The ordinary procedure in such a case would have been to replace the pole by a new one, either in the same location or adjacent to it. In order to accomplish this the various wires, cables, and arc lamp mast arm supported by the old pole would have been transferred, and the cross-arms would have been taken off. Moreover, the final removal of the pole would be difficult when the wiring is so complicated as in this case.

This pole was not only repaired by reinforcement, but was also raised twelve inches in order to better meet the requirements at this point, the entire work being accomplished without exposing the linemen to the danger of coming in contact with any of the circuits, lighting lines and fixtures, telephone lines, or trolley span wire, all of which were dependent on this pole for support. By this method of repair a pole at least as substantial as the average to be found in service was obtained, with promise of no further attention being required for a long time.

The ordinary cost of replacing a defective pole by a new one, including the cost of the pole itself, haulage of the new pole to the point, labor of setting, transfer of wires and disposition of the old pole, has been shown by experience to be approximately $15. In extreme cases the cost may vary to even $50; for example, the cost of repair is increased where especially high poles are required or when the handling of main trunk lines near power stations is involved. This does not take into consideration loss of service and danger to linemen—items which cannot easily be estimated, but may be quite important.

The expense of repairing poles by reinforcement with rods and cement is in strong contrast to the preceding estimates. For ordinary repairs, such as have been illustrated, the cost averages $3.50 per pole; it being increased, however, in case of isolated repairs and where more elaborate reinforcement is required, either for purpose of obtaining additional strength or as a substitute for guy wires. The cost even in such cases does not equal the minimum cost of renewal.

The inference drawn from the tests and other data obtained regarding this method of reinforcing poles by means of rods and concrete is that it gives reinforcement sufficiently strong to enable the pole to withstand a horizontal strain of not less than 1,000 lbs. applied 27 ft. above ground, and that it is but a question of increasing the number of rods and the amount of concrete to meet any required strength. However, the results which have been outlined in the foregoing are considered to fully meet the requirements of a practical reinforcement, giving a good factor of safety for all ordinary pole line construction, at a minimum cost and without the necessity of giving any attention to the overhead wires during the process of making the repairs.

Additional weight is given to these facts when it is considered that the deterioration of wooden poles is due principally to butt rot. Hence, a pole which has been in service until its strength is perhaps 50 per cent of its original value, is not only restored to practically its original strength by application of this method of reinforcement, but by elimination of the possibility of rapid decay, its deterioration is much more gradual and its useful life is correspondingly increased.

Roadmasters and Maintenance of Way Association.—The twenty-eighth annual convention will be held at Chicago, September 13-16, 1910. Following are the subjects to be discussed and the committees of each:

"Proper Care of Track Material and Tools."—A. Hensen, chairman, C. & N. W., Green Bay, Wis.; J. W. McManama, B. & M., Waltham, Mass.; James Sweeney, C. & E. I., Danville, Ill.; M. Lumm, Wabash, Montpelier, Ohio; C. H. Cornell, C. & N. W., Antigo, Wis.

"Cattle Guards."—C. J. Muschott, chairman, Benton Harbor, Mich.; M. McFadden, C. & N. W., Marinette, Wis.; James Ryan, Jr., C. & E. I., Villa Grove, Ill.; M. H. Connolly, C. N., Van Wert, Ohio; B. F. Brown, B. & M., Lydonville, Vt.; Charles Newberg, C. & N. W., Eagle Grove, Iowa.

"New and Improved Appliances Including Ties."—L. Lawler, chairman, Southern Pacific, Lafayette, Ind.; L. C. Ryan, C. & N. W., Baraboo, Wis.; E. P. Safford, L. S. & M. S., Adrian, Mich.; B. A. West, A., T. & S. F., Pueblo, Colo.; John Nugent, C., R. I. & P., Iowa City, Iowa; John Mulvoy, M. & O., Meridian, Miss.

"Standard Switch Targets."—J. M. Meade, chairman, A., T. & S. F., Topeka, Kan.; M. Hermans, C. & N. W., Green Bay, Wis.; W. H. Putcamp, U. P., Omaha, Neb.; J. G. Hutchison, C., R. I. & P., Herrington, Kan.; F. D. Harrigan, P. M., Saginaw, Mich.; A. Clough, N. Y. C. & H. R., Batavia, N. Y.

"Rail Fastenings Including Insulated Joints."—Thomas Thompson, chairman, A., T. & S. F., Joliet, Ill.; W. A. Brandt, C. & N. W., Clintonville, Wis.; John Heshion, Mo. Pac., Concordia, Kan.; Tilman Burket, Penn. R. R., Bedford, Pa.; M. Foley, B. & O., Myersdale, Pa.; C. E. Boone, B. & A., Houlton, Me.

"Tie Plates and Rail Anchors."—L. C. Ryan, chairman, C. & N. W., Baraboo, Wis.; F. E. Sampson, B. & M., Concord, N. H.; J. O'Leary, C. & A., Joliet, Ill.; P. J. McAndrews, C. & N. W., Belle Plaine, Iowa; Warren Peachy, E. & T. H., Evansville, Ind.; John Boland, U. P., Lawrence, Kan.

Paper on "Treated Timber," by J. L. Single, Newark, N. J.

Paper on subject to be selected by himself by W. M. Camp, Chicago.

Topical questions for discussion: "Dressing of Gravel Ballasted Track," "Paving of Ditches," "Length and Size of Ties," "How to Drain the Midway of Double Track Whether by Surface Ditches or by Tile Drains," "Should the Gage on Curves be Readjusted to the Side of the Rail Head and by Moving which Rail," "Quality of Track Labor."

Committee of Arrangements: W. E. Emery, chairman, Peoria, Ill.; A. E. Hansen, C. & N., Green Bay, Wis.; W. M. Camp, Railway and Engineering Review, Chicago.

The Rockingham R. R. Co. has been chartered with a capital stock of $150,000, for the construction of a railroad from Roberdel, No. 1, Richmond county, North Carolina, to Gibson, Scotland county, via Rockingham, N. C., a distance of 24 miles. The incorporators include J. P. Leak, W. C. Leak and M. L. Hinsen.

Roads and Streets Section

Note: This section is devoted to methods and costs of road and street construction. It will cover road building in all its details, the construction of pavements, sidewalks and gutters, the testing and use of paving materials and the machinery and tools used in road building and paving.

Notes on the Influence of Tramways on Street Paving.*

The conditions imposed by the exigencies of modern civilization with regard to cheap, rapid, and convenient means of locomotion, from one part of a district to another, have introduced new problems for solution by borough and town engineers. The author has personally observed the effects of the introduction of tramways; he also, when acting as sole arbitrator, appointed by the government to settle certain matters involved in two important tramway schemes in or near the metropolis, had to digest voluminous evidence submitted by a number of expert witnesses on the question of the paving, etc., best suited to meet the requirements under various conditions, and in different localities. At these arbitrations, many points of interest were dealt with, some of which will be referred to in the following notes, in the hope that they may be conducive to an interesting and useful discussion.

It will be unnecessary to describe the electrical details of a tramway construction, as they are foreign to the object of this paper. It will therefore suffice if the more salient points of tramway and pavement construction of import to road engineers are discussed.

Up to March 31, 1908, there were 2,286 miles of tramways and "light railways" in this country opened for traffic and worked by electrical power, 52½ miles by steam, 27½ miles by cable, 4¾ miles by gas motors, and 94 miles by horses, making a total of 2,464¼ miles, of which 177 undertakings, measuring 1,619¾ miles, were owned by local authorities, and 128 undertakings, with a total length of 824½ miles, by public companies. The capital invested in these tramways amounted to £68,199,918. It will be observed by the foregoing statistics that tramways contribute a valuable and potent factor in matters of public convenience, and must also have an important influence on the question of street paving and works in general.

Foundations.—Tramway foundations, including a width of about 1 ft. 6 in. on the outside of the rails, are generally constructed of Portland cement concrete; the tram rails are usually blocked up to the required levels, and concrete is deposited in the trench, and brought up to the level suitable to accommodate the paving material; but on portions of the Kidderminster, Poole, Kinver, Aberdeen and other tramways, cross sleepers have been used, laid at 3 ft. to 3 ft. 6 in. centers; in some places these are embedded in concrete and in others in ordinary ballast. Where the subsoil is clay, or where it is liable to be wet and treacherous, it is a question whether rough stone drains to intercept the subsoil water, or, as in the case of the Middlesex County Council tramway, a blanketing of cinders and clinkers laid on the subsoil under the concrete are best suited for this purpose. The author is informed that the latter method has proved to be satisfactory.

Some of the Hull tram rails are laid on 4-in. by 7-in. creosoted wood stringers, and anchored through to the under side of the concrete, at intervals of 3 ft. 6 in. Mr. A. E. White, M. Inst. C. E., the city engineer, has supplied the author with a statement showing the average cost of such a permanent way, which was as follows:

*From a paper by R. O. Wynne Roberts, read at the Metropolitan District Meeting of the Incorporated Association of Municipal and County Engineers held May 24 at Caxton Hall, Westminster, England.

Rails, Etc., Per Ten Yards Single Track.

	£	s.	d.
Rails	5	8	11
Five tie rods	0	7	4
Eighteen holding-down plates	0	3	6
Eighteen holding-down bolts	0	4	6
One sole plate	0	1	4
One pair fish plates	0	2	9
Eight sole-plate bolts	0	0	9
Six fish-plate bolts	0	0	9
Stringers	1	4	3
Bricks	0	1	6
Dogs	0	6	4
	£8	1	11

	£	s.	d.
10 = per yard	0	15	2.3
Labor of plateplayers, etc.	0	4	2
Concrete and paving exclusive of wood block 2¾ super. yds. at 8s. 8d.	1	3	10
Hardwood block 2¾ sq. yd. at 8s. 1d.	1	2	2.75
Cost of single track per yard	3	6	5.05

1,760 × £3 6s. 5. = cost per mile £5,844 13s. 4d.

There is about 6 in. additional concrete under the track as compared with ordinary paving, and the paving work on the tramway area is assumed to have cost 2s per super. yard more than similar work in the wings.

Mr. White also states that on the outer part of one of the routes sufficient land was purchased to enable a strip to be separated from the rest of the road by an avenue of trees, and reserved for tramways down its center; on the length the rails have been laid on cross sleepers and the road leveled with ballast and gravel. The cost of this length was only about £1 10s per lineal yard single track. The running is stated to be particularly smooth.

In the case of the Kinver 3 ft. 6 in. light railway, which is virtually an electric tramway running from Stourbridge to Kinver—4½ miles in length, with connection to the center of Birmingham—the 87-lb. grooved girder rails are, in the urban district, laid on 6-in. concrete foundations; but on the rural roads the 56-lb. vignole rails are laid on 7-ft. by 9-in. by 4½-in. red fir sleepers, supported and packed with broken stone ballast, on the waste land along the roadside; a portion of this line is also laid across fields. The maintenance of the sleeper track is stated to be low, working out at about £15 per mile per annum.

The foundations for sett or wood block pavements are usually 6 in. thick; where the subsoil is unstable, or the loads usually hauled on the streets are heavy, the thickness of concrete is increased. Six-inch bed of concrete is usually ample for most streets. The depth of concrete under the rails, and at times under the whole width of the track, is about 9 in.

When paving, tramway, or other works are carried on in busy thoroughfares, it is to the interest of the engineer that the public inconvenience should be as small as possible. When there is a considerable quantity of concrete work to be done, the employment of a small portable concrete mixer would, doubtless, be advantageous. Many mixers, however, are too cumbersome to be included in the portable class. A small and compact mixer, which has come under the author's notice, is so designed that the aggregates and matrix can be mechanically measured and mixed so as to conform with any specified proportions—the operations and cost of measuring are therefore unnecessary—one gang of men wheel up the materials into the hoppers and another gang of men remove the mixture as it is discharged at the outlet side. This machine is used on important government works in connection with reinforced concrete structures in the Metropolis, and as its weight is under one ton, its portability should make it useful on roadworks. The capacity of this mixer is about ten tons per hour, the concrete is made continuously, not in batches, and is uniform in quality. The energy required to operate this machine is less than one horsepower, as compared with a much greater power necessary for driving other mixers. The cost of mixing and laying by hand is about 2s 6d per cubic yard; by the ordinary mixer it is about 1s 4d, while with this machine it is reduced to about 8d. Incidentally it might be mentioned that the measuring device of this machine can be utilized in connection with the gauging of lime for water, sewage and other works.

Tram Rails.—Tramway rails have been standardized as to pattern, weight and quality, by the British Standards Committee, and these standards are recognized by most engineers. From the road engineers' point of view, rails 60 ft. long are more satisfactory than shorter ones, as the number of joints is less and the need for repairs is reduced, consequently minimizing the disturbance of street paving.

Joints.—The efficiency of the tram-rail joints, apart from its material influence on the life of the rail itself, and therefore on the cost of maintenance of the line, is a potent factor of tramway construction which tends more or less to minimize the necessity for disturbing the paving and thereby reducing the accompanying inconvenience to the general wheel traffic. A good mechanical joint must be as rigid as possible, and thus prevent deflection which causes the rail-ends to be burred by the hammering action of the tram-car wheels, inducing a pumping condition to take place and thereby admit water to the foundation, ultimately creating considerable trouble. A patent riveted fish-plated joint has, the author understands, given satisfaction on the Middlesex light railways.

The joint is claimed to cost less than the ordinary bolted fish-plate, and much less than the Thermit welded joint, while the cost of renewing is even more favorable.

There are of course other forms of joints, each with its advocates and special advantages, which the author leaves to the members to discuss and compare. The principal object which the road engineer has to advocate is the employment of the form of joint that obviates frequent attention to rail-ends.

A patent renewable plate made of special manganese steel has been used by many tramway authorities. The insertion of the renewable plate is made by cutting away the worn part of the head of the rail on the tramway track by a shaping machine, and afterwards truing up the surface by the same machine converted into a grinder. The joints can be seen at East Ham and elsewhere. The author has observed that they afford a smooth and durable running surface. The cost of inserting these plates is about £1 10s each joint.

Tie-Bars.—The tie-bars, which are necessary to maintain the rails in true gauge, when straight sometimes disturb the paving blocks by reason of the frequent vibration caused by tram-cars passing on the rails. It is usual to under-cut and side-splay the setts or blocks so as to accommodate the tie-bars. This, when wood blocks are used, tends to weaken the blocks, and, owing to the vibratory action referred to, together with side expansion of the timber, they are gradually worked up, causing the surface to be uneven. When cranked bars are used, this trouble is reduced, but straight ties are required in connection with the London County Council tramways. In this case the difficulty might be overcome by laying a paving block on each side of the bar, filling in the spaces between to the top of the bar with cement grout, and when this is set, inserting a 1-in. by 2-in. closure.

Position of Tram Lines.—In the case of single tracks, the tram lines are usually laid in the middle of the street, with passing-places at divers convenient points, and in the case of double tracks, they are located on the two sides of the crown at about 8 ft. or 9 ft. centers, taking up about 16 ft. to 18 ft. of the carriageway. This has an important effect on the remainder of the street, for

the ordinary traffic is, in proportion to the frequency of the tram-car service, prevented from using the best part of the carriageway, and also from passing from side to side. On the other hand, when the tram-cars pass at more or less prolonged intervals, the vehicular traffic tends to cling to the rails and cause tracking on the marginal pavements. The renewal of rails, repairs to pavements, and other operations appertinent to tramways are liable to obstruct the ordinary traffic to a large or small degree according to its density. The obstruction caused by tram-cars may, however, be considered as a momentary one, but the maintenance of public streets in a satisfactory condition is one of increasing difficulty.

The introduction of tramways in busy thoroughfares, together with the rapid growth of self-propelled vehicles plying about the public streets, calls for greatly increased width of streets and the provision of subways or bridges to enable pedestrians to cross with safety.

Paving.—The construction of tram lines tends in certain districts to depreciate the value of properties, especially along the routes, by inducing a deflection of certain traffic to new channels, and thus affecting the amenities of some neighborhoods, while, on the other hand, it undoubtedly assists in the development of suburban areas, and in enhancing the value of some properties by affording great facilities for convenient transport.

While the cost of maintaining the street paving outside the tram lines may be increased by the greater concentration of traffic thereon, it is largely compensated by the fact that the tramway authorities have to maintain the tracks, which saving to the road authorities must be an appreciable amount.

The question of paving materials to be employed depends on the gradients, the density of the vehicular traffic, and also on the character of the properties adjoining.

Setts.—In some towns, for instance, on important, high-class, busy thoroughfares, 5-in. by 4-in. close-jointed Norwegian setts are found to be satisfactory, affording a good foothold for horses, without causing as much noise as is common to stone pavements. Stone setts from the same quarry are often of different qualities, some are non-slippery and satisfactory, but others develop slippery surfaces, and consequently are only suitable for certain streets.

To secure a good sett pavement the setts should be gauged in dimensions, uniform in quality, evenly dressed, free from protuberances at the sides and tops, laid close, having a maximum joint of ⅜ in., evenly inlaid in regular, straight and bonded courses, on a thin layer of sand, pea gravel or crushed ballast, mixed with cement, which should be wetted as the work proceeds, well rammed, racked with ¼-in. to ⅜-in. gravel or crushed ballast to half depth and grouted. Some engineers stipulate laying Guernsey setts against the rail and, say, Aberdeen setts in the area between.

Wood Blocks.—In connection with wood block paving, the choice of timber appears to be largely a matter of individual choice between hard and soft timber. While the initial cost of laying soft wood block paving is less than that of hard wood, according to the experience of some engineers its durability is also greater. A comparison of the qualities and defects of these two classes of paving material is a matter of considerable importance, and an opinion might here be expressed that the wearing properties of wood or other classes of pavements if correlated on some accepted standard, such as, for instance, tonnage per unit width, to reduce the pavement, say, 1 in. in depth, would be useful. In this matter, it must be acknowledged that the Metropolitan engineers have unique opportunities.

The question of the necessary depth of block is, to some extent, also a matter of personal opinion, but hard wood blocks, 4 in. deep, have become more general, and in connection with tramway work a reduction in the depth of wood blocks necessitates increasing the embedment of the rails in concrete; while reducing the cost of the wood blocks this also stiffens the rails, making them more rigid and secure.

The practice of laying wood blocks on a thin cushion of sand and the insertion of thin strips between vertical joints is almost obsolete. The more approved and general plan is to lay them direct on the floated surface of the concrete with close vertical joints.

Grouting.—Grouting of sett paving differs in various towns, bituminous mixtures being employed by some engineers, and cement and sand grout of the consistency of thick cream by others. It is contended that setts grouted with cement can be raised, repaired, and reused with greater facility and at less cost than when pitch and tar solution is run into the joints. Bituminous grouting of wood blocks varies with the class of wood, creosoted timber, being less absorptive than hard wood, therefore requires a different solution. In some instances the joints are filled with the bituminous grout, while in others they are filled to one-half or two-thirds full, the upper portion is then filled in with cement and sand grout to restrain the softening action of the sun's rays. Bituminous grouting on hills, and in some cases on the level, has been found to gradually creep downwards and float under the setts or blocks, causing the pavement to ride and become uneven. This is probably due in a measure to the absence of effective adhesion to the blocks and to the relative viscosity of the solution being low, owing to an excessive proportion of diluents added to the pitch. A pavement, after many years' wear in the metropolis, was recently taken up and the bituminous grouting was found to be in excellent condition, without any creeping under the blocks having taken place.

Various tar compounds are being used for this purpose.

Wood paving on hills is usually considered as undesirable or inadvisable on gradients exceeding 1 in 20, but evidence was given that in some towns steeper inclinations have been wood paved without causing inconvenience. In Bristol, for instance, grades of 1 in 13.8 and 1 in 12.5 have been so paved.

Some engineers consider a granite sett against the rail with wood blocks adjoining to be an excellent arrangement, but others again deprecate such practice. The London County Council engineer has laid a hardwood block runner alongside the rail in Gray's Inn-road. When the track only is paved and the haunches or breast of the road are macadamized, it is found difficult to maintain a true surface between the two. A serrated or hit-and-miss toothing course tends to increase the difficulty, as it is impossible to properly consolidate the metal in the recesses.

Expansion Joint.—Expansion joints are always provided on each side of the road, but between the tram rails such joints are exceptional. The expansion between the rail and the slot in the L. C. C. tramway was shown to be sufficient to considerably reduce the slot opening. Bituminous mixture has been tried along the rail, but this was found to creep under the block, owing to the influence of the vibrations of the rail. At East Ham, Mr. A. H. Campbell, M. Inst. C. E., has made provision for expansion by gradually increasing the spaces between the blocks toward the center of the track, grouting the same with bitumen. This has been found to act efficiently, preventing the displacement of the rail and the fracture of the tie-bars, and obviating the disturbance of the paving.

Sectional Wood Blocks.—Reference might here be made to the sectional wood block, the principal advantage claimed for which is, that thorough seasoning of the thin scantlings out of which the small pieces forming the blocks are cut, and afterwards bound together by wooden underties or by steel strips inserted in side grooves, can be more effectually done (and in less time) than is possible with planks from which the ordinary blocks are cut. Shrinkage of solid wood blocks in dry weather tends to admit dirt into the joints, and this when rain falls or the streets are watered, allows moisture to sink into the body of the pavement, causing the timber to expand, and preventing the joints from effectually reclosing. Moreover, under the rolling concussive action of the traffic, the arises are consequently more liable to be rounded off. As sectional wood blocks are composed of several small pieces, the shrinkage is distributed, the openings are proportionately less, and the defects inherent to ordinary blocks are thereby reduced to a minimum.

Ordinary wood blocks are usually from 4 in. to 5 in. in depth; sectional blocks, however, are only 3 in. to 4 in. The attrite and concussive action of the traffic, together with the development of uneven surfaces, which are the result of the variable quality of solid wood blocks, often renders it necessary to relay the pavement, although the reduction in depth actually worn away is comparatively small; the adoption of more seasoned and better selected hard wood can be more effectually done with thin scantlings, and under these conditions sectional blocks from 3 in. to 4 in. deep may be considered as sufficient. Sectional blocks have been laid in various parts of London; a pattern, 3 in. by 3 in. by 8 in., was, for example, laid in 1906 between the curbstone and the tram line in Clerkenwell road, a road carrying heavy traffic. The writer recently had occasion to inspect this pavement and found it in excellent condition, and it appears to possess superior wearing qualities to the ordinary wood blocks which adjoined. The London County Council have also laid some of these blocks in Old street and City road. These are also in good condition, although the ordinary wood paving adjoining the latter has been frequently repaired.

Other sectional hard wood blocks have been laid along a stretch of the tram line in East Ham, which the author found had an even homogenous surface, exhibiting only slight indication of the joints.

The cost of this form of wood paving is higher than that of ordinary wood block, but the question of increased durability, and the maintenance of a true, even surface for a more prolonged period, may compensate for the additional initial expenditure.

A paved track with macadamized haunches, renders the latter expensive to maintain, and it is a question, when the annual cost of repairs amounts to about 1s per square yard, whether it would not be more economical and satisfactory to pave with some more permanent material. The presence of the track is a strong inducement for carts and wagons to be driven on the same, as the tractive effort required is necessarily much less than on macadam. The results of observation made by Mr. C. F. Wike, the city engineer of Sheffield, points to the fact that a granite track with macadam haunches, cost about 142 per cent per annum more than when the granite paving extended from gutter to gutter.

Life and Cost of Maintenance of Wood Block Pavement at Hampstead, England.

The Metropolitan Borough of Hampstead, England, has 62 miles of improved roads and streets. Of this total 42 miles are macadam and seven miles are wood paved. The remaining 13 miles are made up of three miles of flint roads, three miles of rag-stone roads, two miles of granite paved and smaller amounts of tar macadam, asphalt and basalt lava roads. In his report for the year ending March 31, 1909, Mr. Oliver E. Winter, Borough Engineer and Surveyor, gives considerable data on the construction and maintenance of these wood block pavements, and from this report we have taken the matter that follows:

The earliest use of wood blocks in the Borough of Hampstead for paving purposes appears to have occurred in the summer of 1883. At that time 234 sq. yds. of pavement was laid on West Hampstead News, at a cost of $1.76 per sq. yd., excluding the foundation work, which was done by the owners of the property. The pavement consisted of

6-in. deal blocks, grouted in lime and laid in a 6-in. concrete foundation. This strip was repaved in 1900 with 4-in. Jarrah blocks. The new pavement had close joints run with tar and grouted in Portland cement. The repaving cost $2.56 per sq. yd., which included two years' maintenance, and was done by contract. In the spring of 1885, a total of 11,714 sq. yds. of wood block pavement was laid on High Road, Kilburn, 6-in. deal blocks, grouted in lime being used. The foundation was Thames ballast and Portland cement concrete, 6 ins. thick. The work cost $2.32 per sq. yd. It was done by contract and carried a two-year term of free maintenance. In the spring of 1894, 11,665 sq. yds. of this street was repaved with 4-in. Jarrah blocks. The joints were run with tar and grouted in Portland cement. The greater portion of the courses were separated by wood fillets 3-16-in. thick; the remainder were close jointed. The repairing cost $3 per sq. yd., was done by contract and carried a two-year term of free maintenance. In the summer of 1902, 5,569 sq. yds. on this street were repaved with 4-in. Jarrah blocks. All of the courses were divided by fillets 1-10 in. thick. The joints were run with pitch and grouted with Portland cement. The blocks were laid on the existing foundation. The work was done by contract. It cost $2.62 per sq. yd. and had a two-year term of free maintenance. In the summer of 1903, 3,412 sq. yds. were repaved, the work being similar to that just noted. The cost, however, $2.58 per sq. yd. In the summer of 1905, still further work was done on the street, 2,237 sq. yds. being repaved with 4-in. sectional Jarrah blocks. The courses were divided by fillets 1-10 in. thick and the joints run with pitch. The blocks were laid on the existing foundation. The work was done by contract and cost $2.64 per sq. yd. and carried two-years free maintenance. Details of the cost of repairs on this street are given in the accompanying table.

A portion of Eton Ave. was paved in the autumn of 1887, plain deal blocks being used. A total of 2,106 sq. yds. was laid at a cost of $1.86 per sq. yd., exclusive of the foundation. In the summer of 1902, 455 sq. yds. of this was repaved on the existing foundation with 5-in. creosoted deal blocks, with close joints run with pitch and grouted with Portland cement. The work was done by contract at a cost of $2.04 per sq. yd., and carried a two-year maintenance term. In the summer of 1904, 1,112 sq. yds. were repaved with 4½-in. creosoted deal blocks on the existing foundation. The pavement, as before, had close joints run with pitch and grouted in Portland cement. The work was done by contract and cost $1.76 per sq. yd., this including a two-year free maintenance term. Details as to the cost of maintaining this pavement are given in the accompanying table:

In the summer of 1888 a portion of High Road, Kilburn, was paved with 6-in. deal blocks, grouted in Portland cement. The courses were divided by wood fillets 3-16 in. thick. The foundation consisted of Thames ballast and Portland cement concrete 6 ins. thick. The total yardage was 3,656, and the cost was $2.36 per sq. yd. The work was done by contract and carried a two-year guarantee. This portion of the street was repaved on the existing foundation in the summer of 1898, 4-in. Jarrah blocks being used. The pavement had close joints run with tar and grouted in Portland cement. The work was done by contract and cost $2.70 per sq. yd.

The accompanying table shows the cost of maintaining wood paved roads during the years ending March 31, 1904, 1905, 1906, 1907, 1908 and 1909. These are "main roads" and are consequently subjected to much traffic. Mr. Winter advises us that the cost of repairs to all the wood pavement laid in the year 1900 has been quite exceptional. This was due entirely to the defective manner in which the concrete foundation was constructed in that year.

The details of the various sections of the pavement listed in the table are as follows, all of the sections were maintained for two years by the contractor:

(1) Abbey Road.—4-in. Jarrah blocks. Courses divided by fillets 3-16 in. thick. Joints run with tar, grouted in Portland cement. Foundation, Portland cement and Thames ballast concrete 6 ins. thick; laid by Improved Wood Pavement Co.

(2) Abbey Road.—4-in. Jarrah blocks. Close joints run with tar and grouted in Portland cement. Foundation, concrete 6 ins. thick, made (after screening) of the broken granite found on the ground, Thames sand and Portland cement; laid by Improved Wood Pavement Co.

(3) Adelaide Road.—5-in. creosoted deal blocks; close joints run with pitch and grouted in Portland cement. Foundation, concrete 6 ins. thick (in places 9 ins. thick), made (after screening) of broken granite, Thames sand and Portland cement; laid by Improved Wood Pavement Co.

(4) Belsize Road.—Paved summer 1891. 5-in. deal blocks, grouted in Portland cement. Foundation, 6 ins. thick of Thames ballast and Portland cement concrete; laid by Improved Wood Pavement Co. Repaved in 1900-1 with 5-in. creosoted deal blocks. Close joints run with pitch and creosote oil; laid by Improved Wood Pavement Co.

(5) Belsize Road.—4-in. Jarrah blocks. Close joints run with tar and grouted in Portland cement. Foundation, concrete 6 ins. thick, made (after screening) of the broken granite found on the ground, Thames sand and Portland cement; laid by Improved Wood Pavement Co.

(6) Belsize Road.—4-in. Jarrah blocks; courses divided by fillets 1-10 in. thick; joints run with pitch and grouted in Portland cement. Foundation, concrete 6 ins. thick made (after screening) of the broken granite found on the ground, Thames sand and Portland cement; laid by Acme Wood Flooring Co.

(7) England's Lane.—4-in. Jarrah blocks; close joints run with tar and grouted in Portland cement. Foundation, concrete 6 ins. thick, made (after screening) of the broken granite found on the ground, Thames sand and Portland cement; laid by Improved Wood Pavement Co.

(8) England's Lane.—4-in. creosoted deal blocks; close joints run with pitch and grouted in Portland cement. Foundation, concrete 6 ins. thick, made (after screening) of the broken granite found on the ground, Thames sand and Portland cement; laid by Improved Wood Pavement Co.

(9) Eton Ave.—2,106 sq. yds. First paved in 1887 with plain deal blocks. In 1902, 455 sq. yds. repaved with 5-in. creosoted deal blocks; close joints run with pitch and grouted with Portland cement on existing foundation; William Griffiths, contractor. A total of 1,112 sq. yds. was repaved in 1904, with 4½-in. creosoted deal blocks; close joints run with pitch and grouted in Portland cement on existing foundation; laid by William Griffiths, Ltd.

(10) Finchley Road.—4½-in. creosoted deal blocks; close joints run with pitch and grouted in Portland cement. Laid by Acme Flooring and Paving Co. (1904) Ltd., on 9-in. concrete foundation, made (after screening) of the broken granite found on the ground, Thames sand and Portland cement, by Council's Workmen.

(11) Finchley Road.—4½-in. creosoted deal blocks; close joints run with pitch and grouted in Portland cement. Foundation, concrete 9 ins. thick, made (after screening) of the broken granite found on the ground, Thames sand and Portland cement. Improved Wood Pavement Co., contractors.

(12) Finchley Road.—4½-in. creosoted deal blocks; close joints run with pitch and grouted in Portland cement. Foundation, concrete 6 ins. thick, made (after screening) of the broken granite found on the ground, Thames sand and Portland cement. Foundation over a considerable area 9 ins. thick, at extra cost. Acme Flooring and Paving Co. (1904) Limited, contractors.

(13) Finchley Road.—5-in. creosoted deal blocks; close joints run with pitch and grouted in Portland cement. Foundation, concrete 6 ins. thick, made (after screening) of the broken granite found on the ground, Thames

TABLE SHOWING THE COST OF MAINTAINING "MAIN" WOOD PAVED ROADS IN THE BOROUGH OF HAMPSTEAD, ENGLAND

Name of Street	Kind of block	Area paved sq. yds.	When paved.	1st cost per sq. yd.	Cost of repairs in cents per square yards. 1903-4.	1904-5.	1905-6.	1906-7.	1907-8	1908-9.
(1) Abbey Road	4-in. Jarrah	5,082	Autumn, 1900	$3.16	.076	1.588	1.848	.816	.968	.....
(2) Abbey Road	4-in. Jarrah	4,540	Summer, 1899	2.94	.076	.....	.....	.908	7.582	4.450
(3) Adelaide Road	5-in. creosoted deal	9,275	Summer, 1903	2.88	.528[1]	.018	.....	2.454	1.762	.486
Avenue Road		1,059	Autumn, 1905	2.04	1.812	.252	.....	8.234	.....	6.856
(4) Belsize Road	5-in. creosoted deal	1,677	1900-1[2]	3.16	1.812	.....	2.648	5.462	9.554	3.410
(5) Belsize Road	4-in. Jarrah blocks	14,257	Autumn, 1900	4.46	.....	.....	.....	.....	.....	.....
(6) Belsize Road	4-in. Jarrah	10,113	Autumn, 1900	3.16	.....	.248	.230	.212	.....	3.264
(7) England's Lane	4-in. Jarrah	1,398	Summer, 1903	2.20	.....	.....	.....	.....	.....	.....
(8) England's Lane	4-in. Jarrah	2,195	Autumn, 1900	1.86[4]	4.236	1.102	6.906	5.636	11.496	.470
(9) Eton Avenue	5-in. creosoted deal	989	Autumn, 1905	2.34	.....	.....	.....	.....	.....	.....
(10) Finchley Road	4½-in. deal	2,106[3]	Autumn, 1887	2.30	.....	.....	.....	.....	.....	.....
(11) Finchley Road	4½-in. creosoted deal	3,230	Autumn, 1906	2.77	.....	.....	.....	.....	.....	.....
(12) Finchley Road	4½-in. creosoted deal	3,498	Summer, 1908	2.64	.....	.....	.....	.....	.....	.....
(13) Finchley Road	4½-in. creosoted deal	2,734	Autumn, 1907	2.64	.....	.....	.....	.....	.....	.....
(14) Finchley Road	5-in. creosoted deal	2,536	Summer, 1904	2.88[5]	.....	.....	.....	.....	3.888	.....
(15) Finchley Road	Creosoted deal, Jarrah	4,898	Summer, 1903	2.94	5.342	.....	3.782	6.962	5.014	9.266
(16) Finchley Road	4-in. Jarrah	9,498	Summer, 1899	3.16	5.342	8.688	4.958	10.754	.986	.....
(17) Haverstock Hill	4-in. Jarrah	9,660[6]	Autumn, 1900	3.40	.706	.690	1.254	1.410	.....	1.542
(18) Haverstock Hill	4-in. Jarrah	5,594[6]	Summer, 1901	2.88	.....	.....	.....	.....	.....	.....
(19) Haverstock Hill	5-in. creosoted deal	3,602	Summer, 1903	2.16	.....	.....	.....	.....	.....	.....
(20) Heath St.	4½-in. creosoted deal	1,905	Autumn, 1905	2.22	21.550	2.30	2.74	13.750	6.412	7.008
(21) High Road	6-in. pitched deal	2,105	Summer, 1893	2.58	.....	10.816	4.624	7.282	9.464	.....
(22) High Road	5-in. deal[8]	5,189[8]	Summer, 1892	2.36	10.022	30.790	33.946	.654	.....	.....
(23) High Road	6-in. deal[9]	3,656[9]	Summer, 1888	2.32	.....	.....	.818	.246	1.676	7.666
(24) High Street	6-in. deal	11,714[10]	Spring, 1885	2.48	.....	.....	.....	.....	.....	.....
(25) Mill Lane	4½-in. creosoted deal	1,687	Autumn, 1904	3.40	.....	.....	1.434	.922	.....	.....
(26) Mill Lane	4-in. Jarrah blocks	959	Autumn, 1903	3.10	.....	.....	.....	.....	.....	.....
(27) Rossiter Hill	4-in. Jarrah blocks	3,201	Summer, 1904	3.10	.....	.....	.....	.....	.....	.....
(28) West End Lane	6-in. deal blocks	2,335	Summer, 1904	3.16	1.192	2.326	3.376	4.912	6.844	13.426

[1]Renewal of expansion joint. [2]Original pavement laid in summer, 1891, at a cost of $2.58 per sq. yd; repaved 1900-1. [3]455 sq. yds. were repaved with 5-in. creosoted deal blocks in the summer of 1902 at a cost of $2.04 per sq. yd.; 1,112 sq. yds. were repaved in the summer of 1904, 4½-in. creosoted deal blocks being used, the cost being $1.76 per sq. yd. Repaving was done on existing foundation. [4]Not including foundation. [5]For creosoted deal; $3.40 for Jarrah. [6]3,256 sq. yds. were repaved in 1907. [7]2,707 sq. yds. repaved in 1906-7. [8]Excluding foundation. [9]5,106 sq. yds. repaved with 4-in. Jarrah blocks in summer of 1899 at a cost of $2.40 per sq. yd.; 5,101 sq. yds. repaved with 3¼-in. sectional Jarrah blocks in summer of 1908 at a cost of $3.24 per sq. yd. [10]Repaved with 4-in. Jarrah blocks in summer of 1898; repaved in summer of 1906 with 3-in. sectional Jarrah blocks. [10]11,665 sq. yds. repaved with 4-in. Jarrah blocks in spring of 1894; 5,565 sq. yds. repaved with 4-in. Jarrah blocks in summer of 1902; 3,412 sq. yds. repaved with 4-in. Jarrah blocks in summer of 1903; 2,237 sq. yds. repaved with 4-in. sectional Jarrah blocks in summer of 1905.

sand and Portland cement; laid by William Griffiths, Ltd.

(14) Finchley Road.—1,667 sq. yds. of 4-in. Jarrah blocks; courses divided by fillets 1-10 in. thick. Joints run with pitch and grouted in Portland cement. Foundation, concrete 6 ins. thick, made (after screening) of the broken granite found on the ground, Thames sand and Portland cement; laid by Acme Wood Flooring Co., 3,231 sq. yds. 5-in. creosoted deal blocks; close joints run with pitch and grouted in Portland cement. Foundation, concrete 6 ins. thick, made (after screening) of the broken granite found on the ground, Thames sand and Portland cement. Improved Wood Pavement Co., contractors.

(15) Finchley Road.—4-in. Jarrah blocks; courses divided by fillets 3-16 in. thick. Joints run with tar, grouted in Portland cement. Foundation, Portland cement and Thames ballast concrete 6 ins. thick; laid by Improved Wood Pavement Co.

(17) Haverstock Hill.—4-in. Jarrah blocks. Close joints run with pitch and grouted in Portland cement. Foundation, concrete 6 ins. thick, made (after screening) of the broken granite found on the ground, Thames sand and Portland cement; laid by Improved Wood Pavement Co.

(18) Haverstock Hill.—5-in. creosoted deal blocks. close joints run with pitch and grouted in Portland cement. Foundation, concrete 6 ins. thick, made (after screening) of the broken granite found on the ground, Thames sand and Portland cement. Improved Wood Pavement Co., contractors.

(19) Haverstock Hill.—4½-in. creosoted deal blocks. Close joints run with pitch and grouted in Portland cement. Foundation, concrete 6-in. thick, made (after screening of the broken granite found on the ground, Thames sand and Portland cement; laid by Improved Wood Pavement Co.

(20) Heath St.—5-in. deal blocks, pickled in creosote oil. Close joints, run with tar and grouted in Portland cement. Granite paving taken up and wood laid on same foundation; laid by Improved Wood Pavement Co.

(21) High Road.—In summer 1892, 4,995 sq. yds. paved with 5-in. deal blocks, grouted in Portland cement. Courses divided by wood fillets 3-16 in. thick. Foundation, Thames ballast and Portland cement concrete, 6 ins. thick. Improved Wood Pavement Co., contractors. At the same time 194 sq. yds. was paved with 5-in. Jarrah blocks. In summer of 1899, 5,106 sq. yds. was repaved with 4-in. Jarrah blocks. Courses divided by wood fillets, joints run with tar and grouted in Portland cement. Acme Wood Paving Co., contractors. In summer of 1908, 5,101 sq. yds. was repaved with 3¼-in. sectional Jarrah blocks. Courses divided by fillets 1-10 in. thick, joints run with pitch and grouted in Portland cement on existing foundation. Acme Flooring & Paving Co. (1904), Limited, contractors.

(22) High Roads.—3,656 sq. yds. paved in summer of 1888, with 6-in. deal blocks, grouted in Portland cement. Courses divided by wood fillets 3-16 in. thick. Foundation, Thames ballast and Portland cement concrete, 6 ins. thick; laid by Improved Wood Pavement Co. Repaved in summer of 1898 with 4-in. Jarrah blocks. Close joints run with tar and grouted in Portland cement on existing foundation. Improved Wood Pavement Co., contractors.

(23) High Road.—Described in first part of article.

(24) High St.—4½-in. creosoted deal blocks. Close joints run with pitch and grouted in Portland cement. Foundation, concrete 6 ins. thick, made (after screening) of the broken granite found on the ground, Thames sand and Portland cement; laid by Mowlem & Co.

(25) Mill Lane. — 4-in. Jarrah blocks. Courses divided by fillets 1-10 in. thick, joints run with pitch and grouted in Portland cement. Foundation, concrete 6 ins. thick, made (after screening) of the broken granite found on the ground, Thames sand and Portland cement. Acme Wood Flooring Co., contractors.

(26) Mill Lane. — 4-in. Jarrah blocks. Courses divided by fillets 1-10 in. thick, joints run with pitch and grouted in Portland cement. Foundation, concrete 6 ins. thick, made (after screening) of the broken granite found on the ground, Thames sand and Portland cement; laid by Acme Flooring & Paving Co. (1904), Ltd.

(27) Rosslyn Hill.—4-in. Jarrah blocks. Courses divided by fillets 1-10 in. thick, joints run with pitch and grouted in Portland cement. Foundation, concrete 6-in. thick, made (after screening) of the broken granite found on the ground, Thames sand and Portland cement. Acme Flooring & Paving Co. (1904), Ltd., contractors.

(28) West End Lane.—590 sq. yds. laid in autumn 1898, with 4-in. creosoted deal blocks. Total of 13,667 sq. yds. laid in autumn, 1900, with 4-in. Jarrah blocks. Close joints run with tar and grouted in Portland cement. Foundation, concrete 6 ins. thick, made (after screening) of the broken granite found on the ground, Thames sand and Portland cement; laid by Improved Wood Pavement Co.

Mechanical Road Haulage (Considered Commercially).*

The vital importance to Ireland of an improved, better organized, and cheaper system of internal goods traffic over comparatively short distances is perfectly well understood by all who have studied the subject. I wish I could think that it was fully realized by the public at large, or even by those whose immediate interests it concerns. Yet during my experience of the country, covering a period of over twenty years, several official inquiries have been held in the form of Royal or Viceregal Commissions, with the view of eliciting information as to the conditions of railway and canal traffic, and, it must be presumed, of providing remedies for the deficiencies this brought to light. A vast body of evidence has accumulated and has been buried away in blue books as the result of these investigations, and voluminous reports embodying recommendations that were valuable or otherwise have been submitted by the various Commissions. That has been, practically, the only result of all the great expenditure of time and money that these inquiries involved. Like many others, I was in high hopes that a great change for the better was coming when it was announced a few years ago, that Lord Pirrie and some other public spirited gentlemen of the highest standing contemplated the organization of a system of mechanical road haulage in certain selected districts where the want of means of transit is severely felt. The experiment, under such direction and control, could not fail to have most noteworthy consequences. What difficulties arose to prevent the carrying out of the scheme on the proposed lines I am not aware; sufficient to say, that it appears to have fallen through from one cause or another.

This is not an audience that needs to be reminded of the direct bearing which transit rates on produce exercise upon the producer. Without entering into the economic principles that rule the question, it is enough to observe that the all-important considerations for him are the cost of the raw material at his works (which includes the cost of transit thither), the cost of manufacture, the cost of carrying the products to market, and the market or selling value. In the case of the farmer you have the cost of seeds, implements, artificial manures, and so forth—what may be termed the raw material, the cost of transit to his farm, the cost of growing his crops and preparing them for market, the cost of transit to market, and the market value. How important the cost of transit becomes, since it enters not once but twice into consideration, is clearly obvious. It is not too much to say that, without economical transit, all efforts to promote the industrial development of the country, no matter how energetic and judicious, must be greviously hampered or entirely frustrated. This is especially true of manufactures in which heavy or bulky articles are handled, as in the case of flax mills, the various operations of the linen trade, woolen mills, flour mills, paper mills, wood products, agricultural produce, and so on. Country breweries with a local trade, already hard pressed by the competition of the great Dublin concerns, and of English and Scotch firms in the matter of ales, are another case in point. All this applies, too, to the quarrying industry, particularly as regards the profitable production of macadam, and the mining industry, which, after a long season of neglect, is again receiving attention.

My subject divides itself naturally into two parts. First, there is the case of road haulage over a short distance, say, fifteen or twenty miles, in competition with an existing railway service. Secondly, we have the problem of mechanical haulage from a railway station or shipping port through a district in which no railway, canal, or similar means of communication exists, and between points in that district. In the first case the railway terminal charges, the cost of loading and unloading trucks, varying from 3d. to 6d. per ton at either end, amounting in the whole to a prohibitive rate as regards many classes of traffic, render the alternative method far the cheaper. Moreover, delays in receipt and delivery are avoided, and you attain to the seeming paradox that the apparently slower mode of transit is, in actual fact, the speedier. In this connection I would call attention to what I consider a most untoward incident that lately came to my knowledge. The owner of a traction engine was summoned by County Council, before the magistrates sitting in petty sessions, for an alleged breach of the law relating to road locomotives. The chairman of this council was chairman of the local railway company with which the defendant was in competition.

The second section of the matter under notice, dealing with road haulage by mechanical means as supplementing the work of the railways, again sub-divides itself into two parts. The first has to do with the case where heavy loads are to be hauled, and where accordingly a heavy engine must be employed; the second applies to lighter loads, such as farm produce, like butter, milk, cream, eggs and fruit, or parcels of groceries, drapery and things of that kind are to be handled expeditiously. Here a lighter motor or tractor may be advantageously employed, and in certain circumstances, as in the absence of roads and bridges, that would be safe for the more powerful but heavier traction engine. As I shall show later on the lighter is also the more expensive of the two.

Since I have touched upon the subject of roads and bridges, I would like to add a few further words, though I may fairly be told that this is outside my province. We cannot, however, separate the road from the road locomotive, except in the happily unusual occurrence of the latter straying into the ditch or adjacent field.

I know perfectly well what is the great difficulty that confronts the engineer to the road authorities—a trouble to us all in every walk of life—the problem of providing money to adequately meet requirements. We all understand how hard it is to convince even the shrewdest men ordinarily once they become elected representatives of the community, and, therefore, burdened with a sense of responsibility that they should look far ahead of their own probable tenure of office. Their natural desire is to do what appears best in their own time, and it will look all the better if a reduction in the rates can be temporarily effected. Somebody else will in due course be called upon to take up the burden of the representatives' work. Any one of the good class of men whom I now speak about would, in the management of his own individual affairs, carefully consider the permanent effect and value of his expenditure upon improvements. Human nature being what it is, the tendency to adopt the principles that "Sufficient for the day is the evil thereof" must always influence the conduct of public business. Yet it should not be impossible to con-

* Paper by H. T. Harris, Dublin, read at Irish Road Congress, April 20-22, 1910.

vince men of intelligence that good roads are the cheapest in the long run and that money well laid out is, in the event, money saved. The well-made road is best for everybody—for the farmer who depends upon horse haulage, for the motorist, for the traction engine owner, for the community at large. All interests are here combined and merged in the greatest benefit of the greatest number. Public opinion must be educated upon the subject, but public opinion does not resist education; on the contrary, it welcomes enlightenment, and, therefore, I anticipate that this Congress will have beneficial consequences of far-reaching importance.

To start at the beginning, it must be always borne in mind that our roads were not designed and constructed to meet modern conditions of power haulage and mechanical traction generally. It is clear that these conditions will prevail more and more, and the inevitable inference is that the task of reconstruction must be faced and dealt with as thoroughly as the means at our disposal will allow. In several counties, as we know, this has been recognized, and the policy of those county engineers who boldly tackled the problem has been amply justified by results. It may seem invidious to particularize, but it is in no such spirit I would mention the admirable work that has been accomplished in wide districts so far separated as County Dublin, County Armagh, County Tipperary, parts of County Waterford—to name but a few. I should name Mr. Cowen, C. E., as the first to introduce steam-rolling of roads many years ago when County Surveyor of Down. He faced great difficulties and triumphed. The adoption of steam-rolling is now becoming general, and that involves good foundations for our roads, and the selection of the best procurable road metal for surfacing. It would be nothing short of an impertinence to tell engineers how important both matters are; but I would venture upon the reminder that the steam traction engine is—given proper conditions as to foundation and surface material—a steam-roller and a beneficent rather than a destructive agent in regard to the unkeep of the roadway. Certain obvious precautions on the part of the designers will at once suggest themselves to your minds. Wheels, for instance, should not be in alignment so as to cut ruts; they should be broad, especially where the country is low-lying and soft; they should be of good diameter so that the surface in contact with road-face should be large, thus securing a sure friction grip without tearing; in most cases I would add it will be found advisable to have them rounded off at the edges, so as to avoid cutting or breaking the skin of the road. Provision to this effect is contained in the English Heavy Motor Car Order, 1904.

At this point I will ask your leave to make a slight digression leading to a matter that may merit your attention. On a very moderate estimate we have in the country at least one thousand traction engines employed primarily for hauling and driving threshing machines. They are in demand during some of the autumn and winter months: to the owners of these engines the development of road locomotion means that capital invested on them becomes profit-earning throughout the year, instead of lying idle for comparatively long intervals. Such a consideration cannot be overlooked in a country where the agriculturist counts for so much. Again, a large proportion of these engines are readily convertible into road rollers. Some firms have adopted this economical method, when desired by customers, in regard to both light tractors and heavy road locomotives, and I shall be happy to give full and detailed information on the subject to any interested inquirer. My point, if I may put it in the briefest and simplest terms, is that roadmaking and road using can be thus worked in together.

I am quite conscious that I have only touched the fringe of my subject, but I cannot trespass further on your time beyond giving some figures that I have prepared as the result of my own experience and confirmed by inquiry from reliable sources. I have reason to expect, too, that where I have omitted details and possible matters of controversy that will come before you, other papers submitted will completely cover the ground:—

SHORT STATEMENT OF COMPARATIVE COST OF HAULAGE PER TON OF GOODS ON FAIRLY AVERAGE MACADAM ROADS.

A—Load out only; cost per ton mile:

	S.	D.
Heavy traction engine	0	1⅛
Medium traction engine	0	1⅜
Tractor and trailer wagon	0	2¾
5-ton steam motor wagon	0	2
5-ton petrol lorry (rubber tires)	0	2½
3-ton petrol lorry (rubber tires)	0	3

B—If loaded both ways:

Heavy traction engine	0	0¾
Medium traction engine	0	0¾
Tractor with trailer	0	1½
5-ton steam wagon	0	1½
5-ton petrol lorry (rubber tires)	0	1½
3-ton petrol lorry (iron tires)	0	1¾

Actual Cost of Steam Haulage, the amount of work done by each of three Locomotives and by Steam Lorry, a Compound Road Locomotive on Springs, with three speeds and awning weight, 14 tons, for 6 months, from October 29th, 1906, to April 27th, 1907, showing Estimated Expenditure for 128 working days:—

Prime cost, £208 2s 10d.

	£	S.	D.
Depreciation, at 10 per cent, on £708 2s 10d (6 months)	35	8	2
Interest on capital at 5 per cent, on £708 2s 10d (6 months)	17	14	1
Wages for driver and assistants	117	2	10
Fuel	24	17	0
Oil, water, etc.	2	13	0
Repairs (say at 5 per cent on outlay for 6 months)	17	14	1
License (proportion for 6 months)	9	0	0
Total	£224	9	2
Less amount earned by hire	42	1	1
Total	£182	8	1

Total working days, 128.
Total weight carried, 2,164 tons.
Work Done—17 tons × 15 miles × 128 days — 32,640 net ton miles.
Cost—£182 8s 1d; 32,640—1⅛d per ton mile.
Average cost per ton transported 15 miles, 1s 8¼d.

A Compound Road Locomotive on Springs, with three speeds and awning, for 6 months, from October 29th, 1906, to April 27th, 1907, showing Estimated Expenditure for 131 working days, 14 tons:—

Prime cost, £708 2s 10d.

	£	S.	D.
Depreciation at 10 per cent on £708 2s 10d (6 months)	34	8	2
Interest on capital at 5 per cent on £708 2s 10d (6 months)	17	4	1
Wages for driver and assistants	118	1	6
Fuel	24	17	0
Oil, Water, etc.	2	13	0
Repairs (say, at 5 per cent on outlay, 6 months)	17	14	1
License (proportion for 6 months)	9	0	0
Total	£224	17	10
Less amount earned by hire (stationary)	42	14	11
Total	£182	2	11

Total working days, 131.
Total weight carried, 2,252 tons.
Work done — 17 tons × 15 miles × 131 days — 33,405 net ton miles.
Cost, £182 2s 11d—33,405, 1⅛d per ton mile.
Average cost per ton transported 15 miles, 1s 7½d.

A Compound Road Locomotive on Springs, with three speeds and awning, for 6 months, from October 29th, 1906, to April 27th, 1907, showing Estimated Expenditure for 132 working days (weight 12½ tons):—

Prime cost, £688 8s 0d

	£	S.	D.
Depreciation at 10 per cent on £688 8s 0d (6 months)	34	8	5
Interest on capital at 5 per cent on £688 8s (6 months)	17	4	2
Wages for driver and assistants	113	16	10
Fuel	23	10	0
Oil, water, etc.	5	6	0
Repairs (say, at 5 per cent on outlay, 6 months)	17	4	2
License (proportion, 6 months)	7	0	0
Total	£218	9	7
Less amount earned by hire	42	11	0
Total	£175	18	7

Total working days, 132.
Total weight carried, 2,165 tons.
Work done — 16 tons × 15 miles × 132 days — 31,680 net ton miles.
Cost, £175 18s 7d; 31,680, 1⅛d per ton mile.
Average cost per ton transported 15 miles, 1s 7½d

Working of Steam Motor for 6 months, from October 1st, 1906, to March 30th, 1907, showing Estimated Expenditure for 104 Working Days; Weight, 4 tons 17 cwt.:—

Prime cost, £600.

	£	S.	D.
Depreciation at 15 per cent for 6 months	45	0	0
Interest on capital at 5 per cent for 6 months	15	0	0
Wages for driver and assistant	58	6	7
Coke	18	6	0
Oil, water, etc.	10	16	0
Repairs and adjustments	21	2	6
Total	£168	11	1
Less amount earned by hire	20	9	8
Total	£148	1	5

Total working days, 104.
Total weight carried, 1,170 tons.
Total outward journeys, 190.
Work done (per journey)—6 tons × 13 miles × 190 journeys = 14,820 net ton miles.
Cost, £148 1s 5d—14,820—2¾d per ton mile.
Average cost per ton transported 13 miles, 2s 6d.

ANNUAL APPROXIMATE WORKING COSTS OF 5-6 TONS, STEAM WAGON, 150 MILES PER WEEK.

	£	S.	D.
Cost, interest on £550 at 5 per cent per annum	27	10	0
Depreciation at 10 per cent per annum	55	0	0
Fuel, 50 tons of coke at 12s per ton	30	0	0
Driver at 35s per week	91	0	0
Loader (sometimes not necessary) at 20s	50	0	0
Repairs and adjustments	40	0	0
Lubricants	12	10	0
Insurance and sundries	17	0	0

A.—Work done, without trailer, loaded in both directions, 6 tons×30 miles×260 days equals 46,800 ton miles per annum. £323, 46,800=1s. 7d. per ton mile.

B.—With trailer, loaded in one direction, 10 tons×15 miles×260 days, equals 39,000 tons miles per annum. £323—39,000=2d. per ton mile.

C.—With trailer, loaded in both directions, 9 tons×30 miles×260 days, equals 70,200 ton miles per annum. £323—70,200=1.2d. per ton mile.

Approximate Cost of Working 5-ton Petrol Lorry on Rubber Tires. Conditions similar to steam wagon, but distance too great to be accomplished by a steam wagon in a day, viz., 40 miles out and 40 miles home, at a speed of 10 miles per hour.

Prime cost, excluding tires, £600.

	£	S.	D.
Interest on £600 at 5 per cent per annum	30	0	0
Depreciation at 15 per cent per annum	90	0	0
Repairs	40	0	0
Petrol, 20 miles at 5 miles per gallon, at 9d	150	0	0
Tires, £145 per set, a set lasting about 8 months	217	10	0
Driver at 35s per week, 50 weeks	87	10	0
Lubricants	10	0	0
Insurance	15	0	0
Total	£640	0	0

Work done—40 miles, with 5 tons by 250 days, equals 100,000 ton miles per year.

Equals 1.5d. per ton mile, or allowing for less wear and tear of tires, etc., and less patrol consumption, about 2.5d., if loaded one way only.

ANNUAL APPROXIMATE WORKING COST OF 3-TON PATROL LORRY.

Prime cost, with rubber tires, £655; without rubber tires, £550.

	£	S.	D.
Interest on capital of £550 at 5 per cent per annum	27	10	0
Working costs 57-70 cwt. petrol:			
Depreciation at 15 per cent per annum	82	10	0
Repairs	30	0	0
Petrol, 100 miles per day, 250 days per annum, at 7 miles per gallon, 9d per gallon	134	0	0
Tires, £105 per set, a set lasting about 8 months, at 12,000 miles per set	182	0	0
Driver, 35s per week, 50 weeks	87	10	0
Lubricants	8	10	0
Insurance, etc.	15	0	0
Total	£567	0	0

Work done—3 tons by 100 miles by 250 days—75,000 ton miles per annum.

Cost £567÷75,000=say, 1¾d. per ton mile, loaded both ways; or, if loaded one way only, 3d.

Water-works and Sewer Section

Note: This section is devoted to methods and costs of constructing sewers and water-works. It will cover the construction work for all details of water supply and sewerage, including sewage purification and water filtration.

Typical Structural Details of Large Concrete Sewer Work at St. Louis, Mo., with Some Notes on the Specifications.

Some very heavy sewer work is being done in draining the Harlem Creek and Glaise Creek sewer districts in St. Louis. Trunk sewers of concrete and brick varying from 5 ft. diameter to 15x11 ft. in section and of various sectional forms are being built. Some of the general and several of the special structural details of these sewers are of interest and they are described here from information furnished by Mr. H. R. Fardwell, Commissioner of Sewers, St. Louis, Mo.

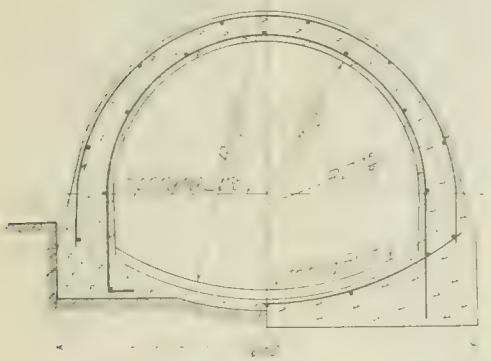


Fig 1—Section of Harlem Creek Sewers, St. Louis, Mo.

Concrete Horseshoe Sections.—The main trunk sewer in the Harlem Creek District has the concrete horseshoe section shown by Fig. 1, but varying in dimensions. In our issue of Feb. 20, 1907, and July 1, 1908, methods and costs were given of constructing some of the larger sections of this sewer. The section shown by Fig. 1, 4,793 ft. long and a similar section 10x8 ft. and 3,557 ft. long, are to be built this season. As shown by Fig. 1 the sections in rock and in earth vary slightly. The quantities per lineal foot are as follows:

Item.	Earth.	Rock.
Concrete in arch, cu. yds.	1.07	1.07
Concrete in walls, cu. yds.	0.35	0.35
Total above invert, cu. yds.	1.42	1.42

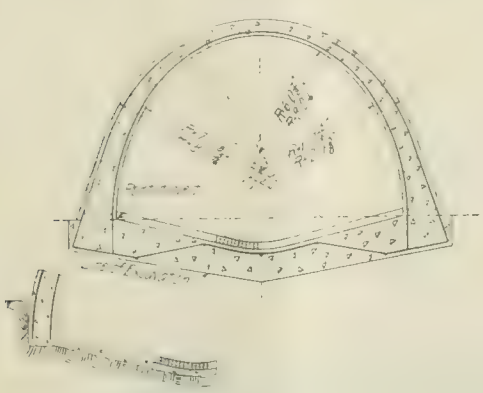


Fig. 2—Section of Glaise Creek Sewer, St. Louis, Mo.

Concrete below invert, cu. yds	0.50	1.20
Total concrete, cu. yds.	1.92	2.62
⅝-in. bars, lin. ft.	90.2	73.7
½-in. bars, lin. ft.	22.0	19.0
Vitrified brick, cu. yds.	0.17452	0.17452

The main trunk sewer in the Glaise Creek District has the section shown by Fig. 2, decreasing from the dimensions shown to a 11 ft. by 7 ft. 9⅝-in. size. The area of the section shown is 121 sq. ft., giving a capacity of 1,700 sec. ft. with an 0.0038 slope.

Figure 3 shows the manhole construction for concrete horseshoe sections. It will be noted that the manhole has a side entrance into the sewer and consists of a reinforced concrete base section carrying a brick shaft of the ordinary bottle form. The feature of interest is the arrangement of the reinforcement. The concrete spandrel wall supporting the vent pipe should also be noted.

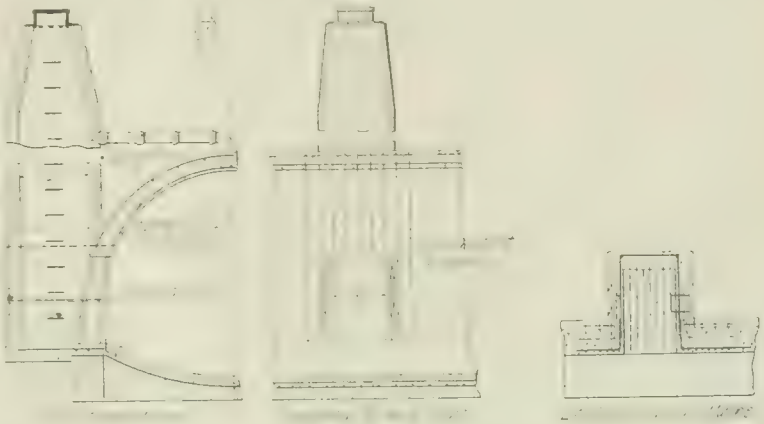


Fig. 3—Manhole Construction for Concrete Sewers, St. Louis, Mo.

In building these horseshoe sections provision is to be made for connections for lateral sewers as shown by Fig. 4. Where the laterals are not yet built the openings are to be walled up with brick work as shown.

Materials and Methods.—Excavation on this work is classified as follows: *A*. Ledges and well defined masses of rock and all detached pieces of rock and boulders of 1 cu. yd. volumn or more; *B*, all materials not coming within Class *A*. In trenching below the "point of invert" the excavation must conform to the lines of the "half-section in rock"; if overbreakage exists the voids are to be filled with Class *C* concrete. Above "the point of invert" the contractor may slope the sides of the trench to suit his convenience, but is to be paid only for the volume between vertical walls the outside dimensions of the sewer apart. Back-filling is intended to follow the sewer construction as fast as the concrete becomes hard.

Concrete is to "be made by mixing with broken stone or gravel an amount of mortar of the proper class which is 10 per cent in excess of the voids in the aggregate." For Class *B* concrete the mixture proportions will be 1 bbl. (380 lbs. net) of cement to 11.4 cu. ft. of sand; for Class *C* concrete the mixture proportions will be 1 bbl. cement to 15.2 cu. ft. of sand. These figures correspondent to proportions of 1:3 and 1:4, considering a barrel to contain 3.8 cu. ft. of cement. In measuring the sand for mortar, "it shall be shoveled damp into a suitable box and struck with a straight edge, without shaking or packing." The coarse aggregate is required to be graded as follows:

Diam. of ring, ins.	Amount Passing Rings. Not over.	Not less.
1½	100%	100%
1¼	70%	50%
⅝	40%	30%
¼	5%	

The proportioning of the concrete, as will be noted, involves as an essential a close determination of the voids in the coarse aggregate. The specifications require that:

After the broken stone or washed gravel has been graded to meet the above requirements, the voids will be calculated in the following

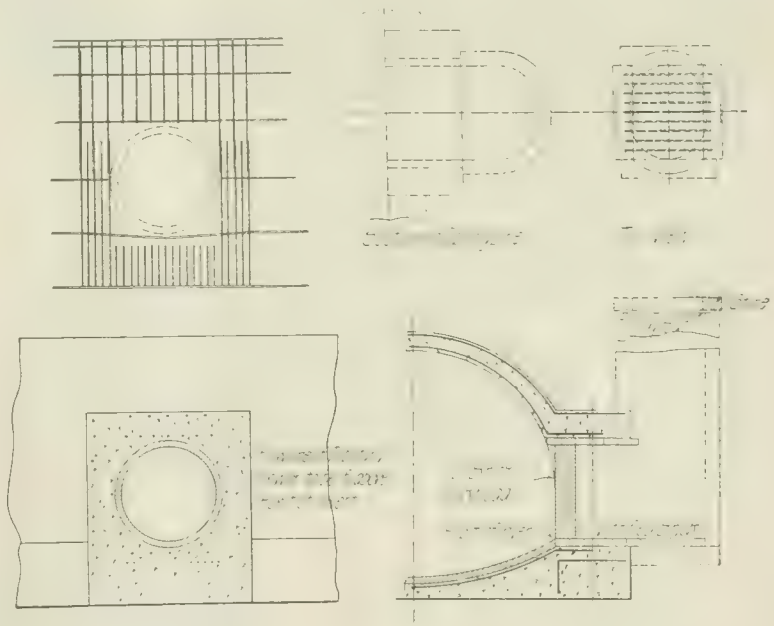


Fig. 4—Construction Providing for Lateral Sewer Connections, St. Louis, Mo.

manuner: The broken stone or washed gravel shall be shoveled loosely, without compacting, into a box of known capacity, and shall be struck with a straight edge level with the top of the box. The actual volume of the broken stone or gravel shall then be determined. The following expression represents the percentage of voids in the mass under consideration: Volume of box minus volume of broken stone or washed gravel divided by the volume of the box.

This clause misses telling the thing which is of vital importance, namely, how to determine the "actual volume of broken stone or washed gravel" in the box. It is probable that the common method of measuring water into the filled box is intended to be used, but confusion would have been prevented by so specifying.

The requirements for reinforcing steel call for high carbon steel having an ultimate strength of 85,000 lbs. and an elastic limit of from 50,000 to 60,000 lbs. per sq. in. The requirements for absence of rust are as follows: "Bars with slight rust that can be easily removed with the aid of a wire brush, may be used when rust is removed, but where rust scale is formed or beginning to form, they shall be rejected." Protection of the bars from rust by oiling or painting is properly prohibited. This amounts practically to requiring shipment of bars fresh from the mill for each day's work. The specified lap of bars at splices is: Lap in inches = (160 × area of bars in square inches) ÷ (diameter of bar in inches). Deformed bars are required.

Methods of Constructing 2,723 Ft. of the Northwestern Trunk Sewer, Louisville, Ky., with Some Costs.

One of the larger sewers now being constructed in Louisville, Ky., is the Northwestern sewer. Section B^2 of this work is being built under contract to Chas. F. Fitch & Co. of Louisville. The contractor here has worked out a system for handling this class of sewer work and in each phase of the work has used, what he believes, according to his experience, the proper and most economical method of handling that phase of the work. This contract is for 2,723 ft. of sewer through unimproved land. The sewer is of concrete, 12 ft. x 9 ft. for 1,126 ft. in length, and of three centered arch section. For the balance of the length it is horseshoe shaped, and about 9 ft. 3 ins. x 9 ft. in section. Kosmos and Speed Portland cements are used, and the reinforcement is Johnson corrugated bars.

The average depth of excavation was 22.4 ft. and the average number of cubic yards of excavation per lineal foot of trench was 12¼. The material excavated consisted of 6 ft. of blue and yellow clay below which was 6 to 12 ft. of yellow clay and loam and the balance, fine and coarse sand.

In opening the trench horse scrapers were used as shown by Fig. 1, and enough of the trench was excavated in this way, and used for filling in low land nearby, to take up the amount which would necessarily have to be spoiled. An average of half a dozen teams were used on this work with one team acting as a snap team. The longest haul was about 100 yards.

Plant.—The main plant for this contract consists of three ten-ton Browning locomotive cranes, two of which were equipped with automatic buckets. One orange-peel of 1 cu. yd. capacity and one clamshell of ½ cu. yd. capacity are used. The cranes run on standard gage track of 60 and 65-lb. rails. The track is laid along the trench for 600 ft. The mixer is a No. 2½ Smith. It is located on the opposite side of the trench from the cranes and is mounted on a section of portable track. Another section of track is placed handy for moving the machine along the trench by successive steps. The contractor maintains small blacksmith and carpenter shops on the work. On account of there being plenty of good sand in the trench, it is screened and used for the concrete. The screen used consists of a framework placed opposite to one of the cranes as shown by Fig. 2. This crane dumps part of the sand into the hopper at the top of the screen and the sand and rejections are carried by chutes to separate piles 15 or 20 ft. away from the trench.

The frame for the screens can be carried along the trench with the aid of one of the cranes. This arrangement saves quite a little money in producing a good sand on the job and in placing it along the trench in such quantities as are needed and at such a distance from the trench as not to be in the way of the mixer, and other work. The screen is the idea of the inspector of the work, Mr. Starkweather and was designed and built by him for the contractor.

Excavation and Backfill.—The cranes operate about as follows. Crane No. 1 is equipped with an Owens clamshell bucket and takes out the cut to a depth of about 10 or 12

Fig. 1—View Showing First Cut with Scrapers in Trenching for Northwestern Trunk Sewer, Louisville, Ky.

Fig. 2—View Showing Method of Trenching With Locomotive Cranes, Northwestern Sewer, Louisville, Ky.

ft. The sheeting is started as soon as practicable and crane No. 2 equipped with a ¾-cu. yd. bucket takes out the balance of the cut. The cranes dump all excavated material in a spoil bank except the sand, which is dumped on the screen by crane No. 2. Crane No. 3 brings up the rear of the work and does all the backfilling and pulling of timbers and sheeting.

Sheeting.—Hardwood sheeting 2 ins. thick and of various widths is used, and enough is kept on hand for sheeting about 250 ft. of trench. The bottom set of sheeting is required by contract in this case, to be left in

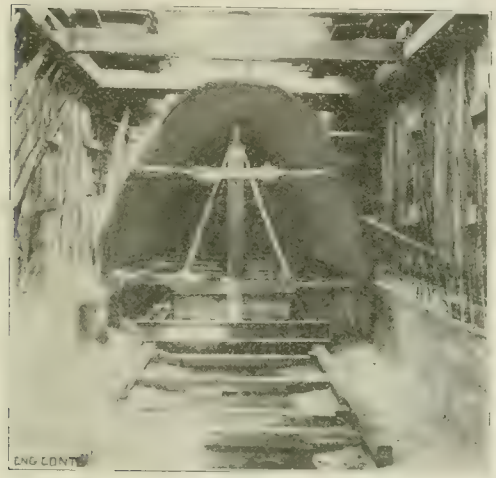


Fig. 3—View Showing Blaw Forms in Place and Carriage for Moving Them, Northwestern Sewer, Louisville, Ky.

place in the trench. The braces and waling timbers are of 8x8-in. pine; the tiers of cross braces are about 5 ft. apart vertically and the struts are usually 10 ft. apart.

Forms.—The sewer section is built in two operations, the invert and sidewall in one and the arch in another. The length of section handled at one time is 60 ft. and three sections are built in a week. The forms for the invert and sidewalls are of wood and are made of 1-in. material. Blaw arch forms are in use, and altogether 180 lin. ft. of forms are employed. The wooden forms are made in sections easily handled and are carried forward and set in place by laborers. The Blaw forms are shown by Fig. 3. They rest on carriages which run on tracks upon the completed invert. The carriages are provided with sets of screw jacks for bringing and holding the steel forms to the true radii as shown by Fig. 3. The forms are scoured with sand and oil before concrete is placed on them and the oily surface prevents adhesion of the concrete. The concrete material is brought to the mixer in wheelbarrows and the concrete is dumped directly from the mixer into galvanized iron chutes which convey it to place.

Figure 4 shows a typical junction chamber of the work in Louisville, and this chamber is a part of the work of this contract. The chamber is about 18 ft. long. The main sewer here is 9 ft. high by 12 ft. wide and the diameter of the branch is 7 ft. 6 ins. The chamber contains 39 cu. yds. of concrete.

The forms for the arch and invert were built of wood. The contractor was furnished by the engineers with sections of the chamber, drawn to scale, and representing a section every 2 ft. along the center line and at right angles to it. The ribs were sawed out to the dimensions shown by the drawings and put in place and braced. The 1-in. lagging was then laid on them, forming the arch center. The cost of the forms for this chamber, including the material in the forms, amounted to $4 per cu. yd. of concrete or $156 in all.

Progress and Costs.—Progress and costs of various parts of the work are interesting. The working day is 10 hours. Crane No. 1 operates a ½-cu. yd. Owens clamshell bucket and averages 400 buckets in 10 hours or 200 cu. yds. This bucket handles a full half yard at each operation. The labor cost on this machine is as follows:

1 engineer at	$3.50
1 fireman	2.00
1 tagman	1.75
1 signalman	1.75
Cost of labor for 200 cu. yds. (clay)	$9.00

Cost of labor per cu. yd., $0.045.

The second crane handles sand in a ¾-cu. yd. dump bucket filled by hand. It handles 300 buckets or 225 cu. yds. a day. The labor cost on this is as follows:

1 engineer	$3.50
1 fireman	2.00
1 foreman	2.00
8 men in bottom at $1.75	14.00
Cost of labor for 225 yds.	$21.50

This gives a cost of labor for 1 cu. yd. of $0.095. The third or backfill crane operates a 1-cu. yd. orange-peel bucket and handles 500 cu. yds. of material in 10 hours. The cost of labor backfilling is as follows:

1 engineer	$3.50
1 fireman	2.00
1 signalman	1.75
Labor cost backfilling, 500 cu. yds.	$7.25

Labor cost per cu. yd. of backfilling, $0.0145.

This crane when not backfilling, pulls timbers and sheeting. The average amount of coal used by one crane in a day is 1,200 lbs. Run-of-mine coal is used at $4 per ton. About 160 gals. of water are used per crane per day. The cranes each cost $5,000 new and their annual interest and depreciation is figured by the contractor at 30 per cent or 15 per cent for each item.

Moving and resetting 60 ft. of the large Blaw forms required the time of 6 men for 4 hours. The forms are rented for the length of time required to complete the work (8 months). There are 300 ft. of Blaw forms, 150 ft. of 9x12 ft. size and 150 ft. of 9x9 ft. size; and the rent on them is $1.25 per cu. yd. of concrete, or about $15 per lineal ft. of form. The freight on the forms is paid one way by the contractor. It is estimated by the contractor that he has saved 15 per cent by using the Blaw forms instead of wooden forms. On larger work on a 15-ft. sewer he estimates 20 per cent difference in favor of the Blaw forms, and on smaller sewers of 4 ft. diameter where Blaw forms were used for 1,000 ft. the saving was between 7 and 10 per cent.

The average wages paid upon this work and which fairly represent the wages paid on all the Louisville sewer work are as follows:

Superintendent, per month	$135.00
Street foreman, per month	80.00
Carpenter foreman, per month	80.00
Concrete foreman, per month	80.00
Timber foreman, per month	80.00
Team foreman, per month	80.00
Man in charge of all form work, per month	135.00
Timekeeper, per month	50.00
Water boy, per day	1.00
Stud men, per day	2.00
Carpenters, per day	2.50
Concrete men, per day	2.00
Timbermen, per day	2.00
Crane engineers, per day	3.50
Crane firemen, per day	2.00
Laborers, per day	1.75
Blacksmith, per week	20.00
Blacksmith's helper, per week	15.00
Teamsters, per day	2.00

Eight teams are kept at work steadily hauling material from the railroad. The haul is 1½ miles over good roads for the greater part of the distance. The cost of steel delivered on the work is $1.52 per 100 lbs. The cost of Ohio River gravel is $1.50 per cu. yd. delivered. The sand is taken from the trench and screened and costs about 50 cts. per cu. yd.

We are indebted for much of the above information, on costs and methods on this contract, to Mr. Chas. F. Fitch, General Contractor, Louisville, Ky.

The work is under the supervision of the Commissioners of Sewerage of Louisville, Ky., Mr. J. B. F. Breed, Chief Engineer, and Mr. Harrison P. Eddy, Consulting Engineer. Mr. Harrison P. Wires is Resident Engineer.

The Calumet-Sag Channel of the Chicago Drainage Canal Recommended as the Best Means of Sewage Disposal for the Calumet District.

The original Sanitary District of Chicago was confined approximately to the city limits of Chicago. In 1903 the District was extended to include Evanston, Ill., and other districts north of Chicago and on the south to include the so-called Calumet District. A channel known as the North Shore Channel is now being constructed and is virtually a branch of the Main Channel designed to take the sewage of the North Shore districts. On May 11, the Committee of Engineering of the Trustees of the Sanitary District submitted the following report on the question of disposing of the sewage of the Calumet District:

Your Committee on Engineering is of the opinion, that it is advisable at this time to state its position to the Board of Trustees of the District with reference to the question of affording relief to the Calumet District the sewage which flows into Lake Michigan through the Calumet River.

As early as 1904 the Board of Trustees passed ordinances establishing a route for a channel extending from its main drainage channel near the Sag, to connect with the Calumet River at a point east of Blue Island. In 1905 it was found that the channel as from the contamination of its water-supply by

Fig. 4—View of Junction Chamber on Northwestern Sewer, Louisville, Ky.

planned could not be sufficiently supplied with water unless it was extended to the improved portion of the Calumet River and your committee at once formulated a plan for its extension. But at the same time there arose vexatious engineering and legal problems, which have continued to the present time.

The most serious of these were (1) the recommendation of the International Waterways Commission (appointed to draft a treaty between the United States and Great Britain) to limit, forever, the amount of water which could be drawn from the southern end of Lake Michigan to 10,000 cu. ft. per sec.; (2) the reports of experts submitted by that commission that the sewage of the Calumet District could be disposed of in other ways than by water dilution, and (3) the refusal of the Secretary of War to permit the District to withdraw from Lake Michigan an additional 4,000 cu. ft. per sec. through the proposed Calumet-Sag Channel.

Then came the filing of a bill of complaint by the United States to enforce the decision of the Secretary of War by a perpetual injunction, which suit is a battle of hydrographic experts and is still waging in the Circuit Court of the United States for the Northern District of Illinois. Also an unsuccessful suit in the Supreme Court of the State of Illinois to declare the Sanitary District Act of 1903, extending the boundaries of the District, to be unconstitutional. And last, but not least, the recent refusal of the Secretary of War to permit any water to be withdrawn from Lake Michigan by way of the Calumet River, or in any manner to reverse its flow.

Your committee has not waited upon the determination of the suits referred to by the courts, but has steadily sought to find an efficient substitute for the method imposed on the District by law to dispose of the sewage of the entire district by water dilution, so that, if in the end the refusal of the Secretary of War to permit the flow of the Calumet River to be reversed was sustained by the courts, relief could be obtained in some other way.

The Board of Trustees has considered every phase of sewage disposal which has been brought to its attention. It has especially considered the broad questions of the advisability of constructing a sewage disposal plant, the effluent of which could be discharged into the lake or into the proposed channel, and of constructing a system of intercepting sewers and controlling works.

The Trustees had published in pamphlet form the exhaustive report of Messrs. Hering & Fuller to the International Waterways Commission on "The Disposal of Sewage of Chicago in the Calumet Region," dated Dec. 18, 1906; and procured and published a comprehensive report by Mr. Rudolph Hering to the President of the District on the "Sewage Disposal of the Calumet Region," dated Oct. 15, 1907; and a report by the Chief Engineer, Mr. George M. Wisner, dated June 9, 1909.

In addition to obtaining the reports of eminent experts on sanitation and hygiene, early in 1909 your Board authorized the construction of an experimental station at the 39th St. pumping works where the operation of the more rapid forms of sewage treatment by the use of settling tanks and sprinkling filters could be studied, under the conditions obtaining in Chicago. This plant was placed in charge of Assistant Engineer Langdon Pearse, with Dr. Arthur Lederer as Chemist and Bacteriologist. For more than a year there has been conducted a series of chemical and bacteriological analyses of sewage, and experiments to determine the safest way to dispose of the effluent from the settling tanks and the filter beds.

A full description of the experimental plant appears in an illustrated article in Engineering News of March 31, 1910, and was reprinted in pamphlet form by the District.

As time has passed, the population of the Calumet River District has largely increased and there has been a corresponding increase in the contamination of its water-supply, not only from the growth in population, but also by reason of the location in that district and in northern Indiana of many large manufacturing plants, which discharge into the Calumet River industrial waste, some of which is highly favorable to the growth of bacteria.

Your committee further reports that by reason of the refusal of the Secretary of War to grant a permit to take through the Sag Channel 2,000 of the 10,000 cu. ft. already permitted to be withdrawn from Lake Michigan, it has during the past few weeks again reviewed the entire subject of the contamination of the water-supply of the Calumet District, and presents herewith reports and communications relating thereto from its Consulting Engineer, Mr. Isham Randolph; its Chief Engineer, Mr. George M. Wisner; its Assistant Engineer, Mr. Langdon Pearse; its Chemist and Bacteriologist, Dr. Arthur Lederer; from Dr. William A. Evans, Health Commissioner of the City of Chicago, and from Mr. C. D. Hill, Engineer of the Board of Local Improvements of the City of Chicago, all of whom are experts of high standing in matters of sanitation, hygiene and the public health.

From the reports and communications mentioned, it is apparent that the present condition of the Calumet River and the extreme south end of Lake Michigan is simply intolerable and, unless rectified, will result very speedily in a serious epidemic of typhoid and other diarrheal diseases among the 500,000 people using water from the 68th St. intake. And, as the water mains of the entire city are inter-connected, occasions may arise when the water from that pumping station may flow beyond its normal territory and extend an epidemic.

The vital statistics of the industrial towns in Indiana at the foot of Lake Michigan, when compared with the vital statistics of the population in Chicago living under practically the same conditions as to food, climate and shelter, also demonstrate that the death rate from typhoid fever and other diarrheal diseases is practically 25 times as great as prevails in the city of Chicago. This abnormal condition can only be attributed to the fact that their water-supply is grossly contaminated by pathogenic germs, introduced by sewage.

It further appears from the report of your Chief Engineer that at the present time there are sewering into the Calumet River from the territory of the Sanitary District nearly 130,000 people and probably as many more living in the State of Indiana, and it is not only to remedy the conditions which now exists in that part of the Sanitary District which lies within the Calumet District, but to place the Sanitary District in a position where it can vigorously protest against the contamination of a common water-supply by the people of an adjoining state, that it is now necessary for the Board of Trustees to afford the people of that district such relief as it is able to do, in the face of the engineering and legal problems which have so long confronted and still do confront the Board.

Your committee is, however, of the opinion that the officials of the State of Indiana and its municipalities which border on Lake Michigan will at once co-operate with this District to prevent further contamination of the common water-supply if they are convinced that the Sanitary District is taking actual steps to abolish unsanitary conditions within its own boundaries.

Your committee, before coming to any conclusion, again considered the advisability of constructing a system of intercepting sewers and of the building of a filtration plant for the purification of the sewage of the Calumet District, but, as is well stated by Dr. W. A. Evans, in his letter of April 28, 1910, to the Chief Engineer of the District:

The state of the art of sewage purification by mechanical separation, bacterial action, oxidation and filtration probably has not advanced to the point where it would be safe to place the effluent in a quiet body of water so close to intakes used for drinking-water supplies.

In addition to this objection, the cost of adequate sewage purification on a large scale, as shown by the estimates of our engineers, is almost prohibitive.

There appears to be but one remedy available. The sewage of the District, whether subjected to purification processes or not, must be kept out of the Calumet River and Lake Michigan, and an outlet provided for its diversion.

Your committee is of the opinion that it is the duty of the Board of Trustees of this District to furnish such an outlet for the sewage of the Calumet District at once by acquiring the necessary right of way and proceeding to construct a channel to connect the Main Drainage Channel, at the Sag, with the Little Calumet River at a point just east of Blue Island; and that, until the question of the right of the District to take additional water from Lake Michigan through the proposed channel is fully determined, it will dilute the sewage which will necessarily flow into the channel by taking the normal flow of the Little Calumet River, amounting to about 720 cu. ft. per sec., and storm water drainage, which will result in preventing the scouring of the channel of the Calumet River lying in South Chicago into the lake for most of the time during the year.

Respectfully submitted,
WALLACE G. CLARK, Chairman.
EDWARD I. WILLIAMS.
Committee on Engineering.

Depreciation in Water-Works Accounts, With Reference to Uniform Reports.*

Some twenty years ago the writer was superintendent of a water works in one of the smaller cities of New England, and subsequently became treasurer, and was also manager of the gas plant in the same municipality. During his administration the water works were rebuilt, new pumps were installed, a water tower erected, a filter introduced, and the mains extended in many streets. At the same time a complete reorganization of the gas plant went on, with new works and holders. The process was changed from coal gas to water gas, and the mains throughout the town were repaired and relaid. This was the first practical experience with questions of depreciation on a considerable scale with which the writer had to do, for, as may be surmised, no allowances for depreciation had ever been made in the accounts of the water works or of the gas works prior to that time. All these renewals and reconstructions required the investment of new capital for the time being, although this was ultimately made up out of earnings in subsequent years.

From that time questions relating to depreciation in public service corporations and in municipal industries have played a prominent part in the writer's experience, as he has been engaged as an expert witness in a number of important suits relating to water works, gas plants, and electric light works in which the determination of fair rates for depreciation was fundamental. In each case, in fact, the result of the suit depended almost wholly upon a correct setting forth of these matters. The Holyoke Water Power case was one of these suits. Boston Consolidated Gas Co., Haverhill Gas Light Co., Norwich Gas & Electric Co., were others.

Having been called upon in a professional capacity to reorganize the accounts of various municipalities during the past ten years, the accounting of public water works and electric light works has been drawn forcibly to the writer's attention. Moreover, as chairman of a committee of the American Association of Public Accountants which has reported upon questions pertaining to uniform accounts in public service corporations and in municipal industries, the necessity for correct accounting of depreciation has been further impressed upon him. The reports of this committee may be found, by those interested, in the Proceedings of the American Association of Accountants for past years.

In connection with the Bureau of the Census, special attention has been given by the

*Extracts from a paper by Harvey S. Chase, Public Accountant, Boston, Mass., before the New England Water-Works Association, Feb. 9, 1910.

writer to water-works accounts, while in 1907 a report was submitted by him to the New England Telephone & Telegraph Co. which pertained especially to depreciation and kindred questions in the telephone field. These matters have been mentioned here in order to show how wide a field, in the experiences of public accountants as well as of water works, gas, and electric engineers, is covered by matters related to depreciation.

Mr. Albert H. Wehr, at the annual convention of the American Water Works Association last June, presented an admirable paper relating to uniformity in the accounts and reports of water works, in which he refers to the recent work of the United States Census Bureau and to the conclusions of Dr. Powers of the Census in the Bureau's bulletin, "Statistics of Cities," published early in 1909.

It may be advisable for me to summarize the statements of Mr. Wehr and Dr. Powers before proceeding to my own conclusions concerning the subject of this paper.

Mr. Wehr's considerations in favor of a uniform classification of accounts are as follows:

The evolving of any uniform classification of accounts for water supply or any other form of public service enterprise must be based on certain considerations of purely practical utility, of which the five following are the most important, viz.:

(1) To afford managers such detailed information relative to the operation of their properties as to enable the making of careful analyses of income and expense, both separately and as compared with previous similar periods.

(2) To afford accurate comparability of the operating results of such enterprises with those of any other similar enterprise.

(3) To so divide and subdivide the expenses as to easily enable the ascertainment of the separate and distinct elements of cost which make up the total cost of service. . . .

(4) To so devise the scope of the classification as to place the enterprise, whether privately or municipally owned and operated, on a basis which will disclose all income earned by the enterprise, whether actually received or not, and show the actual expense of operation or cost of service, whether actually paid or not.

(5) To so devise the classification as to divide the various branches or departments of such classification into certain fixed and clearly defined centers of division, from which all subdivisions radiate. . . .

In this connection, Mr. Wehr has devised a scheme of enumeration for the classified accounts which is simple, effective, and cleverly arranged. Mr. Wehr's paper sets forth definitions of the classifications, following in the main the terms accepted by the Census Bureau, and gives a complete scheme of the classified accounts under these heads:

1. Income Accounts.
2. Expense Accounts.
3. Allocation and Profit and Loss Accounts.
4. Outlay, or Property Accounts.
5. Asset Accounts.
6. Liability Accounts.
7. Proprietary Interests, or Proprietorship.

In this classification *depreciation* appears under various headings, the first of which is 214, "Expenses for General Depreciation," with subdivisions as follows:

2140. Undistributed Expenses for General Depreciation.
2141. Depreciation of Administrative Property.
2142. Depreciation of Accounting and Commercial Property.
2143. Depreciation of General Operating Property.

Also under the heading 224, "Expenses for Water Service Depreciation," appear the following subdivisions:

2240. Undistributed Expenses for Water Service Depreciation.
2241. Depreciation on Sources of Supply Property.
2242. Depreciation on Intakes and Aqueducts.
2243. Depreciation on Purification System.
2244. Depreciation on Pumping Station.
2245. Depreciation on Transmission and Distribution Storage System.
2246. Depreciation on Distribution System.
2247. Amortization of Preliminary Expenditures.

And under 23, "Miscellaneous Expenses," appear

23115. Depreciation on Tools and Appliances—Plumbing.
23125. Depreciation on Buildings, Tools, and Appliances—Shops.
23136. Depreciation on Buildings, Teams, and Equipment—Stables.
23144. Depreciation of Rental Property.
23155. Depreciation on Tools and Appliances—Meters.
23164. Depreciation of Forest Lands and Reservations.
23174. Depreciation of Other Accessory Enterprises.

Under 232, "Expenses of Invested Funds," there is an item 2322, "Expenses of Depreciation Funds"; also 325, "Depreciation in Invested Funds Values"; and 342, "Depreciation and Amortization Funds." Among the assets under the general heading 5 appears 563, "Depreciation and Amortization Funds."

No accounts appear among the liabilities under general heading 6, where we should expect to find "Depreciation Reserves." This fact particularly appeals to me, as it is the special point on which I must criticize the otherwise admirable and exhaustive classification of Mr. Wehr. No explanations of Mr. Wehr's views concerning depreciation reserves appear in the text of his paper, but in the Census Bulletin, on page 334, the term "depreciation" is defined as given below. In the Census classification, depreciation accounts appear under the following headings:

VII. Expenses for Water Service Depreciation.
208. On General Administrations Buildings and Equipment.
209. On Accounting Equipment.
210. On Operating Management Buildings and Equipment.
211. On Sources of Supply.
212. On Intakes and Aqueducts.
213. On Purification System.
214. On Pumping System.
215. On Transmission and Distribution Storage System.
216. On Distribution System.

There are also accounts for depreciation of pumping, rental property, meters, stables, etc., these being in accord with Mr. Wehr's classification. The Census definition of depreciation is as follows:

Depreciation.—Depreciation is a general designation of the gradual diminution in value which is caused by wear, decay, displacement, or obsolescence in the value of buildings and equipment, and of the sudden diminution which results from fire or other destructive forces. It is never actually or relatively the same for any two establishments, even of the same industry. For this reason it is impossible to frame concise, general rules for making allowances for depreciation which will not in their application be attended with a large margin of possible error. To use such rules without causing errors, those employing them must have for each individual establishment exact data based upon inspection, showing how far and in what respects its actual depreciation differs from that of the average establishment of its class. For this reason, a physical examination and appraisal of water works should be made every ten years, or even more frequently, in order to provide the basis for an approximate statement of the annual loss chargeable, as an expense, to depreciation. In the absence of such exact data for each water-supply system, however, it is to be assumed that depreciation takes place according to the average life of the several parts of such a system and of water-supply plants as a whole. The knowledge at the command of the Bureau of the Census leads to the conclusion that this average life is approximately as follows: For horses, carriages, automobiles, and laboratory fixtures and meters, ten years; office furniture and general equipment, fifteen years; boilers, steam pipes, and filtration equipment, twenty years; engines, pumping machinery, and wood pipes, twenty-five years; masonry of filtration plant, cribs, iron water pipes, intake pipes, fire hydrants, standpipes, and buildings, fifty years; reservoirs, tunnels, and aqueducts, one hundred years; and for the water system as a whole, fifty years.

There are many methods which may be employed in the computation of depreciation from data such as are above referred to, all of which involve the assumption that depreciation proceeds either with a uniform or with a geometrically accelerated rate throughout the life of the plant or fixture. The actual rate of depreciation unquestionably increases geometrically, and for this reason the best method of computing the amount of depreciation which has taken place during a series of years, or during a particular year, is that which is sometimes called the sinking fund or compound annuity method. The depreciation during the first year of any property having an expected life of fifty years is represented by a quantity equal to the annual payment which would have to be made each year during the fifty years, and invested at some specified rate of interest, to amount at the expiration of the fifty years to a sum equal to the original value of the property. The depreciation for any subsequent year would be the same quantity plus an amount equal to the interest on the prior payments and accumulated interest earnings at the specified rate. . . . By means of tables and diagrams, the depreciation for each particular portion of the water-supply system can be computed for any given year of its life, and thus the total depreciation for the system be ascertained, provided the enterprise has a detailed statement of its property and equipment as explained later under "tentative instructions for accounts, with cost and present value;" and, provided further, that the probable life of each division of the system has been ascertained by physical inspection, and that the rate of depreciation has also been determined in the same manner. The depreciation taking place in the water-service system in a given year, calculated as above, should be charged as an expense in primary accounts 208 to 216. This depreciation, however, is primarily an entry in the accounts with property and equipment, as shown in the accompanying summary of the cost and value of the water supply system and of its extensions, additions, and renewals. When detailed data are lacking for computing depreciation as outlined above, it may be assumed that the aggregate depreciation to be included in the accounts mentioned, or in subgeneral account VII, is 2 per cent of the present value of the water system. . . .

The Census classification for water works accounts does not set up a complete balance sheet of assets and liabilities, nor does it give a detailed list of liability accounts, in which should appear, according to the writer's opinion, a series of depreciation reserve accounts. It is owing to this omission, both in the Census classification and in Mr. Wehr's, that the present paper has been written, and the writer will, therefore, give a brief explanation of his reasons for urging the inclusion of depreciation reserves in all such classifications.

Much experience under the conditions in which public service corporations are acting in most municipalities convinces the writer that it is fundamentally necessary that questions of depreciation should be carefully considered, accurately worked out, and regularly entered upon the books of all such corporations. This being the case in private works, it is also necessary that municipally managed public services should have similar accounts. The reason in both cases is the same, viz., in order that *fair* rates may be established, that is, rates which will be just to the consumers and also fair to the plant. Such rates cannot be just unless full allowances shall have been made for deterioration of the plant, or, in other words, for the capital losses which arise from depreciation. Such losses must be provided from income, or otherwise they will require new capital. Therefore, they should be handled in the accounts as regular charges against income. This is most forcibly true in all plants which have to do with electricity, for in such plants depreciation during past years has been rapid, and changes in the art have frequently demanded that machinery should be scraped even though the machines themselves might be in excellent physical condition. Electric street railway companies, electric lighting companies, and telephone companies are fast coming to see the necessity for proper and complete provisions for depreciation. Gas companies are next in importance in this particular, while water works may be considered last. It must be noted that it is frequently the fact that "appreciation" in the general value of any water works, due to increase of population in its territory, may offset in great part, and sometimes may even exceed, the

losses by depreciation which occur during a given period. Therefore, while the emphasis which is here laid on depreciation accounting is accepted in full by electrical concerns today, and accepted in part by gas companies, it is nevertheless true that water works have not as a rule acknowledged the necessity for such accounting, or, at least, have not adopted such accounts in their bookkeeping systems. The same arguments which have compelled the use of depreciation accounts in electrical concerns will, in my opinion, compel their use ultimately in water works. This will come about mainly through the instrumentality of state supervising boards, which will require uniform reports from all municipalities and from their departments, in which a water department is frequently included.

Just as the Gas Commissioners of Massachusetts have required definite allowances for depreciation in the accounting of municipally operated plants, so, in due time, similar requirements will be promulgated for municipal water works.

If the writer has stated the facts correctly, and if his deductions in regard to the future are true, it is evident that proper accounting for depreciation should be undertaken promply in all such plants. The best way to handle these matters, in the writer's opinion, is by a series of *depreciation reserve* accounts, that is, by reserve accounts which correspond to the different classes of assets, and which appear in the balance sheet as liabilities (credit balances). Every monthly closing should provide for items to be charged to *expense* and at the same time credited to these various reserve accounts. Each of these charges should be based upon a carefully calculated percentage which will vary according to the estimated life of the particular class of asset. Whenever depreciation is made good by actual expenditure for renewals or reconstruction, such amounts should be charged against the corresponding depreciation reserves and thereby the balances remaining in these reserve accounts will show whether or not sufficient monthly allowances are being made year by year to provide for depreciation losses, shown by the actual expenditure for renewals and reconstructions. The necessity for depreciation reserve accounts being evident, the writer urges that particular attention be given to them in all public service accounting, and trusts that, in future editions of the Census classifications, statements of liability accounts will be included in which will be set forth in detail a depreciation reserve for each of the various classes of deteriorating assets.

Wooden Water Pipes in Australia.—In speaking at the opening of a new factory for making wooden water pipe, New South Wales, the Minister of Works said that the cast iron and steel pipe factories could not fully supply the requirements of the state. In giving figures of cost of pipes he said that the wood pipe here was lower. For example, a 3-inch wood pipe to withstand a head of 100 feet would cost 21 1-5 cts. a foot; cast iron, 45 cts., and steel 38 2-5 cts. With larger diameters and the same pressure a 12-inch pipe costs 72 1-7 cts. per foot and cast iron $1.55 per foot.

A 3-inch wood pipe weighs about 4 lbs. per foot, and cast iron 13 lbs. per foot. A 12-inch wood pipe weighs 15 lbs. per foot, and a cast iron pipe weighs 77½ lbs. It was estimated that with inland towns a saving of 50 per cent of the cost could be shown in the installation, thus making water extension possible in many cases where now impossible.

The pipe is constructed of timber staves, dressed on both sides, with galvanized steel wire, and then coated with a heavy coating of bituminous composition and wrapped with Hessian cloth.

It is expected by the Chicago, Milwaukee & St. Paul Ry. officials to have completed 70 per cent of the double track work between Chicago and the Twin Cities by July 15. As mentioned in a recent issue of Engineering Contracting, all contracts for the work have been closed.

Unclassified and General Articles

Note: This section is devoted to methods and cost articles on construction work not properly coming under any of the preceding classifications.

Experience With Day Labor Work in the Maintenance and Repairs of Bridges in Chicago, Ill.

The numerous city bridges in Chicago are built and maintained by a division of the Bureau of Engineering of the Department of Public Works, this division being known as the Division of Bridges and Harbor. During the last few months this division has been made the subject of investigation by the Chicago Commission on City expenditures, popularly known as the Merriam Commission, and in the report of their investigation recently issued, some interesting facts are brought out respecting the efficiency and cost of day labor, maintenance and repair work on city bridges.

In conducting the investigation inspectors were sent out to take observations on the work of the men employed, with instructions to report on the amount of time worked by the men observed, the amount of time idle, the amount of time away from work, and to give such description of the character of performance as would indicate the degree of efficiency of the laborers under investigation. The observations were made chiefly by six men who were men of practical experience as carpenters, rodmen, or inspectors of construction work. Subsequently, an expert bridge engineer was secured to make estimates of the time and necessary labor cost required for such repair jobs as it seemed practical to investigate.

The reports of the inspectors showed generally a material loss of time due to loafing and poor management. Specific figures of lost time are 40 per cent for painters; electricians 14 per cent, machinists 32 per cent, and carpenters 28 per cent. Study of the system of accounting showed inaccuracies and omissions and generally unsatisfactory conditions throughout. The most specific dates, however, are contained in the report of the special expert, Mr. W. W. Curtis, M. Am. Soc. C. E., which we reprint substantially in full as follows:

The work of the Bridge Department naturally divides itself into two branches: The design and supervision of new construction, and the maintenance and repair of present structures.

New Work.—The number of new bridges built by the city during recent years has been small. There have been new structures erected during the last two or three years, however, at Erie, Kinzie and Polk streets. The bridge at Madison street has had large repairs made to it, necessitated by a collision with a boat. All of this work was done by contract. Bids were received from a reasonable number of contractors, the work was awarded to the lowest bidders, and the cost completed shows but little, and that natural, variation from the expected cost, based upon the prices bid and the quantities given in the invitation to bidders.

I have made inquiries, personally and confidentially, as to the manner in which the specifications have been lived up to in the execution of this new work. I have every assurance that the contracts have been carried out substantially and that there has been no connivance at poor work or skimped quantities. Nor can I learn that there has been any petty grafting on the part of inspectors. I believe my information along these lines to be reliable.

The Madison street bridge repair was emergency work. The price paid was large, but the conditions imposed on the contractor were severe and the work was worth the cost.

Rumors having reached me that the contractor had been helped by the City Repair Department in an improper manner, by having the city forces do work which properly was the duty of the contractor, I made a careful examination of the facts, so far as available. I find only one instance in which the daily reports of the city forces indicate any such condition. It is, perhaps, questionable in this case whether the work was properly contract work or not, and I have no criticism to make on the decision of the Bridge Department.

The printed annual reports of the Department of Public Works give the gross cost only of substructure and superstructure of bridges completed during the year. I recommend that this be supplemented in the future by a statement in detail of the estimated and actual quantities and costs, so that any one can check the estimates submitted to bidders with the actual quantities paid for. I also recommend that in this statement the cost of engineering be given, separated into cost of designing and cost of supervising.

The cost of engineering on the three new bridges recently built, as determined by your representatives, emphasizes the necessity for this information. According to the payrolls of the Bridge Department, the engineering on the Erie St. bridge has cost $30,146.99; on the Kinzie St. bridge, $17,344.04. These bridges were designed by the City Bridge Department, and the costs above include the expense of preparation of the plans and specifications.

For the Polk street bridge, the plans and specifications were purchased from private parties, and the engineering cost on this, amounting to $14,859.97, covers only the supervision during construction.

If these were the real costs of the engineering on these jobs, they would be inexcusable. The cost of each of the bridges is from $165,000 to $215,000. The usual charge of entirely competent engineering firms for inspection and field supervision would be 3½ per cent of the contract price. Their charge, including plans and specifications, would not exceed 7½ per cent on bridges of the type in question. These commissions, of course, include large compensation for the responsible engineers.

The City Bridge Engineer has submitted a statement to the Commission showing what the charges of engineering include. It appears that the records of the department do not represent the facts. It has been customary to charge the expense of any engineering work called for in connection with projects for which there is no appropriation to some other job which has an appropriation. Mr. Pihlfeldt, Engineer in Charge of Bridges, explains that he is repeatedly called upon for designs and estimates without any provision of funds to pay therefor.

The remedy for this, of course, is an appropriation annually of an amount sufficient to cover whatever expense of this nature the Council sees fit to incur. Evidently, the greatest safeguard against improper or injudicious expenses is publicity of financial statements. What such statements can be good for, when they do not represent the facts, is beyond my comprehension.

My attention was called to the contract under which $20,000 was paid for the plans, specifications, and royalty on the Polk street bridge. This is a bascule structure and one which required some special modifications in order to clear a railroad track at one end.

The Sanitary District, at one time, contemplated building this bridge for the city, and had purchased the plans and the right to use the patented design at an expense of $18,000. Later this arrangement was abandoned, leaving the city to build its own bridge. The right to use the patented design, however, remained. The design as made apparently interfered with the railroad track above mentioned, and in February, 1907, the Chief Engineer of the railroad wrote the Commissioner of Public Works recommending the structure of a competitive company, which had been designed to clear this track.

It should be understood that there are several types of bascule bridge in use, most of which

are patented, and one, developed by the City Bridge Department, which is not patented. The mere fact that a particular type is covered by patents, and that consequently a royalty must be paid for its use, should not condemn it. The city should adopt that design which will produce the best bridge at the least ultimate cost, whether it be its own design or some other.

The Department of Public Works also is that authority which should decide for the city on what is best and cheapest. In this particular case, the City Bridge Engineer reported the regular city type of bascule would not suit the situation, and, while it could be modified so that it would, the cost would then exceed that of the patented structure recommended by the railroad. The City Engineer recommended that if the city designs were not to be used, the work should be thrown open to competition.

The payment of $20,000, without any competition or any attempt to utilize the license for which the Sanitary District had already paid $18,000, is properly a matter of serious criticism; especially as constituting a precedent for subsequent actions of the same character.

REPAIR AND MAINTENANCE.

I have examined the reports on the work of the painters, electricians, carpenters, machinists and structural iron workers. I have also examined certain of the jobs on which these men have worked. The efficiency of all these branches except the last has been very low. Whether the structural iron workers are really more efficient or not, I am not sure. I have been asked to pass on the efficiency of the men on the basis of what their work costs, compared with what it should have cost. It is a very easy thing to under-rate difficulties which may have existed in estimating work which is completed; just as it is equally easy for a foreman to exaggerate these difficulties. I have consequently only been willing to criticise unfavorably work which was so conditioned that considerable complications could be eliminated and a fair estimate could be made.

In the only instance of this kind I found affecting the iron workers, the cost of the work as drawn off the daily report sheets compared very favorably with my estimate. In this case, my judgment was fortified by that of a contractor for steel erection, who visited the bridge with me.

Painters.—The work of the painters has been investigated in a number of instances, in every case showing very excessive cost.

The labor cost on the Loomis street structure was $1.53 per ton. Mr. Pihlfeldt testified at the hearing before the Commission that this was a reasonable cost. I think he is mistaken. My opinion is that even done by day's labor it should not have cost over one-half that amount. I have had propositions made me verbally by two contractors—one an erection contractor, the other a metal-painter contractor—to clear and paint this bridge for 60 cts. per ton for the labor. On some bridges of the same type, across more congested portions of the river, this cost might reach 85 cts. per ton.

The bridge house at the North Western avenue bridge was painted in November and December last. It took two painters 14½ days, or 29 days' time, to do the work. Your estimators report the house to measure 23½ squares which were varnished, and 21 squares which were painted. They estimate a fair cost per square for varnishing to be $1.47, and for painting 88 cts. Mr. Pihlfeldt has testified that $1 would be a fair price for painting. When questioned in detail, however, he stated that a day's work for a painter on some of these houses would be 8 squares; and on those badly cut up by switchboards, etc., 5 squares. A painter's rate is $4.40 per day, which, at 8 squares, would be 55 cts. per square, or at 5 squares 88 cts. per square, or just what your estimators figured. According to your estimators' figures, the total cost of labor on this building would be $54. The actual cost was $123. Using Mr. Pihlfeldt's figure of $1 for painting and increasing the estimated cost of varnishing to correspond, the cost should have been $69.

The allowance of 85 cts. per square means that a man at 55 cts. per hour should cover a space of 10x10 ft. in 1 hour and 36 minutes. Considering the fact that bridge houses are not very elaborate or decorative buildings and the work is plain, unquestionably a contractor would demand and secure this rate of speed.

The bridge house on the Eighteenth street bridge required 26½ squares of painting, which at 88 cts. would have cost $23.32, or, at Mr. Pihlfeldt's figure, $26.50. The actual cost was $132.

The bridge house at the Ninety-fifth street bridge required 12 squares of painting and 12 of varnish. At the rate of 88 cts. and $1.47 for painting and varnishing, respectively, this should have cost $28.20. It did cost $52.80.

As a commentary on the work of the painters, please note that while Ninety-fifth street house had 24 squares, as compared with the 26½ squares at Eighteenth street, one-half of the former was varnished work; so that the cost of the smaller should have been slightly greater than that of the larger. As a matter of fact, it cost less than one-half—$52.80 as compared with $132.

The house at the North Halsted street bridge shows a cost about seven times a reasonable one.

The one at Archer avenue cost about five times a reasonable cost.

At the Van Buren street bridge there has been some dispute as to the actual amount of painting done. Your estimators conclude there was not over 27 squares, at a cost of nearly six times a reasonable one. Even if all the surface claimed by the foreman is allowed him, the cost is 2¾ times a reasonable one.

These comparative costs correspond well with the apparent efficiency of the painters, as indicated by the record of observations.

I am unable to discover any good reason for maintaining a painting department. This is never emergency work. It can be done better and cheaper by contract, and I suggest for your consideration a recommendation that the department be abolished.

Electricians.—The work of the electricians was checked up at the Kinzie street bridge, where in January last they had done certain work which could be positively identified. It consisted in making up and placing about 200 ft. of 1½-in. pipe, pulling wire into it, drilling holes into and cutting a small amount of concrete; with certain other work connected therewith. All of this was itemized on the daily report sheets, so it was possible to figure out the amount of time spent on each item.

The actual time, as well as our estimated time, is shown in the table herewith. The amount estimated is very liberal.

Kinzie Street Bridge.	*Actual time spent. Hours.	Estimated time required. Hours.
Transferring material	24	16
Drilling concrete	32	8
Cutting concrete	16	8
Making and installing 1½-in. conduit	120	64
Pulling 2/0 wire	16	16
Wiring switchboard	16	16
Making kicking coils, etc.	16	16
Fitting up pole board	16	8
Hanging pole board	8	4
Wiring pole board	16	8
Connecting pole board	8	4
Total	288	168

*As shown by the foregoing daily report.

The foreman, Mr. Ross, attempts to explain the time spent in making and installing the conduit, on which was the largest waste, on the theory that it was necessary to tunnel under the walk, and that this could not be done by pick and shovel as usual, but had to be cut out with a bar. As a matter of fact, the tool used in this tunneling was Mr. Ross' imagination. After my first visit to this work with Mr. Weir, who had measured and estimated it, I sent him back to determine how the men had got under the walk, suspecting that the space was open on the adjoining property. He reported that he could get under the walk in this way. Ross testified that the conduit ran under a wood and also a concrete sidewalk. As a matter of fact, it is under the wood walk only. It runs to where the concrete begins, and there turns up to the surface and extends up the pole set at the curb. To install the pipe, a hole was cut into the end of the pavement and curb down to below the level of the adjoining wood joists, giving easy passage from below the wood walk to the street surface. Below the wood walk was sufficient space to permit the ready assembling of the pipe.

After Ross' testimony regarding tunneling, I revisited the bridge with Mr. Weir, got underneath the walk from the adjoining property on the north, and found no difficulty in getting from one end of the pipe line to the other. There was no occasion for any tunneling or any excavation of any consequence, and every indication that there was none done.

The attention of the Commission is called to the reports of the watchers on the electricians, as well as to the foreman's testimony at the hearing.

Carpenters.—The carpenter force during November last built two small police houses, such as are used at the various bridges for protection for the officers on duty there. One of these houses was for the Adams street bridge, the other for the Jackson boulevard bridge. The houses were built at the Eighteenth street shop of the city. The Adams street house cost for labor, not including any painting or cartage, $96. The Jackson boulevard one cost for the same $79.30. The material for one house figures to have cost $23.20, making the total cost for material and labor in one case $119.20 and in the other $102.50.

One of your estimators, Mr. Schutt, has had several years' experience in architectural work, and he prepared a plan and specifications covering the house, asking bids from two contractors thereon. One party bid $75 for one house, or $50 each for five or more. The other bid $75 for one, or $53 each for ten or more. The estimator's judgment for the labor on one house was $17.40, making a net cost of $40.60.

The cost to the city, as given above, includes no charge for use of shop, foreman's pay, nor, of course, any profit. Mr. Schutt's allowance of $17.40 for labor represents 3½ days for one carpenter, which I think is ample.

In justice to the foreman, it should be noted that he reports these houses to have been made entirely by hand, everything being ripped and dressed by hand from rough stock—"just as it would have been done fifty years ago." The paneled doors, window frames and sash were so made. Whether this indicates an error in judgment on the part of the foreman or of his superiors, is not very material to this investigation. It is the department we are investigating, primarily.

As the city probably uses a number of these houses each year, I can see no reason for not contracting for a year's requirement.

Two scows were built during the year—one by the foreman on the North Side and one by the foreman on the South Side. The first built a scow 43 ft. 4 ins. x 18 ft. 6 ins. x 5 ft. 8 ins. As indicating the value of the records of material supplied, your estimators find charged to this scow 9,305 ft. of lumber, while the scow itself, as measured up, contains 13,180 ft., without any allowance for the item of waste, upon which much stress was laid by the foreman when testifying. If the material found but not billed be added to the items charged to the job, the total is 15,301 ft., of which 2,121 ft. cannot be found. The shopkeeper's reports show no lumber returned. The total cost of labor on this scow, including no charge for foremen or superintendence, is $1,356, or about $103 per thousand feet of lumber.

The second scow, built by the foreman on the South Side, at the Eighteenth street shops, was smaller, being 38 ft. 8 ins. x 16 ft. 2 ins. x 3 ft. 5 ins. This should, of course, cost less in total, but might be expected to cost slightly more per thousand feet of lumber. The discrepancy between the material charged and that actually found is much less in this case, amounting to only 7½ per cent. The total cost of labor was $531.27, or at the rate of $61.77 per thousand.

In order to fortify my own judgment as to what would be a fair cost of labor on this class of work under the conditions existing, I have advised with several contractors, two of whom have worked on the Chicago River for years and who know the conditions. They have recently built similar work. They were both of them practical superintendents. One advised me $30 and the other $35 per thousand as a reason-

able labor cost for scows of this size. I consider the higher amount to be an entirely fair criterion by which to judge the efficiency of the carpenters on this work.

The same two foremen have been in charge of the reconstruction of draw-protections during the years 1908 and 1909; the South Side foreman building the one at Adams street, and the North Side foreman the one at Rush street.

The Adams street bridge protection is charged with 53,250 ft. of lumber, of which 43,750 are found in the work, 4,526 ft. were returned to the yard, and 4,974 ft. are short. Mr. McKinley, Foreman of Carpenters, states that some material was used repairing damage done during construction, but there were no special reports made covering such loss, and it could not have represented a very large amount, anyhow. He also claims a considerable waste on this work, but declined to commit himself as to what a reasonable waste would have been.

This amount of shortage would be equivalent to 20 pieces of 12 x 12 x 20 ft. long, or twice that amount of 6 x 12 material. Nothing but a catastrophe would account for such a loss.

The total cost of labor on this work, including cutting off and lining up the piles, framing and placing the lumber, is $2,942, or at the rate of $67 per thousand. If the cutting and lining up of piles is allowed for at $2 each (twice what it should cost), the framing and placing of lumber cost $57.75 per thousand.

Again to fortify my own judgment, I had three practical contractors place a fair labor cost on this work. One of these gentlemen was not very familiar with work on this river, so I have not considered his estimate, which was actually the lowest. One of the others estimated a fair cost as $18 and a liberal cost as $22. The other reported that he was now doing work of a similar character and under the same conditions at a cost of $20, which he seemed to consider quite high.

The Adams street protection was built between March 22 and June 3, 1909. The Rush street protection, built under Mr. Carmody's direction, was begun March 16, 1908. The time taken off the rolls by your estimators extends from this date to September 10, 1908. The job is not yet completed and no work has been done since the last date. Thirteen thousand eight hundred and forty-two feet of lumber are now on the job waiting to be used, and have been there since September, 1908.

The amount of lumber charged to the job is 99,011 ft. The amount found built into the work is 72,132 ft. Mr. Carmody claims he used some of the material in the construction of the north sidewalk on the bridge, but his reports fail to show any such use. Your estimators have figured up the amount of this walk, however, and find it to be 1,050 ft. Mr. Carmody testified that there was a large amount of timber used in repairing done by vessels during construction, and was very positive that his reports would show the amounts so used. We have been able to find only one such report, covering 936 ft. He also states that 3,850 ft. were used in building a temporary sidewalk at the southeast end of the bridge. Unfortunately, no reference to this temporary work is found in his reports, nor does it appear what became of the lumber when the temporary walk was removed. I think it is safe to neglect this item in balancing the amount of material furnished and the amount used.

Deducting the lumber found in the completed work, the amount claimed for the north walk, the amount reported used in repairing after accidents, and that stored on the job, from the amount charged to the job, there is a deficiency of 11,051 ft., or 11 per cent. Such a shortage is unexplainable except on the theory that during the eighteen months since any work was done much has been taken away without authority.

The total charge for labor has been $4,777.25. The amount of labor used in the protection has been 72,132 ft., making the labor charge per thousand $66.23. Making the same allowance for the piles sawed off as in the Adams street protection, the net cost of framing and placing lumber is $58.21 per thousand.

In Mr. Pihlfeldt's opinion, the Adams street work should have cost more than the Rush street, because of its lesser accessibility to scows. In my judgment, the difficulties surrounding these jobs have been much exaggerated. I think any contractor who found the labor cost exceeding $20 per thousand would immediately get another foreman.

Machinists.—I looked over several jobs performed by the machinists and selected the East Division street bridge as the simplest and fairest one to check.

At this bridge the center lock had been operated by an electric motor, located near the center of the span and geared to a transfer shaft, to which are attached the locks, which are of the projectile type. Difficulty being found with this mode of operation, the motor was removed and a cable, manipulated from the bridge house, was substituted to rotate the shaft which operates the locks. Mr. Wehr and I made an estimate in detail of the time necessary to do this work, allowing 60 hours' time for handling the boat from which part of the work was done. Our estimate amounted to 340 hours, while the amount charged to the job was 822 hours.

I called on the foreman and asked him to itemize the time required for the various parts of this work. Omitting lost time, his estimate was less than ours, but he claimed a great loss on account of bridge movements. When testifying, he said that about two-thirds of the time spent on this job was wasted, due to interruptions from boats. This allowance is just about the amount necessary to raise his detail estimate as made for me to the actual time.

In my judgment, the explanation is not sufficient. Making every allowance that is at all reasonable, one-half the time on this job was wasted.

This foreman had five or six different jobs going on at separate bridges and could spend only a short time each day with each. His men simply soldiered on him.

Conclusions.—I have not attempted to determine the average efficiency for the department. The important question is how to remedy the evident inefficiency.

To secure good work at fair cost, there is necessary good workmen, an efficient foreman, strict supervision, and accurate accounting. In public work, two other things are required—the right to discharge men below the grade of foreman without any formalities, and publicity of accurate records.

I have no reason to suppose the workmen employed by the city were not once competent. Whether they can be induced to perform a good day's work in eight hours now, after years of loafing, in some cases may be doubtful. Without the right of a foreman to discharge them, it is not doubtful.

Some of the foremen who testified clearly demonstrated their entire unfitness for their positions. Their attitude on the stand, with the record of the results they have produced, is recommended to the consideration of the Commission.

I believe that some of them, properly supported and stimulated by being held to an accountability for future results, will serve the city well. No man will continue to exert himself to produce the best results for ten years against political pressure and with no knowledge on his own part or on those of his superiors of what his work is costing. All of the total costs of work, as well as the unit costs, given in this report, were prepared by your employes from the daily reports. I do not believe that any of them had ever been figured by any of the city employes. Only on the simplest work is it possible to merely look at a job and tell in gross what it should cost. It is necessary to estimate it in detail or to reduce the work to units to determine what a proper gross cost should be.

Part of the work now done by city forces could better be done by contract. The temptation with a city force is to keep the men, whether there is work for them or not; which means nursing a job when the work in sight is small. The man who loafs on a job at one time is apt to loaf all the time. All the painting and nearly all the carpenter work could better be done by contract.

Before beginning any repair work by city employes, the foreman should be required to submit a detailed cost estimate of the material and labor required to complete it. The job should then be examined and reported on by an assistant engineer and approved by the City Bridge Engineer.

After the work is completed, the cost should be figured up by the clerical force, reduced to units where possible, submitted to the Bridge Engineer, and be approved or disapproved by him in writing. His disapproval, of course, should be followed by charges. These records should be public, and should be embodied in the annual reports. This would definitely locate responsibility and would make very easy the checking of results by public organizations.

Eighteenth National Irrigation Congress.—The National Irrigation Congress will hold its eighteenth session at Pueblo, Colo., on Sept. 26 to 30. The program will include addresses and papers by Experts in Irrigation and Forestry, including public officials and eminent citizens. Foreign Delegates. Governors of States and Territories, Senators and Representatives in the Federal Congress, Statesmen and Scientists. Industrial and financial leaders. Promoters of Cary Act Reclamation Projects. Officials of private irrigation enterprises. In connection wit hthe Congress there will be an exposition, international in scope and character, which will include machines and devices for the development of power used in irrigation and drainage, methods and devices for the transmission of power used in irrigation and drainage, machines and devices for raising surface and ground waters for irrigation and drainage purposes, methods and devices for distributing water to users thereof and to lands, machinery, devices and methods for the economical cultivation or irrigated and agricultural lands, plans or models of existing or contemplated irrigation and drainage systems, and products of agricultural and horticultural lands; literary, graphical and pictorial presentation of knowledge, pertinent to the subject of irrigation and drainage, including precipitation, evaporation, percolation, geology, forestry, sociology, irrigation policies and irrigation civilizations; miscellaneous exhibits, including measuring instruments and devices, weirs, rectangular, trapezoidal, automatic water registers, smudge pots, spraying devices. L. M. Markham, Pueblo, Colo., is Director of Exhibits.

Repairing Brick Sewer.—The following method of repairing a brick sewer was employed at Worcester, Mass, by Matthew Gault, Superintendent of Sewers. The sewer was built in 1870 and the bricks were soft, the cement poor and sparingly used and the grade steep. The result was that many of the brick in the bottom of the invert were loose and badly worn and the sewer in a dangerous condition. The sewer is a 24x36-inch oval and, as it was necessary to lay hose inside of the sewer to provide for the large flow of sewerage from the district above, the space availage for working was very much contracted. The work was done in sections. At the upper end of each a sand bag dam was placed. Two and sometimes three lines of 3-inch pump hose, 60 feet long extended through the dam thus taking the flow and keeping the invert dry. When a connection was encountered an extra line of hose was laid to accommodate it. The hose were supported on short strips of boards laid across the sewer about 6 inches above the invert. From three to four inches of cement mortar placed in the invert and carefully troweled completed the work. After the cement had hardened sufficiently to withstand the flow of sewerage, the dam and hose were moved ahead.

The Coastwin Dredging Co. is at present working two dredges, five tugs and 16 scows on its government contract for dredging the harbor at Norfolk, Va., for deep water in Hampton Roads to the junction of the eastern and southern branches of the Elizabeth River. The contract was let at 7.3 cents per cubic yard and up to June 15 6,000,000 cubic yards have been taken out. It is expected that the work will be finished one year ahead of contract time

The Fundamental Principles of Efficiency.*

It is of "efficiency" in railway operation that I wish to speak to-night, and I define "efficiency" as attaining standards of time, place and cost. In spots there is very high efficiency in the operation and maintenance of American railways, but the easily determined wastes due to preventable inefficiency still aggregate one million dollars a day; wastes that would as inevitably disappear, if properly attacked, as the inequalities revealed by a railway survey disappear when the cuts and fills are finished for any predetermined grade and curvature. It costs to build a railway with low grades and mild curves, *but as a rule it not only does not cost to attain high efficiency, but high efficiency of operation and maintenance always results in lessened costs since high efficiency means the elimination of waste.*

Costs, operation, difficulties take care of themselves the moment we forget all about them, and substitute the one ideal of "efficiency." The practical results of substituting the ideal of efficiency for worry about costs is shown in the diagram above, in which the efficiency of labor, in the same shops, with the same men, the same equipment, the same foremen, and on the same schedules was gradually increased from 55 per cent to 93 per cent, the cost of locomotive repairs dropping over $1,000 each, yet the locomotives averaged heavier, hauled more tons and made more miles per failure. If this road had 2,000 locomotives the direct saving was over $2,000,000, but in addition each locomotive hauled 3,300,000 more tons and in one year the net earnings increased $3,000 per locomotive, an additional gain of nearly $6,000,000, due to the ability to haul more freight.

One railway in the United States maintains its freight cars for $37 per annum. Another railway in similar service spends over $100. The $37 cars cost $100 less to build, weigh 6,000 lbs. less for the same capacity. At $37 on 50,000 cars there is an annual saving of $3,150,000 in maintenance cost alone below the rival figures.

Efficiency, like any other branch of applied knowledge, has its own laws. These laws are absolute. You cannot have high and continuous efficiency if any one of these laws is neglected. Wherever there is high efficiency it will inevitably be found that it is attained by observance of one or more of all these laws.

These principles are twelve in number.

(1) *Inspiration, enthusiasm,* the desire to accomplish.

(2) *Common sense,* usually flagrantly lacking in human affairs and to some extent on even the best railways.

(3) *Special Expert Advice.*—Specialists generally furnish the methods best suited to the principles as applied. The line officials use what is furnished. Few railway presidents would be competent to design a bridge, design a locomotive or freight car, design a steam engine or a dynamo, design a machine tool, or analyze tool steel or keep his own accounts. If the president needs expert advice as to all these matters, how much more does the worker at the bottom of the line need advice?

(4) *Discipline.*—Discipline means that there must be specific duties for everyone, and that he must perform them. Discipline does not mean severity, harshness, arbitrariness.

(5) *The Fair Deal.*—In spite of the ten commandments, in spite of the Golden Rule, in spite of all our laws and customs, in spite of the desire of most of us to have the other man do the fair thing, the fair deal is often lacking in the relations of employer and employe, of corporation and client or customer.

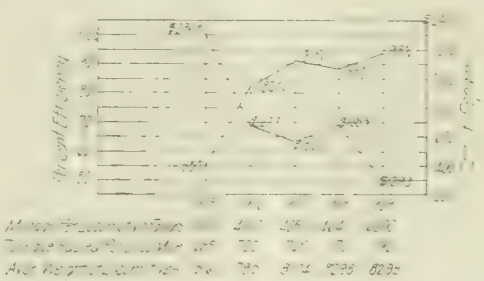
(6) *Definite and Specific Standard Practice Instructions.*—As to some matters—time tables and rules for train employes—these are very minute and exact; as to other matters wholly lacking. Most of the best shop practices are carried around under one's hat and are not reduced to writing.

(7) *Reliable, Immediate and Adequate Efficiency Records.*—These include cost distribution. Proper records give positive and incontrovertible knowledge. In usual operations nine-tenths of what goes on is guess work. Most of us would make the wildest guesses about the operations of his own body, and we know less about our own work.

(8) *Scheduling and Despatching.*—The principles of a train time table and control of train movement by despatchers can be and should be applied to shop and other maintenance operations.

(9) *Time study work* gives the necessary facts for proper schedules and despatching. Time study is a principle, not a method. There are many different methods just as there are many methods of determining a quantity of wheat—weight, measure, estimate, guess, counting the grains, etc.; that method is preferable which gives the greatest amount of accuracy in the shortest time and with the least trouble.

(10) *Standardized Conditions.*—You give the locomotive engineer both a locomotive and a clear track; you give him water tanks and coal chutes; you give him a set of signals. You rely far more on the conditions than you do on the man. The Pennsylvania



Railroad has more engineers than it has engines capable of pulling the 18-hour train. When conditions are standardized it is not difficult to find men.

(11) *Standardized Operation.*—When conditions are standardized it is easy to realize standard operation. It is an easier task to run the 18-hour train on time than to run a local freight. The more conditions are standardized the more we can demand a standard operation.

(12) *Efficiency Reward.*—Efficiency reward is a principle. It is one of the fundamental laws of the universe. The most efficient in some line or other obtain the biggest rewards. The most efficient have survived, the inefficient have perished. Every worker, from president down, ought to be compensated, partly at least, on the basis of his efficiency.

The particular form of efficiency reward is not a principle, but a method. In France they reward a lifetime of efficiency by a button of the Legion of Honor, which entitles a man to a military funeral. In England they give him a title; in China they bonus his ancestors; in this country he pulls down the money. The so-called bonus method is a definite increase of wages based on a definite and measurable increase of average efficiency. High efficiency is impossible for either man, gang or shop until many of the other principles have been recognized and made effective; therefore, a bonus is the last—not the first—thing to be offered. Upright and conscientious management, including foremen, good tools, proper work and health conditions precede bonus.

When I am given the privilege of examining the organization and operation of a large plant, it is not the details that interest me. The men about the plant are far more competent than I am to give an opinion as to details. I look for evidences of lack of common sense, for lack of discipline, for unfair conditions, for inadequate records, for unstandardized conditions, for unstandardized operations, and I base my estimate of preventable wastes on the observance of principles, not of details. It is not the system, the particular form of blank, that counts. It is the ideal behind any and all system that counts.

The methods used to determine losses are so positive, so absolute, so indisputable and so simple, that any competent committee of qualified experts could verify the conclusions, and the name of any one of fifty railways could be drawn by lot and a similar investigation would show that it was contributing its quota to the loss of one million dollars a day. Do not imagine that I, an outsider, am slandering a great business of which I know nothing. I have been intimately associated with railway planning and maintenance for nearly thirty years. I have also learned intimately about other businesses, and the losses complained of are universal and inevitable under our present methods of inadequate check.

Railway management is not worse than the average; it is, on the contrary, in many respects better. The railways of the United States, as to special operations, set up and realize as high standards as the world has ever seen. The 18-hour trains between New York and Chicago, the fastest and longest run high-speed trains in the world, maintain a standard of promptness of 99.96 per cent. A man living on the line could set his clock by these trains. Here is a case of: (a) Reliable records. (b) Standardized conditions. (c) Standardized performance. (d) Continuously attained.

In the accounting department standards are equally high. Not a cent is spent untraced, or without authority. Here also: (a) There are abundant records. (b) Standard methods of bookkeeping. (c) Specialized for the operation. (d) Balances have to be made.

The whole auditing and accounting is in the hands of specialists who take their inspiration not from the board of directors, not from the executive officers, but from standards that are not only older than railroading, but which antedate the discovery of America.

Standardized conditions in railway operation have already been referred to. Among the most important of these are track and way. No higher standards are conceived, created and maintained than the track, way and bridges of a first-class American road. Here again there are: (a) Records, not always adequate. (b) Standards of construction. (c) Standard realization. (d) The work being conceived and put into effect by specialists, engineers.

Enough to show that in these respects and many others American railways set up and realize high standards, and to justify what I am about to say as to absence in much of railway operation of: (a) Adequate and reliable records. (b) Standardized conditions. (c) Standards of performance. (d) Definite responsibility and reward. (e) Competent specialists.

Usually the man who best executes is not always the best man to create proper conditions, and the best creator is not always the best doer. A locomotive engineer, even though he takes the 18-hour train over his division in perfect manner every day, neither created the track, the locomotive, the despatching or the signal system, but, on the other hand, the inventors and improvers of these matters were never fitted for locomotive engineers. Let it not, therefore, be supposed that I am in any way criticizing the great operating contingent in American railways. They do what they can, and no higher body of men exists. My criticism of results is based, not on the inefficiency of the men, but on the: (a) Inadequate records. (b) Inadequate and inferior conditions. (c) Inadequate special skill.

To illustrate what I mean: There is no railway east of the Rocky Mountains in which locomotives ought not to be maintained in first-class operating condition for 5 cts. per locomotive mile. I go further, and believe 4 cts. is an ideal to be striven for and ultimately reached. This does not mean that if a railway only had two locomotives, and

*From a paper read before the Railway Club of Pittsburg by Mr. Harrington Emerson, and revised and amplified for the "Railway Age-Gazette," May 6, 1910.

they collided, the maintenance expense that year would not exceed 5 cts.; it does not mean that if there were so little business that each locomotive only made 10,000 miles in a year, 5 cts. could be realized; it does not mean that every locomotive or every division will come down to 5 cts., or that any locomotive on some divisions will come down to this figure. It does mean that any railway with 10,000,000 miles a year of mixed freight and passenger service ought to maintain its power for $500,000.

We actually find, however, astonishing variations for similar operations. Comparing the locomotive maintenance costs of five trunk lines operating between the same terminals between 400 and 500 miles apart, under largely similar conditions, in round figures, it costs:

Road A— 6 cents a mile.
Road B— 8 cents a mile.
Road C—10 cents a mile.
Road D—12 cents a mile.
Road E—16 cents a mile.

Assuming 30,000,000 locomotive miles a year, and a $0.06 a mile standard:

Road A wastes nothing.
Road B wastes $600,000.
Road C wastes $1,200,000.
Road D wastes $1,800,000.
Road E wastes $3,000,000.

My assistants and myself have been in the shops of all these companies, and, as to a large part of the loss, we know, in part, why and where it occurs. If, as to every minute operation, there were a standard and a record, showing actual cost compared with standard cost, it would be easy for every man, every foreman, every superintendent, to check what was going wrong. Many railway records are not available for six weeks after the fact has occurred, and as to many facts, not available for more than a year. It has been my experience that if you give a fireman a water-glass and a gage, he will watch them, and make a strong effort to maintain standards; and it has also been my experience that if standards are supplied to shop and track men and if records are available from hour to hour, a strong effort will be made to attain and maintain standards, and that it is just as easy to maintain a shop or roundhouse efficiency of 99.96 per cent as it is to maintain this efficiency in a train schedule.

In a very large locomotive shop conditions were first standardized, and then standards of performance were furnished. The shop went on as before, same equipment, same work, same men, same foremen and other officials, but standards as to his own particular duties were set up for every man.

The results were as follows:

Month.	No. of men.	Hours— Standard.	Actual	Efficiency.
1st	21	2,011.2	3,613.9	55.6
2d	50	4,350.2	7,418.8	58.6
3d	77	7,649.6	12,748	60.0
7th	251	27,051.8	41,463	89.3
12th	656	122,736.4	126,534.4	97.0
13th	731	129,357.5	129,478	99.9
14th	771	148,841	146,434	101.7
15th	819	155,276.5	160,701	96.5

The 819 men have by no means reached the highest efficiency, as is shown by the table of classification below, average wages assumed at $0.30 an hour and working hours at 250 in the month:

Workers	Average efficiency per cent.	Wages.	Bonus, per cent.	Bonus.
61	30.3	$4,575	.....	.....
32	45.0	2,175	...	.....
50	75.8	3,750	...	.....
72	64.6	5,400	.....	.....
216				
81	74.2	$6,075	1.1	$66.82
76	84.3	5,472	5.8	317.37
74	90.0	5,500	15.0	825.00
90	105.9	6,750	25.9	1,748.25
94	114.6	7,050	34.6	2,439.30
64	123.9	4,800	43.9	2,107.20
56	132.4	4,200	52.4	2,200.80
20	145.3	1,950	65.3	1,271.35
19	154.1	1,425	74.1	1,055.95
6	183.3	450	83.3	374.85
17	196.4	1,275	116.4	148.40
662		$61,147		$12,555.29
Total wages				$61,147.00
Total bonus				12,555.29
Average bonus per cent to bonus workers				27.9%
Average bonus to all workers				20.5%

If 603 men out of 819 earn bonus it is evident that the schedules are not severe.

In a particular gang of 32 men, an average efficiency of 95.8 per cent was attained, standard time being 7,211.6 hours, actual hours 7,523.5. The highest man showed 139.2 per cent efficiency, the lowest 7.8 per cent. These men were on the same kind of work, under the same foreman. Each man was receiving the same rate of wages. In the name of common sense and justice, what are you going to do with such conditions? Bury your head in the sand like an ostrich and pretend that these differences do not exist? Object, as some of the union officials do, to any records or checks that show up these differences? Assuming the cost per hour of operation being $0.30 for wages, $0.30 for machine charge and $0.25 for overhead expenses on the man, we have an hourly average operating cost of $0.85 an hour. The man and machine work 250 hours in the month at a cost to the company of $212.50.

The table shows how the cost of work per hour varies as efficiency varies:

Efficiency, per cent.	Hours.— Worked.	Standard.	Cost, per mo.	Cost, standard hour.	Relative costs.
60	250	150	$212.50	$ 1.42	167
100	250	250	212.50	.85	100
140	250	350	212.50	.61	72
8	250	20	212.50	10.62	1,248

This is an actual record—not an imaginary one—taken from a railway shop.

Are you going to pay full wages to the man who only delivers one-twelfth of a fair day's work?

Are you going to allow work to cost $10.62 that ought to be done for $0.85?

Are you going to pay the same wages to the man who does, in the same month, seventeen and a half times as much work as some other man?

Are you going to pay the same wages to the man who makes a given job cost $0.61 as to the man who makes the same job cost $10.62?

Everyone of the twelve fundamental principles are violated when such evils are not remedied.

Economy of the Piece Work System in Handling Supplies.*

If we are going to get the largest possible output for the smallest cost, we must interest the man doing the work more than paying him by the hour. A man's interest must be vital if we are to get the best there is in him. We must pay for what we get, and not for what we do not. We must get 100 cents worth of work for every dollar paid out. This the piece work system accomplishes, as its organization and introduction shows.

At first blush it would seem to be a difficult matter to resolve the handling of supplies into given factors or units. This is not so, as we have a unit to issue or receive everything we handle in the store department, and a record to refer to that is permanent. Lumber is handled per thousand feet B. M. Iron, castings, coal, sand, etc., are handled by the ton. Pipe is handled by the foot. Mixed merchandise is handled by per package of 100 lbs. or less, over 100 lbs. to 200 lbs., etc. Filling requisitions and delivering material to the shops is handled by per item, per piece or per pound, depending upon the kind of material and the local conditions.

Filling requisitions and delivering material shows a very large saving put on piece work, due to the amount of lost motion that creeps in under the day work basis. Shop men will ask what has happened to the store men after they have been put on piece work, as they no longer stop to talk, but drop the material and hurry away for more. The men group their work, taking or getting all the material wanted from the different sections at one time. One foreman, planning the getting and placing of material, is only one part efficient as compared with a whole gang of four to eight men planning the same thing. In establishing piece work for a delivery gang composed of foreigners, who did not know the material and could not understand English, the prices were based on what was considered fair. The foreigners could not make one-half their day rate with the prices set, and were transferred. English speaking laborers were hired in their place, and they, being able to use their heads, made from 30 to 50 cts. per hour.

The men should be given to strictly understand that after a price is approved it will not be changed unless conditions are changed. They can make as much money as it is possible for them to make, and will be paid accordingly. As soon as the men are assured that they will be paid for what they do they will work their heads as well as their hands and feet, and will take advantage of everything possible. For instance, in one of our yards a derrick gang use long bridge bolts to handle 6-in. cast-iron pipe. These bolts are put in the end of the pipe to slip the sling around, enabling them to handle very quickly six to ten pieces at a time. These bolts are carried on the derrick to be used when needed. When loading a small order the men run ahead of the derrick with bolts and sling and load the pipe without stopping. It is impossible to get work done this way at an hourly rate, but there is money in this method for both the men and the company, as shown below:

Work done on hourly basis on which price was based:

Labor	$2.50
Use of derrick	2.00
Total	$4.50

Work done piece work in one-half the time:

Labor, P. W. rate	$2.00
Use of derrick	1.00
Total	$3.00

Saving, $1.50, of 33⅓ per cent.

We had four men in one of our lumber delivery gangs and the day we were about ready to start piece work one man quit, and the other three refused to work until another man was put in his place. The piece work system was explained to the three men, and they were asked if they would do the work on this basis, which they agreed to do. Soon after, one of the three left the service of the company, and the remaining two are handling this work, together with a large increase, in about 70 per cent of their regular working time, making a high rate of pay. The company is saving one man's time and about 30 per cent of three men's time on this particular work.

At one of the large icing stations, where an average of 100 cars per day are iced, and some days as many as 250 cars, it was necessary under the day work system to take a large force of men from one of the other departments to help during rush hours. However, since piece work has been installed the regular force has handled the work without delaying a single train or having a complaint from the shippers. The men know the more they hurry the more they make.

On one of the scrap docks it was impossible under the day work system to keep the pile of miscellaneous mixed scrap sorted and cleaned up as fast as it came in with the regular gang assigned to this work, it being necessary to put on additional help to prevent congestion. Ninety days after piece work was installed the regular gang cleaned up this scrap without additional help, and now take care of it and have time to do other work; yet a better foreman than the man in charge of this dock cannot be found.

It is impossible to work unintelligent foreign laborers to advantage. A gang cannot be divided, sending one man for a given article, another to the shop for manufactured material and have others sorting out material. The foreman has to take the whole gang with him, or have part idle, to get even a given

*A paper by D. C. Curtis before the Railway Storekeepers' Association, St. Louis, Mo., May 16-18, 1910.

size of bolt or article of any kind, as the thing wanted has to be pointed out and motions used to direct their movements.

With the piece work system we are able to hold the men after we have them educated. In May, 1908, a storekeeper hired 50 Austrians who had just come to this country, and they, after becoming familiar with the conditions, were put on piece work. Thirty-five of the original 50 are still working for this storekeeper, one having died and the others leaving the service. The men are making good wages, and it is needless to say they are an efficient force. For increased and intelligent effort men make enough for the work to be attractive. The longer men stay, the more proficient they become, the more money they make, fewer mistakes and breakages occur, and discipline is easier.

Piece work keeps men and methods of doing work out of ruts, as the men are continually scheming short cuts and new kinks. It gives us machines and tools with which to handle work quickly. To show a saving in having machinery to handle material is a very simple problem in arithmetic when on a piece work basis; i. e., lumber handled by hand costs 5 cents to 85 cents per 1,000 ft., B. M.; with a derrick, 15 cents per 1,000 ft., B. M.

Piece work forces the storing of material in the most convenient places for handling. In one of the large new storehouses recently built the connecting rods for engines are kept in a closed rack in the center of the house, without lifts of any kind to handle them with. Piece work would very quickly show the saving to be made by putting these rods where they could be handled with a small crane at a great saving.

Piece work gives a contented set of men, each man in business for himself. Men would rather work piece work than day work, as is shown by the engine men and trainmen being paid by the mile, miners by the ton, etc. These men would not think of going back to the hourly unit. The rapid, intelligent workman receives wages in proportion to work done; ability is paid for.

The Compensation of Workmen.*

In any discussion of this subject, however much we may differ as to the means by which our end is to be accomplished, we all must agree that if there is a final solution it must be an equitable one. Any solution, therefore, which is based upon the ability of the more powerful party to impose its will on the other, is only temporary and liable to be reversed. High wages can only be paid permanently for high efficiency, and any attempt to get high wages without a corresponding efficiency can only be temporarily successful. This is an economic law, and any man or body of men that exacts a compensation out of proportion to the service rendered will ultimately come to grief.

Turning to the workman we ask why is he inefficient. A little consideration of the methods of compensation that oftenest exists leads us irresistibly to the conclusion that there is but little inducement offered to him to be anything else. We can hardly expect him to understand the importance of a subject so many better educated people so utterly fail to appreciate, hence the only inducement that appeals to him is the immediate one of increased pay. We must not expect him to learn any more than this except by a long series of object lessons. It is therefore up to the educated man to learn economic laws and set the workmen an example by conforming to them.

Under the system of day work that oftenest exists but little provision is made for awarding extra compensation to the efficient man, and under the most common form of piece work, he is liable to be penalized by having his rate cut if he does much more than was expected.

There are in many plants, both among the mechanics and clerks, men who are far more capable than the average, and who, if they had a chance, could do much to increase the efficiency of the whole plant by teaching their methods to those whose methods are less efficient. The question at once arises as to why we do not make foremen of such capable mechanics, and the reply comes just as quickly that they often have no ability as executives and make very poor foremen. We realize, however, how much the efficiency of the shop would be increased if the other workmen had their efficiency. The best way to get this increase of efficiency is to make our expert men instructors, and award additional compensation to those that learn. This is a step in the direction along which we have been working, and according to which, in its best development, we have succeeded in increasing the average efficiency of shops to a point greater than that of the best workmen before we started.

In brief, our method is to put into the shop a system of orders and returns that ensures any work being done as we direct. Then each job is analyzed by the best expert available, who specifies the sequence of the operations and ultimately how they shall be done. Plans are then made and orders issued to have the work done as the expert directs. Finally, each operation is studied in detail by an expert, who determines the best method and shortest time in which it can be performed. A task is then set in accordance with the study of the expert, who gives detailed written instructions for carrying out his methods.

The workmen are paid additional compensation when they accomplish the task in the time and manner specified, and the foreman, who acts as an interpreter of the directions of the expert and an instructor, is awarded additional compensation for each workman who performs properly each day all his tasks. In order that the foreman may be induced to give his attention to the least efficient man, he is given additional compensation if all his task workers succeed.

For several years past the writer has been training workmen on the lines indicated above, and although his work has usually been with people older than the ordinary apprentice, his results have been successful to a degree entirely unanticipated. About five hundred of those so trained are textile workers who are now earning at an average of 40 per cent more than previously, and turning out over 100 per cent more work, some as much as 300 per cent more. The average wage cost per unit has been reduced to about 60 per cent of what it was.

One other result, which was to be expected in a general way, is that the trained workman, working under expert teachers, should also produce better work, but we were not quite prepared to find the extent to which this was so in some cases.

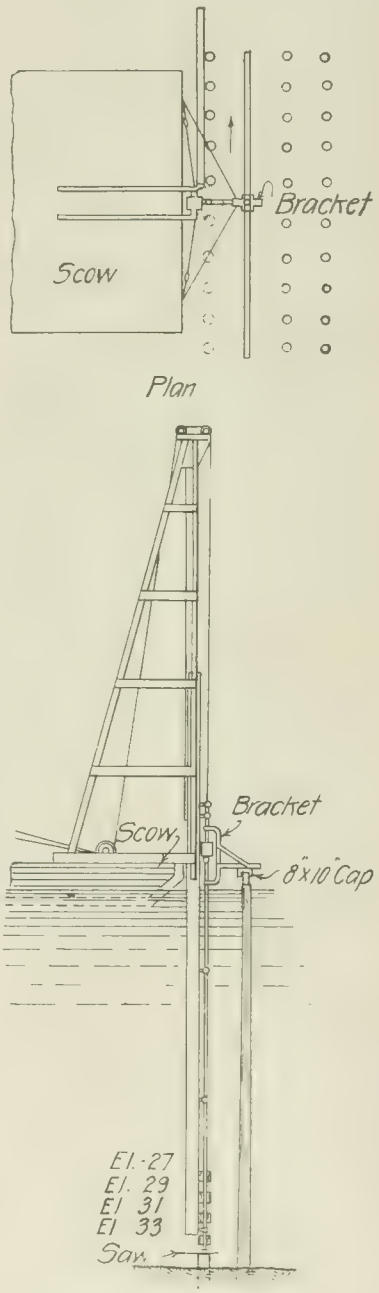
If we wish to improve the ordinary workman up to a point where his work compares favorably with that of the efficient workman, we must do so by making it to his financial interest to learn, and to that of the expert workman to help us teach, for the ordinary workman must be taught and trained.

*Extracted from a paper by H. L. Gantt read before the National Metal Trades' Association, New York, April 14, 1910.

A Machine for Cutting off Submerge Piles to Exact Elevation.*

The heads of the rubble mound breakwaters at Superior Entry, Wis., will consist of large timber cribs filled with stone ballast and seated on a foundation of piles cut off at an elevation of 2 ft. above the bottom of the lake and a maximum depth of 35 ft. below low-water datum. These piles are jetted in place with a water jet working under a pressure of 600 lbs. per sq. in., and then settled to their final bearing with a 3,500-lb. hammer. They are placed butt ends down and driven from 15 to 18 ft. in the sand. It is necessary that these piles should be cut off at an even grade for the reception of the cribs.

Ordinarily the work of cutting off piles under water is performed by divers, by machines using either circular or straight crosscut saws working from a trestle or by machines working from floating scows. In the case under consideration the conditions as to depth of water, risk from storms, and the interference with work on account of the existence of rapid currents, necessitated the design of an original machine for performing this work with accuracy and dispatch. With this in view a set of ordinary pile-driver leads was erected on a small scow, as shown on the accompanying drawing. A vertical beam 12x16 ins. x 56 ft. carries a steel shaft 3 7-16 ins. in diameter and 50 ft. long. This shaft is mounted on the beam with proper standards as shown, and the beam with the



Device for Cutting Off Submerged Piles to Exact Level.

shaft is installed between the leads in such a manner as to travel vertically by means of a small hoisting engine on the scow to any desired elevation. A 48-in. circular cross-cut saw is attached to the lower end of the steel shaft, which is rotated by a belt connected with the driving engine on the scow. The steam is furnished by a 30-hp. horizontal boiler for the entire plant.

The special feature of this machine is the guide bracket constructed of steel and equipped with two double flanged trolley wheels designed to move on an 8x8-in. timber cap which is placed on the row or bent of piles just forward of the row which is to be

*From a paper by Clarence Coleman in "Professional Memoirs," Vol. II, No. 5, U. S. Engineer School, Washington, D. C.

cut. These caps are moved ahead one row as often as the row immediately behind is cut and are lightly spiked in place until the next row has been cut, and so on until each row or bent has been cut. For cutting the last row, three special piles are driven for carrying the cap and afterwards removed. As stated, the guide bracket is the special feature, in that it insures cutting the piles to a perfectly even grade at the depth desired. It will be seen from the drawing that the bracket when its wheels rest on the cap fixes with great exactness the vertical distance between the top of cap and the saw, the elevation of the cap having been carefully determined by instrumentation from a U. S. B. M.

The shaft is rotated at a speed of 500 revolutions per minute, and the scow itself is controlled by proper lines operated from winch heads on the engine. The work is done very rapidly. With good weather and quiet water, the machine has frequently cut 45 miles per hour. The accuracy of the grade can be checked by measuring the cut-off piles and only errors of a few hundredths of a foot have been discovered. Delays occur through inability to clear away the cut-off piles, for which the machine is in no way responsible.

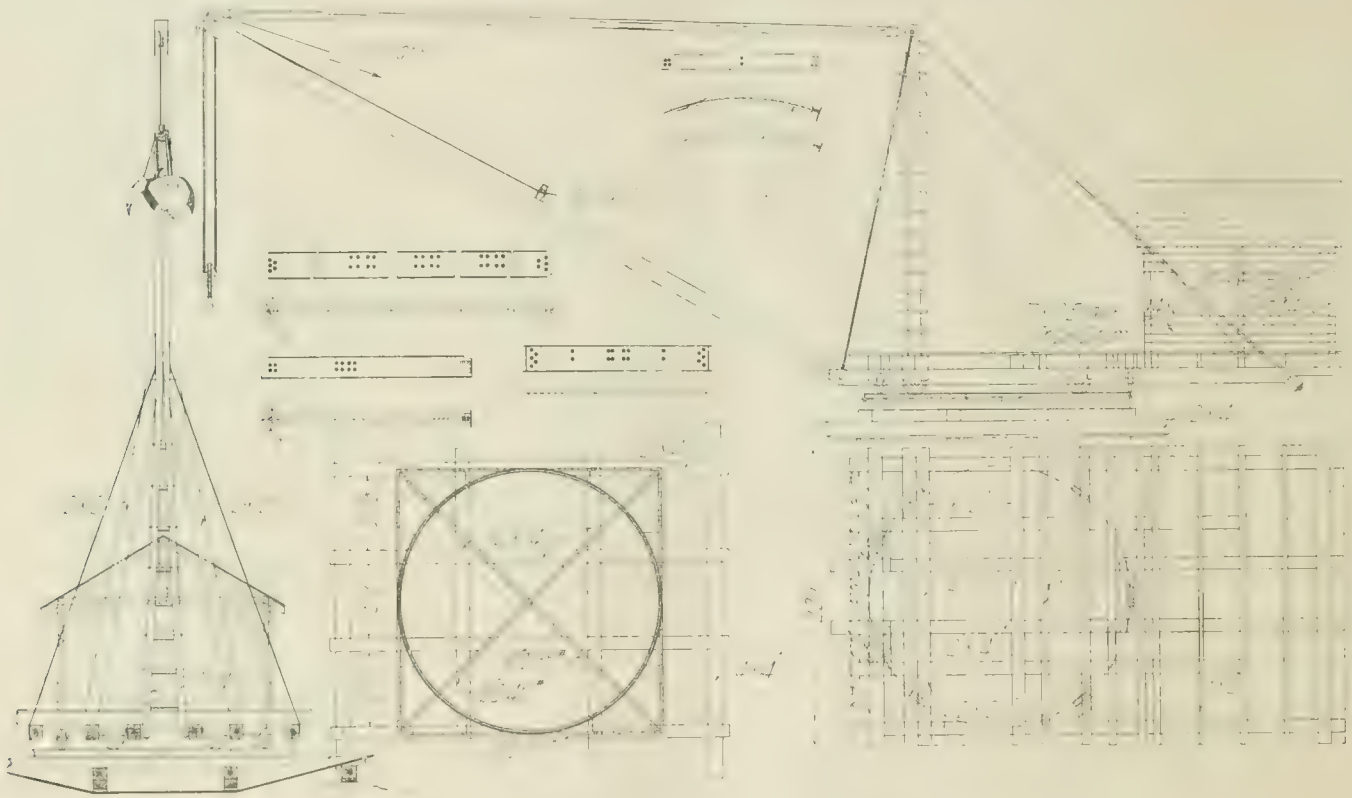
For the operation of this machine seven men are required on the scow. Five other men are engaged in taking care of the piles as they are cut off and cutting off piles above water and placing the caps for the guide bracket. The total cost per 8-hour day for crew, fuel and oil was $36.15. The results obtained may be tabulated as shown below.

Time actually worked, 5 hrs.
Time worked, including transfer of machine and setting it in position, 7 hrs.
Number of piles cut off, 230.
Average time to cut off one pile, based on 5 hours' actual running, 1.3 mins.
Mean cost per pile at 230 piles in 7 hours, $0.1375.
Error of cut-off, ¼-in. and less.

On several occasions a bent containing 10 piles was cut off in 6 minutes. Diameter of piles at cut-off point was from 11 to 19 ins.

The work done by this machine could not be performed by a diver with such uniform accuracy. A day's work for a diver operating a hand saw rarely exceeds 20 piles. The average cost of a diver with his outfit in this harbor is $40 per day. This would mean a cost of $2 per pile as against 13.75 cts. for the machine, or $5,000 for cutting 2,500 piles as against $343.75 for the same work with the machine. From the foregoing description of this machine, it is easy to see that where the work to be performed is considerable, as in this case, there can be no question of the economy of the machine and especially is this true when great dispatch is required. With a diver it would have required 125 days to complete the work as against nine days with the machine. This same machine without the bracket attachment cut off upwards of 2,000 piles for the north and south concrete revetment foundations at Superior Entry at a depth of 18 ft. below low-water datum and was then modified for the more accurate work on the cut foundations of the breakwater heads.

The machine was designed and built under the direction of Col. Graham D. Fitch, by the author and Mr. M. W. Lewis, U. S. Junior Engineer. With the exception of the vertical beam and shaft, with their accompanying devices, the machine is entirely made up of plant used for other purposes on the work; the boiler, engine, etc., being removed and used on other plant as soon as the purpose of cutting off piles has been accomplished.



Derrick for Excavating Sewer Trenches, Louisville, Ky.

An Efficient Derrick Used on Louisville, Ky., Sewer Work.

The accompanying illustration shows a derrick owned by the American Engineering & Construction Co. of Chicago and used on one of their sewer contracts at Louisville, Ky. The work was the construction of a large concrete sewer 14 ft. in diameter and 4,230 ft. in length. The depth of sewer averaged 39.3 ft., and the average number of cubic yards of excavation per lineal foot was 26.5. In the beginning of the work a steam shovel was used for the first cut but was abandoned as it was soon seen that the derrick could do the work required. The derrick took out the excavation to within 14 ft. of the bottom and the balance was taken out with a Potter machine and carried back for backfill. The derrick was equipped with an orange-peel bucket. The spoil material was deposited in wagons and was hauled away under a sub-contract at 11 cts. per cu. yd. The rest of the material excavated by the derrick was dumped into Koppel cars, located along side the trench and hauled directly to the backfill.

The derrick is a stiff leg, mounted on a portable turntable. The power plant consisting of a 30 h. p. boiler and a 7x10-in. engine operating three drums, is mounted on the turntable in such a position as to balance the weight of the derrick and boom. The drums are equipped with two sets of gears permitting arrangement for a dragline bucket, if desired. The entire outfit cost about $6,500. The output of the derrick was about 63,000 cu. yds. and averaged 1,500 cu. yds. per week. The maximum output in one day was about 850 cu. yds or 1,200 swings with the ¾ cu. yd. orange-peel bucket working in sand.

The derrick was formerly known as a Kearns derrick and the patents on the swinging arrangement are held by the Lidgerwood Manufacturing Co. We are indebted for the use of the drawing to Mr. Shaw, President of the American Engineering & Construction Co., Chicago, Ill.

Public Convenience Stations in Vienna.—The privilege of erecting, managing and operating all public comfort stations in Vienna was granted a single firm in 1883, the contract running until 1940. The company can prohibit the erection of stations by others within 1666 feet of its own.

There are 77 stations, 74 of which are above ground. These contain 564 water closets, of which 136 first class and 148 second class are for women, and 136 first class and 144 second class are for men. The first class water closets contain washstands. There are also 128 urinal stations for men built at a cost of $121 each. A charge of two cents for use of first class and 1 1-5 cents for second class closets is made. The city pays the firm a yearly subvention of $16 for each urinal in these stations.

The cost of building a station above ground is $3200 and of an underground station is $16,000. The cost of management and maintenance of a station above ground is about $600 a year and of an underground station is $1200 per year.

Norton Griffiths, M. P., of Griffiths & Co., the English concern, which, as noted in our last issue, received the contract for the construction of the new Chilian Ry., at $21,250,000, has sailed for Chili with a number of engineers and surveyors preparatory to starting actual construction work.

Comparative Economy of Steel I-Beams with Jack Arches vs. ReinforcedConcrete for Railroad Culverts and Short Span Solid Floor Bridges.

FRANK H. CARTER,* ASSOC. M. AM. SOC. C. E.

The design of a solid floor highway bridge, or the roof of a railroad culvert or other underground structure subject to heavy loads, furnishes interesting comparisons in selecting suitable and economical material for the roof. In choosing between steel I-beams with "jack arches," and reinforced concrete, there is little choice either way in respect to economy.

If the floor or roof is suspended above a swiftly running stream or it is difficult in any way to support centering from the bottom, or if the structure is subject to heavy loading very soon after construction, the choice lies with the steel beams and jack arches. If many structures are to be built of the same spacing as I-beams, then economy of design will probably point to the selection of the I-beams. If, however, the abutments or sidewalls can be built in such a manner with respect to forms as to enable the centering for the roof to be supported directly on the supports for the side wall forms, then economy will point to the selection of the reinforced concrete type of roof. A reinforced concrete roof will probably distribute concentrated live loads to far better advantage than the I-beam with jack arches, particularly if reinforced with steel rods longitudinally as well as laterally.

Costs per square foot of floor are given in Figs. 1 and 2, for both types of construction.

In computing the cost of I-beams with jack arch construction as given in Fig. 1, concrete including forms as estimated at $8 per cu. yd., and steel beams including punching for tie rods with the cost of tie rods, were estimated at 2½ cts. per pound of beam. The safe load in pounds per square foot was computed by first subtracting the weight of the roof itself. Otherwise the diagram is self explanatory.

In estimating the cost of the reinforced concrete roof, the concrete was estimated at $9 per cu. yd. and steel reinforcement at 3 cts per lb., reinforcement being computed in one direction only.

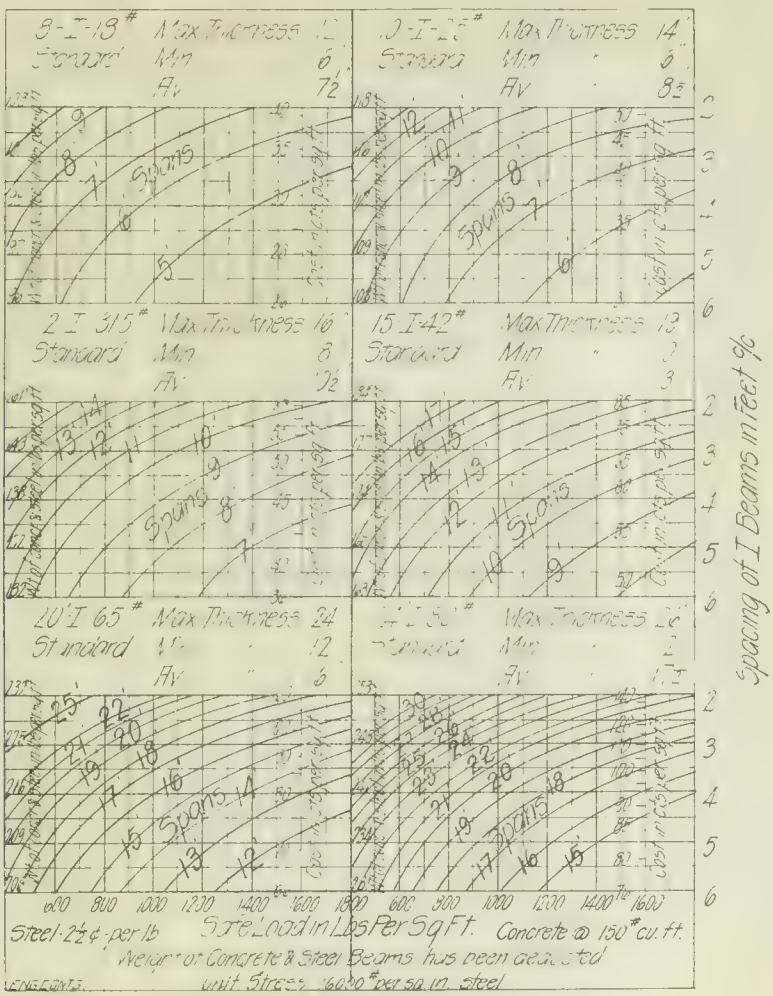

Spacing of I Beams in Feet
Steel 2½¢ per lb
Safe Load in Lbs Per Sq Ft.
Concrete @ 150# cu. ft.
Weight of Concrete & Steel Beams has been deducted
Unit Stress 16000# per sq. in. Steel

Fig. 1.

The cost of each type of construction per square foot is given in each case on a scale on the right hand side of the diagram.

The dead load was taken at 150 lbs. per cu. ft. for concrete, and 110 lbs. per cu. ft. for earth with a live load varying from 250 lbs. per sq. ft. for 15 ft. cover to 500 lbs. per sq. ft. for 2 ft. cover, to allow for impact and distribution of loads through the earth cover.

*Designing Engineer, Cambridge Main St. Subway, Boston Elevated Ry., Cambridge, Mass.

Method of "Spotting" Foundation Piles for a Bridge Pier.

The following method of "spotting" or locating piles in a bridge pier foundation is given by Mr. George A. McKay.* The work was on the foundations of a railway bridge across the Rio Grande, at Brownsville, Tex.:

In the location, or "spotting" of the piles, two lines were necessary, one parallel to the center line of the bridge, and the other at right angles to it. For lining in the piles parallel to the center line, a transit was used, set up on the bank over hubs spaced as per plans. To get the right-angled spacing, a location frame was established in the river about 100 ft. above the pier site. This frame was built on four temporary piles, so spaced as to form a square the size of the pier, or slightly larger. The piles were capped with timbers parallel to the bridge center line. A point was then located on each of these timbers by direct measurement with a 300-ft. tape. These points were directly up stream from the center of the pier where the piles were to be driven; and boat spikes, 6 in. long, were driven at the points and painted white. It was then an easy matter for a man on the barge to get on his centerline by moving his barge until these two spikes appeared in line to him, sighting between the driver leads. Other sets of spikes were also driven at equal distances from the first two, and spaced as the plans called for. The locating was thus done by only one man with an instrument. Each pile, when driven, was marked off on a chart.

LETTERS TO EDITORS.

Tests of Concrete Waterproofing Compounds for the Louisville, Ky., Sewer Work.

Sirs: In the issue of Engineering-Contracting of June 8, 1910, there appeared an article on tests of concrete for impermeability made by the Commissioners of Sewerage of the city of Louisville, Ky., to determine the impermeability of various waterproofing compounds.

I would respectfully invite your attention to the fact that our own product, Ceresit, was placed in a very damaging light in this article, inasmuch as the tests given show a rather low percentage and the logical conclusion of this was to discourage its use. This fact was further emphasized by the attention which was focused on the Louisville sewerage work. Furthermore, this article will be a strong weapon in the hands of competitors.

I would further invite your attention to the fact that in preparing our product for these tests, same was not done in conformance with the specifications which have been worked up by our chemist, as the proportion used was 1 part Ceresit to 20 parts of water, whereas our specifications are very definite that the proportion should be 1 to 12.

This hardly seems fair and we would think

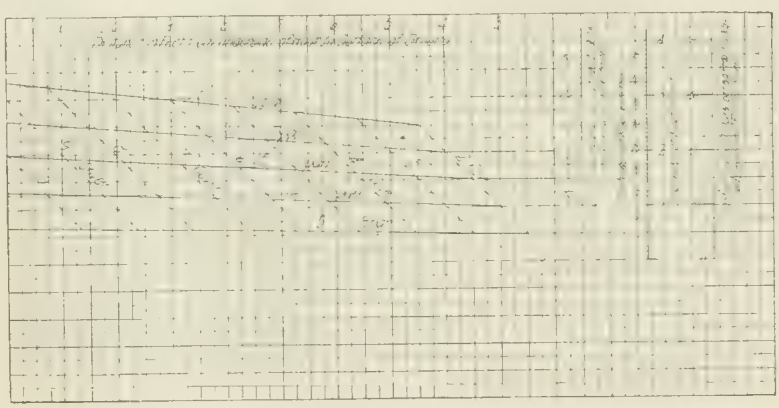


Fig. 2.

*Harvard Engineering Journal, May, 1910.

that a piece of concrete would certainly be condemned where the proper amount of cement was not used. In view of the fact, that parties who have not used our product, are unfamiliar with these specifications, the article in your columns is very misleading and likewise discouraging, and consequently we think we have received very unfair treatment by this article.

Trusting to your spirit of fairness and policy which have successfully marked your publication, we ask for a correction on this.

We are Very truly yours,

CERESIT WATERPROOFING CO.,

P. H. Hansen, Sec.

Chicago, Ill., June 20, 1910.

Directory of Principal Civil Engineering Societies.

American Railway Bridge and Building Association—Secy., C. H. Lichty, 215 Jackson Blvd., Chicago, Ill.

American Railway Engineering and Maintenance of Way Association.—Secy. E. H Fritch, Monadnock Block, Chicago, Ill.

American Society for Municipal Improvements.—Secy. A. Prescott Falwell, 239 West 39th St., New York, N. Y.

American Society for Testing Materials.—Secy. Edgar Marburg, Univ. of Pa., Philadelphia, Pa.

American Society of Civil Engineers.—Secy. C. W. Hunt, 220 W. 57th St., New York, N. Y.

American Society of Engineering Contractors.—Secy. Daniel J. Hauer, Park Row Building, New York, N. Y.

American Street and Interurban Railway Association.—Secy. B. V. Swenson, 29 W. 39th St., New York, N. Y.

American Water-Works Association.—Secy. J. M. Diven, Charleston, S. C.

Boston Society of Civil Engineers.—Secy. S. E. Tinkham, 60 City Hall, Boston, Mass.

Canadian Society of Civil Engineers.—Secy. Clement H. McLeod, Montreal, Can.

Engineers' Club of Philadelphia.—1317 Spruce St., Philadelphia, Pa.

Engineers' Club of St. Louis.—Secy., A. S. Langsdorf, Washington University, St. Louis, Mo.

Engineers' Society of Western Pennsylvania.—Secy., E. K. Hiles, 803 Fulton Bldg., Pittsburg, Pa.

National Association of Cement Users.—Pres., Richard L. Humphrey, Harrison Bldg., Philadelphia, Pa.

New England Water-Works Association.—Secy. Willard Kent, Narragansett Pier, R. I.

Roadmasters and Maintenance of Way Association.—Secy., W. E. Emery, P. & P. U. Ry., Peoria, Ill.

Society for the Promotion of Engineering Education.—Secy., Henry H. Norris, Cornell University, Ithaca, N. Y.

Technical Society of the Pacific Coast.—Secy., Otto Van Geldern, 865 Pacific Bldg., San Francisco, Cal.

Western Society of Engineers.—Secy., J. H. Warder, Monadnock Block, Chicago, Ill.

Coming Meetings.

American Society for Testing Materials.—Annual meeting, Atlantic City, N. J., June 28-July 2.

American Society of Civil Engineers.—Annual Convention, Chicago, Ill., June 21-24.

Society for the Promotion of Engineering Education—Annual Meeting, Madison, Wis., June 23-25.

Personals.

Samuel Gardiner Adams, a well known bridge builder, died June 14 at Willimantic, Conn., aged 81 years.

Mr. H. C. T. Haultain has been appointed Professor of Mining at the University of Toronto, Toronto, Ont.

Mr. David R. Lyman, formerly Assistant City Engineer of Louisville, Ky., has been appointed City Engineer of that city.

Mr. W. D. Hines, Elkton, Md., has been appointed Roads Engineer of Cecil County, Maryland, succeeding the late Roger B. Irwin.

Mr. Samuel Whinery, Consulting Engineer, New York City, has been retained by the Commission on City Expenditures of the City of Chicago to examine into conditions and report upon improvements in the street department of Chicago.

Mr. John Duder, Assistant City Engineer of Salt Lake City, Utah, for the past four years, resigned from the city's staff June 1 to take the position of Chief Engineer in charge of the practice of the Birch Company, Engineers, of the same city.

Pete King, General Manager of Mason & Hauger, tunnel and railroad contractors, Cornwall-on-Hudson, N. Y., died June 19, at Loomis, N. Y., from tuberculosis. Mr. King had been in charge of much tunnel work in the southern and western states. He was buried at Louisville, Ky.

Theodore Lescher, an architect of Chicago, Ill., died June 14 in St. Luke's Hospital, New York, following an operation for appendicitis. Mr. Lescher assisted in drawing the plans for beautifying Washington and Chicago. He also drew plans for the new Field Museum in Chicago and was to have superintended its erection.

William H. Brown, formerly Chief Engineer of the Pennsylvania R. R., died suddenly June 25 at Belfast, Ireland, from heart failure. Mr. Brown in the civil war served under Col. Thomas A. Scott, who had charge of the military railroad forces, and as engineer of the United States military railroads in northern Virginia. He was made chief engineer of the Pennsylvania Railroad June 1, 1881, and was retired Feb. 28, 1906, on a pension.

The U. S. Civil Service Commission, Washington, D. C., will hold an examination on July 27, 1910, to secure eligibles from which to make certification to fill a vacancy in the position of engineer in timber tests, $1,200 per annum, Forest Service, Madison, Wis., and vacancies requiring similar qualifications as they may occur, unless it shall be decided in the interest of the service to fill the vacancy by reinstatement, transfer or promotion.

The U. S. Civil Service Commission, Washington, D. C., will hold an examination July 27-28, 1910, to secure eligibles from which to make certification to fill a vacancy in the position of topographic draftsman (male), Coast and Geodetic Survey, Washington, D. C., $900 per annum, and vacancies requiring similar qualifications as they may occur in any branch of the service, unless it shall be decided in the interest of the service to fill the vacancy by reinstatement, transfer or promotion. The salary of the position of topographic draftsman ranges usually from $1,000 to $1,500 per annum, and for copyist topographic draftsman from $900 to $1,500 per annum. Both men and women will be admitted to this examination.

The U. S. Civil Service Commission, Washington, D. C., will hold an examination on July 27-28, 1910, to secure eligibles from which to make certification to fill a vacancy in the position of forest engineer, $1,800 per annum, in the Forest Service, and vacancies requiring similar qualifications as they may occur, unless it shall be decided in the interest of the service to fill the vacancy by reinstatement, transfer or promotion. Applicants must have had at least five years' good experience in civil engineering work. Graduation in civil engineering from any reputable technical school will be considered equivalent to three and one-half years of this period. They must also have had at least two years' actual experience in forestry work, either as civil engineers in connection with forestry or as practical foresters. The experience in forestry may be concurrent with the experience in civil engineering.

Catalogs Worth Having.

Engineers and contractors should have on file the latest catalogs of machines, tools and supplies that they use. In sending for catalogs reviewed or advertised in this paper, you will confer a favor on us if you will write directly to the advertisers and state that you saw the catalog mentioned in ENGINEERING-CONTRACTING. If you are in the market for tools, machinery or supplies, tell us and we will notify promptly the leading manufacturers.

Port Huron Engine and Thresher Company.—Paper, 12x9 ins., 80 pp. Port Huron, Mich.

This is the general catalog for 1910 and is quite complete with cuts of detailed parts, descriptions, reasons for design and on the whole is a valuable catalog for a careful buyer of this class of machinery.

Old Faithful.—Paper, 6x9 ins., 24 pp. Weber Subterranean Pump Co., 90 West St., New York.

A careful explanation of the principles involved in subterranean pumping in regard to the uses of pumps of the positive displacement type, in which compressed air acts as a piston on the upper surface of a liquid depressing it to a given level and discharging it through a vertical outlet pipe located in the water chamber or intake cylinder.

J. M. Fibre Conduit.—Paper, 3½x6 ins., 12 pp. H. W. Johns-Manville Co., 100 William street, New York.

An illustrated booklet about the molded asbestos fibre conduit with price lists.

The Emerson Steam Pump.—Paper, 6½x9½ ins., 52 pp. J. Jacob Shannon & Co., 1744 Market street, Philadelphia, Pa.

This is a very complete catalog illustrating and describing the Emerson pump, its simplicity and economical features, and giving information as to how to install and operate them. Tables of prices, sizes and other valuable data are given.

"Morris" Centrifugal Pumps.—Paper, 9x6 ins., 96 pp. J. Jacob Shannon & Co., 1744 Market street, Philadelphia.

This is an excellent catalog covering all services to which centrifugal pumps can be applied; with illustrations of pumps and accessory machinery and price lists.

American Power Pumps and Compressors.—Paper, 6⅜x7½ ins., 16 pp. **American Pumping Machinery.**—Paper, 6⅜x7½ ins., 24 pp. J. Jacob Shannon & Co., 1744 Market street, Philadelphia, Pa.

These pamphlets illustrate types and sizes of American simple and compound steam pumps, geared power pumps and compressors.

Carpenters' and Mechanics' Tools.—Paper, 6x9 ins. J. Jacob Shannon & Co., 1744 Market street, Philadelphia, Pa.

An illustrated hardware catalog with especial reference to the tools in use by carpenters and mechanics.

Contractors' Supplies.—Cloth, 7¼x10¼ ins., 614 pages. J. Jacob Shannon & Co., 1744 Market street, Philadelphia, Pa.

This is the general catalog of the company. It is the result of an endeavor to illustrate and describe the best types of plant, tools, supplies and general equipment most desirable for the requirements of railroads, industrial establishments, contractors and builders. It contains "everything for the contractor."

Rock Drills.—Paper 6x9¼ ins.; 30 pp. Wood Drill Works, 30-36. Dale Avenue, Paterson, N. J.

This catalog deals with the Wood Rock Drill and drill mountings, and is quite complete with descriptions and illustrations of all sizes and parts of drills, operated by steam and compressed air. The catalog shows diagrams, which indicate the different drill parts by letters, for convenience in ordering. A line of blacksmiths' tools for forging and sharpening drill steels is also given. A portion of the book is devoted to advice about the handling and setting up of this kind of machinery. Tables of sizes, and of our pressures necessary for different conditions, are given.

Silicate Brick Machinery.—Paper 8¾x11¼ ins.; 50 pp. Wiebe Engineering Co., 170 Broadway, N. Y.

This catalog embodies a complete description of the process of manufacturing perfect sand-lime brick. The process is well illustrated, showing all the machinery involved and containing a large amount of special machinery for the performance of particular functions of the process.

Contractors' Supplies.—Paper 8¾x11¾ ins. 44 pp. Contractors' Supply & Equipment Co., Denver, Colo.

This is a general catalog containing illustrations, descriptions and prices of everything in the line of contractors' machinery, tools and supplies.

Aggregate.—Paper 6x9 ins.; 12 pp. Edison Portland Cement Co., New Village, N. Y.

Being a series of illustrations of garages and property improvements which are examples of the use of Edison Portland Cement.

All About Roofing.—Paper 5⅝x8½ ins.; 18 pp. The standard Paint Co., 100 William St., New York City.

Containing descriptions and illustrations and results of tests as to the uses of Ruberoid roofing.

Paints.—Paper 5x6¾ ins.; 24 pp. The Standard Paint Co., 100 William St., New York City.

This pamphlet devotes a page or more to each of the different kinds of paints manufactured, giving the composition, characteristic properties, uses and method of application of each. This company also puts out a dozen or more small cards and leaflets describing various products.

Boilers.—Paper 4x8¾ ins.; 16 pp. The Pressed Radiator Co., Pittsburg, Pa.

A booklet giving illustrations and complete descriptions and tables concerning the Presto Boilers, which are now being built to operate with Kinnear Pressed Radiators, Blowers and Gas Exhausters. Paper 6x9 ins.; 20 pp.

Highway Culvert Pipe.—Paper 4x6 ins.; 8 pp. Penn Metal Ceiling & Roofing Co., Ltd., 201 Devonshire St., Boston, Mass.

A folder illustrating the uses of and describing this type of culvert pipe.

American Air Compressors.—Paper 7¾x10½ ins.; 80 pp. The American Well Works, First National Bank Bldg., Chicago.

A complete catalog showing the "American" type of air compressors. It goes thoroughly into details and gives tables of data relating to air compression. Root Spiral Riveted Pipe; paper 4¾x7⅜ ins.; 108 pp.

Abendroth & Root Mfg Co.—New York; Chicago office, First National Bank Big. B. M. Osbun Co., Selling Agents

A handsome book for use in connection with the spiral riveted pipe. contains descriptions, illustrations, tables, prices and useful information.

American Locomotives.—Paper 8¼x10¾ ins.; 10 pp. American Locomotive Co., New York City.

Being a bulletin of the company, No. 1004. A description of a new freight locomotive—articulated type—with illustrations and drawings.

Contract News Section

of

ENGINEERING-CONTRACTING

A Consolidation of ENGINEERING-CONTRACTING—CONTRACT NEWS—ENGINEERING WORLD—THE DIRT MOVER.

Containing Items of Interest to Railroad, Public Works and Other Contractors.

The Doings of the Week.

The Canadian Government through the Department of Railways and Canals is calling for bids for constructing the new Quebec bridge. The work is being extensively advertised in Germany and England and it is expected that several foreign firms will bid on the work. The bids are to be opened Sept. 1. Each bidder is required to submit a guarantee bond of $1,000,000.—The oyening of the Tieton irrigation canal of the U. S. Reclamation Service was formally celebrated last week at North Yakima. The canal reclaims 35,000 acres of semi-arid land, and has cost $1,800,000.—A decision to construct the proposed new $25,000,000 terminal of the Pennsylvania R. R. between Canal St. and the Chicago River and from Madison St. south to Van Buren St. at Chicago has been reached by the management and concurred in by the directors of the St. Paul. the Alton and the Burlington roads, which will occupy the costly station jointly.—The Board of Public Improvements of St. Louis, on June 22, awarded the conrtact for the construction of the Kings Highway Viaduct to Wm. P. Carmichael Co., St. Louis, Mo., at about $336,000. The structure will be wholly of reinforced concrete and will be 90 ft. wide and 1,850 ft. long.—Another large piece of bridge work which was let last week was the contract for the construction of the substructure of a bridge to be built across the Ohio River at Louisville, Ky., for the Kentucky & Indiana Bridge & Railroad Co. The work calls for eight piers, six of which will be in the river, and requires about 25,000 cu. yds. of concrete. Foster-Creighton-Gould Co., Nashville, Tenn., secured the contract.—The stockholders of the Lehigh Valley R. R. have voted to increase the capital stock from $40,334,800 to $80,000,000. The directors were empowered to issue and dispsoe of as many of the additional shares as they think necessary for paying the debts of the company, constructing and completing the railroad and to construct branches not exceeding 12 miles in length.—The chief feature of railroad construction work of the past week was the opening of bids at Denver, Colo., by the Denver & Rio Grande and the Colorado & Southern for the construction of double track from Pueblo to Walsenburg, a distance of 50 miles. The work includes 6,000,000 cu. yds. of embankment. A large number of contractors figured on the work.—Among the railroad construction contracts let recently are the following: Sharp-Hauser Constructing Co., Los Angeles, Cal., for about 1,700 ft. of concrete work near Keenbrook, Cal., for the Santa Fe., the work amounting to about $35,000; M. C. Connors & Co., Chicago, Ill., for grading for six miles of interurban line from Palmyra, Mo.; Murch Bros. Construction Co., St. Louis, Mo., at about $500,000 for constructing the Union depot at Memphis, Tenn.; Roach & Stansell, Memphis, Tenn., for 25 miles of grading work on the Kansas City, Mexico & Orient R. R. from Del Rio, Tex., north; J. P. Mullarkey, Montreal, Que., for constructing the line of the Canadian Northern Ry., from Hawkesbury to Montreal, Que.; Kneal & Ryan, Lansing, Mich., for constructing an electric railway from Grand Ledge, Mich., to Lansing; McIntosh Bros., Milwaukee, Wis., for constructing the proposed railroad from White Sulphur Springs to Dorsey, Mont.; W. O. Lipscomb, Roanoke, Va., for the construction of a coal carrying railroad in Kanawha County, W. Va., for the Campbell Creek Railway & Coal Co.; Ransom & Cook, Ottawa, Kan., for the earthwork and excavation for the Atchison, Topeka & Santa Fe's $76,000 reservoir to be constructed north of Chanute, Kan.; Foley, Welch & Stewart, for constructing 25 miles of the Kootenay Central Ry., in Canada, a subsidary line of the Canadian Pacific Ry.

The Panama Railroad.

It is not generally known that the Panama R. R. outranks in age many of the railroads of this country. But such is the case, for on Jan. 28, 1855, an engine passed over this road from ocean to ocean. In the Journal of the Western Society of Engineers Mr. Joseph E. Murphy gives an interesting historical sketch of this railroad and from his paper we have taken the notes that follow. The earliest reconnaissance of the Isthmus for the purpose of finding a railroad route was made in 1835 by Charles Biddle, who had been commissioned by the U. S. Government to examine the different routes for inter-oceanic communication and report on their value. He returned to the United States in 1837, having obtained a decree from the Government of New Granada authorizing the building of a railroad across the Isthmus of Panama. Nothing further was done until 1848 when John L. Stephens, accompanied by J. L. Baldwin, a civil engineer, made an exploration of the proposed route and found it entirely practicable. A company was then formed in the State of New York with a capital stock of $1,000,000, and in 1849 a detailed survey was undertaken under the direction of Col. G. W. Hughes of the U. S. Topographical Corps. A contract for the construction of the road was let in 1849 to George M. Totten and John C. Trautwine, both of whom had had previous experience in construction in the tropics. The terms of the contract were based on the assumption that labor on the Isthmus was cheap and easy to secure. This, however, was not the case, and Messrs. Totten and Trautwine were released from the contract but were retained as engineers. The city of Panama was the only logical terminus for the Pacific end, and after much exploration it was decided to locate the Atlantic terminus on the Island of Manzanilla, in Navy Bay. It was planned to build first from Gorgona to Panama and operate this portion of the line in connection with steamboats plying between Chagres and Gorgona. In Harper's New Monthly Magazine for January, 1859, the "breaking ground" by John C. Trautwine and J. L. Baldwin is thus described: "Two American citizens, leaping, axe in hand, from a native canoe upon a wild and desolate island, their retinue consisting of half a dozen Indians, who clear the path with rude knives, strike their glittering axes into the nearest tree; the rapid blows reverberate from shore to shore, and the stately cocoa crashes upon the beach. Thus unostentatiously was announced the commencement of a railway, which from the interests and difficulties involved, might well be looked upon as one of the grandest and boldest enterprises ever attempted." In the month of August, 1850, actual construction was begun from the Atlantic terminus toward Gatun. At about the same time supplies and machinery were received from the United States and taken to Gatun, the Chagres being navigable to that point. Construction was begun across the swamps to meet the work already in progress at the Atlantic terminus. The work was constantly hampered, and at times practically brought to a standstill, by sickness and by the desertion of large numbers of workmen to take service in the Transit, where better wages and an easier life were offered. It was necessary to bring in recruits constantly, mainly from Carthagena and Jamaica. On the first day of October, 1851, a work train passed over the road as far as Gatun. In January, 1854, the road was completed to the summit ridge at Culebra. At this time an additional force started construction north from Panama to meet the advancing work from Culebra. On the night of January 27, 1855, the two lines met, and at last the Panama Railroad was an accomplished feat. On the following day an engine passed from ocean to ocean. In the month of January, 1859, the construction account was closed, the total cost of the road to that date being $8,000,000.

The River and Harbor Bill.

President Taft has at last given his approval to the Rivers and Harbors Bill, not because he likes it, but because he thinks the failure of the bill thus late in the session would seriously embarrass the constructing engineers. In a message to Congress he points out what he considers to be defects in the bill and makes recommendations for the preparation of future bills. The chief defect that he finds in the present bill is the large number of projects appropriated for and the uneconomical method of carrying on these projects by the appropriation of sums small in comparison to the amounts required to effect completion. He points out that the appropriation of a small sum for a doubtful enterprise is thereafter used by its advocates to secure further sums from Congress on the ground that the investment made is a conclusive recognition of the wisdom of the project, and its continuance becomes a necessity to save the money already spent. The proper policy, according to the message, is to determine from the many projects proposed and recommended, what are the most important and then to proceed to complete them with due dispatch and then take up others and do the same thing with them. The present River and Harbor Bill carries an appropriation of some $52,000,000 and provides for many important pieces of work. It provides for the canalization of the Ohio River, to be prosecuted at a rate which will insure its completion within 12 years; the improvement of the Mississippi River between Cairo and the Gulf of Mexico, to be completed within 20 years; and of the Mississippi River between the mouth of the Missouri and the mouth of the Ohio River, to be completed within 12 years. It also provides for the improvement of the Mississippi River between Minneapolis and the mouth of the Missouri River, to be completed within 12 years; of the Hudson River for the purpose of facilitating the use of the barge canal in the vicinity of Troy, N. Y.; of the Savannah River from Augusta to the sea, with a view to its completion within four years; of a 35-ft. channel in the Delaware River from Philadelphia to the sea; of a 35-ft. channel to Norfolk, Va.; of a 27-ft. channel to Mobile, Ala.; of a 30-ft. channel to Jacksonville, Fla.

Confirmed Reports by Engineers and Contractors

RAILROADS, POWER DEVELOPMENTS, LEVEES, DRAINAGE AND IRRIGATION WORKS.

Railroads—Steam and Electric.

ALABAMA.

The Tuscaloosa Mineral R. R. has completed surveys for its projected 18-mile line from Tuscaloosa, Ala., to Brookwood, Ala., and contracts for the work will probably be let to the Tuscaloosa Contracting Co., of Tuscaloosa. F. G. Blair, Tuscaloosa, Ala., is President of the railroad, and Woolsey Finnell, Tuscaloosa, is Chief Engineer.

The Decatur & Falls City Development Co. is now making surveys and has partly secured the capital for the construction of its projected 50-mile railway from Decatur to Falls City, Ala., through Morgan, Lawrence, and Winston counties. E. J. Wind, New Decatur, Ala., is chief engineer, and E. H. Allison, New Decatur, is president. D. W. Day, Hartselle, Ala., is also interested.

CALIFORNIA.

The Highland Pacific R. R. Co. has completed surveys and has in part secured the capital for the construction of its projected line. Construction contracts are to be let soon. The projected length of this road is 70 miles, and it is to extend from Santa Rosa to Upper Lake and Kelseyville, via Highland Springs and Lakeport. Dr. A. E. Dickinson, Ukiah, Cal., is president.

IOWA.

The Iowa City, Ottumwa & Southwestern Ry. Co. is planning to let construction contracts this fall. The company projects a 70-mile line, and has secured $240,000 of capital for construction purposes. Frank Tanner, Iowa City, is vice-president and general manager.

KANSAS.

The Motor Grand Traction Co. has completed surveys for 65 miles of its projected line and has secured about $100,000 for construction purposes. Construction contracts are to be let soon. The projected length of this road is 165 miles and the route is from Chester, Neb., to Wichita, Kan., via Concordia, Salina and Newton. Jno. E. Daugherty, Wichita, Kan., is Chief Engineer; E. S. Alnutt, Canton, Kan., is President, and H. G. Knickerbocker, Canton, Kan., is General Superintendent.

The Oklahoma-Kansas Ry. Co. has completed surveys and has negotiations underway for securing the capital for the construction of its projected line. The projected length is 35 miles and the route is from Galena to Riverton, from Riverton to Columbus, and Riverton to Miami, Okla., via Baxter. W. K. Palmer, Kansas City, Mo., is Chief Engineer; C. M. Jones, Baxter Springs, Kan., is President, and Chas. L. Smith, Baxter Springs, Kan., is Treasurer.

MONTANA.

The city of Billings, Mont., at a special election June 20, granted the Eastern Montana Electric Ry. Co., a 50-year franchise. F. A. Kesselluth, Billings, Mont., is chief engineer.

NEW YORK.

We are advised that the Auburn & Syracuse Electric R. R. Co. has no present intention to construct a cut-off from Auburn to Skaneateles. T. H. Mather, Syracuse, N. Y., is chief engineer.

OHIO.

The Massillon & Brewster Air Line R. R. Co. has made preliminary surveys for its projected 6½-mile line from Massillon to Brewster. The capital for construction has not been secured as yet and no date has been set for awarding construction contracts. J. G. Wise, Massillon, O., is President.

TEXAS.

The contract will be let early in July for the construction of the projected line of the Crosbyton-South Plains R. R. Co. As projected, this line will be 120 miles long. It is to extend from Crosbyton to Lubbock. Prentiss L. Coonley, 39th street and Stewart avenue, Chicago, Ill., is president.

Grading has been practically completed for the projected line of the Crystal City & Gardendale R. R. The projected length of this road is 41 miles and it is to extend from Crystal City, Tex., east to Gardendale, Tex. The construction capital has been received. E. Breaker, Crystal City, Tex., is Chief Engineer; J. E. Franklin, St. Louis, Mo., is President, and A. R. Ponder, Crystal City, Tex., is General Manager.

Power Developments, Levees, Drainage and Irrigation Works.

FLORIDA.

Henry Monk, Pensacola, Fla., was low bidder June 15, for extending the wharf at Fort Pensacola for the U. S. Quartermaster.

ILLINOIS.

The following bids were received June 20 by C. L. Webster, county surveyor, Wheaton, for the cleaning out of South Side drainage ditch: McAllister & Peterson, Zion City, Ill., $2,550; A. Bennema, 303 West 111th place, Chicago, $3,850; American Engineering & Construction Co., Chicago, $4,440; Stephens Construction Co., Chicago, $4,649; Joseph Lewis, Attwood, Ill., $4,950; Horton & Mosely, Fort Wayne, Ill., $7,500.

The estimate of this work was $3,500; approximate amount 12,000 cu. yds.

INDIANA.

The following bids were received June 20, by Major Thos. H. Rees, U. S. Engineer, Chicago, Ill., for construction of concrete superstructure, steel sheeting, etc., at Michigan Harbor, Ind.: (1) Standing for the bid of the Fitzsimmons & Connell Co., Chicago, Ill. (recommended for acceptance), and (2) for the Great Lakes Dredge & Dock Co., Chicago, Ill.:

	(1)	(2)
Preparing foundation for concrete superstructure, per lin. ft., 100 lin. ft.	$ 5.00	$ 6.00
White oak plank, per M. ft., 700 ft. B. M.	80.00	65.00
Pine timber, per M. ft. B. M., 3,300 ft. B. M.	70.00	60.00
White oak piles, 50', each, 26 only	20.00	25.00
Interlocking steel sheeting, per lin. ft., 750 lin. ft.	22.00	30.00
Steel screw bolts and tie rods, per lb., 3,580 lbs.	.05	.06
Steel drift bolts and mooring bolts, per lb., 420 lbs.	.05	.05
Steel staples, per 100, 1½ C.	5.00	3.00
Wrought iron spikes, per lb., 500 lbs.	.04	.04
Wire rope, per lin. ft., 360 lin. ft.	.05	.15
Riprap stone, per cord of 128 cu. ft., 65 cords	12.00	10.00
Spall or gravel filling, per cu. yd., 150 cu. yds.	2.00	2.00
Concrete in mass, per cu. yd., 660 cu. yds.	12.00	10.50
Use of dredge with outfit complete, per hour, 20 hours	25.00	25.00
Total	$16,492	$17,637

IOWA.

O. P. Herrick, Observatory Bldg., Des Moines, Ia., has been awarded the contract for constructing a drainage ditch for Polk County Drainage District No. 11, in Elkhart township. The contract requires the moving of 53,471 cu. yds. of earth. Bids were opened June 20 at Des Moines, Ia.

KENTUCKY.

Foster, Creighton, Gould Co.; Nashville, Tenn., has been awarded contract for the sub-structure of bridge to be built across the Ohio river at Louisville, Ky., by the Kentucky & Indiana Bridge & Railroad Co. The work consists of eight piers, six of which will be in the river and will require approximately 25,000 cu. yds. of concrete.

LOUISIANA.

Richard M. Murphy, New Orleans, La., was the low bidder, June 24, for furnishing willows from July 1 to June 30, 1911, at South or South West Pass, Mississippi River, for the U. S. Engineers.

The City of New Orleans, La., proposes to create a park on the shore of Lake Pontchartrain at the rear of the city. This work will consist of a reinforced concrete sea wall and the filling in of the lake bed between the sea wall and the shore. The sea wall will be placed about 500 ft. from the shore line at a point where the water is about 30 ins. deep and the daily tidal oscillation about 6 ins. The wall will be approximately 2,600 ft. long and 14 ft. high. The embankment will be about 2,200 ft. long by 500 ft. in width and from 8 to 10 ft. in height and will embrace approximately 400,000 cu. yds of earth to be obtained by dredging in the lake bed outside of the sea wall. Plans and specifications for this work are now being prepared by the City Engineer's department and it is expected that the city will advertise for bids in about 40 days. W. J. Hardee is City Engineer; Thos. L. Willis is Principal Assistant Engineer.

MINNESOTA.

G. E. Brown, Windom, Minn., has been awarded the contract for constructing County Ditch No. 18 at Caribou, Minn. The work includes 85,445 cu. yds. of ditch work and the contract price was 12 cts. per cu. yd. Bids were opened June 20 at Hallock, Minn.

Bids are asked by C. J. Hemmingson, Auditor of Kitson County, Hallock, Minn., until 1 p. m., July 9, for constructing Judicial Ditch No. 10, requiring 381,508 cu. yds. of excavation of main ditches and branches. The estimated cost is $62,957.

MISSISSIPPI.

Bids are asked by R. H. Hicks, City Clerk, of Greenwood, Miss., until 8 p. m., July 5, for installing a drainage system, the work including 22 acres of clearing, 14,800 lin. ft. of main canal, 3,800 lin. ft. of lateral canal containing 75,000 cu. yds. of excavation, 3,000 ft. of 36-in. by 39-in. and 26-in. by 28-in. reinforced concrete conduit, etc.

OHIO.

Bids are asked by James R. Marker, Chief Engineer State Board Public Works, Columbus, O., until noon, July 13, for the building of Lock No. 1 at New Bremen, and the superstructure of the aqueduct crossing Loramie Creek, near the village of Loramie.

G. H. Breyman & Bro., Toledo, O., have been awarded the contract at $16,750, for dredging Black River for the city of Lorain. The work includes 100,000 cu. yds. of dredging and reclaming swamp land by filling in with mud excavated from the river, the latter work requiring about 15,000 cu. yds. Bids were opened Jan. 21. The contract price for the dredging was 11 cts. per cu. yd.; the contract price for the fill was 35 cts. per cu. yd.

RHODE ISLAND.

Following bids were received June 23 at the U. S. Engineer's office, Newport, R. I., for repairing breakwater at Sakonnet Harbor, R. I., (1) standing for bid per ton of 2,000 lbs.

Items Concerning Contractors and Their Work

RAILROADS, POWER DEVELOPMENTS, LEVEES, DRAINAGE AND IRRIGATION WORKS.

(Confirmed Reports Continued.)

for furnishing and placing 1,500 ins. of stone, (2) for bid for furnishing lighter, and (3) for total: J. C. Terry, Fall River, Mass., (1) $4, (2) $5 per hr., (3) $6,600; E. S. Belden & Sons, Hartford, Conn., (1) $1.63, (2) $6 per hr., (3) $3,165; The Breakwater Co., Philadelphia, (1) $2.43, (2) $50 per day of 8 hrs., (3) $4.395; U. S. Drainage & Irrigation Co., New York City, (1) $3.77, (2) $7 per hr., (3) $6,495; The Estate of John Beattie, Leetes Island, Conn., (1) $1.65, (2) $7 per hr., (3) $3,315.

TENNESSEE.

Contracts for work in the Reelfoot and White River levee districts, bids for which were opened June 15, by Major M. L. Walker, U. S. Engineer, at Memphis, have been let as follows: W. S. Mosby, Memphis, Tenn., 60,000 cu. yds. of enlargement in the Reelfoot District, at 23.7 cts. per cu. yd.; Roach & Stansell, Memphis, at 15.8 cts. per cu. yd., for 100,000 cu. yds. of enlargement in White River Levee District.

Arkansas Notes.

FROM CORRESPONDENTS AND OTHER SOURCES.

The Hot Springs Street Ry. Co., H. E. Martin, General Manager, Hot Springs, has applied to the City Council for a franchise for an extension of its car line in South Hot Springs.

The Prescott & Northwestern Ry., W. N. Bemis, President, Prescott, Ark., is now in operation to Helbig, Pike county, and will at once be extended in a northwestern direction to a connection with the Mena and Eastern which will give Mena an eastern outlet.

Advices from Greenwood, Ark., state that work on the Gurdon link of the Fort Smith and Gurdon Ry. will be commenced at once.

The construction gang on the Central Arkansas & Eastern, including about 100 men and 60 teams, are about to start work on the proposed 30 mile line from Stuttgart to England, Ark. After the completion of the main line it is reported that an extension will be built. As noted before in these columns, John Scott & Sons, St. Louis, Mo., are the contractors. The railway company recently filed a certificate with the secretary of state showing an increase of capital stock from $880,000 to $1,100,000 to provide funds for the new work.

Upon the application of the Commonwealth Trust Co., St. Louis, Mo., Judge John H. Rogers appointed William Fordyce of St. Louis receiver for the Dardanelle, Ola & Southern Ry. The road is regarded as a possible link of the trunk line which is expected to be formed some time by the consolidation of a large number of short roads between Fort Smith, Ark., and Little Rock. A great many of the stockholders of the road are located at St. Louis.

The Cache Valley R. R. is said to be planning to extend its line to Paragould. The road at present is 12 miles long and connects with the Frisco at Sedgewich. The extension would add 18 miles. G. W. L. Brown, Sedgewich, Ark., is General Manager.

The Memphis, Paris & Gulf R. R. is said to be about to start the permanent survey for the eastern extension from Murfreesboro to Memphis. The road will run from Murfreesboro to Arkadelphia, Pine Bluff, Dewitt, St. Charles, Helena and Memphis. The route is now definitely settled, the only work now remaining for the engineers being the permanent survey. C. W. Dodson, Nashville, Ark., is General Superintendent.

According to an announcement made by Will Bemis, director of the Prescott & Northwestern R. R. at Little Rock, Ark., work is to be started at once for the proposed extension of the line from Helbig, Pike County, northwest to a connection with the Mena & Eastern, thus giving Mena a connection with the Iron Mountain and opening up one of the best fruit sections in the state.

Hodges & Downey, contractors of Dermott, Ark., have established headquarters preparatory to starting work on their contract for ballasting the entire Valley line of the St. Louis, Iron Mountain & Southern Ry.

California Notes.

FROM CORRESPONDENTS AND OTHER SOURCES.

The Sharp-Hauser Contracting Co., Los Angeles, have the contract for about 1,700 ft. of concrete work near Keenbrook for the Atchison, Topeka & Santa Fe Ry. The work will cost about $35,000.

Preliminary surveys have been started for the new channel of the Santa Ana river. This work is to be done for the Newbert Protection District of Santa Ana, which plans to dike the river, beginning at a point above where Santiaga creek empties in order to control the winter storm waters. This survey is necessary because the first one made was for a 600-ft. channel. Since that time the width has been changed to 400 ft.

The City Council of Oakland has been considering the application of the San Francisco, Oakland & San Jose Ry. Co. (Key Route), Oakland, for a franchise for a 1,000 ft. fairway extending from the low tide line to the government bulkhead line with the privilege of constructing wharves, docks, railway terminals, warehouses and other facilities. The Key Route also wants the privilege of maintaining a single or double track street railway along the extension of 14th St. to the low tide line. In exchange, the company offers to settle the low tide controversy which has been in course of litigation for half a century, and to join in the petition of the city to the federal authorities for permission to extend the bulkhead line 2,000 ft. into the bay, thus giving the city 206 acres of made land.

The North Pasadena Land & Water Co., of Pasadena, is planning to construct a 15,000,000 gallon reservoir in Altadena.

The Western Pacific Ry. has work under way preparing the site for the construction of its shops at Sacramento. They will cost about $1,000,000 and will be used as a general repair establishment for that part of the system between the coast and Salt Lake City. The work of the construction of the shops will be under the supervision of Division Engineer W. J. Calvin.

An agreement has been made by George S. Oliver, Chief Engineer of the Nevada, California-Oregon R. R., and W. Thompson, attorney of the Oregon Land Company, Lakeview, Ore., for right of way through the XL ranch on Pitt River for the proposed line into Goose Lake Valley. Under the present plans the line will be extended from Alturas, Modoc County, the present terminus, into Goose Lake Valley this summer and into Lakeview, Ore., by 1911. The contract for the construction work will be let at once and pushed as rapidly as possible.

Southern Pacific surveyors are located at Redding, Cal., and are making surveys for the construction of the proposed line to Harrison Gulch.

The Central Pacific Ry. Co. has filed an application with the City Council of Oakland, Cal., for a franchise to run a line from Melrose eastward to Stanley Road, a distance of two miles.

Advices from Willows, Cal., state that the Southern Pacific Co. will soon begin construction of the branch road to Arbuckle upon the old survey made some time ago.

The Riverside Portland Cement Co. of Riverside, Cal., is extending the Crescent Ry. line from the plant northward to Bloomington on the Southern Pacific. Rights of way are also being secured for the further extension to Rialto. The road will be operated by trolley.

The Southern Pacific Co. has applied to the City Council of Oakland for a franchise from Melrose station, in the annexed district, easterly to the Stanley road, which is the eastern boundary line of the city.

The request of the railroad company for this franchise is in line with the plans of improvement and will provide for the extension of the local system to the farthest eastern point in the city.

Advices from Escondido state that the Mutual Water company has secured the services of Lewis Hosp, Jr., as engineer to take charge of the construction of the flume line at the upper end of the system. The enterprise calls for an expenditure of about $12,000 and the work will be done by day labor.

Colorado Notes.

FROM CORRESPONDENTS AND OTHER SOURCES.

Bids were opened at Denver on June 20 by the Denver & Rio Grande R. R. and the Colorado & Southern Ry., for the construction of a double track from Pueblo to Walsenburg, a distance of 50 miles. The work includes 6,000,000 cu. yds. of embankment. The section between Walsenburg and Huerfano must be completed by Nov. 1, 1910. This stretch includes 1,600,000 yds. of embankment. The track will be a 34 ft. crown on the embankment and 30 ft. through the cuts. The grade will be 1 per cent maximum. The heaviest cut will be 65 ft. and the heaviest fill will be 100 ft. Among the contractors figuring on the work were MacArthur Brothers Co. of New York and Chicago, Kennefick, Quigley & Hoffman of Kansas City, Utah Construction Co. of Salt Lake, Phillips & O'Gara of Denver and Orman & Crook of Pueblo.

Knowles, Ellsworth & Klaner, Salt Lake City, Utah, are reported to have been awarded the contract for constructing a dam in the upper Rio Grande River for the San Luis Valley Irrigation District. The contract price is said to be $230,000.

C. C. Sullivan, Pueblo, has been awarded the contract for the excavation work for the Daniels & Fisher store to be erected at 16th and Arapahoe Sts., Denver.

The interests owning the Denver Tramway Co., Denver, have acquired control of the Denver & Intermountain R. R., which operates for a distance of 17 miles between Denver and Golden. It is planned to spend about $150,000 in improving the road and in providing new equipment. The following officers have been chosen: William G. Smith, president, to succeed Charles F. Propst; F. L. Butler, vice president and general manager; Frederick G. Moffat, treasurer, and James H. Brown, secretary.

The Union Pacific construction forces have work under way surfacing the tracks between LaSalle, Colo., and Sand Creek on the new branch line, which, when completed with the main line, will give the company a double track line between Denver and LaSalle.

Surveyors of the Laramie, Hahn's Peak & Pacific Railway have been at work for some time in the vicinity of Pearl, Colo., and it is reported that the company intends the extension of its Laramie-Centennial line to Pearl and thence into the rich coal and gold fields near there. J. J. Argo, Laramie, Wyo., is Chief Engineer.

The Colorado Springs Electric Co., the Pikes Peak Hydro Electric Co. and the Colorado Springs Light & Power Co., operating in Colorado Springs, Colorado City and Manitou, have been merged under the name of the Colorado Springs Light, Heat & Pow-

er Co., with a capital stock of $2,000,000. George Bullock and associates of New York controlled the old companies and will be supreme in the management of the new concern. George B. Tripp will continue as general manager. J. C. Lawler, the electrical engineer, will be transferred to a Bullock company at Richmond, Ind.

A bill is before the Board of Aldermen of Denver providing for the creation of a terminal commission, to serve without pay and to take complete charge of the plans on the part of the city for having a new union depot erected in Denver. The plan for the commission contemplates that it shall be composed of eight members, two to be chosen by the mayor independently of any commercial organization, and the other six to be selected from the commercial bodies, two each from the Real Estate exchange, chamber of commerce and Manufacturers' association.

Connecticut Notes.

FROM CORRESPONDENTS AND OTHER SOURCES.

The Connecticut Co., New Haven, Conn., has petitioned the town of North Haven for the right to double track its trolley line in Whitney Ave. from a point near the Web shop in Augurville to the present terminus of the double tracks near the second bridge at Lake Whitney.

Construction work is to be started on the projetced line of the Bridgeport & Danbury Ry. Co. as soon as a certificate of necessary and convenience is secured. A charter was granted by the last legislature and court proceedings to secure the certificate are now under way. A. William Sperry, 82 Church St., New Haven, Conn., is Engineer.

Florida Notes.

FROM CORRESPONDENTS AND OTHER SOURCES.

Swann & Holtsinger of Tampa, Fla., owners of dock front property adjoining the Seaboard Air Line right-of-way across the Seddon Island, the latter's terminals at Tampa, have engineers engaged in drawing plans for a 500-ft. channel extension of the dredged channel from the Seaboard's space, This 500-ft extension will be occupied by modern docks, warehouses, etc., which this company will build. The work will necessitate the Seaboard's dredging its right-of-way which crosses the channel at its lift bridge.

Capitalists of Pensacola, Fla., are dealing with one of the large syndicates of Baltimore, Md., with the prospects that a deal will be closed by which a railroad will be constructed between Andalusia and Pensacola, Fla. About $200,000 of local stock has been subscribed for the project.

Right of way is being cleared and graded for the rapid construction of the projected railroad from Fernandina to Jacksonville, Fla. Site for the depot in the city of Fernandina has been selected and soundings are being made in the harbor preparatory to the construction of river front terminals. All bridges along the right of way have been ordered.

Illinois Notes.

FROM CORRESPONDENTS AND OTHER SOURCES.

The Tri-Cities & Northeastern Interurban Co. has had a survey made for a northern route for its projected line. As originally proposed Albany was to be the northern terminal, but Morrison is now under consideration for this. The road will probably be built by J. W. Crowley of the People's Construction Co., Davenport, Ia. Wallace Treichler, Rock Island, Ill., is in charge of surveys.

The Chicago, Blue Island & Joliet Traction Co., 1st National Bank Bldg., Chicago, has filed a mortgage for $500,000 to secure an issue of bonds of a like amount.

The Chicago, Milwaukee & St. Paul Ry. has started work on the construction of a freight yard terminal near Franklin Park, about 15 miles from Chicago. The company has purchased about 800 acres of land at that place, but at the present time will develop only about 200 acres. The cost of the present improvements will be about $600,000. The first improvement on which the company is now working is a receiving yard of eight tracks, with a capacity of 680 acres. When this yard is fully developed it will accommodate nearly 1,400 cars.

The Rock Island Alexis Ry. Co., a subsidiary company of the recently completed Rock Island Southern Ry. has been incorporated into a capital stock of $5,000 and principal office at Alexis, and will build a line from and through the City of Alexis, in Warren County, to some point on the main line of the Rock Island Southern Ry., in Mercer County. The incorporators and first Board of Directors are E. C. Walsh, Clinton, Ia.; M. A. Walsh, Clinton, Ia.; J. W. Walsh, Davenport, Ia.; C. H. Walsh, Burlington, Ia.; G. H. Higbee, Burlington, Ia.

The Falkenau Electrical Construction Co. of Chicago, Ill., has increased its capital stock from $5,000 to $25,000 and the number of directors from three to four.

The Elgin, Joliet & Eastern Ry., A. Montzheimer, Chief Engineer, Joliet, has temporarily suspended operations for the enlargement of the East Joliet yards of the E. J. & E. railroad, pending the settlement of the Meeker Ave. subway and other questions, all of which are involved in the expenditure of the $600,000 appropriation in and around Joliet. All contractors engaged on the preliminary work in Joliet were called off.

The Chicago & Alton R. R. has begun preliminary work for improvements at Bloomington. These, as proposed, include the following: A new and wider bridge over Locust St.; a suitable footbridge over the tracks on Chestnut St.; a similar bridge on Seminary Ave.; a wagon bridge over the tracks at Emerson St.; a wide and deep subway at Division St.

The Kelly-Atkinson Construction Co., a bridge building firm, with offices at 188 Madison St., Chicago, has purchased 2½ acres of land at Rondout, Ill., and will locate its plant and a large warehouse there. Construction work is to begin at once.

The commissioners of Lawrence County, Lawrenceville, are considering a project of straightening the Embarrass River from the Maxwell-Weger levee to Lawrenceville at an expenditure of $175,000. The new work is five miles long.

The construction of an interurban line from Princeton to La Moille and possibly to some point beyond, preferably Mendota or Amboy, is under consideration, and a meeting has been held at Princeton to perfect an organization. It is estimated that the line could be constructed for about $12,000 to $15,000 per mile. The line would pass through a comparatively level country having few gullies or heavy grades. Among those interested are: S. P. Clark, F. W. Clark and H. H. Priestley, Princeton; L. J. Kendall and A. D. Hopps, LaMoille, and H. G. Wells and C. H. Kelly, of Dover.

Advices from Cairo, Ill., are to the effect that the Cleveland, Cincinnati, Chicago & Louisville R. R. will soon construct a spur to the Indian Refining Co., in the drainage district. Arrangements are now being made for the work.

Preliminary work is under way for the new round house and terminal improvements for the Cleveland, Cincinnati, Chicago & St. Louis Ry., in Mattoon. The round house will contain 30 stalls. An appropriation of $150,000 has been made for the work in Mattoon.

Indiana Notes.

FROM CORRESPONDENTS AND OTHER SOURCES.

The Fort Wayne & Winona Traction Co., the incorporation of which was mentioned in our last issue, proposes an interurban line to parallel the Pennsylvania Railroad between Fort Wayne and Warsaw, a distance of 40 miles, in the course of which it will touch Arcola, Coesse, Columbia City, Larwill, Pierceton, Wooster and Winona Lake. It is believed, however, that this is merely the first link in a line from Fort Wayne to Chicago, projected along a route that will touch every county seat between the two cities except Knox. The line to Warsaw, it is estimated, will cost $1,000,000, and the construction will be provided for by a bond issue of approximately $25,000 a mile. The directors are J. A. Barry, Edward G. Hoffman, Ernest W. Cook and Gaylord M. Leslie of Fort Wayne, and Ralph A. Barry of New York.

The Lake Shore & Michigan Southern Ry., according to a communication to the City Council of Laporte, desires to raise its tracks 8 ins. through that city.

T. E. Petrie, City Engineer, of Marion, Ind., has estimated that a retaining wall can be constructed along the river between Boots Creek and Nebraska St., Marion, at a cost of $2,000. It is also planed to make Boots Creek a covered drain, with a promenade from Island Park to Fourteenth street.

Construction work has been started between Hanover and Madison on the new Cincinati, Madison & Louisville traction line and it is said the road will be completed by next January. From Madison the road will go along the river bottoms to Aurora, where it will connect with the Aurora-Cincinnati line. From Hanover the line cuts across the table land to Scottsburg, where it joins the Indianapolis & Louisville traction line. The power house at Scottsburg is being enlarged and a new union station was finished last week. When completed the road will be 60 miles long.

The Muncie & Portland Traction Co., E. B. Ball, President, Muncie, is said to be considering extending its line eastward from Portland to Celina, O., by way of Coldwater and Fort Recovery, O.

The City Council of Hammond has granted a 50-year franchise to the Indiana-Northwestern Traction Co. of Chicago, promoted by Eugene Purtelle of Chicago. The line will connect Cedar Lake, Hammond, Crown Point and Chicago.

The Bluffton, Geneva & Celina Traction Co., Fred Davenport, Chief Engineer, Bluffton, has started preliminary surveys for an extension from Geneva to Celina, O. One of the routes under consideration leads south from Geneva to Bryant, and thence east through the small town of Wabash, near the state line, to Celina. The other route to be surveyed is almost due east from Geneva, by way of New Corydon, Scudder and Durbin.

The Hirschberger Ditch Association of South Bend has been incorporated. The association was organized for the purpose of cleaning all ditches held in common in St. Joseph and Marshall counties.

The University of Notre Dame, Notre Dame, Ind., is to construct a canal one mile long to connect Lakes St. Joseph and St. Marys.

The Elkhart circuit court and the county commissioners have been holding hearings at the court house, Goshen, on a large drainage improvement project. It embraces the straightening, widening and deepening of Rock Run and will drain many acres. The improvement will cost over $100,000.

Iowa Notes.

FROM CORRESPONDENTS AND OTHER SOURCES.

The Iowa City, Ottumwa & Southwestern Electric Ry. Co., with headquarters at Iowa City, and a nominal capital stock of $10,000, has filed its articles of incorporation. Frank Tanner is president; Otto Hill, secretary. The company proposes to build from Iowa City to Ottumwa.

The T. J. Walsh Construction Co., of Davenport, has been incorporated with a capital stock of $25,000, the incorporators being P. T. Walsh, T. J. Walsh and H. C. Kahl, all of Davenport.

The Mason City & Clear Lake Ry. Co., Mason City, is to extend its local tracks at Mason City north along Main St. as far as the cement plant and then extending west to the new Lehigh cement plant site.

In Des Moines, Ia., the Northwestern will extend its tracks across Des Moines St. for the purpose of connecting with the proposed new freight house planned to be built in that vicinity.

Advices from Cedar Rapids, Ia., state that the Milwaukee R. R. has purchased the lower

half of Cedar Lake and is planning some big improvements. The right of way through this city will, it is said, be altered, carrying it straight across the lake on the same grade as the Illinois Central R. R.

The Muscatine North & South Ry., Chas. Howard, President, Muscatine, has sold $1,000,000 of bonds, the proceeds of which are to be used for the extension of the line from Elrich Junction to Burlington. Construction work is to be started soon, it is said.

Kansas Notes.

FROM CORRESPONDENTS AND OTHER SOURCES.

City Commissioners of Wichita have directed Bert C. Wells, City Engineer, to prepare a preliminary estimate for the cost of extending the drainage canal to the Arkansas River. The work will cost about $40,000.

Preliminary surveys are being made for the Owl Creek Drainage District which proposes the straightening of Owl Creek. A cut of about 1½ miles will be made. Otto Hough, Iola, Kan., has been making the surveys.

As a result of the conference between Mayor Davidson, Wichita, Kan., and the officials of the Rock Island, Frisco and Santa Fe railroads immediate steps will be taken toward the elevation of the tracks through that city. This work has been under consideration by the railroad heads for some time, but not until this last meeting has anything definite been decided upon.

After inspecting the surveyed route of the proposed Kearney-Beloit Ry., the promoters have begun arrangements for securing the necessary right of way. F. T. Burnham, Kearney, Kan., is interested.

Preliminary surveys are being made under direct supervision of the Chief Engineer for the construction of the proposed line of the Gulf & Northwestern R. R., directly north and south through Western Kansas. Tribune, Kan., it is said, will be the division point.

Ransom & Cook, Ottawa, Kan., have been awarded the contract for the earthwork and excavation for the Atchison, Topeka & Sante Fe Ry reservoir to be constructed south of Chanute. The reservoir will cover about 200 acres and an appropriation of $76,000 has been set aside for the work. The concrete work will probably be done by the railway.

T. L. Campbell of Fort Scott, who has been doing the grading work for the Central Ave. bridge at Topeka, has moved to 422 Park St., North Topeka.

Kentucky Notes.

FROM CORRESPONDENTS AND OTHER SOURCES.

The new stockholders of the Owensboro City Railway Co., of Owensboro, have elected C. H. Battin and Arthur Funkhouser, both of Evansville, Ind., directors. The railway company was recently purchased by an Evansville syndicate. W. A. Carson, Evansville, Ind., will be General Manager of the lines in Owensboro and Henderson and the Southern Indiana traction lines. Extensions will be made in Owensboro immediately.

Surveyors have started work on the proposed railroad from Tazewell, Va., to Pikesville, Ky., through Buchanan County, Va., and it is expected that plans will soon be completed and that active construction work will be rushed through.

Surveys are being made on the Lexington & Eastern R. R., recently taken over by the Louisville & Nashville, through Betcher county, entering the county at Cornettsville and passing up the north fork of Kentucky River, by Whitesbury, and on into the great Elkhorn coal field. It is expected that this road will also be extended on into Virginia to form a connection with one or more of the lines entering that section. It is stated that actual construction work will be begun shortly.

The Louisville & Nashville R. R. is said to be planning to expend about $100,000 on yards, construction of a new freight house and the remodeling of the passenger station at Paris, Ky.

Michigan Notes.

FROM CORRESPONDENTS AND OTHER SOURCES.

The property of the Owasso & Corunna Electric Co., of Owasso, has been sold at public auction for $80,000. The property was bought by W. M. Eaton of New York City, a stockholder in the Commonwealth Power Co. of Jackson. It is understood that the Detroit United Rys. will take over the property. This company operated 10 miles of electric railway.

Handy Bros., coal operators, Bay City, who are now building a railroad to Caro, have secured a track laying machine for the work. The roadbed has been graded through to the Akron switch and mine of the company, and the grading will be pushed to Caro as rapidly as possible. Practically all the right of way from Akron to Caro has been secured. The laying of ties and rails, however, will not begin until the grading is well underway towards Caro.

The Grand Rapids & Indiana Ry., E. H. Barnes, Chief Engineer, Grand Rapids, is stated to have started location work for a line to Cedar Springs and to the Muskegon River, 20 miles further north.

Kneal & Ryan, Lansing, have been awarded the contract for constructing the proposed electric railway from Grand Ledge to Lansing. R. E. Olds, Lansing, is the promoter of the line.

The first survey for the through electric railway from Detroit to Grand Rapids, which is being promoted by Wallace & Lau, Detroit, has been completed between Lansing and Detroit, and the engineers have started at Brighton, to work east into Detroit. According to one of the promoters, it is expected that work will be started on the Lansing-Detroit section line this fall. He stated that $500,000 will be available for work on the Lansing-Detroit section this year and $2,500,000 next spring for extending the line west.

The Grand Trunk Ry. has purchased two blocks on McKinley Ave. at Bay City, and proposes the construction of station buildings and freight warehouses, and the laying of terminal tracks, etc., at an expenditure of over $100,000.

Missouri Notes.

FROM CORRESPONDENTS AND OTHER SOURCES.

M. C. Connors & Co., Chicago, Ill., have been awarded the contract for grading six miles of the projected interurban line from Kirksville to Hannibal. This section is located between Palmyra and Philadelphia, the contract covering six miles of line from the latter place.

The Manufacturers' Ry. Co., of St. Louis, George F. Moore, President, will, it is said, ask the Municipal Assembly of St. Louis for a franchise to use several acres of public streets as part of its $10,000,000 terminal yards in South St. Louis. The Manufacturers' Ry. Co. is stated to be negotiating with three Eastern trunk lines, one of which is said to be the Chicago & Northwestern, with a terminus 47 miles from St. Louis.

The Board of Water Commissioners of Kansas City, Mo. will probably have to construct about two miles of revetment between Quandaro and Parkville in order to prevent the intake stations of the Kansas City, Mo., and the Kansas City, Kan., water works at Quindaro from being left inland and put out of commission by the shifting of the Missouri River.

The Springfield Traction Co., F. A. Gallagher, Superintendent, Springfield, is to commence work on its Grand St. subway in that city. The traction company will do most of the work of building the subway. It will have charge of the excavating and the concrete work, while the Frisco railway will provide for the iron work of the structure.

M. M. Stephens, ex-mayor of East St. Louis, Ill., has offered to build a 4-mile electric road from Columbia to the coal fields at a cost of about $100,000, if the men in the county who are interested will raise $30,000 in stock, to be paid for after the road is completed and running. The money is to be subscribed within the next month, at the end of which construction work will begin. According to the plan the road will be completed within six months.

The several properties of the Missouri Water, Light & Traction Co., at Nevada, Mo., are to be transferred to a new company headed by Judge Erb of Chicago. If the deal goes through a general reorganization and improvement of the system will result. Among the proposed improvements is a plan to either buy the park or build a line to the state rifle range, three miles out of Nevada, and establish a park somewhere on the new line.

W. C. and W. R. Gunn of Fort Scott, Kan., have applied to the City Council of Nevada, Mo., for a franchise for supplying that city with natural gas. The source of supply is the Oklahoma fields, and it is proposed to lay an 8-in. pipe line to Nevada from Fort Scott, a distance of 21 miles. The promoters say they will have natural gas by the coming winter if granted a franchise.

The injunction suit of the Rock Island R. R. against the city of St. Louis to prevent the enforcement of the ordinance doing away with steam trains in Forest Park has been adjourned until June 30 by Circuit Judge Fisher. Engineers of the Rock Island testified that the change to electric trains would entail a cost of $1,000,000 to $1,500,000.

According to advices from Springfield, Mo., the T. P. Jones Construction Co., of Jefferson City, Mo., has been awarded the contract for the Missouri Pacific Ry.'s Bagnell extension from that city south 60 miles. This work, it is said, has been under consideration by the officials for several years.

Surveys are now under way by the Kansas City, Sapulpa & Southwestern for the construction of the proposed line for which a charter was granted about two years ago. As projected the route will be along the original survey from Joplin, Mo., southwest through Sapulpa and Shawnee, Okla. W. H. Henderson, Guthrie, Okla., is Chief Engineer of the company and will be in charge of surveys.

Meetings of the Mississippi River Commission have been held at its offices in the Liggett building, St. Louis, to consider making allotments for levee work. Among the applications received at the meeting on June 23 were the following: William Holloway and Judge W. T. Marshall reported to the commission regarding the progress of levee work in Mississippi County, Mo., for which the commission made the survey about a year ago. I. M. Worthington, president of the Chico County Levee Board of Arkansas, urged the need of work in that district. W. J. Shackelford, chief engineer, and Walton Shields, attorney, asked bank revetment to protect the levee at Albemarle Bend, south of Greenville, Miss., where the cutting of the banks threaten the levee. John G. Jones, connected with the Yazoo and Mississippi Valley Railroad, urged the same work, declaring the railroad, which runs behind the levee, was threatened with overflow should the levee be broken by the river. Jeff Truly and John F. Jenkins, both of Natchez, representing riparian owners in Mississippi between Vicksburg and Fort Adams, told the commission the lands of the petitioners were overflowed at high water, and asked aid in the construction of a levee. A survey to locate the levee in the most desirable place and expert supervision in its construction was asked of the commission.

St. Louis Items.

BY A. B. KOENIG.

Costello Bros. have finished their work on the Mo. Pac. R. R. at Kirkwood and have shipped this outfit on to their Big Four work in Indiana.

McCann Bros. have their outfit at work now at Bridgeport, Ill.

Tom Keating of Keating Bros. came to town last week, bought some more mules to add to their outfit at work on the Big Four R. R. near Evansville, Ind.

The Carter Construction Co. have about finished their contract on the Herrin & Metropolis branch of the Burlington R. R. in Southern Illinois and have moved a part of

their outfit to Maryland, where they have an extensive contract.

John Marsch has finished his work at Benld, Ill., and has moved his steam shovel up into Wisconsin.

Foley Bros. came in from Minneapolis, bought 122 mules and 4 horses which they shipped to their Grand Trunk work in Canada.

H. B. Johnson of Denver, who is one of the vice-presidents of the projected St. Louis-Kansas City Electric Railway, after arriving in St. Louis the other day, told friends in the financial district that arrangements are being concluded to finance the enterprise. He said DeWeese C. Nevin, president, has sailed for France, having received assurances from Paris that a syndicate will furnish the requisite capital. The undertaking was launched by W. H. Chase at St. Louis. Mr. Chase retired as an officer and Selden P. Spencer became a member of the Board of Directors. Mr. Nevin, who was connected with an insurance company at Denver, was chosen to take charge of the work. For several months agents have been obtaining stock and bond subscriptions as well as right-of-way and terminal properties and engineers have been locating the route. The intention is to construct a double-track "gradeless and curveless line" from St. Louis to Kansas City, crossing Missouri by a direct route of 250 miles. The projectors contemplate a road even shorter than the Wabash, and plan operating exceptionally high-class through trains at high speed. Progress has been made with citizens, municipalities and counties in the interior of the state regarding subscriptions and right-of-way, and Mr. Nevin is confident of obtaining financial backing in France. After the route is definitely selected, it is probable arrangements will be made for entering St. Louis and Kansas City. Although it was thought the company would arrange to cross the present St. Charles bridge, it is considered doubtful whether the plan will be adopted as bridge traffic has been restricted to passenger business and the company proposes handling freight. The Missouri River will be crossed twice. The road may enter St. Louis from the north instead of the west.

Wm. Nuttal of M. C. Connors & Co. of Chicago spent last week with us.

The Cape Girardeau & Thebes Terminal Railroad has been undergoing some changes. Six miles of the line from the Cape south have been made a bee line and several bad curves have been taken out. This insures quicker time for the suburban trains out of the Cape to Kelso, Illmo and Edna, and for Cairo and St. Louis connection with the Cotton Belt at the Thebes bridge.

Quite a number of our western contractors are out looking over the new Colorado Southern work which they are going to let between Pueblo and Walsemburg. So far we have not heard the name of the lucky bidder, but will publish same as soon as we get this information.

Henry Schweitzer got in on some new Big Four work the other day at Vermillion Grove, Ill.

Street Commissioner Travilla last week submitted his annual report to the Board of Public Improvements showing the expenditures for the fiscal year in that department. The largest items were for sprinkling and street cleaning. The report shows that about 19 miles of streets were made; brick, miles, 8.16, $360,389.50; asphalt, 5.49 miles, $299,-314.70; bitulithic, 3.79 miles, $222,201.61; granite, .02 miles, $744.50, and telford, 2.02 miles, $72,814.20. During the year the city paid $310,241.39 for construction and reconstruction of about 17 miles of alleys. The Street Department spent $434,212.74 for repairs and $652,233.86 for street cleaning. Other items of expense were: Labor and carts, $192,503.53; cleaning stone, wood block and asphalt streets, $289,909.76; block system, $169,730.57; garbage removal, $186,793.39; street reconstruction, $104,120.38. According to the report, the department used 25,325 loads of macadam, which was furnished by the Workhouse prisoners. In connection with the report was that of the City Forester, which showed that 14,368 trees were pruned, 2,387 were removed and 51,777 were treated at an expenditure of $11,660.55.

Air was turned last week into the caisson for the west shore pier of the Municipal Free bridge, which is on its way to rock bottom at the foot of Lombard St. The floating of air compressor plant, which has been keeping the water out of the east shore caisson, was moved across the river some time ago and put in readiness for work on the west side of the river. Work on the east pier has been stopped by the high water. An air pressure is required inside the working chamber of the caisson to keep out the water as soon as the cutting edge of the caisson reaches below the level of the water in the river. President Reber of the Board of Public Improvements ordered the city dump for street refuse moved from the foot of Gratiot St., above the site of the pier to Chonteau Ave., below the site of the pier, because the floating refuse interfered with the operation of the pumps on the compressor barge, the refuse being drawn into the suction pipe of the pump and clogging the contrivance. The pump carries water into the caisson to be mixed with the material being excavated so that it can be drawn out of the caisson in a fluid state.

The Morey Faulhaber Co., 1212 Chemical Bldg., St. Louis, have some awful nice work to let on the extension of the Santa Fe R. R. in Texas.

Claude Mimms & Co. have their outfit at work near Nortinville, Ky.

Laborers are very scarce in St. Louis at the present time.

We understand that some of the Northern roads are laying off quite a number of men. There will be no trouble for all of these men to get work if they come to St. Louis. There is not one-fourth enough laborers in this city to supply the demand.

L. P. McClavy is building a muck ditch near East Cape Girardeau.

The Board of Public Improvements last Tuesday awarded the contract for the construction of the first section of the Baden sewer to the Hoffman-Hogan Construction Co. for $288,157.15, which is about $25,000 above the original estimate. A bill to appropriate the difference was passed by the Municipal Assembly recently. Bids were opened on the second section of River Des Peres foul water sewer, the Universal Construction Co. submitting the lowest of four proposals. That company offered to do the work for $604,-518.85. The others were Scott, Hannon & Hickey, $616,518.71; John F. McMahon, $614,-638.44, and Fruin-Colnon Contracting Co., $678,032.88. The estimate was $615,000. The board did not award the contract to the lowest bidder, which is a firm unknown to the members of the board and if, after investigation, the board is convinced the company can do the work, its bid will be accepted. Wm. P. Carmichael Co. got the contract for the Kingshighway viaduct, its bid being $336,380. The estimate of the board was $400,000.

McCaughey Bros. report rapid progress with their Burlington work in Wisconsin.

T. B. Jones & Co. are at work on the Missouri Pacific R. R. just west of Jefferson City, Mo.

Jock Lee, send your address to Koenig in St. Louis.

Montana Notes.

FROM CORRESPONDENTS AND OTHER SOURCES.

A bill has been introduced in Congress to permit the Columbus Power & Electric Co., organized in South Dakota, to build a dam across Clark's fork of the Columbia River at Thompson, Sanders County.

H. H. Nelson, Vandalia, Mont., has moved his construction outfit to North Dakota where he has some railroad work.

Contract for the construction of the proposed line from White Sulphur Springs to Dorsey, Mont., on the Chicago, Milwaukee & Puget Sound R. R., mentioned in our last issue, has been let, it is reported, to McIntosh Bros., Milwaukee, Wis. John Ringling is promoter of the line.

The Gilmore & Pittsburg Surveyors who are working from Armstead toward Dillon, Mont., through Ryan's Canyon, have just moved their camp from the mouth of the canyon, nine miles south of Dillon, and are now surveying down the valley toward the latter city. According to the survey through the canyon, there will be a 600 ft. tunnel near Grayling and an overhead crossing above the Oregon Short Line tracks will be made at Beaver head rock, the tressle passing close by the rock and striking the hill side about 100 yds. north.

New Jersey Notes.

FROM CORRESPONDENTS AND OTHER SOURCES.

The Wildwood & Delaware Bay Short Line R. R. Co., of Wildwood, N. J., organized several months ago to construct a new line of railroad from the resorts on the island to the line of the Reading that runs to Cape May, has taken out a charter, and work will be begun in a short line. The promoters propose a double-track line to the intersection of the Reading line and thence continue with a single track to the bay shore, from which point a steamboat line will be operated to Philadelphia.

The Ocean City Electric R. R. Co., Ocean City, is to start work at once on a new line down Bay Ave. from 7th to 18th Sts., also on the spur down 10th, from the bay to the boardwalk.

The lines and equipment of the Burlington County Railway Co., which recently fell into the hands of a receiver, have been sold to the bondholders on a bid of $120,000 made by A. Merritt Taylor, of Philadelphia, who represented the purchasers. This line is 14.8 miles long and connects Moorestown, Hartford, Masonville, Hamesport, Burlington and Mount Holly.

New York Notes.

FROM CORRESPONDENTS AND OTHER SOURCES.

The town board of Saratoga Springs has granted a franchise to the Hudson Valley Ry. Co., Glen Falls, N. Y., to lay tracks in East Ave. for the purpose of connecting the Glens Falls and Troy divisions of the electric railway.

The Fonda, Johnstown & Gloversville R. R., J. Ledlie Hees, President, Gloversville, N. Y., has asked the City Council of Amsterdam for a franchise giving it the privilege of double-tracking East and West Main St, and of constructing a belt line from the tracks in the east end of the city over the hill to the company's tracks in the Eighth Ward. The cost of the work will be about $140,000.

The directors of the Hudson Valley Ry. Co. will hold a special meeting at Glens Falls on July 20 to consider among other things the action of the management in accepting a franchise to build a line on East Ave., Saratoga.

City of Fulton, N. Y., is in receipt of information that the New York, Ontario & Western R. R. Co. contemplates enlarging the freight yards both in the northern and southern parts of the city.

The Board of Estimate of New York City will shortly provide funds for the commencement of work on the Jamaica Bay improvement. The Board several weeks ago appropriated $1,000,000 for the preliminary work. Congress has appropriated $750,000 for the Federal Government's part of the work and the state has set aside $250,000 for its share.

The stockholders of the Lehigh Valley R. R. in special meeting have voted to increase the capital stock of the company from $40,334,800 to $80,000,000. The directors were empowered to issue and dispose of as many of the additional shares as they think necessary for paying the debts of the company, constructing and completing the railroad and to construct branches not exceeding 12 miles in length.

Ohio Notes.

FROM CORRESPONDENTS AND OTHER SOURCES.

The Norfolk & Western Ry., C. F. Losh, Assistant Engineer, Portsmouth, O., is to

build an underground passageway between its shops and Norfolk St. at Portsmouth. The subway will be commenced immediately.

The Cincinnati, Lawrenceburg & Aurora Electric Street R. R. Co., Cincinnati, O., is planning to extend its line up to Mill Creek, a distance of five miles from its present terminus at Anderson Ferry. The extension will be made to secure an entrance to the new union depot at Cincinnati.

The Commissioners of Clark County, Springfield, have been petitioned to widen, straighten and deepen Mad Run for a length of 2½ miles, from the bridge across the Enon road down stream towards Medway.

The Baltimore & Ohio R. R. is reported to be planning several improvements at Massillon, to include the changing its right of way to eliminate curves south of Walnut St., and double tracking the road to the town at Columbia.

The Pennsylvania R. R. has made surveys for yards in East Hamilton. The new track will consist of three storage tracks, one of a capacity of 100 cars and the other two will hold 60 cars.

A company is to be organized at Toledo to build and operate a street car line to extend from the present Ottawa Park line west along Bancroft St., to the Minert road, Talmadge Ave., thence to Monie St. The line will be about nine miles long and nearly all of the right of way has been secured. Attorney H. C. Adams, Toledo, is interested.

Surveys are to be made at once for double tracking the Baltimore & Ohio Southwestern Ry. between Cozaddale, O., and Midland City, O., a distance of 14 miles. About $200,000 is to be spent for the improvement, which will be made this summer.

The Cleveland & Pittsburg Ry. construction crew have pitched a camp at Homeworth, which will be their headquarters until the 7 mile link between Alliance, O., and Homeworth is double tracked. The work includes widening a number of bridges and the construction of a number of concrete piers. Work will be completed, it is said, in about one year.

The Chesapeake & Ohio Ry., which has recently taken over the Chicago, Cincinnati & Louisville Ry., is planning the improvement and development of the latter. The high trestle entrance to Cincinnati, O., will be eliminated by constructing a cutoff between the C. C. & L. and the C. & O. from Cottage Grove, Ind., 45 miles north of Cincinnati, to Silver Grove, Ky. The proposed extension will circle across the country a few miles for Cottage Grove to a point on the Ohio side of the river opposite the C. & O. station of Brent, which is 11 miles from the Cincinnati Union depot. This will necessitate the erection of a bridge across the Ohio River, and it is said Chesapeake and Ohio officials have estimated this will involve the expenditure of between $2,000,000 and $3,000,000. The new connection will be double-tracked, as will the whole of the present line from Cottage Grove to Chicago, according to present plans, and the whole road will be put in a strictly up to date condition, the intention being to make it capable of extremely heavy freight traffic with a view to carrying a great bulk of the Chesapeake and Ohio coal tonnage.

Oklahoma Notes.

FROM CORRESPONDENTS AND OTHER SOURCES.

The Board of Park Comissioners of Oklahoma City have awarded the contract for the construction of the spillway of the dam for the lake in Northeast Park to the Illinois Concrete Machinery Co. of Buda, Ill., for $8,300. The contract stipulates that the company use its own steel forms in the construction of the spillway.

The Muskogee Electric Traction Co., R. D. Long, Manager, Muskogee, is to extend its Fon du Lac line 1⅜ miles west to the fort or Agency Hill at Muskogee.

The Clinton & Oklahoma Western, now in operation between Clinton and Butler in western Oklahoma, is planning the extension of its line. C. C. Goodman, Fort Smith, Ark., is promoter of the line.

The Cherryvale, Oklahoma & Texas R. R. has grading well under way on the first division of the projected line and work will be completed to Wann, Okla., by July 1, it is expected. S. M. Porter, Caney, Kan., is at the head of the company.

Citizens of Colony, Okla., have appointed a committee to take charge of the matter of securing the necessary bonus for the construction of the Oklahoma Western railway through that place. J. W. Graves is one of the committee.

Petitions, having the backing of the State Federation of Labor and the Farmers' Union, are to be circulated calling for state ownership of a system of interurban railway lines to compete with the steam railroads. It is expected that the right of the state to own and operate lines shall be incorporated in the constitution. Provisions are made for the creation of a state board of railway construction and transportation, and that all employes shall work under a civil service system. It is further proposed that all control of the railroads be put up to the state board and the question removed from politics and legislative control. Special attention is to be paid to the question of the feasibility of hauling children to the rural school free of charge whenever practical.

A construction company has been organized at Granite for the purpose of constructing the Granite, Willow & Western Ry. The proposed line will pass through the towns of Granite, Willow, Blair, Erick and several other places. It is planned to start the work of construction as soon as possible. Surveys are under way.

Oregon Notes.

FROM CORRESPONDENTS AND OTHER SOURCES.

FROM CORRESPONDENTS AND OTHER SOURCES.

Engineers of the United Railways Co. are making surveys for the construction of a 30 mile line from Tillamook, Ore., to Pacific City. It is expected that no heavy grades will be encountered and that no large cuts or fills will be made, as the proposed route will follow, to some extent, the county roads. J. E. Gardner, Portland, Ore., is Chief Engineer.

Southern Pacific Surveyors, according to reports, are running lines for the construction of a road from Sheridan to Pacific City, Ore., by way of Beaver, Hebo and Cloverdale.

Track laying has been completed on the Gray Harbor & Puget Sound line, a subsidary of the Union Pacific, to Cosmopolis, thus making connection with Portal Junction, southeast of Rochester. As the Chicago, Milwaukee & Puget Sound line between Portal and Rochester are completed, the Union Pacific will give a direct communication from McKenna, 25 miles south of Tacoma, to Cosmopolis. The Union Pacific also has under construction a belt line radiating from Cosmopolis, Wash., and a line from Portal to Centralia to connect with the Oregon & Washington Ry.

C. J. Young, who has the contract for grading about 40 miles of the Oregon Trunk Line Ry., has shipped his entire outfit, consisting of about 40 cars of teams, wagons, scrapers and various camp equipment, up the Upper Klamath Lake to the Klamath Agency landing, from where it will be transported to the site of construction. Work will be rushed with all possible rapidity and it is expected to have the line in operation from the north by the end of this year.

Pennsylvania Notes.

FROM CORRESPONDENTS AND OTHER SOURCES.

The Cumberland Ry. Co., of Carlisle, Pa., now operating seven miles of electric railway from that place, and which also is constructing a line to Newville, is to make three extensions of its lines. One is from a point in South Middleton Township to and along the Carlisle and Chambersburg turnpike; the other two are over various streets in the borough.

The Philadelphia & West Chester Traction Co., Philadelphia, is to double track its Ardmore and Llanerch branch from Llanerch to Ardmore.

The route has been approved for a further extension of the Hanover & McSherrystown Street Ry., to run from the present terminus of the extension now being built, to the public square in New Oxford borough.

Final surveys have been made and right of way secured for a new branch of the Lehigh Valley R. R., E. B. Ashby, Chief Engineer, New York City, between Lumber Yard on the Hazleton branch and Hayes Creek on the main line of the Lehigh Valley. The branch will pass through Old Buck Mountain and will cross the main line of the Central Railroad of New Jersey and Lehigh River, opposite Hayes Creek, by a bridge 90 ft. high and over 1,300 ft. long. The bridge will cost approximately $1,200,000 and will take over two years to build.

The Pennsylvania R. R. is said to be planning the expenditure of $700,000 more for increased passenger terminal facilities between the Broad Street Station at West Philadelphia and Philadelphia. The work is to be completed before next fall. Across the Schuylkill River the south bridge, used by main lines and New York division trains, is to be widened to carry four tracks. Under this arrangement the four-track system at West Philadelphia may be carried right through to the elevated lines east of the Schuylkill River.

Advices from Scranton state that rights on the Paujack River, which divides Wayne and Pike Counties, have been bought for an electric power plant for Northeastern Pennsylvania. The rights cover 10,000 acres from Wilsonville to Lodgedale. It is proposed to construct a dam holding 40,000,000,000 gallons and flowing back 14 miles.

Rapid progress is reported by the Pennsylvania Railroad forces on the construction of new line through Bristol, Pa. The work will eliminate ten grade crossings and the heavy curve now through the city. The work includes the construction of four tracks. To make this change of line will necessitate the grading of some 550,000 cu. yds. of earth and the construction of 5,000 cu. yds. of arch masonry and 12,000 cu. yds. of bridge masonry. The street bridges will be constructed with reinforced concrete, with solid floors. At the present time about 256,000 cu. yds. of embankment have been made and 4,000 cu. yds. of concrete masonry built. One of the present tracks will be left on the old location as an industrial side-track to reach the new large factories in that part of the city.

South Carolina Notes.

FROM CORRESPONDENTS AND OTHER SOURCES.

The Greenville, Spartanburg & Anderson Trolley Co., of Greenville, S. C., which projects an extensive electric railway system, is to make a survey for an extension from Greenville via Laurens to Clinton.

The Columbia & Atlanta Ry. & Steamboat Co. has been chartered with an initial capitalization of $100,000 and proposes to operate a line of steel freight and passenger boats between Columbia and Charleston and Georgetown and to build and operate a steam railway terminal and warehouse system in Columbia. T. C. Williams of Columbia is president and principal stockholder.

South Dakota Notes.

FROM CORRESPONDENTS AND OTHER SOURCES.

The organization of the South Dakota Interurban Ry. Co. has been perfected at Parkston, S. Dak., the following officers being elected: President, V. E. Miller, Bijou Hills, S. Dak.; vice-president, A. F. Grimm, Parkston; secretary, F. E. Graves, Bijou Hills; treasurer, R. W. Thwing, Bijou Hills. The company proposes to construct an electric railroad from Parkston to Bijou Hills, and from Parkston to other places.

It is reported that equipment and laborers are being shipped to Granite Falls and Montevido, Minn., by the Chicago, Milwaukee & St. Paul for the purpose of constructing double track on their Hastings and Dakota line from St. Paul to South Dakota line. It is said that the increase of freight traffic makes this move necessary.

Advices from Omaha, Neb., are to the effect that promoters have not dropped the proposition to construct the projected railroad

from that city to Yankton, S. Dak. The idea seems more probable now than ever, as the Milwaukee lines will be constructed through Fremont, a station on the proposed Omaha-Yankton line.

D. C. Washburn, County Surveyor, Aberdeen, S. Dak., is making surveys for a railroad from Watertown to Fargo, via Webster.

The Chicago & Northwestern R. R. has completed track laying on its new line into Newell, and it is expected that trains will be operated as far as Nisland, a town 18 miles east of Belle Fourche, S. Dak., by the last of June.

Tennessee Notes.

FROM CORRESPONDENTS AND OTHER SOURCES.

The Memphis Union Depot Co., Memphis, has awarded the contract for its station building to the Murch Bros. Construction Co. of St. Louis, Mo. The station will cost about $500,000. The Murch Bros. Co. is now established in Memphis, being engaged in erecting the Central Bank and Trust Co.'s office building at Madison Ave. and Second St., Memphis. This work is in charge of Thomas Jarvis, who has offices in the Porter building.

The Athens & Tellico Ry., J. B. Wright, President, Athens, Tenn., will expend about $75,000 for replacing trestles with fills, revising grades and laying new track. The road is 25 miles long and was recently purchased by the Louisville & Nashville.

The Southern Ry. is planning a number of improvements for its main line between Memphis and Chattanooga. Orders were placed some time ago for a large amount of new steel rails and portions of the line between Memphis and Chattanooga will be rebuilt with the new steel, and all bridges will be reconstructed.

Work is to be started at once, it is said, on converting the Holston Valley Ry. of Bristol into an interurban electric line. The work will cost about $100,000. The line at present is 11 miles long.

Texas Notes.

FROM CORRESPONDENTS AND OTHER SOURCES.

N. A. Brown of Dallas has been granted a franchise to construct a street car line in Amarillo, connecting San Jacinto Heights with Polk St., and it is understood that actual construction will begin within less than six months. The line will be about two miles long.

Roach & Stansell, Memphis, Tenn., are to at once start work on their contract for grading the first 25 miles of the line of the Kansas City, Mexico & Orient R. R., from Del Rio north. This makes about 115 miles of work which Roach & Stansell have on this road.

A drainage district is to be organized in Bell County and Milam County for improving Little River by dikes and levees. The improvement work will be carried on from the Bell County line to the San Gabriel River, and approximately 10,000 acres will be protected from overflow.

According to advices from Temple the contract which the C. H. Sharp Construction Co., Kansas City, Mo., now have underway for revising the grade of the Santa Fe line from Temple to Coleman, amounts to $1,394,805.63, distributed as follows: Temple to Lometa, $356,558.50; Lometa to Brownwood, $454,044.45; Brownwood to Coleman, $584,202.68. The maximum grade from Temple to Brownwood after the work is completed will be 1¼, and from Brownwood to Coleman, .6.

The Dallas Terminal Ry. & Union Depot Co., Dallas, is planning to construct large yardage, round house and terminal facilities in South Dallas, close to the Trinity River.

The City Commission of Fort Worth decided upon the construction of a modern subway under the numerous tracks of 14th St. from Jones St. to the point where Lucella and Crump Sts. converge.

The Railroad Committee of the Chamber of Commerce, Dallas, Tex., are taking steps to secure the construction of the Gulf, Texas & Western from its present terminus at Seymour to Dallas. Benjamin B. Cain, Dallas, Tex., is Vice President and General Manager of the company.

The Sonora, Tex., Business Men's Club has accepted the proposition of the Kansas City, Mexico & Orient R. R. to purchase $200,000 of bonds and donate 160 acres of land to secure the construction of the company's proposed line to Del Rio through that city within two years.

Advices from Corpus Christi, Tex., are to the effect that an announcement has been made stating that construction work will begin shortly on the St. Louis & San Francisco R. R. line from Brady to Corpus Christi, via Kingsville, Tex. The route of the proposed line will pass through five counties at the present time with no railroad service.

Information received from Pecos, Texas, states that a party of Santa Fe Engineers have completed an automobile survey from Brady, Tex., via Rudd, Eldorado, Ozona, Sheffield and Fort Stockton, Texas, to Pecos, Texas, a distance of 300 miles. Permanent location of the road has been made as far as Rudd, 70 miles, and the party is pushing westward. On account of the possibility of obtaining an easier grade from Pecos to a connection with the Santa Fe south from San Angelo, it is thought the road will be constructed direct from Brady, leaving San Angelo, Tex., about 30 miles to the north.

Engineers are now running the preliminary lines for the St. Louis & San Francisco extension from San Antonio to Alice. The latter place has raised a bonus of $20,000 for the line and other places along the route have also raised bonuses. It is said that construction work will be started within 12 months.

In connection with the construction of the Kansas City, Mexico & Orient line to Del Rio, Tex., the Mexican National Railroad is now constructing a line from Allende, Mex., north to Del Rio. When finished the lines will form the shortest possible route between Kansas City and the City of Mexico.

J. J. Lannin, representative of Chicago capitalists, who promoted the Sterling, Tex., extension, is expected to arrive at Garden City, Tex., shortly to take up the matter of building a railroad from Big Spring to Ozona.

The San Antonio, Rio Grande & Tampico Ry. Co., which projects the construction of a new line from San Antonio through Southwest Texas to Tampico, Mex., has applied to the Railroad Commission for authority to cross at grade the track of the Artesian Belt R. R. at Artesia, Tex. It offers to provide a strong gate for safety purposes and an interlocking plant as soon as operations commence.

As a result of a recent visit of officials of the Southern Pacific Co. to Llano, it is said that the company has under consideration the project of extending its Llano branch west to a connection with the Fort Worth & Rio Grande division of the Frisco, which is now being extended southwest from Brady to Menardville. The extension of the Southern Pacific would be about 75 miles long, and, if conditions are deemed favorable, it is said that it may be extended all the way to a connection with the transcontinental line of the Southern Pacific at Sanderson, Tex., 250 miles. Two railroads are now being constructed south from the coal fields of Erath and other counties of that section, with Llano as their southern objective point. The completion of these roads will place the iron ore and the coal fields within 150 miles of each other, and it is expected that this will bring about the establishment of iron and steel works in the Llano district.

It is reported in Comanche, Tex., that grading on the roadbed of the proposed Temple & Northwestern Ry., from Temple to Comanche, is to start at once on this end of the line. Practically all right of way has been deeded the company.

Surveys are well under way by engineering department of the Texas North & South Ry. Co. The corps is divided in two parties working north and south of Fredericksburg, Tex. When surveys have been completed from Boerne to Mason, Tex., grading contracts will be let.

Mass meeting of citizens of Colorado City and Robert Lee has been held to consider the engineer's report for building the Colorado & Conchos R. R. The line, as proposed, will be 43 miles long, and the two cities have already raised $125,000 for its construction. S. B. Kemp, Robert Lee, is interested.

Utah Notes.

FROM CORRESPONDENTS AND OTHER SOURCES.

The Bonneville Mining Co., organized by Jesse Knight of Provo, for the purpose of prospecting the mountains between Provo and Springville for mineral and water, has started work on the Bonneville tunnel. The tunnel is east of the Crandall farm, about three miles southeast of Provo. It is possible another tunnel will be started, but this is not certain. In all events the country will be thoroughly tested by deep tunneling for mineral and water. George A. Storrs is in charge of the work.

The Oregon Short Line surveyors are now working up the Gentile Valley country from Preston, Utah. It is said that an extension into this section, which is being rapidly settled, has been under consideration for some time. Such a line would place Logan, Utah, on a practically through route.

The Utah Copper Co., it is said, is considering the construction of a railroad through Bingham County, Utah, for the purpose of transporting ore from the company's mines. The line would be 17 miles in length and is estimated to cost $2,500,000.

M. T. Burgess, C. E., Salt Lake City, Utah, is taking steps toward securing the support of the Commercial Club for the Iron Mountain, St. George & Grand Canyon R. R. The proposed line will take off the main line of the Salt Lake Route at Thermo, about half way between Milford and Lund, and from there will extend southward to Cedar City, taking in the great iron and coal fields of that region. From Cedar City one branch will extend to St. George, and eventually to a connection with the Santa Fe at Kingman, Ariz. The other branch will extend from a point near Cedar City, through the Virgin river oil fields to the Kaibab plateau and the Grand canyon of the Arizona.

Plans are reported under consideration for the extension of the street car system of Logan to Providence, a town two miles north. David Eccles, Ogden, Utah, is president.

West Virginia Notes.

FROM CORRESPONDENTS AND OTHER SOURCES.

It is stated that work is to be started soon on the first section of the projected interurban line from Wheeling to Uhrichsville. This section will extend from Cadiz to New Athens, and will be eight miles in length. The two towns have subscribed for $90,000 of stock. The J. J. Burns Construction Co., Isabella Bldg., Chicago, Ill., will build the line.

A charter has been granted to the Parkersburg, Glenville & Burnsville Electric Ry. Co., which proposes to build this season from Parkersburg, W. Va., to Burnsville. Surveys have already been made.

Joe Fuccy, contractor, of Weston, has recently completed a deep cut at Everson, which will prevent a fire in an abandoned mine from reaching a valuable acreage and from getting into the various mines in that section being worked by the Consolidation Co. Mr. Fuccy has also been grading for a railroad siding at Meadowbrook for the Grasselli Chemical Company's new plant there.

Contract for the construction of the coal carrying railroad in Kanawha County, W. Va., has been let to W. O. Lipscomb, Roanoke, Va. The line will be used by the Campbell Creek Railway and Coal Co., a large coal mining corporation in West Virginia.

Washington Notes.

FROM CORRESPONDENTS AND OTHER SOURCES.

The Chicago, Milwaukee & Puget Sound Ry. and the Oregon & Washington R. R., the latter a Harriman line, have filed condemnation suits to obtain right of way through Cow-

litz Valley south to Tacoma. The Harriman lines seek to build up the valley from Winlock, where the largest agricultural region of the state is now without railroad transportation.

Advices from Vancouver, Wash., state that notice of the dissoltion of the Wallula Pacific R. R. Co., and the Columbia Valley R. R. Co. was filed June 9 with the clerk of the Superior Court of Clarke County. The capital stock of the first was $10,000 and the latter $30,000. The stockholders were James P. Stapleton and E. M. Rands.

According to reports Engineers are preparing to make preliminary surveys for the construction of the proposed Huntington-Lewiston R. R. Officials, it is said, were in Clarkston, Wash., recently preparatory to starting condemnation suits to secure right of way for the line through that place.

Work is to be completed by early winter on the rebuilding the line of the Great Northern Ry. for several miles west of the Cascade tunnel. For a great part of the eight miles west from Cascade tunnel to Scenic Hot Springs the road will be double tracked instead of single tracked as now. Reinforced concrete snow sheds will be built over the two tracks for a mile west of the point where the Wellington avalanche occurred last March. These snow sheds will have roofs of solid steel and concrete and will be most substantially built. Approximately 400,000 cu. yds. of rock work is to be handled by the contractors, Grant Smith & Co., of Spokane. These figures indicate the magnitude of the exacavation work along the steep slope of the mountain west of Wellington. Practically a new roadbed will be dug out of the mountain side wide enough for two tracks, above which the concrete and steel snow sheds will be erected as a protection against future trouble from slides. It is stated that there will be 14,000,000 feet of timber used in the reconstruction of the line west of Wellington. The cost is estimated at more than $1,000,000.

Favorable progress is being made with the double tracking of the Northern Pacific Ry.'s main line from Tenino to Kalama. The double track between Chehalis at Centralia was placed in use some days ago and the sections between Centralia and Bucodam completed by June 16. Seventeen steam shovels are at work along the line and between 1,700 and 1,800 men are employed either on the grading or track laying. By November it is hoped to have the double tracking entirely finished.

Wisconsin Notes.

FROM CORRESPONDENTS AND OTHER SOURCES.

The State Railroad Commission has given the Chicago & Northwestern Ry. authority to build 16 miles of railroad in Barron county.

The Neillsville Electric Co., Neillsville, is planning to construct a new power plant at Weston Rapids, requiring the construction of a dam. A bond issue of $60,000 has been authorized for the work.

The Milwaukee Northern Ry., Cedarburg, Wis., is said to be considering a plan to extend its Milwaukee-Sheboygan interurban line through to Manitowoc.

The Milwaukee Western Electric Ry. Co., Milwaukee, is to build an extension this summer from Fox Lake to Green Lake.

The receivers of the Chicago & Milwaukee Electric Railway are said to be planning to build a line into the heart of Racine to connect the main line of the company with the center of Racine.

The Wausau Sulphate & Fibre Co., Wausau, Wis., began excavation work for a plant 520x92 feet at Mosinee. A dam for the purpose of generating power will be built some time this summer.

Canadian Notes.

FROM CORRESPONDENTS AND OTHER SOURCES.

The Toronto, Niagara & Western Ry. Co. has applied to the Ontario Railway Board for permission to build a line from Burlington.

The Canadian Northern Ry. has awarded the contract for building its line from Hawkesbury to Montreal to J. P. Mullarkey, of Montreal, Que. The line is in operation between Ottawa and Hawkesbury. This line from Hawkesbury to Montreal, as originally surveyed, follows the Carillon & Grenville Railway—now controlled by the Canada Central—between Grenville and Carillon. From the latter point it continues in almost a straight line to St. Eustache, through St. Andrews and St. Benoit. The back rivers are to be crossed near Ste. Genevieve. On the island of Montreal the route is still somewhat uncertain. The original survey shows the route as running from Cartierville to the present C. N. R. terminals at Longue Pointe.

Foley, Welch & Stewart have been awarded the contract for constructing 25 miles of the Kootenay Central Ry., a subsidary line of the Canadian Pacific.

The Canadian Northern Ry. will make extensive improvements on the main line between Winnipeg and Edmonton this summer. The road will be thoroughly ballasted and relaid with 80-lb. steel in place of the 60-lb. rails now in use.

The Ontario Railway and Municipal Board has issued a preemptory order directing the Toronto Street Railway to proceed with the construction of the lines of railway referred to in the order of May 18.

The Canadian Pacific railroad has awarded a contract to the American Bridge Co. of Pittsburg, Pa., for supplying 10,000 tons of structural steel for the new bridge over the River St. Lawrence at Lachine. Contract has been hanging fire for some time.

Forest fires on June 21 exploded two powder magazines owned by Contractor McEween, who is working on the N. T. R. north of Lake Nepigon. The magazines contained 100 cases of explosives, and were valued at $15,000. They were on an island, and the fire jumped across from the mainland. No one was injured.

The city of Edmonton, Alberta, has voted to grant a franchise for a radial railway and for a Pintsch gas plant.

The Canadian Northern R. R. has a large force of men and teams at work on Gypsumville extension of its Oak Point branch. It is the intention of the company to complete the road and have it in operation to the gypsum mines by winter.

The completed portions of the Oakland branch of the C. N. R., from Oakland and from the Ochre river, are being ballasted and put in first-class shape. It is not yet known when the gap between Sandy Bay and Rose du Lac will be closed up. It is not likely to be included in this year's construction operations.

The Department of Railways and Canals, Ottawa, Ont., is calling for bids until Sept. 1 for the construction of the Quebec bridge. The work is advertised in all leading engineering journals of Canada, the United States and Germany, and it is expected that practically every great bridge-building company in the world will submit a tender. The Dominion Bridge Co. of Montreal will, it is understood, make an effort to secure the contract, and the Krupps of Germany, who have the largest iron and steel construction plant in the world, will also tender. Each tenderer must submit a guarantee bond of $1,000,000 to insure the Government against loss.

Construction work on the main line of the Canadian Northern R. R. from Edmonton to the Yellowhead Pass will be commenced at once. The contract for the first section from Edmonton to the Pembina river, a distance of 70 miles, has been awarded to McMillan Bros., who are now on the scene preparing to start work. The whole 70 miles will be graded as rapidly as possible and the company hope to have the rails laid before Christmas. The contract for the line from near Stettler to the Brazlau coal fields will be let shortly.

The Alberta Central R. R., which proposes a line from Red Sash to Rocky Mountain House, B. C., with a branch to Moose Jaw, has awarded the contract for the first 70 miles of line.

The citizens of Saskatoon, Sask., have voted to make a contract with Saskatchewan Power Co. This means that the Saskatchewan River at this point will be harnessed in no distant future to provide cheap electrical energy with which to drive the present industrial concerns, as well as to offer power at minimum cost to manufacturers intending to locate in the west. The company is to build a generating plant 12 miles below the city, at a cost somewhere in the neighborhood of $1,000,000.

Mexican Notes.

FROM CORRESPONDENTS AND OTHER SOURCES.

Subsidies aggregating about $5,000 per mile have been assured for the projected railway to be built for Edwardo Hartmann and Mexican capitalists. The line will be 450 miles long, and will extend across a stretch of Mexico, running within about 100 miles of the United States frontier. The survey for the proposed road was made several months ago, and it was found that no construction difficulties stood in the way of obtaining a low-grade line the whole distance. The road will run from Monclova, on the International line of the National Railways of Mexico, to Chihuahua, where it will connect with the Mexican Central line of the government merger system.

A tract of land comprising 400,000 acres has been purchased near Torreon, Coah, and arrangements are being made for the colonization of the tract with Americans. The El Paso R. R. runs through the tract and within the boundaries of the property on the line are four towns, Conejo, Yermo, Cabellos and Zavalza. The distance between the first and last named villages is 40 kilometers. An irrigation project has been decided upon by the company and it is said several millions of dollars have been set aside for the improvement.

David Coe, City of Mexico, is now working on a re-survey of the two optional routes for the Veracruz, Tabasco & Campeche R. R., for which a concession was recently granted by the Mexican federal government to the Veracruz, Tabasco & Campeche Railway Construction Co., City of Mexico. Decision as to the route will not be reached before Aug. 15.

Two routes are now being surveyed for the proposed link to connect the Guatemala Central and the Pan-American railroads. One is to run through the mountain coffee district and the other through the low land. It is probable that the higher route will be selected. The line will be 46 miles long, whichever of the two routes is followed.

The Southern Pacific Co., is now said to be considering important changes in its railroad construction plans in Mexico. The report of the engineers on the proposed route across the Sierras Madres, between Orendain and Tepic, is said to show that the cost of constructing this division will be very heavy on account of the great barrancas that must be crossed and many mountains that must be tunneled. In order to avoid these physical obstacles the matter of abandoning the route across the Sierras Madres, between Orendian from Tepic down the Pacific Coast to Manzanillo is said to be under consideration. At Manzanillo connection would be made with the Mexican Central line of the National Railways of Mexico that runs to Guadalajara. While the distance to Guadalajara would be somewhat longer by the Manzanillo route, the cost of operating the road would be much less than if it is built through the mountains to Orendian, as was originally proposed, it is claimed. Construction is now in progress between the Santiago River and Tepic, and considerable work has been done on the line south from Orendian, a station on the Mexican Central's Ameca branch, 25 miles west of Guadalajara. The Southern Pacific is also considering the proposition of constructing a branch line of road from a point on its Yaqui River line to the City of Chihuahua. The preliminary survey for this proposed road has been made. It will be a direct competitor with the Mexico Northwestern Railroad which is invading Northwestern Mexico by the extension of its system.

BIDS ASKED

Bridges.

Bids are asked on following work, the notes being arranged alphabetically by states:

Columbus, Ga.—Until noon, July 18, by W. C. Campbell, supt. Department of Public Works, for the construction of a concrete and steel arch bridge (Melan System) over the Chattahoochee River at Dillingham St. Concrete Steel Engineering Co., Park Row Bldg., New York, N. Y., are the engineers.

Miami, Fla.—Until July, by County Commissioners, for the construction of a bridge across the drainage canal at Boynton, Fla. R. H. Rousseau is chairman.

Des Plaines, Ill.—Until 11 a. m., July 6, by Town Clerk, for the construction of seven concrete culverts. H. L. Emerson, 1118 Chamber of Commerce Bldg., Chicago, Ill., is Engineer.

Freeport, Ill.—Until 2 p. m., July 18, by Board of Local Improvements, for the construction of 300 ft. of 9 ft. culvert. Plans are on file at the office of the city engineer, John A. R. Daniels.

Bluffton, Ind.—Until July 8, by Board of County Commissioners for the construction of 7 county bridges. O. D. Garrett is auditor of Wells County.

Greenfield, Ind.—Until 10 a. m., July 5, by Board of County Commissioners, for the construction of three concrete and steel bridges in Brandywine Township and one in Sugar Creek Township. C. H. Troy is auditor of Hancock County.

Lebanon, Ind.—Until 1 p. m., July 8, by County Commissioners, for the construction of 7 bridges. B. F. Herdrich is auditor of Boone County.

Shelbyville, Ind.—Until 1 p. m., July 6, by Commissioners of Shelby and Johnson Counties at Shelbyville, Ind., for the repair of Cutsinger bridge. G. B. Huntington is auditor of Shelby County.

Solon, Me.—Until 2 p. m., July 23, by Solon Bridge Commission, at the Carratunk House, for furnishing labor and material for the construction of the superstructure of a steel highway bridge over Kennebec River between the towns of Solon and Embden. The structure will be about 480 ft. in length.

Red Lake Falls, Minn.—Until 1 p. m., July 8, by Board of Supervisors of township of Deer Park, for the material and labor necessary for the construction of a steel bridge over Clearwater River between Sections 31 and 32 in the township of Deer Park. C. H. Martz, C. E., is engineer of the work. As planned the structure will be 96 ft. long on steel tube foundations and reinforced concrete backing with 6-ft. wing.

Wylie, Minn.—Until 1 p. m., July 1, by Board of Supervisors of the township of Polk Center, Red Lake County, for the construction of a 35-ft. steel beam bridge.

Greenville, Miss.—Until noon, July 4, by Board of County Supervisors, for the construction of a steel bridge across Bogue Phalia at Ingram. W. W. Miller is clerk of the Board.

Vicksburg, Miss.—Until noon, July 5, by J. D. Laughlin, clerk Board of County Supervisors, for the construction of a new steel and concrete approach to Fisher's Ferry Bridge.

Cincinnati, O.—Until noon, July 8, by Board of County Commissioners, Fred Dreihs, clerk, for the construction, under specifications No. 71, of concrete bridge and widening of road on Harrison Ave., Mt. Washington, in Anderson Township.

Cleveland, O.—Until 11 a. m., July 13, by Board of County Commissioners, for the construction of a bridge per report No. 2658, retaining wall, St. Clair road, Euclid Township. Frank Lander is county surveyor.

Sandusky, O.—Until 10 a. m., July 9, by Board of County Commissioners, for the furnishing labor and material for the construction and erection complete of the substructure and superstructure of a highway bascule bridge and approaches over the Huron River at Van Rensselaer St. crossing, in Huron. The structure, according to the plans, will be 250 ft. long, 20 ft. roadway and 6 ft. sidewalk, with an 11-ft. right of way for street cars. John Deist is auditor of Erie County.

Tiffin, O.—Until 1:30 p. m., July 16, by John H. Lennartz, county auditor, for the necessary labor and material for the construction of new concrete piers under the Heck bridge in Section 25 township, Seneca County, Ohio.

Toledo, O.—Until 10 a. m., July 8, by C. J. Sanzenbacher, county auditor, for the following bridge improvements, each of which will exceed a cost of $1,000: Abutments and bridge over ditch No. 424, on road No. 65, in N. E. ¼ Section 26, T. 9 S., R. 5 E., Richfield Township. Bump or automatic swing bridge on county road No. 555, over the Miami & Erie Canal, on line between river tracts 17 and 18, T. 3, U. S. R., Adams Township.

Fairfax, S. Dak.—Until 2 p. m., July 9, by Ludwig Trautmann, county auditor, for the necessary labor and material for the construction of all bridges, both wood and steel, also repair work as is required by said county, for one year from date.

Bellingham, Wash.—Until noon, July 7, by Board of County Commissioners, for the construction of an additional 220-ft. span on the United States bridge at Deming. The estimated cost of the work is $10,000.

Bellingham, Wash.—Until noon, July 7, by Board of County Commissioners, for the moving of a 150-ft. span of steel across Middle Fork to a point on Riddle Slough. The work is estimated to cost $2,000.

Bellingham, Wash.—Until noon, July 7, by Board of County Commissioners, for replanking the Abbott Road bridge near Lynden.

Spokane, Wash.—Until July 1, by Board of County Commissioners, for the construction of a combination bridge across Latah Creek at Waverly. The structure will be built on tubular concrete piers and will be a 120-ft. span, and will replace the pile trestle washed out last spring.

Ottawa, Ont.—Until Sept. 1, by Department of Railways and Canals, for the construction of the superstructure of Quebec bridge. The cantilever is favored.

Buildings.

Bids are asked on following work, the notes being arranged alphabetically by states:

Salem, Ill.—Until 10 a. m., July 6, by Board of County Supervisors, for the erection of a court house for Marion County, on the Public Square, at Salem, Ill.

Bluffton, Ind.—Until July 8, by Board of County Commissioners, for the remodeling of the County Infirmary. O. D. Garrett is Auditor of Wells County.

Indianapolis, Ind.—Until 8 p. m., July 12, by Board of School Commissioners at 312 N. Meridian St., for changes and improvements at Public School No. 2, corner of Delaware and Walnut Sts., and for changes and improvements at Public School No. 6, Union St. between Norwood and McCarty Sts. John E. Cleland is Business Manager.

Indianapolis, Ind.—Until 10 a. m., July 12, by Board of School Commissioners at 312 N. Meridian St., for changes and improvements at Manual Training High School, also for plumbing. John E. Cleland is Business Manager.

New Castle, Ind.—Until 10 a. m., July 7, by County Commissioners, for the improvement of county jail. W. L. Risk is Auditor of Henry County.

Baltimore, Md.—Until 11 a. m., July 6, by Board of Awards, for labor and material necessary to erect in place the steel floor joists under the roadways on Guilford Ave. bridge over Jones Falls. J. B. Mahool is President of Board of Awards.

Brookline, Mass.—Until 4 p. m., July 7, by School Committee, Franklin W. Hobbs, Chairman, for the construction of an 8-room primary school building on Westbourne Terrace. Kilham & Hopkins, 9 Park St., Boston, Mass., are architects.

Lansing, Mich.—Until noon, July 12, by E. A. Bowd, architect, Lansing Mich., for the construction of a church building at East Lansing, Mich. A. R. Sawyer is Chairman of the Building Committee.

West Park, O.—Until noon, July 9, by W. J. Featherstone, West Park, O., Clerk, Board of Education, Rockport Village School District, for the construction and material of a high school building in the Village School District.

Homestead, Pa.—Until 7 p. m., June 30, by School Directors of School District of Borough of Homestead, Pa., for the construction of new central school building. D. T. Powelson is Secretary of the Board of Directors.

Winnipeg, Man.—Until June 30, by James Chisholm & Son, architects, 310 Enderton Bldg., Winnipeg, Man., for the erection of a reinforced concrete building on Market St. for Gowans Kent Western, Ltd.

Ottawa, Ont.—Until 4 p. m., July 13, by R. C. Desrochers, Assistant Secretary, Department of Public Works, for the construction of a post-office at Fergus. William Mahoney, Guelph, Ont., is architect.

Ottawa, Ont.—Until 4 p. m., July 13, by R. C. Desrochers, Assistant Secretary, Department of Public Works, for the construction of a post-office at Elora, Ont. William Mahoney, Guelph, Ont., is architect.

Roads and Streets.

Bids are asked on following work, the notes being arranged alphabetically by states:

Washington, D. C.—Until noon, July 9, by District Commissioners, for the paving of various streets and avenues in the District of Columbia with sheet asphalt and asphalt block.

Des Moines, Ia.—Until 9 a. m., July 6, by City Council, for the paving with sheet asphalt, consisting of 1-in. binder course with 1½-in. wearing surface upon 5 ins. concrete foundation, Center St. from the west curb line of 16th St. to the east curb line of 18th St., and also from the west curb line of 18th St. to the east line of 19th St. The work includes about 3,656 sq. yds. of pavement. Neal Jones is City Clerk.

Des Moines, Ia.—Until 9 a. m., July 6, by City Council, for the construction of asphalt pavement on concrete foundation with 1-in. binder and 1½-in. wearing surface, on 35th St. between Grand Ave. and Woodland Ave. The work includes about 4,000 sq. yds. of pavement. Neal Jones is City Clerk.

Vinton, Ia.—Until 8 p. m., July 11, City Council, for the construction of 35,800 sq. yds. of brick block pavement on 4-in. concrete foundation and 2-in. sand cushion, 11,000 lin. ft. of concrete curb. W. E. Klinganman is City Clerk. Samuel N. Parsons, Marion, Ia., is Engineer.

Columbus, Ind.—Until 10 a. m., July 8, by County Commissioners, for the construction of a gravel road in Wayne Township. John M. Davis is Auditor of Bartholomew County.

Indianapolis, Ind.—Until noon, by Board of School Commissioners, for the grading and graveling, sodding and for cement sidewalks on lot surrounding two school buildings. E. Cleland, 312 N. Meridian St., is Business Director.

Kentland, Ind.—Until 1 p. m., July 5, by Board of County Commissioners, for the construction of a gravel road 2 miles in length, also macadam road 3 miles in length. Elmer R. Bringham is Auditor of Newton County.

Lebanon, Ind.—Until 2 p. m., July 8, by County Commissioners, for the improvement of highways in Harrison and Eagle Townships. B. F. Herdrich is Auditor of Boone County.

Lebanon, Ind.—Until 2 p. m., July 8, by County Commissioners, for the construction of gravel roads in Eagle and Harrison Townships. B. F. Herdrich is Auditor of Boone County.

Paoli, Ind.—Until 2 p. m., July 5, Board of County Commissioners, for the construction of roads in Beech Grove and Orangeville Townships. U. B. Ham is Auditor of Orange County.

Princeton, Ind.—Until 10 a. m., July 6, by County Commissioners, for the improvement of 13 public highways. William T. Roberts is Auditor of Gibson County.

Winamac, Ind.—Until noon, July 5, by Board of County Commissioners, for the construction of two county roads. Ellis S. Rees is Auditor of Pulaski County.

Baltimore, Md.—Until 11 a. m., June 29, by Board of Awards, for grading, curbing and paving with sheet asphalt, asphalt blocks, vitrified blocks or bitulithic, Laurens St. from Park Ave. to Bolton St.

Baltimore, Md.—Until 11 a. m., July 6, by Board of Awards, for necessary labor and material for the renewal of such armored concrete curb on York Road as may be ordered by B. T. Fendall, City Engineer.

Baltimore, Md.—Until noon, July 6, by State Roads Commission, Union Trust Bldg., Baltimore, Md., for building six sections of state highway aggregating 19.33 miles in counties as follows: Allegany—On the National Pike, between Standard Oil warehouse and the Pennsylvania Railroad crossing, in one section, a distance of about 0.53 mile, and on the National Pike, between Six-Mile House and Allegany Grove, in one section, a distance of about 1.02 miles; stone macadam. Carroll—On the road between Eldersburg and Gamber, in one section, a distance of about 5 miles; stone macadam. Garrett—On the National Pike in Garrett County, from the Allegany County line toward Piney Grove, in one section, a distance of about 2.38 miles; stone macadam. Prince George's—On the Marlboro Pike, from the District of Columbia line, in one section, a distance of 5.20 miles, to Meadows, including the repairs to the existing stone macadam road of about 6,900 ft. St. Mary's—On the Mechanicsville-Leonardtown Road, from Hellen toward Leonardtown, in one section, a distance of about 5.20 miles. Bids will be received for grading, bridging and draining only. E. E. Geslin is Secretary of the Commission.

Towson, Md.—Until noon, July 14, by County Highway Commission, for the improvement of Hillsdale Road from Liberty Road to Forest Ave., First District of Baltimore County, Md. Henry G. Shirley is Roads Engineer.

Fairmont, Minn.—Until 11 a. m., July 12, by H. P. Edwards, County Auditor, for the construction of a portion of State Road No. 1, commencing at Station No. 133, to Station 239.

Batesville, Miss.—Until July 4, by Board of Supervisors for working by contract the road from J. F. McNeely place to intersection of Batesville & Oxford Road. R. W. Draper is Clerk of the Board of Supervisors.

Lexington, Miss.—Until July 4, by Board of Supervisors for the working of the public roads of the hill portion of Holmes County, Miss., now being worked under contract, together with any roads that may be added thereto. Parham Williams is Clerk of the Board.

Tupelo, Miss.—Until July 6, by County Road Commissioners, for the construction of about 25 miles of road, as follows: Tupelo and Fulton Road, from east end of Tupelo levee east to county line; Mooresville and Marietta Road, from Mooresville north 3,600 ft. to bridge over Boguefala Creek; Tupelo and Saltillo Road, from Tupelo to Town Creek bridge; Tupelo and Belden Road, Tupelo to Belden; Beldon and Ellistown Road, from Beldon north; Tupelo and Ellistown, from beginning of Tupelo and Beldon Road north; Tupelo and Chesterville Road, from Tupelo west.

Jefferson Barracks, Mo.—Until 11 a. m., June 30, by Stanley H. Ford, Quartermaster, for the construction of roads, walks, etc.

Elizabeth City, N. C.—Until noon, July 5, by D. M. Jones, Chairman Street Paving Committee, for the improvement of several streets by paving.

Allenstown, N. H.—Until 1 p. m., July 8, by H. C. Hill, State Engineer, Concord, N. H., for the construction of 1,120 ft. of trap rock in this town.

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Title Engineering-Contracting

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